UNIT 12 QUALITY CHARACTERISTICS AND PARAMETERS OF RAW MATERIALS

Structure

12.0 OBJECTIVES

After reading this unit you should be able to:

- know the meaning of quality of raw materials
- define and determine important physical properties of cereals, pulses and oilseeds for the purposes of value addition
- know the composition of some important food grains
- understand microbiological and toxical aspects of raw materials
- find possible adulteration, prevention and detection
- describe quality determination techniques
- know about a few standards and certification agencies

12.1 INTRODUCTION

Quality conscious consumers, now-a-days, want to get assured about various quality attributes of their food items. They test them at their own level before they purchase. Cereals, Pulses and Oilseeds are the most commonly used ingredients for developing any value added products. Quality of processed food depends on quality of raw materials. If raw materials are good, naturally quality of processed product will be good. Meaning of quality, quality parameters of raw materials, especially for the purpose of value addition in cereals, pulses and oilseeds, and its measuring techniques are discussed in this unit. Some standards and specifications for good quality grains are also discussed in brief.

12.2 WHAT IS QUALITY

The term quality stands for “rated ability of a product to perform its functions.” Quality implies the degree of excellence of product or its suitability for a particular use. In other words quality can be viewed as conforming of a product to a standard.

The meaning of quality thus is different to different handlers within the food distribution chain.

Quality of raw as well as processed food embraces both sensory and hidden attributes such as safety and nutrition. Sensory attributes are easily perceived by the human senses. Nutritional and safety parameters require sophisticated instrumentation to measure. Quality is thus not a single well-defined attribute, but comprises many properties and characteristics such as sensory properties (appearance, texture, taste, flavour and aroma); nutritive values, chemical constituents, mechanical properties, functional properties, defects etc.

In the ISO 9000 standard (developed by the International Standard Organization), quality is defined as "the totality of the features and characteristics of product or service that bear on its ability to satisfy stated or implied needs." It may be equated to meeting the standards required by a selective customer. Customer is the person or organization receiving the product at each point in the production chain. This is important because quality is perceived differently depending on the needs of the particular customer. If some thing is not a quality product, this implies that the product does not meet a certain standard that has been adopted by the customer. In this case, the market price is adversely affected. Conversely, if a product is perceived to be a quality product, then it can be sold at a better price.

Quality Orientation

Quality of raw materials changes as it proceeds from farmers (after harvest) to processors and different handlers. The relative importance of different quality attributes changes from handling to purchase to consumption. Quality is often defined from either product orientation or a consumer orientation. Both orientations have strengths and limitations in the delivery of fresh items from harvest to the consumer. An understanding of the different perspectives of different participants in postharvest distribution is essential in an attempt to select raw materials for any value addition through processing.

Product-oriented Quality

A product orientation views quality as a bundle of attributes that is inherent in a product. It can be easily quantified throughout the handling and distribution chain. Most of the people engaged in this business, use product orientated quality, which is as a series of attributes selected on the basis of accuracy and precision of measurement. These attributes are used to evaluate the quality of raw materials for its processing and getting better and more quantity of value added products. Product-oriented quality is easily defined and clearly understood. Quality changes can be plotted as a function of time and directly related to changes which have occurred, such as increase in free fatty acid in oil and hardness of wheat upon drying either in field or storage. Product-oriented quality is usually measured with some instruments, analyzed and reproduced.

Product-oriented quality has its limitations however. Measurements that are less readily quantified carry less weight than those that are readily quantified. In addition, the product-oriented approach is unable to keep pace with changes in consumer desires and expectations. Such biases then tend to favour handling and storage treatments that maintain appearance (a readily quantifiable attribute) over texture (less quantifiable) over flavour (very difficult to quantify). Likewise, sugar and acid measurement (readily quantified) are likely to predominate over volatile compound analysis. Instrumental methods are preferred to sensory evaluation, which is preferred over consumer testing.

A product orientation to quality is best at assessing the effectiveness of change in a handling system, harvest techniques or postharvest treatments. It can be adjusted to be more responsive to the marketplace if the quality attributes important to consumers are known and accurate and precise measurements can be obtained. Measurable quality parameters for processing & value addition to the raw materials are physical properties, chemical constituents, microbial loads, toxins etc.

a) Physical properties

The knowledge of important physical properties such as size, shape, volume, sphericity, bulk and true densities of different grains is necessary for selection for their use in processing. These properties are natural and vary from grain to grain and variety to variety of the same grain. A few important physical properties have been discussed hereunder.

Size and shape: Grain size of cereals is measured in terms of length (along the major axis of the grain), breadth (along the minor axis of the grain) and thickness (axis perpendicular to the major and minor axes). Size of whole pulse grain (usually called *gota*) and oilseeds is determined in terms of its diameter and are expressed in millimeter. Shape of these grains is defined based on measurement of three axes and are called cylindrical, spherical, etc. Size and shape are usually used for grading of grain. Uniform grain size and shape are desired quality parameters.

Test weight: It is the weight of counted number of grain. Usually 100 or 1000 grains, are taken and weighed on a precision digital balance. It gives an idea of soundness and boldness of grain.

Volume: It is measured for both a single grain as well as a bulk grains. Volume measured for a single grain is known as true or particle volume and that for a bulk of grains is called bulk volume. Its measuring units are cubic millimeter, cubic centimeter or cubic meter. True volume is measured either by a pycnometer or by liquid displacement method, provided the grain does not absorb selected liquid. Pycnometer is an instrument, which gives volume of air displaced by the grain put in an airtight cup. For measuring volume of bulk of grains, put sufficient amount of grain in a measuring cylinder made up of glass, tap it gently for uniform packing and then read the mark at the brim of the grain.

Bulk and true density: Density of a grain gives an idea of heaviness of a grain as compared to other one. It is computed by dividing the weight of the bulk or a single grain by a corresponding volume of the bulk or a single grain as the case may be. These values are used in designing of equipment for packaging, transportation and processing.

Sphericity: It is defined as the ratio of surface area of sphere having same volume as that of the particle to the surface area of the particle. Mathematically it can be written as:

$$Sphericity = \frac{d_i}{d_e}$$

where d_i = diameter of largest inscribed circle and d_e = diameter of the smallest circumscribed circle of the particle. The sphericity of different grain varies widely.

b) Chemical composition of raw materials

The grain is composed of both organic and inorganic substances, such as carbohydrates, proteins, fats, vitamins, minerals, water, ash, salts and enzymes. Paddy, corn and wheat seeds are especially rich in carbohydrates whereas legumes are rich in proteins and oilseeds in oils. Structure of a few grains are presented in Fig. 1(a) Fig. 1(b), Fig. 1(c), Fig. 1(d) and Fig. 1(e).

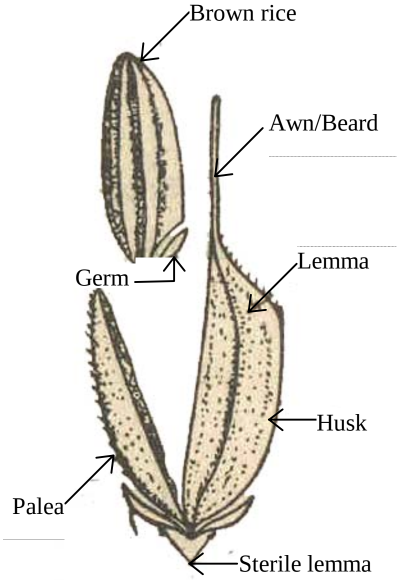

Fig. 1(a): Different Parts of Paddy

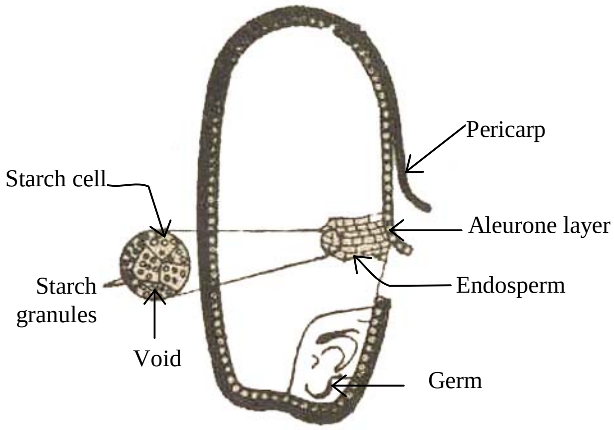

Fig. 1(b): Structure of Brown Rice Kernel (Longitudinal Section)

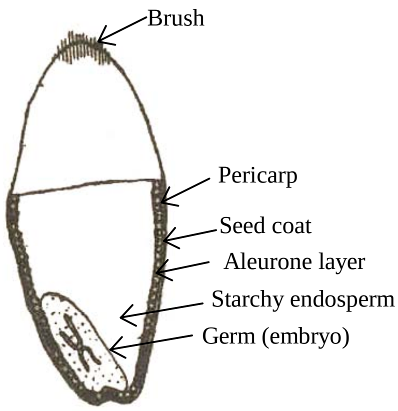

Fig. 1(c): Structure of wheat

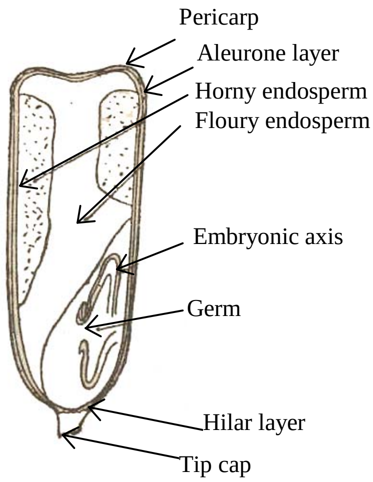

Fig. 1(d): Structure of shelled corn (Longitudinal section)

Generally, pericarp contains cellulose, pentosan and ash; the aleurone layer contains mainly albumin and fat. The endosperm contains the highest amount of carbohydrates in the form of starch, small amount of reserve protein and a very little amount of ash and cellulose whereas, the germ contains the highest amount of fat, protein and a small amount of carbohydrate in the form of sugars and a large amount of enzyme. The chemical composition of different grains are given in Table 1 and 2.

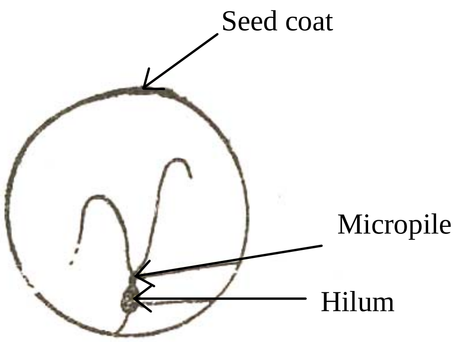

Fig. 1(e): Whole *arhar* pulses (*Cajanus-cajan*)

Table 1: Average chemical composition of cereals and pulses

Constituents	Raw brown rice	Whole wheat	Whole maize	Sorghum	Millets	Pulses (Lentils)	Broad beans' kernel
Moisture, %	12.0	12.5	13.8	11.0	11.8	12.2	10.6
Calories per 100 gram	360	330	348	332	327	351	354
Protein, %	7.5	12.3	8.9	11.0	9.9	23.7	25.0
Fat, %	1.9	1.8	3.9	3.3	2.9	1.3	1.8
N-free extract, %	77.4	71.7	72.2	73	72.9	57.4	53.7
Fibre, %	0.9	2.3	2.0	1.7	3.2	3.2	5.9
Ash, %	1.2	1.7	1.2	1.7	2.5	2.2	3.0
Thiamine, mg/100 g	0.34	0.52	0.37	0.38	0.73	-	-
Riboflavin, mg/g	0.05	0.12	0.12	0.15	0.38	-	-
Niacin, mg/g	4.7	4.3	2.2	3.9	2.3	-	-

Table 2: Average range of oil contents in important oilseeds

Oilseeds	Oil content, %
Cotton seed	18 – 20
Shelled groundnuts	45 – 50
Rapeseeds/mustard	40 – 45
Soybean	18 - 20
Oil palm kernel	45 – 50
Safflower	30 – 35
Sesame	50
Flaxseed	35 – 42
Sunflower	35 - 45

c) Appearance and texture of raw materials

Acceptance of a material on first sight either for value addition or for direct consumptions depends on its appearance. Appearance of a grain is governed by its colour, texture and distribution of grain size. These are physical parameters and nowadays measured using various instruments as described below:

Colour: Analysis of colour is frequently an important consideration for determining the efficacy of variety of postharvest treatments of raw materials. Consumers can easily be influenced by preconceived ideas of how particular materials should appear. Marketers often attempt to improve upon what nature has painted. Colour is unique in several aspects. Every material is said to possess a specific property such as mass, no material is actually coloured as such. Colour is primarily an appearance property attributed to the spectral distribution of light. It is related to source of the illumination type, characteristics of the materials illuminated and to the eye of the observer. Without light or the illuminant, colour does not exist. Several factors therefore influence the exact colour that an individual perceives:

- Spectral energy distribution of light
- Conditions under which the colour is viewed
- Spectral characteristics of the object with respect to absorption, reflection, and transmission, and
- Sensitivity of the eye

Thus, in reality, colour is in the eye of the observer, rather than in the "col-oured" object. The property of an object that gives it a characteristic color is its light-absorptive capacity.

Fig. 2: Measurement of colour of wheat using a colorimeter

There are three characteristics of light by which a colour is specified: hue, saturation, and brightness. Hue is an attribute associated with the dominant wave-length in a mixture of light waves, i.e., it represents the dominant colour as per-ceived by an observer. Saturation refers to relative purity or the amount of white light mixed with a hue. Brightness is a subjective term, which embodies the chromatic notion of intensity. Hue and saturation taken together is called chro-maticity. Therefore, a colour may be characterized by brightness and chromaticity. Colour is also measured using a colorimeter (Fig 2) in terms of Hunter *L*, *a* and *b* values. In the Hunter scale, *L* measures lightness and varies from 100 for perfect white to zero for black, approximately as the eye evaluates it. *a* is the chromaticity dimension, which measures redness when positive, grey when zero, and greenness when negative, and *b* measures yellowness when positive, gray when zero, and blueness when negative. Other systems of colour measurements also exist, but the most commonly used are the above two. One can use either one of them and values can be converted to each other using the following formula:

$$L^* = L$$

$$h^0 = \tan^{-1}\left(\frac{b}{a}\right)$$

$$C = \sqrt{\left(a^2 + b^2\right)}$$

where, h^o and C are hue and chroma values of the object respectively while L^* is brightness of the object when colour values are used in hue and saturation systems of colour measurement.

Gloss: It is another physiological surface attribute of any materials. Gloss is defined as a perceptual attribute of surfaces related to the degree to which it stimulates a perfect mirror in its capacity to reflect incident light. Glossiness of materials depends upon the amount of specular reflection of light from their surfaces. Various instruments are available to measure the gloss index of any material. Glossiness is more important in case of fruits than the cereals, pulses and oilseeds.

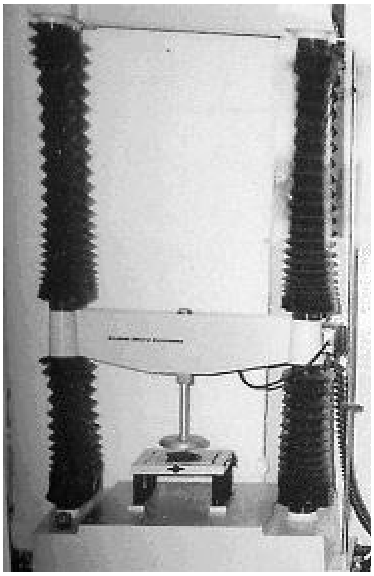

Fig. 3: A modern texture analyzer

Texture: Texture is defined as the sensory feelings of the structure of a food and the manner in which that structure reacts to applied force. Texture is thus a multidimensional sensory quality. In case of cereals, pulses and oilseeds, hardness is the most important textural parameter for processing point of view. Hardness is the noun form of word hard, which is actually resistance to deformation upon applying a force. It is measured as the maximum force required to push a probe into or through a product. Hardness is measured using modern texture analyzer (Fig 3).

Flavour and aroma: Flavour is a mixed feeling of taste and odour. If you eat something, you will feel taste like sweet, salty, sour, bitter or tasteless along with some fragrance through mouth. That fragrance is called flavour. Aroma is fragrance of any material felt through smell, i.e. directly through nose. Both flavour and aroma can be quantified by a gas chromatography (GC) and high-performance liquid chromatography (HPLC).

Consumer-oriented quality

A consumer orientation defines quality in terms of consumer satisfaction. It is much less quantifiable and hardly sustainable. A consumer-orientation to quality requires an understanding of consumer behaviour. It is mainly focused at predicting product performance in the marketplace. Measurement of consumer attitudes can be simplified to determine either acceptability (superior, acceptable or unacceptable) or willingness to purchase.

(a) Factors affecting consumer-orientation on quality: Consumer frequently is monolith. It is very difficult to change consumers' preferences. It varies widely from one cultural or demographic group to another, even from one consumer to another within a cultural or demographic group. Mood of the consumer at particular time or event is also important for acceptance of a product. These attributes of consumer-oriented factors is difficult to measure accurately and precisely because they are not good at expressing their views concretely in explicit term. It is particularly difficult to quantify during handling and storage of cereals, pulses & oilseeds.

A consumer-orientation to quality is best for identifying consumer's need and expectations. It can be made more useful if the consuming population can be segmented into distinct groups for particular type of products, based on quality preference rather than demographic groupings. It is an exact tool in assessing the acceptability of particular grains for development of a product for a particular group of people.

(b) Sensory parameters and their evaluation: Since quality is a degree of acceptability of the product by the consumer, it can be best measured by sensory evaluation. Sensory parameters include taste, texture, flavour, colour, etc. as has been described in preceeding paragraphs. In case of cereals, pulses and oilseeds you should concentrate more on colour, extent of damages, hardness, oil contents (in oilseeds only), percentage of foreign materials (if it is more, it has to be rejected), uniformity in size and shape etc for making value added products.

Generally sensory evaluation is performed using nine point Hedonic scale. For conducting sensory evaluation, select a group of trained panel for conceiving the taste of a particular raw or processed product. Number of persons in a panel is determined using statistical tools. Scale of evaluation varies from 1 to 9. Nine points is given when product is "extremely liked" and one point is given when it is "extremely disliked".

12.3 PROCESSABLE CHARACTERISTICS OF RAW MATERIALS

There are numerous varieties of each raw material. Some are good for consumption in raw form, some in the form of partially or minimally processed products while others are totally converted to new product. Raw materials should be selected based on their suitability for processing to a certain end products. For example, if a variety of rice breaks excessively during polishing, it is not suitable for excessive polishing. So, certain amount of hardness in rice is a desirable processing characteristic. In case of wheat, if it is too hard for milling, it may be undesirable characteristics for bread making. In case of maize, usually germs are removed before making any value added product, so it should be as less in amount as possible in a variety selected for processing. I mean to say that you fix first in your mind what actually product you want to make and accordingly select the variety of raw material suitable for that product.

Check Your Progress 1

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit

1. Define quality of food materials. List its different orientations.

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2. Explain important physical, chemical and sensory attributes of cereals, pulses and oilseeds for value addition.

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3. Describe the two common ways of expressing colour of raw materials.

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12.4 MICROBIOLOGICAL ASPECTS OF RAW MATERIALS

Various molds (fungi) are known to cause spoilage of many cereal and oilseed crops in the field and /or during storage. Species of *Fusarium*, *Altrnaria*, and *Helminthosporium* commonly infect cereal grains before harvest. Several species of *Aspergillus* (*A. glaucus, A. ochraceous, A. versicolour, A. flavus*, and *A. niger*) and Penicillium (*P. citrinum, P. viridicatum,* and *P. expansum*) frequently infect various stored grains (e.g; wheat, maize, rice, soybean and nuts). Some of these storage molds (*e.g; A. flavus* and *A. parasiticus*) can also infect maize and groundnuts in field. These molds cause quality and safety problems in cereals and oilseeds.

Storage fungi on cereal grains and oilseeds affect their quality by causing heating and spoilage, caking, off-odours and mycotoxins. Mycotoxins are toxic secondary metabolites produced by certain toxigenic molds when they grow on agricultural products before or after harvest and/or during storage. It poses serious threat to food safety and reduces the cost of raw materials drastically, sometimes even leads to total rejection.

Microbial load

There is a high chance that the raw materials are infected with various microbes such as molds in the field itself and/or in threshing grounds and during storage. These infections are harmful for health and are usually the cause of rejection by the purchaser. It is thus necessary to know the level of infections in raw materials to be used for value addition. The microbial and/or fungal load means the amount (in quantitative terms, *e.g;* population in number of microbes) of microbes per unit weight or volume of the raw materials.

Methods for detecting mycotoxins and spoilage of raw materials

Methods of detecting mycotoxins range from simple visual observations made with black light to complex laboratory analysis using high-performance liquid chromatography (HPLC). The black light test utilizes a long-wave ultraviolet light in a dark area to detect bright greenish-yellow fluorescence, indicative of aflatoxin (most commonly found mycotoxins) in maize, rice, groundnut etc. Mycotoxins can be isolated through different chromatography tools such as thin-layer chromatography (TLC), HPLC, and mini-column chromatography. TLC has been the most widely used quantification method since the early 1960.

Now-a-days various ready-to-use kits for specific mycotoxins, based on Enzyme-Linked Immuno Sorbent Assay (ELISA) methods, are commercially available. These are affinity column, microtitre well, cup, card type, and are either semi-quantitative or instrumental-quantitative.

Prevention and Control of microbial load and mycotoxins

Careful harvesting and drying of crop produce can minimize post-harvest contamination in raw materials. During harvesting, it is important to control such factors as timeliness, mechanical damage, clean up and drying of the crop produce. Such control is essential for preventing mycotoxin contamination during post-harvest phase in the field and during storage. It is important to harvest the crop as soon as it is matures. Crops left on the field for longer periods of time may present higher levels of mycotoxin contamination. Adequate drying is essential to prevent fungal growth and subsequent mycotoxin contamination during storage.

Storage losses of cereals and oilseeds can be minimized by providing hygienic conditions in godowns/stores, by drying the crop produce properly (at safe moisture level), and by preventing molds during transition between field and store. Such preventive measures are obviously more profitable for the post-harvest storage control measures. Low relative humidity (less than 70 %) and low temperature (around 5 ^{o}C) provide ideal conditions for prolonged storage period for most cereals and oilseeds without any tangible loss in quality. Insects and molds become inactive under these conditions in the stored material.

12.5 ADULTERATION

Adulteration means addition of some unwanted materials knowingly or unknowingly in a material, which are under consideration. For example suppose if you purchase Arhar dal from market and you find out some *khesari dal* in that. It means *arhar dal* is adulterated with *khesari dal*. Similarly, in a lot of basmati rice, you can find out rice of some other varieties. So, mixing or addition of some unwanted materials in a lot of material is called “adulteration” and the unwanted material is known as “adulterant”. There may be uncounted number of adulterants in cereals, pulses and oilseeds. The main motive behind the adulteration is greed of extra gain by adding cheap materials in relatively costly items. Sometimes, these adulterants become dangerous to health. *e.g;* adulteration of mustard seeds with argemone seeds which causes disease like dropsy. Some health hazards due to common adulterants are described in Table 3.

(a) Sources of adulterants: It can be broadly divided into two: one is known sources and other unknown sources. Known sources: people bring adulterants from the known sources and add knowingly in relatively costly and similar looking materials for more gain. It is an illegal and inhuman activity. It should be banned and the culprit should be given appropriate punishment to stop or minimize this type of adulteration.

Adulteration from unknown sources is getting done unknowingly. It may be due to lack of proper care during harvesting, transport, storage and marketing. For example, presence of excessive straw in paddy during sale in *mandi* may be taken as adulteration due to improper cleaning. Another example is adulteration of any grain from grass seeds or same grain of some other varieties came in field and remained with that grain throughout the chain of its handling and processing. This type of adulteration can be reduced by applying suitable and precise post-harvest machinery for cleaning, screening, grading and similar other operations.

Table 3: Health hazards of common in food

Sl. No.	Material	Unwanted Material (Adulterants)	Health Hazard
1.	Edible oils	Argemone oil	Glaucoma, Blindness, Dropsy
2.	Mixed/ Turmeric spices / Dals / Sweets	Melanin yellow	Cardiac Arrest, Tumours, Testicular degeneration
3.	Pulses	Kesari dal	Lathyrism (paralysis)
4.	Sweets	Aluminium foil	Gastric disorder
5.	Food grains	Mold	Liver damage
6.	Turmeric	Lead chromate	Anaemia, Brain damage
7.	Red chilli powder	Rhodamine B	Kidney / Spleen / Liver damage, Cancer
8.	Tandoori items	Ponceau 4R	Anaemia

Adulteration of any food material can be prevented, if a protocol for post-harvest operation for a certain grain is prepared and followed strictly. The population engaged in the chain of its business, including the consumer, should be vigilant and a law-enforcing agent should be proactive to punish the real culprit.

(b) Adulterants-detection techniques: There are numerous methods of adulterants- detection techniques. It varies between simple physical methods of separation to use of sophisticated instruments. For example, if iron or any metal flakes/pieces are available as adulterant in any grain, it can be detected by using a strong magnet by attracting those pieces of metals. Adulterants like dust, earth or any other foreign materials can be observed by physical inspection and may be removed by simple gravity separation methods or winnowing techniques. For detection of adulterants of similar nature as that of the main material and any other chemical agent, biochemical methods are used. Instruments based on near infrared spectroscopy, nuclear magnetic resonance technique, x-ray etc. are also being used for these purposes in developed countries. A few sample tests for detecting adulterants are enumerated below:

Simple tests for detecting adulterants:

Melanin yellow test: Add dilute HCl into water solution of suspected food, if red colour appears it confirms the presence of an adulterant.

Rhodamine B test: Rub the outside of a red chili with cotton soaked in liquid paraffin. Cotton will turn red if there are any adulterants on chili or grain.

Coal tar dye test: Dissolve 2 grams of melted butter in ether, shake with 2 ml of diluted HCl in butter and allow it to settle. The lower layer will turn red.

Argemone test: Formation of reddish brown precipitate when an acid of oil is treated with 10 % extract ferric chloride solution.

12.6 QUALITY DETERMINATION TECHNIQUES

Quality evaluation methods depend on orientation of food quality as described in preceding sections. It could be broadly divided into two:

a) Analytical or objective methods

b) Subjective or sensory methods

Both methods have their own advantages and disadvantages. Analytical methods are based on product attributes, whereas, subjective or sensory methods are consumer oriented. For scientific works we need to measure attributes numerically and thus may not be variations in that perspectives. Sensory attributes changes with sensory panels, place, religion, society and so on. Practically sensory methods of quality determination is better for adoption in that region, whereas the objective evaluation may be helpful in development of specific instruments, processes for value added products with specific quality attributes.

The objective methods too are of two types:

i) Destructive methods and

ii) Non-destructive methods

Most of the destructive methods use small samples and utilize them during investigation. The used sample will not be reusable by the consumers. Generally it is chemical analysis and used at laboratory level. It is not necessary that whatever attributes you have measured in sample will be closely related with the bulk from where samples had been drawn. There must be substantial variations. In non-destructive methods, samples or bulk of materials remain untouched. It is non-destructive because samples are not destroyed. It remains intact for consumer use even after several tests. There are recent advances in these methods. Instruments have been developed using near infrared spectroscopy (NIR) visual spectral and colour analysis, magnetic resonance imaging (MRI) technique, X-ray and computer tomography (CT) scanning.

Visual and NIR spectroscopy, and colour analysis are optical methods. Light energy in a range of known wavelengths, is exposed on the sample. Reflected / absorbed or transmitted light is measured using spectrometer and computer. Within the visual range of wavelengths colour of the object is also measured in different scale using colorimeter. These measured parameters are analyzed and correlated with different compositional and visual attributes of the sample. X-ray, CT and MRI techniques are nowadays very common for medical diagnosis. These techniques are now also being used for quality evaluation of agricultural products, but are costly and requires expert knowledge for data analysis.

12.7 QUALITY STANDARDS AND CERTIFICATION

The Indian food processing sectors are now quality conscious for their raw materials to achieve the quality of International standards of processed and value-added products. To cope up with these situations, good hygienic practices, good agricultural pre-and post-harvest practices and good environmental conditions are necessary. These practices are often mandatory to have minimum standard of quality at International level. The major purpose of these is to ensure that products are not adulterated or do not contain dangerous contaminants, besides a minimum nutritional level. For introduction of quality systems in food industries, Government is also enacting various laws and legislation.

Standardization and certification agencies: There are various agencies to frame standards for different products and to certify and categorize them in different grades after meeting a certain minimum requirement for marketing. Important amongst them are:

i) Bureau of Indian Standard (BIS)
ii) Prevention of Food Adulteration Act. (PFA)
iii) AGMARK
iv) Codex Alimentarius
v) National advisory committee for microbiological criteria for foods (NACMCF)
vi) International Standard Organization (ISO)

BIS has developed more than one hundred standards related to quality of various raw materials including cereals, pulses, oilseeds, and storage structures. Out of them, more than eighty are presently in active form. PFA and NACMCF have established microbiological criteria (limits) for different foods primarily depending upon the nature and constituents of food items. Under PFA act BIS must certify a food item for marketing. AGMARK is given to processed foods, which fulfill certain criteria of quality set by Rural Development Department under the Ministry of Agriculture, Government of India. Codex and ISO are International standardization and certification agencies. Limits of various parameters set by these agencies have to be met for export of our food products.

In addition, standards fixed by industries themselves or by an organized industry association in order to establish a reliable and quality raw materials for manufacturing a particular value added products is also in practice. Normally, such standards become effective because the majority of processors agree to them. For example, how quality standards of paddy and grading systems of rice are achieved practically is discussed below:

Quality standard of paddy: For getting quality rice, high quality of paddy is necessary, which cannot be obtained at a single isolated point from production to consumption. The first important place is the farmers' field where certain precautions are to be taken to maintain quality standards at later stage. These are:

i) The method of harvesting
ii) The staking of harvested crop and length of stacking time
iii) Weather conditions during harvesting
iv) Moisture content of paddy at the time of harvesting

Then paddy is brought to the market where it is cleaned, weighed and bagged for procurement. The various specifications of paddy for procurement in a particular season are as in Table 4 below:

Table 4: Uniform specifications of all varieties of paddy for procurement

Sl. No.	Constituents	Maximum limits, %
1.	Foreign matters	
	Inorganic	1.0
	Organic	1.0
2.	Damaged, discoloured, sprouted and shriveled grains	3.0
3.	Immature grains	3.0
4.	Admixture of lower varieties	10.0
5.	Moisture	18.0

After procurement, this paddy goes for milling in modern rice mills and rice is procured for sale, which should have specifications given in Table 5 below:

Rice should be in sound merchantable condition. It should be sweet, dry, clean, wholesome of good food value, uniform in colour and size and free from molds, weevils, obnoxious smell and admixture of unwholesome poisonous substances. *Argemone mexicana* and *Lathyrus sativus* in any form, or colouring agents and impurities except to the extent in schedule below are unacceptable. It should also conform to PFA standard for marketing.

Table 5: Uniform specification for grade 'A' and common rice in marketing season 2000 – 2001.

Sl. No.	Refractions	Maximum limit, %
1.	Broken*	
	Raw-	25
	Parboiled	14
2.	Foreign matter	
	Raw/ Parboiled	0.5
3.	Damaged/slightly damaged	
	Raw	2
	Parboiled	3
4.	Discoloured grain	
	Raw	3
	Parboiled	4
5.	Chalky grains	
	Raw	5
6.	Red grains	
	Raw/Parboiled	3
7.	Dehusked grains	
	Raw/Parboiled	12
8.	Moisture content	
	Raw/Parboiled	14

* including 1 % small broken

Basmati rice is exported extensively but for export purposes this should conform to certain specifications as given in Table 6.

Table 6: Grade designation and definitions for Basmati rice for export

	Maximum permissible limit by weight, %				
General Characteristics	Foreign Matter	Broken and Fragments	Other Rice including Red Grains	Damaged, Discoloured and Chalky Rice	Moisture
Special	0.5	0.5	10.0	1.0	14.0
A	1.0	10.0	15.0	2.0	14.0
B	2.0	10.0	20.0	3.0	14.0

In addition to above it should also meet the following general characteristics

1. The grains should be long slender of white, brownish or greyish colour and translucent
2. The rice:
   a) should be dried matured kernels of *Oryza sativa* and have uniform size, shape and colour;
   b) should possess a marked degree of natural fragrance characteristics of Basmati rice both in the raw and cooked state;
   c) should not have been artificially coloured and should be free from any polishing agents;
   d) might contain up to 3 % of grains with appreciable amount of bran thereon;
   e) should be free from musty or obnoxious odour and should carry no sign of mold or containing webs and dead or live weevils;
   f) should have length 6 mm and above and length-breadth ratio 3 and above;
   g) should be in sound merchantable conditions.

Some of the terminologies used in previous sections for rice grading are defined hereunder in brief:

a)	Impurities/Dockages	all matter other than paddy or rice
b)	Organic matters contain	sticks, straw, weeds etc.
c)	Inorganic matters are	sand, dust, mud balls, stones, etc.
d)	Other food grains	grains other than the grain under consideration
e)	Admixture of lower varieties	rice grains considered to be of inferior varieties
f)	Brokens	length <3/4 and >1/8
g)	Damaged grains	growth of microorganisms or bacteria in grains
h)	Immature grains	grains that are not fully developed
i)	Chalky grains	½ or more with white belly
j)	Red grains	weed seeds
k)	Dehusked grains	if patches of brans are left, called dehusked grains
l)	Discoloured grains	loss in natural colour due to moisture/heat.

Milling parameters of rice:

When rice is milled, i.e. husk and bran layer is removed, the various items are calculated as:

$$\text{Husk content (\%)} = \frac{W_h}{W} \times 100$$

$$\text{Degree of polish (\%)} = \frac{W_{b1}}{W_b} \times 100$$

$$\text{Brokens (\%)} = \frac{W_{b2}}{W_m} \times 100$$

$$\text{Total yield}\,(\%) = \frac{W_m}{W} \times 100$$

$$\text{Head yield}\,(\%) = \frac{W_r}{W} \times 100$$

Where W, W_b, W_h, W_{b1}, W_m, W_{b2}, and W_r respectively are total weight of paddy, weight of rice bran, weight of husk after dehusking, weight of bran after polishing, weight of polished rice, weight of broken rice and total weight of head rice finally obtained, Where

W – Total Weight of Paddy

W_b – Weight of Rice Bran

W_h – Weight of Husk after Dehusking

W_{b1} – Weight of Bran after Polishing

W_m – Weight of Polished Rice

W_{b2} – Weight of Broken Rice

W_r – Total Weight of Head Rice Finally Obtained

Grading of rice based on length (L) and breadth (B) ratio

Grading or categorizations of rice based on their length (L) and breadth (B) has been done by various standardization agencies. BIS and American standards are given hereunder for your understanding:

As per Indian BIS standard rice is called as:

Category	**L, B Ratio (L:B)**
Slender	>3
Medium	2.5 to 3.0
Bold	< 2.5

As per American standard rice is graded as:

Category	**Length, mm**	**L, B Ratio (L:B)**
Extra long	7.5	-
Long	6.61 – 7.5	-
Slender	-	3.0
Medium	5.51 – 6.60	2.1 – 3.0
Bold	-	1.1 – 2.0
Round	-	1.1
Short	<5.5	-
Superfine long slender	> 6.0	>3
Fine		
Medium slender	4.5 – 6.0	2.5 – 3.0
Long bold	> 6.0	< 3.0
Course		
Short slender	< 6.0	> 3
Short bold	< 6.0	< 2.5

Check Your Progress 2

Note: a) Use spaces given below for your answers

b) Check your answers with those given at the end of the unit

1. What is microbial load and what are the factors responsible for microbial and mold growth in cereal, pulses and oilseeds?

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   ....

   ....

   ....

2. What do you understand by mycotoxins? How do you determine it?

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   ....

3. Enumerate few ways following which infections due to molds/microbes and development of mycotoxins can be minimized.

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4. Define adulteration and identify some possible adulterants in cereals, pulses and oilseeds.

   ....

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   ....

5. What are the quality determination techniques? Enumerate some of the important methods used as non-destructive methods of quality evaluation.

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   ....

6. What do you understand by quality standardization and certification? Identify some important agencies active in India for the purpose.

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7. What are the main parameters for grading of rice? List the BIS and American standard for procurement of Basmati rice.

   ....

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   ....

12.8 LET US SUM UP

Quality of raw materials for value addition is their abilities to produce more amounts and highly acceptable processed products. Quality is a relative term. Some products may be very good for some one, while the same products may not be acceptable by other. Quality is thus viewed from product and consumers' point of views. Product oriented quality parameters are easier to conceive and measure than that of orientation.

There are various factors responsible for mold (fungi) growth and microbial infections in cereal, pulses and oilseeds. It also produces many toxic substances, which causes rejection of raw materials for value addition. In addition these raw materials are also get adulterated either unknowingly or knowingly to get some extra gains, These infections and adulterations should be checked and determined either by destructive or nondestructive methods. Nondestructive methods are quick and do not destroy the sample.

12.9 KEY WORDS

Processeable characteristics : It is the attributes of a raw material to produce more amounts of processed value added products.

Mycotoxins : Mycotixins are toxic secondary metabolites produced by certain toxigenic molds when they grow on agricultural products before or after harvest and/or during storage.

Nondestructive methods : It is a method of quality evaluation in which samples remain intact for reuse.

Adulteration : It is a process of addition of some unwanted materials knowingly or unknowingly in main material.

12.10 SOME USEFUL REFERENCES

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6. Pingale, S.V. (1976). Handling and Storage of Foodgrains. Indian Council of Agricultural Research, New Delhi

12.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

Your answer should include the following points:

1. • Meaning of quality
   • Product-orientation and
   • Consumer-orientation
   • Different parameters and their description for both the orientation of quality
2. • Physical properties such as shape, size, test weight, bulk and true densities etc.
   • Appearance, colour, gloss and texture.
   • Chemical constituents of raw materials
   • Sensory attributes such as flavour, aroma, taste etc.
3. • Meaning of hue, saturation, and brightness
   • Measurement of colour in terms of Hunter *L, a, b* colour values
   • It should also explain relationships between the above two ways of expression of colour

Check Your Progress 2

Your answer should include the following points:

1. • The meaning of microbial loads
   • Factors such as poor harvesting and postharvest operations, stacking for longer period in threshing yards, improper storage practices, mould and fungi growth etc.
2. • Definition of mycotoxins
   • HPLC, TLC ELISA tests for mycotoxins
3. • Good pre and postharvest practices
   • Proper cleaning
   • Sorting out the damaged grains and
   • Proper drying of grain and crop residues
4. • Meaning of adulteration and adulterants
   • Types of possible adulterants such as low valued varieties of grain in higher valued grain, argemone seeds etc.
5. • Destructive and laboratory methods
   • Nondestructive methods
   • You should enumerate NIR spectroscopy, X-ray and CT scanning, NMRI etc
6. • Meaning of quality standardization
   • Certification for minimum level of quality
   • Quality standardization and certification agencies such as BIS, PFA etc.
7. • Length, breadth, length and breadth ratio
   • Flavour before and after cooking
   • Percentages of broken, foreign materials, moisture etc.
   • BIS and American standard for rice