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ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY

B. Tech (Food Technology)

Course No.: FDST 318

Credit Hours: 3 (2+1)

THEORY STUDY MATERIAL

FOOD QUALITY AND CERTIFICATION

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Lecture-1

- *Food Quality – its need and its role in Food Industry*

Principles of Food Quality Assurance

Food manufacturers usually have two stated levels of quality for products marketed. One deals with a product's quality established as company policy to meet consumer needs and the other deals with product quality in terms of meeting governmental regulations and laws. Branded products marketed by a company are matters requiring the most careful attention by company management. It is a general rule that company policy relating to branded product quality is more rigid than that required to meet governmental regulations. Company policy statements generally include a statement demanding that all products marketed meet the laws and regulations of all federal, state and local governments.

The Need: The epidemiology of food-borne hazards has been summarized by the U.S. Centre for Disease Control Their analysis of where foods are mishandled is given in the table below. While the percentage of cases traced to food processing plants is low (6%), one factory can create widespread difficulty compared to a home or a restaurant.

The outbreaks traced to foods from food processing plants are because of inadequate refrigeration as well as preparing foods in advance resulting in re-infection after the final heat processing, inadequate heat processing and holding foods at temperatures that favor bacterial growth.

Places where foods were mishandled in such a way that

Food - borne diseases outbreaks resulted

Place	Number	Percentage
Food service establishment	589	37
Homes	230	14
Food processing plants	104	6
Unknown or unspecified	692	43
Total	1615	100

Food - borne outbreaks in which processed foods were incriminated and the relationship between reported diseases and processes by various food industries

Processed foods that received no heat treatment were often made up of contaminated raw ingredients. The source of contamination with salmonellae was raw ingredients. In the few cases of contamination with trichinellae (increasingly rare in the United States), the incoming pork was infested.

Heat process failures were common. Processes such as smoking, often failed to kill salmonellae or trichinellae that were on or in the product. Clostridium botulinum cells multiplied and produced neurotoxins in canned or vacuum-packed foods after their spores survived improper heat processing.

Post-processing contamination with salmonellae or trichinellae by cross-contamination from raw products to heat processed food by equipment or workers during subsequent handling was another significant source. The frequency with which certain food processing plants have produced foods that have been incriminated in food-borne disease outbreaks and the factors that led to contamination, survival or multiplication of pathogens . Incoming raw materials (usually foods of animal origin) are revealed as hazards in the processing of meat, poultry, eggs, baked goods containing eggs, milk, fish salads and confections.

Role of Government: Responsibility for the safety, wholesomeness and nutritional quality of food rests with the food industry, not with the Food and Drug Administration. The task of the FDA is to monitor the industry to determine whether it is meeting its responsibilities. The FDA has the role of motivating compliance, but does not act as a company's quality assurance division. The FDA takes appropriate corrective actions when industry fails to meet its responsibilities.

A number of techniques are used by the FDA in determining the manner in which industry accepts its responsibilities. These include:

(1) Establishment of inspection - which may vary in comprehensiveness and intensity from that of the Hazard Analysis and Critical Control Point (HACCP) inspection to that of a less-comprehensive key indicator inspection.

(2) Sample Collection and Analysis of a product during processing and of finished product in distribution channels.

(3) Surveillance intended to identify new problems as well as to quantify the extent and significance of known problems that may be associated with processing, the environment, and other factors.

Though these techniques are useful, the best hope for safety and quality in food lies in the development and maintenance of adequate in-plant quality assurance programs. Promoting quality assurance at the plant level is thus a primary goal in FDA regulation.

Good Manufacturing Practices (GMP): The FDA has recently embarked upon a course of public rule making as a means of obtaining industry-wide compliance with the responsibilities of industry. Public rule-making developed with the input of all interested and affected parties. It provided the means by which to inform all persons of what is considered appropriate.

The initial Good Manufacturing Practice Regulations for foods was published in 1969, and is often referred to as the Umbrella GMP. It made use of such words as "adequate," "proper," and "sufficient." Despite the fact that many provisions in the GMP were written as mandates, compliance was often difficult because of the vagueness of the subjective terms. In spite of these shortcomings, the most important objective of the Umbrella GMP was to provide guidance relative to long range improvement programs and

directed to plant facilities and practices. This general regulation served to encourage the adoption of quality assurance systems and to indicate the need for such systems where they were absent.

The FDA has now embarked on a program of expanding the GMPs to include regulations that will ultimately apply specifically to all the major segments of the food industry. Detailed and specific GMP regulations which have been publically developed are now in effect for many areas of concern.

A typical GMP outline has similarities to a quality assurance system. A preamble introduces the subject, discussing the background of the industry and why a GMP is considered necessary, and reports on information gathered in plant inspections. It also stresses reasons why certain features or requirements are needed.

Each regulation has a definition section. Each definition states that the word "shall" mean that the requirement is mandatory and that the word "should" refers to an item that is desirable but not absolutely essential for the carrying-out of an operation. The next section refers to the Umbrella GMP regulation and is followed by specific sections pertaining to the industry. If there is concern for contamination from outside the factory or the possibility of cross-contamination between different operations, note is made. The next section deals with equipment and utensils and stresses general overall design criteria for equipment that is unique for that industry, or that requires special controls for safety and sanitation. A section on personnel sanitation facilities is frequently included. Sections on the cleaning and sanitizing of equipment follow. The FDA believes the most important part of the GMP involves processes and controls that are vital for the particular type of food manufacturing operation. A section usually is devoted to records and record-keeping that covers at least the average life of the product in distribution.

FDA believes that the Good Manufacturing Practice regulations materially reduce the probability of release of food products that are not in compliance (i.e., distribution of an unsafe product, exactly the aim of any effective quality assurance system).

An example of a GMP that delineates specific quality assurance requirements is the low-acid canned food GMP-"Thermally Processed Low-Acid Foods Packaged in Hermetically Sealed Containers." This GMP details the operations that must be conducted to assure the production of a safe low-acid canned food, according to the FDA. It contains the same elements found in quality assurance systems throughout industry. Quality assurance systems in industry dovetail the low-acid canned food GMP into their operations.

Microbiological Standards: Another FDA regulatory area having an impact upon quality assurance systems is the establishment of microbiological quality standards. Acceptable microbiological levels for food products at the retail or consumer level, taking into account post-production abuses, are established. This is done by conducting a nationwide· statistical survey of the food under evaluation. The data are reviewed, and proposed standards are developed that considers both the producer's and consumer's risks in realistic terms. Once a

proposed standard is developed it is published in the Federal Register as a proposal with provision for comment. Each comment received is reviewed and is responded to through subsequent publication in the Federal Register, and changes indicated by comments are made. When the proposed standard is finalized, it is a mandatory standard that must be met under the provisions of Section 401 of the Food, Drug and Cosmetic Act.

The projected impact of microbiological quality standards upon the food processing industry's quality assurance system greatly affects the distribution and retail outlet industries. The establishment of certain microbiological quality standards requires a re-evaluation of some quality assurance systems and causes the introduction of such systems in areas that now operate without such controls.

Good manufacturing practices and microbiological quality standards are examples of FDA regulatory initiatives that affect quality assurance systems. The FDA indicates it supports efforts to require all food processors to establish and use quality assurance systems in their production operations, with emphasis upon monitoring and disclosure of hazards associated with the product and the means employed to control the hazards, in the public interest.

Role for Industry: There are some ten elements of production safety if strict compliance with FDA safety standards is maintained. The minimum a food manufacturer must do is to assure the quality and ensure the safety of marketed products.

(1) **Product Safety Analysis:** Food safety analyses must be conducted on all products to assess their microbiological, physical and chemical safety. All aspects of a product's makeup are evaluated (e.g., product formulation, processing, distribution and final use) to ensure safety in use.

New products should not be manufactured, distributed or sold until a rigorous review of all aspects of a product's composition has been completed. The purpose of such a review is to assure that the proper formulation, processing and distribution of every product results in the offering for sale of unadulterated foods for consumption that meet or exceed federal regulations and requirements.

(2) **Product Specifications:** Each product must have certain specifications for manufacture. These specifications must cover all safety, quality and regulatory requirements. They must specify the uses of processes, ingredients, and acceptance tests, packaging materials and labels, and include descriptions of utilized processes and finished products. Such specifications serve as the vehicle through which a company can communicate federal standards and regulations to factory production.

Depending on the size of the manufacturing operation within a given company, the amount of documentation required for each product, packaging material, ingredient specification and testing procedure is compatible with simple specification files. However,

as the size of company's operations expands, the magnitude of the files is such that an alternative means of recording specifications may be necessary. It is not difficult to computerize this process, once the specification files reach a certain size. Computerization creates an effective and efficient storage and retrieval system of documentations of product specifications.

(3)**Physical Systems Hazard Control:** Industry is required to make and maintain inventories of food processing systems and their environments and the possible hazards that may occur within the context of each system. A hazard control system is usually generated by the particular facility in which food processing or production takes place. It is the responsibility of the manufacturer to prepare and maintain these documents so that clear identification of all physical systems hazards are known, and a complete and lucid understanding of each step in the processing and packaging of manufactured products is available. Flow diagrams are particularly suited for this purpose, because they can show where possible hazards may occur in a particular process or part thereof. A schematic representation of the manufacturing procedures and processes allows for their exposure on a level where hazards may otherwise pass unnoticed.

The following procedure is useful in trouble-shooting for physical systems hazards:

(a) Develop and maintain flow diagrams to cover all food processing and physical systems and environments

(b) Identify all physical systems hazards to the safety and integrity of products.

(c) Establish and document systems of control for all hazards, whether actual or possible.

(d) Maintain records of control procedures for all physical systems hazards that are critical to product safety.

Whenever possible, correctible hazards must be eliminated. Physical plant and systems hazards must be reviewed before a food product is manufactured in a facility.

(4)**Purchasing Requirements:** Purchase of raw materials should be limited to approved suppliers who can offer an acceptable continuous guarantee of a material's quality. Further, it is in the company's interest to require the supplier to submit proof of ability to supply the appropriate quantities of materials of certain predetermined quality and safety standards. Raw materials must pass a plant inspection. Routine inspections assure that raw material quality is kept at the appropriate level. A supplier who frequently delivers products below the stated requirement levels should be covered by contracts describing specifications and safety analyses. The facilities used should be submitted to regular inspections by those who must approve any and all such products.

(5) **GMP Compliance:** High sanitation standards must be maintained, documented and rigorously observed in all production, storage and distribution facilities. Sanitation procedures instruct personnel on how to comply with sanitation standards. They must know the essential technical aspects of these procedures and why they must be followed. The knowledge behind these practices is given to personnel during their in-plant training.

(6) **Product Recall System:** A tracing system is needed so that all products sold can be accounted for and located if it is necessary to recall products in retail distribution. Either manual or computerized systems suit these purposes, depending upon the size of the overall operation. Tests can be conducted periodically to ensure the workability of the system. Results should be recorded and documented for future reference or for possible improvements in the system employed. Some tests that can be conducted to measure the capabilities of a recall system are:

(a) What is the least traceable unit of distribution, i.e., date, shift, batch, low, etc.?

(b) How effective is the method used in determining the amount of product to be traced?

(c) How long does it take to make a complete trace of a product?

(7)**Customer Service**: Means of recording and responding to consumer and customer complaints are needed. This is not for public relations but is a means of detecting safety and/or deficiencies in products. Prompt attention is essential.

(8) **Inspections and Safety Incident:** Means of recording and responding to all safety or regulatory incidents are needed. A regulatory incident is a visit by federal, state or local inspectors or any regulatory agency to any facility. A company facility is any of the following: plant, mill, warehouse, restaurant, research and development canter, factory, etc. Some of the regulatory agencies that might make such a visit are: FDA, USDA, EPA, OSHA, FEA, military veterinary corps, or state and local health inspectors.

A means of instant communication on all regulatory incidents is needed so that those involved may be able to intelligently respond if a letter or notice is received from an inspection agency. Safety incidents should also be communicated, such as: products presenting a threat to the consumer; personnel safety incidents where serious infectious disease, injury or death have occurred; environmental incidents where hazardous material(s) is released into the environment, etc. Keep a comprehensive written record of all such incidents, containing the date, time, location, description of incident, and action taken to correct the condition if possible.

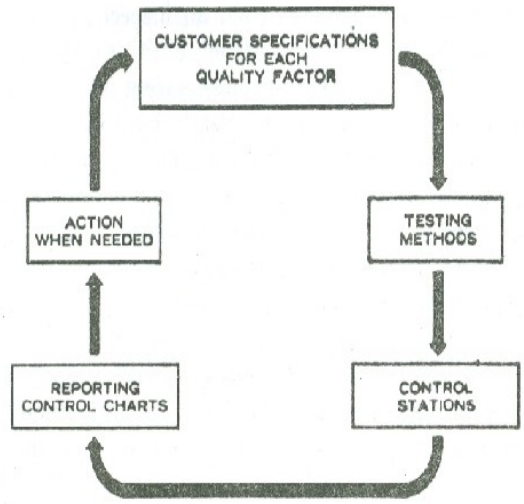
(9)**Auditing:** All processing plants, warehouses, and other storage facilities should be routinely and periodically audited by company personnel to gauge the level of compliance with company standards regarding specifications, product safety and regulatory requirements. Regular audits for the purpose of evaluating the adequacy of safety,

documentation and the degree of compliance with established company procedures and standards are needed.

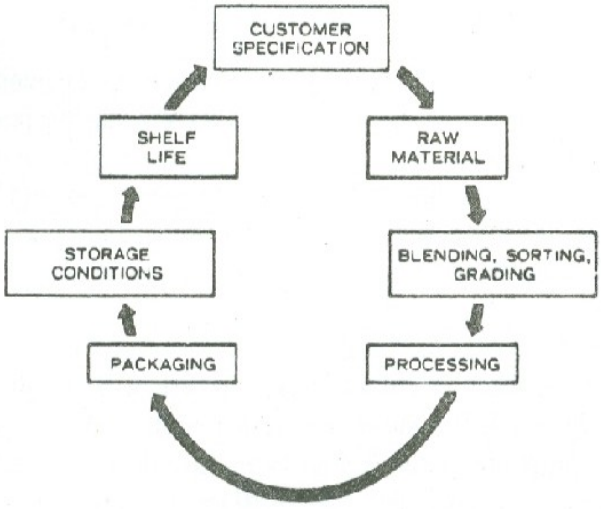
(10) **Product Integrity:** To maintain a high standard of product excellence, a company must have an organized and centralized means of surveying and controlling the contributing processes and procedures. A company must be on guard against violations. Therefore, it is imperative that a company have an effective and efficient program to protect itself and the public it serves.

Design of Company QA Program: Quality assurance (QA) is a major management function, usually organized at the senior level, reporting directly to the president of a company. For illustrative purposes, assume a company composed of divisions, each operating factories, each factory having a Quality Control (QC) Laboratory. The company has a central Purchasing Department.

The approach is to conceive of a program in the form of two cycles. In the Quality control cycle, customer specifications for each quality factor are established, and then means of measuring them are developed. In the production cycle control is maintained over incoming raw materials and finished product. They believe such an approach prevents products which do not meet customer specifications from entering the channels of trade.



QUALITY CONTROL CYCLE



PRODUCTION CYCLE

Objectives

- To establish, issue and maintain standards and specifications for all raw materials used and for all finished products sold by the company.
- To assure that all ingredients and all finished products adhere to the company's quality standards and to recommend corrective action as required. This includes microbiological purity and nutritional integrity of all products and conformance to state and federal regulations.

To be of service to the company in all areas related to product quality. These areas include: trouble-shooting when quality problems exist; visiting production facilities for review and updating of QC Programs; designing laboratory installations and. expansions and training QC personnel in routine and new testing procedures. Further service is rendered by answering consumer nutritional inquiries and in reviewing consumer complaints concerning product quality.

RAW MATERIAL QUALITY ASSURANCE:

Specifications: All approved raw materials are covered by tentative or permanent specifications. As new raw materials are required for new products, tentative specifications are developed to cover their purchase. All specifications are constantly being updated and, as conditions permit, the limits of acceptance are made stricter. Bacteriological conditions are constantly stressed and limits are reviewed to be kept at least as strict as governmental regulations. New and/or revised specifications are generally prepared each month for raw materials.

Survey Program: All company units sample and inspect raw materials as received. Most of the tests are simple and/or organoleptic in nature. More thorough and sophisticated tests are performed at the Company Central Analytical Laboratory. Raw material surveys are conducted periodically. Greatest attention is given to so called "critical" raw materials. Physical, chemical and bacteriological examinations are made not only to be sure that all public health regulations are met, but also to establish conformance with established company specifications.

The average number of raw material samples handled monthly might be:

Current raw materials	100
Alternate sources of supply	50
New raw materials	10

Service: In the area of raw materials, QA is in daily communication with production units, the Purchasing Department, and current or potential suppliers. With the number of ingredients used and the multitude of suppliers and production units involved, it is normal for many minor, yet important, problems to develop. These problems must be handled quickly and effectively. A considerable portion of the effort by QA for the company is related to these "little" day to day jobs which usually require numerous telephone calls, confirming letters, sample reviews, and discussions to arrive at the proper recommendations for resolving these problems.

Vendor's Appraisal: An important aspect of raw material procurement is reliability of the supplier. In order to implement the program of Certified Analyses (which is particularly important for critical ingredients) visits are made by QA personnel to vendors' production

plants to observe sanitation conditions and technical facilities. While such activities are more directly related to the Purchasing Department, the Operating unit shares in their values, since the continued and efficient production of quality merchandise is possible only with sound and reliable raw materials.

Complaint Handling: Shipments of raw materials received at the factories in an unsatisfactory condition are rejected by management. Copies of the complaint form plus a sample of the material is sent to the laboratory for concurrence and for filing (so that Vendor Histories can be kept current). A report and/or letter are sent to the Purchasing Department with copies to Division Management and Factory Production with observations and/or recommendations as needed.

Shipments which are questionable are temporarily isolated and the factory laboratory acts as the monitor. Complaint forms and samples are expedited for examination. Based on the findings QA will recommend rejection or, if the violation is not serious, discuss rejection or acceptance with the Production and Purchasing Departments, based upon the specifics involved.

IN-PROCESS QUALITY ASSURANCE: Obviously the use of high quality raw materials does not automatically result in high quality finished products. To achieve the latter, well balanced formulas must be followed accurately and proper mixing and processing procedures must be maintained with the minimum variation at all times.

In order to control these processing procedures, programs for "In-process" QC are developed by QA for implementation at the various factories. As new products and new processing techniques (such as extrusion) become a part of the production scene in a number of the· factories, the role of In-process controls takes on added importance.

Plant Quality Coordination (a department of QA) receives weekly QG reports from all factories. All reports are reviewed and specified production periods are discussed with Factory Production. Monthly status reports giving statistical analyses of specialized process conditions are prepared and issued by QA. Such reviews make it possible to follow long-range trends and to alert Factory Production so that corrective actions may be taken.

FINISHED PRODUCT QUALITY ASSURANCE:

Finished Product Monitoring: With many of the newer type products, QA has developed definite Finished Product Quality Assurance 'Programs which are followed in the company plants. Daily QC reports are received by QA and monthly statistical status reports are issued to show the degree of conformance with established standards and the range of variation from the average.

Special Finished Product Survey: QA develops a program of Finished Product Surveys, which includes all products produced by the company. Since some of these products may be enriched or will carry label claims concerning vitamin and mineral content, a frequent check for these factors must be made. All products in this program are submitted periodically to taste panels for organoleptic evaluation and may be subjected to objective tests for colour and texture. Compositional analyses are made on a scheduled· basis so that up-to-date information will be available for company publications covering this subject.

Bacteriological analyses are conducted on all products so that the sanitary and public health aspects are known and recorded. A detailed report of the finished products tested and all analyses performed is prepared and distributed. The modern approach to total QA embraces both the product and the package containing the product. Therefore, the quality condition of the package is reviewed and all defects are noted and reported. Periodic reports are issued to transmit this information to all sectors of the company.

Special Studies: In addition to routine examination of finished products, QA is involved in frequent "crash" programs to assist in the resolution of various aspects of finished product quality; including, for example, off-taste, a lack of colour development, too high a pH, excessive moisture content, out of specification free fatty acid content, etc. These problems may require special plant visits, or the assistance may be limited to frequent telephone calls and follow-up letters. All of this effort requires many man hours of discussion, sample review and communication.

Factory Visits: In order to standardize the functions and activities of all company Quality Control Laboratories, factory visits are made to assure that they are fully informed and to ascertain that they are equipped and up-to-date in methodology so that they can carry out their programs efficiently and accurately, QA personnel visit all plant laboratories on a well established schedule.

Other Services: Also related to operating division activity is the effort expended by QA in reviewing and answering consumer complaints. Most replies are made directly to the Treasurer's Department, but copies are given to Division Production so that follow-up can be made to possibly eliminate the sources of such complaints.

Another consumer service is rendered by QA for the Operating Division in the area of answering nutritional inquiries, and other related consumer problems-allergies, special diets, etc. Again this is not always direct service to a division, but an informed and contented consumer is an asset to any production unit.

Central Analytical Services: In order to· implement the examinations and surveys programmed for Operating Division in the areas of raw materials and finished products and to answer urgent daily requests, a very large number of individual physical, chemical and

bacteriological analyses are required. The Central Analytical Services (usually another department of QA) carries out these tests. In addition to this activity, collaborative studies are carried out periodically with all company Division Laboratories. Analytical personnel are also involved in field trips to review new methods and to train plant personnel in their application.

A typical summary of the number of tests carried out for a Division might be:

Analyses	Average per Month
Chemical	2000
Nutritional	1000
Bacteriological	500

Communications: An excellent rapport is needed among Division, Factory and QA personnel. There is usually a constant and continuing exchange of telephone conversations .which might concern raw material and/or finished product evaluation and/or testing, questions on specifications or plant trials.

These exchanges are daily and often take up a major part of the working time of specialized personnel in the critical areas of the Operating Division. All decisions and related matters should be recorded in memorandum for the record, copies being distributed to all personnel involved for future reference.

Lecture - 2 & 3

- *Food Quality and Quality Attributes - Classification of Quality Attributes and their role in Food Quality*.
- *Objectives, Importance and Functions of Quality Control*.

Introduction

Quality is a measure of the degree of excellence or degree of acceptability by the consumer. By quality, one can differentiate the individual unit of a product from the other units and can determine the degree of acceptability of the individual unit by the consumer. The quality may also be defined in term of end use and may vary depending upon consumer's perception and need. Quality is the combination of attributes or characteristics of a product that have significance in determining the degree of acceptability of the product to the user. For industry, quality is measure purity, strength, flavour, colour, size, maturity, workmanship and condition or any other distinctive attributes of the product.

According to Code of Federal Regulations "Quality is the inherent properties of any processed product which determine the relative degree of excellence of such product and includes the effect of preparation and processing and mayor may not include the effects of packaging or added ingredients/ additives" .

Characteristics of Quality: There are three types of the quality characteristics viz. sensory, hidden and quantitative by which quality of food can be judged (Fig 1). So, the quality criteria for the consumers depend upon various attributes like appearance, texture, flavour, nutritive value and safety (Fig 2).

Fig.1 - Different types of the quality Characteristics of foods

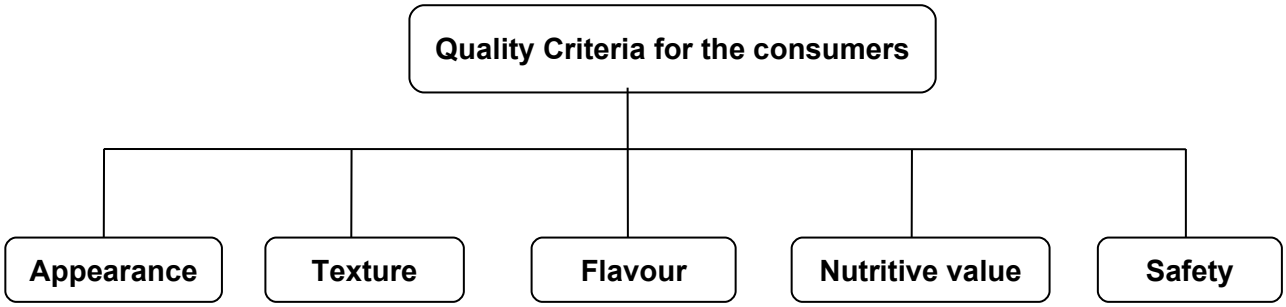


Fig.2 - Different criteria of the consumers towards quality evaluation

SENSORY CHARACTERISTICS: It includes appearance, texture and flavour which the consumer can evaluate with his senses.

Appearance / Colour: It is more important than taste and odour. It (colour) increases the attractiveness of the product. It is the prime factor which also determines the flavour, texture nutritive value and wholesomeness. By the sense of sight, size, shape and colour of the food and other characteristics such as transparency, opaqueness, turbidity, dullness and gloss could be perceived. Judgment of the ripening of the fruits is also influenced by colour. The strength of coffee and tea is also judged on the basis of the colour of the beverage. Appearance is first important attributes in selection of food. Appearance of any food commodity can be judged by the eye. Appearance may be in term of colour, size, shape uniformity and absence of defects. The second important attribute for sensory evaluation of food is Kinesthetic i.e. texture and consistency.

Texture: It is overall assessment of the feeling by mouth and hand or it is sense of touch by hand and mouth. Mouth feeling include lips (hairy / smooth), tongue (soft/mushy), teeth (rigidity) and ears. Objective instrumental methods are available for measurement of these attributes which could be correlated to the consumer's preferences. Mouthfeel is a product's physical and chemical interaction in the mouth. It is a concept used in many areas related to the testing and evaluation of foodstuffs, such as wine-tasting and rheology. It is evaluated from initial perception on the palate, to first bite, through mastication to swallowing and aftertaste. In wine-tasting, for example, mouthfeel is usually used with a modifier (big, sweet, tannic, chewy, etc.) to the general sensation of the wine in the mouth. Some people, however, still use the traditional term, "texture". Mouth feel is often related to a product's water activity, hard or crisp products having lower water activities and soft products having intermediate to high water activities.

Product Mastication:

1. Cohesiveness: Degree to which the sample deforms before rupturing when biting with molars.
2. Denseness: Compactness of cross section of the sample after biting completely with the molars.
3. Dryness: Degree to which the sample feels dry in the mouth.
4. Fracturability: Force with which the sample crumbles or cracks or shatters. Factorability encompasses, Crumbliness, crispiness, crunchiness and brittleness.
5. Graininess: Degree to which a sample contains small grainy particles.
6. Gumminess: Energy required disintegrating a semi-solid food to a state ready for swallowing.

7. Hardness: Force required for deforming the product to given distance, i.e. force to compress between molars, bite through with incisors, compress between tongue and palate.

8. Heaviness: Weight of product perceived when first placed on tongue.

9. Moisture absorption: Amount of saliva absorbed by product.

10. Moisture release: Amount of wetness/juiciness released from sample.

11. Mouth coating: Type and degree of coating in the mouth after mastication (for example, fat/oil).

12. Roughness: Degree of abrasiveness of product's surface perceived by the tongue.

13. Slipperiness: Degree to which the product slides over the tongue.

14. Smoothness: Absence of any particles, lumps, bumps, etc., in the product.

15. Uniformity: Degree to which the sample is even throughout.

16. Uniformity of Chew: Degree to which the chewing characteristics of the product are even throughout mastication.

17. Uniformity of bite: Evenness of force through bite.

18. Viscosity: Force required for drawing a liquid from a spoon over the tongue.

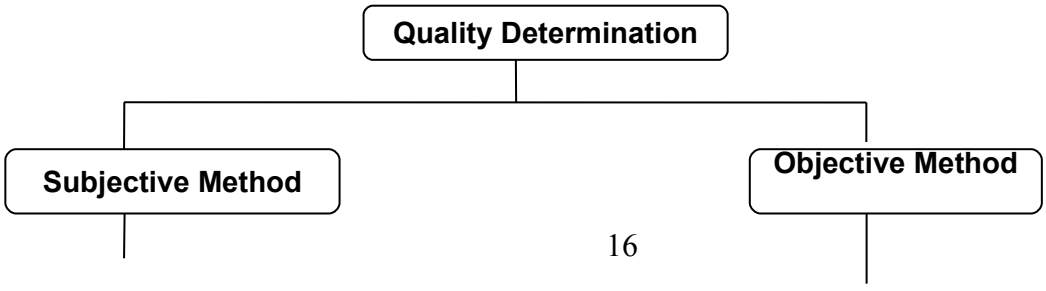
19. Wetness: Amount of moisture perceived on product's surface.

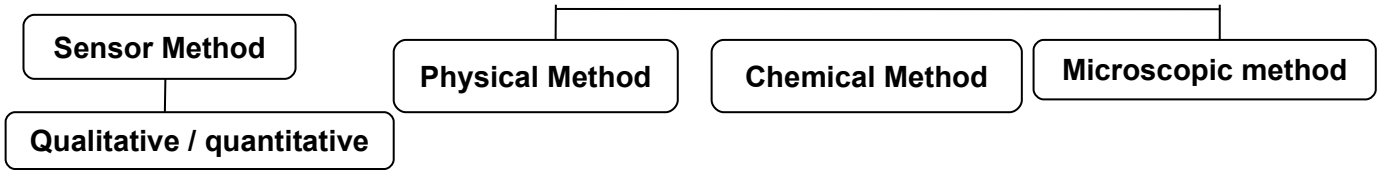
Flavour: Flavour is a combination of taste, smell/aroma and feeling (astringency, bite etc. especially in spices, wine and coffee) in short it is combination of taste and aroma. Flavour embraces the senses of taste, smell and a composite sensation known as mouth feel. Taste is due to sensation felt by tongue. Taste is limited to sweet, sour salty and bitter. The dimension of these can be measured chemically and can be related to the consumer's preferences. Smell /odour, an important factor in flavour can be estimated by gas chromatography and related to flavour acceptability. Aroma is due to stimulation of olfactory senses with volatile organic compounds. Aroma may be fragrant, acidic, burnt, pungent, enzymatic, spoilage.

Hidden Characteristics: Nutritive value and toxicity (toxic compounds) present in food come under hidden characteristics.

Quantitative Characteristics: Crop yield and finished product yield are the quantitative characteristics for determination of food quality. The ratio of weight of raw material to the weight of the pre-packaged finished product is known as shrinkage ratio. Higher the ratio, greater will be the unit cost. So, low shrinkage ratio is desirable.

Methods for Determining Quality: Broadly two methods are used for determination of the quality in food industry as shown below:





Various methods used for determination of the quality in food industry

Subjective Method: In this method, individual is required to give his opinion about qualitative/quantitative values. This method is also referred as sensory method. It is by experience of the individual. Different subjective methods are used for estimation like: 9 -point Hedonic Scale, Triangular test or Composite test.

Objective Methods: These are based on recognized standardsd scientific tests to any sample of the product without regard to its previous history. They represent the modern idea in quality control (QC) because the human element has been excluded. This method divided into three groups:

(a) Physical methods
(b) Chemical methods
(c) Microscopic methods

Physical method: It is the quickest method. It is used to measure size, colour, consistency, headspace, drained weight and vacuum as shown below:

Common physical tests used for food products

Physical factor	Test	Description
Colour	Colour difference meter	Measures differences in tri-stimulus values
	Munsell colour system	Based on colour standards
	Spectrophotometry	Measure light reflectance at different wavelengths
Viscosity	Ostwald Viscometer	Flow through a capillary tube
	Rotating Spindle	A rotating cylinder is immerged in the fluid and stress measured.
	Falling weight	Measures the time required for a weight to fall through a tube containing the sample.
Texture/Tenderness	Finger feel	Test of firmness and softness
	Mouth feel	Test of chewiness, fibrousness and grittiness
	Texture value (texture meter, Penetrometer) and Shear press	Indication of texture, firmness, tenderness and shear value.
Container	Weight, volume and vaccum	Gross, net, drained weight and fill of container
	Seal integrity	Seal evaluation
Size and shape	Length, breath and diameter (Vernier Callipers)	Uniformity and classification.

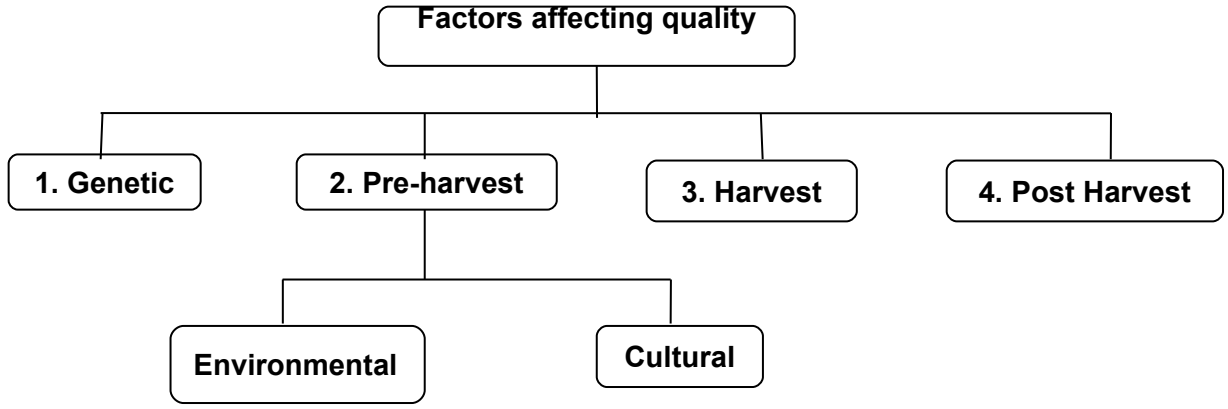
Chemical methods -These are standard food analysis methods. These are used for quantitative evaluation of nutritive value e.g. moisture, specific gravity, fat, oil, protein, carbohydrates, fibre, enzyme, vitamin and pH as shown below:

Common chemical tests used for food products

Chemical factor	Test	Description
Moisture	Drying	Measures weight loss due to evaporation
Solids	Hydrometer	Concentration of dissolved solids
Specific gravity	Titration	Reaction of water with specific chemicals
Total soluble solids (TSS)	Refractive index	Measures TSS and indicates the sugars
Ascorbic acid	Dye method	Measures Vit C content
Fat-oil	Ether extraction	Dried, ground material extracted in petroleum ether
Protein	Kjeldahl method	Total N_2 determined and N_2 * 6.25 = Protein
Carbohydrates	Molisch general test	Colour reaction with Naphthol
Fibre	NaOH extraction residue	Measures organic residues including cellulose and lignin
Ash / Minerals	Burns at 550 ^{0}C in Muffle Furnace	Determines total ash by weight of residue after incineration
Enzymes	Catalase, peroxidase	Chemical reaction with H2O2 or indicators
Vitamins	Bioassays for each vit	Vitamin analysis using analytical procedures
pH, acidity	pH meter or titration	Measures alkalinity or acidity of samples
Chlorine	Chemical titration	Measurement of chlorine residue

Microscopic methods: These methods are excellent in quality control. It is used for detection of contaminants in foods. So, these methods prevent food from adulteration and contamination.

Factors Influencing Quality of Food: There are mainly four factors which are affecting the quality of food and these are depicted as shown below:



Major factors affecting quality of food in a processing industry

Genetic Factors: Selection of cultivars and rootstock: Not all varieties of fruits and vegetables are suitable for processing purposes. The choice of proper cultivar is perhaps

the most important single factor for preparation of quality product. Specific recommended cultivars for one area of the country or even within the state may not apply to another area. Although high visual quality is desirable for most processing methods, the composition of the fruit in relation to flavour, texture, colour and nutritional value is of paramount importance.

Pre-harvest Factors: These include climate / environmental, cultural and harvesting factors.

(a) **Environmental Factors**:

Factors	**Quality affected**
Temperature	Maturity, colour, sugar, acidity. High temperature reduces the quality of citrus, radish, spinach, cauliflower and increase the quality of grapes, melon, tomatoes. Low temperature causes chilling and freezing injury.
Light	Essential for anthocyanin formation. Fruits exposed to light develop lighter weight, thinner pee, lower juice and acids, higher TSS than shaded fruits
Rains	Cracking of grapes, dates, litchi, limes, lemon, tomatoes and sweet potatoes and reduces sweetness
Wind	Bruising, scratching and corking scar on the fruits
Humidity	High humidity reduces colour and TSS, increases acidity in citrus, grapes and tomatoes, increases the quality of banana, litchi and pineapples

(b) **Cultural Factors**:

Factors	**Quality Affected**
(1) **Mineral Nutrition**:	
Nitrogen	High nitrogen reduces ascorbic acid content, TSS / acid ratio and keeping quality but increases vit B_1, B_2 and carotene, Deficiency reduces fruit size
Phosphorous	High P decreases size, weight, vit C. Deficiency causes poor appearance in fruit.
Potassium	Increases size, weight and vit C. Deficiency causes uneven ripening.
Calcium	Increases firmness of many fruits like apple, mango and guava.
Magnesium	Increases size, weight and vit C.
Zinc	Increases size, weight and vit C. Deficiency causes straggled clusters in grapes.
Boron	Deficiency causes flesh browning in fruits and gummy discoloration of albedo in citrus fruits.
Copper	Due to deficiency irregular blotch occurs in citrus fruits and spoil the appearance.
(2) **Growth regulators**:	
Auxins	Increases fruit size in loqout (2, 4, 5 TP), mandarins (NAA) and TSS in mango (2, 4 – D)
Gibberlic acid	Increases size and weight of grapes, berries, apricot and strawberry. It causes parthenocarpic fruits and reduces disorder of fruits like water spots and corky spots in citrus.
Cytokinin	Maintains green colour green leafy vegetables and causes parthenocarpic fruits in fig.
Ethylene	Ethepon increases anthocyanins, carotenoids, ascorbic acid and TSS. Reduces tannins and acidity.

Growth retardant	Alar (B_9) increases colour in fruits. Malic hydrazide (MH) inhibits sprouting in onion bulbs.
(3) Rootstock	In citrus, Troyer and Carrizo rootstock produces the fruits of excellent quality of oranges, mandarins and lemons.
(4) Irrigation	Excess irrigation causes high acidity and deficiency of moisture reduces fruit size, juice content and increases thickness of peel.
(5) Pruning	It affects the size, colour, acidity and sugar content of the grapes, phalsa, pear, peach and apple.
(6) Thinning	Increases size, colour and sugar content of fruits.
(7) Maturity	All vegetables except potatoes and onion are of higher quality when less mature. Ripen fruits are of better quality when harvested at proper maturity stage.
(8)Mechanical injury	Reduces appearance and source of infection.

(c) **Harvesting factors**: Stage of maturity, ripeness and physiological age are important factors affecting quality.

Factors	**Quality Affected**
Maturity *	All vegetables except potatoes and onions are higher quality when less mature. Ripen fruits are of better quality when harvested at proper maturity stage.
Physiological age / Horticultural maturity	It is the stage of development when a plant or plant part will continue ontogeny (further development) even if detached.

Physiological maturity: It refers to the stage in the development of fruit/vegetables when maximum growth and maturation has occurred. It is usually associated with full ripening of the fruit. The physiologically mature stage is followed by senescence.

Commercial maturity: It is the stage of the plant organ required by a market. Commercial maturity commonly bears little relation to physiological maturity and may occur at any stage during development/ senescence. The terms immaturity, optimum maturity and over maturity related to these requirements.

- Stem and leaves: Asparagus, celery, lettuce, cabbage.
- Inflorescence: Artichoke, broccoli, cauliflower
- Partially Developed Fruits: Cucumber, green beans, okra, sweet corn.
- Fully developed fruits: Apple, pear, citrus, tomato
- Roots and tubers: Carrots, onions, potatoes.

Criteria for Judging Maturity

Skin or flesh colour flesh firmness, electrical or light transmittance characteristics, chemical composition, size and shape, respiration behavior, time to ripen, time from flowering or planting (Calendar date), heat units etc. are some of the criteria used for judging the maturity.

Post harvest treatments / Factors: Environmental factors, handling methods, processing times and storage methods.

Factors	Quality Affected
Temperature	Higher temperature causes off flavour, weight loss and wilting particularly of GLV and reduces vit C content. Low temperature reduces the appearance of fruits by checking carotenoid development and chilling injury (below optimum).
Heat of respiration	Deteriorate quality, increased spoilage during storage and transport
Relative humidity	Low RH causes weight loss and wilting, High RH causes growth of microbes.
Cleaning and Washing	Improves appearance, removes microbes and dirt.
Trimming	Improves appearance.
Grading	Maintains uniformity in size, shape and quality.
Chemical treatment	Treatment with oil and wax reduces weight loss and maintains freshness. Treatment with ethephon and Alar increases colour and reduces astringency. GA, Cytokinin, MH, CCC retard colour development.
Pre-cooling	By removing field heat reduces weight loss and maintains freshness.
Hot water treatment	Increases carotene, total sugars in fruits and protect from diseases like anthracnose in mango.
Packing	Loose packing – more damage of fruits and vegetables. Wrapping fruits in tissue paper or PE reduces weight loss and maintains colour.
Transportation	Ambient temperature transport – weight loss, spoilage. Refrigerated transport – reduces / nil weight loss and spoilage.
Storage	The temperature during storage affects the length of storage and the quality of fruits or vegetables.

Lecture-4

- *Methods of quality concepts of Dough Rheology*

DOUGH RHEOLOGY: With regard to wheat flour, rheology is the measure of the flow and deformation of doughs. These dough properties can affect product qualities such as geometry (Ex. cookie spread or cake volume), texture, and handling during processing. Dough rheological instruments were originally designed for use with materials such as bread doughs, where strength and elasticity are valued. Soft wheat flour products, however, generally require doughs that are weaker.

Correlation Coefficients for Solvent Retention Capacity and various Flour Quality Parameters

	Water	50% Sucrose	5% Sodium Carbonate	5% Lactic acid
Protein content	0.33a	0.39a	0.31a	0.39a
Damaged starch	0.94a	0.77a	0.95a	0.23
Flour yield	0.51a	0.41a	0.54a	-0.06
AWRC	0.97a	0.81a	O.97a	0.33a
SSC diameter	-0.88a	-0.76a	-0.86a	-0.33a,
Mixograph	0.50a	0.49a	0.43a	0.69a
Notes: AWRC, alkaline water retention capacity; SSC, sugar-snap cookie.				
a Significant at the 1% level.				

Results obtained from these rheological instruments should-not be interpreted using the same criteria as results from hard wheat flours, as the rheological properties of soft and hard wheat flours are not simply opposites. Dough-forming properties of flours are commonly evaluated using the Alveograph, Mixograph, and the Farinograph

Alveograph: The Alveograph measures air pressure inside of a dough bubble as it is inflated until it bursts. This biaxial extension is meant to simulate the deformation of dough during fermentation and oven spring during baking.Itallows for the measurement of the maximum overpressure (P), which relates to the resistance of dough to deformation, and the average length of the curve baseline at rupture (L), which is a measure of dough extensibility. The deformation energy (W) is a measure of the energy needed to inflate the dough and is derived from the area under the curve. W is related to the flour strength.

Correlation Coefficients between Rheological Properties and Qualities of Japanese Sponge Cakes and Sugar-Snap Cookies Made from Soft Wheat Flour Grown in the US

Quality Parameter	Japanese Sponge Cake Volume	Sugar-Snap Cookie Diameter
P	-0.639[a]	Ns
L	0.492[b]	0.522[b]
MPT	Ns	0.577[b]
MPH	-0692[a]	-0.590[b]
FWA	ns	-0.667[a]
FPT	-0.490[b]	ns

[a] significant at 1%level, [b] significant at 5%level

Mixograph and Farinograph: The Mixograph and Farinograph are both mixers that record changes in dough properties over time. These instruments are able to give information regarding optimum dough water absorption, strength, mixing time, and tolerance to over mixing. The main difference between the two is in the geometry of the mixers. The Mixograph uses vertically oriented pins that move in a planetary motion, and the Farinograph uses sigmoid-shaped mixing paddles.

The Mixograph was developed to provide the more intensive mixing that North American wheat's require. It is therefore mainly used there as well as in Australia. The Farinograph is widely used around the world. Found significant negative correlations between Farinograph water absorption and cookie diameter, and with cake volume, in

products made from soft red winter wheat. Cake tenderness was correlated with Farinograph departure time and mixing stability

Lecture-5

- *Quality Assessment of Food materials – Fruits and Vegetables*

Quality Characteristics of Fruits and Vegetables for Processing

The quality of a processed fruit or vegetable product ultimately depends upon the quality of the raw material that is used to make the product. Most of the fruits or vegetables are marketed as they are, without undergoing any further processing. For marketing purposes, the characteristics of primary importance are size, attractiveness, maturity, organoleptic quality and freedom from infection.

When the same vegetable/fruit is to undergo processing, other properties assume more importance; these are colour, flavour and texture. Obviously, fruits or vegetables of

poor quality cannot ensure that a good quality processed product will be obtained. In many countries, there are precise specifications of various characteristics for products intended for processing.

Quality characteristics are importance since they are related to the total yield of a finished product, and are, therefore major considerations in processing.

Quality is a measure of the degree of excellence or degree of acceptability by the consumer. Quality characteristics of a product may be divided into three major categories are:

(A) **Sensory characteristics** of quality include appearance (colour, size and shape and defects), texture and flavour (taste and odour) which the consumer can evaluate with his senses.

(B) **Hidden characteristics** of quality are those which the consumer can- not evaluate with his senses, such as nutritive value, presence of harmless adulterants, and presence of toxic substances.

(C) **Quantitative characteristics** are also considered as an attribute of food quality, since it forms a part of the total quality evaluation of a product, e.g., the finished product yield of a variety of fruit or vegetable.

Sensory Characteristics:

(a) **Appearance (Eye appeal judged by sense of light)**: The overall eye appeal of a food product is more important than dependence on taste and odour, and may determine acceptance or rejection without a trial tasting. Appearance therefore deserves much consideration in food processing. It includes colour, size and shape and defects.

(1) **Colour**: Colour increases the attractiveness of fruits and vegetables and in most cases it is used as a maturity index. It is also associated with flavour, texture, nutritive value, and wholesomeness. Surface colour is important for the fresh market and internal colour for the processing. Green colour is indicative of insufficient ripeness in fruits but it is desirable attributes in vegetables. Coloured fruits, when picked at the firm-ripe stage, should be fully and uniformly coloured. Three major classes of pigments occur in fruits: the carotenoid, the chlorophyll, and the anthocyanin pigments.

Carotenoids play an important part in the colour of canned mangoes, citrus, and pineapple. The red and violet colour in fruits and vegetables is due to anthocyanins, and this has to be accounted for in processing, since the colour gradually passes out into the syrup or brine used in canning. Certain fruits and vegetables - notably guava, litchi, banana, and broad beans - may turn pink during processing due .to the presence of leuco-anthocyanin, and this appears to differ with variety. Non-enzymatic browning or discolouration is also caused by the presence of chlorophyll in certain products. The browning of cooked tomatoes, presumably due to phaeophytin formation, greatly reduces the intensity of the natural red colour.

Use of too great a proportion of green fruit during the manufacture of tomato products will give a brown or brownish-red product. The condensation of reducing sugars with amino acids, a process accelerated by heat, is responsible for much of the darkening that occurs during the drying of fruits such as dates and grapes. Potatoes with high sugar content have a tendency to turn dark during dehydration and during subsequent storage as a result of this reaction. Conditioning of potatoes is done to reduce sugar content and application of $S0_2$ before processing to control non-enzymatic browning.

Many fruits and vegetables undergo rapid browning during peeling and slicing operations. Bananas, potatoes and grapes will turn brown if injured during the preparation, unlike pineapple and tomatoes. The browning reaction is mainly caused by the enzyme(s) polyphenol oxidase acting on a suitable phenolic substrate in the presence of oxygen. Dates and grapes become dark upon drying and are acceptable in this form. With other fruits and vegetables in which darkening is unacceptable, enzyme inhibition is effected partially or totally by heat (blanching), by sulphur dioxide, or by addition of ascorbic acid, sodium chloride, etc. Another solution is to select varieties having fewer tendencies to discolour during preparation for processing.

The colour requirements of fruits and vegetables used for quick-freezing differ markedly from those needed for canning, since in quick-freezing there is little change of chlorophyll to phaeophytin, no marked change in leuco-anthocyanins, and little migration of the anthocyanins from fruit to syrup. Colour and appearance are, however, extremely important quality attributes in unblanched, frozen, cut fruits, because they are subject to enzymatic browning when thawed.

The measurement of surface colour presents many problems. When the unit size is large, such as mango, papaya, guava, apple, melons, tomato, etc., individual units have to be measured. When the unit size is small such as, strawberry, grape berries, phalsa, peas, etc., a representative sample can be measured. The instruments used for colour measurement are Hunter colour-difference meter, Spectronic-20 (reflectance measurement) and Spectrophotometer**.**

(2) **Size and shape**: Size is of major interest to the grower as it is directly proportional to the yield in certain crops, e.g., pineapple.

The importance of size and shape of fruits and vegetables is often underestimated. They make important contribution to the appearance of fresh produce and processed product. Grading of fruits and vegetables into various size and shape categories is usually one of the first steps in packaging and processing operation. Size grading is done mainly to facilitate succeeding operations such as cutting, peeling or blending, to obtain uniformity in the product, and to provide consumers with the preferred size.

Shape of the raw materials sometimes determines the suitability for processing. The reduce losses during mechanical trimming and handling, the shape of the fruit or vegetable should readily lend itself to such processes. Selection and breeding of raw

materials for shape is yet to be attempted in most crops. In fact, many tropical fruits are often of inconvenient shape or size and thus present problems of handling while processing, e.g., mango, papaya, guava, etc.

Size and shape can be measured with manual operation (human judgement), simple scale, vernier calliper, micrometers, planimeters and machine which measures weight, diameter and length.

(3) **Defects**: Most defects or imperfections are still largely evaluated by the consumer's eye, though in some cases instruments may be used. The presence of defects frequently lowers the grade of products which are otherwise of very high quality. Defects may be caused by-

(i) Deformities caused by unfavourable environmental conditions.

(ii) Insects and microorganisms.

(iii) Mechanical injury caused during handling, transportation and processing such as damage, bruising and crushing.

(iv) Specks and sediments.

(v) Foreign material or any other harmful added substance.

(b) **Texture (Hand and mouth feel judged by sense of touch):** Texture characteristics involve touch sensations. It includes hand feel and mouth feel which determine the quality.

(1) Hand feel: It is finger feel such as firmness (apple), softness (mango and plum) and juiciness (citrus and grapes).

(2) Mouth feel: It includes sensory characters such as chewiness, fibrousness, grittiness, mealiness and stickiness.

Instruments developed for measuring the textural qualities of fruits and vegetables are:

(1) Succulometer**:** Instrument developed for measuring the maturity of sweet corn. It is also used to determine the storage life of apples.

(2) Tenderometer: Instrument developed for measuring the tenderness of peas. It determines the suitability of raw peas for canning.

(3) Pressure Tester: This is a very light and portable instrument used for measuring the maturity of various fruits.

Texture of fruits and vegetables can also be measured by texture meter, puncture meter and fibrometer.

In addition, certain physico-chemical tests are also used successfully for measuring textural properties. These are -

(1) Moisture content: Moisture content or the total solids is a useful index for determining the tenderness of vegetables.

(2) Alcohol-insoluble solids: It is a measure of texture rather than an index of maturity.

(3) Fibre content: In vegetable, such as asparagus, fibrousness of the product is determining the texture.

(4) Brine flotation: It is used for grading of maturity of peas for canning. Density of the material is made use of to separate lighter,more tender units from heavier, more mature units.

(c**) Flavour**: Flavour distinguishes one food from another. It is a combination of taste and smell (odour or aroma).

(i) Taste: It includes sweet, salty, sour and bitter.

(ii) Smell: It may be fragrant, acidic and burnt,

(iii) Off-flavour: Enzymatic, physiological or chemical.

Feelings such as astringency, bite, pungency are all attributes which are significant to flavour, especially in spices and other foods, such as wine. Basic characteristics of taste like sweetness, saltiness, sourness and bitterness can be determined but odour characteristics are difficult to measure. Odour or aroma is a vastly complex sensation and the most important factor in flavour. It has not yet been successfully measured by an instrument. Estimation of volatile acids, amines and succinic acid provides indications of off-flavour in stored fruits and vegetables. Gas chromatographic technique has been developed for isolating specific volatiles, and spectrometry and nuclear magnetic resonance for their identification in the direct measurement of flavour quality.

(B) **HIDDEN CHARACTERISTICS:**

(a) Nutritive value**:** Consumers pay little attention to the nutritive value of the fruits and vegetables. The more nutritious form may incidentally be preferred if it is associated with one or more attractive features. Fruits and vegetables are of high food value.

(b) Toxicity: Various chemical compounds are used extensively in fruit and vegetable production. Edible tissues may accumulate amounts of persistent insecticides belonging to chlorinated hydrocarbon group even beyond permissible limits. These residues may lead to bitter or musty flavour in the canned and other processed products and present a health hazard.

(C) QUANTITATIVE CHARACTERISTICS:

(a) Crop yield: High yields and disease resistance cut costs of production and processing.

(b) Finished product yield: Raw material cost per kg of finished product is another important consideration in processing. This is calculated by determining the amount of product yield per kg of raw material. The, ratio of the weight of raw material to the weight of pre-packaged finished product is called the overall shrinkage ratio. The higher the ratio for a given product, the greater will be the unit cost of the processed product. Naturally, low shrinkage ratios are to be desired, consonant with the limitations of the particular vegetable and fruit, e.g., in potatoes for dehydration, factors important in determining overall shrinkage ratios include:

(i) dry matter content of the raw material

(ii) peels, cores, roots, bruises, deep eyes, and other undesirable material that must be removed and discarded

(iii) size and shape of tubers (small and irregular shapes have greater peeling, trimming, and sizing losses), and

(iv) rejects for poor colour, odour, and composition.

In the processing of juice concentrate, the solids content and the yield of juice are equally important and determine the cost of the finished product. Another important factor which determines the product yield is the loss which occurs in preparing the material for processing, such as smooth shape and shallow eyes eliminate much waste in the preparation of potato tubers for dehydration.

Factors affecting fruit and vegetable quality: Not all varieties of fruits and vegetables are satisfactory for processing. There are many factors involved in selecting fruit and vegetable varieties for processing. Although high visual quality is desirable for most processing methods, the composition of the fruit in relation to flavour, texture, colour, and nutritional value is of paramount importance. In addition, these qualities should be impaired as little as possible during the specified process, e.g., some vegetables cannot be dehydrated or frozen because of their chemical composition or physical structure. Some kinds have a bitter taste when dried; others loose colour and flavour, or do not reconstitute to even near their original form. Varieties suitable for processing must have satisfactory quality both at harvest time and after storage at low temperatures. The factors affecting quality of fruits and vegetables can be classified largely into two groups –

(a**)** Pre-harvest factors: They can be grouped into environmental and cultural factors.

(b) Post-harvest factors: These factors can be grouped into environmental factores, handling, methods, processing time and methods, storage methods.

Lecture-6

- *Quality Assessment of Food materials –Cereals and legumes*

Quality of raw materials: Poor quality grain is one of the most common problems facing millers and is caused by inadequate post-harvest control by farmers and inadequate storage conditions in the mill. Most millers buy their grain from farmers and have little control over the way in which grain is grown, harvested, stored or transported. Contract agreements with farmers can improve the amount of control that millers have over the quality of raw materials.

Contracts with farmers: Quality assurance in contract growing covers the following areas:

- Correct application of chemicals during cultivation
- Harvest at the correct stage of maturity
- Correct threshing and winnowing
- Adequate drying and post-harvest storage
- Correct packaging and transport of grains.

Contamination by pesticides and chemical fertilisers can be due to inadequate information or training for farmers in the amounts of chemicals to use, or the timing of their application. A sprat of contract agreements, millers can prevent such problems by supervising chemical use and checking that chemical applications are in line with manufacturers' recommendations. The use of agricultural chemicals is controlled by law in Uganda and millers should check with the Ministry of Agriculture, Animal Industries and Forestry and the UNBS for details of the specific laws.

Guidelines for correct grain storage:

1. Make sure the storeroom is waterproof by locating it on well drained land, raising it above the ground and fitting a waterproof roof
2. Prevent the temperature in the store from fluctuating by using insulating materials (brick, mud, clay, wood or other insulation), painting the outside white and fitting an overhanging roof to keep sunlight off the walls.
3. Ensure that the store is insect-proof, rat-proof and bird-proof
4. Thoroughly clean storerooms by removing and burning all old grain, straw, insects etc. to prevent contamination of new grain
5. Make sure that grain is properly dried before putting it into a store
6. If chemical insecticides or fungicides are used, ensure that manufacturer's recommended dosages are followed.
7. Regularly check the grain for infestation, signs of mould or discolouration and ensure that it is not getting hot (each is a sign of excessive moisture). If these are found, remove the grain and re-dry it.

Most grain is transported in sacks, but the quality of re-used sacks is often not checked. Dirty sacks contaminate grain and inadequately sealed sacks allow birds, insects and rodents to contaminate the grain. Control over transport to the mill is part of a QA scheme and millers should supply good quality sacks for collecting grain and preferably arrange transport to collect grain directly from the farmers using their own vehicles, or contracted haulers' vehicles that have been inspected to ensure that they are clean. When sacks arrive at the mill, they should be checked to ensure that there are no holes in the sacks or loose sewing at the top. Sacks should be dry and clean and not obviously contaminated by oil, grease, kerosene etc. Grain may contain field contaminants (weed

seeds, stalks, soil, stones and dead or living insects), as well as metal or wood fragments, diesel, oil, etc. from transportation.

When the sacks are opened at the mill, the grain should an inspection checked visually for:

- Contamination by foreign materials
- Damage or contamination caused by insects, birds and rodents
- Excessive moisture content or mould growth
- Broken or immature grains

Foreign materials, mouldy or discoloured grains should be removed by hand. Some millers also wash grain in a tank to remove sand, small stones or dust. A periodic QA check is to collect and weigh the contaminants that are separated from grain. The weight can be expressed as a percentage of the batch weight using the calculation:

% contamination = weight of contaminants x 100 weight of batch

A record of the weight and types of contaminants from different farmers over a period of time to negotiate and either reduce the price or improve the quality of future deliveries. If farmers know that such checks are being made, it may influence them to improve their handling and storage procedures, particularly if the miller is willing to offer a price premium for higher quality grain. Millers should keep a small sample of grain from different suppliers so that if there is any dispute over quality, the sample can be used for further testing. One component of the HACCP system is that processors should be able to trace their ingredients back to individual suppliers. This applies today for those who are exporting and will in the future to all processors. Keeping samples and written records of purchases and sales is part of a HACCP system.

This inspection and removal of contaminants is essential to ensure that high quality flour is produced and to protect the mill from damage and hence additional operating costs for repairs.

Moisture content: The correct moisture contents for safe storage of grains and flours are shown below:

Moisture contents of cereals for safe storage and milling

Cereal	Moisture content (%) Storage Uganda	Codex Standards (Maximum)	Milling Moisture
Maize	13.5	15.5	15.0
(shelled)	16.0	13.0	13.0
Millet	15.0	15.0	14.0
Rice	13.5	14.5	11.0-13.0
Sorghum	13.5	15.5	14-16
Wheat			

Moisture content (%) for the safe storage of flours

Flour	Moisture content (%) Storage Uganda	Codex Standards (Maximum)
Maize flour	13.5	15.0
Millet flour	15.5	13.0
Rice flour	13.0	
Sorghum flour	14.0	15.0
Soy protein flour	9.0	10.0
Wheat flour	12.0	15.5

With experience, a miller can assess the correct moisture content of grains by placing them on a hard surface and tapping them with a metal or stone weight. The hardness (or softness) of the grain indicates the approximate moisture content. A more accurate method is to dry a weighed sample of grain in a laboratory oven at 100°C for 4 hours (or 104°C for 2 hours),cool and re-weigh it. The weight loss is calculated as moisture content using the following formula:

$$\% \text{ moisture content} = \frac{\text{Initial weight of grain - Final weight of grain}}{\text{Initial weight of grain}} \times 100$$

Quality checks on flours: If adequate quality assurance procedures are followed for inspection of grains, operation of the milling equipment and storage of flour, there are relatively few checks that are needed on the flour. The main one is to ensure that the weight filled into bags or sacks is not below the weight declared on the label or printed on the sack.

Lecture-7

- *Quality Assessment of Food materials – Dairy Products*

MILK TESTING AND QUALITY CONTROL

Introduction: Milk testing and quality control is an essential component of any milk processing industry whether small, medium or large scale. Milk being made up of 87% water is prone to adulteration by unscrupulous middlemen and unfaithful farm workers. Moreover, its high nutritive value makes it an ideal medium for the rapid multiplication of bacteria, particularly under unhygienic production and storage at ambient temperatures. We know

that, in order for any processor to make good dairy products, good quality raw materials are essential. A milk processor or handler will only be assured of the quality of raw milk if certain basic quality tests are carried out at various stages of transportation of milk from the producer to the processor and finally to the consumer.

MILK QUALITY CONTROL: Milk quality control is the use of approved tests to ensure the application of approved practices, standards and regulations concerning the milk and milk products. The tests are designed to ensure that milk products meet accepted standards for chemical composition and purity as well as levels of different micro-organisms.

Testing milk and milk products for quality and monitoring those milk products, processors and marketing agencies adhere to accepted codes of practices costs money. There must be good reasons why we have to have a quality control system for the dairy industry in Kenya. The reasons are:

i) To the Milk Producer - The milk producer expects a fair price in accordance with the quality of milk she/he produces.

ii) The Milk Processor - The milk processor who pays the producer must assure himself/herself that the milk received for processing is of normal composition and is suitable for processing into various dairy products.

iii) The Consumer - The consumer expects to pay a fair price for milk and milk products of acceptable to excellent quality.

iv) The Public and Government Agencies - These have to ensure that the health and nutritional status of the people is protected from consumption of contaminated and sub-standard foodstuffs and that prices paid are fair to the milk producers, the milk processor and the final consumer.

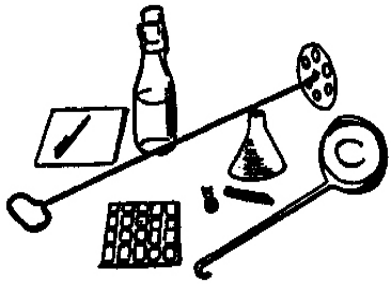
All the above is only possible through institution of a workable quality testing and assurance system conforms to national or internationally acceptable standards.

TECHNIQUES USED IN MILK TESTING AND QUALITY CONTROL:

Milk sampling: Accurate sampling is the first pre-requisite for fair and just quality control system. Liquid milk in cans and bulk tanks should be thoroughly mixed to disperse the milk fat before a milk sample is taken for any chemical control tests. Representative samples of packed products must be taken for any investigation on quality. Plungers and dippers may used in sampling milk from milk cans.

Sampling milk for bacteriological testing: Sampling milk for bacteriological tests require a lot of care. Dippers used must have been sterilised in an autoclave or pressure cooker for at least 15 min at 120 °C before hand in order not to contaminate the sample. On the spot

sterilisation may be employed using 70% Alcohol swab and flaming or scaling in hot steam or boiling water for 1 minute.



Equipment used for taking milk samples

Preservation of sample:

Milk samples for chemical tests: Milk samples for butterfat testing may be preserved with chemicals like Potassium dichromate (1 Tablet or ½ ml 14% solution in a ¼ litre sample bottle is adequate.) Milk samples that have been kept cooling a refrigerator or ice-box must first be warmed in water bath at 40 ºC, cooled to 20 ºC, mixed and a sample then taken for butterfat determination. Other preservative chemicals include Sodium azide at the rate of 0.08% and Bromophenol (2-bromo-2-nitro-1, 3-propanediol) used at the rate of 0.02%. If the laboratory cannot start work on a sample immediately after sampling, the sample must be cooled to near freezing point quickly and be kept cool till the work can start. If samples are to be taken in the field e.g. at a milk cooling centre, ice boxes with ice packs are useful. Labelling and records keeping samples must be clearly labelled with name of farmer or code number and records of dates and places included in standard data sheets. Good records must be kept neat and in a dry place. It is desirable that milk producers should see their milk being tested, and the records should be made available to them if they so require.

COMMON TESTING OF MILK:

Organoleptic tests: The organoleptic test permits rapid segregation of poor quality milk at the milk receiving platform. No equipment is required, but the milk grader must have good sense of sight, smell and taste. The result of the test is obtained instantly, and the cost of the test is low. Milk which cannot be adequately judged organoleptically must be subjected to other more sensitive and objective tests.

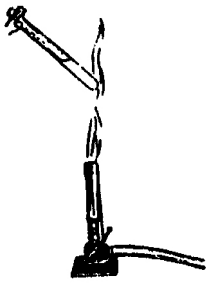
Procedure:

- Open a can of milk.
- Immediately smell the milk.
- Observe the appearance of the milk.
- If still unable to make a clear judgement, taste the milk, but do not swallow it. Spit the milk sample into a bucket provided for that purpose or into a drain basin, flush with water.
- Look at the can lid and the milk can to check cleanliness.
- Judgement: Abnormal smell and taste may be caused by:

- Atmospheric taint (e.g. barny / cowry odour).
- Physiological taints (hormonal imbalance, cows in late lactation- spontaneous rancidity).
- Bacterial taints.
- Chemical taints or discolouring.
- Advanced acidification (pH < 6.4).

CLOT ON BOILING (C.O.B) TEST: The test is quick and simple. It is one of the old tests for too acid milk (pH<5.8) or abnormal milk (e.g. colostral or mastitis milk). If a milk sample fails in the test, the milk must contain many acid or rennet producing micro-organisms or the milk has an abnormal high percentage of proteins like colostral milk. Such milk cannot stand the heat treatment in milk processing and must therefore be rejected.

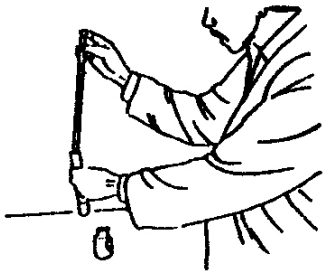
Procedure**:** Boil a small amount of milk in a spoon, test tube or other suitable container. If there is clotting, coagulation or precipitation, the milk has failed the test. Heavy contamination in freshly drawn milk cannot be detected, when the acidity is below 0.20-0.26% Lactic acid.



Equipment used in C.O.B. test

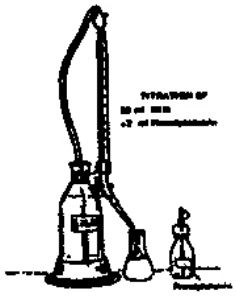
THE ALCOHOL TEST: The test is quick and simple. It is based on instability of the proteins when the levels of acid and/or rennet are increased and acted upon by the alcohol. Also increased levels of albumen (colostrum milk) and salt concentrates (mastitis) results in a positive test.

Procedure: The test is done by mixing equal amounts of milk and 68% of ethanol solution in a small bottle or test tube. (68% Ethanol solution is prepared from 68 ml 96% (absolute) alcohol and 28 ml distilled water). If the tested milk is of good quality, there will be no coagulation, clotting or precipitation, but it is necessary to look for small lumps. The first clotting due to acid development can first be seen at 0.21 - 0.23% Lactic acid. For routine testing 2 ml milk is mixed with 2 ml 68% alcohol.



Equipment used in alcohol test

ACIDITY TEST: Bacteria that normally develop in raw milk produce more or less of lactic acid. In the acidity test the acid is neutralised with 0.1N Sodium hydroxide and the amount of alkaline is measured. From this, the percentage of lactic acid can be calculated. Fresh milk contains in this test also "natural acidity" which is due to the natural ability to resist pH changes. The natural acidity of milk is 0.16 - 0.18%. Values higher than this range signify the development of acidity due to the action of bacteria on milk sugar.



Apparatus used be acidity test

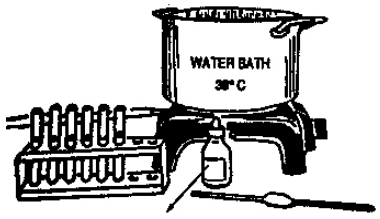
Procedure: 9 ml of the milk measured into the porcelain dish/conical flask, 1 ml phenolphthalein is added and then slowly from the burret, 0.1 N Sodium hydroxide under continuous mixing, until a faint pink colour appears.The number of mls of Sodium hydroxide solution divided by 10 expresses the percentage of lactic acid.

RESAZURIN TEST: Resazurin test is the most widely used test for hygiene and the potential keeping quality of raw milk. Resazurin is a dye indicator. Under specified conditions Resazurin is dissolved in distilled boiled water. The Resazurin solution can later be used to test the microbial activity in given milk sample.

Resazurin can be carried out as**:**

i. 10 min test.
ii. 1 hr test.
iii. 3 hr test.

The 10 min Resazurin test is useful and rapid, screening test used at the milk platform. The 1 hr and 3 hr tests provide more accurate information about the milk quality, but after a fairy long time. They are usually carried out in the laboratory.



Apparatus used in 10 min. Resazurin Test

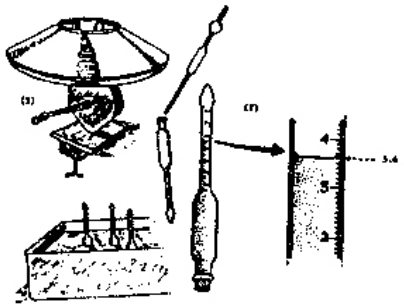
Procedure: The solution of Resazurin as prepared by adding one tablet to 50 ml of distilled sterile water. Resazurin solution must not be exposed to sunlight, and it should not be used for more than eight hours because it losses strength. Mix the milk and with a sanitized dipper put 10 ml milk into a sterile test tube. Add one ml of Resazurin solution, stopper and mix gently the dye into the milk, mark the tube before the incubation in a water bath, place

the test tube in a Lovibond comparator with Resazurin disk and compare it colorimetrically with a test tube containing 10 ml milk of the same sample, but without the dye (Blank).

READINGS AND RESULTS (10 MINUTE RESAZURIN TEST)

Resazurin Disc No.	Colour	Grade of milk	Action
6	Blue	Excellent	Accept
5	Light blue	Very Good	Accept
4	Purple	Good	Accept
3	Purple pink	Fair	Separate
2	Light pink	Poor	Separate
1	Pink	Bad	Reject
0	white	Very bad	Reject

THE GERBER BUTTERFAT TEST: The fat content of milk and cream is the most important single factor in determining the price to be paid for milk supplied by farmers in many countries. Also, in order to calculate the correct amount of feed ration for high yielding dairy cows, it is important to know the butterfat percentage as well as well as the yield of the milk produced. Furthermore the butterfat percentage in the milk of individual animals must be known in many breeding programmes. Butterfat tests are also done on milk and milk products in order to make accurate adjustments of the butterfat percentage in standardised milk and milk products.



Equipment used in Gerber Butterfat test

Treatment of samples: Fresh milk at approximately 20 ºC should be mixed well. Samples kept cool for some days should be warmed to 40 ºC, mixed gently and cooled to 20 ºC before the testing.

Procedure: Add 10ml sulphuric acid to the butyrometer followed by 10.94 or 11 ml of well mixed milk. Avoid wetting of the neck of the butyrometer. Next add 1 ml of Amyl alcohol, insert stopper and shake the butyrometer carefully until the curd dissolves and no white particles can be seen. Place the butyrometer in the water bath at 65 ºC and keep it there until a set is ready for centrifuging. The butyrometer must be placed in the centrifuge with the stem (scale) pointing towards the centre of the centrifuge. Spin for 5 min. at ll00 rpm. Remove the butyrometers from the centrifuge.

Put the butyrometers in a water bath maintained at 65 ºC for 3 min before taking the reading. The fat column should be read from the lowest point of the miniscus of the interface of the acid-fat to the 0-mark of the scale and read the butterfat percentage. he butyrometers

should be emptied into a special container for the very corrosive liquid of acid-milk, and the butyrometers should be washed in warm water and dried before the next use.

Appearance of the Test**:**

The colour of the fat column should be straw yellow.

The ends of the fat column should be clearly and sharply defined.

The fat column should be free from specks and sediment.

The water just below the fat column should be perfectly clear.

The fat should be within the graduation.

Problems in Test Results:

Curdy tests:

- Too lightly coloured or curdy fat column can be due to:
- Temperature at milk or acid or both too low.
- Acid too weak.
- Insufficient acid.
- Milk and acid not mixed thoroughly.

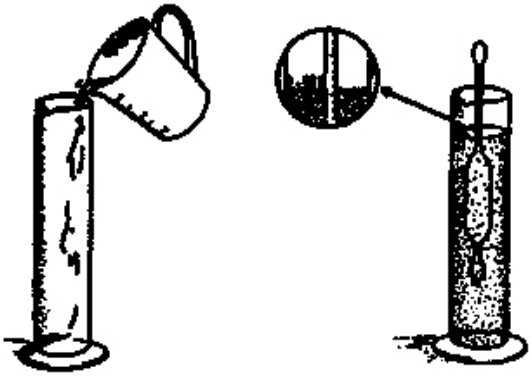
Charred tests: Darkened fat column containing black speck at the base is due to:

- Temperature of milk-acid mixture too high.
- Acid too strong.
- Milk and acid mixed too slowly.
- Too much acid used.
- Acid dropped through the milk.

THE LACTOMETER TEST: Addition of water to milk can be a big problem where we have unfaithful farm workers, milk transporters and greedy milk hawkers. A few farmers may also fall victim of this illegal practice. Any buyer of milk should therefore assure himself/herself that the milk he/she purchases is wholesome and has not been adulterated. Milk has a specific gravity. When its adultered with water or other materials are added or both misdeeds are committed, the density of milk changes from its normal value to abnormal. The lactometer test is designed to detect the change in density of such adulterated milk. Carried out together with the Gerber butterfat test, it enables the milk processor to calculate the milk total solids (% TS) and solids not fat (SNF). In normal milk SNF should not be below 8.5% according to Kenya Standards (KBS No 05-l0:-1976).

Procedure: Mix the milk sample gently and pour it gently into a measuring cylinder (300-500). Let the Lactometer sink slowly into the milk. Read and record the last Lactometer degree (ºL) just above the surface of the milk. If the temperature of the milk is different from the calibration temperature (Calibration temperature may be 20 ^{0}C) of the lactometer, calculate the temperature correction. For each ºC above the calibration temperature add 0.2 ºL; for each degree C below calibration temperature subtract 0.2 ºL from the recorded lactometer reading.

Ex: Calibration temperature of lactometer at 20 ºC.

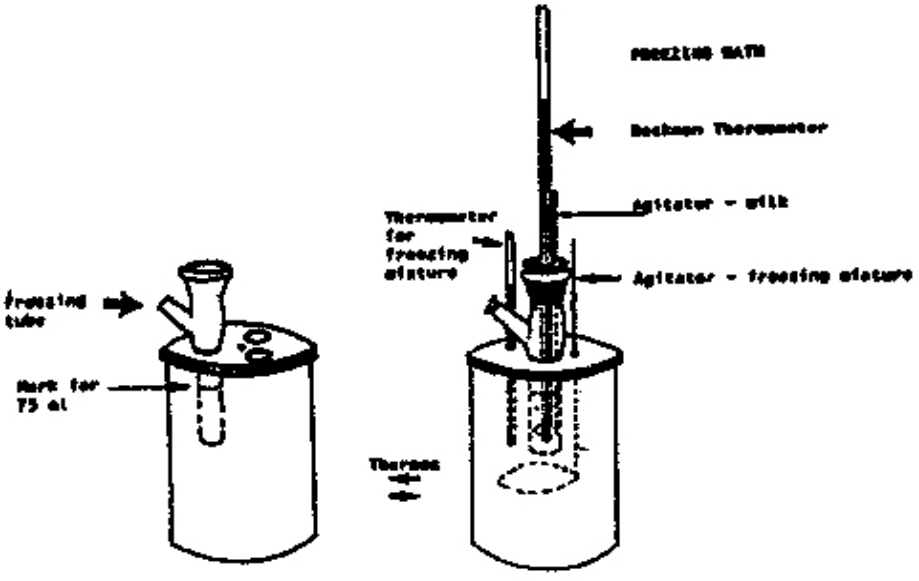


Equipment used for determination of milk density

Sample	Milk temperature	Lactometer reading	Correction	True reading
No.1	17 ºC	30.6 ºL	- 0.6 ºL	30.0 ºL
No.2	20 ºC	30.0 ºL	Nil	30.0 ºL
No.3	23 ºC	29.4 ºL	+ 0.6 ºL	30.0 ºL

For the calculations, use lactometer degrees, and for the conversion to density write 1.0 in front of the true lactometer reading, i.e. 1.030 g/ml. People may try to adulterate milk in such a way that the lactometer cannot show the adulteration. Check if there is unusual sediment from the milk at the bottom of the milk can and taste to find out if the milk is too sweet or salty to be normal. Samples of milk from individual cows often have lactometer reading outside the range of average milk, while samples of milk from herds should have readings near the average milk, but wrong feeding, may result in low readings. Kenyan standards expects milk to have specific gravity of 1.026 -1.032 g/ml which implies a Lactometer reading range of 26.0 - 32.0 ºL. If the reading is consistently lower than expected and the milk supplier disputes any wrong doing arrange to take a genuine sample from the supplier (i.e. inspect milk right from source).

FREEZING POINT DETERMINATION:



A Cryoscope is used for determination of freezing point of milk.

The freezing point of milk is regarded to be the most constant of all measurable properties of milk. A small adulteration of milk with water will cause a detectable elevation of the freezing point of milk from its normal values of -0.54ºC. Since the test is accurate and sensitive to added water in milk, it is used to detect whether milk is of normal composition and adulterated.

INHIBITOR TEST: Milk collected from producers may contain drugs and/or pesticides residues. These when present in significant amounts in milk may inhibit the growth of lactic acid bacteria used in the manufacture of fermented milk products such as malai, cheese and yoghurt, besides being a health hazard.

Principle of the method: The suspected milk sample is subjected to a fermentation test with starter culture and the acidity checked after three hours. The values of the titratable acidity obtained are compared with titratable acidity of a similarly treated sample which is free from any inhibitory substances.

Materials used to test inhibitory substances in milk

Procedure: Three test tubes are filled with l0 ml of sample to be tested and three test tubes filled with normal milk. All tubes are heated to 90 ^{0}C by putting them in boiling water for 3 - 5 minutes. After cooling to optimum temperature of the starter culture (30, 37, or 42 ºC), 1 ml of starter culture is added to each test tube, mixed and incubated for 3 hours. After each hour, one test tube is from the test sample and the control sample is determined.

Assessment of results: If acid production in suspected sample is the same as the normal sample, then the suspect sample does not contain any inhibitory substances. If acid production as suspect sample is less than in the normal milk sample, then, the suspect sample contains antibiotics or other inhibitory substances.

QUALITY CONTROL OF PASTEURISED MILK: When milk is pasteurised at 63 ºC for 30 min in batch pasteuriser or 72 ºC for 15 seconds in heat exchanger, continuous flow pasteurisers, all pathogenic bacteria are destroyed, there by rendering milk safe for human consumption. Simultaneously various enzymes present in milk, and which might affect its flavour, are destroyed.

In order to determine whether or not milk has been adequately pasteurised, one of the enzymes normally present in milk phosphatase, is measured. A negative phosphatase result indicates that the enzyme and any pathogenic bacteria have been destroyed during pasteursation. If it is positive, it means the pasteurisation process was inadequate and the milk may not be safe for human consumption and will have a short shelf life.

Reagents:

Buffer solution: The buffer is mixed using 0.75 g anhydrous sodium carbonate and l.75 g sodium bicarbonate in 500 ml distilled water.

Buffer-substrate solution: Place 0.l5 g of Disodium para nitro phenyl phosphate (the substrate) into a clean 100 ml measuring cylinder. Add the buffer solution to make to 100 ml mark. Store this buffer-substrate solution in a refrigerator and protected against light. It should not be used after one week. Prepare a fresh stock.

Procedure: Pipette 5mls buffer-substrate solution into a test tube, stopper and warm the solution in the water bath at 37 ºC. Add to the test tube 1ml of the milk to be tested, stopper and mix well and place in water bath at 37 ºC. Prepare a blank sample from boiled milk of the same type as that undergoing the test. Incubate both the test samples and the blank sample at 37 ºC for 2hrs. After incubation, remove the tubes and mix them thoroughly.

Place one sample against the blank in a Lovibond comparator "All Purposes" using A.P.T.W. disc and rotate the disc until the colour of the test sample is matched and read the disc number.

Interpretation:

Disc Reading after 2 hrs incubation at 37ºC	Remarks
0-10	Properly pasteurised
10-18	Slightly under pasteurised
18-42	Under pasteurised
> 42	Not pasteurised

Lecture-8

- *Quality Assessment of Food materials – Meat, Poultry, Egg and Processed food Products*

Introduction: The dramatic changes in the market forms of poultry in recent years, from a predominantly whole bird commodity to modern highly diversified industry focused on cut up, deboned meat, and ready to eat further processed products, have resulted in a change of quality expectation. The major poultry meat quality attributes are appearance, texture, juiciness, flavour and functionality. With increasing trends in further processing, meat functionality has increased in relative importance, especially because of its key role in determining the sensory quality of complex ready-to-eat products.

Many different methods measuring meat quality traits are available which are based on different principles, and instruments and/or probes. Particular attention should be taken also in order to standardize meat sample preparation and handling before and during

analysis. In view of the complexity of meat process during post mortem time and quality trait determination, it is not surprising that the results obtained in different studies and laboratories are not always in agreement with for comparison of results it is therefore necessary to keep strictly to the measuring specifications and that are why standardisation is indispensible.

Chemical and Physical Characteristics of Poultry Meat

Chemical	Physical
Moisture	pH and R-value
Total lipids	Colour
Protiens	Water holding capacity
Ash	Texture
Fatty acid composition	Sarcomere length
Cholesterol	
Susesptability to oxidation	
Amino acids	
Collagen	
Pigments	

CHEMICAL CHARACTERISTICS: They are as follows:

Moisture (Water): Objective: Measure the water content of poultry meat and poultry meat products as part of proximate analysis, its content is complement of dry matter.

Measurement: The standard reference method for measurements of moisture in meat has been oven drying. Ground muscle or meat (about 4 g) may be dried in a conventionan oven (air drying) at 100-102 ^{0}C for 16 -18 hours are in convection oven at about 125 ^{0}C for 24 hours. A vacuum oven (≤ 100 mmhg) at 95 -100 ^{0}C for about 5 hours may also be used. The residue is weighed. Use of the higher temperature is not recommended.

Ovens and / or use of vacuum serve to shorten drying time but may be not suitable for samples with high fat content. In all cases, it is necessary to hold samples in desicators during cooling to prevent water absorbtion from the air prior reweighing. If high fat content samples are dried in cellulose thimbles for subsequent fat extraction, for example some melted fat may soak through thimble and may be lost, resulting in anormously high values for moisture. Use of aluminium weighing dishes allieviates that concern. It is also important to measure a volatile materials driven off at temperature used. To be the consistent, these methods must follow prescribed conditions carefully in order to achieve expected results. It is recomemded atleast to determine in duplicate on one muscle sample from each bird.

Total lipids: Objective: Measure the lipid content of poultry meat and poultry meat products as a part of approximate analysis.

Measurement: The method of choice for official fat analysis has long been a solvent based method for measurement total fat content in meat. These methods include ether extraction followed by gravimetric measurement, tetrachloro ethylene extraction followed by specfic gravity measurements, methylene chloride extraction followed by gravimetric measurements.

Conventional extraction with ether typically requires several hours, while the Fosslet and CEM require specialised equipment that is relatively expensive. While these two methods are still being used in some laboraties, both the Fosslet and the CEM extraction

units have been discontinued by the manufacturers (and in some countries are no longer allowed) because of concerns for toxicity of waste organic solvents. Rapid solvent extraction can be achieved by soxlet units, which have been approved by the AOAC for meat analysis.The amount of sample required is generally about 20 g of ground and homogenized meat.

Protiens: Objective: Measure the protien content of poultry meat and poultry meat products has part of proximate analysis.

Measurement: The long time stsndard for protien analysis has been the Kjeldahl method. This method includes two phases:

i) A catalised mineralisation of nitrogen by heating in concentrated sulphuric acid;

ii) An alkaline treatment followed by a distillation and dosage of the produced free NH_3.

The content of total nitrogen included proteins and non-peptidic components. This contentent may be related to the total protien content using a general coefficient (6.25). Generally the sample amount required is about 2g. It is recommended atleast to determine in duplicate on one muscle sample from each bird.

The heavy metal catalyst used plus concentrated acid and alkali waste generated by conventional Kjeldahl procedures have become an increasing disposal concern for laboratories. Impovements in instruments to provide automated, relatively rapid Kjeldahl analysis have included accelerated digestion units (Labconco) and automated, rapid distillation (Kjeltec). These instruments are based on the Kjeldahl mrthod but provide far easier and more rapid analysis than the traditional Kjeldal method.

Lecture-9

- *Statistical Quality Control of Foods*

Statistical Quality Control: Quality of food refers to the composite characteristics which differentiate individual units and enable determination of the degree of acceptability by the consumer. The overall quality may be broken down into component characteristics such as colour, texture, flavour, nutritional value, freedom from harmful microorganisms and undesirable substances. Each of these may be measured and controlled independently. Quality is a measure of the degree of excellence. For purpose of control, it may be considered as specifications. The precision and the accuracy of the specifications are the two important requirements of quality.

The purpose of quality control is to ensure production of products which meet the defined standards within the accepted tolerances as illustrated with the FAO/WHO Codex Alimentarius Standards in the case of canned fruits, vegetables, juices, jams, jellies and marmalades, etc. These have to be produced at a cost which is compatible with the market for which they are designed, and the price at which they will sell. Hence, QC involves control of –

- raw material
- process and
- Examination of the finished product.

Once a product has gone through the manufacturing process, little can be done to alter its
quality or to overcome the faults. Examination of the finished product at the most represents analysis with respect to standards to accept or reject. Effective control over raw materials and process minimizes the rejection of the products as not being up to the desired standards

QUALITY CONTROL TECHNIQUE: The following procedure is usually carried out:

1. Identify the critical points in the process flow sheet which contributes to the major quality characteristics.
2. Sample each critical point depending upon batch or continuous operation, what is being sampled, and to what extent it is critical.
3. Evaluate and relate quality at critical successive stages to costs and yields.
4. Relate costs to deviation from specified levels.
5. Evaluate data collected against standards and legal requirements.
6. Provide consistent system for the orderly continuous evaluation of quality from the selection of raw material through different stages of processing.
7. Diagnose problems and predict troubles before they happen. Determine the extent of drifts and shifts in production, and minimize or localize.
8. Evolve a system to determine how well the quality control program is succeeding.

Critical Control Point inspection for canned fruit in syrup is as follows:

1. **Raw material:** The important materials used are fruit, sugar and citric acid. Water used making syrup should be suitable for purposes of canning.
   a. Fruit: Variety, maturity, extent of spoilage or damage, pesticide residues deterioration in handling and storage, potential contamination, with Accerprai affects it.
   b. Sugar and citric acid with respect to physical, chemical characteristics and microbiological quality.
2. **Tin Containers:** Type of tin plate, weight of tin coating, side seam, and double seam accuracy.
3. **Washing of fruits:** Public health significance and quality of water
4. **Preparation of fruit:**
   a. Efficiency of preparatory operations like peeling, slicing, coring, trimming and freedom from damaged or diseased portion.

b. Uniformity with respect to colour, texture and maturity.

5. **Preparation of syrup:**
   a. Calculation of strength of covering syrup required in relation to total soluble solids in fruit, filled weight of slices, weight of covering syrup added and cutout Brix required in the finished product.
   b. Control of weight, temperature and uniformity of strength at the time of filling control chart.
6. **Filling:** The coefficient of variation in the weight of empty cans is generally about 4%. This presents the problem of check weighing. Adequate provision has to be made in the filled weight of fruit for this variation. The fill-in weight of fruit required to get the desired drained weight in the canned product is best controlled by X and R charts discussed subsequently.

   To ensure adequate drained weight of slices and complete freedom from the cans being rejected with respect to drained weight, the mean line in the filling weight control chart should be at least 3 standard deviations above the lower control limit.

   In addition to the strength of covering syrup used and maintaining the strength uniform throughout the filling operation, a known weight of syrup should be metered into each can co prevent losses in filling and get proper net weight in the canned produce and desired cut-out Brix in drained syrup.
7. **Exhausting:** Periodic checks should be made to ensure that the cans coming out of the exhaust box have attained the desired can centre temperature. It has direct relation CO ultimate vacuum in the can which in turn is related to shelf-life and behavior at different altitudes.

8. **Container closure operation:**
   a. Protection of empty containers
   b. Cleaning of containers before filling
   c. Maintenance of can steamers
   d. Measurement of can steams-external and internal
9. **Processing:**
   a. To be according to good manufacturing practices
   b. Pasting of process schedules near retorts
   c. Recording of retorting operation
10. **Cooling water:**
   a. Microbiological quality
   b. Chlorine content
11. **Post-process handling:**
   a. Prevention of filled containers from damage and contamination
   b. Cooling

c. Ware housing – temperature and humidity.

12. Clean up and sanitation

13. Steam quality

14. Examination of finished product

15. **Sanitation control:**

a. Sampling

b. Location: product or ingredient contact surfaces and non-product contact surfaces-number of colonies in each case

c. Visual appearance

d. d Microbiological level

e. Rating-good, fair or poor

16. **General inspection:**

a. Raw-material receiving department

b. Produce preparation area

c. Packing and dispatching area

d. Windows, doors, wall surfaces, floor, etc.

Statistical Quality Control (SQC) : It is a useful tool that can be of great value co-manufacturing efficiency. It prevents waste, reduces the amount of necessary inspection, facilitates understanding between producer and consumer, ensures uniform quality of the product, and helps co insure acceptance of product. Many plants do not employ statisticians to do this work, but rely upon well-trained quality control personnel to develop and install the SQC procedures and programs.

SQC consists of optimal methods of sampling, presenting the test data control chart methods and deciding the significance of the reported data on the basis of statistical assurance.

SQC employs statistical principles and methods which have been developed to assess the magnitude of chance cause variation and to detect assignable cause variation. It indicates the limits beyond which these variations in the product should not go without correction. SQC determines the variations based on the laws of probability which may be defined as the number of times an event occurs to the total number possible. Thus, SQC involves sampling of the product, determining the quality variation of the sample, and relating the findings to the entire lot under consideration.

In the preparation of fruit and vegetable products, apart from containers, the edible raw materials consist of fruits, vegetables, sugar, salt, spices, colors, preservatives, flavouring materials, ere. Unlike sugar and salt which are the manufactured products, the horticultural produce substantially differs in size, shape, maturity, resistance to physical damage, etc. Varietal differences further add to the variation. Fruits and vegetables for processing are selected on the basis of maturity and ripeness. Sampling plans for specific purposes, charts for process control

and FAO/WHO Codex Alimentarius statistical procedure for accepting or rejecting processed fruit and vegetable products are discussed under this heading.

SAMPLING

Terms used: Inspection by attribute refers to those quality characteristics which are either good or bad, and involves classifying the product as acceptable or unacceptable. There are two types of attributes: (i) where measurements are not possible like scratches, damages, etc., or (ii) where measurements can be made but are not made because of time, cost or need. In contrast to inspection by attributes, inspection by variables refers to actual values obtained in terms of some scale used to establish a level of quality as, for example as ^{0}Brix and juice yield of oranges on which basis the payment is made in orange juice concentrate processing plants in USA.

The quality characteristic may be critical (e.g., injurious to the health of the consumer-microbial contamination or presence of toxic substance), major (Brix-acid ratio in citrus fruits, alcohol-insoluble solids in peas and corn, colour of tomato, etc., which determine the ultimate quality of the product), and minor (a defects which can be sorted out or removed in the preparatory processes).

When the buyer is confident of quality depending on the source, and is prepared to take normal risk, the level of inspection might be reduced. On the contrary, when the buyer wishes to minimize the risk, the level of inspection is tightened (more samples taken). The supply may come in a bulk lot (e.g., a truck load of fruits) or in sub-lots (e.g., fruits or vegetables packed in crates or baskets; canned foods packed in cartons).

Types of Sampling Plans: The purpose of inspection, the nature of the material to be tested, and procedure for testing differ. Hence, sampling plan selected must achieve the desired purpose.

The sampling may be to accept or to reject the supply when attribute sampling is done. In cases where rejection is not possible, variable sampling (involving actual measurement) is adopted to determine the average quality. When discrete units are packed, it is necessary to determine uniformity of the units in a lot and a variable plan is adopted.

The size of the sample is dependent upon the homogeneity of the material, size of the unit, source of supply (of reliable quality or not) and the cost of material. To these factors may be added the importance of the test, destructive or non destructive, the time required for the rest, and the cost.

Sample Selection: Horticultural produce arrives either in bulk (mango, pineapple, orange, etc.) or in unit packs (grape, tomato, etc. in baskets or crates; lime, peas, etc. in gunny bags). The samples selected for inspection should be representative of the entire lot. All sampling plans are based on the premise that each piece in the lot has equal likelihood of being selected. This is referred to as random sampling.

Acceptance Sampling of Lots by Attributes : Lot by lot acceptance sampling by attributes is the most common method made use of in the sampling of supplies of fresh fruits and vegetables, containers, etc, with this type of sampling; a pre-determined number of units (sample) from each lot are inspected by attributes.

A single sampling plan is defined by the lot size, N, the sample size, n, and the acceptance number, C.

Thus the plan

N = 3000

n = 125

C = 3

Indicates that from a lot of 3000 units, 125 units are inspected. If the number of defectives are 3 or less in the 125-unit sample, the lot is accepted; if 4 or more defectives are found, the lot is rejected. The standard is applicable to attribute inspection of raw materials, operations, materials in process, and products, supplies in storage, etc.

The standard provides for three types of sampling: single, double, and multiple. For each, provision is made for inspection at normal, tightened, or reduced levels.

Acceptable Quality Level: The most important part of the MIL-SID 1050 is the Acceptable Quality Level (AQL) because the AQL and the sample size code letter index the sampling plan.

AQL is defined as the maximum number of defects per 100 units that, for purposes of sampling inspection, AQL can be considered satisfactory as a process average. The phrase "can be considered satisfactory" is intended as a producer's risk, a, equal to 0.05; actually varies from 0.01 to 0.10.

Sample Size: The size of the lot and the level of inspection determine the sample size. Three general levels of inspection (I, II, and III) as shown in the table below:

Lot or Batch Size	S-1	S-2	S-3	S-4	I	II	III
2 to 8	A	A	A	A	A	A	B
9tO 15	A	A	A	A	A	B	C
16 to 25	A	A	B	B	B	C	O
26 to 50	A	B	B	C	C	O	E

	B	B	C	C	C	E	F
	B	B	C	D	O	F	G
	B	C	O	E	E	G	H
	B	C	O	E	F	H	J
	C	C	E	F	G	J	K
	C	O	E	G	H	K	L
51 to 90	C	O	F	G	J	L	M
91 to 150	C	O	F	H	K	M	N
	O	E	G	J	L	N	P
151 to 280	O	E	G	J	M	P	Q
281 to 500	O	E	G	J	M	P	Q
501 to 1,200	O	E	H	K	N	Q	R
1,201 to 3,200							

The different levels of inspection provide approximately the same protection to the producer, bur different levels of protection to the consumer. Inspection level II is generally used, with level I providing about half the amount of inspection and level III providing about twice the amount of inspection. Thus level III gives a steeper operating characteristic (OC) curve, more discrimination and inspection costs.

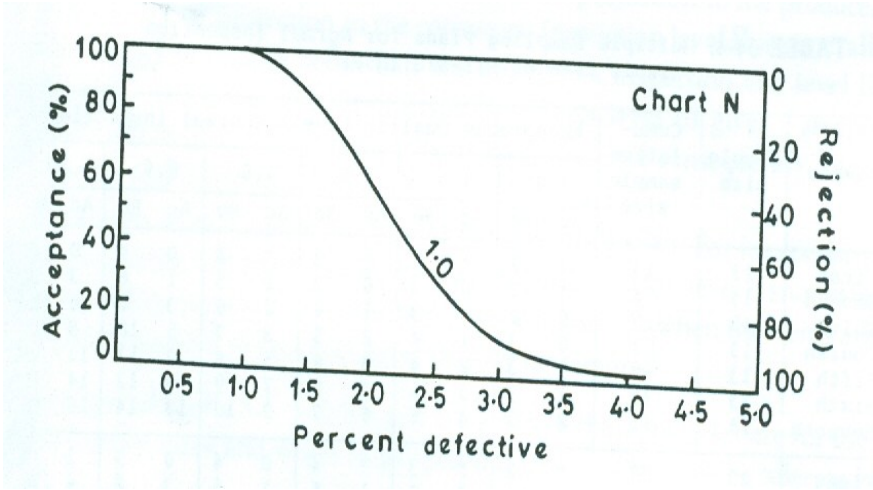
The inspection level is also a function of the type of product. For inexpensive items, for destructive testing or while testing for health hazards, level II should be made use of. When subsequent production costs are high, or when the items are complex and expensive, inspection level III may be required.

The four special levels S-I, S-2, S-3 and S-4 given in the above table are for use with small sample sizes and when large sampling risks can or must be tolerated. The above table gives only a sample size code letter based on lot size and inspection level.

Double and Multiple Sampling Plans: In the sampling plan discussed above, the entire sample is collected and examined to decide whether to accept or reject the lot. Double and multiple sampling plans enable reducing the samples to be drawn substantially in lots which are decidedly good or poor.

Operating Characteristic Curves: Every sampling plan may be fully described by its operating characteristic (DC) curve. The OC curve corresponding to sample-size code letter N and AQL of 1.0 % is shown in figure below. Suppose the lot contains 3% of spoiled fruits, refer to the bottom scale labeled percent defective, and from the 3% follow the vertical line up, until you reach the curve. At this level, on the right, is the 87% point on the vertical scale

reading "Rejections %". At the same level to the left, find 13% the vertical scale reading "Acceptance %". This means that about 13% of the time this sampling plan will accept a lot containing 3% spoiled fruits. Suppose the lot contains only 1 % spoiled fruits, the lot would be accepted 98% of the time. The OC curves for different sample size code letters can any alphabet.



OC curve for single sampling plan of sample size code letter N.

Acceptance Sampling Plans for Variables: Attribute sampling plans are the most common type of sampling for acceptance. Variable sampling plan may be used in certain situations for acceptance or rejection. Examples of these are purchase on the basis of juice yield, soluble solids content, etc. Generally a variable sampling plan is made use of in the sampling of raw materials upon acceptance inspection, in the control of process, and in the examination of finished products involving quantitative measurements.

Variable sampling plans are based on the sample statistics of mean and/or standard deviation, and the type of frequency distribution. The sample size required is considerably less than with the attribute sampling. The plan provides a better basis for improving quality and gives more information for making a decision. The main disadvantages are that only one characteristic can be evaluated, and a separate plan is required for each quality characteristic.

There are two types of variable plans-per cent defective and process parameter. Variable plans for per cent defectives help to determine the proportion of product that is outside specifications. The plans for process parameter are designed to control the mean and the standard deviation of the distribution of the product to specified levels.

SAMPLLING PLAN FOR PREPACKAGED FOOD - FAO/WHO Codex Alimentarius Procedure for AOL.6.5: Quality standards. These standards refer to determinations like fill of container, drained weight, quality criteria, defects and allowances which are evaluated by organoleptic, physical or chemical means. The quality specifications do not cover factors which present health hazards, unwholesome or otherwise highly objectionable to the consumer, which call "for a decision on the part of the controlling authority to accept or to

reject". Typical examples of such defects are metal contaminants, pesticide residues, rot or insect fragments, microbial spoilage, etc.

The Codex Alimentarius sampling plan covers all prepackaged fruit and vegetable products like canned and frozen fruits and vegetables, juices, jams, jellies and marmalades, tomato products, etc.

"Defective" is a sample unit which does not conform with certain specified requirement(s) of a Codex Standard on the basis of total demerit points, individual tolerances for 'defects'.

The sampling plans and acceptance procedures given cover various lots representing substantial portions of factory production or relatively large blocks of merchandise. The plans may also be used for small lots but the ratio of sample size required is high. Further, when the production lot is divided into small segments, the distribution of defective product is not likely to be uniformly divided between and within the smaller lots.

AQL of 6.5 adopted in Codex Standards will accept a lot or production which has 6.5% defective units approximately 95% of the time. The acceptance number (C) in the sampling plan indicates the maximum number of defectives permitted in the sample in order to consider the lot as meeting the requirements of a Codex Standard. Unless otherwise stated, the same procedure may be used with respect to other standards.

Procedure for Using the Sampling Plan:

(i) From the lot size, N (i.e., number of individual containers or units) and the container size, determine the number of samples *(n)* to be drawn for inspection level I or II. Inspection level I is for normal sampling and level II in case of disputes (i.e., Codex referee purposes), enforcement or in case of need for better lot estimate.

(ii) Draw at random the required number of sample units from the lot giving, proper consideration to code or other identifying marks in the selection of the sample.

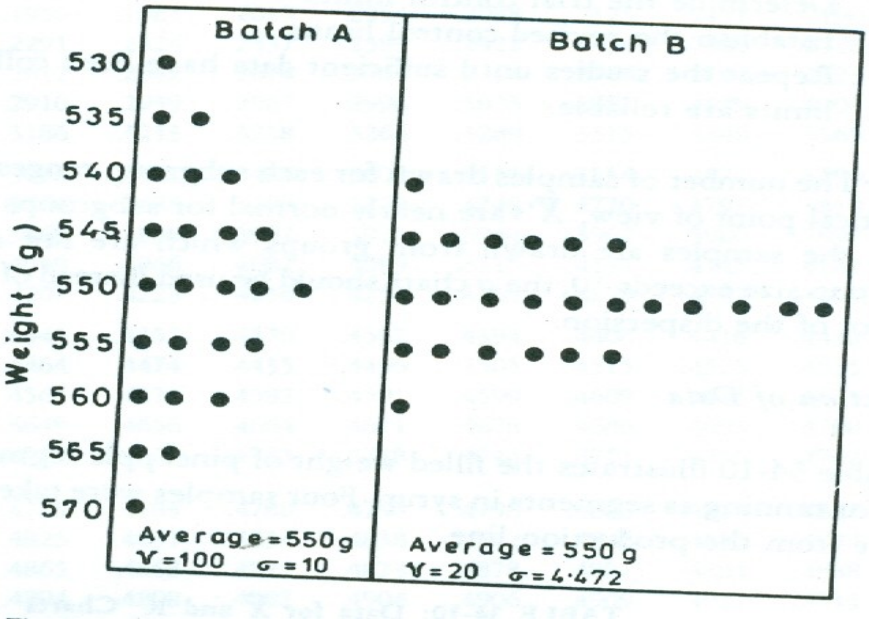
(iii) Examine the sample units with respect to the requirements of the Codex Standard.

(iv) Consider the lot acceptable if the number of defectives is equal to or lower than the corresponding acceptance number, C, given in the table

CONTROL CHARTS FOR PROCESS VARIABLES: No process can turn out identical products unit to unit, hour to hour or day to day. The variations observed in the product reflect the variability of the row materials, processes, operators and other causes. At best, one can try to keep the variability within limits to meet the requirements of the specification limits. Process inspection is best accomplished by using control charts. It is a means of the dividing line between acceptable and unacceptable quality levels. The main purpose of the control charts is to provide the means of anticipating and correcting whatever causes may

be responsible for defective products.

The simplest and generally the most practical approach to measure variability is to use the averages of a series of samples. The figure below illustrates how the quality of a product is directly affected by the test results. Both lots have the same average; yet the lot exhibiting less variability (greater uniformity) is the better lot. It is possible for a process to be statistically in control and yet not be at a satisfactory level.



Control Charts: The X and R charts are used to control the variables whose values can be expressed numerically. The X chart is used to control the variation in the mean or average value of samples. The R (range) chart is used to indicate the difference between the highest and the lowest values, i.e., the limits of variance.

Control limits should not be confused with specification limits which are the permissible limits of a quality characteristic of each individual unit of a product. However, control limits are used to evaluate the variations in quality from subgroup to subgroup. A frequency distribution of the subgroup averages can be determined with its corresponding mean and standard deviation (σ read as sigma). The control limits are then established at ± 3 standard deviations from the mean which is equal to 99.73 % of the normal curve.

Steps for Developing X and R Charts:

a. Select the quality characteristic
b. Select a method to measure the variable
c. Determine the size of the sample to be used for preparing X and R chart
d. Select the time interval to take out the sample.
e. Ensure the samples taken out are representative.
f. Record any change that might have occurred at different intervals while

taking out the samples, e.g., change in operators, product quality, etc.

g. Collect the data

h. Determine .the trial control limits

i. Establish the revised control limits

Repeat the studies until sufficient data have been collected so that the limits are reliable.

Lecture-10

- *Sensory Evaluation of Food Quality – Introduction -Panel Screening- Selection of Panel members*

EVALUATION OF FOOD QUALITY

Quality: It is the ultimate criterion of the desirability of any food product. Food quality can be evaluated by sensory and objective methods.

Sensory Evaluation: When the quality of a food product is assessed by means of human sensory organs, the evaluation is said to be sensory or subjective or organoleptic. Every time food is eaten a judgment is made.

Sensory quality is a combination of different senses of perception coming into play in choosing and eating a food. Appearance, flavour and mouthfeel decide the acceptance of the food.

The effective characteristic is not the property of the food but the subject's reaction to

the sensory qualities of foods. This reaction is highly conditioned by a variety of psychological and social factors thus playing a vital role in the acceptance and preference of food.

Sensory Characteristics of Food:

Appearance: Surface characteristics of food products contribute to the appearance. Scrambled egg with a very dry surface is not acceptable. Fudge with a glossy surface is rated high. Interior appearance can also be evaluated. Lumps in a pudding or gravy are not desirable can be judged by the eye.

Sight plays a role in the assessment of the lightness of foods like the bread, cakes and idli. Transparency, opaqueness, turbidity, dullness and gloss is mediated by the organs of sight.

Quality of fish can be ascertained by the brightness of the eyes of fish. Quality of sweet limes can be found out by appearance. If the skin is thin it is juicy. Infestation with insects can be found out in brinjal by the appearance of black spots on it. Completeness of cooking can be judged by appearance in products like meat and rice.

Colour: In addition to giving pleasure the colour of food is associated with other attributes. Ripeness of fruits like banana, tomato, mango, guava, papaya and plum can be assessed by the colour.

Colour is used as an index to the quality of a number of foods. The strength of coffee and tea is judged in part by the colour of the beverages. The colour of roast beef is used as an index to doneness. Toast, dosa, and chapathi which are too brown are likely to be rejected in anticipation of scorched bitter taste.

Flavor: The flavour of food has three components odour, taste and a composite of sensations known as mouth feel.

Odour: A substance which produces odour must be volatile and the molecules of the substance must come in contact with receptors in the epithelium of the olfactory organ.

Aroma is able to penetrate even beyond the visual range when comparatively volatile compounds are abundant as is true in boiling sambar.

The volatility of aromas is related to the temperature of the food. High temperatures tend to volatilise aromatic compounds, making them quite apparent for judging cool or cold temperatures that inhibits volatilization.

Taste: We value food for its taste. Taste sensation on the taste buds is categorized as sweet, salt, sour or bitter. Taste buds near the tip of the tongue are more sensitive to sweet and salt. Those on the sides to sour and

those near the back to bitter.

The sensation known as sour is associated with hydrogen ions supplied by acids like vinegar and by those found in fruits and vegetables. Salt taste is due to ions of salt. Sodium chloride is said to be the only one with a pure salt sensation.

Substances which elicit the sweet sensation are primarily organic compounds like alcohols, certain amino acids, and aldehydes. Glycerol tastes mildly sweet. Sugars are the main source of sweetness in food. Not all sugars are equally sweet. Fructose gives the most intense sweet sensation followed by sucrose, glucose, maltose, galactose and lactose. Sweetness appears to be associated with the hydroxyl radicals on the sugar molecules.

The concentration required for identification is known as the "threshold" for that particular substance. Individuals differ in their sensitivity to the four taste sensations and the threshold for each of the primary tastes is usually not at the same level in any one individual.The pleasant sensations in eating come more from odour than from taste.

Taste interaction : Foods contain mixture of substances which elicit all four taste sensations. Salt in subthreshold concentration reduces the tartness of acid. Some threshold concentrations of salt also increase the apparent sweetness of sucrose. The addition of salt to lime juice, sherbet, lassi, and to fruits like apple or guava improve the taste.

Conversely acids in subthreshold concentration intensify the saltiness of sodium chloride so it is easy to over salt tart foods. Sugar in subthreshold concentration reduces the saltiness of sodium chloride so a pinch of sugar may improve vegetable soup that has been over salted. Sugar also reduces the sourness of acids and bitterness of coffee.

Mouth feel : Texture and consistency and hotness or burning sensation of pepper can be felt in the mouth.

Temperature: Hot and cold sensations contribute to the composite flavour of a food like coffee, soup or ice-cream. Taste sensations are less intense as the temperature of food is lowered below 20 ^{0}C and raised above 30 ^{0}C. Thus really hot coffee is not as bitter as that which has cooled in the cup, iced coffee is not as bitter as that which is warm but not really hot. Melted ice-cream tastes unpleasantly sweet although in the frozen state it is acceptable.

Texture: Texture in ice cream depends upon the size of the crystals. How they feel on the tongue is characterised as coarse or fine. Coarse textured crystalline products are said to be grainy.

The brittleness of food is another aspect of texture. Tissues in a raw vegetable and fruit

are brittle or crunchy. The cells offer moderate resistance to fraction by the pressure of the teeth, e.g. crispness of apple and raw carrots. Tenderness in fruits and vegetables depends on how easily the cells separate. In meats ease of separation of the lean (without fat) tissue determines the tenderness. Tenderness in pastry is assessed by the ease with which the crisp crust breaks.

Astringency: It is dry puckery sensation due to precipitation of the proteins in the saliva and in the mucous membrane lining of the mouth which deprives them of their lubricating character. Astringent substances may also constrict the ducts leading from the salivary glands to the mouth. Unripe fruits like cashew fruit, wood apple, blue berry and gooseberry are astringent.

Consistency: Ice-creams may be too hard or too soft which can be found out by mouth feel. Gravies, sauces and syrups range in consistency from thick to thin. Temperature may affect the consistency of food, e.g. ghee, butter, cheese and ice-creams.

The consistency of soft custard besides being thick or thin may be smooth or curdled. Cream soups may be smooth or lumpy. Gels may be rubbery or fragile (easily breakable). Particles of cooked cereal can be pasty or separate in grains.

Psychological factors: In addition to colour, odour, taste and mouth feel certain psychological factors contribute to the acceptability of foods. Food is accepted when there is pleasant association.

Lecture- 11

- *Requirements for conducting Sensory Evaluation and serving procedures*

SENSORY TESTS: Sensory tests conducted are well integrated with the overall plan of development of the product.

Trained panel members: The sensory qualities, particularly the flavour attributes are essentially to be measured subjectively. From early times this judging has been the preserve of experts who used to evaluate tea, coffee and wine. With the development of sensory evaluation techniques on scientific lines, the experts are being replaced by panels whose sensitivity and consistency have been established by training and repeated tests. The panel members analyse food products through properly planned experiments and their judgements are quantified by appropriate statistical analysis.

Selection of panel of judges: Actually one extremely discriminating pains taking and unbiased individual would suffice for tasting. Further one individual may not be able to discriminate different aspects of food quality. Hence a panel of judges may be used. Members of the panel should be carefully selected and trained to find out difference in specific quality characteristics between different stimuli and also direction and intensity of difference. The requirements for an ideal panel member are as follows.

- He should be able to discriminate easily between samples and should be able to distinguish appreciable differences in taste and smell.
- He should have good health. If he is suffering from cold his sensitivity may be affected. A sick patient cannot judge the food correctly he should not be habituated to chewing pan
- He should be experienced in the particular field.
- He should have high personal integrity. He should not be prejudiced.
- He should be able to evaluate objectively.
- Willingness to spend time for the sensory evaluation work is required.
- He should have interest in sensory analysis of samples and intellectual curiosity.
- He should have ability to concentrate and derive proper conclusion.
- He should be available and willing to submit to periodic test to get consistent results.

Different types of panels:

Trained panel*:* Laboratory panels must then be carefully trained for specific products or purposes. These tests aim at finding differences in specific quality characteristics between different stimuli and also direction and/ or intensity of the difference. Periodically the panel is given refresher training and tests. The number of members in the trained panel should be small varying from 5 to 10.

Discriminative, communicative or semi-trained panels: These panels are constituted of technical people and their families, who are normally familiar with the qualities of different types of food. They are capable, with few preliminary test runs, of following instructions for tests given, discriminating differences and communicating their reactions. Such panels of 25-30 are used to find the acceptability or preference of final experimental products prior to large scale consumer trials.

Consumer panels: Such panels are made up of untrained people chosen at random to represent a cross-section of the population for which the product is intended. The greater the number, the greater is the dependability of the result. A group of not less than 100 is considered the minimum.

Testing laboratory: Testing laboratory consists of five separate units -

- Reception room where the panel members meet the person in charge of the laboratory and get acquainted with the type of the samples to be tested
- The sample preparation room which is clean and well equipped for the preparation and serving of samples.
- The test booths are where the actual sensory evaluation of the samples are carried out by the panel members
- The entire testing laboratory should be air-conditioned, free from noise and extraneous odours.
- Whenever samples with difference in colours are tested, colour lights should be used to mask the colour of the samples.
- Stainless steel, glass dishes and cups as well as plain serving china are the most convenient as utensils.

Preparation of samples: Samples for presentation must be from homogeneous lot. Careful sampling of the food is necessary for sensory evaluation. Samples to be tested should be prepared by identical methods. All samples should be at the same temperature optimum level and kept constant during the test. Stainless steel forks and spoons can be used for tasting the samples Samples are presented with 3 to 5 digit code markings to obscure the identify of the samples. The order of presentation should also be randomized within each test session.

Techniques of smelling and tasting: For odour tests of food products a special technique is used to perceive the aroma more clearly. Smelling is done with short, rapid sequence of sniffs. Tasting of coffee or tea or fruit juice is done by slurping. One teaspoon of the liquid is rolled on the tongue so that the liquid reaches all parts of the tongue where the taste buds are located.

Testing time: Testing should be done at a time when the panel members are fresh. The test time is generally between 10 AM to 12 noon. Too many samples should not be given as they may produce fatigue and lead to errors in the results. (Not more than 4 - 5 samples at a time).

Design of experiment: Experimental error can be minimized through the use of techniques of randomizing. A statistical design is used in order to measure variables separately and together and to establish the significance of results. The experiment should be designed on the basis of the accuracy needed and the amount of sample available.

Reasons for testing Food Quality:

To know the consumer preference : This helps the producer to discover which qualities of the product need to be developed and emphasized. He should obtain the

cross-section of all potential consumers. Consumer preference panels may consist of several hundred persons and the products are tested under ordinary conditions of use. The results are considered to represent the taste of the significant portion of the population and are used to predict market out- look for a product.

Effect of variation in processing on quality *:* Tests are done to investigate the influence of factors in production. They should have the ability to distinguish among degrees of difference in flavour. The members of this type of panel are not required to be expert tasters of the product under investigation. Their highly developed ability to identify different tastes in similar products is the key quality required. Its purpose is to determine whether a given variation in processing has altered the quality of flavour of the products. It is also used to test the effects of storage and packaging on two items originally alike but subjected to different storage environment.

To detect the presence of off-quality: Here the panel members are usually trained to recognise and to evaluate the standard flavours of food so that they can use their powers of discrimination consistently, e.g. rancidity in fats and butter.

Lecture-12 & 13

- *Methods of Sensory Evaluation and Evaluation cards – Difference/discrimination procedures*
- *Methods of Sensory Evaluation and Evaluation cards- Ranking and Rating procedures*

EVALUATION CARD

The questionnaire or score card should be prepared carefully for each test. The card should be clearly typed or printed. It should be simple and use unambiguous terms and directions in the desired sequence of action as a guide to the evaluation.

The design of score cards for sensory evaluation is challenging and difficult because the key characteristics of the product need to be evaluated on paper in a way that permits the judges to transmit their assessments of the samples accurately to the researcher. A score card with too much detail and clutter may discourage careful judgement too brief a form may fail to obtain some important

information.

A score card may be as simple as indicating which sample is different as is done when duo-trio or triangle testing is the mode being used. A sheet for indicating rank order for a single characteristic also is extremely simple. It is in the descriptive tests that the score card becomes a critical part of the planning for an experiment.

A table utilising the hedonic ratings ranging from unacceptable to very acceptable is relatively easy to construct.

No single score card fits all experiments. Instead, the score card needs to be developed for the specific experiment. All score cards should contain the date and name of the judge.

TYPES OF TESTS: Different sensory tests are employed for food evaluation. The tests are grouped into four types.

A. Difference tests.
B. Rating tests.
C. Sensitivity tests.
D. Descriptive tests.

The selection of a particular test method will depend on the defined objective of the test, accuracy desired and personnel available for conducting the evaluation.

A. **DIFFERENCE TESTS:**

A1. **Paired Comparison Test**

(i) The panel members receive several pairs of samples. These may be dif ferent or the same samples in each pair. Samples are always given in code numbers

(ii) Different samples are given in each pair which differs in the intensity of one characteristic, e.g. sweetness, bitterness or rancidity. In each pair the sample with more or less intense taste will have to be picked out.

Specimen evaluation card:

Paired Comparison Test

Name: ---------- Date:

Product:----------

You are given one or several pairs of sample. Evaluate the two samples in the pair for ----------.

Is there any difference between the two samples in the pair

Code no. of pairs	Yes	No
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Signature

Note: The less preferred sample need not be of poor quality and may still fall in the acceptable category and this should be decided by a separate test.

* Mention the specified sensory characteristic to be studied, e.g. sweetness, texture, flavour or overall quality and use separate cards for each characteristic

A2. **Duo-Trio Test:**This test employs three samples, two identical and one different. The panel is first given one of the pair of identical samples called reference sample R and then the other two successively in random orders, and asked to match one of these with the first. A positive answer is required even if it is a guess. The chance probability of placing the samples in a certain order is one-half. Trained or untrained panellists can be used.

Specimen evaluation card:

Duo-Trio-Test

Name: ---------- Date:

Product:----------

The first sample 'R' given is the reference sample.

Taste it carefully.

From the pair of coded sample next given, judge which sample is the same as 'R'

Set No	Code no. of pairs	Same as R
I.	_____	_____
II.	_____	_____
III.	_____	_____
IV.	_____	_____

Signature

A3.**Triangle Test:** This test employs three samples, two identical and one different, presented simultaneously to the panel. The judge is asked to determine which is the odd sample of the three. A positive answer is required even if it is a guess. Since all three samples are unknown, the chance probability of placing the sample in a certain order is one-third. Two samples A and B can be presented in two combinations AAB and BBA and for replication in six different arrangements-AAB, ABA, BAA, BAB, ABB and BBA

Specimen evaluation card:

Triangle Test

Name: ---------- Date:

Product:----------

Two of the three samples are identical. Determine the odd sample.

	Code no. of samples	Code no. of samples	Comment on odd samples
I.	_____	_____	_____
II.	_____	_____	_____
III.	_____	_____	_____
IV.	_____	_____	_____

Signature

B. **RATING TESTS:** These tests give more quantitative data than difference tests and can be used for the analysis of more than two samples at the same time.

B1. **Ranking Test:** This test is used to determine how several samples differ on the basis of a single characteristic. A control need not be identified.Panellists are presented all samples simultaneously (including a standard or control if used) with code numbers and are asked to rank all samples according to the intensity of the specified characteristic. In consumer analysis, the panellists are asked to rank the coded samples according to their preference.

Specimen evaluation card:

Ranking Test

Name: ---------- Date:

Product:----------

Please rank the samples in numerical order according to your preference or intensity of aroma/taste characteristic of the product.

Intensity/Preference	Sample code
I	
II	
III	
IV	

Comments: (type of off-flavour. etc.).

Signature

B2. **Single Sample (Monadic) Test:** This test is useful for testing foods that have an after taste or flavour carry over which precludes testing a second sample at the same session. The panellist is asked to indicate the presence or absence and/ or intensity of a particular quality characteristic. With trained panellists, the completed analyses of two or more samples evaluated at different times can be compared. Also, in market and consumer analysis, the results of different samples evaluated at different times by a different set of untrained panellists can be compared.

Specimen evaluation card:

Single Sample (Monadic) Test

Name: ---------- Date:

Product:----------

Please taste and rank the sample carefully. Can you detect any off-flavour in the product?

Circle one

Yes No

If you detect any off-flavour please describe it below

Intensity (circle one)	Comments
Trace	Off-flavour is due to
Moderate	Off-odour
Strong	Off-taste
	Residual taste
	Other defects

Signature

B3. **Two Sample Difference Test:** This test is a variation of the paired comparison test and measures the amount of difference. Each taster is served four pairs of samples. Each pair consists of an identified reference and coded test sample. In two pairs, the

test sample is a duplicate of the reference sample. In the other two pairs, the test sample is the test variable. The panellist is asked to judge each pair independently as to the degree of difference between the test sample and standard on a scale of 'a' representing no difference to '3' representing extreme difference. Additional questions on direction of difference can also be asked. The panellist is not to guess and he is panelised for guessing through the coded duplicate standards in two pairs.

Specimen evaluation card

Two Sample Difference Test

Name: ---------- Date:

Product:----------

Compare the coded sample to the reference sample independently in each of the four pairs given. Test sample mayor may not be different from the reference sample

Determine the degree and direction of difference on the following scale

Degree		Direction	
No difference	0	Superior to standard	S
Very slight difference	1	Equal to standard	E
Moderate difference	2	Inferior to standard	I
Large difference	3		

3. Comment on what the difference is based on odour, taste or both.

Sample code No	Degree of difference	Direction	Comment
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

(Note: If there is no difference, there is no degree or direction)

Signature

B4.**Multiple Sample Difference Test**

In this test, more than one test variable can be evaluated per session but with reduced reliability. Each panellist is served 3-6 samples depending upon the number of test variables. One sample is a known standard. The panellist compares each coded sample with the known standard. One coded sample is a duplicate of the standard. Whatever score the panellist assigns to the blind standard is subtracted from the score he assigns to the test variables. The panellist does not guess. Direction and degree of difference is also to be judged.

Specimen evaluation card:

Multiple Sample Difference Test

Name: ---------- Date:

Product:----------

You are given a standard or reference sample marked 'R'. Taste it carefully for the quality characters to be evaluated. You are next given a number of samples which are to be compared to the reference sample for odour and flavour. Rate in each sample degree of difference and the direction of quality according to the following scale

Degree of difference Direction of quality

Rating		Difference from standard
0	None	E Equal
1	Slight	I Inferior
2	Moderate	S Superior
3	La	

Sample Code No	Odour	Degree	Direction	Comments	Flavour	Degree	Direction	comments

Signature

B5. **Hedonic Rating Test:** Hedonic rating relates to pleasurable or unpleasant experiences. The hedonic rating test is used to measure the consumer acceptability of food products. From one to four samples are served to the panellist at one session. He is asked to rate the acceptability of the product on a scale, usually of 9 points, ranging from 'like extremely' to dislike extremely'. Scales with different ranges and other experience phrases could also be used. The results are analysed for preference with

data from large untrained panels.

Semi-trained panels in smaller number are used to screen a number of products for selecting a few for consumer preference studies.

When pronounced after-effects are met with, precluding testing of a second sample or when independent judgments are sought for, separate cards are used for each product. When relative preference is the object of study, cards with multiple columns for the number of test samples are used.

Specimen evaluation card:

Hedonic Rating Test

Name: ---------- Date:

Product:----------

Taste these samples and check how much you like or dislike each one. Use the appropriate scale to show your attitude by checking at the point that best describes your feelings about the sample. Please give a reason for this attitude. Remember you are the only one who can tell what you like. An honest expression of your personal feeling will help us

	code	code	code
Like extremely	_____	____	_____
Like very much	_____	_____	_____
Like moderately	_____	____	_____
Like slightly	_____	_____	_____
Neither like nor dislike	_____	_____	_____
Dislike slightly	_____	_____	_____
Dislike moderately	_____	_____	_____
Dislike very much	_____	_____	_____
Dislike extremely	_____	_____	_____

Reason

Signature

B6. **Numerical Scoring Test:** One or more samples are presented to each panellist in random order or according to a statistical design. The panellist evaluates each sample on a specific scale for a particular characteristic indicating the rating of the samples. The panelists are trained to follow the sensory characteristics corresponding to the agreed quality descriptions and scores. Without this understanding the rating will not be of any use.

Specimen evaluation card:

Numerical Scoring Test

Name: ---------- Date:

Product:----------

Please rate these samples according to the following descriptions:

Score	Quality description
90	Excellent
80	Good
70	Fair
60	Poor

Sample Score Comments

Signature

B7. **Composite Scoring Test:** The rating scale is defined so that specific characteristic of a product are rated separately. The definition of the rating scale is weighed so that the most important characteristics will account for a large part of the total score. The resulting scores are compounded for anyone panellist to arrive at a composite score. This method is helpful in grading products and comparison of quality attributes by indicating which characteristic is at fault in a poor product. It gives more information than the straight numerical method. The panellists are trained to evaluate the dimensions of the individual quality characteristic critically, and in the use of the weighed scale.

Specimen evaluation card:

Composite Scoring Test

Name: ---------- Date:

Product:----------

Quality	Possible score	Sample Scores			
Colour	20	_____	____	____	_____
Consistency	20	_____	____	___	____
Flavour	4	_____	_____	____	____
Absence of defects	20	_____	_____	____	____
Total score	10	_____	_____	_____	_____

Signature

Lecture-14 and 15

- *Different methods of Quantitative descriptive analysis*
- *Determination of Sensory thresholds and taste Interactions*

C. **SENSITIVITY TESTS:** Sensitivity tests are done to assess the ability of individual to detect different tastes, odours and feel the presence of specific factors like astringency or hotness (pepper). These tests are used to select and train panel members for evaluating the quality of products containing spices, salt and sugar, e.g. tomato ketchup or sauce. For this purpose threshold tests for the recognition of basic tastes (sweet, sour, bitter and acid) are employed for selecting the panel members.

C1. **Sensitivity-Threshold Test:** Sensitivity tests are to measure the ability of an individual to smell, taste or feel specific characteristics in food or beverages or pure substances are used frequently in selecting for evaluations in product research and development. Also, they are used to establish intensity of sensory response of a food.

Threshold Test: Threshold is defined as a statistically determined point on the stimulus scale at which transition in the series of sensations or judgements occur. There are mainly three types of threshold as described below:

a. Stimulus detection threshold is that magnitude of stimulus at which a transition occurs from no sensation to sensation.

b. Recognition identification threshold is the minimum concentration at which a stimulus is correctly identified.

c. Terminal saturation threshold is the magnitude of a stimulus above which-there is no increase in the perceived intensity of the stimulus.

The recognition threshold tests with basic tastes or odours are most frequently

employed for panel selection and with materials such as spices for assessing the intensity of odour or flavour as the main threshold value by a trained panel. The threshold value is given as a mere number which is the denominator of the dilution where the odour or flavour is recognized. These tests are also used where a minimum detectable difference of an additive or of an off-flavour are to be established.

Specimen evaluation card:

Sensitivity-Threshold Test

Name: ---------- Date:----------

You receive a series of beakers with increasing concentrations of one of the four taste qualities (sweet, salt, sour and bitter). Start with beaker no. 1 and continue with beaker no. 2, no. 3, etc. Retasting of already tasted solutions is not allowed. Describe the taste or give intensity scores

Use the following intensity scale:

o = None or the taste of pure water
? = Different from water, but taste quality not identifiable
x = Threshold very weak (taste identifiable)
1 = Weak
2 = Medium
3 = Strong
4 = Very strong
5 = Extremely strong

Set No	Description of taste and feeling a factors
1	--------
2	-------
3	-------
4	-------
5	-------

Signature

C2. **Dilution Test:** Dilution tests are designated to establish the smallest amount of an unknown material, developed as a substitute for a standard product that can be detected when it is mixed with the standard product, e.g., margarine in butter dried whole milk in fresh milk, synthetic orange flavour ingredients with natural flavour and so on. The quality of the test material is represented by the dilution number which is the percent of the test material in the mixture of the standard product such that there exists adjust identifiable difference in odour and taste between them. The bigger the dilution number the better is the quality of the test material

D. **Descriptive Flavour Profile Method.** This is both qualitative and quantitative description method for flavour analysis in products containing different tastes and odour. For tomato ketchup the flavour profile analysis is given:

Flavour profile analysis of tomato ketchup

Aroma	**Taste**	**Mouth feel**	**Texture**
Garlic 1	Sour (Tomato) 1	Chillies 1	Smoothness
Pepper 2	Sweet (Sugar) 2		
Onion 3	Salt 1		
Cinnamon 2			
Cloves 1			

The different test methods are laboratory analysis with trained panelists and consumer analysis with untrained panelists.

Number of panel members and samples

Required for Sensory Tests

	Method	**Panelists**		**No. of samples per test**
		Type	**Number**	
A.	Difference (Qualitative)		.	
1.	Paired	Trained	5-12	2
		Untrained	72-80	
	Comparison		<	
2.	Duo-Trio	Trained	5-12	3 (2 identical and 1 different)
3.	Triangle	Trained	5-12	3 (2 identical and 1 different)
B.	Rating (Quantitative differences)			
1.	Ranking	Trained	5-12	2-7
		Semi-trained	10-25	
		Untrained	72-80	
2.	Single sample	Trained	6-25	
	(Monadie)	Untrained	72-80	
3.	Two sample difference	Trained	6-25	4 pairs of unknown and control sample
4.	Multiple sample and quality difference	Trained	6-25	3-6
		Semi-trained	10-25	Including control and depending on number of quality factors evaluated

5.	Hedonic	Semi-trained	10-25	5-10 , Larger number only if mild flavoured or rated for colour or texture
		Untrained	72-80	1-4
6.	Numerical scoring	Trained	5-12	1-6, 5-10, Large number only if mild flavoured or rated only for texture
7.	Composite	Trained	5-12	1-4
C.	Sensitivity			
1.	Threshold	Untrained		5-10
2.	Dilution	Trained	12-24	5-10
D.	Descriptive			
Flavour Profile		Trained specially in the technique	3-6	1-5

Limitations of sensory evaluation

1. The result may be highly variable
2. People with colds or other health problems temporarily lose their maxi- mum effectiveness.
3. Emotional burdens may influence an individual's ability.

Lecture-16

- *Objective/Instrumental analysis of Quality Control*

OBJECTIVE EVALUATION: Methods of evaluating food quality that depend on some measure other than the human senses are often called objective methods of evaluation.

Advantages:

- Confidence can be gained as they are reproducible.
- The results would be accurate. Human sensitivity is not involved. Minute differences can be noticed by doing objective tests.
- They are less subjected to errors when compared to sensory methods.
- These methods provide permanent record so that comparison can be made over a period of time.
- They are not affected by factors other than the one being measured.
- Emotional burdens and individual ability can be overcome.

Disadvantages:

- It is time consuming.
- It is expensive.
- Technical knowledge is required.
- Instruments may not be available sometimes.
- Some aspects of food cannot be evaluated by objective methods e.g.flavour.

Usually both sensory and objective methods are done. Objective evaluation supplements or reinforces the data obtained subjectively through sensory evaluation.

Tests used for Objective Evaluation:

Chemical methods: Chemicals are estimated in food spoilage like peroxides in fats. Adulterants in food e.g., presence of starch in milk, metanil yellow in turmeric powder and loss of nutrients during cooking can be estimated.

Physico-chemical methods

a. Measurement of hydrogen ion concentration can be found by the use of pH meter. It utilizes a glass indicating electrode and a reference electrode to complete the electrical circuit.

b. Digital salt meter: This refractometer has electrodes built in the measurement unit and it indicates salinity percentage in digits in three seconds with one ml sample dripped on it.

c. Sugar concentration can be found by refractometer. It is used to determine the concentration of a sugar solution. Light is refracted as it passes through sugar solution, with the specific values being calibrated in degrees, Brix an indication of the percent of sucrose in the solution.

Brix or Balling hydrometer gives directly the percentage of sugar by weight in the syrup. It is always necessary to make a temperature correction since the hydrometers are usually calibrated at 20°C. Each instrument used by canners usually covers a range of only 10° Brix, e.g. 10 - 20, 20 - 30, 30 - 40, 40 - 50, 50 - 60 ^{0}Brix respectively and are graduated in 1/10th divisions. Brix is defined as percent sucrose measured by a Brix hydrometer. Since continued use of hydrometers in hot syrups affects their accuracy, they should be checked frequently by more accurate instruments.

d. **Polariscop**e is used for quantitative analysis of sugar.

e. **Butyromete**r: It is an instrument consisting of a calibrated glass tube for measuring the butter content of milk. The milk is mixed with a certain volume of ether which dissolves the butter. Then an equal volume of alcohol is added. The butter floats on the surface in the form of an oily layer and its thickness, measured by the graduation of the tube, clearly shows the proportion of butter.

Microscopic examination: Some properties of foods depend on their structure and valuable information can be obtained by microscopic examination. Examples are given below.

1. Type of organisms present in fermented products like idli batter.
2. Examination of starch cells under the microscope for identification.
3. Spoilage of the food can be found out by observing the organisms under the microscope.
4. Size of crystals in sugar is related to smoothness of the product.
5. Number and size of the air cells in batters and foams.

Physical methods:

Weight: Weight of a food indicates the quality like in case of apple or egg.

Volume: Liquid volumes can be measured by using measuring cups.

Solid food volume can be found by displacement method. In this method the volume can be calculated by subtracting the volume of seeds held by a container with a baked product from that of volume of seeds without the baked product. Usually mustard seeds are used.

Specific volume: The determination of specific volume of any product should be done with care and average of replicates is to be taken since experimental errors are likely to be large. Measurement of bulk volume in a porous and spongy product like idli is difficult. The volume may be measured by displacement with solvents like kerosene. The idli is given a momentary dip in molten wax to seal off the pores. Increase in volume is taken as the measure of its bulk volume.

$$\text{Specific volume} = \frac{\text{Bulk volume}}{\text{Wt. of the substance}}$$

Index to volume: It can be found by measuring the area of a slice of food with a planimeter. It is important to use a slice that is representative of the product such as a centre slice.

Index to volume is a measurement made by first tracing detailed outline of a cross section of the food. This tracing can be done with a sharply pointed pencil or a pen or by making a clear ink blot of the cross section. The ink blot is made simply by pressing the cross section of the sample lightly onto an inked stamp pad and then making the imprint of the inked sample on paper. A planimeter can also be used to trace the entire outline of the sample, being careful to follow all indentations and protrusions so that the final measure recorded on the planimeter represents the circumference of the slice.

Specific gravity: It is a measure of the relative density of a substance in relation to that of water. The measurement is obtained by weighing a given volume of the sample and then dividing that weight by the same volume of water. This technique is used for comparing the lightness of products physically unsuited for volume measurements e.g., egg white foams. Potatoes with low specific gravity (waxy type potatoes) have cooking characteristics different from those of potatoes with a comparatively higher specific gravity.

Moisture: Press fluids: Initial weight of the sample is noted. After the appropriate pressure has been applied for a controlled length of time, the sample is again weighed. The difference between the two weights represents the amount of juice contained in the original sample e.g. juiciness of meats, poultry and fish.

Drying*:* The weight of the original sample is determined and then the food is dried until the weight remains constant.

$$\text{Moisture content} = \frac{\text{Initial - dried weight}}{\text{Initial weight}} \times 100 = \%$$

Karl Fischer Titration: In 1990 Karl Fischer showed that food to be analysed by this method is homogenised in a high-speed blender at speeds up to 7,500 rpm to release the water and the water is titrated with Karl Fischer reagent until all the water has reacted with

the reagent. The calculation for water content is handled by a microprocessor, which is built into the machine. It is costly but gives quick response.

Wetability: Baked products can be tested for moisture level by conducting a test for wettability. For this test, the sample is weighed before being placed for 5 seconds in a dish of water. Immediately at the end of the lapsed time, the sample is removed from the water and weighed again to determine the weight gain. High moisture retention is synonymous with good wettability, a sign that a cake probably will be considered to be appropriately moist when judged subjectively.

Cell structure: Cell structure of baked products is an important characteristic to measure the uniformity, size and thickness of cell walls.

Photocopies of cross-sectional slices give this valuable information. This technique gives third dimensional view into the cells on the cut surface of the sample and gives the actual size clearly.

Size of the grain*:* This can be found by using photography or ink prints with stamp pad or sand retention e.g. idli. Retention of sand is more if the grains are coarse. Cut the idli into 2 pieces and take one piece and press it on the stamp pad and take an impression on the paper. Ink prints may be less clear but satisfactory for some purposes.

Measurement of colour: Colour is the first quality attribute a consumer perceives in food. Change of colour is generally accompanied by flavour changes.

Colour Dictionaries*:* The dictionary of Maerz and Paul is most commonly used. The dictionary consists of 56 charts. Seven main groups of hues are presented in order of their spectra. For each group there are 8 plates. In place of colour dictionary, colour reproduced on secondary standards such as painted test panels, rings, discs or plastic models may be used.

A mask of neutral grey having two openings is used. The size of each opening should be equal to the size of the individual colour patch in the sheet. An opening should be placed over the sample and the other over different patches on the chart until a match is achieved and the colour is noted.

Disc colorimeter*:* Here the discs have radial slits so that a number of them may be slipped together with varying portions of each showing. The discs are spun on a spindle at about 2700 rpm so that the colours merge into a single hue without flickering. The test sample is placed adjacent to the spinning disc under controlled illumination and both are viewed simultaneously.

Colored chips: A simple method is to match the colour of the food with the colour chips or colour glass, chart or colour tiles. This method is not very small block of colour or the chart. The data are difficult to tabulate and analyse also.

Spectrophotometer*:* Visual matching of colours is subject to shortcomings of human observers. To overcome this spectrophotmeter can be used. In this, tube with the liquid is placed in a slot and light of selected wavelength is passes through the tube. This light will be differentially absorbed depending upon the colour of the liquid and the intensity of the colour. Two liquids of exactly the same colour and intensity will transmit equal fractions of the light directed through them. If one of the liquid is a juice and the other is the juice diluted with water, the latter sample will transmit a greater fraction of the incoming light and this will cause a proportionately greater deflection of the sensing needle on the instrument. Such an instrument can also measure the clarity cloudiness of a liquid depending on the amount of light the liquid allows to pass.

INSTRUMENTS USED FOR TEXTURE EVALUATION: Various instruments are used to measure the texture of liquids, semi solids and solids. Rheology is defined as the science of deformation and flow of matter. It has three aspects-elasticity, viscous flow and plastic flow.

The science of rheology deals with the measurement of various mechanical properties of foods. A study of rheological properties of foods is important for two reasons.

(i) To determine the flow properties of liquid food stuffs.

(ii) To ascertain the mechanical behavior of solid foods when consumed and during processing.

Instruments used for testing Viscosity: The resistance or internal friction to the flow of liquids is normally known as viscosity.

Viscosity or consistency is an important factor in influencing the quality of a large number of food products. The more important among these are cream style corn, salad creams, tomato products, jellies, jams, mayonnaise, syrups, and fruit pulps where the acceptability largely depends on their having proper consistency or viscosity. Measurement of this factor for the raw material or the product at various stages of manufacture serves as an aid in checking or predicting the consistency of the final product. Further, such quality control measurements also serve as indicators in calculating the amount of an ingredient (thickening agent, etc.) that should be added in a particular food product. Duration and amount of heat applied in a process may also be suitably regulated to some extent by viscosity measurements as heat penetration and consistency are closely interrelated

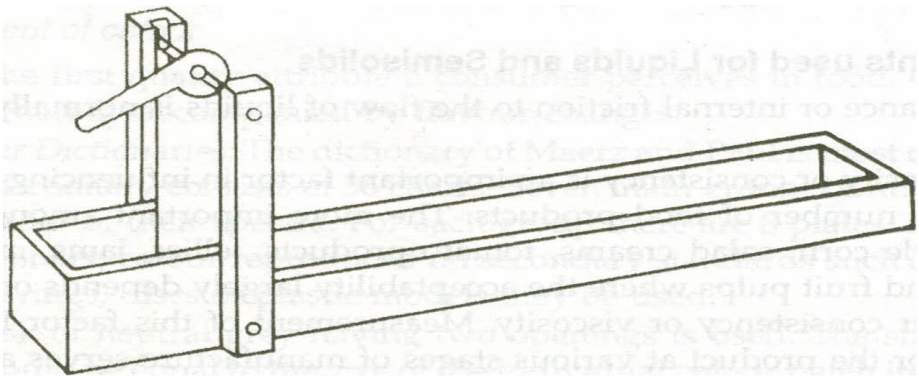
Percent Sag: The depth of a sample such as jelly is measured in its container by using a probe. The product then is unmolded onto a flat plate. The greater the percent sag, the tenderer is the gel.

$$\text{Percent Sag} = \frac{\text{depth in container - depth in plate}}{\text{depth in container}} \times 100$$

Stormer viscometer: It is used to measure the viscosity or consistency of certain food products and to give an index of the resistance of the sample to flow. The number of seconds required for the rotor to make 100 revolutions has been used to measure the consistency of some food samples.

Brookfield Synchrolectric Viscometer: This is based on measurement of resistance to rotation of a spindle immersed in the test material. This can be used successfully in measuring the consistency of custards, pie fillings, tomato products, cream style com, mayonnaise, salad dressings and dairy products.

Bostwick Consistometer: This is used for measuring the consistency of tomato ketchup and sauce. The Bostwick consistometer consists of a channel *(2x12")* with sides which are 2" high. It has triggered gate on one side. A centimeter scale is etched on the floor of the channel. The use of this instrument is based on the theory that the length of flow is proportional to consistency



Bostwick Consistometer

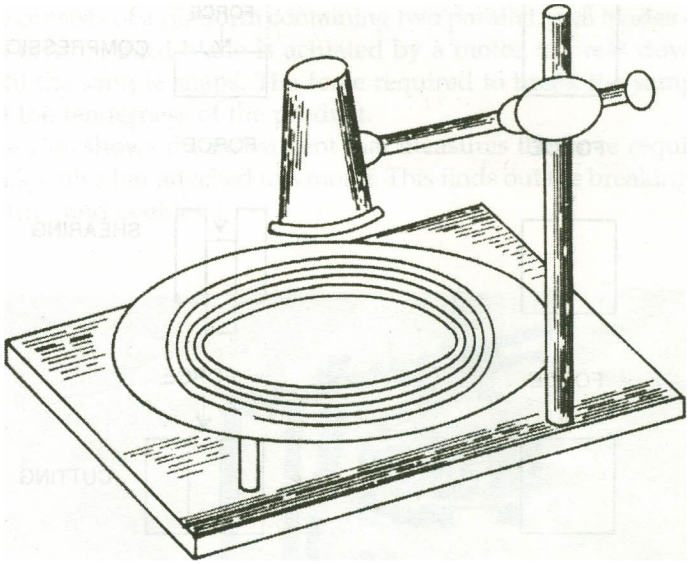
Efflux-Tube Viscometer: It measures the time necessary for a quantity of fluid to pass through an orifice or capillary under standard pressure, e.g. tomato puree.

Adams Consistometer: While this Consistometer was designed primarily for measuring consistency of cream style com, there are possibilities of using it in measuring the consistency of other products like tomato puree, apple sauce and fruit pulps.

The Adams consistometer has been designed and constructed to accommodate a greater mass and measure the unrestrained flow in all directions by means of concentric

circles. It consists of a large metal disc upon which are engraved 20 concentric circles, increasing 0.25 inch in radius. A steel truncated cone, which can be lifted vertically, fits tightly against the disc so that the circumference of the cone coincides with the inner most circle.

Fill the cone with the sample to the level. Then raise the cone quickly and after 30 seconds, measure the consistency of the cream style com by recording the extent of flow of the product at four equidistant points as indicated on the calibrated disc. Average the four values thus determined to obtain an average consistency value for the product. A simpler version of this principle is used in Line spread test.



Adams Consistometer

Penetrometer: A Penetrometer also may be used to measure tenderness of some foods. This device consists of a plunger equipped with a needle or cone that is allowed to penetrate the sample by gravitational force for a selected period of time. The larger the reading the longer the distance the more tender is the product.

Gels and many baked products are particularly well suited to tenderness measurements using the penetrometer The Bloom gel meter is a special type of penetrometer in which lead shot drops into a cup which forces a plunder into the sample. When sufficient weight has been added to the cup to move the plunger a set distance, the test is completed and the amount of shot required is determined as the measure of the test.

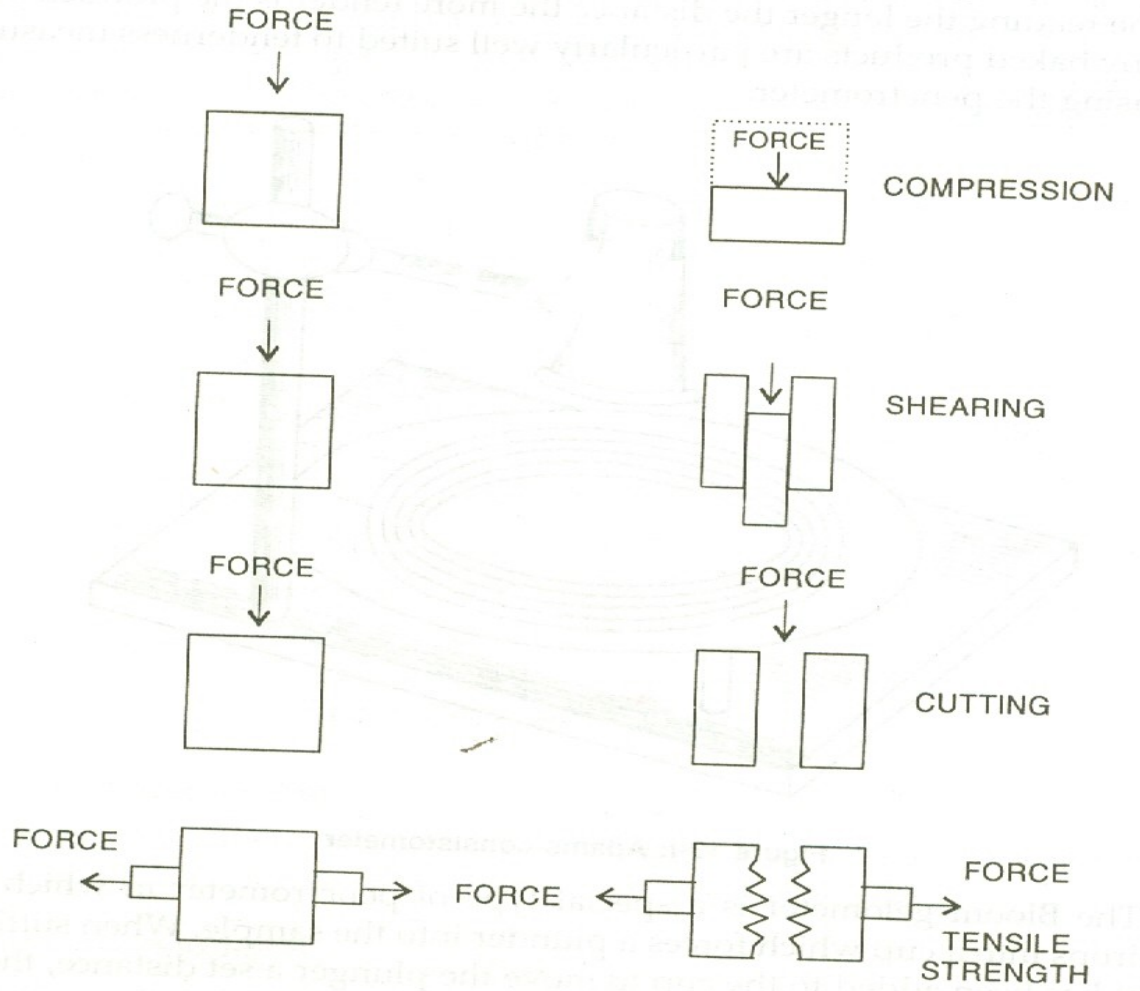
Brabender Farinograph: This is used to measure the plasticity of wheat dough for preparing bread products. It is designed to study the physical properties of the dough by recording the force required to turn the mixer plates through the dough. The force required increases as the solution develops during mixing and later decreases as solution is slowly broken down by over mixing.

Instruments used for solids: Food texture can be reduced to measurements of resistance to force.

If we squeeze food so that it remains as one piece this is called compression, e.g. bread.

If we apply a force so that one part of the food slides past another it is shearing, e.g. chewing gum.

If the force goes through the food so as to divide it like in cutting. If the force is applied away from the material, the food pulls apart by which we measure tensile strength, e.g. chapatti



Types of resistance to force

Magness-Taylor Pressure tester (compression): It consists of a plunger of variable diameter which is pressed into the fruit to a given depth. The sprint attached to the plunger contracts and measures the compression force, e.g. peas (suitability of peas for the harvest or to find out the correct stage of ripening of a food).

Succulometer (compression): This instrument is used to measure the maturity of com and storage quality of apples as determined by the volume of juice extracted under controlled conditions of pressure and time.

Tenderometer (compression and shearing): This is an example of an instrument based on shearing force in which compression is preceded by shearing action, e.g. suitability of peas for preservation.

Fibrometer: This is based on the cutting principle and used to differentiate mature stocks from the tender stocks, e.g. green beans.

Shortometer: This device consists of a platform containing two parallel, dull blades on which the sample rests. A third blade is actuated by a motor to press down on the

sample until the sample snaps. The force required to break the sample is the measure of the tenderness of the product.

Christal texturometer (cutting): This is designed with series of rods which are pushed into the meat sample. The harder the meat more force is required to penetrate

Voldokevich Bite Tenderometer (cutting and shearing): This attempt to imitate the action of teeth on food. It records the force orbiting on a piece of food which results in deformation and this determines total energy utilised for this deformation, e.g. meat and meat products.

Grinding and Extensibility: The power used by a household food grinder is measured. Increased toughness would increase the power consumption of the grinder. Extensibility proved to be inversely related to tenderness.

Kramer shear press: This is a multipurpose instrument with same power unit and with differen test cell assemblies. This instrument is widely used.

Tensile strength: An instrument used to find out the tensile strength of chapathi. One end of chapathi is attached to a stand and the other end is attached to a paper glass Water is added to the cup till the chapathi breaks. The more water require, the tougher the chapathi.

Compressimeter: The Compressimeter is related to the shear press, but it measures only compressibility not shear strength. The usual technique for operating the compressimeter is to apply pressure until the sample has been deformed specific amount and then to measure the force that is required to accomplish this amount of deformation. The greater the force required, the firmer the product.

Warner-Bratzier Shear: It is a device used to measure the tenderness of meat. Meat samples of carefully controlled dimensions are placed through an opening in a thin mete plate and the force required for two parallel bars to shear the meat as the: pass down opposite sides of the place holding the sample is recorded.

Shear press: The shear press, a related device, is a machine that compresses, extrudes an, shears the sample at the same time. This is a suitable method for measuring textual characteristics of some fruits and vegetables.

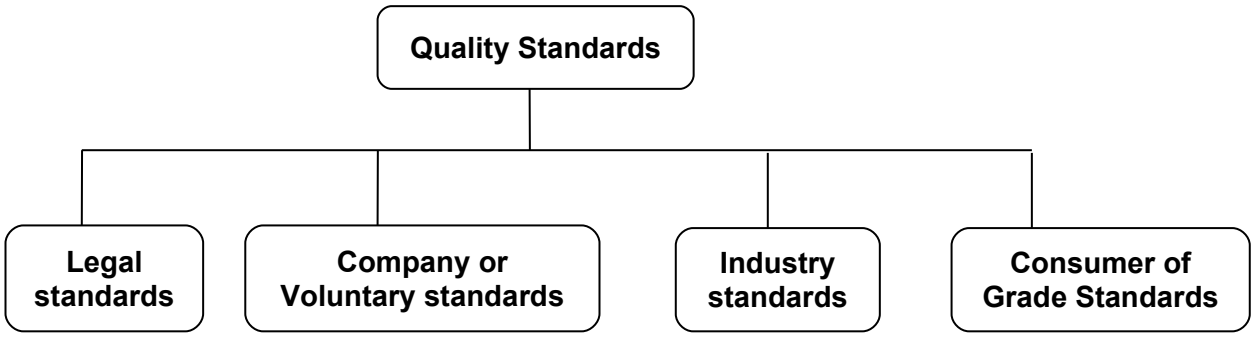
Universal Testing Machine: The Universal testing machine can provide a record showing seven aspects like texture from various food samples These are cohesiveness, adhesiveness, hardness, springiness, gumminess, chewingness and fructurability.

Lecture-17

- *Food laws and Standards (BIS)*

Introduction: Food is the basic need of all living organisms and hence, its quality is of top priority. Food processing involves number of unit operations for material handling and there are always chances that the food may be contaminated or adulterated. The food is said to be contaminated if food is injurious to health and contain filthy, putrid rotten odour of insect pests etc. and hazards may occur. However, a food is said to be adulterated if it contains any other substance which affects the nature and quality product or substance is substituted with cheaper substance. So, it is essential to set the minimum limits of the desirable characteristics required and the maximum limits of the undesirable components that the food should contain. This helps to set common standards for commodities and to prevent confusion among the consumers.

Quality Standards: Quality standards in relation to any food article of food mean the standards notified by the Food Authority. Governmental or Private bodies that establish standards may be the subject of a certification programme. Food quality standards are the body of rules directly concerning foodstuffs, whether they take the form of official, semi-official or factory form, and whatever the aspect treated, from food ingredients to retail marketing. So, number or agencies and organization are involved at national and international level to make the standards implement and regulate them. The four standards which are commonly used as shown below:



Commonly used quality standards in Food industry

Legal Standards: These are established by federal, central, state or municipal agencies and are generally mandatory. These are set up by the law or through regulation. They generally concerned with freedom from adulteration by insects, mould, yeasts and pesticides.

Company or Voluntary Standards: These are established by various segments of the food industry. These standards generally represent consumer image and become symbol of product quality. These are used by private firms or supermarkets.

Industry Standards: These standards are established by an organizational group to maintain the quality of the given commodity. These standards become effective by pressure where other legal standards are not involved.

Consumer or Grade Standards: These standards represent consumer's requirements of the product and generally based on the experience of the industry for consumers. Out of these, the legal standards are most important. The government empowered agencies promulgated a number of acts and orders to minimise the menace. Several agencies and institutions have also been created to lay down standards for the quality of foods. The manner in which the food is processed and packaged is also covered by a number of regulations. Several types of standards apply for evaluation, testing and monitoring dietary supplements. The food standards and their regulations are used as yardsticks for assurance of the food safety and consumer health. These standards encourage the safety and quality of the products by manufacturer, making sure that the food product meets the desired standards. Different countries have different standards based on the type of product being manufactured, environmental and cultural practices, raw material etc. So, in India, food manufacturer follow Indian standard to sell their products in the domestic markets and international standard to export the products out of country.

Food Standards are for the following reasons:

- The contamination of food can affect a large number of populations at a time and hazards may occur. So standards are needed to prevent the transmission of the diseases.
- Consumer must get the product for which he has paid and to limit the sale of unsatisfactory products.
- The processors may add any prohibited preservative or permitted preservative in excess of the prescribed limits. So standards are needed to check such malpractices.
- To set common standards for commodities and prevents confusion among consumers.
- To simplify the marketing of food.
- Standards are made to set the limits of the preservatives / additives / method of applications for production of the quality product to sell it nationally or internationally.
- Standards are made to prevent adulterations of food products.

Food Laws are for the following reasons:

- To maintain the quality of the food produced in the country.
- To prevent exploitation of the consumers by the sellers.
- To safeguard the health of the consumers.
- To establish criteria for quality of the food products.

Lecture-18

- *Consumer Studies – Types of Consumer studies- Preference Studies and Acceptance Studies*

CONSUMER STUDIES

Although the fate of a food product has always rested on acceptance by the consuming public, formal studies of consumer preference are a comparatively recent development. Consumer reactions are difficult to measure (Hicks, 1948), but the necessity for such studies will continue to grow as competition for the consumer food increases. The competitive aspects are readily visualized when it is considered that the daily per-capita calorie intake remains relatively constant in many countries. For a new food product to succeed it should replace another food item or benefits should be there to be accepted by population. In a household budget, food takes up bulk of it. So buying power of this magnitude it is obviously advantageous for the food industry to study the needs and desires of the consumer in some cases, it possible to create markets for certain foods where none existed previously.

Well established industries strive to maintain their sales by determining whether alterations in formulation, packaging, diversification or advertisement are advantageous. It has been theorized that people do not know what they want and can be manipulated through psychoanalytically oriented promotion campaigns.

Demand by the time-conscious housewife for partially prepared foods and "convenience items" has increased rapidly, requiring alterations in raw-material selection, processing, packaging distribution, and advertising. The acceleration of new-product development emphasizes the need for reliable, efficient and representative sampling of consumer opinion as well as continuous study of changes in food habits. .

The influence and magnitude of consumer opinion is recognized by such large consuming groups as the United States Army, which supports a very active food acceptance program . Private industries rely heavily on consumer reaction obtained by their preference surveys. Private firms, government agencies, and various educational and research organizations are actively engaged in studies of techniques, methodologies, and application of results of consumer food surveys .

One must distinguish carefully between studies of consumer preference and studies of consumer practice. Those who prefer may not be those who buy pref erence studies are designed to determine consumer's subjective reactions to external phenomena, and their reason for having them. Practice studies are designed to determine what consumers actually do under given circumstances, such as the numbers of ripe and under ripe peaches purchased when ripe peaches cost certain amounts more. The techniques for these two types of studies are usually quite different, although some approaches can be used for both types. Both acceptance and

preference are primarily economic concepts. Acceptance of food varies with standards of living and cultural background, whereas preference refers to selection when presented with a choice Preference are frequently influenced by prejudice, religious principles, group conformance, “status value,” and snobbery, in addition to the quality of the food.

I. **Factors Influencing Acceptance and Preference:** Many complex factors combine to influence the public’s acceptance and selection of food as indicated. The extent to which the sensory properties modify the selection and utilization of a food is difficult to ascertain since all of these factors interact and influence the consumer’s decisions.

Attributes of the food product	**Attributes of the consumer**
1. Availability	1. Regional preference
2. Utility	2. Nationality, race
3. Convenience	3. Age and Sex
4. Price	4. Religion
5. Uniformity and dependability	5. Education, socio-economics
6. Stability, storage requirements	6. Psychological motivation
	a. Symbolism of food
	b. Advertising
7. Safety and nutritional value	7. Physiological motivation
8. Sensory properties	a. Thirst
a. Appearance	b. Hunger
b. Aroma and taste	c. Deficiencies
c. Texture, consistency	d. Pathological conditions
d. Temperature	
e. Pain	

Appearance probably has the greatest initial influence. Since visual properties significantly control selection of the item from the hundreds of choices on the grocer’s shelves. Later, on the dinner table, appearance either succeeds or fails to stimulate appetite. To test the importance of color and appearance in food selection, the U.S. Testing Company asked a large group of shoppers to wear specially tinted goggles while doing their normal food buying. When the glasses were removed prior to the checkout counter, every shopper was surprised at her selections of meats, cheese, fruits, vegetables, and even of strange brands. The experiment should have been replicated to test its repeatability and reliability.

Once the food has been tasted, color and texture become secondary to flavour. Flavour is mentioned by an overwhelming proportion of consumers as the reason for over-all preference and continued use of a product. The reason cited most often for disliking a given food is that “it does not taste good”. It is possible that degree of liking and flavour quality are synonymous in the minds of many consumers, but that would be difficult to measure.

A. **Preference in Relation To Cost:** Price is an important limitation on the freedom with which the consumer selects foods. Consumer buying behavior for 'canned pears indicated that 68% of 179 families said selection of a specific brand was made on the basis of flavour whereas 59% of the 128 families who purchased eight minor brands did so because of lower price.

Questionnaire for Household Milk Preference Test:

A. Prefer sample in; Container "A" _____; container "B"_____

(A Preference must be indicated).

B. Why did you prefer the sample of your choice? (Check one or more)

Preferred milk has:

Richer taste_____

Sweeter taste_____

Smoother body_____

More pleasing taste_____

Less aftertaste_____

Other: (Please write in)_____

C. If you have the choice of buying only these two beverages for regular consumption, how much more (if any) per quart would you be willing to pay for the sample marked as being preferred on this questionnaire?

1. Cent_____
2. Cents_____
3. Cents_____
4. Cents_____
5. Cents_____
0. Cents_____

Examples of questionnaire used to determine Preference-price interrelationship for milk the family preferred. The questionnaire used to determine the relationship between preference for milk and willingness to pay more for the preferred sample. All of the foregoing studies involve single occasion testing, so that no information is available on whether the preference or the opinion on pricing would be sustained over a period of exposure.

Products with the panel's approval have fared well at the hands of the consumer when such foods have gone through the normal channels of distribution. Although the cost of a food item may be directly related to consumer, preference, it cannot be assumed, that these items will be purchased more frequently than other items. Rather, the prices of many foods are determined by the maximum amount the consumer is wiling to pay, in addition to availability and costs of production and distribution. It is interesting that although a consumer opinion poll will show that oysters are generally disliked, the demand for oysters exceeds the supply, so that they are among the most expensive nutrition man can buy.

The preference-cost curves for appetizers and desserts followed the expected principle of diminishing returns, whereas the curve fitted for the entrees was approximately linear. Benson also noted the role of price as a psychological attribute of an article, and reported, "The marginal preference for price is determined by observing how much the preference for a commodity changes when the price tag is altered, while its other qualities remain unchanged."

Meat preferences of military personnel (who received their meals free of charge) increased as the cost of the meat constituent increased; of 17 items, chilli con carne at 8.8 cents per serving received the highest score (Benson and Peryam, 1958). When scores were plotted against cost per serving, the slope of the curve diminished with increasing cost, indicating that equal increments in cost did not produce equal gains in the soldier's satisfaction.

B. **Regional preferences:** Some regional food preferences exist for specific food such as coffee (variation in roasts and blends), eggs white vs. brown shells, wieners, and the many interesting food items associated with nationality and ethnic groups. Ex.: In an Iowa study Scandinavians differed from other group in their food preferences and showed signs of adhering to customs and habits of their ancestors. Although some culture influences are deeply embedded, it is generally believed that in the United States most regional or national or nationality preferences for specific food items are diminishing because of

1. Population mobility and intermarriage.
2. Standardization of processing.
3. Increased use of partially prepared food and decreased consumption of dishes "Prepared from scratch".
4. Greater availability as result of refrigeration controlled ripening development varieties, improved distribution.
5. Impact of national advertising via television, newspapers, radio.etc

C. **Age:** The age of the consumer has been reported to influence preferences for some food products Children under 16 and adults over 50 preferred sweeter canned fruit than did the participants in the middle age group. A definite preference for 3% sucrose in rose wine was shown by all consumers tested, regardless of frequency of consumption, and the preference increased with the age of the consumer.

D. **Sex:** Difference in personality, sensory acuity and likes and dislikes are usually more pronounced between people of the same sex than between the two sexes as groups. There are, however, group differences between the sexes which can be used effectively in planning and conducting marketing campaigns.

E. **Other Factors:** Interest, motivation, discrimination, intelligence and many other attributes of the consumer undoubtedly influence responses to food the role of the sensory stimulation of food is not completely understood. The nutritional value of food as well as sensory properties like appearance, flavour and texture properties are considered. However, subjects on the low level of feeding (2400 calories/day) tended to reject the same food items rejected by men on the high level (4000 calories/day). Effects of menu combination,

frequency of serving, subjective satiety, and stability of food preference.

Lecture-19

- *Consumer Studies – Types of Consumer studies- Preference Studies Objectives of Consumer Preference Studies-factors affecting consumer acceptance*

OBJECTIVES OF CONSUMER PREFERENCE STUDIES

A. **Determination of market potential:** Whether consumers will purchase a product at a rate commensurate with the supply and at a price high enough to ensure a continuous flow of the product into the market is of constant concern to the producer. An awareness of market conditions may be of greater interest to producer of convenience food, specially items and new product than to distributors of standard staples and product, but all food producers' benefits from studies of market potentials for their products.

For the creation of food that appeal to a specific population, knowledge is needed of the size, distribution, socio-economic make up and potential purchasing power of that population in marketing baby food. Differentiating between total sales and repeat sales can yield useful information. Differentiation between food fads and food trends is difficult but may mean the difference between success and failure for an item.

This is always an unpredictable amount of risk involved in applying results from market surveys. This is complicated by the time lapse between the survey and the actual marketing of the product. The producers may follow these:

1. Don't change a product until it has been product tested, market tested and actively promoted.
2. Build a different feature into the product which can be promoted.
3. Pioneer a new field rather than imitate successful leaders.
4. Enter market that are growing
5. Seek rapid acceptance through products featuring convenience in preparation, performance or packaging.
6. Design a reliable test program of ample sample size adequate cross section with proper collection and interpretation of the data.
7. Be patient, testing takes time.

B. **Introduction of New Products:** Years ago a manufacturer could maintain a loyal clientele for a product of acceptable quality through advertising and special services. Increased competition has infringed upon brand loyalty, necessitating increased competition has infringed upon brand loyalty, necessitating development of new products to attract consumer attention and to meet the needs of constantly changing society.

A combination of retail sales audit and a household survey was a used effectively by the US Department of Agriculture to establish consumer opinion of a new product, canned

frozen grapefruit sections. Opinions were obtained on uses of the product, taste, size, container, price, and frequency of purchase.

C. **Quality Control of Existing Products:** When a specific brand of foods has enjoyed popularity as indicated by repeated sales over the years, there is reluctance to change the product unless the alteration increases sales. Consumer testing can serve as a quality-control measure to assure uniformity and to maintain standards. As a check on quality, a processor many have consumer compare his product against that of his nearest competitor in a test where the identity of the sample is not known to the consumer.

D. **Establishment of specific factors to the consumer:** A food product may sell well because of quality, price size, packaging, promotion, availability or a combination of all or any of these factors. The processor may wish to study consumer criteria for selection groups of foods in order to concentrate on influential characteristics:

(a) What is the maximum price the consumer will pay?
(b) What is the minimum quality the consumer will tolerate?
(c) How great a deviation in colour, size, texture, uniformity, or flavour can a product has and still have good acceptance?
(d) How important are the sensory properties of a production relation to other characteristics?
(e) Where will consumers purchase specific items in what quantities, and how often?
(f) How often do consumers switch brands and why?
(g) Which items are planned purchases and which are selected on impulse?
(h) How do changing socio-economic pattern influence food selection?

E. **Effects of Advertising Campaigns and Educational Programs:** Survey research groups are actively involved in evaluating the effectiveness of promotional campaigns and programs by government and industry to educate consumers in wise use of their money. Population may be interviewed and oral and/or written responses obtained, other behaviour of consumers in the market is observed directly. Whenever possible, both the magnitude and duration of the influencing medium are measured. Producers may investigate market conditions to eliminate less popular food items.

F. **Effect of Group feeding:** For adequate nutrition and proper morale, group eaters must like their meals. Extensive research has been undertaken by these organizations to assure that proper nutrients are available and eaten. Effective group feeding involves close collaboration among dieticians, food processors, cooks and psychological stress.

G. **Methodological and Statistical studies:** Consumer may be surveyed to test the adequacy of sampling methods, type of interview, and length and wording of the questionnaire, or to compare the opinions of laboratory panels with those of the public pilot testing, i.e. pretesting of the methodology prior to the distribution of samples, can orient the

participants to the method and check on the clarity of the questions. A large number of reactions may be collected to test the sensitivity of various statistical methods of analyses. Assure of this nature is sometimes included as part of another study of food habits or preferences.

Lecture-20

- *Information obtained from Consumer Study - Factors influencing results from Consumer surveys*

Information Obtained from Consumer Studies:

A. **Past behavior of consumers:** Information may be obtained on food selection and preparation, meal planning, quantities consumed, use of leftovers, or amount of waste. A consumer may not be able to recall accurately the quality and quantities of food selected and consumed. The questionnaire must be carefully worded to avoid influencing the type of response; since many consumers will give what they consider to be “correct or desirable" answer rather than describe the true situation. All survey methods are limited by the inability of the subject to remember, to generalize and to identify motives, by biases and by desire to please the interrogator.

B. **Present behavior of consumers:** The consumer's behavior in the grocery store may be observed, oral or written opinions may be recorded, specific preferences obtained between two experimental food products. In each case the past experience of the consumer influences the response, and there is no assurance that retesting in the future will give the same response.

C. **Estimate the Future Behavior:** It would be presumptuous to state that consumer preferences of the future can be adequately predicted. Estimates of future consumption patterns are based on past behavior under known conditions and extrapolations made to fix expected market conditions of the future. However, a more accurate estimate would be of great value to the foodindustry.

Factors Influencing Results from Consumer Surveys

A. **Population sampled**: He reasons for conducting a survey of course, determine the methodology selected, the population sampled, and the type of questions asked in evaluating results obtained by consumer sampling, it is well to consider what population the investigators used for their consumer panel.

B. **Amount of pilot testing:** Pretesting of the questionnaire, the commodity or the population can yield important information that can save time and money. Ambiguous and misleading question can be eliminated from the questionnaire, antagonistic or apathetic can be determined from the sample or the experimental

sample may be modified in packaging size or method of presentation to accommodate unanticipated condition of testing.

In pilot testing the emphasis is on the inherent properties of the products aroma, flavor, texture, shape, colour and consistency. There is no effect of marketing factors such as brand, label, price, packaging, distribution or advertising, one important use of pilot trsting in the food industry is to provide an estimate of the relative importance of the flavor of the product in comparison with other properties such as convenience storage stability, or brand identity. To test first impressions, the consumer may be given only enough of the samples for a single use the single exposure method. This method is a valuable tool when the amount of sample to be tested is limited, when time and money are limited, when few consumer are available, or when only an estimate of consumer preference, is desired. Single exposure tests can be given in supermarkets, mess halls, fairs, conventions, or other public gatherings.

C. **Method of sampling, amount of replication, size of statistical error:** Techniques employed in consumer preference studies are often deficient because of failure to define the universe sampled or the use of inadequate sampling methods which gives immeasurable degrees of error. If the population is small, it is sometimes convenient to sample the entire population to obtain the desired information. Usually time and money can be saved by studying only a sample portion of the population.

There are many possible methods of selecting a sample from a population. Some of these depend on the judgment of people who claim to know the population; some merely define the sample as that part of the population which is most conveniently available; others are random. Based on the theory of probability, use of an expert's opinion is generally a relatively inexpensive method of obtaining information. There are situations where objective measurement is not possible and complete dependence must be placed on expert judgment. In the evaluation of estimates which rely heavily upon the opinions of experts, one must have faith in the validity of these opinions. Limitations of the procedure are the inability to evaluate this faith, and the lack of an objective basis for choosing between the varying opinions of two or more experts.

Method which selects for the sample that portion of the population which is conveniently available, offer no assurance that the sample is representative of its whole population. When the required information is more than a general survey, methods based on probability theory should be selected. For the laws of probability to be applicable, sampling methods must ultimately result in random samples from the population.

With sampling methods employing reasonably large samples, the precision of the results from a sample can be measured from the sample itself, and, limits on the magnitude of possible sampling. Errors can be assigned so that the probability

of exceeding these limits is very small.

The uses made of results from some surveys are sufficiently general that a sample selected by any will yield satisfactory information. The simplest and least expensive method that fulfills all the requirements of a 'Survey' should be used.

If little or nothing is known about the characteristics of the population being sampled, probability sampling methods may not be possible and, certainly, if probability methods have not been employed in the sampling procedure. Probability statements concerning precision of the survey should not be made. The application of such statements to non probability surveys can lead to confusion and misunderstanding.

In planning a sample survey, the size of sample needed to estimate the population value with a specific precision must be determined. Questions regarding size of sample, replication and magnitude of sampling error vary with the type of material to be sampled, the degree of reliability "desired, and the costs involved.

In designing a sample to serve a specific purpose, the following questions must be answered:

1. How large an error in the estimate is permissible before the inference drawn will be Incorrect?
2. How great a risk is one willing to take that the conclusions drawn from the sample differ by more than the permissible error?

Before the size of the sample can be estimated, "error risk" limits must be established. In some cases the results of a survey might be acceptable if the chances were 19:1 that the sample estimate would be w ithin 10% of the true value. In other cases, where an error could be more costly, greater accuracy might be required and higher odds demanded that is: one might require that the sample estimate not differ from the true value by more than 5% in 99 out of 100 trials.

Once a tolerable error and an acceptable significance level are established, a sample can be designed to meet these specifications. For Example in a normal population with variance σ^2 let a population characteristic under study be defined by its mean value, m, the best estimate of which, from a random sample of n measurements, is X. Then the normal deviate, z, is:

$$Z = \frac{X-m}{\Sigma\sqrt{n}}$$

from which

$$n = \left(\frac{z\sigma}{X-m}\right)^2$$

In this expression, if $X - m$ is replaced by the allowable error and if the value of z is assigned according to the levels of significance adopted, then the numerical

value of n can be calculated. Application of the method depends on some knowledge about the variability of the population. After the sampling is completed, the variability of the sample may be used to verify the assumption about that of the population. If one has no knowledge of population variability, preliminary sampling can be used to provide a satisfactory estimate.

Having obtained the size of sample necessary to provide the required amount of precision and knowing the cost factors involved in the sample design, the cost of the survey can be estimated. If it is acceptable, the design can be used as specified, if, however, the cost is excessive, additional funds must be found or some balancing of precision against cost must be effected. Frequently, some relaxation of precision will still provide usable results and will permit development of the survey within available resources. If, however, it is impossible to design an acceptable survey within the budget allowance, then the survey must be abandoned.

Cost limitations often lead to the use of "cluster sampling," in which the population is first divided into groups which serve as sampling units. A sample is drawn from the groups to represent the population.

Another type of sample selection which is widely used is systematic sampling in which the design calls for selection from the population of every R th element or the use of some other specified pattern. An example is sampling by the selection of every 10 th name from the telephone directory. This, of course, samples only the population with listed telephone numbers.

D. **Method of collecting and analyzing data** : Carefully worded questionnaires are frequently used to obtain consumer reactions on a multitude of topics related to selection and use of commodities. The questionnaire may be range from one short question to several hundred inquiries about past, present and future behaviour. The effectiveness of this method depends on the questionnaire and degree of cooperative spirit elicited from the consumer, as well as the type of approach employed.

In a comprehensive, nationwide survey of food consumption, made in the spring of 1955 by the United States Department of Agriculture (1955), a national stratified probability sample of 6000 households was polled. Trained interviewers used a detailed food list to help respondents recall quantities of foods used and amounts paid for purchased items the recall list method. Consumption figures reported refer to food used in an economic sense, i.e., eaten, thrown away as waste, or fed to pets. In surveys of this nature, the consumer may tend to report consuming foods of a high nutritional value in substantial quantities when this may not be fact. In addition, the interviewer may influence the direction of the responses to an immeasurable degree.

E. **Retesting and/or follow-up studies** : Retesting is advisable:

(a) if a survey shows inconclusive results

(b) if the investigator suspects that the consumer misinterpreted the questionnaire

(c) if there is any question whether the samples. May have been served or tested incorrectly; or

(d) if there is a possibility that the sampling procedures may not have been adequate. A follow-up testing at a specific interval after the first server can be used effectively for establishing the persistence of the preference over a given period and can measure the degree to which the preference has been affected by changes in the market or in the general economy.

F. **Interpretation of results:** As with any investigation, results are not necessarily valid except under the conditions of the study, the investigators should be conservative in projecting findings to other populations or to other commodities unless the prediction is adequately supported by the data obtained. There are always a number of consumers who, when approached, refuse to cooperate, Between 60 and 95% of those who agree to cooperate actually return their questionnaires. We know nothing about the preferences of the non-cooperating consumers, but as the number of the noncooperators increases, conclusions reached on the basis those who did cooperate become less reliable, and it is more difficult to estimate the way in which the opinions of the non co-operators might change the direction of the response.

Correct interpretation and projection of results requires that consumer opinion be viewed in its proper perspective, Undue importance should not be placed on selection of a specific food Item on a single occasion, since the decision is but one of hundreds that the consumer makes each day.

G. **Psychological consideration:** Allowances may have to be made for the "human element" in a food Surv ey. Unexplainable inconsistencies in response are sometimes obtained. Careful reorganization of the data may reveal the causative factor, but there maybe no effective way of measuring all factors that influenced the responses. Some of the psychological factors which; influence laboratory panels can affect the consuming public also Some of these apparent variations can be minimized or accounted for by dose control and/or observation of all details of the testing p rocedure and the testing environment and by interviewing a sufficiently large number of consumers to reduce the standard error the mean.

Lecture-21

- *Methods of Approach - Development of the questionnaire - Types of Questionnaire and other methods of data collection*

METHODS OF APPROACH

A. **Historical Methods:** Statistics of food distribution, sales, and product turnover rate should be consulted to understand present market activities and to estimate future market events in the food industry, where the mark up on certain commodities is very low, it is essential that trends be observed accurately to assure achieving the volume of sales necessary for profit.

B. **Observational Method:** A person trained to observe group behaviour can gather quantitative and qualitative data on food habits and selection. Hidden observers have watched consumer in supermarkets to determine whether purchases are planned or impulsive, to establish what displays and packaging appeals to them, to determine whether certain food items are selected more often by men than by women. Merchandisers may be interested in knowing the effect of background music, product location or other physical or physiological factors. Advertisers and producers are interested in how the consumer appraises the product does she smell it, squeeze it, weigh it, read the label, study the instructions, or compare it with others on shelf? The value of observational method can be enhanced if the same customers are observed during a second or third shopping session and if they are interviewed in the home about preparation methods, serving and food waste. Results obtained from observational studies may be difficult to interpret because of the complexity of the environmental factors influencing the behaviour.

A combination questionnaire and observational technique was used to establish consumer preference for six brands of bottled beer. On each of seven days, families were provided with more beer than they needed so they could have an unrestricted choice of brands (identified only by code).Each day, the remaining bottles and empties were collected as well as questionnaires, with preferences recorded.

Questionnaires: Carefully worded questionnaires are frequently used to obtain consumer reactions on a multitude of topics related to selection and use of commodities. The

questionnaire may be range from one short question to several hundred inquiries about past, present and future behaviour. The effectiveness of this method depends on the questionnaire and degree of cooperative spirit elicited from the consumer, as well as the type of approach employed.

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The Market Research Corporation of America has published a national menu census and a retail food audit to provide manufacturers with insight on consumer food habits. The detailed questionnaire covers conventional topics but also includes inquiries into more unusual aspects of food consumption such as the percent of the population eating cheese for breakfast, the characteristics of families who never serve canned meat, and food preferences of teenagers versus parents. Methods of approach by this organization are:

(a) Depth interviews
(b) Word association
(c) Sentence completion
(d) Projective questioning
(e) Role playing
(f) Recorded group discussion and
(g) Pre-test questionnaire.

With the questionnaire method the four most common approaches are: telephone, mail, personal interview, and public test. The telephone approach is economical provided no long-distance calls are made. It has the disadvantage of not reaching those in the population who are not telephone subscribers. Also, decisions made on the telephone may lack depth and sufficient though, and questions can be misinterpreted by people with hearing defects or by those who are not fluent in the vernacular language.

Approach by mail has the advantage of economy and allows the respondent to answer at his leisure. However, the replies constitute only a percentage of the total number sent out, since not all people return their questionnaires. In addition, some recipients of the questionnaires may not be able to read and many may misunderstand the questions.

Personal interview has the advantage of collection observational data concomitantly but is more expensive and introduces the potential bias of non authoritative, does not argue or give advice, and, insofar as possible, present and is difficult to measure. Often, mailing techniques and personal interview are used together. At times the personal interview is the only reliable way of obtaining information on food preferences that need to be classified by race, age, education, political affiliation, or income level.

In experiential studies, sample of the food product are tasted by the consumers, and opinions are obtains. The consumers may be approached in a public meeting place, such as a market or a country fair, at private function such as a meeting or dinner or in the home.

Development of the Questionnaire

One of the most difficult aspects in measuring consumer response is wording of the questionnaire to obtain the exact information desired.

Questionnaires are the following : A question should not be ambiguous. The inquiry "What kind of oil do you use?" does not indicate whether the oil is auto, fuel, mineral, salad, or hair oil. Even if the type was specified, the respondent might give the brand name, the weight, the color, or the price range. In each case, he would be answering the question but his answer might be useless to the researcher, depending upon the specific information desired.

Questions should be realistic: The respondent cannot be expected to recall specific details of meals consumed several weeks previously or to predict specific behavior accurately into the distant future. The average consumer cannot be expected to evaluate the sensory properties of a food as thoroughly, as rapidly, or as consistently as a highly trained judge can.

Use of Appropriate Terminology: The wording should not appear to be above or below the intelligence of the population being sampled. A pretesting of the level of understanding of the specific population would be useful, although expensive and time-consuming.

Avoid stereotype answers: Questions must be worded to elicit the participant's true opinion rather than the answer the participant thinks is the most "proper." To a question on belief in freedom of speech, 97% of a certain population indicated they believed in it. However, when asked specifically who was to be allowed the freedom, most of these same people thought it should be limited to certain individuals, which, of course, would not be freedom of speech at all.

Placement: Placement of questions on the ballot is important since, in long questionnaires, often only the first few are answered. Placement of selections on the menu can influence the frequency with which they are ordered. Arrange questions in logical order, since one question can influence the response to the

following question.

Allowance for no opinion: In planning the original experimental design, the investigator must decide whether he will allow a respondent to express a "no preference" or "don't know" opinion. Some participants may have a "don't care" attitude. A large percentage of "no preference" votes by the respondents may mean either that differences between the products were undetected or that there was no preferences between detectable differences. The questionnaire can be worded so as to distinguish between these two types of "no preference" response.

Lecture-22

- *Comparison of Laboratory Panels with Consumer panels. Limitations of Consumer Survey.*
- *Comparison of Laboratory Panels with Consumer Panels*

Although members of a laboratory panel are consumers, their opinions and preferences may not be representative of the general population. The laboratory group is carefully selected, highly trained, and hypercritical as compared to the consumer. Distribution of age, sex, income, and general intelligence will reflect the consuming population only by accident. Test booth conditions, coded containers and scoring methods are certainly not typical of normal conditions food consumption. In addition, the opinions of the laboratory panel are not influenced by extraneous factors such as packaging, advertising. Easy of preparation, price, or prestige, as the opinions of the consumer may be. In general, consumers agree with laboratory panel findings maintains but not in magnitude. In a comparison of panel and consumer acceptance of sardines, ranking methods more nearly predicted consumer preference than did paired presentation.

Limitations of the Consumer survey: Consumer surveys are expensive, time consuming, and subject to numerous uncontrollable variables. Although most surveys yield valuable information, investigators experience many problems and should recognize the limitations of their methods. Careful consideration must be given to the manner in which participation is solicited since they may be which rapport is established with the consumer not only influences the cooperative attitude of the respondent but may influence the answers given.

Prospective participants may react differently depending upon whether the survey is being conducted by a nearby university, a commercial processing firm, or an advertising agency. In addition, answers are biased by methods of sampling, techniques of sample presentation, amount and type of instruction pro vided, and the

construction of the questionnaire, as previously indicated. Consumer opinion, as individuals or as a group, can easily be under estimated or overestimated. The following consumer characteristics are:

1. Inability to remember, to generalize, or to identify motives.
2. Inability to describe likes, dislikes, and attitudes.
3. Inability to weigh the numerous alternatives.
4. Unawareness of what influenced their behavior.
5. Awareness of more factors than the impact of the influence warrants.
6. Desire to please the interrogator.
7. Desire for social status and prestige.

Most surveys do not reveal why people buy that is the conscious and unconscious factors that control behavior. In most surveys it is impossible to duplicate market conditions, so responses are not obtained under normal buying conditions. What consumers say they do may not represent actual behavior? It is extremely difficult to estimate potential patterns of behavior on the, basis of past purchases, just as it is to predict whether the item will have short-time or long-time acceptance.

Surveys seldom identify the leaders and the followers i.e., the consumers with definite preferences who set the styles, tastes, and trends, versus those who are easily swayed and merely "follow the crowd."

The failure of consumers to provide answers to the above mentioned questions does not mean that surveys should be discontinued. On the contrary increased efforts should be made to develop techniques for adequately measuring these variables.

The areas of needed research, described by Morse in 1951, still apply today:

(1) Vigorous and systematic studies on methods, techniques, and analysis of data.

(2) Designing of surveys to include evaluation of research methods as well as of the commodity.

(3) Active use of new and improved methods and publication of methodology data to benefit others in the field. Progress could be faster if there were more collaborative studies between food technologists' economists, psychologists, and statisticians.

Lecture-23 to 25

- *Fundamentals of Food regulations-pertaining to Additives and Contaminants.*
- *Food regulations pertaining to aspects of Hygiene- Novel Foods & aspects of Labelling.*
- *Different existing Food legislations-norms in implementation.*

LEGISLATION ON FOOD HYGIENE

The "Hygiene package" consists of a total of five legislative parts, of which four were adopted in April 2004 and provided the Member States and the stakeholders with a preparatory period of 18 months before becoming applicable with effect from 1 January 2006. The hygiene package puts the responsibility for producing safe food on the food business operator, while the competent authority of the Member State verifies correct implementation of the new rules. Production should be based on good hygienic practice and the HACCP principles and products are subject to microbiological criteria and temperature limits. The legislative texts deal with a variety of food types and cover the entire food chain ("from stable to table"). Two of the Regulations apply directly to food business operators:

- Regulation (EC) No. 852/2004 of the European Parliament and of the Council on the hygiene of foodstuffs."
- Regulation (EC) No. 853/2004 of the European Parliament and of the Council laying down specific hygiene rules for food of animal origin.

- **Regulation (EC) No. 852/2004**: Regulation (EC) No. 852/2004 lays down general hygiene requirements to be respected by food businesses at all stages of the food chain including primary production. The Regulation does not apply to small quantities of primary products supplied directly by the producer to the final consumer or by the

producers to local retail establishments directly supplying the final consumer. Examples of such products are vegetables, fruits, eggs and raw milk or products collected in the wild such as mushrooms and berries. All bee-keeping activities are also considered as primary production. However, fresh meat is not a primary product since it is obtained after slaughter.

The Regulation requires all food business operators to put in place, implement and maintain a permanent procedure based on the Hazard Analysis and Critical Control Point (HACCP) principles with the exception of those involved in primary production. Food hygiene is the result of the implementation by food businesses of prerequisite requirements (such as concerning infrastructure and equipment, pest control, water quality, personal hygiene) and procedures based on the HACCP principles. The prerequisite requirements provide the foundation for effective HACCP implementation and should be in place before a HACCP-based procedure is established. The Regulation allows the HACCP based procedures to be implemented with flexibility so as to ensure that they can be applied in all situations including in small businesses. Guides to good practice for hygiene and for the application of the HACCP principles developed by the food business sectors themselves, either at national or at community level, should help businesses to implement HACCP based procedures tailored to the characteristics of their production. In addition, the Regulation requires food businesses to be registered with the competent authority. Such registration is a simple procedure whereby the competent authority is informed about the address of the establishment and the activities carried out. Already existing registration systems used for other purposes (environmental, animal health or other administrative purposes) can be used.

- **Regulation(EC) No. 853/2004:** Regulation (EC) No. 853/2004 is more specific than the previous one by laying down the hygiene requirements to be respected by food businesses handling food of animal origin such as meat, live bivalve mollusks, fishery products, raw milk and dairy products, eggs and egg products, frog legs and snails, collagen and gelatin at all stages of the food chain. The Regulation does not apply to retail, which for food hygiene purposes means all activities involving direct sale or supply of food of animal origin to the final consumer. In such cases regulation (EC) 852/2004 will apply. Those establishments carrying out only primary production, transport operations, storage of products not requiring temperature controlled storage conditions or retail operations are exempted from the approval procedure. However, some of the retailers, especially the larger ones, do need approval. Approval procedures involve an on-site visit by the competent authority to verify if the establishment fulfils all the requirements concerning infrastructure, layout, equipment and hygiene. One of the requirements for approval is that the

HACCP programme has been validated and implemented correctly. By granting a conditional approval for 3 months (and up to a maximum of 6 months) the competent authority will be able to assess the correct implementation of the HACCP programme under working conditions

Other Legislation as Part of the Hygiene Package:

- **Council Directive 2002/99/EC:** Council Directive 2002/99/EC lays down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption.

- **Directive 2004/41/ EC**: Directive 2004/41/EC of the European Parliament and of the Council repeat the old legislation, a total of 16 Directives. Each Directive dealt with a specific food item (there was a Directive for meat, fish, milk, minced meat, etc.). Regulation (EC) No. 852/2004 repeals an additional Directive. Consequently, the legislation has been transformed from the so-called vertical Directives into a more horizontal approach ("from farm to fork").

- **Legislation on Official Controls:** This legislation is directed at the competent authorities and lays down the general principles to be respected for ensuring the official controls are objective and efficient. Furthermore, the legislation has been designed to promote a more risk based approach to official controls.

- **Regulation (EC) No. 882/2004(Official Feed** and **Food Controls):** Regulation (EC) No. 882/2004 of the European Parliament and of the Council on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules is the result of a review of the existing community rules on the subject, which were adopted separately for the animal feed sector, the food sector and the veterinary sector. The Regulation covers the basic principles and the entire range of activities dealing with feed and food law, including animal health, animal welfare and in certain aspects plant health. It applies with effect from 1st January 2006, except for the provision on financing of official controls, which applies with effect from 1st January 2007.

As a consequence of the new rules, the Member States have to reorganize their official control systems so as to integrate controls at all stages of production and in all the concerned sectors, using the "farm to fork" principles. They have to submit and annually update a multi annual national control plan for the implementation of feed and food legislation and to report annually on the implementation of that plan. The control plans and reports shall take into account guidelines published by the Commission as Commission Decision 2007/363/EC.

At present, community controls in the Member States and in third countries are organized largely on a sectoral basis and are related to the mandates the Commission has in different sectoral legislation. By means of this Regulation the community approach to controls will evolve. The role of the Food and Veterinary Office as part of the European Commission will be essentially based on audit with the main purpose of verifying the efficiency of the control systems in the Member States and auditing the compliance or equivalence of third country legislation and control systems with EU rules. The requirement for all Member States to submit a multi-annual national control plan will facilitate the carrying out of these audits. Account will also be taken of Member State's own audits and of their annual reports.

The Regulation provides for a set of general rules applicable to the official controls of all feed and food at any stage of production, processing and distribution, whether produced within the EU, exported to or imported from third countries. In addition to these rules, there are other specific control measures, which are important in order to maintain a high level of protection and therefore must be kept in place. This is, for example, the case for the specific veterinary control rules on imports of animals and food of animal origin or for the specific control rules for organic products. The Regulation provides the possibility to draw up a list of feed and food of non animal origin, which shall be subject to an increased level of official controls at the point of entry.

- **Regulation (EC) No. 854/2004:** Regulation (EC) No. 854/2004 of the European Parliament and of the Council lays down specific rules for the organization of official controls on products of animal origin intended for human consumption. The Regulation forms the third part of the "hygiene package" and deals, among other things, with the official control of animals sent for slaughter, official control with regard to fresh meat, fishery products, raw milk and dairy products and with procedures concerning imports. Modern meat inspection should be based on risk assessment and should prevent cross contamination in the slaughter hall. In addition, meat inspection can be improved by imposing stricter hygiene measures at the farm level and by requiring the farm operator to send animals for slaughter in a clean state together with relevant management and health information called food chain information. These principles have been introduced in the Regulation.

Implementing Measures of the Hygiene Package:

- **Implementing Measures:** A wide range of implementing measures have been

adopted on the basis of the hygiene package as foreseen in Article 12 of Regulation (EC) 852/2004, Articles 9 and 11 of Regulation (EC) 853/2004 and Articles 16 and 18 of Regulation (EC) 854/2004.

The measures laid down in Commission Regulation (EC) 2074/2005 include provisions concerning food chain information, fishery products, recognised testing methods for detecting marine biotoxins, calcium content of mechanically separated meat, lists of establishments, model health certificates for a number of products (frog legs, snails, gelatin, collagen, fishing products and honey), a derogation for foods with traditional characteristics and a number of amendments to Regulations (EC) 853/2004 and (EC) 854/2004. The amendments rectify some minor details in the Regulations.

- **Transitional Arrangements**: Transitional arrangements in respect of certain new provisions have been taken to permit a smooth change over from the old to the new regime. The principle of granting transitional arrangements was agreed by the European Parliament and the Council through Article 12 of Regulation (EC) No. 852/ 2004, Article 9 of Regulation (EC) No. 853/2004 and Article 16 of Regulation (EC) No. 854/2004.

The measures laid down in Commission Regulation (EC) No. 2076/2005[12] include provisions concerning stocks of food of animal origin, placing of food of animal origin on national markets, materials bearing pre-printed health or identification marks, marking equipment, health import conditions, food chain information, composition criteria for minced meat, use of clean water, raw milk and dairy products, eggs and egg products, training of slaughterhouse staff, certification of establishments, accreditation of laboratories carrying out official controls and some amendments to Regulations (EC) 853/2004 and (EC) 854/2004.

- **Regulation on Microbiological Criteria/or Foodstuffs:** Previously existing microbiological criteria were reviewed taking into account recent developments in food microbiology and scientific advice from the European Food Safety Authority (EFSA). Commission Regulation (EC) No.2073/ 2005 revised these criteria and introduced additional ones. The main objectives of the Commission Regulation are to ensure a high level of consumer protection with regard to food safety and to harmonise the microbiological criteria in the Member States, thus facilitating international trade. In particular the target of the commission regulation is to reduce the number of Salmonella Listeria and Enterobacter sakazakii cases in humans. A main component of the Regulation is to set two different types of criteria for foodstuffs, which need to be complied with by the food business operator:

- A food safety criterion defining safety of a product or a batch applicable to products placed on the market
- A process hygiene criterion indicating the correct functioning of the manufacturing process
- Food safety criteria have been laid down for certain micro organisms which are common causes of food-borne diseases in humans, such as Salmonella, Listeria monocytogenes, E. sakazakii, Staphylococcal enterotoxins and histamines. If food safety criteria are exceeded, the batch has to be withdrawn from the market.

Guidance Documents for the Legislation on Food Hygiene: A number of documents have been prepared to give guidance on the implementation of the food hygiene requirements and related subjects. The documents aim to assist the food business operators and the competent authorities of the Member States. The guidance documents are not formal acts of legislation, but the Commission will defend where necessary the consensus laid down in these documents.

- Guidance document on the implementation of the main General Food Law requirements.
- Guidance document on Regulation (EC) No. 852/2004.
- Guidance document on Regulation (EC) No. 853/2004.
- Guidance document on the implementation of HACCP and facilitation of the implementation of the HACCP principles in certain food businesses.
- Guidance document on community guides to good practice.
- Practical guide on food contact materials.
- Guidance documents on import requirements.
- Guidance document on the preparation of multi-annual control plans as laid down in Regulation (EC) No. 882/2004 (published as Commission Decision 2007/363/EC).
- Guidance document laying down criteria for the conduct of audits (published as Commission Decision 2006/677/EC).
- Guidance document on official controls, under Regulation (EC) No. 882/ 2004, concerning microbiological sampling and testing of foodstuffs.

Related Food Safety Legislation:

Legislation on Transmissible Spongiform Encephalopathy: The recognition of the first cases of bovine spongiform encephalopathy (BSE) in the mid-1980s and the first diagnoses of variant Creutzfeldt Jacob disease in humans in 1996 together with the causal link between BSE led to one of the major crises which ever affected the feed and food sectors. The key piece of legislation to protect human and animal health from the risk of BSE and other transmissible spongiform encephalopathies (TSEs) is Regulation

(EC) No. 999/2001 of the European Parliament and of the Council which lays down rules for the prevention, control and eradication of certain TSEs and is commonly known as the "TSE Regulation". The TSE Regulation provides measures targeting all animal and public health risks resulting from all animal TSE and governing the entire chain of production and placing on the market of live animals and products of animal origin. It consolidates much of the existing legislation on BSE or TSE, including rules for the monitoring of TSE in bovine, ovine and caprice animals and prohibitions concerning animal feeding. It also introduces new legislation for areas such as eradication of TSE as well as trade rules covering the domestic market, intra community trade, import and export. Furthermore, it provides for the procedure, criteria and categories for the classification of countries according to BSE status. This very comprehensive framework is constantly evaluated through scientific review. The removal of the so called specified risk material is one of the most important measures to protect the health of consumers against the risk of BSE. Specified risk materials are defined as the animal tissues being most at risk of harboring the TSE agent. In order to prevent any recycling of possible BSE agent, these tissues are collected and completely destroyed through incineration. Recently the Commission produced a road map on the TSE strategy which outlines possible amendments of certain measures in the short, medium and long term without endangering the health of the consumer and policy for eradicating BSE.

Legislation Oil Animal By-Products: Regulation (EC) No. 1774/2002 of the European Parliament and of the Council lays down health rules for the collection, transport, storage, handling, processing and use or disposal of all animal by-products (ABPs) not intended for human consumption. It completes the rules laid down in Regulation (EC) No. 852/2004 on food waste. Its purpose is to prevent by products from presenting a risk to animal or public health. To that end, it distinguishes three different categories of ABPs, based on risk.

(a) Category I material has the highest risk and is usually incinerated.

(b) Category 2 is less risky material and can not only be incinerated but also be com posted or used for biogas production.

(c) Category 3 materials can be used for animal feed under certain conditions. The last category includes parts of slaughtered animals that have been found fit for human consumption, but are not for one reason or another intended for human consumption.

Legislation on Residues: Residues are substances that can occur in foodstuffs as a side effect of using veterinary medicines or phyto sanitary products. They are unwanted traces of

medicines or plant protection products or derivatives thereof which remain in

the final product. Member States need to adopt and implement every year a plan to monitor live animals and products thereof, including meat, for residues of prohibited substances (for example, hormonal substances for fattening purposes) or for substances permitted below a certain threshold, the so-called maximum residue limit (MRL). The latter group of substances includes veterinary medicinal products, pesticides and environmental contaminants. Details of the substances involved and of the residue monitoring plan can be found in Council Directive 96/22/EC and Council Directive 96/23/EC and their amendments. The aim of the national residue monitoring plan is to ensure that permitted levels are not exceeded and that forbidden substances are not present in food products.

Legislation on Contaminants: Contaminants are substances that can unintentionally enter food during the various stages of its production, packaging, transport or holding or as a result of environmental contamination. Council Regulation (EC) No. 315/93 lays down the basic principles to minimize contaminants in food, while Commission Regulation (EC) No. 1881/2006 sets maximum levels for certain contaminants in foodstuffs.

International Aspects: Where international standards exist, they have been taken into consideration in the development or adaptation of the food safety legislation. This applies to standards developed by the Codex Alimentarius Commission, which has been created by the Food and Agriculture Organization and the World Health Organization to develop food standards, guidelines and related texts such as codes of practice. It also applies to standards related to animal health and animal welfare developed by the World Organisation for Animal health (OTE). Similarly, ISO and CEN standards have been incorporated in the legislation as analytical reference methods.

FutureLegislative Work:

Treatment to Remove Surface Contamination: Article 3(2) of Regulation ET No. 853/2004 provides a legal basis to permit substances other than potable water to remove surface contamination from products of animal origin.

With the adoption of the hygiene package and the introduction of the HACCP principles in the entire food chain, establishments are obliged to improve their hygiene and processing procedures. Under such circumstances the use of substances to remove surface contamination of food of animal origin can be reconsidered. It is essential that a fully integrated control programme is applied throughout the entire food chain including reduction of pathogens in water and in feed, on farms, during transport and in the processing plant. Treatment to remove surface contamination might constitute an additional element in further reducing the number of pathogens, especially with regard to Salmonella and Campylobacter, provided an integrated control strategy is applied throughout the entire food

chain.

Lecture-26

- *Food grade and standards*

Specification for Canned Apricot - IS: 9789 – 1981: The specifications for apricot are:

- The material should be free from artificial colouring mater of flavouring and synthetic sweetening agents.
- Requirements for covering syrup: The covering syrup shall be clear. It shall be made from nutritive sweeteners like sucrose, dextrose or glucose. The citric acid and/or ascorbic acid may be added to the covering syrup.

Specification for Canned Mango Pulp:

- The pulp when packed in natural form shall contain minimum 95% mango pulp. However, sweetened pulp shall contain minimum 85% mango pulp.
- Colouring matter, flavouring and synthetic sweetening agents The material shall be free from artificial colouring matter, flavouring and synthetic sweetening agents.
- Total sugars The total sugars (expressed as sucrose) in the mango pulp shall be not have less than 14% by mass when tested.

- The ethanol content of mango pulp shall not exceed 3g/Kg.

Organoleptic requirements: The requirements for the two grades of canned mango pulp shall be as given below:

Grade I Mango pulp shall posses a good body, uniform colour, good consistency normal characteristic taste and flavour and practically free from defects. It shall score not less than 85 points.

Grade II Mango pulp shall possess a good body, reasonably uniform colour, reasonably good consistency, normal characteristic taste and flavour reasonably free from defects. It shall score not less than 75 points.

Limits for poisonous metals in Canned Mango pulp

Characteristic	Requirement
1) Arsenic (as As) mg/Kg Max	1.0
2) Lead (as Pb) mg/Kg Max	1.0
3) Copper (as Cu) mg/Kg Max	5.0
4) Zinc (as Zn) mg/kg Max	5.0
5) Tin (as Sn) mg/kg Max	250.0

The maximum and minimum number of points to be scored by different factors shall be as below:

Factors	Max.	Min.	
		Grade 1	Grade 2
Color	20	15	13
Consistency	20	15	13
Taste and flavor	40	30	26
Absence of defects	20	15	13

Requirement for Canned Mango pulp:

Characteristics	Requirement
1) Vacuum of the can in mm Min	150
2) Headspace of the can in mm Max	16
3) Degree Brix of clear sample	14 to 25
3) Acidity (m/m) % expressed as anhydrous citric acid, Min	0.3
4) Acid insoluble ash, % by mass Max	0.5
6) Microbiological requirements	To satisfy the requirement of the test

Specification for Apple Juice - IS: 7732 -1975: Requirements are as follows:

1) General: Apple juice shall be obtained by a mechanical process from sound, ripe apples or by reconstituting concentrated apple juice. The juice shall have characteristic colour, taste and flavour**.** It may be turbid or clear. The juice shall not show any signs of fermentation.

2) Food additives:

(a) Ascorbic acid - not limited
(b) Clarifying and filtering agents - as approved by PFA rules, 1955
(c) Vegetable carbon - Pure
(d) Nitrogen - Pure
(e) Carbon dioxide - Pure
(f) Plantation white sugar - Max. level of 3% by mass (for standardization)

Requirements for Apple Juice:

S. No.	Characteristic	Requirement
1)	Degree Brix, Min	12
2)	Volatile oil, g/kg, Max.	0.4
3)	Acid insoluble ash, mg/kg, Max.	20

- The ethanol content of apple juice shall not exceed 5 g/kg when tested according to the method given in Indian Standard method of test for determining ethanol.

- Apple juice shall possess good body, uniform colour, characteristic taste and flavour, shall be free from defects and shall score not less than 80 points. The maximum and minimum. Numbers of points scored by different factors shall be as follows

Factor	Max	Min
Colour	25	20
Taste and Flavor	50	40
Absences of defects	25	20

Specification for Canned Pineapple:

Characteristic	Requirement
1) Vacuum of the can in mm ,Max	125
2) Headspace of the can in mm. Max	16
3) Drained weight of the contents of the cans, as % of net wt. Max	55

4) pH of cut out syrup, Max	4.5
5) Specific gravity of cut-out syrup (Brix)	1.07 to1.11 (19^0 to 26 ^{0}C)
6) Acidity of cut- out syrup, as anhydrous citric acid, % by weight, Max.	0.3 to 0.8
7) Arsenic, ppm, Max	1.1
8) Lead, ppm, Max.	2.5
9) Copper, ppm, Max.	30
10) Zinc, ppm, Max	19
11) Tin, ppm, Max	250
12) Microbiological requirements	To satisfy the requirements of test

Specification for Dehydrated Carrots - IS: 4625 – 1968: Dehydrated carrots shall be free from loose skin, discoloration grit, insect infestation, moulds, rodent excreta and any other foreign material. The proportion of material that passes through 2.0 nm is sieve (see IS: 460 - 1962) shall not exceed 5 percent by weight. Dehydrated carrots shall also conform to the requirements given in the table below:

Requirements for Dehydrated Carrots:

Characteristics	Requirement
1) Moisture, percent by wt. Max.	6.0
2) Sulphur dioxide, ppm, Max.	1500
3) Peroxidase test	Negative
4) Rehydration ratio, Min.	3.5 : 1.0

Reconstitution: Dehydrated carrots shall reconstitute to a tender, crisp product having typical flavour, colour and odour of cooked carrots, when one part by wt. of the dehydrated carrots are boiled in ten parts by weight of one percent sodium chloride solution for 20 minutes.

Specification for Fruit Squashes - IS: 4936 – 1968:

Additives: The only additive that shall be used in fruit squashes are ascorbic acid, citric acid, permitted artificial colouring matters, peel oil, fruit essences and flavours.

Preservatives: The only preservatives that may be used in fruit squashes are Sulphur dioxide or any other suitable sulphite or benzoic acid or its water soluble salts.

The $S0_2$ content shall not exceed 350 parts per million when tested or benzoic acid content shall not exceed 600 parts per million when tested.

Requirements of the finished product: The fruit content in the squash shall not be less than 25% by weight on dry basis. The fruit squash shall posses a good body, uniform colour, shall be free from defects and shall possess normal characteristics taste and flavour and shall score not less than 80 points. The max and min. number of points scored by different factors shall be as follows:

Factor	Maximum	Minimum
Colour	25	20
Taste and Flavour	50	40
Absence of defects	25	20

Requirements for Fruit Squashes:

Characteristics	Requirement
I) Degree Brix of clear sample, Min.	40.0
2) Acidity (as anhydrous citric acid), % by weight, Min.	1.0
3) Microbiological requirements	To satisfy the requirement of test

Limits for poisonous metals in Fruit Squashes:

Characteristic	Requirement
I) Arsenic (as As), ppm, Max.	1.1
2) Lead (as Pb), ppm, Max.	2.5
3) Copper (as Cu), ppm, Max.	30.0
4) Zinc (as Zn), ppm, Max.	19.0
5) Tin (as Sn), ppm Max.	250.0

Specification for Dehydrated Cabbage - IS: 4627 – 1968: The dehydrated cabbage shall be free from any discoloration, grit and any other foreign matter. The proportion of material that passes through 2.0 mm IS sieve (see IS: 460 - 1960) shall be not more than 10 percent by weight. Dehydrated cabbage shall be free from moulds, insect infestation and rodent excreta.

Requirements for Dehydrated Cabbage:

Characteristics	Requirement
1) Moisture, percent by wt. Max.	6.0
2) Sulphur dioxide, ppm, Max.	2000.0
3) Peroxidase test	Negative
4) Rehydration ratio, Min.	5.0 : 1.0

Reconstitution: Dehydrated cabbage when cooked by adding one part by weight of the dehydrated cabbage to 10 parts by weight of one percent sodium chloride solution and boiling for 15 minutes shall reconstitute to a tender crisp product free from toughness and mushiness having a typical flavour and colour of cooked cabbage.

Specification for Canned Tomato Paste - IS: 3884 – 1966: The liquid derived from ripe tomatoes shall contain a minimum of 5% by weight of total soluble solids. The juice may contain finely divided insoluble solids

from tomato flesh. Common salt, sugar, dextrose, malic acid, ascorbic acid, citric acid and permitted colours may also be added.

Tomato Ketchup (Sauce): Preparation of round and ripe tomatoes with more than 25% by weight of total soluble solids, common salt, spices, sugar, vinegar, onion, garlic and other permitted additives may be added to tomato ketchup.

Tomato puree: Concentrated tomato juice containing 9 to 25% by weight of total soluble solids. The puree may contain common salt, permitted colours and additives.

Tomato paste: Concentrated tomato Juice containing more than 25% by weight of total soluble solids. The paste may contain added common salt, permitted colours and additives.

Requirements for canned Tomato Paste:

Characteristics	Requirement
1) Vacuum of the can in mm, min	125
2) Headspace of the can in mm, Max	21
3) Total solids (tomato solids), free of salt % by weight, Min	25
4) Microbiological requirements	To satisfy requirement of the test
5) Mould count	Not more than 60% of the fields examined

Additives: Common salt and permitted colours may be added to tomato paste. No preservative other than sodium benzoate shall be used in tomato paste. Benzoic acid content shall be not more than 250 ppm when tested according to Method prescribed in IS: 3500 - 1966.

Limits for poisonous metals in canned Tomato Paste:

Characteristics	Requirement
1) Arsenic (as As), ppm, Max.	1.1
2) Lead (as Pb), ppm, Max.	2.5
3) Copper (as Cu), ppm, Max.	30.0
4) Zinc (as Zn), ppm, Max.	19.0
5) Tin (as Sn), ppm Max.	250.0

Specification for Dehydrated Potatoes - IS: 4626 – 1968: Botanical name of Potato is Solanum tuberosum.

Rehydration Ratio: The ratio of the weight of the dehydrated material after

cooking and draining of excess water to its weight before cooking.

Potato Chips: Strips of potatoes having a thickness between 3 and 6 mm, obtained by cutting, washing, peeled and trimmed potatoes transversely.

Potato Cubes: Diced, cuboids of3 to 6 mm dimensions.

Potato Fingers**:** Diced potatoes in the form of fingers having a thickness 3 to 6 mm and length ranging between 25 and 40 mm.

Dehydrated potatoes shall be of the following types:

(a) Chips

(b) Fingers and

(c) Cubes

Requirements for raw materials: Dehydrated potatoes shall be prepared from tubers of a suitable variety of potatoes harvested at appropriate maturity. The potatoes shall have been properly and fully cured, and shall be free from damage caused by insects and diseases.

Requirements of the End product:

- Dehydrated potatoes shall have a uniform white, golden or slightly yellow colour. They shall have the characteristic odour of potatoes and shall be free from scorched, musty or other objectionable odours.
- Dehydrated potatoes shall be free from any preservatives other than $S0_2$, artificial colouring matter, bleaching or flavouring substances.
- Dehydrated potatoes of chips, cubes or finger types shall be free from dust, dirt, stones, lumps of earth or any other extraneous matter. The proportion of blemished pieces bearing eyes, skin or discoloured pieces shall be not more than 1.5% by weight.
- Dehydrated potatoes shall be free from moulds, insect infestation, rodent excreta and other foreign matter.
- Dehydrated potatoes shall also conform to the requirements as given below.

Requirements for Dehydrated Potatoes:

S. No.	Characteristics	Requirements
1.	Moisture % by weight, Max.	7.0

2. Sulphur dioxide, ppm, Max. 1500

3. Peroxidase test Negative

4. Rehydration ratio, Min. 3.5 : 1.0

Reconstitution: Dehydrated potatoes shall reconstitute to a good quality product, free from toughness or mushiness having a characteristic taste, colour and odour of cooked potatoes, when one part by weight of the dehydrated potatoes are cooked in 10 par by weight of one percent sodium chloride solution for 30 minutes.

Dehydrated Vegetables ASC specification no. 198-C for Dehydrated Okra (Bhindi):

a) Moisture - not more than 8.0%

b) $S0_2$ - not less than 300 ppm and not more than 1500 ppm

c) Peroxidase test - Negative.

ASC specification no. 198-B for Dehydrated Cabbage:

a) Moisture - not more than 6.0%

b) $S0_2$ - not more than 2000 ppm

c) Peroxidase test - Negative

ASC specification no. 198-A for Dehydrated Carrots:

a) Moisture - not more than 7.0%

b) $S0_2$ - not less than 300 ppm and not more than 1500 ppm

c) Peroxidase test – Negative

ASC specification no. 142 for Dehydrated Onions:

a) Moisture - not more than 8.0%

b) Total ash - not more than 5.0%

c) Acid insoluble ash - not more than 0.5%

d) Thickness of reconstituted slice - 0.3 to 0.4 cm.

ASC specification no. 145 for Dehydrated Peas:

a) Moisture - not more than 5.0%

b) Proportion of - not more than 5.0%

c) Proportion of - not more than 50% of which discoloured peas shall not be more than 1 %

d) $S0_2$ - not less than 300 ppm and not more than 750 ppm

e) Peroxidase test - Negative

ASC specification no. 198-A for Dehydrated Potatoes:

a) Moisture - not more than 7.0%

b) $S0_2$ - not less than 300 ppm and not more than 1500 ppm

c) Peroxidase test - Negative

Specification for Pickles - IS: 3501-1966:

Pickles: Fruits or vegetables preserved in common salt, vinegar, oil or citrus juices

Types of Pickles: Types 1 - Pickles in vinegar
Types 2 - Pickles in citrus juice or brine and
Types 3 - Pickles in oil

Pickles shall be of two grades: Grade 1 and Grade 2

Requirements for Pickles:

General: Pickles shall be prepared from fresh or cured, clean and sound fruits or vegetables. The material used shall be free from insect damage or fungal attack. The substances that may be added to pickles are: Spices, onions, ginger, garlic, salt, sugar, jaggery and acetic acid.

- The material shall be free from extraneous colouring matter and synthetic sweetening agents.
- No preservatives other than benzoic acid shall be used. The benzoic acid content shall not exceed 250 ppm.

S. No.	Types of Pickles	Characteristics	Requirement
1	Type 1 to 3	Fluid portion, % by weight of the net weight, Max	33.3
2	Type 1	Acidity, as acetic acid of fluid portion, % by weight, Max.	3.0
	Type 2	Acidity (For pickles in citrus juice) as anhydrous citric acid, % by weight, Min	l.2
3	Type 2	Sodium chloride, % by weight, Max	12
4	Type 1 to 3	Arsenic, ppm, Max.	1.1
5	Type 1 to 3	Lead, ppm, Max.	2.5
6	Type 1 to 3	Copper, ppm, Max.	30

7	Type 1 to 3	Zinc, ppm, Max.	19
8	Type I to 3	Tin, ppm, Max.	250

Lecture-27

- *International food regulations and certifications*

International Standards and Regulations: Quality of the food is major concern worldwide now-a-days. So, each country has formulated its own standards and created agencies for strict quality control measures of the food products. Some of them are internationally accepted standards. International standards may apply to a certain region of the world or any trade between parties of different countries. Setting up of international standard for the purpose of food safety depends upon the following agreements.

- Agreement on Agriculture (AoA)
- Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement)
- Agreement on Technical Barriers to Trade (TBT Agreement)
- International Health Regulation (2005)

List of main International standards and statutes:

- International Standards Organization (ISO)
- Codex Alimentaires Commission (CAC)
- World Health Organization (WHO)
- Food and Agriculture Organization (FAO)
- World Trade Organization (WTO)
- World Organization for Animal Health (WOAH)
- European Union (EU) Standards
- Food and Drugs Administration (FDA), USA
- International Plant Protection Organization (IPPO)
- Convention on Bio Diversity (CBD)
- International Commission on Microbiological Specifications for Foods (ICMSF)

International Standards Organization (ISO): The product sell based on the product quality as perceived by the customer is the major factor for

sustained what makes a sales of a product. The method of quality control consisted largely of physical inspection of the end product against the product specification. However, technical specifications may not by themselves guarantee, that a customer's requirements will be met, if there happens to be any deficiency in the specifications or in the organizational system, to design and produce the products, or service. Consequently, this has led to the development of quality system standards and guidelines that complement relevant product, or service, requirements given in the technical specifications. It is the main criteria for a management system, which will improve a company's performance. It is a media for ensuring orderly and systematic maintenance and upkeep of system. It is applicable to all type of organizations, independent of product size and country and ensures consistent improvement of quality. The role of ISO series is given in Table below.

The role of International Standards Organisation (ISO) series

ISO series	Role of ISO
ISO 9000 – 1, 2, 3, 4	Quality management and quality assurance
ISO 9004 - 1	Quality management and quality system elements sub contractor
ISO 9004 – 2	Guidelines for services
ISO 9004 – 3	Guidelines for processed materials
ISO 9004 – 4	Guidelines for quality improvement
ISO 9004 – 5	Guidelines for project management
ISO 9004 – 6	Guidelines for quality plans
ISO 9004 – 7	Guidelines for configuration management
ISO 10011 – 1, 2, 3	Guidelines for auditing quality system
ISO 10012 – 1, 2	Quality assurance requirement for measuring equipment
ISO 10013	Guidelines for developing quality manual
ISO 10014	Guidelines for economic effect of quality
ISO 10015	Continuing education and training guidelines
ISO 22000 : 2005	Specifies requirements for a food safety management system where an organisation in food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption.

Salient features of International Standards Organization (ISO):

- Most important international standards setting non-governmental organization
- World federation of 123 countries national standards bodies
- Develops consensus based international standards
- Develops standard through 200 technical committees split into 650 sub-committees and 200 working groups
- All of its standards are voluntary in nature
- 1SO-9000 series is the general quality certification standard
- Presently, India has about 5000 ISO-9000 companies

ISO 9000: A Quality System: Today consumer is not quantity oriented but quality oriented instead. Hence, for consumer's satisfaction, the manufacturers are focusing on quality products. The quality of particular product is determined by the ISO, whose certification is of great importance. A 'quality system' is a mechanism by which a company can organize and manage its resources to achieve, sustain and improve quality economically.

Evolution of ISO 9000: The first attempt to standardize quality was made in the USA. It gave rise to MIL-Q 9858 (Masoneilan India Limited-Quality 9858), which is a quality system specification and MIL-I 45208, which is an inspection system specification. These standards are involved in American defence contracts. Based on these standards, three standards were designed for the use of NATO (North Atlantic Treaty Organisation) called Allied Quality Assurance Publication (AQAP).

- AQAP 1 - Quality System Specification
- AQAP 2 - Inspection and Manufacturing Specification.
- AQAP 3 - Inspection System Specification

In 1979, Britain adopted its first version of BS 5750 based on AQAP, which can be used in contractual situations. Based on this standard, a Technical Committee of the International Standard for Organization (ISO), under the chairmanship of Canada, worked to produce a series of international quality standards. This series comprises ISO 9000, which embraces ISO 9001, ISO 9002, ISO 9003 and ISO 9000.

ISO 9001: Model for quality in design/ development, production, installation and servicing. This standard specifies quality system requirements for use when a contract between two parties is required.

ISO 9002: Model for quality assurance in production and installation. This standard is applicable in situations where the specified requirements of products are stated in terms of established design or specifications.

ISO 9003: Model for quality assurance in final inspection and testing this standard is used for external quality assurance purposes. It is suitable for two party contractual purposes, where conformance to specified requirements is to be assured by the supplier solely at final inspection and testing.

ISO 9004: This standard provides guidance on the technical, administrative and human factors affecting the quality of products and services at all stages of the quality loop from detection of need, to the

customers' satisfaction. Throughout this standard, emphasis is placed on the satisfaction of the customer's need.

Benefits of ISO 9000 Quality System: Implementing a quality system based on ISO 9000 can help to transform an adhoc method of quality control into an organized and cost-effective quality management system. An effective quality system confers the following:

- It enables the user to identify and plan tasks and their method of performance.
- It provides the means for identifying and resolving problems and preventing their reoccurrence, there by improving conformance.
- It cuts down the poor quality cost.
- It generates objective evidence to demonstrate the quality of products and the effectiveness of the systems and thus builds up confidence among customers.
- This standard demands training for all personnel performing activities effecting quality and hence improved performance,
- Reduces fire-fighting operations and better job satisfaction.
- Registration to ISO 9000 is a necessary prerequisite in different countries.
- It is not a product standard and hence, can 'be used for any type of industry and for companies employing very few persons as well as whose work force runs into thousands.
- Marketing advantages, recognition and publicity.
- Reduced liability risks.

Essential steps to ISO 9000 certification: Companies in developing countries should generally go about implementing an ISO 9000 under a major project involving the following steps:

- Acceptance by top management of quality as a vital element in the business.
- Consultation with the worker’s representatives to explain the concept and benefits of ISO 9000.
- Training task force members in the various aspects of ISO 9000 and the methodology for its implementation.
- Writing down work instructions, procedures, and manuals complying with the various clauses of the standard.
- Preparing a quality manual setting out the company's policy and ensuring that these are better understood by all employees.

- Training staff and workmen in the methods and procedures.
- Implementing the document systems and subjecting to a trial for few months.
- Conducting internal audits to assess its compliance with the ISO
- 9000 standards and taking corrective actions.
- Arranging a preliminary audit by an external agency.
- Taking corrective actions on the basis of the external audit team.
- Arranging formal assessment by an accredited certification or registration body.

ISO 22000: 2005: It specifies requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. It is applicable to all organizations, regardless of size, which are involved in any aspect of the food chain and want to implement systems that consistently provide safe products. The means of meeting any requirements of ISO 22000:2005 can be accomplished through the use of internal and/or external resources.

ISO 22000:2005 specifies following requirements to enable an organization:

- To plan, implement, operate, maintain and update a food safety management system aimed at providing products that, according to their intended use, are safe for the consumer
- To demonstrate compliance with applicable statutory and regulatory food safety requirements
- To evaluate and assess customer requirements and demonstrate conformity with those mutually agreed customer requirements that relate to food safety, in order to enhance customer satisfaction
- To effectively communicate food safety issues to their suppliers, customers and relevant interested parties in the food chain
- To ensure that the organization conforms to its stated food safety policy
- To demonstrate such conformity to relevant interested parties and
- To seek certification or registration of its food safety management system by an external organization, or make a self-assessment or self-declaration of conformity to ISO 22000:2005.

Lecture-28

- *Indian food regulations and certification*

Indian Standards / Laws and Regulations: Government of India is fully aware to the possibilities of food being adulterated. Therefore, several agencies, acts, standards and orders were formed to formulate standards, implement them, check the adulteration and protect the consumers. Some agencies and institutions were created to lay down standard for the quality control of foods.

Law is necessary to control every trade. Indian Food Industry can be categorized in organized (25%), Small Scale Industries (33%) and unorganized (42%). Due to globalization and agreement with WTO, it has become necessary for the Indian Food Industry to make up their food products up to the level so that they can with stand in the National / International market with competitive price & quality. This can be achieved by tracing the mandatory and voluntary rules. Each country has its own set of rules for its food products, which are necessary to protect the right and health of the consumers and ensure fair practices in food trade. In India, different Government ministries are upholding different necessary and voluntary regulatory acts. The main agencies involved in setting standards / laws are presented in table below:

Ministries / agencies involved for setting up standards and legislations

Ministry involved in setting legislation	Standards and legislation
Ministry of Agriculture	The Insecticide act, 1968; MMPO, 1992; MFPO 1973
Ministry of Rural Development – Directorate of marketing and inspection	Agricultural Produce (Grading and Marketing) act, 1937
Ministry of Health and Family Welfare	PFA, 1954
Ministry of Food Processing Industries	FPO, 1955
Ministry of Commerce	Export (Quality Control and Inspection) act, 1963
Ministry of Food and Civil Supplies, Consumer Affairs and Public Distribution	Standards of Weights and Measures (Enforcement) act, 1976; Consumer Protection act, 1986; Solvent Extracted oils, De-oiled meal and Edible Flour control order, 1967; Vegetable Oil Products Control order, 1998; BIS act, 1986
Ministry of Environment and Forests	Aquaculture Authority Notification, 1997 and 2002; Environment (Protection) act, 1986
Ministry of Law and Justice	Food Safety and Standards act, 2006

List of Domestic / Indian standards Acts:

- The Prevention of Food Adulteration Act, 1954
- The Fruit Products Order, 1955
- Essential Commodities Act, 1955.
- Agricultural Produce (Grading and Marking) Act (AGMARK), 1937
- Agricultural and Processed Food Product Export Development Authority (APEDA), 1963.
- Marine Product Export Development Authority (MPEDA),1972
- Indian Standard Institute (ISI) : Bureau of Indian Standards (BIS) (ISI Mark), 1986
- The Meat Food Products Order, 1973
- Trade and Merchandise Marks Act, 1958.
- Sale of Goods Act, 1930
- The Vegetable Oil Products (Control) Order, 1947
- The Solvent Extracted Oil, De oiled Meal, and Edible Flour (Control) Order, 1967
- The Milk and Milk Products Order, 1992
- The Edible Oils Packaging (Regulation) Order, 1998
- Food Safety and Standard Act, 2006

Prevention of Food Adulteration Act (1954) and Rules (1955): One of the early acts to be promulgated in food laws and standards was the Prevention of Food Adulteration Act of 1954, which has been in force since June I, 1955. The objective of this act was to ensure that food articles sold to the customers are pure and wholesome. This prevents

fraud or deception and encourages fair trade practices. Amendments were made to plug loopholes in the act and to ensure stringent punishment for those indulging in malpractices. The PFA Act lays down the guidelines for setting up standards for various food items like cereals and cereals products, pulses, ghee etc. All these processed items are expected to conform to these standards.

The Act prohibits the manufacture, sale and distribution of not only adulterated foods but also foods contaminated with toxicants and misbranded foods. A central committee for food standards has been constituted under the Act and has been charged with the function of advising the Central Government on matters relating to the Food Standards.

It is mandatory & comes under the Ministry of Health and Family Welfare to operate Central Committee for Food Standards (CCFS). The act provides minimum standards for all types and categories of food products. It extends to the whole of India. Adulteration also covers misbranding or mislabelling and anything else which may be injurious to consumers health. Not following of PFA Act lead to fine and imprisonment for a term of not less than 3 months to one year.

Salient features of the PFA Act:

- The act is mandatory
- PFA -1954 and 1955 protects consumers against impure, unsafe, and fraudulently lebelled foods
- Applies to domestic and imported products and cover various aspects of food processing and distribution-food colour, preservatives, pesticide residues, packaging and lebelling, etc.
- All imported products must adhere to the rules specified in the Act and its regulations
- Focuses primarily on the establishment of regulatory standards for primary food products, which constitute bulk of the Indian diet
- According to the Act, an article of food shall be deemed to be adulterated if
- If the article sold by a vendor is not of the nature, substance or quality demanded by the purchaser and as it is represented to be.
- If it contains any other substance or processed as to affect injuriously the nature.
- If any inferior or cheaper substance has been substituted wholly or in part for the article.

- If the article had been prepared, packed or kept under unsanitary conditions whereby it has become contaminated or injurious to health;
- If the article consists of any filthy, putrid, disgusting, rotten, decomposed or diseased animal or vegetable substance or is insect-infested or otherwise unit for human consumption.
- If the article is obtained from a diseased animal;
- If the article contains any poisonous or other ingredient which renders its contents injurious to health;
- If the container of the article is composed of any poisonous or deleterious substance which renders it contents injurious to health;
- If any coloring matter other than as prescribed and in amounts not within the prescribed limits of variability is present in the article;
- If the article contains any prohibited preservative or permitted preservative in excess of the prescribed limits;
- If the quality or purity of the article falls below the prescribed standard or its constituents are present in quantities, which are in excess of the prescribed limits of variability.

Essential Commodities Act, 1955: This Act is administered by the Ministry of Consumer Affairs, Food and Public Distribution through the State/Union Territory. The aim of this Act is to regulate the manufacturer toward quality aspect, commerce and distribution of essential commodities like food. Number of orders has been listed in the provision of the act.

Fruit product order, 1955: The Government of India promulgated a Fruit Products Order in 1946. In 1955, the order was revised. FPO (1955) is administered by the Union Ministry of Food Processing Industries. This order is issued under Essential Commodities Act 1955. The Fruit Products Order (FPO) lays down statutory minimum standards in respect of the quality of various fruits and vegetable products and processing facilities. This order is implemented by Department of Food Processing Industries through the Directorate of Fruit and Vegetable Preservation at New Delhi. The Directorate has four regional offices located at Delhi, Mumbai, Calcutta and Chennai, as well as sub-offices at Lucknow and Guwahati. The FPO is enforced by the Department of Health and regulates the production and sale of fruit and vegetable products like jams, jellies, squashes, pickles, processed vegetable, synthetic vinegar and synthetic beverages. A manufacturer of these products has to obtain a Licensee before setting the unit and ensure the quality and hygiene of these

products as per standards laid down under the order. Presently there is a little over 6600 units registered under the Fruit Products Order of 1955 distributed all over the country.

Salient Features of the FPO:

- Fruit Products Order aims at regulating sanitary and hygienic conditions in manufacture of fruit and vegetable products.
- It is mandatory for all manufacturers of fruits and vegetable products to obtain license under this Order to ensure good quality products, manufactured under hygienic conditions.
- The Fruit Product Order lays down the minimum requirements for sanitary and hygienic conditions of premises, surroundings and personnel, water to be used for processing, machinery and equipment, product standards.
- Besides this, maximum limits of preservatives, additives and contaminants have also been specified for various products.

Meat food product order (MFPO) 1973: It provides means to detect and destroy meat of diseased animals. It ensure that the preparation and handling of meat and meat products be conducted in a clean and sanitary manner. It prevents the use of harmful substances in meat foods. It sees that every cut of meat is inspected before sale to ensure its wholesomeness. The order also lays down rules and conditions for procedure to be adopted for the selection of disease free animals, slaughterhouse practices. It deals with the products prepared from meat and their licensing manufacture, trade and distribution including hygiene condition. This order is operated by the Directorate of Marketing and Inspection.

Solvent extracted oils, de-oiled meal & edible flour control order, 1967: It applies for oils and fats and deals with the licensing manufacture distribution and trade of solvent extracted edible oils and quality, thereof and operated by Directorate of Vanaspati, Vegetable Oil and fats.

Vegetable oil products (regulation) order, 1998: It controls the manufacture, trade and distribution of vegetable oil including the quality thereof. This order supersedes the Vegetable Oil Order (Control), 1947 and Vegetable Oil Products (Standards of Quality Order, 1975). BIS certification for the tin plates used for Vanaspati packing is deleted.

Sugar (control) order, 1966: Indigenous production of raw sugar and its quality are controlled under this order. The Directorate of Sugar, Ministry of Agriculture and Rural Development is the operating authority of this order.

Milk and milk products order, 1992: MMPO 1992 is exercised under the Essential Commodities Act and is regulated by the Ministry of Agriculture through the Department of Animal Husbandry and Dairying. According to this order, it is essential for a dairy plant to process more than 10,000 litres of milk per day or handle more than 500 tones of milk solids per annum.

The Coffee Act, 1942: It provides rules and regulations regarding curing, assessment of quality and enforcement of quality control measures at different stages of marketing coffee within the country and abroad.

The Tea Act, 1953 and the tea (distribution & export) control order, 1957: This regulates production and sale of tea in home and abroad. The order prohibits the export of tea by any person other than a licensee who has also to comply with the requirement in regard to packaging and marking of every container meant for export.

Plant food & seeds (regulation of import in to India) order, 1989 (amendment 1992): Plant Food & Seeds (PFS) Order issued and amended by the Department of Agriculture and Cooperation, Ministry of Agriculture. Amendment in PFS Order, 1992 banned import of plants and plant materials even for consumption purpose unless accompanied by an import permit and official phyto-sanitary certificate issued by the Agriculture Ministry.

The Edible Oils packing (regulation) Order, 1998: This order is regulated by the Department of Sugar and Edible Oil under Ministry of Food and Consumer Affairs.

The standards and weights measure act, 1976 and The standards of weight and measures (packaged commodities) rules, 1977: The act is governed by the Ministry of Law, Justice and Company Affairs. In India, a uniform standard of weights and; measures is based on the metric system established in 1956. Act control and regulate the weight and measures of different commodities in packaged form. The Packaged Commodities

Rules, 1977, by providing labelling condition have given protection to the consumer in knowing the ingredients that have come into manufacture of composite food. This act/ rules prescribe provision of label declaration. It is necessary to declare on each package, name and address of manufacturer, net quantity packed, moth/year of manufacture, expiry date, sale price, ingredients etc.

Consumer protection act, 1986: The Act is enforced by the Department of Consumer Affairs, provides the constitution of district Forum/State/National Commission for settlement of dispute between seller and buyer. This Act applies to all goods and services provide the rights of the consumers.

Environments protection act, 1986: This Act is regulated by the Ministry of Environment and Forests, Government or India. Under this act it is mandatory for every food manufacturer to discharge plant waste into main stream to obtain a no objection certificate (NOC) from respective State Pollution Control Board.

The insecticide act, 1968: This Act is regulated and governed by directorate of Plant Protection, Quarantine and Storage under the Ministry of Agriculture. This Act describes the safe use of insecticides to ensure that residual levels of chemicals in food do not pose a health hazard.

Export (quality control and inspection) act, 1963: The Act was framed by the Department of Commerce, Government of India to promote and regulate the export trade through Export Inspection Council (EIC), Export Inspection Agency (EIA), Agricultural and Processed Food Products Export Development Authority (APEDA). Under this Act, exportable commodities have to be notified for compulsory pre-shipment inspection, but in some circumstances it is exempted from pre-shipment Inspection.

Bureau of Indian Standards (BIS): BIS is the National Standards Organization established as Society in 1947 as Indian Standards Institution and subsequently made its statutory body as BIS under Bureau of Indian Standards Act 1986. It revoked Indian Standards Institutions (Certification Marks) Act 1952 but incorporated all its provisions. The Bureau is a body corporate and responsible for laying down policy guidelines for BIS. It comprises of members Representing Industry, Consumer Organizations, Scientific and Research Institutions,

Professional/technical institutes, Central Ministries; State Government and Members of Parliament. The act is mandatory for milk powders, sweetened condensed milk, infant formula etc. This act generally covers hygienic conditions of manufacture, raw material quality and safety. It also ensures the quality to the consumers by certification.

Salient Features of the BIS:

- Standard Formulation,
- Certification : Product Quality Management System, Eco Mark, Environment Management System, Hazard Analysis' and Critical Control Points,
- Laboratory: Testing, Calibration and Management,
- Standards Promotion,
- Consumer Affairs and
- Awareness and Training Programs.

There are 14 different technical departments engaged in formulation of the standards. So far 17000 standards have been formulated in different technological areas depending upon the national priority. These standards are evolved through the consensus from different sectors like industry, consumers, testing and laboratory experts and committees / sub-committees of Govt organization. The standards are reviewed time to time and continuously updated to match the technological changes. The BIS has formulated 1133 standards pertaining to food products.

Plant Quarantine Order, 2003: India introduced the Plant Quarantine (Regulation of Import into India) Order in 2003 to prohibit and regulate the import of agricultural articles. Orders include:

- A ban on the import of certain plants and planting materials from designated countries (e.g. Sugarcane from Australia).
- A restriction on the import of other plants and plant materials to authorized institutions.
- A requirement for additional declarations and special conditions for further positive list of plants and plant materials.

Food Safety and Standards Act, 2006: An act to consolidate the laws relating to food and to establish the Food Safety and Standards Authority (FSSA) of India for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, import, to ensure availability of safe and wholesome food for human consumption and for matters connected therewith or incidental thereto. FSSA, 2006

bring the different pieces of legislation pertaining to food safety under one umbrella which will override the PFA, 1955 and various Quality Control Orders under Essential Commodities Act, 1955.The aim is to better coordinate and integrate food safety controls across India to give highest level of health protection.

Salient Features of Food Safety and Standards Act:

- Enhanced food safety in the country should provide opportunities for additional value-added agri-food exports
- Food safety is no longer a national issue. It will become an increasingly important global issue. India can play an important role in enhancing food safety capacities of developing countries which in turn will bring additional benefits
- The food safety programs offer opportunities for human capital formation through food safety education and training

Agricultural Produce (Grading & Marketing) Act, 1937: It is popularly known as 'Agmark'. The AGMARK standard was set up by the Directorate of Marketing and Inspection of the Government of India by introducing an Agricultural Produce Act in 1937. The word 'AGMARK' seal ensures about quality and purity of the food products. The quality of a product is determined with reference to the size, variety, weight, colour, moisture, fat content and other factors are taken into account. The act is voluntary. It covers quality assurances of unprocessed, semi processed and processed agricultural commodities. It lays down the specifications for various adulteration prone commodities viz. butter, ghee, vegetable oils, ground-spices, honey, wheat atta etc. AGMARK also covers pulses, cereals, makhana, vegetable oils, fruits and vegetables, roasted Bengal gram, vermicelli, macroni and spaghetti. Blended edible vegetable oils and fat spread are compulsorily required to be certified under AGMARK.

Salient Features of AGMARK Standards:

- Quality standards for agricultural commodities are framed based on their intrinsic quality.
- Food safety factors are being incorporated in the standards to compete in World trade.
- Standards are being harmonized with international standards to keeping in view the WTO requirements.
- Check is kept on the quality of certified products through 23 laboratories and 43 offices spread all over the country

- The grades incorporated are grades 1, 2, 3 and 4 or special, good, fair and ordinary. In this Act an article is said to be misgraded if does not meet any of the following points
- The article is not of the quality prescribed for the grade and designation with which it is marked.
- The composition of the article offered for grading is altered in any way after a sample has been drawn for analysis and determination of the grade designation of the article in accordance with the rules made under this Act.
- If the article is tampered with another material.
- Any false claim is made for the quality prescribed for its grade designation, upon the label or through advertisement or in any other manner.

The actions which can be taken on misbranding are:

- Seize and detain any agricultural produce in relation to an offence under this Act or the rules.
- Penalty for un-authorized marking with grade designation mark
- Penalty for counterfeiting grade designation mark
- Penalty for selling misgraded articles
- Power to prescribe compulsory grade designations in respect of certain articles

Eligibility for AGMARK Standards: Parties desirous to grade their commodities under AGMARK have to obtain Certificate of Authorization. For the purpose, they should have adequate infrastructure to process the commodity and access to an approved laboratory for the determination of quality and safety factors.

Procedure to apply: Interested parties have to apply in prescribed proforma along with prescribed documents to the nearest office of the Directorate. Parties have to give details of infrastructure, processing facilities, details of laboratory etc. for obtaining Certificate of Authorization.

Trade and Merchandise Marks Act, 1958: This acts as safeguard to help the buyer of quality as well as to protect the genuine manufacturer. Under this act, any person who deceptively uses as a registered trade mark rights of the genuine manufacturer and is liable for civil as well as criminal proceedings in the court of law.

Sale of Goods Act, 1930: This act plays an important role in sale of the prepared food and drinks etc. However, the provision of Indian Contract Act continues to apply the contracts of sale of the foods.

ECO Mark Act: The Ministry of Environment and Forest has instituted a labelling of environment friendly products, on a national basis. BIS also started Eco Mark Scheme.

Lecture-29

- *Concept of Codex Alimentarius*

Codex Alimentarius Commission (CAC): The term Codex Alimentarius is taken from Latin and means food code. The Codex Alimentarius Commission develops food standards, guidelines and related texts such as codes of practice under the Joint FAO / WHO Food Standards Programme. It is also called Codex (Hormonized International Standards due to involvement of both FAO and WHO. About 170 countries were member of the commission. The purpose of this program is to protect the health of consumers and to ensure fair practice in the food trade; to promote coordination of all food standards work undertaken by international governmental and non-governmental organizations; to determine priorities and initiate and guide the preparation of draft standards through and with the aid of appropriate organizations; to finalize standards and after acceptance by Governments, publish them in a

Codex Alimentarius either regional or worldwide standards. It brings together all the interested parties viz. scientists, technical experts, governments, consumers and industry representatives to help develop standards for food manufacturing and trade. These standards, guidelines and recommendations are recognized worldwide for their vital role in protecting the consumer and facilitating international trade. As Codex Alimentarius represent a consensus of food and trade experts from around the world, these standards are more and nl0re being used in international trade negotiations and also for setting of disputes by WTO.

The Codex contract Point in India is the Directorate General of Health Services (DGHS) in the Ministry of Health; however, the Ministry of Food processing Industries is closely associated with the activities of Codex Alimentarius.

Salient Features of Codex Alimentarius:

- Protecting health of the consumers and ensuring fair trade practices
- Promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations
- Determining priorities and initiating and guiding the preparation of draft standards.
- Finalizing standards
- Amending published standards
- Submission of a proposal for a standard
- A decision by the Commission or the executive committee
- Preparation of a proposed draft standard by subsidiary body
- Adoption of standard by the Commission
- Addition of Codex Standard in the Codex Alimentarius

Lecture-30

- *The concept and process of implementation of HACCP in an industry*

Hazard Analysis Critical Control Point (HACCP): The Hazard Analysis Critical Control Point (HACCP) is a scientific, rational and systematic approach to identify, assess and control hazards during production, processing, manufacturing and use of food. It ensures safety of the food. The Hazard Analysis Critical Control Point (HACCP) system is a

preventative system used by the food industry to ensure food and pharmaceutical safety that addresses physical, chemical and biological hazards as a means of prevention rather than finished product inspection. HACCP system controls hazardous elements in the food system such as contaminants, pathogenic microorganisms, physical objects (glass, metal, and bone), chemicals (toxins, heavy metals, and pesticide residues), raw materials, processing conditions, use directions for the consumer, or storage conditions. So, HACCP consists of plan and system. HACCP plan is a written document that is based on the principles of HACCP and that delineates procedures to be followed. HACCP system is result of implementation of the HACCP plan. HACCP presents a good opportunity for the food industry for upgrading quality and bringing uniformity and consistency in their supplies to international market. The food industry plays an important role in the national economy and has major share in India exports. The most effective way to implement HACCP is through ISO 9000which provide better framework for managing the activities of an organization. Main objective of HACCP concept is to assure production of safe food products prevention instead of quality inspection.

HACCP may be described as:

- A scientifically based protocol that is applied directly to the food procurement, production and distribution process.
- A systematic approach to the identification, evaluation, and control of food safety hazards based on seven principles.
- It's an analytical tool that enables management to introduce and maintain a cost-effective, ongoing food safety programme.
- It is part of quality assurance system that ensures product safety, reliability, service, etc especially the technological requirements (technological focus).

History of HACCP: HACCP is used in the food industry to identify potential food safety hazards, so that key actions, known as Critical Control Points (CCP's) can be taken to reduce or eliminate the risk of the hazards being realized. The system is used at all stages of food production and preparation processes including packaging, distribution, etc. In addition to ISO 9000, the HACCP technique has become widely accepted in food industry for assured food safety. The application of HACCP to food production was pioneered by the Pillsbury Company with the cooperation and participation of the National Aeronautic and Space Administration (NASA), Natick Laboratories of the US Army, and the US

Air Force Space Laboratory Project Group. In the Indian food industry, HACCP is not compulsory practice but due to increase in the cases of food poisoning in the country, HACCP has been recognized internationally as a science-based logical tool for management of food safety. Now-a-days, more peoples depends upon ready to cook, the legal implications associated when something goes wrong may be quite serious thus HACCP is one internationally accepted system implemented for ensuring food safety. India as signatory to WTO, TBT & SPS agreements along with TQM and ISO is committed to follow WTO regulations whose priority is to protect health of consumer. Our food industry thus needs to install HACCP to avoid any rejection of foods shipped to international market. HACCP replaced end product testing to provide food safety assurance and provided a preventive system for producing safe food that had universal application. This effort resulted in a set of three HACCP principles, which has since been expanded to seven principles.

Principles of HACCP system: Before a food company can develop a HACCP programme, they should assemble a multi-disciplinary team that includes individuals involved with food safety, food quality, and food processing operations. This team could include personnel from quality assurance, quality control, management, front line workers, and maintenance. The group also could include an external food safety consultant. After the team has been assembled, they begin developing a HACCP programme. HACCP is "product specific", which means that a plan is developed for each specific product manufactured by a company. HACCP is based around seven established principles. These principles are associated with development and implementation of the HACCP system. The successful implementation of HACCP demands that each of these principles be well understood. It should cover all the processes from the point of receiving raw material through manufacturing, packaging and all post manufacturing steps like storage, distribution and consumer handling. Seven principles are as follow:

Principle 1 - Conduct hazard analysis: In this first step, the team assesses hazards associated with growing, harvesting, raw materials and ingredients, processing, manufacturing, distribution, marketing, preparation, and consumption of the food. They identify all significant hazards (biological, chemical, and physical) that need to be controlled to assure food safety throughout each step in the process.

Principle 2 - Determine critical control points: After identifying the significant hazards, the team establishes preventative measures to control the identified hazards. The team identifies areas or points in the flow of a food product with their critical limits that must be met to control the identified hazards. These are called critical control points (CCPs). A Critical Control Point (CCP) is a point, step, or procedure in a food process at which control can be applied and as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level. If loss of control occurs at a CCP, it likely will lead to an unacceptable health risk.

Principle 3 - Establishment of specification for critical limits: At each CCP, teams define boundaries or limits of safety to assure that the CCP is in control. They establish upper limits for CCPs. CCP limits are usually based on time, temperature, pH, and moisture content of a food.

Principle 4 - Development of monitoring and testing system to control critical point: CCP and CCP limits are only effective if they are monitored during food processing. Monitoring ensures that the process is in control. Testing procedures have to be developed to ensure that each critical control point is consistently monitored and the process is under control.

Principle 5 - Establishment of corrective actions when particular CCP is not under control: Whenever food companies note a deviation in the critical limits for a CCP, they must correct the deviation. Corrective action may include changing the process, reprocessing, or discarding the product. Corrective actions are intended to ensure that no product injurious to health.

Principle 6 - Establish record keeping procedures: Food companies must keep records of the results of monitoring critical control points. These records are the only proof for a company that process is in control and that they are complying with the HACCP plan. Depending on the commodity, records should be accessible for one to three years. Thus, a system must establish documentation of procedures and records for all aspects of the HACCP programme and give evidence of its functioning base on all data obtained from testing and analysis, deviation or correction actions.

Principle 7 - Verification of HACCP system to confirm efficacy: The procedure need to be established to verify and confirms that operating HACCP system is working effectively. Verification ensures that HACCP

plan is adequate and verification includes such activities as review of HACCP plans. They may request an internal or external food safety audit to verify that the HACCP plan is working. It may also include testing for absence of food borne hazards in the finished product.

Procedure for applications of HACCP in plant assembling of the HACCP team: The first task in developing a HACCP plan is to assemble a HACCP team consisting of individuals who have specific knowledge and expertise appropriate to the product and process. It is the team's responsibility to develop the HACCP plan. For the application of HACCP plan a multi disciplinary team comprising of food technologist, food microbiologist, food chemist and an engineer can be formed. The team should also include local personnel who are involved in the operation as they are more familiar with the variability and limitations of the operation. The team should also include representatives from inspection team & personnel directly related to processing operations and expert advice should be obtained from other sources. The scope of HACCP plan should be identified.

Activities / responsibilities of HACCP team

Team	Activity/ responsibility
Quality assurance/quality control specialist	Knowledge on micro / chemical hazards and other associated risk for product
Production specialist	Responsible for or involved with production process
Engineer	Knowledge on hygiene design and engineering operation of process equipment
Other specialists	Buyers, operators, packaging experts, distribution experts, and hygiene manager
A member of management	To ensure management commitment

Product description and distribution: The HACCP team first describes the food. This consists of a general description of the food, ingredients, processing methods, physico chemical properties, treatments during processing, packaging, storage durability and its distribution methods along with information on whether the food is to be distributed frozen, refrigerated, or at ambient temperature.

Description on products during distribution should include:

- Composition and physical features of final product e.g. a_w and pH.
- Process information e.g. production method used
- Method of packing
- Required shelf life

- Storage and distribution conditions along the chain e.g. frozen, refrigerated, shelf-stable
- Legislative product requirements
- Instructions for use and storage by consumers

Identification of intended use and consumers: HACCP team should identify the target population and relevant food safety issues where product finds its final use. Intended use of product by consumers may be defined e.g. for special groups, which put higher demand on food safety like babies or reduced resistance people, immuno-compromised individuals, the elderly, etc.

Development of flow chart for description of the process: Process flow chart must possess clear and simple outline of the steps involved in the process. Process flow diagram must cover all the steps in the process from receiving of raw material to the final dispatch of product. It should also describe product flow and employee's pattern within the process area and a simple schematic of the facility is often useful in understanding and evaluating product and process flow.

Technical data to be provided for description of flow chart: All raw materials/ingredient and packaging used include microbiological, physical or chemical data

On-site verification of flow diagram: The HACCP team should perform an on-site inspection of the operation to verify the accuracy and completeness of the flow diagram during all stages of processing operation. Modifications should be made to the flow diagram as necessary and documented. After these five preliminary tasks have been completed, the seven principles of HACCP are applied.

The following points will need to be considered in order to implement the HACCP plan:

- Allocation of responsibility for the management and supervision of the plan, monitoring of CCP and record-keeping and documentation
- Development of simple, but clear, work instructions for the monitoring of CCPs
- Development of recording sheets and other documentation
- Training and education of staff based on the HACCP plan and on work instructions indicating what, how, when and who should do what

- Allocation of responsibility for decisions on corrective actions and disposition actions.

Important criteria are for application of HACCP:

i) Pre-requisite programmes: Pre-requisite programmes are defined as the universal procedures used to control the conditions in the food plant environment which contribute to the overall safety of the products. The documented prerequisite programmes serve as the most important foundation for food safety management. HACCP is not a stand alone programme but is part of a entire control programme. Implementation of HACCP relies on adherence to prerequisite programmes. Prerequisite programmes must be developed, implemented and documented. Prerequisite programmes include good manufacturing practices (GMP) and other programmes. Pre-requisite programmes must see that the HACCP system is built on a solid foundation of prerequisite programmes such as GMP codes. The effectiveness of HACCP programme in any industry is dependent upon the existence of adequate procedures that control the operational conditions with in the factory or industry so that the environmental conditions are favourable for the production of a safe product. For successful HACCP, prerequisite programmes like design and development, operational control, maintenance control, product description, sanitation and personal hygiene and product traceability etc are needs to be sincerely implemented. All these programmes are documented and audited regularly. The pre-requisite programmes include:

- Facilities: Including location, construction and maintenance according to sanitary principle. Product flow must be linear and traffic must be controlled to minimize cross contamination.
- Cleaning and sanitation programme: All written procedures and a master scheme for cleaning and sanitation of equipment and facilities must be operational.
- Training: All employees must receive documented training in personal hygiene, GMP, cleaning and sanitation procedures, personal safety and their role in HACCP programme.
- Traceability and recall: All raw materials and products must be lot-coded and recall system must be present in order to perform rapid and complete traces or recall if required.
- Pest control: Effective pest control programme must present in the HACCP pre-requisite programme.

ii) Training and Education: Success of HACCP system depends on proper understanding of HACCP principles by both Management and Employees. Thus, education and training should be provided to know the importance of HACCP in producing safe food and in controlling food borne hazards in all production stages of processing.

iii) Management Commitment: Success also depends on management. Thus, management must be committed to HACCP approach, indicate awareness of benefits and cost of HACCP. Management must be provided with necessary team members for a number of periods and financial support. Prior to implementation of HACCP, quality policy and objectives of companies' must be clearly stated.

Implementation of HACCP is carried out by:

Processor: Processors are responsible for upgrading the facility, designing the HACCP system, implementing it, documenting & maintaining records.

Government: Governments are responsible for creating a scientific, technical and financial environment favourable to HACCP implementation.

Benefits of HACCP: There are numerous benefits for the food industry while applying HACCP system as a management tool for food safety control. Some of the important benefits are as follows:

1) Application of the HACCP concept is the cost effective approach to food safety.
2) Application of the HACCP concept is enough flexible.
3) Helps to maintain the global food quality and safety standards.
4) The HACCP approach is a systematic approach for all aspects of food safety and can be applied to all stages of the food chain, including raw materials, growth, harvesting, purchase, production, distribution, and storage to final product use.
5) Provides scientifically sound base for protections of a hazard from reaching the end consumer products.
6) HACCP systems can promote international trade by increasing confidence in food safety.
7) HACCP system can facilitate the design and construction of new food processing facilities and equipment.
8) The HACCP system can be readily integrated in to quality management systems like TQM and ISO 9000 etc.

9) HACCP system focuses resources mainly on those parts of the process which are critical for assuring safe products.

10) HACCP system can reduce product losses due to spoilage.

Lecture-31

- *USFDA-the cause of its existence-its role in safe guarding food quality – Significance*

History: Up until the 20th century, there were few federal laws regulating the contents and sale of domestically produced food and pharmaceuticals, with one exception being the short-lived Vaccine Act of 1813. The history of the FDA can be traced to the latter part of the 19th century and the U.S. Department of Agriculture's Division of Chemistry (later Bureau of Chemistry). Under Harvey Washington Wiley, appointed chief chemist in

1883, the Division began conducting research into the adulteration and misbranding of food and drugs on the American market. Wiley's advocacy came at a time when the public had become aroused to hazards in the marketplace and became part of a general trend for increased federal regulations in matters pertinent to public safety during the Progressive Era. The 1902 Biologics Control Act was put in place after diphtheria antitoxin was collected from a horse named Jim who contracted tetanus, resulting in several deaths.

In June 1906, President Theodore Roosevelt signed into law the Food and Drug Act, also known as the "Wiley Act". The Act prohibited, under penalty of seizure of goods, the interstate transport of food that had been "adulterated". The act applied similar penalties to the interstate marketing of "adulterated" drugs, in which the "standard of strength, quality, or purity" of the active ingredient was not either stated clearly on the label or listed in the United States Pharmacopoeia or the National Formulary. The responsibility for examining food and drugs for such "adulteration" or "misbranding" was given to Wiley's USDA Bureau of Chemistry. Wiley used these new regulatory powers to pursue an aggressive campaign against the manufacturers of foods with chemical additives, but the Chemistry Bureau's authority was soon checked by judicial decisions, which narrowly defined the bureau's powers and set high standards for proof of fraudulent intent. In 1927, the Bureau of Chemistry's regulatory powers were reorganized under a new USDA body, the Food, Drug, and Insecticide organization. This name was shortened to the Food and Drug Administration (FDA) three years later.

Food and Drug Administration: The Food and Drug Administration (FDA or USFDA) is an agency of the United States Department of Health and Human Services, one of the United States federal executive departments. The FDA is responsible for protecting and promoting public health through the regulation and supervision of food safety, tobacco products, dietary supplements, prescription and over-the-counter pharmaceutical drugs (medications), vaccines, biopharmaceuticals, blood transfusions, medical devices, electromagnetic radiation emitting devices (ERED), veterinary products, and cosmetics.

The FDA also enforces other laws liking sanitation requirements on interstate travel and control of disease on products ranging from certain household pets to sperm donation for assisted reproduction. The FDA has its headquarters at White Oak, Maryland.

The agency also has 223 field offices and 13 laboratories located throughout the 50 states.

Organization: The FDA comprises several offices and centers. There are:

- Office of the Commissioner
- Center for Biologics Evaluation and Research
- Center for Devices and Radiological Health (CDRH)
- Center for Drug Evaluation and Research (CDER)
- Center for Food Safety and Applied Nutrition
- Center for Tobacco Products
- Center for Veterinary Medicine
- National Center for Toxicological Research
- Office of Regulatory Affairs

Most federal laws concerning the FDA are part of the Food, Drug and Cosmetic Act (first passed in 1938 and extensively amended since). The programs for safety regulation vary widely by the type of product, its potential risks, and the regulatory powers granted to the agency. For example, the FDA regulates almost every facet of prescription drugs, including testing, manufacturing, labeling, advertising, marketing, efficacy and safety, yet FDA regulation of cosmetics is focused primarily on labeling and safety. The FDA regulates most products with a set of published standards enforced by a modest number of facility inspections.

The Center for Food Safety and Applied Nutrition is the branch of the FDA that is responsible for ensuring the safety and accurate labeling of nearly all food products in the United States. One exception is meat products derived from traditional domesticated animals, such as cattle and chickens, which fall under the jurisdiction of the United States Department of Agriculture Food Safety and Inspection Service. Products that contain minimal amounts of meat are regulated by FDA, and the exact boundaries are listed in a memorandum of understanding between the two agencies. However, medicines and other products given to all domesticated animals are regulated by the FDA through a different branch, the Center for Veterinary Medicine. Other consumables that are not regulated by the FDA include beverages containing more than 7% alcohol (regulated by the Bureau of Alcohol, Tobacco, Firearms and Explosives in the Department of Justice), and

non-bottled drinking water is regulated by the United States Environmental Protection Agency (EPA).

Lecture-32

- *Food Adulteration and Food Safety*

Food Adulteration: Adulteration of food stuffs is commonly practiced in India by the trade. The consumers like to get maximum quantity for as Iowa price as possible. The sellers must meet the needs of the buyers, to be able to exist. This is a vicious cycle. When the price of the food production is higher than the price which the consumer is prepared to pay, seller is compelled to supply a food product of inferior quality. Thus adulteration occurs. It was to check such malpractices that the first central act called the Prevention of Food Adulteration Act was passed in 1954 and come into force from June I, 1955. The PFA pertains to food sold and defines what may be considered as adulteration. It requires that foods be pure, wholesome and honestly labeled.

Definition: Adulteration is defined as the process by which the quality or the nature of a given substance is reduced through

(i) the addition of a foreign or an inferior substance and

(ii) the removal of a vital element.

A good example for the first one is addition of water to milk and that for the second is removal of fat from milk. Adulteration of food may endanger health if the physiological functions of the consumer are affected due to either addition of a deleterious substance or the removal of a vital component.

Types of adulterants: Adulteration may be intentional or unintentional. The former is a willful action the part of the adulterator intended to increase the margin of profit. Incidental contamination is usually due to ignorance, negligence or lack of proper facilities.

Intentional adulterants: Intentional adulterants are sand, marble chips, stones mud, chalk powder, water, mineral oil and coal tar, dyes. These adulterants cause harmful effects on the body.

Contamination of foods with harmful microorganisms: Raw foods such as meat, fish, milk and vegetables grown on sewage are likely to be contaminated with harmful microorganisms. These are generally destroyed during cooking or processing of food. Some of the microorganisms may survive due to inadequate heat processing. Further, some of the foods, if consumed in the raw state, may cause food poisoning. Recent studies have shown that food grains, legumes and oil seeds when stored in humid atmosphere are infected by pathogenic fungus which can cause serious illness. The pathogenic microorganisms commonly contaminated foods and responsible for causing serious illnesses.

Metallic contamination: If arsenic, lead or mercury get accumulated in the body they can be harmful. Lead is a toxic element and contamination of food with lead can cause toxic symptoms. For example, turmeric is coated by illiterate manufacturers in India with lead chromate. Lead brings about pathological changes in the kidneys, liver and arteries. The common signs of lead poisoning are nausea, abdominal pain, anemia, insomnia, muscular paralysis and brain damage. Fish caught from water contaminated with mercuric salts contain large amounts of mercury. The organic mercury compound methyl or dimethyl mercury is the most toxic. The toxic effects of methyl mercury are neurological. When the brain is affected, the subject becomes blind, deaf and paralysis of the various muscles can be seen. The other elements which are toxic in small doses are cadmium, arsenic, antimony and cobalt.

A survey conducted by the Indian Council of Medical Research (ICMR) also found high levels of pesticide residues in bovine milk and metals arsenic, cadmium and lead in infant formula canned products and turmeric.

Pathogenic Organism	Food commonly involved	Ill effects and diseases
Bacteria :		
Bacillus cereus	Cereal products	Nausea and vomiting
Clostridium botulinum toxins	Defectively processed meat and fish	Botulism (muscular paralysis) death due to respiratory failure.

Salmonella	Defectively processed meat, fish and eggs, raw vegetable grown on sewage.	Salmonellosis (vomiting, diarrhea and fever)
Shilgella sonnei , Staphylococcus aureus and Streptococcus pyogenes	Foods kept exposed or sale in unhygienic conditions	Bacillary dysentery, diarrhea, increased salivation,
Fungal :		
Aspergillus flavus (aflatoxins)	Corn and groundnuts	Liver damage and cancer
Claviceps purpurea	Rye and pearl millet infested with ergot	Ergotism (burning sensation in extremities) peripheral gangrene
Pencillium islandicum	Rice	Liver damage
Parasitic :		
Trichinella spiralis	Port and its products	Nausea, vomiting and diarrhea.
Entamoeba histolytica and Ancylostoma duodenale (hook worm)	Raw vegetables grown on sewage farms	Dysentery, epigastric pain , loss of blood and anemia.

Heavy metals and toxic effects

Name	Food commonly involved	Toxic effects
Arsenic	Fruits sprayed by lead arsenate, drinking water	Dizziness, chills, cramps, paralysis leading to death
Barium	Foods contaminated by rat poison (Barium carbonate)	Violent peristalsis, muscular twitching and convulsions
Cadmium	Fruit juices and soft drinks that come in contact with cadmium and plated vessels, crabs, oysters and kidneys.	Excessive salivation, liver, kidney damage, prostrate cancer, multiple fractures due to cadmium poisoning as reported in Japan
Cobalt	Water and beer	Cardiac failure
Copper	Acid foods in contact with tarnished copper ware	Vomiting, diarrhoea and abdominal pain
Lead	Some processed foods and lead water pipes	Paralysis and brain damage
Mercury	Mercury fungicide treated seed grains or mercury contaminated fish	Paralysis, brain damage and blindness
Tin	Canned foods	Colic, vomiting and photophobia
Zinc	Foods stored in galvanized iron ware	Dizziness and vomiting
Pesticides	All types of foods	Acute or chronic poisoning causing damage to liver, kidney, brain and nerves leading to death
Diethyl stilbestrol	Present in meat of stilbestrol fed animals and birds	Teratogenesis and carcinogenesis
Antibiotics	Meat from animals fed with antibiotics	Drug resistance, hardening of arteries and heart diseases

Incidental adulterants: Incidental adulterants are pesticide residues, tin from can, droppings of rodents, larvae in foods. Metallic contamination with arsenic, lead, mercury can also occur incidentally.

The Argaemone mexicana is frequently found growing in brassica fields
and if proper care is not taken during cultivation its seeds get mixed with
those of brassica and the oil expressed contains also argemone oil. Its presence in edible mustard oil is injurious and outbreaks of epidemic dropsy are probably due to it.

Wood smoke which contains chlorodioxins is toxic and contaminates the
food coming in contact with the smoke.

Pests such as rodents and insects introduce into the food a high degree of filth in the form of excreta, bodily secretions and spoilage microorganisms. Effective means of food quality can be achieved by legislative measures, certification schemes and public participation and involvement in the programme.

The most common incidental adulterants are pesticides. DDT and malathion residues may be present on the plant product much more than what is considered as safe. The maximum permissible residue allowed for DDT, Malathion is 3 ppm and for pyrethrum it is 10 ppm.

Chemicals like DDT are absorbed by the small intestine when ingested. These then adhere to the fatty tissues-the toxins usually pile up in the fatty tissues of such vital organs as the thyroid, heart, kidney, liver, mammary gland and testes and damage these organs. They can be transferred from the umbilical cord blood to the growing fetus and through breast milk. In children the disease apart from crippling them inhibits their growth.

The sequence of incidental adulterants in foods:

Contamination begins when farmers use pesticides to protect crops. The Health
department sprays pesticides to control malaria-causing mosquitoes

↓

Residues remain long after spraying. Cattle fodder and chicken feed are affected.
Ground water is poisoned. Meat, fish, milk and egg get toxic

More spraying is undertaken to prevent fungus and rodents from attacking stored
grain. This further increases the residue levels in foodstuffs

↓

Sellers dip vegetables in pesticides to make them look fresh as well as to preserve them. Oils and sweets are adulterated with prohibited substances

↓

Washing vegetables and other foodstuffs helps. But cooking rarely destroys toxic
residues. When ingested, pesticides are absorbed by the small intestine

↓

The fatty tissues distributed throughout the body store these pesticides. These can damage vital organs like the heart, brain, kidney and liver

The poison chain - sequence of incidental adulterants in foods

This incidental poisoning can be prevented by :

- Regular market surveys to warn people of dangerous build-up of toxins in food.
- Stepping up the integrated pest management programme to teach farmers to use pesticides judiciously. No spraying should be done a week, before harvest.
- Taking up on a war footing the control of pests using their natural predators.
- Using safer pesticides like synthetic pyrethroids or Malathion.
- By washing vegetables thoroughly before cooking

Packaging hazards: Polyethylene, polyvinyl chloride and allied compounds are used to produce flexible packaging material. While this method of packaging is very convenient, it must not contain any noxious thermal breakdown products which could be injurious to health. Further temperatures used for heat sealing, or sterilization should not result in formation of toxic residues. It has been observed sometimes that in foods like pickles the acid and oil could attack the plastic packaging material and create a health hazard. To avoid such incidences, it is essential that only food grade plastic packaging materials be used for packaging foods.

New adulterants: The newer adulterants include the legumes such as

imported toxic lentils marketed as local lentils, local legume like Subabul (Lencana *leucocephala)* seeds, veterinary drug residues in milk, flours made from moldy wheat, strychnos potatorum, a forest produce in arecanut, animal fat in bakery products and industrial contaminants like orthonitro aniline in vanaspathi. The Lathyrus sativus, Lens Culinaris (lentils) and Vicia sateva are three closely related species containing unusual amino acids.

Ginger is used widely in culinary practice in India in the fresh or dry states. Dry ginger is often coated with blue coloured dye ultramarine blue to prevent insect infestation. It is an inorganic pigment used as laundry whitener. In USA and Canada its use is restricted to addition in salt meant for animal consumption.

FOOD SAFETY

Introduction: The food safety is one of the most important of assurance system required for global expansion of trade between developed and developing countries. Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use is known as food safety concept. It is set of conditions and measures taken during the food chain like production, processing, storage and distribution in order to ensure that, the product consumption does not represent a risk to the human health.

Importance of Food Safety:

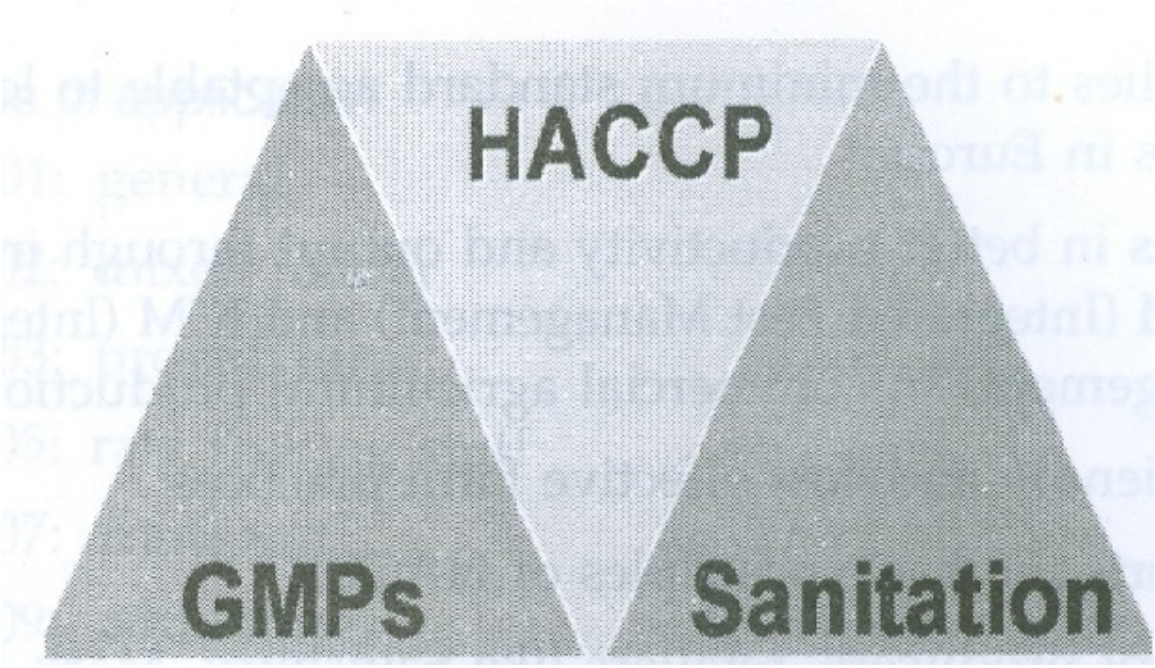
- Food is expected to nourish people
- Unsafe food leads to food-borne diseases predominantly induced by micro-organisms
- Every person is at risk of food-borne illness
- Some populations are highly vulnerable to unsafe food

Concern arising regarding food safety:

- Need to provide consumer guarantee on the safety attributes of the product to be consumed
- Gaining market access and market confidence regarding the safety of the products exported

Quality /Safety Assurance Systems: There are mainly five assurance systems that are mostly adopted to ensure food safety and quality like Good Agricultural Practices (GAP), Euro GAP, Good Manufacturing Practices (GMPs), Good Hygiene Practices (GHP) or Sanitation, Hazard Analysis Critical Control Points (HACCP) and Total Quality Management

(TQM). In practical terms GAP, GMP and GHP have been incorporated. into the code of practices and protocols for certification under a generic concept of Good Agricultural Practices. GAPs, GMPs, Sanitation (GHP) and HACCP collectively make a food product safer and improve quality and thus, are the basis for implementing Total Quality Management programme. HACCP is not a stand-alone program; GMPs and sanitation procedures are important foundations for a successful HACCP program.



GMPs and Sanitation are prerequisite programs for HACCP

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