Aim of the module
(a) to provide an overview of the quality attributes in foods

Objectives of the module
By the end of this module, participants should be able to:
(a) Give a simple definition of quality
(b) Explain the importance of quality for a food product
(c) Describe the physical quality characteristics of a food product
(d) Describe the chemical, nutritional and microbial quality characteristics of a food product
12.1 IMPORTANCE OF QUALITY

Many different types of foods are prepared in the different food enterprises and all food handlers should share the common aim.

Foods they prepare should:
look good
smell good
taste good
be safe to eat
satisfy the buyer

Consumers and buyers are becoming more aware of the importance of safe, high quality products. Small and medium sized food processing businesses all over the world increasingly have to consider the production of good quality products as essential to their survival. Quality attributes are used as a marketing tool.

Producers who sell intermediate products, such as dried fruits, to a secondary processor will find that the buyer expects the foods to meet an agreed standard.

12.2 WHAT IS QUALITY?

Quality has been defined in various ways by different authorities but the term generally appears to be associated with, «fitness for use» or «the satisfaction level of consumers».

Whether quality is defined as a composite of desirable characteristics or as fitness for use, it is measured in terms of consumer satisfaction with the product. Quality is a concept that connotes different things to different people and is always attached to expectations.
based on past experience. From the consumer’s point of view, for as long as the product gives the same level of satisfaction from one purchase period to another, the product is of good quality.

Quality may be equated with availability as well. Some consumers may gauge quality from the viewpoint of brand popularity. From the producer’s point of view quality can imply product reliability. Food manufacturers know that they can get a higher price for or can sell a larger quantity of high quality products.

In simple terms, one can say that quality is as important to the producer as it is to the consumer. Therefore, maintenance of a commodity’s quality level is a very important criterion for an efficient quality control operation.

12.3 QUALITY CHARACTERISTICS OF FOOD

Every food product has characteristics measurable by sensory evaluation methods; physical, chemical, microbiological and nutritional test methods. Some characteristics are physical and are easily perceived, others are unseen. Understanding these quality characteristics and their appropriate measuring tools are vital to the quality control of food products.
The quality characteristics of food can be classified into 2 groups: physical characteristics and hidden attributes. (Figure 2)

<table>
<thead>
<tr>
<th>Physical characteristics</th>
<th>Hidden characteristics</th>
</tr>
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<tbody>
<tr>
<td>Flavour</td>
<td>Chemical Composition</td>
</tr>
<tr>
<td>Odour</td>
<td>Nutritional Value</td>
</tr>
<tr>
<td>Colour</td>
<td>Microbial Safety</td>
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<tr>
<td>Texture</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1: Major Classification of food characteristics**

**12.3.1 PHYSICAL CHARACTERISTICS**

When we selecting and eating foods, we use all of our physical senses, including sight, touch, smell, taste and hearing. Food quality detectable by our senses can be divided into three main categories:

<table>
<thead>
<tr>
<th>Appearance factors</th>
<th>Textural factors</th>
<th>Flavour factors</th>
</tr>
</thead>
</table>


Appearance factors are summarized in figure 2.

**Figure 2: Appearance factors**

*Size and shape.* The size and shape of food products are appearance factors that greatly influence the initial impressions of the consumer. These sensory attributes should not be overlooked, they are very much useful in grading and sizing in food manufacturing process and they ensure uniformity and also facilitate the process of buying and selling. Size and shape can easily be measured. Fruits and vegetables can be graded for size by the openings they will pass through. Shape can include the degree of curvature and machines can be designed specifically.

*Colour and gloss:* Food colour not only helps to determine quality but it can be used as an index of spoilage or ripeness or maturity. End point in potato frying can be determined by colour change. Ideal harvest time can be determined by colour. Visual observations sometimes followed by comparison to standard colour chart can be used for colour.
Many types of colour changes can also be accurately measured in the laboratory (colorimeters, chromameters). Gloss is important to the attractiveness of gelatin desserts, buttered vegetables, and coated fruits. As with colour, there are light measuring instruments that can quantitatively define shine and gloss of a food surface.

Figure 3: A chromameter

**Consistency**
Consistency is an appearance factor even if it may also be considered as a textural quality attribute. A syrup may be viscous, thin or thick. Consistency is measured by viscosity, higher viscosity products being of higher consistency and lower viscosity being of lower consistency. The simplest method to measure consistency is to measure the time it takes for the food to run through a small hole of a known diameter. Viscometers (figure 4) ranging from quite simple to highly sophisticated electronic instruments can be used to measure viscosity.
Figure 4: A viscometer

Textural factors

Textural factors are summarized in figure 5

![Diagram of textural factors]

Figure 5: Textural factors

- **Firmness**
- **Handfeel**
- **Softness**
- **Texture**
- **Chewiness**
- **Mouthfeel**
- **Juiciness**
Texture refers to those qualities of foods that can be felt with the fingers, the tongue, the palate or the teeth. We expect potato crackers to be crisp. Melons can be squeezed as a measure of texture, which indicates ripeness and freshness. Technological advances (figure 6) have enabled food scientists to measure the textural properties of food without relying solely on the human senses. Simple equipments like firmness tester can give an indication of the firmness of a fruit. The texture analyzer is a device composed of moving parts which stimulate the motion of the teeth when chewing, thereby enabling it to provide information regarding the hardness, fracturability, cohesiveness, elasticity, chewiness and adhesiveness of a product.

Figure 6: A texture analyzer
Sensory perception of food is determined by the overall sensation of flavour (taste and aroma), colour, appearance and texture.

**Figure 7: Flavour factors**

Flavour is defined as the sensation felt when a material is placed inside the mouth and is essentially perceived by the senses of taste and smell (see Figure 7). Sensations perceived by the tongue include sweet, sour, salty and bitter. Certain regions of the tongue are most susceptible to each of the following tastes. The apparatus responsible for taste sensitivity is the TASTE BUD. The nose perceives aromas. Flavour can be measured in various ways depending on the objectives. Gas chromatography can be used to measure volatile compounds. Some flavour contributing compounds can be measured chemically or physically with other instruments. For example: salt (conductivity, saltometer), sugar (refractive index), acidity (titration).

Sensory evaluation is commonly used to determine flavours and aromas. Flavour is a combination of taste and smell and is subjective and therefore hard to measure. Since people differ in their sensitivity to detect different tastes and odours, and even if the latter can be detected, people differ in their preferences, sometimes resulting in differences of opinion.
The measurement of food quality by sensory evaluation is a difficult task since the test itself, being dependent on human judgment, is by nature subjective. Sensory tests can be classified into tests for difference and tests for acceptability.

Tests for difference are useful when the intention is to identify detectable differences between given set of samples with regard to reactions of like or dislike. One of the most useful methods for determining differences is the TRIANGLE TEST.

**TRIANGLE TEST**

It involves the presentation to a trained laboratory panel of three coded samples, two of which are identical. The panelist’s task is to indicate the odd sample on a score sheet. Samples are presented at random and are coded with randomly selected three-digit numbers. The completed score sheets of the laboratory panelists are collected and the number of panelists successfully (and unsuccessfully) identifying the odd sample are counted and recorded on a form depending on the number of correct judgment. Conclusion can be made on whether there is or not a significant difference between the samples presented for testing.

Tests for acceptability are useful when subjects are required to state the level of like or dislike for products presented for evaluation.

One of the tests for determining a product’s level of acceptability makes use of the **NINE POINT HEDONIC RATING SCALE**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Like extremely</td>
<td></td>
</tr>
<tr>
<td>Like very much</td>
<td></td>
</tr>
<tr>
<td>Neither like nor dislike</td>
<td></td>
</tr>
<tr>
<td>Dislike slightly</td>
<td></td>
</tr>
<tr>
<td>Dislike moderately</td>
<td></td>
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</tbody>
</table>
The judges are generally randomly selected potential consumers who have not undergone any training. They are asked to indicate on a scale of nine points the degree to which they like or dislike the samples presented. A score of “9” is given to the “Like extremely” and so on down to a score of “1” for “Dislike extremely”. Hedonic ratings are useful for monitoring the level and changes in the level of consumer satisfaction with a product. The results of methods may indicate a need for quality improvement.

Presentation of the sample and its preparation is important. All samples including the control, shall be identified only by code numbers. The panel director shall give to the testers only the minimum amount of information prior to the test. Each individual panel member shall report the type of order for an unknown order and when the order is familiar or established, rating is done.
12.3.2 HIDDEN CHARACTERISTICS OF FOOD

Hidden Characteristics

Three very important quality factors that may not always be apparent by sensory evaluation are nutritive value, chemical composition and microbiological quality.

Chemical composition and nutritive value

Chemical substances play an important role in food processing. According to legislation, generally chemical quality of food products includes contaminants (pollutants), residues of veterinary medicinal products, food contact materials, hormones in meat and food additives. The use of chemicals in food production and distribution have to be balanced with potential risks for the health of the food consumer due to side effects of these chemicals.

Foods are substances which when eaten and absorbed by the body, produce energy, promote growth and repair of tissues or regulate body processes. The chemical components of food, which perform these functions, are called nutrients. The six types of nutrients are proteins, carbohydrates, fats, water, minerals and vitamins.

On the other hand, non-essential compounds, called bioactive compounds, typically occur in small quantities in foods. Bioactive substances have actions in the body that may promote good health. They are being studied in the prevention of some diseases. Examples of bioactive compounds include flavonoids, caffeine, carotenoids, carnitine, choline, creatine, taurine, phytosterols, phytoestrogens, polyphenols, anthocyanins, etc.

Proximate Analysis gives an indication of the major nutrients in the foods (moisture, protein, fat, ash, crude fiber and carbohydrate). Changes in food can be monitored by determining the chemical composition of foods: rancidity of oils, formation of histamine, and saturation of oil during frying.
Unlike the physical characteristics, these hidden attributes of food can neither be seen nor felt and are measurable only by standard tests. There are a wide range of assays and techniques and instrumentation available for analysis of foods. Internationally recognized reference procedures have been published by bodies such as the Association of Official Analytical Chemists (AOAC).
Microbiological aspects of quality control include not only the detection contaminants in foods but also of others properties that may directly affect a process or a product. There are two main microbiological criteria of food products: 1) **food safety criteria** for important foodborne bacteria, their toxins and metabolites, such as *Salmonella*, *Clostridium botulinum*, *Listeria monocytogenes*, *Enterobacter sakazakii*, staphylococcal enterotoxins and histamine and 2) **process hygiene criteria** to indicate the correct sanitation during food processing.

The microbiological quality of the raw material has a significant impact on the quality on the finished product. Excessively high total counts of mould mycelia in fruits and vegetables for canning or freezing indicate an inferior quality that is carried over to the final product. The presence of large number of thermodurics (microorganisms that can endure heat and are thus able to survive pasteurisation) in raw milk may yield pasteurised milk that does not meet bacterial standards.

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**Microbial quality**

- Detection of adulteration. The compliance of foodstuffs within legal & prescribed manufacturing limits.
- The control of the quality of raw materials.
- The control of processed foodstuffs.
- The deterioration of foodstuffs on storage.
- The determination of the nutritive value of foodstuffs.
- The determination of additives and contamination

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**Importance of food analysis**

- Detection of adulteration. The compliance of foodstuffs within legal & prescribed manufacturing limits.
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As other raw materials such as sugar, salt, starch and spices may contribute to the total microbial load, they should be examined to ascertain that they meet specifications for the maximum allowable number of microorganisms.

Sanitary quality is usually measured by counts of bacteria, yeast, and mould, insect fragments. Micro analytical testing carried out with the aid of microscope detects the presence of extraneous materials.

**ACTIVITY**
Participants are requested to bring different food products (raw, minimally processed, processed products). A brainstorming session is carried out to determine the major quality attributes of these different products.

Participants involved in food processing will give an exposé of the products they produce, their processes, the attributes in these products and techniques they use to ensure quality of the products. All the participants can brainstorm on the ways to improve or maintain the quality of these products.

**REFERENCES**


**Questions and Answers**
1. What is quality?
Quality is a composite of desirable characteristics or as fitness for use, it is measured in terms of consumer satisfaction with the product. It is a concept that connotes different things to different people and is always attached to expectations based on past experience.

2. Explain the importance of quality for a food product!
Quality is as important to the producer as it is to the consumer. From the consumer’s point of view, for as long as the product gives the same level of satisfaction from one purchase period to another, the product is of good quality. From the producer’s point of view quality can imply product reliability. Food manufacturers know that they can get a higher price for or can sell a larger quantity of high quality products. Therefore, maintenance of a commodity’s quality level is a very important criterion for an efficient quality control operation.

3. Describe the physical quality characteristics of a food product!
   a. Appearance factors, including size and shape, colour and gloss, consistency.
   b. Textural factors, including handfeel (firmness, softness) and mouthfeel (chewiness, juiciness).
   c. Sensory factors, the overall sensation of flavour (taste and aroma), colour, appearance and texture.

4. Describe the chemical, nutritional and microbial quality characteristics of a food product!
   a. Chemical quality: contaminants, residues of veterinary medicinal products, food contact materials, hormones in meat and food additives.
   b. Nutritional quality: 1) major nutrients in the foods: moisture, protein, fat, ash, crude fiber and carbohydrate, 2) bioactive compounds include
flavonoids, caffeine, carotenoids, carnitine, choline, creatine, phytosterols, phytoestrogens, polyphenols, anthocyanins, etc.

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