1.1 INTRODUCTION

While selecting food products such as cereals, pulses, oilseeds etc., what are the factors that we look for? Yes, colour, gloss, textured defects, wholesomeness etc. are some of the factors on the basis of which we select the food products. In other terms, we often look for good quality grains as judged by the physical appearance. For example, the grain should not be damaged or shriveled. It should be free of any foreign matter or it should not contain the weevilled grain etc. In this first practical, we will introduce you to the basic concept and procedure for evaluation of food grains for their physical characteristics. How do we collect the sample to be analyzed? What are the sampling techniques? What are the physical characteristics we look for while evaluating the food grains? These are a few aspects covered in this practical.

Objectives

After studying this practical and undertaking the activity included in this practical, you will be able to:

- determine the various fractions involved in the physical examination of grains, and
- detect the nonconformance of grains in terms of physical examination to the standards.

1.2 QUALITY OF GRAINS

Food grains for human consumption are whole or broken kernels of cereals, millets and pulses. According to PFA, they shall be free from added colouring matter. The food grains shall not contain any insecticide residues. The food grains meant for grinding and processing shall be clean, free from all impurities including foreign matter (extraneous matter).

Food grains, as you may already know, are available in many processed forms but are extensively used whole or as flours. It is much easier to clean and wash them before cooking or grinding but if ground without cleaning they may be mixed with items of poorer quality, drought resistant varieties which are hard to digest, not nutritious and unhygienic. Thus, to reduce the sanitary risk (food safety) of regulated agricultural products of plant origin intended for human consumption and use, the physical examination is not only important but also necessary for ensuring the food quality.

Quality, you would recall reading in the theory course (MFN-008) in Unit 8, is usually defined as a ‘degree of excellence and includes such things as taste, appearance and nutritional content. It is the composite of characteristics – nature, kind, status, grade of goodness, excellence etc. – that have significance and which help in making the product acceptable’. The parameters of quality are the grades, standards of specifications laid down by the Government or expert bodies constituted
for this purpose. The most important National Standards for quality, you should know by now, are the PFA Standards. At the International level, we have the FAO Standards and the International Codex Alimentarius Commission, which is the principal organ of a worldwide standard programme under the Joint Auspices of the FAO/WHO.

In India, there are two voluntary based product certifications. Can you name them? You have already studied about them in the Food Microbiology and Safety Course in Unit 14. Yes, these two sets of standards are – AGMARK and Bureau of Indian Standards Act. These are the voluntary schemes of certification aimed at providing quality and safety of foods.

Evaluation of food grains for their physical characteristics is a scientific process, as you would realize while reading through the next section. You will come across various terms and procedures, which are involved in evaluation. We shall start our study on this topic by first defining these terms and procedures.

1.3 **SAMPLING OF GRAINS**

The quality of the food grains is assessed starting with the process called *sampling*. A sample of the product to be evaluated is taken and the physical examination undertaken. What do we mean by the terms sample, sampling etc.? Let’s get to know about these terminologies.

*Sample* means one or more units selected from a population of units, or a portion of material selected from a larger quantity of material. A representative sample is intended to be representative of the consignment, the bulk sample.

*Sampling* means the procedure used to draw and constitute a sample.

*Sample size* means the number of units, or quantity of material, constituting the sample.

With a basic understanding of the terms used in the sampling of grains, we shall move on to the sampling process. We shall begin with collection of the sample.

1.3.1 **Collection of Primary Samples**

Sampling of grains begins with the collection of the primary sample i.e. sample of the consignment. The process involved in this exercise should take into consideration the following:

1) Each primary sample should be taken from a randomly chosen position in the consignment, as far as practically possible.

2) The primary samples should consist of sufficient material to provide the laboratory sample(s) required.

3) The minimum number of primary samples to be taken from the consignment shall be as indicated herewith in Table 1.1 in cases where –

<table>
<thead>
<tr>
<th>Weight of the consignment (kg)</th>
<th>Minimum number of primary samples (units)* to be taken from the consignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 kg</td>
<td>3</td>
</tr>
<tr>
<td>50 - 500 kg</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 500 kg</td>
<td>10</td>
</tr>
</tbody>
</table>

(* unit can be either packages, sacks or cartons etc.)

Having collected the primary sample, the next step will involve preparation of the laboratory sample. Let us see how.
1.3.2 Preparation of the Laboratory Samples

Earlier in section 1.2 we learnt that a sample is a unit, which is selected from a large portion of material, which needs to be analyzed. From the primary sample while selecting a representative laboratory sample, we need to consider the following:

a) Laboratory samples should be taken randomly from the bulk sample.

b) Where the bulk sample is larger than is required for a laboratory sample, it should be divided to provide a representative portion. A sampling device, called quartering, or other appropriate size reduction process may be used.

What is the quartering process? Let’s find out.

For carrying out the sample reduction, quartering process may be used which would involve placing the sample on hard, clean, level surface. Divide the sample into four approximately equal portions. Combine the two diagonally opposite portions and weigh. Repeat the quartering process till the desired sample weight is achieved. Figure 1.1 illustrates the quartering process.

![Quartering Process Diagram](image)

Figure 1.1: Acceptance and rejection of diagonal portions in the quartering method

The minimum size required for laboratory samples is as given in Table 1.2.

<table>
<thead>
<tr>
<th>Product</th>
<th>Examples</th>
<th>Nature of Primary Samples to be Taken</th>
<th>Minimum Size of Each Laboratory Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid products</td>
<td>Bread, flour, dried fruit</td>
<td>Packages or other whole units, or units taken with a sampling device</td>
<td>0.5 kg</td>
</tr>
<tr>
<td>Pulses</td>
<td>Dried beans, dried peas</td>
<td></td>
<td>1 kg</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>Wheat</td>
<td></td>
<td>1 kg</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>Peanuts</td>
<td></td>
<td>0.5 kg</td>
</tr>
</tbody>
</table>

Note: A smaller laboratory sample may be taken from a product of exceptionally high value, provided that the reason(s) for doing so should be noted in the sampling record.
Let us understand this concept by taking an example of wheat flour sample. From a given primary sample, take 500 gm of flour. Spread the whole sample into a circle on the table and the circle (containing the flour) is divided into 4 equal parts. Discard the 2 alternate sections. Again spread the remaining 2 sections into a circle and discard 2 alternate samples. Do it 2-3 times, till the left over sample is of the desired size, which may be 25-50 g.

Once the sample size is determined, the sample is ready for physical evaluation. Let us get to know the process of evaluation next.

1.4 PHYSICAL EVALUATION OF FOOD GRAINS

Food grains are judged for quality by their physical, chemical and microbiological examination. The physical examination includes checking grains for foreign matter, organic matter, damaged grains, weeviled grains, fragments, shrivelled grains and admixture. The various fractions as adulterants can be defined as:

1) **Foreign matter** means any extraneous matter other than food grains comprising of:
   - inorganic matter, consisting of metallic pieces, sand, gravel, dirt, pebbles, stones, lumps of earth, clay and mud and in the case of rice, kernels or pieces of kernels, if any, having mud sticking on the surface of the rice, and
   - organic matter, consisting of husk, straws, weed seeds and other inedible grains and also paddy in the case of rice.

2) **Damaged grains** means kernels or pieces of kernels that are sprouted or internally damaged as a result of heat, microbe, moisture or weather, viz., ergot affected grain and kernel burnt grains.

3) **Discoloured grains** means those grains that are discoloured to such an extent that such discolouration materially affects the quality of the grains.

4) **Weevilled grains** means kernels that are partially or wholly bored by insects injurious to grains but does not include germ eaten grains and egg spotted grains.

5) **Admixture** or other edible grains means any edible grains (including oil seeds) other than the one, which is under consideration.

6) **Green grains** means, which are immature or green.

7) **Shrivelled grains** are dried and mature grains.

Grains are checked for their conformance to standards. What is a *standard*? Standard is something, which is set-up and established by the authority for measuring quantity, weight, extent value, quality. The tolerance limit of different fractions in various food grains as given in the Prevention of Food Adulteration Act is given in Table 1.3.

<table>
<thead>
<tr>
<th>Fractions</th>
<th>Wheat</th>
<th>Jowar/ Bajra</th>
<th>Rice</th>
<th>Channa whole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign matter% by wt. (max)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Admixture% by wt. (max)</td>
<td>6.0</td>
<td>3.0</td>
<td>_</td>
<td>4.0</td>
</tr>
<tr>
<td>Damaged% by wt (max)</td>
<td>6.0</td>
<td>6.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Weevilled% by count (max)</td>
<td>10.0</td>
<td>6.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

*Source: 1) Prevention of Food Adulteration Act, 1954
2) Agricultural produce (Grading and Marketing) Act

Table 1.3 is used as a reference standard for physical evaluation. We shall use this standard for physical evaluation of the food grain in the Activity presented next.

So then get started with the first activity of this manual.
PHYSICAL EXAMINATION OF VARIOUS FOOD GRAINS

Aim: To determine the quality of various food grains commonly used and grade them accordingly.

Objectives
After undertaking this activity, you will be able to:

• determine the various fractions involved with the physical examination of grains,
  and
• check the nonconformance of grains in terms of physical examination to the
  standards.

Materials Required
For conducting the activity we would require the following materials:

• Food Grains* (list any seven food grains which you shall evaluate):
  ……………………………………………………………………………………………
  ……………………………………………………………………………………………
  ……………………………………………………………………………………………

• Scoop, dipper or borer to remove a unit from bulk material and from packages
• Weighing machine
• Clean brush for collecting the fractions
• Tared butter paper or poly packs for keeping the fractions.

(* Food grains can be bajra, jowar, arhar dal, wheat grains, rice, channa whole etc.,
the minimum packing should be at least 250 g).

Methodology
Follow the following steps to carry out the activity:

1) Place the sample on a hard, clean, level surface.
2) Mix the sample thoroughly.
3) Divide the sample into four approximately equal portions.
4) Combine two diagonally opposite portions, including all fine material, and
   weigh.
5) If sample does not meet the minimum required weight, then set the sample aside
   and carry out the quartering process for the remaining mixture.
6) Each additional sample, using the quartering process, is to be added to the
   original sample until the minimum weight is obtained.

Note: For each food product, follow the procedure listed above.

Precautions
We would like you to consider the following precautions while conducting the practical:

1) During sampling of agricultural plant products for analytical purposes, every
   precaution should be taken to prevent contamination and deterioration of the
   samples or subjecting the samples to such changes that the residue content
   thereof is affected.
2) Weighing should be carried out accurately.
3) The collection of the fractions should be done with a clean brush and not with fingers.

4) The fractions should be properly categorized.

**Findings**

Put down your findings, for each of the food grain examined, in the tabular form under the different heads in the format given on page 19.

After picking, weigh the sample and the different fractions from the original sample to find % of each in the sample. Put down the findings in the last two columns.

**Inference**

Sum up your findings for each food grain examined here in the space provided.

**Food grains**

1) ........................................................................................................

2) ........................................................................................................

3) ........................................................................................................

4) ........................................................................................................

5) ........................................................................................................

6) ........................................................................................................

7) ........................................................................................................

**Conclusion:** (In this section, present a summary of your findings. Comment which sample had the best or bad quality, had maximum adulteration etc.)

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Submit the activity for evaluation.

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Counsellor Signature