Cereal Processing

Level III

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Module Title: Performing operational tests and evaluating products

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LG #42	LO #1: Prepare operational test equipment before use

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Method and code of practice for preparation of samples
- Setting up of equipment operational test
- Following and defining the measurement techniques
- Identifying hazards control with the sample preparation methods and reagents or equipment
- Performing pre-use and safety checks with manufacturer's instructions
- Common measuring equipment's for specific tests
- Identifying and reporting unsafe/faults of equipment
- Checking calibration status of equipment and reporting out of calibration items

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Method and code of practice for preparation of samples
- Set up of equipment operational test
- Follow and define the measurement techniques
- Identify hazards control with the sample preparation methods and reagents or equipment
- Perform pre-use and safety checks with manufacturer's instructions
- Common measuring equipment's for specific tests
- Identify and report unsafe/faults of equipment
- Check calibration status of equipment and reporting out of calibration items

Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks 5. Perform Operation Sheets 6. Do the “LAP test”

Information Sheet 1- Method and code of practice for preparation of samples

1.1 Introduction

The cereal taxonomic family comprises wheat, triticale, rye, barley, oats, rice, maize, sorghum and millets. As cereals are traded on a global scale the needs for appropriate and standardized quality testing methods are significant.

Sampling method is intended to help enterprises or manufacturers committed to produce cereal products, whether they are enterprises or manufacturing their products in dedicated to different products. It provides an overview of best practices for developing sampling plans and testing protocols to detect cereal from undesirable material.

1.2 Method of practice for preparation of samples

1.2.1 Sample collection

Sample selection may either be carried out manually by a human being or by specialized mechanical sampling devices. Manual sampling may involve simply picking a sample from a conveyor belt or a truck, or using special cups or containers to collect samples from a tank, sack, processing area and market.

1.2.1 Sample Preparation

Sample preparation is Procedure used, if required, to convert the laboratory sample into an analytical sample by removal of parts (soil, stones, bones etc.) not to be analyzed.

Quality control starts when the wheat is received at the mill and before any measurement, a visual inspection should be done to ensure that the wheat is safe and suitable for processing for human consumption. In addition, it should be free from abnormal flavors, odors, living insects and mites is an essential step in analyzing wheat or flour quality since this data is used for other tests.

Moreover to determining sample preparation for the following test:

Basic tests like:

- Moisture content
- Ash Content
- Protein Content and falling Number

Physical Tests

- Flour Color Analysis
- Single Kernel Characterization System (SKCS)

Wet Gluten Test

- Dough and Gluten Strength Tests

1.2.2 Sampling process

The overall aim of a sampling process is to obtain a representative sample for analysis. The complexity of the sampling process the group of activities undertaken to obtain an appropriate test portion from the lot under study for analysis is apparent when the process is broken down into its component steps.

The fundamental actions that are involved in the sampling process include: planning, sampling, commination and subsampling.

I. Planning

Planning is common to all food surveillance and monitoring activities. The sampling scheme chosen during the planning stage ultimately depends upon the goal of the analysis, as well as resources available.

The sampling schemes selected will identify the food items be they whole grain shipments, flour or retail products to be selected for analysis. Such schemes include random sampling, targeted sampling (focusing on food items that potentially contain volatile levels of analyze), and opportunistic sampling (selecting all available food items for a specific category, geographical location, etc.).

During the planning stage, the number of samples, the sampling time period and other factors that define the breadth of data required will also be incorporated into the sampling

scheme. After the sampling scheme is developed in the planning stage, the next step is to obtain a sample.

II. Sampling

Sampling is the result of some sort of a test of a portion of the material with its quality criterion to judge whether each article is non-defective or defective.

It also an acceptability criterion to judge whether a lot is acceptable or not, the portion of the material in a sample used to judge the whole material, improper sampling will lead to inappropriate grading even with correct testing. Without understanding the sampling method of the test sample, one cannot evaluate correctly about the quality of the material being inspected.

Correct sampling is an operation that requires most careful attention.

Emphasis cannot therefore be too strongly laid on the necessity of obtaining a properly representative sample of cereal. Samples shall be fully representative of the lots from which they are taken.

III. Commination

The generic term for particle reduction can be achieved through several processes.

- ✓ Crushing: applying pressure to particles to fragment them into smaller particles; especially for samples with large and hard lumps.
- ✓ Cutting: cutting mills reduce soft to medium-hard and fibrous materials using rotating and stationary cutting knives.
- ✓ Blending (homogenizing): materials that are generally semi-solid (i.e. with a certain water content) are mixed with rotating knives which break fragments in smaller particles and blend the entire sample to a macroscopically more uniform texture (at least in appearance) and consistency.
- ✓ Milling / grinding: reduces solid particles by a combination of cutting, shearing and pressure.

IV. Subsampling

Following the sampling of lots (or sub-lots), precautions should be taken in order to avoid any changes of the incremental samples that can affect preparation of aggregate or laboratory samples, test portions, Samples must be stored under conditions that will not promote the production, or degradation.

The variance associated with subsampling may be reduced either by increasing the size of the subsample or by reducing the particle sizes before subsampling. Grouping and segregation of particles tends to increase the subsampling variance. Grouping and segregation can be reduced by increment sampling, splitting, or mixing.

Splitting is a technique in which the sample is divided into a large number of equal-sized portions and several portions are then recombined to form the subsample. Splitting may be performed by a manual procedure, such as fractional shoveling, or by a mechanical device, such as a riffle splitter.

1.2.3 Sampling Procedure

Samples may be taken from cereal after harvest in the silo, during handling, storage, and at other points in the processing.
Marketing samples can best be obtained by the use of automatic continuous samplers in situations where such equipment can be used, such as manufacturing process streams of materials.

The wheat, flour and product tests described in this section are standardized testing procedures commonly used for quality control purposes.
Results from these tests have a direct relationship to finished product quality. These specifications are requirements for particular wheat and flour product characteristics.

To meet these specifications, wheat and flour quality testing is necessary. Specifications for moisture content, ash content, protein content, and falling number are determined with basic tests. Physical tests included are conducted to determine flour color and wheat kernel characteristics specified by wheat processors.

- **Moisture Content**

Determining moisture content is an essential first step in analyzing wheat or flour quality since this data is used for other tests. Flour millers adjust the moisture in wheat to a standard level before milling.

Moisture content of 14% is commonly used as a conversion factor for other tests in which the results are affected by moisture content. Moisture is also an indicator of grain storability. Wheat or flour with high moisture content (over 14.5%) attracts mold, bacteria, and insects, all of which cause deterioration during storage.

- **Ash Content**

The ash content in wheat and flour has significance for milling. Millers need to know the overall mineral content of the wheat to achieve desired or specified ash levels in flour. Since ash is primarily concentrated in the bran, ash content in flour is an indication of the yield that can be expected during milling.

Ash content also indicates milling performance by indirectly revealing the amount of bran contamination in flour. Ash in flour can affect color, imparting a darker color to finished products. Some specialty products requiring particularly white flour call for low ash content while other products, such as whole wheat flour, have high ash content.

- **Protein Content**

Protein content is a key specification for wheat and flour purchasers since it is related to many processing properties, such as water absorption and gluten strength. Protein content can also be related to finished product attributes, such as texture and appearance. Low protein content is desired for crisp or tender products, such as snacks or cakes.

High protein content is desired for products with chewy texture, such as pan bread and hearth bread. Bakers use protein content results to anticipate water absorption and dough development time for processes and products, because higher protein content usually requires more water and a longer mixing time to achieve optimum dough consistency.

Combustion Nitrogen Analysis (CNA) is often used to develop calibrations for other protein methods, such as Near Infrared Transmittance (NIRT) or Near Infrared Reflectance (NIRR). Flour color often affects the color of the finished product and is therefore one of many flour specifications required by end-users. Generally speaking, bright white color flour is more desirable for many products.

- **Flour Color Analysis**

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- **Dough & Gluten Strength Tests**

Dough refers to a wet mass developed after mixing of wheat flour, water and other ingredients. Physico-chemical properties of dough play important role in the bakery, biscuits, pasta and ready-to-eat cereals processing industry.

Dough is developed due to complex interactions among wheat constituents during mixing operation. The process of dough development begins with addition of water and commencement of mixing operation.

The wet gluten test provides information on the quantity and estimates the quality of gluten in wheat or flour samples. Gluten is responsible for the elasticity and extensibility characteristics of flour dough. Wet gluten reflects protein content and is a common flour specification required by end-users in the food industry.

- **Finished product tests**

Wheat, which is often thought of as the staff of life, is enjoyed by consumers throughout the world in a wide variety of forms;

- Breads are consumed as pan bread, hearth bread, or flat bread
- Steamed breads are made by steaming the dough pieces rather than baking
- Cookies are commonly eaten in a number of countries under a variety of names, including biscuits.

- Paste and Noodle products may be extruded or sheeted and are available in numerous shapes, textures, and colors.
- Sponge cake is a common confectionery item in many countries.

The finished product formulations and processes described in laboratory testing protocols used to evaluate flour quality.

1.2 Code of Practice for Preparation of Samples

Codes of practice define the production, processing, manufacturing, transport, and storage practices for individual foods or groups of foods that are considered essential to ensure the safety and suitability of food for consumption.

For food hygiene, the basic text is the Codex General Principles of Food Hygiene, which introduces the use of the Hazard Analysis and Critical Control Point food safety management. A series of codes of practice gives indications to producers on the prevention or reduction of specific contaminants in specific foods.

To conform to the following standard: only durum wheat should be used and must not contain more than 3% common wheat; M.C. of 12.5% (max.) when packed; ash content of standard pasta of 1.3% dry base (DB); ash content for whole wheat pasta of 2.5% (DB). Degree of acidity and color are no longer specified. In the Ethiopian standards (ES) several codes of practice are recognized.

Code of practice and Product standards assist manufacturers to produce commodities that meet minimum specifications for quality and safety.

Standardization is a process of ensuring uniformity in products and services by use of appropriate standards.

The laboratory used should be accredited under a standard such as the ISO/IEC 17025 standard. ISO/IEC 17025 is the general requirement for the competence of testing and calibration laboratories. A competent laboratory will use ISO/IEC 17025 to implement a quality system to improve and maintain its ability to produce consistently accurate and reliable results. The two main sections in ISO/IEC 17025 are management and technical requirements

Self-check- 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Choose the best from given alternative (each 2pts)

1. Which of the following includes method of practice for preparation of samples?
   A/ Sample collection B/ Sample Preparation C/ Sampling process D/ All
2. The fundamental actions that are involved in the sampling process include?
   A/ Planning B/Commination C/ Subsampling D/All
3. _____ is the result of some sort of a test of a portion of the material with its quality criterion to judge whether each article is non-defective or defective.
   A/ Sampling B/ Preparation C/ Grading D/ None
4. Which of the following achieved through commination processes
   A/ B/Commination B/ Subsampling C/ Sample Preparation D/ All

Test II. Write short answer

1. Define the following words(each 2pts)
   A/ Moisture contents
   B/ Ash Content
   C/ Protein Content

.

Note: Satisfactory rating - 14points Unsatisfactory - below 14 points

You can ask you teacher for the copy of the correct answers

Information Sheet 2 - Setting up of equipment operational test

2.1 Introduction

The sample preparation guidelines describe the procedure for handling a laboratory sample upon its arrival in the laboratory to obtain homogeneous and representative test portions avoiding cross contamination.

In general the whole laboratory sample is homogenized to obtain a test sample for the analysis. Sometimes mass reduction (sub-sampling) has to be done. The procedure followed has to be documented.

All the sample preparation steps should be done under conditions avoiding cross contaminations in the test portion. Storage of the samples prior to and during the sample preparation as well as after the process should be performed under adequate conditions (e.g. at room temperature, refrigerated, frozen) depending on the sample. Sample as prepared (from the lot) for sending to the laboratory and intended for inspection or testing.

2.2 Sampling tools

To avoid the increment delineation errors it is advised that spoons, spatulas and shovels should be square-edged. Some recommendations related to appropriate design of spatulas, scoops and shovels used in sampling.

2.3 Sampling Measuring Equipment

The selection of proper sampling equipment is important to ensure that samples are collected effectively and efficiently. Sampling equipment generally consists of a tool to collect the sample and a container to place the collected sample.

Common measuring equipment for test

- Basic Tests

✓ Moisture content analyzer

✓ Ash content analyzer

✓ Protein content analyzer

- ✓ Falling number analyzer

- Physical tests
- ✓ Flour color analyzer
- ✓ Single kernel characterization system (skcs)
- Wet gluten test
- ✓ Glutomatic
- Dough and gluten strength tests
- ✓ Farinograph
- ✓ Extensigraph
- ✓ Alveograph.
- ✓ Mixograph
- Flour starch viscosity tests
- ✓ Amylograph
- ✓ Rapid visco analyzer

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. choose the best answer from the given alternative (each 2pts)

1. Which of the following measuring equipment used for Physical Tests
   A/ Flour Color Analyzer B/ Single Kernel Characterization System (SKCS)
   C/A&B D/ None
2. Dough and Gluten Strength Tests by using _____
   A/Farinograph C/ Alveograph
   B/Extensigraph . D/All

Test II: Short Answer Questions

1. List the Common measuring equipment for basic Tests(6 points)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points
You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Following and defining the measurement techniques

3.1 Introduction

Measurement is a systematic, replicable process by which objects or events are quantified and/or classified with respect to a particular dimension. This is usually achieved by the assignment of numerical values.

3.2 Following the measurement techniques

Wheat flour is widely used on an industrial scale in baked goods, noodles pasta, food concentrates, and confectionaries. Ash content and moisture can serve as important indicators of the wheat flour's quality and use, but the routinely applied assessment methods are laborious.

The ash obtained from flours consists of mineral compounds of phosphorous, potassium, calcium, magnesium, iron, zinc, and copper.

Phosphorus (approximately 45%), potassium (approximately 38%), magnesium, and calcium (approximately 13% and 3%, respectively) are the main elements present in ash, while the other elements amount to only 1%.

The whole wheat grain contains 1.17–2.96% of the mineral constituents

3.2.1 Measurement of Ash

The test for determining the ash content involves:

- Incinerating a known weight of flour under controlled conditions
- Weighing the inorganic residue
- Calculating the percentage of ash based upon the original sample weight.
- The ash value is corrected to dry or other moisture basis for comparison.

Ash content in flour can be measured by using conventional laboratory methodologies, or rapid instrumental techniques.

The ash content of wheat varies from about 1.5 to about 2.0% on a 13.5% moisture basis, but this value varies according to class of wheat, agronomic conditions and the soil type it was grown on. In the cereal processing industry laboratory, there are official methods of analysis to determine the ash content of flours.

The methods include:

- AACC International Method 08–01.01 — Ash. Basic Method
- AACC International Method 08–21.01 — Prediction of Ash Content in Wheat. Flour—Near-Infrared Method

The AACCI Method 08–01 is based on the fact that when a sample is incinerated in an oven, the high temperature vaporizes the moisture and burns away all the organic materials (starch, proteins, sugars, and fat), leaving only the ash.

The residue is composed of the non-combustible, inorganic minerals that are concentrated in the bran layer.

The AACCI Method 08–01 consists of the following steps:

- Weighing a sample of flour or ground wheat (3–5 g) and placing it into an ash cup
- Heating the sample at 585°C (1,085°F) in an electric muffle furnace/oven until its weight is stable (stops decreasing). This process may take several hours.
- Cooling residue to room temperature
- Weighing residue
- Calculating ash content according to the following equation:5

$$\%\ Ash = \frac{Weight\ of\ residue\ (g)}{Initial\ weight\ of\ sample\ (g)} \times 100$$

Ash in flour is usually expressed on a common moisture basis of 14%

3.3 Defining the measurement techniques

Test food safety equipment ensures you are storing, manufacturing, and processing food safely from farm to fork. Applications are to be found in the food industry for almost all the standard techniques for measuring physical quantities on-line; this article looks particularly at the way these techniques have been adapted to suit particular conditions.

There are very large numbers of applications in the industry for the measurement of ash, temperature, moisture, flow, weight, and level (contents),
There then follows composite section on the slightly more specialized needs for measurement of pressure, force, pH, humidity, density, and color.

Some examples are given of dimension gauging, foreign body detection, and viscosity measurement. There are a number of instruments used in food laboratories that can be applied to assure food quality which applies to cereal products.

Most common measurement instruments and their use are described below:

- **Food analysis equipment** – various instruments that can be used to measure the fat, protein, food samples and detect the level of gluten in foods.
- **Pesticide detection instruments** – detects the presence of pesticides in food samples.
- **Electron Spin Resonance Spectrometers** – also known as electron paramagnetic resonance (EPR), these instruments can be used to test the purity of products without physically destroying or altering samples.
- **Cell and colony counters** – can be used to measure the colonies of microorganisms that have grown on an agar plate prepared from a sample.
- **Incubators** – are used to provide a controlled environment (i.e. temperature, humidity, CO2 level) for food safety testing.
- **Magnetic analyzers** – detect low levels of iron in food samples by measuring the imbalance in resonance between two air core coils which can be translated into a signal that reflects the level of iron present in the sample.

- **Moisture analyzers** – also known as moisture balances, these devices are used to establish the percentage of moisture in a food sample, either by weighing the sample before and after an evaporation process or by using an absorption spectrometer to analyze the gas emitted during evaporation to establish its content.
- **Polari meters** – devices that pass polarized light through a sample and measure the angle at which the emitted light emerges. Optically active substances will cause a change in the polarization angle of the emitted light, which can be used to establish concentrations of sugars such as glucose and sucrose.
- **Rheometers & Viscometers** – are instruments that can measure the viscosity of a fluid and the behavior of fluids when shear or stress forces are applied to it.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer from given alternative (each 2pts)

1. The test for determining the ash content involves by_____
   A/ Incinerating a known weight of flour under controlled conditions
   B/Weighing the inorganic residue
   C/ calculating the percentage of ash based upon the original sample weight
   D/ The ash value is corrected to dry or other moisture basis for comparison
   E/ All
2. _____ is a systematic, replicable process by which objects or events are quantified and/or classified with respect to a particular dimension.
   A/ Measurement B/ method C/ Sampling D/ None
3. Which of the following is an important aspect of cereal handling in which moisture plays an important role?
   A/ Drying A/ Storage B/Roasting D/ All

Test II. Write short answer (each 4pts)

1. List the AACCI Method 08–01 ash analysis consists steps:

Note: Satisfactory rating - 10 points Unsatisfactory - below 510points
You can ask you teacher for the copy of the correct answers.

Information Sheet 4 - Identifying hazards control with the sample preparation methods and reagents or equipment

4.1 Introduction

Hazard means the unacceptable contamination, growth or survival in food of microorganisms that may affect food safety or lead to spoilage, and/or the unacceptable production or persistence in foods of products of microbial metabolism.

4.2 Identifying hazards control with the sample preparation methods and reagents

In attempting to identify potential hazards, it is necessary to consider three areas:

- The raw materials used,
- The processing procedures,
- The manner in which the product is used.

Facilities required in the laboratory room are:

- A changing room where clothing and shoes that are not worn for work can be stored.
- Separate hand-washing facilities for staff, with soap, clean water, nail brushes and clean towels.
- Toilets, which should be separated from the processing room by two doors or located in a nearby building.
- First aid materials
- Fire extinguisher/sand bucket
- Protective aprons or coats washed regularly, hats/hairnets and if necessary, gloves and shoes.
- Cleaning chemicals, stored away from the processing room.

4.2.1 Potential Sample Losses during Preparation

Materials may be lost from a sample during laboratory preparation. Such preparation steps may include homogenization or sample heating. The addition of tracers or carriers prior to these steps helps to account for any analyses loss during sample preparation.

I. Losses as Dust or Particulates

When a sample is dry ashes, a fine residue (ash) is often formed. The small particles in the residue are suspended readily by any air flow over the sample. Air flows are generated by changes in temperature (e.g., opening the furnace while it is hot) or by passing a stream of gas over the sample during heating to assist in combustion.

These losses are minimized by ash samples at as low a temperature as possible, gradually increasing and decreasing the temperature during the ash process, using a slow gas-flow rate, and never opening the door of a hot furnace.

Samples may be moistened carefully with a small amount of water before adding other reagents. Reagents should be added slowly to prevent losses as spray due to reactions between the sample and the reagents.

II. Losses through Volatilization

Some radionuclides are volatile under specific conditions (e.g., heat, grinding, strong oxidizers), and care should be taken to identify samples requiring analysis for these radionuclides. The loss of volatile elements during heating is minimized by heating without exceeding the boiling point of the volatile compound.

Ash aids can reduce losses by converting the sample into less volatile compounds. These reduce losses but can contaminate samples. Volatilization losses can be prevented when reactions are carried out in a properly constructed sealed vessel.

4.2.2 Contamination from Sources in the Laboratory

Contamination leads to biased data that misrepresent the concentration or presence of radionuclides in a specific sample. Therefore, laboratory personnel should take

appropriate measures to prevent the contamination of samples. Such precautions are most important when multiple samples are processed together.

Possible sources of contamination include:

- Airborne
- Reagents
- Glassware/equipment;
- Facilities
- Cross-contamination between high and low activity sample

The laboratory should use techniques that eliminate air particulates or the introduction of any outside material (such as leaks from aerosols) into samples and that safeguard against using contaminated glassware or laboratory equipment.

Contamination of samples can be controlled by adhering to established procedures for equipment preparation and decontamination before and after each sample is prepared.

Simply keeping samples covered whenever practical is one technique to minimize cross-contamination. Laboratory personnel should be wary of using the same equipment (gloves, tweezers for filters, contamination control mats, etc.) for multiple samples.

I. Airborne Contamination

Airborne contamination is most likely to occur when grinding or pulverizing solid samples. Very small particles (~10 µm) may be produced, suspended in air, and transported in the air before settling onto a surface.

Therefore, the grinding or pulverizing of solid samples or the handling of samples that could produce airborne contamination should be carried out under a laboratory hood or ventilated enclosure designed to prevent dispersal or deposition in the laboratory of contaminated air particulates. These particles easily can contaminate other samples stored in the area. To prevent such cross-contamination, other samples should be covered or removed from the area while potential sources of airborne contamination are being processed.

II. Contamination of Reagents

Contamination from radiochemical impurities in reagents is especially troublesome in low level work Care must be taken in obtaining reagents with the lowest contamination possible.

III. Contamination of Glassware and Equipment

Other general considerations in sample preparation include the cleaning of glassware and equipment. Criteria established in the planning documents or laboratory SOPs should give guidance on proper care of glassware and equipment (i.e., scratched glassware increases the likelihood of sample contamination and losses due to larger surface area).

Glassware should be routinely inspected for scratches, cracks, etc., and discarded if damaged. Blanks and screening should be used to monitor for contamination of glassware. Glassware should be routinely inspected for scratches, cracks, etc., and discarded if damaged.

Equipment

In order to avoid cross-contamination, grinders, sieves, mixers and other equipment should be cleaned before using them for a new sample. Additional cleaning of equipment prior to use is only necessary if the equipment has not been used for some time.

IV. Contamination of Facilities

In order to avoid contamination of laboratory facilities and possible contamination of samples or personnel, good laboratory practices must be constantly followed, and the laboratory must be kept in clean condition.

4.2 Laboratory Contamination Control systems

The laboratory should establish a general program to prevent the contamination of samples. Included in the program should be ways to detect contamination from any source during the sample preparation steps if contamination of samples occurs.

The laboratory contamination control program should also provide the means to correct procedures to eliminate or reduce any source of contamination.

Some general aspects of a control program include:

- Appropriate engineering controls, such as ventilation, shielding, etc., should be in place.
- The laboratory should be kept clean and good laboratory practices should be followed.
- Personnel should be well-trained in the safe handling of radioactive materials.
- Counter tops and equipment should be cleaned and decontaminated following spills of liquids or dispersal of finely powdered solids. Plastic-backed absorbent bench top coverings or trays help to contain spills.
- There should be an active health physics program that includes frequent monitoring of facilities and personnel.
- Wastes should be stored properly and not allowed to accumulate in the laboratory working area.
- Personnel should be mindful of the use of proper personnel protection equipment and practices (e.g., habitual use of lab coats, frequent glove changes, routine hand washing).
- Operations should be segregated according to activity level. Separate equipment and facilities should be used for elevated and low-level samples whenever possible.
- SOPs describing decontamination and monitoring of lab ware, glassware, and equipment should be available.

4.4 Measurement and Control

Measurement and control equipment is used to ensure that the laboratory equipment operates correctly, and the sampling stages proceed as specified. These instruments can be used to analyze ingredients and machines, as well as allow manufacturers to perform and duplicate laboratory procedures.

Measurement devices are particularly crucial during food production, as minor changes in cooking temperature, ingredient ratios, and operation times can lead to drastic changes in the finished product.

Some of the measurement and control devices commonly used for cereal processing laboratory include:

- Precision controls
- Pressure gauges
- Scales and weighing systems
- Thermometer
- Timer

4.5 Cleaning and decontaminating reagents

All equipment (e.g. mills, grinders, blending devices, sampling tools, balances, laboratory benches, used in the sample preparation procedure must be carefully cleaned upon completing and, if deemed necessary, during sample preparation. Vacuum cleaning alone is not sufficient, a wet cleaning is necessary to eliminate contaminating particles.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Choose the best answer from the given alternative (each 2pts)

1. Which of the following areas attempting to identify potential hazards?

   A/Raw materials used B/ processing procedures

   C/ manner in which the product is used D/ All

2. Which of the following includes in potential sample losses during reparation?

   A/ Losses as Dust or Particulates B/ Losses through Volatilization C/ A&B D/ None

Test II Write short answer

1. List facilities that required in the laboratory room?(each 6pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information sheet 5- Performing pre-use and safety checks with manufacturer's instructions

5.1. Performing pre-use with manufacturer's instructions

5.1.1 Pre-operational Inspection

- Personal protection
- Ear protection
- Eye protection
- Respirators & dust/vapor masks
- Safety clothing & lab coats
- Safety shields

Verification of the sanitation program is by pre-operational inspection. Pre-operational inspection is a visual / organoleptic examination of the post-sanitation and pre-operation environments. Documented organoleptic pre-operation is required as part of the laboratory and there is no regulatory requirement to incorporate other investigative tools.

Organoleptic evaluation uses the physical senses of sight, smell and touch. The objective is the verification of sanitation by looking and smelling for indication that food residues have not been removed. It is important to have proper tools to assist in the inspection, including a flashlight, ladder for accessing high areas of the equipment or plant and reflective mirror (polished stainless, not glass) to access undersides of equipment.

Other tools and documentation provide extra insight into the thoroughness of the sanitation process. Measurement is an extremely effective, relatively inexpensive tool that many food manufacturers employ for rapid verification feedback about sanitation.
Validation of the sanitation program is by microbial and chemical residue testing, if necessary.

The preventative prerequisite programs may include: Allergen Control Program, Employee Hygiene, Facility Condition and Temperature, Food Defense / Security, Ingredient Traceability and Lot Coding, Maintenance Programs, Pest Prevention Program, and any other activity utilized by the facility.

5.2 Safety checks with manufacturer's instructions

Ethiopian Food and Drug Administration(EFDA) advises baking or cooking items containing flour, raw dough, or raw batter thoroughly before eating them (including flour used for thickening), and following package directions on mixes for proper cooking temperatures and times.

The EFDA advises consumers avoid:

- Eating or playing with flour, raw dough, or raw batter that is intended to be cooked.
- Using flour in items that are not intended to be cooked.
- Adding flour to foods that will not be cooked, such as milkshakes, ice-cream mixes.
- Tasting flour, raw dough, or raw batter. Eating even a small amount can make you sick.

Food manufacturers or enterprises must have traceability in their industry to ensure their food products are safe, with no contaminants or residues, and to provide accurate nutritional information.

General laboratory testing of a manufacturer's product may include the following techniques:

- **Analytical chemistry testing**: The study of the separation, identification, and quantification of the chemical components of natural and artificial materials such as pH, additives, colors, contaminants, preservatives, minerals and trace elements, among others.
- **Food microbiology testing**: The study of the microorganisms that inhabit or contaminate food to help manufacturers assess the safety of raw materials, components, ingredients and final products, thus guaranteeing the safety of food products.

- ✓ Testing for spoilage organisms and pathogens may be used to examine and prevent food poisoning outbreaks caused by food products and ingredients.
- ✓ This is important, as the whole supply chain may be contaminated in the process of food production.

- **Food nutrition analysis:** An analysis of value and the nutritional content in foods and food products. It provides information for nutrition labeling on food packaging that manufacturers or enterprises are required to include complying with the labeling regulations of destination countries.
  - ✓ Therefore, manufacturers and importers/exporters should be fully aware of the applicable laws and regulations of a country before offering their foods for distribution there.
- **Food allergen testing:** Food allergens are proteins that can appear in large quantities and often remain in food processing.
  - ✓ The requirement is to find the target allergen in the ingredients and finished products.
  - ✓ The allergens that must be tested for in food products include gluten in cereal products.
- **Sensory testing:** Sensory testing is identification of food product properties by using the human senses (sight, smell, taste, touch and hearing) for the purposes of evaluating consumer products.
  - ✓ In smell testing, olfactory receptors in the nose identify rancidity in a product.
  - ✓ In tasting, the sensory organs on the tongue can identify the intensity of sweetness in food products.

Test results should come from a competent laboratory with appropriate technical expertise in food analysis using techniques such as gas chromatography and high-pressure liquid chromatography for analysis of the purity, or determination of the content, of many substances in mixture samples.

5.3 Quality Standards

Measures are basis for making comparisons or judging the accuracy of unknown samples. Quality standard of "Ethiopian Standard(ES)" 665: 2017 wheat grains specification" which

was developed in order to harmonize wheat quality requirements in Ethiopia developed by national, regional and international standards institutions often to enforce legislation; specifications for commodities as well as methods of testing.

Ethiopian standard agency (ESA); East African Community (EAC); American Association of Cereal Chemists (AACC); Association of Analytical Chemists (AOAC) and; International Standards Organization (ISO). It is common for standards bodies to adopt standards issued by another body.

For example: ES 665: 2017 (Wheat grains specifications) has adopted ISO 605 test methods to determine foreign matter.

5.4. Wheat Quality Standards

Based on “Ethiopian Standard (ES)665: 2017 Wheat grain specifications”; a wheat standard passed by EAC and adopted by partner states for implementation in their respective countries. Wheat varieties are called "soft" or "weak" if gluten content is low, and are called hard" or "strong" if they have high gluten content.

Figure1. To show hard and soft wheat

- **Test weight**

Test weight, also called, “bulk density”, “bushel weight” or “standard of quality” in ES 665:2017;is the weight per unit volume of wheat (grain density); It can be expressed as kilograms per hectoliter or grams per liter; High test weight grain tends to yield more flour.

- **Grain Defects**

i. Broken Grains Pieces of wheat kernels that pass through a 1.6 mm wide, 9.5 mm long slotted sieve.

ii. Foreign Matter Organic and inorganic material other than wheat, broken kernels, other grains and filth; Organic matter is material of plant origin e.g. stalks, chaff, weed seeds, etc. and also, inorganic matter includes plastics, stones, glass, metals, etc

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the pre-operational inspection in laboratory?(each 5pts)
2. List general laboratory testing of a manufacturer's product following techniques(each 5pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 6 - Common measuring equipment's for specific tests

6.1 Introductions

The quality control laboratory is an important part of the cereal processing industry. The objectives of the quality control laboratory of cereal product are to monitor uniformity throughout the processing run; ensure uniformity between flour lots or shipments; ensure that the products meets the customer's specifications; and verify that the flour has desirable characteristics for a different product processing.

Commonly used standard methods used in the food industry that are most applicable to measuring equipment to quality control laboratory are published by the American Association of Cereal Chemists International (AACCI) and the International Association for Cereal Science and Technology (ICC).

6.2 Common measuring equipment for test

The tools used for analysis may be subdivided into four categories:

- Primary measuring equipment (pipettes, diluters, burettes, balances, thermometers, flow meters, etc.)
- . Analytical apparatus or instruments.
- Miscellaneous equipment and materials (ovens, furnaces, fridges, stills, glassware, etc.)
- Reagents.

Major measuring equipment related to cereal products includes

- Grain – Protein analyzer , Moisture analyzer, Ash analyzer, Whole meal Wet Gluten
- Flour – Amylograph, Rapid Visco Analyzer,e, Solvent Retention Capacity (SRC)
- Dough – Farinograph, Extensograph, Alveograph, Mixolab, Mixograph

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the major measuring equipment related to cereal products?(5pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points
You can ask you teacher for the copy of the correct answers.

Information Sheet 7 - Identifying and reporting unsafe/faults of equipment

7.1. Faulty equipment

When an employee goes to work, they are right to expect that the equipment they use and the environment in which they work is safe and well maintained. Unfortunately, accidents often occur in the workplace due to employees being given or told to use equipment which is either unsafe or not working correctly. It would be impossible for an employer to eliminate every risk in the workplace, as accidents can and do happen, but they do have a duty to take reasonable steps to keep employees safe and make sure risks are as reduced wherever possible, this is particularly the case when it comes to work place equipment.

The term 'equipment' in the context of the workplace is wide ranging and encompasses everything from power tools and heavy machinery to laboratory appliances.

Common risks caused by faulty equipment or machinery include:

- A missing or defective safety guard on a piece of machinery
- Poorly maintained electrical sockets/cabling
- Malfunctioning equipment
- Equipment/machinery provided not being fit for the job an employee is being asked to undertake
- Inadequate training being provided by an employer.

7.2 Safety measures required of employers include in laboratory are:

- Carrying out adequate training on the use of equipment
- Providing appropriate personal protective equipment ('PPE')
- Undertaking risk assessments on equipment to minimize the risk of injury

7.3 Ensure equipment is regularly inspected by:

- Repairing or replacing faulty or broken equipment give employee's adequate training on the use of equipment.

- Faulty equipment accidents could often be easily be avoided if all health and safety measures are utilized and followed by an employer.
- If an employer has failed to adhere to any of the above rules and an employee sustains an injury as a result, the employee may have a right to bring a claim against the negligent employer.

7.4 Reporting unsafe/faults of equipment

Working safely with hazardous chemicals requires proper use of laboratory equipment. Maintenance and regular inspection of laboratory equipment are essential parts of this activity. Many of the accidents that occur in the laboratory can be attributed to improper use or maintenance of laboratory equipment.

The most common equipment-related hazards in laboratories come from devices powered by electricity devices for work with compressed gases, and devices for high or low pressures and temperatures. Seemingly ordinary hazards such as floods from water cooled equipment, accidents with rotating equipment and machines or tools for cutting and drilling, noise extremes, slips, trips, falls, lifting, and laboratory accidents and injuries.

Maintenance is one of the workplace activities that can affect health and safety not only of the workers directly involved, but also of other workers if safe procedures are not followed and the work is not done properly. Maintenance activities include replacement of parts, testing, measurement, repair, adjustment, inspection and fault detection among other procedures. Industrial maintenance operations involve specific safety risks for maintenance workers.

Documents and records needed for maintaining the system include:

- Records of unique identification of measuring instruments;
- The manufacturer's booklet of instructions on handling, storage and operation;
- Procedures for handling and storage of specific instruments
- Safety instructions for operators of instruments
- Training notes for operators
- Calibration reports
- Records of breakdown, repair and maintenance of instruments.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test II Choose the best answer from given alternative (each 2pts)

1. Which of the following NOT include in common risks caused by faulty equipment**?**
   A**/** missing or defective safety guard on a piece of machinery
   B/ poorly maintained electrical sockets/cabling
   C/ Malfunctioning equipment
   D/ None
2. Which of the following NOT include in ensure equipment is regularly inspected?
   A/ Repairing or replacing faulty or broken equipment give employees adequate training on the use of equipment.
   B/ Faulty equipment accidents could often be easily be avoided if all health and safety measures are utilized and followed by an employer
   C/ If an employer has failed to adhere to any of the above rules and an employee sustains an injury
   D/ None
3. Which of the following maintenance activities NOT include replacement of parts among by procedures
   A/Testing B/ Measurement C/ Repair D/ inspection and fault detection E/ None

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points
You can ask you teacher for the copy of the correct answers.

Information Sheet 8 - Checking calibration status of equipment and reporting out of calibration items

8.1 Introduction

Calibration is the comparison of two measurement devices or systems (one of known uncertainty (your standard) and one of unknown uncertainty (your test equipment). Calibration is described by the VIM as the process of establishing the relationship between values shown by a measuring instrument or system, and the values provided by measurement standards.

Calibration can be applied to parts of a measurement system. In particular, instruments are normally calibrated in isolation, and then used in a larger measurement system. Items such as balances and thermometers are calibrated less frequently.

8.2 Equipment Calibration Guide for Food Processors Laboratory

Adequate equipment calibration plays an important role in food safety when food is handled and produced. Calibration ensures that equipment monitors a food process accurately and consistently, and controls physical, chemical or biological hazards in the food operation.

Equipment shall be operated by authorized personnel using up to date manuals containing:

- Instructions for use and maintenance
- Procedures for safe handling, transport, storage, use and planned maintenance to ensure proper functioning and to prevent contamination or deterioration

There need to be defined procedures and schedules for carrying out checks needed to maintain confidence in the calibration status of:

- Reference standards
- Primary standards
- Working standards
- Transfer standards
- Reference materials

8.3 Measuring & Monitoring Devices

All measuring and monitoring devices used in a food processing laboratory should be:

- Calibrated at scheduled intervals
- Identified with an approved identification record/mark after calibration
- Protected from adjustments that may invalidate the calibration used and calibrated under suitable environmental conditions
- Handled and stored cautiously to protect against deterioration
- Calibrated by trained employees, using manufacturer's specifications to ensure accuracy

8.4 Calibration Using Standards

Calibration is the set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument, a measuring system or values represented by a material measure, and the corresponding known values of a measure. Understanding of calibration is not complete without understanding traceability.

Traceability: The concept of establishing valid calibration of a measuring standard or instrument by step-by-step comparison with better standards up to an accepted national or international standard. SI defines base units for mass (kilogram, kg), length (meter, m), time (second, s), thermodynamic temperature (kelvin, K), electric current (ampere, A), luminous intensity (candela, cd) and amount of substance (mole). It also defines many derived units in terms of the base units, and a selection of important derived units for laboratory measurement is provided.

Calibration of equipment should be performed against:

- Standards
- Certified equipment
- New or recently certified unit that can be traced to a standard as a reference

Common equipment needing calibration includes:

- **Magnets and Metal Detector** These are critical devices that should be calibrated by an accredited agency or the manufacturer at a predetermined frequency.
- **Temperature Measuring Devices** These calibrated temperature devices should be used to monitor temperature of thermal operations. (Ex: cooking, irradiation, infrared heating) and cold storage rooms.
- **Scales** ensure ingredients are weighted consistently. Inaccurately measured ingredients can be a source of food safety issues (ex: variation in product content of a preservative such as nitrates can allow bacterial growth).
- **Water Activity Meters (aw)**
  The use of an inaccurate aw meter may lead to the growth of bacteria, yeasts and Mould in food products.

Support Equipment that requires calibration:

- Balances
- Ovens
- Refrigerators
- Freezers
- Incubators
- Water baths
- Temperature measuring devices
- Thermal/pressure sample preparation devices
- Volumetric dispensing devices

Temperature calibration of moisture analyzers

To ensure the comparability of results of moisture determinations, the compliance of the correct temperature in the heating chamber and thus the sample is decisive.
Over time deposits or soiling can reach the boiler room and falsify the measurement results. Regular calibration of temperature is therefore necessary.

The in the calibration certificate indicated temperature calibration set is installed by the manufacturer disclosures in the heating chamber, which is cooled to room temperature, and sealed this.

8.5 Calibration with certified reference materials

The VIM defines a “certified reference material” as a “reference material, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceability, using valid procedures”.

The key features which distinguish these materials from other calibration standards are therefore:

- Demonstrable traceability to national or international standards
- A statement of uncertainty.

In many cases it is possible to purchase certified reference materials or calibration solutions and it is convenient and usually cost effective to utilize these. Because the values are traceable to national or international standards and are consequently very reliable, their use is recommended where practicable.

Characteristics of data reliability

For measurement data to be reliable, measurement should be:

- Accurate
- Precise
- Reproducible

Accuracy: The closeness of the agreement between the result of a measurement and a true value of the measure.

Precision: The closeness of the agreement between the results of successive measurements of the same measure and carried out under the same conditions of measurement. Precision is also called repeatability.

Reproducibility: The closeness of the agreement between the results of measurements of the same measure and carried out under changed conditions of measurement

8.6 Periodicity of calibration

Periodicity of calibration generally would be finalized based on recorded investigation. This means that calibration results of an instrument must be monitored over time and, depending on the drift it exhibits, the time period between recalibration can be decided.

The initial decision to determine the calibration interval is based on the following factors:

- Recommendation of the instrument manufacturer
- How frequently and severely the instrument is expected to be used
- The influence of the environment
- Maximum allowable variation of the measure and;
- The uncertainty of measurement required

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Choose the best answer from given alternative (each 2pts)

1. _____ is the comparison of two measurement devices or systems (one of known uncertainty (your standard) and one of unknown uncertainty (your test equipment)

   A/ Calibration B/ Sampling C/ Method D/ Tools
2. Which of the following is NOT includes measuring and monitoring devices used in a food processing laboratory?

   A/ Calibrated at scheduled intervals

   B/ Identified with an approved identification record/mark after calibration

   C/ Calibrated by trained employees

   D/ None

Test II: write short answer

1. List the decision to determine calibration interval is based factors?(6pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

LG #43	LO2: Check products before transferred to the next operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Enterprise procedure and manufacturers instruction in each unit operation
- Carrying typical laboratory tests
- Recording data with enterprise procedures
- Identified and reporting out of specification to minimizing environmental impacts
- OHS environmental management requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Enterprise procedure and manufacturers instruction in each unit operation
- Carry typical laboratory tests
- Record data with enterprise procedures
- Identify and reporting out of specification to minimizing environmental impacts
- OHS environmental management requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1- Enterprise procedure and manufacturers instruction in each unit operation

1.1 Introduction

Cereal product specifications often require specialized testing to determine how flour will perform during processing. There are five basic operations performed when officially inspecting and weighing grain going aboard a ship: stowage examination, weighing, sampling, inspection, and certification.

1.2 principles of quality control

The aim of procedures is to achieve as good and as consistent a standard of quality in the product compatible with the market for which the product is designed.

The Principles of quality control are:-

- raw material control
- process control
- Finished product inspection

The food industry is highly competitive and food manufacturers are continually trying to increase their market- share and profits. To do this they must ensure that their products are of higher quality, less expensive, and more desirable than their competitors whilst ensuring that they are safe and nutritious.

To meet these rigours standards food manufacturers need analytical techniques to analyse food materials before, during and after the manufacturing process to ensure that the final product meets the desired standards by laboratory analysis. One of the most important concerns of the food manufacturer is to produce a final product that consistently has the same overall properties, i.e. appearance, texture, flavor and shelf life.

- **Raw material control**

Manufacturers measure the properties of incoming raw materials to ensure that they meet certain minimum standards of quality that have previously been defined by the manufacturer. If these standards are not met the manufacturer rejects the material. Even when a batch of raw materials has been accepted, variations in its properties might lead to changes in the properties of the final product.

- **Process control**

It is advantageous for food manufacturers to be able to measure the properties of foods during processing. Thus, if any problem develops, then it can be quickly detected, and the process adjusted to compensate for it. This helps to improve the overall quality of a food and to reduce the amount of material and time wasted. Samples are taken from the process and tested in a quality assurance laboratory.

- **Finished product inspection**

Once the product has been made it is important to analyze its properties to ensure that it meets the appropriate legal and labeling requirements, that it is safe, and that it is of high quality. It is also important to ensure that it retains its desirable properties up to the time when it is consumed.

1.3 Sampling and data analysis

Analysis of the properties of a food material depends on the successful completion of a number of different steps: planning (identifying the most appropriate analytical procedure), sample selection, sample preparation, performance of analytical procedure, statistical analysis of measurements, and data reporting.

Population The whole of the material whose properties we are trying to obtain an estimate of is usually referred to as the “population”.

Sample Only a fraction of the population is usually selected for analysis, which is referred to as the “sample”. The sample may be comprised of one or more sub-samples selected from different regions within the population.

Laboratory Sample The sample may be too large to conveniently analyze using a laboratory procedure and so only a fraction of it is actually used in the final laboratory analysis. This fraction is usually referred to as the “laboratory sample”.

- **Sampling plan**

To ensure that the estimated value obtained from the laboratory sample is a good representation of the true value of the population it is necessary to develop a “sampling plan”. A sampling plan should be a clearly written document that contains precise details that an analyst uses to decide the sample size, the locations from which the sample should be selected, the method used to collect the sample, and the method used to preserve them prior to analysis.

- **Sample selection method**

The primary objective of sample selection is to ensure that the properties of the laboratory sample are representative of the properties of the population; otherwise erroneous results will be obtained. Selection of a limited number of samples for analysis is of great benefit because it allows a reduction in time, expense and personnel required to carry out the analytical procedure, while still providing useful information about the properties of the population. The cereal material within the sample selected from the population is usually heterogeneous, i.e., its properties vary from one location to another. Homogenization can be achieved using mechanical devices (e.g., grinders, mixers, blenders).

- **Sample identification**

Laboratory samples should always be labeled carefully so that if any problem develops its origin can easily be identified.

The information used to identify a sample includes:

a) Sample description

b) Time sample was taken

c) Location sample was taken from

d) Person who took the sample and

e) Method used to select the sample

The analyst should always keep a detailed notebook clearly documenting the sample selection and preparation procedures performed and recording the results of any analytical procedures carried out on each sample. Each sample should be marked with a code on its label that can be correlated to the notebook. Thus if any problem arises, it can easily be identified. The first thing to decide when choosing a suitable sampling plan is the purpose of the analysis.

Samples are analyzed for a number of different reasons in the food industry laboratory and this affects the type of sampling plan used:

- **Official samples**. Samples may be selected for official or legal requirements by government laboratories. These samples are analyzed to ensure that manufacturers are supplying safe foods that meet legal and labeling requirements. An officially sanctioned sampling plan and analytical protocol is often required for this type of analysis.
- **Raw materials**. Raw materials are often analyzed before acceptance by a factory, or before use in a particular manufacturing process, to ensure that they are of an appropriate quality.
- **Process control samples**. A food is often analyzed during processing to ensure that the process is operating in an efficient manner.

  Thus if a problem develops during processing it can be quickly detected and the process adjusted so that the properties of the sample are not adversely effected. Techniques used to monitor process control must be capable of producing precise results in a short time.

Manufacturers can either use analytical techniques that measure the properties of foods on-line, or they can select and remove samples and test them in a quality assurance laboratory.

- **Finished products**. Samples of the final product are usually selected and tested to ensure that the food is safe, meets legal and labeling requirements, and is of a high and consistent quality.

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1.4 Data analysis & reporting

Food analysis usually involves making a number of repeated measurements on the same sample to provide confidence that the analysis was carried out correctly and to obtain a best estimate of the value being measured and a statistical indication of the reliability of the value. A variety of statistical techniques are available that enable us to obtain this information about the laboratory sample from multiple measurements.

1.5 Quality check for wheat flour

Wheat flour

Types

- **White flour** :- obtained from clean & sound hard ,soft or blended wheat in the commercial milling with a minimum extraction rate of 78 **% by mass**
- **Wholemeal or wheat meal flour**: - obtained by grinding & milling of clean & sound wheat containing all the constituents of such wheat with a 100 **%** extraction rate **by mass.**
- **Self – raising flour**: - wheat flour to which acid ingredients, sodium bicarbonate & salt have been added.
- **Enriched flour:** - wheat flour, which has been enriched, with the addition of permitted vitamins & minerals.
- **Starch reduced or protein increased flour**: - wheat flour with low starch or increased protein.
- **Atta / soft / wheat flour** :- flour milled from clean & sound soft wheat with a minimum extraction rate of 76 **% by mass**
- **Bleached wheat flour**: - flour milled from clean & sounds hard or soft or blended wheat whitened with bleaching or oxidizing agents.

Moisture Content

- 2-3 gm sample is heated at 130 degrees Celsius in an air oven for 1 hour.
- Standard ≤ 14 %
- Flour with high moisture content (greater than 14.5 percent) attracts mold, bacteria, and insects, all of which cause deterioration during storage.
- Wheat with too low moisture, however, may require special equipment or processes before milling to reach the standard moisture level.

Total Ash /mineral / Content

- 3-5 gm. sample is heated at 585 degrees Celsius in an air oven for 1 hour.
- The high temperature drives out the moisture and burns away all the organic materials (starch, protein, and oil), leaving only the ash. The residue (ash) is composed of the non-combustible, inorganic minerals that are concentrated in the bran layer.
- Has significance for milling.
- Is an indication of the yield that can be expected during milling
- Indicates milling performance by indirectly revealing the amount of bran contamination in flour.
- Can affect color, imparting a darker color to finished products.
- Standard ≤ 6 %, for white, protein increased, Atta & bleached wheat flour; ≤ 1 for self – raising & enriched flour; 1.5 – 2.0 for Wholemeal or wheat meal flour.

Protein Content

- Since protein is the major wheat compound that contains nitrogen, the protein content can be determined by measuring the amount of nitrogen released during burning.
- Is a key specification for wheat and flour purchasers since it is related to many processing properties, such as water absorption and gluten strength.
- Can be related to finished-product attributes, such as texture and appearance.

- Low protein content is desired for crisp or tender products, such as snacks or cakes. High protein content is desired for products with chewy texture, such as pan bread and hearth bread.
- Used to bakers to anticipate water absorption and dough development time for processes and products, because higher protein content usually requires more water and a longer mixing time to achieve optimum dough consistency.
- Protein (Nx5.7), on dry basis,% by mass :- 8-16 for white, protein increased, Atta & bleached wheat flour ; 9-10 for self – raising flour & 12-14.5 for Wholemeal or wheat meal flour.

PH value

- 4.8-6.5 ; for all types of flour

Particle size /granularity/, on 180 micron sieve size % by mass

- 99.5; for white, self – raising & bleached wheat flour.
- 70-80; for whole and wheat meal flour, protein increased & enriched flour.
- 80-85; for Atta wheat flour.

Falling Number

- Is the resistance of a flour-and-water paste to a falling stirrer
- Is recorded as an index of enzyme activity in a wheat or flour sample and the results are expressed in time as seconds.
- A high falling number (for example, above 300 seconds) indicates minimal enzyme activity and sound quality wheat or flour.
- A low falling number (for example, below 250 seconds) indicates substantial enzyme activity and sprout damaged wheat or flour.
- Yeast in bread dough, for example, requires sugars to develop properly and therefore needs some level of enzyme activity in the dough. Too much enzyme activity, however, means that too much sugar and too little starch are present.
- Since starch provides the supporting structure of bread, too much activity results in sticky dough during processing and poor texture in the finished product.

- If the falling number is too high, enzymes can be added to the flour in various ways to compensate. If the falling number is too low, enzymes cannot be removed from the flour or wheat, which results in a serious problem that makes the flour unusable.

Flour Colour Analysis

- Flour color is determined by measuring the whiteness of a flour sample with the Minolta Chroma Meter
- The color values of a typical white flour, for example, are:
- L* value +92.5 whiteness
- a* value –2.4 green color
- b* value +6.9 yellow color
- Flour color often affects the color of the finished product and is therefore one of many flour specifications required by end users.
- a bright white color flour is more desirable for many products.

Determination of wet Gluten by manual method;-

The wet gluten is separated by hand washing; the dough with sodium chloride; then the residue is weighed.

Determination of wet Gluten by mechanical means:-

- The operations of preparation and washing of the dough are carried out as a continues process by the automatic apparatus.
- Wet gluten content of hard or mixed wheat flour for the baking of bread shall be between 24 to 35 **%** by mass.

Several tests evaluate dough and gluten strength properties.

- The farinograph and mixograph tests measure the resistance of dough to mixing.
- The extensigraph test measures the resistance of dough to stretching.
- The alveograph test measures the resistance of a bubble of dough to expansion.
- The wet gluten test measures the amount of gluten protein in flour.
- The starch properties of flour are measured by the amylograph and the rapid visco analyzer tests.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Choose best answer from given alternatives (each 2pts)

1. Which of the following basic operations includes performed when officially inspecting and weighing cereal going aboard a ship?
   A/weighing B/ sampling C/Inspection D/ All
2. which of the following includes principles of quality control
   A/ raw material control B/ process control C/ Finished product inspection D/ All
3. which of the following is NOT includes the information used to identify a sample
   A/Sample description B/ Time sample was taken C/ Location sample was taken from D/ Person who took the sample E/ None

Test II: Short Answer Questions

1. List tests evaluate dough and gluten strength properties?(4pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information sheet 2 – Carrying typical laboratory tests

2.1 Typical laboratory test

Wheat is considered as a good source of protein, minerals, B-group vitamins and dietary fibre. Wheat grain is stable food used to make flour for leavened, flat, and steamed breads, biscuits, cookies, cakes, breakfast cereals, pasta, and noodle and for fermentation to make beer, other alcoholic beverage.

Wheat Composition: Carbohydrate 70%, Protein 9-15% ,Fat 2-2.2% ,Fibre 2-2.5% ,Ash 1.8 % ,Moisture 9-13%. Wheat is one of the most important foods in a balanced diet. The nutrition community recommends that 55-60% of our daily calories come from carbohydrates. Also, no more than 30% of our calories should come from fat, and approximately 12-15 % of calories should be derived from protein. Wheat cultivars are further classified in terms of wheat hardness, protein content, and protein quality.

Hard wheat: They have high gluten content (higher protein quantity and quality).When hard wheat is milled the endosperm cells separate along the cell wall margin into easily sifted particles.

It has high extraction of white flour hard types tend to have possessing a vitreous endosperm with starch granules tightly packed in a protein.

During milling, some starch grains are damaged, resulting in an increased surface area that leads to higher water absorption.

Soft wheat: The gluten content is low. Soft wheat has much lower extraction rate

The flour consists of a mass of fine cell debris with poor flow characteristics

The softer wheat have a less compact starch-protein complex which results in less starch damage and lower water absorption.

The protein level of soft wheat is usually lower, producing less resistant, more extensible dough. It is required for biscuit making

Durum wheat: It is the hardest wheat grown. Durum wheat is suitable for pasta and macaroni.

It is most often ground into granular flour with a light yellow colour known as semolina, which has the ideal properties for making the best pasta.

Durum is high in protein and gluten, which are necessary for making good pasta. It is occasionally used for baked goods (especially risen breads), but it is not used for this purpose as often as other wheat varieties

2.2 DOUGH TESTS

Physical dough testing instruments collect objective data about the physical and rheological properties of flour and dough and are useful for quality testing and process control. Because they only measure some of the properties that determine quality, the usefulness of the data in predicting baking or end-use quality of the flour is limited. The instruments are very useful at characterizing or “fingerprinting” flours to give the baker or end user confidence in the consistency of flour from lot to lot or shipment to shipment.

- **Farinograph analysis**

The Farinograph is an apparatus which is commonly used to measure the rheological properties of dough. Rheological properties such as elasticity, viscosity and extensibility are important in the prediction of the processing parameters of dough and quality of end product. Farinograph results include absorption, arrival time, stability time, peak time, departure time, and mixing tolerance index.

- **Alveograph**

In recent years, the alveograph has gained popularity as a dough testing instrument for all wheat classes. The alveograph measures the resistance to expansion and the extension of a thin sheet of dough as it is formed into a bubble and expanded. It was designed to mimic gas bubble expansion in fermenting dough.

The Alveograph test provides information on dough strength, dough extensibility, the balance of strength and extensibility and the work input requirement to form and expand the dough bubble.

- **Extensigraph**

Results from the Extensigraph test are useful in determining the gluten strength and bread-making characteristics of flour. The effect of fermentation time and additives on dough performance can also be evaluated.

- **Mixograph**

The Mixograph Test quickly analyzes small quantities of flour for dough gluten strength. Wheat breeders use mixograph results to screen early generation lines for dough gluten strength. Flour water absorption measured by the mixograph often serves as bake absorption in bread baking tests.

The mixograph is dough testing equipment used to assess the baking quality of flours from soft, hard and durum wheat. It provides information on the mixing and absorption characteristics of flour.

- **Amylograph**

The Amylograph Test measures flour starch properties and enzyme activity which results from sprout damage (alpha amylase enzyme activity).

Sprouting in wheat, as indicated by high enzyme activity, produces sticky dough that can cause problems during processing and results in products with poor color and weak texture. For Asian noodle products, flour of medium to high peak viscosity is preferred because it gives noodles better texture characteristics.

2.3 PRODUCT TEST

To make sufficient interpretation and because it is more convenient for the customer to get consistent flour without any changes in his recipes, we as millers should conduct experimental baking trials in order to ensure the consistency of our products. And by applying these trials, we forecast the customer's evaluation of volume, colour, appearance, and texture. Baking tests provide the end-users with information on flour quality characteristics. In addition, these tests provide information that can be used to optimize processing conditions prior to commercial-scale baking.

Achieving baking objectives is done by evaluating:

- The balance between gluten strength and dough extensibility during processing
- The dough machinability
- The fermentation process at different conditions
- The effect of using additives and flour corrector solutions

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Self-Check – 2	Written test

Name……ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Choose the best answer from given alternatives (each 2pts)

1. _____ is a hot paste viscometer that is used to measure the alpha amylase activity of wheat and flour

   A/ Protein content B/ Ash content C/ Falling number D/ All

2. _____ is an apparatus which is commonly used to measure the rheological properties of dough.

   A/ Farinograph B/ Mixograph C/Extensigraph D/ None

Test II: Write short answer

1. Define the following words(each 2pts)

   A/ Hard wheat and Soft wheat

   B/ Extensigraph

   C/ Mixograph

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Recording data with enterprise procedures

3.1 Enterprise Procedure

After registration and check of the laboratory sample, a first optional step may consist of a representative mass reduction of this laboratory sample. In a next step the particles in the test samples are reduced to adequate sizes to minimize the subsampling error arising when the test portion is taken from the test sample.

Special sample preparation procedures are useful / necessary. Storage of the samples before and during sample preparation as well as after the analysis should be performed under adequate conditions, be it at room temperature. For particulate material a flow chart of the several steps with a decision tree can be found

3.2 Laboratory sample check

Firstly, the laboratory sample will be registered and uniquely identified (e.g. with a unique code number).Before starting the proper sample preparation procedure some laboratory sample checks have to be carried out.

3.3 Check of laboratory sample constitution

Upon arrival in the laboratory the sample should be free from any sign of damage and should be cooled or frozen if prescribed by the shipment conditions.

Products Recommended laboratory sample size

Products	Recommended laboratory sample size
Seeds	Mass equivalent of 3 000 kernels (see table below for mass equivalent of 1 000 kernels)
Commodity grains	Mass equivalent of 10 000 grains (see table below for mass equivalent of 1 000 kernels)
First transformation products (semolina, flour, grits, oilcake etc.)	From 100 g to 1 kg
Liquids	500 ml
Doughy and viscous products	500 g
End products (e.g. packed rice noodles)	From 100 g to 1 kg

3.4 Record keeping

Records promote traceability and provide documentation that the food business has followed appropriate practices. Food laboratory maintain detailed records for several reasons, such as, document how the food was handled and labelled to establish that the food was not adulterated or misbranded while under the control of the food business.

Food laboratory also maintain records of who they received the food from (previous source) and who received the food from the business (immediate subsequent recipient). This second purpose of records is to facilitate traceability.

Record all analysis activities in your laboratory notebook. These should include calculations, weight slips, chromatograms and spectra, Records help future workers to learn from your mistakes so even negative results are equally important. Logbook records on usage of instruments, balances, pH meters, etc. Test records are documents that provide accurate evidence of the quality of products. As such, they are very important legal documents. The record for a test must contain all testing data, dates and signatures. It must also identify the test method and must allow all calculations to be checked.

3.4.1 Selected Food Product Record Requirements

The records are demonstrating compliance with the good manufacturing practices and quality control procedures.

Required records include those pertaining to nutrient premix testing; results of testing conducted concerning nutrient premixes; records necessary to ensure proper nutrient quality control; records necessary to ensure required nutrient content at the final product stage; records pertaining to distribution of the infant formula; records pertaining to the microbiological quality and purity of raw materials and finished powdered infant formula; records pertaining to audits, including audit plans and procedures; and a description of how complaints regarding infant formula will be handled.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Write True, if the statement is correct and False, if the statement is incorrect (each 2pts)

1. Storage of the samples before and during sample preparation as well as after the analysis.
2. Before starting the proper sample preparation procedure some laboratory sample checks have to be carried out.
3. Records promote traceability and provide documentation that the food laboratory has followed appropriate practices.
4. Record all analysis activities in your laboratory notebook.
5. The record for a test must contain all testing data, dates and signatures.

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Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4 - Identified and reporting out of specification to minimizing environmental impacts

4.1 Introduction

Solid wastes are all the wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. The term solid waste as used in this text is all- inclusive, encompassing the heterogeneous mass of throwaways from the urban community as well as the more homogeneous accumulation of agricultural, industrial, and mineral wastes.

The environmental impact caused by teaching and research with regard to chemical waste is of increasing concern, and attempts to solve the issue are being made. Most laboratory and non-laboratory activities, contribute to the generation of small quantities of waste, many of them highly toxic. Of this waste, some is listed by government agencies who are concerned about environmental pollution: disposal of acids, metals, solvents, chemicals and toxicity of selected products of synthesis, whose toxicity is often unknown.

4.2 Hazardous Solid Waste in laboratory

Refuse: Includes all solid wastes. In practice this category includes garbage, rubbish, ashes, and other wastes.

- **Garbage**: designates putrescible wastes resulting from the growing, handling, preparation, cooking, and serving of food. It attracts insects, rats and rapidly decomposes with production of unpleasant odour.
- **Rubbish**: This term includes all non-putrescible refuse except ashes. There are two categories of rubbish: combustible and non-combustible.

a. Combustible: This material is primarily organic in nature and includes items such as paper, cardboard, wood and bedding.

b. Non-combustible: This material is primarily inorganic and includes tin cans, metals, glass, ceramics, and other mineral refuse.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. List and explain Hazardous that Solid Waste in laboratory? (5pts)

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points
You can ask you teacher for the copy of the correct answers.

Information Sheet 5 - OHS environmental management requirements

5.1 Safety and Health Management System

A safety and health management system means the part of the laboratory management system which covers:

- The health and safety work laboratory and policy in a company
- The planning process for accident and ill health prevention
- The line management responsibilities
- The practices, procedures and resources for developing and implementing,
- Reviewing and maintaining the occupational safety and health policy.

The key elements of a successful safety and health management system are:

- **Policy and commitment**

The workplace should prepare an occupational safety and health policy programme as part of the preparation. Effective safety and health policies should set a clear direction for the organisation to follow. They will contribute to all aspects of business performance as part of a demonstrable commitment to continuous improvement.

Responsibilities to people and the working environment will be met in a way that fulfils the spirit and letter of the law. Cost-effective approaches to preserving and developing human and physical resources will reduce financial losses and liabilities. In a wider context, stakeholders' expectations, whether they are shareholders, employees or their representatives, customers or society at large, can be met.

- **Planning**

The workplace should formulate a plan to fulfill its safety and health policy as set out in the Safety Statement. An effective management structure and arrangements should be put in place for delivering the policy. Safety and health objectives and targets should be set for all managers and employees.

- **Implementation and operation**

For effective implementation, laboratory should develop the capabilities and support mechanisms necessary to achieve the safety and health policy, objectives and targets. All staff should be motivated and empowered to work safely and to protect their long-term health, not simply to avoid accidents.

These arrangements should be: underpinned by effective staff involvement and participation through appropriate consultation, the use of the safety committee where it exists and the safety representation system and, sustained by effective communication and the promotion of competence, which allows all employees and their representatives to make a responsible and informed contribution to the safety and health effort.

There should be a planned and systematic approach to implementing the safety and health policy through an effective safety and health management system. The aim is to minimize risks. Risk Assessment methods should be used to determine priorities and set objectives for eliminating hazards and reducing risks.
Performance standards should be established and used for measuring achievement.

- **Measuring performance**

The laboratory should measure, monitor and evaluate safety and health performance. Performance can be measured against agreed standards to reveal when and where improvement is needed. Active self-monitoring reveals how effectively the safety and health management system is functioning.

- **Reviewing performance**

The laboratory should review and improve its safety and health management system continuously, so that its overall safety and health performance improves constantly. The laboratory can learn from relevant experience and apply the lessons. There should be a systematic review of performance based on data from monitoring and from independent audits of the whole safety and health management system.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I .Choose the best answer from given alternative (each 2pts)

1. Which of the following is a key element of a successful safety and health management system?

   A/ Policy and commitment B/Planning

   C/Implementation and operation D/ Measuring performance E/ All

2. Risk assessment methods should be used to determine priorities and set objectives for

   A/ Eliminating hazards B/ Reducing risks C/ A&B D/ None

Test II Write True, if the statement is correct and False. If the incorrect

1. The workplace should prepare an occupational safety and health policy programme as not part of the preparation.
2. Safety and health objectives and targets should be set for all managers and employees.
3. The laboratory should measure, monitor and evaluate safety and health performance.

Note: Satisfactory rating - 10points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

LG #44	LO3: Determine methodology for evaluating product quality

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Defining cereal product and examining specific criteria of product • Identifying and researching national and international standard for product range • Identifying applicable tests and methodologies for product • Selecting evaluation of methodology to ensure standardized approach This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Define cereal product and examine specific criteria of product • Identify and research national and international standard for product range • Identify applicable tests and methodologies for product • Select evaluation of methodology to ensure standardized approach
Learning Instructions: 1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks 5. Perform Operation Sheets 6. Do the “LAP test”

Information Sheet 1- Defining cereal product and examining specific criteria of product

1.1 Defining cereal product

Cereal crops provide essential nutrients and energy in the everyday human diet through direct human consumption and also via meat production since they comprise a major livestock feed.

The most common cereal processes include dry milling (wheat and rye), pearling (rice, oat, and barley), wet milling (corn and wheat), and malting (barley, corn, and wheat). During cereal processing, by-products that differ in their physical state and chemical composition are coproduced. Since cereals are an important source of carbohydrates, proteins, lipids, vitamins, mainly of B-complex and vitamin E, and inorganic and trace elements, the reutilization and valorization of their by-products is a great challenge toward the sustainable development of the agro food sector.

These principal cereal products are utilized in several ways:

- Flour is made by grinding cereals and is used in a variety of products.
- Batters are baked or cooked to produce cakes or muffins,
- Sponge is a batter to which yeast is added. In the sponge process, the yeast is allowed to work in a batter like mixture before other ingredients are added.
- Dough differs from batter in that it is stiff enough to be handled. In addition to the ingredients listed under batter, dough may contain bakers' yeast.
- Bread is produced by fermentation of dough with yeast to produce an aerated mix, which is then heated (baked) to produce a rigid, somewhat dried product. Some types of bread are produced without yeast, especially in the Middle Fast.
- Pasta is produced from wheat flour, water, semolina, farina, and other ingredients mixed and forms. Pasta may be stored frozen or chilled, or dried at about 40◦C to a l0–l2% moisture level.

Milled cereals are mixed with other ingredients and converted into a variety of products through baking, boiling, frying, extrusion and fermentation. These processes are described in greater detail in the individual product category sections.

Cereal processing represents an important part of the food production chain, but the contribution of cereals to the nonfood sector should not be overlooked. Milling represents the principal procedure in the cereal industry and is classified in two categories: dry and wet, while each has its own characteristics.

Dry milling separates the outer fibrous materials and germ, which are considered by-products of the grain endosperm. On the other hand, wet milling is mainly used for the production of starch and gluten. Wheat is used by industry for the production of starch, paste, malt, dextrose, gluten, alcohol, and other products. The greatest portion of the wheat flour produced is used for bread making.

1.2 Examining specific criteria of product

Cereals starchy grains used as food. Cereals can be prepared and eaten in their natural form or Cereals can be used to make cereal products. I.e. Flour, Pasta, Breakfast cereals Muffins and Bread

1.2.1 Physical Properties of Foods

While chemical properties measures the chemical components of food such as water, protein, fat, carbohydrates, the physical properties determine how the chemical properties and processing ultimately effect the color and texture of foods. Physical properties include; Color**,** Texture**,** Viscosity to quality assurance is as follows.

The floor should be raised or sealed to prevent moisture entering from the ground. If the climate is suitable for storage (if the humidity of the air does not cause the dried grain to lose or gain moisture) there should be a free flow of air through the store. In very humid areas the store should be sealed to prevent the grain absorbing moisture. Stores should be inspected to ensure that they are clean before use.

All dust, old grains, insects, etc. should be carefully swept out. Any grain placed in the store should be completely dried to the correct moisture content.

The air in the store should not undergo large changes in temperature. If this occurs, moisture from the air may condense on the grain to cause localized wetting. This in turn will create hot spots.

The store should be inspected regularly by checking for heating of the grain, smelling for moldiness and looking for discolored grains, signs of Mould or insects. This will prevent small infestations developing into major problems and losses. If any of these signs are found, the grain should be removed, re-dried, sorted and replaced.

1.2.2 Quality factors

- **Water absorption**

Good quality bread flour absorbs water to 60-65% of the weight of the flour and biscuit flour to 55%. Too much absorbed water gives sticky dough and too little produces a tough, product. This test can be used to indicate a wrong grade of flour or to compare new batches of flour with an existing supplier.

- **Gluten measurement**

The gluten content of flour can be checked by washing out the starch from dough and examining the gluten that remains. With experience, a baker can quickly tell strong from weak flour.

- **Starch gelatinization**

Gelatinization of starch granules in flour is caused by moderate heat and moisture and increases the viscosity of the starch paste. The degree of breakdown of starch granules is controlled to give different baked products.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Write True, if the statement is correct and False, if the statement incorrect (each 2pts)

1. During cereal processing, by-products that differ in their physical state and chemical composition are coproduced.
2. The floor should be raised or sealed to prevent moisture entering from the ground.
3. Good quality bread flour absorbs water to 60-65% of the weight of the flour and biscuit flour to 55%.
4. Gelatinization of starch granules in flour is caused by moderate heat and moisture and increases the viscosity of the starch paste.
5. The gluten content of flour can be checked by washing out the starch from dough and examining the gluten that remains.

Test II. Write short answer

1. List the products that processed from cereals?(5pts)

Note: Satisfactory rating - 15points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Identifying and researching national and international standard for product range

2.1 Standards of Cereal Products

ISO (International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees is International Standard specifies a routine reference method for the determination of the moisture content of cereals and cereal products.

This International Standard applies to: wheat, rice (paddy, husked and milled), barley, millet, rye, oats, and triticale, sorghum in the form of grains, milled grains, semolina or flour. Laboratory work into methods for the identification of varieties may hold the key to grain grading systems of the future. Consumers are becoming accustomed to buying cereal products by variety.

Typical % composition of cereal grains

Grain	moisture	Carbohydrate	Protein	fat	cellulose	ash
Corn	11	22	10	4-5	2	2-7
Wheat	14	69	12.6	1.6	3	1.9
Oat	13	66	9-15	3-11	10.6	1.7
Sorghum	11	65-81	8-17	1.5-6	0.4-7	2-7
Barley	12	78-83	8-15	2-3	10-20	2-3
Rice	11	77-89	6-7	0.3-0.5	0.2-0.5	3-0.8
Teff	12	73	9-13	2-3	2-3	2.5-3

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions

1. List and explain the composition of cereal grains?(7pts)
2. Define the word ISO?(3pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Identifying applicable tests/methodologies for product

3.1 Applicable test of cereals

The characteristics of raw materials of cereals include sensory characteristics, physicochemical properties, and processing characteristics. The fingerprint spectra of characteristic ingredients mainly consist of fingerprints spectra of the species of cereals and the analysis and test spectra concerning the characteristics or typical ingredients, composition and structure of the species of cereals, such as gas chromatography-mass spectrometer (GC-MS) and near-infrared spectroscopy (NIR). The identification of characteristics and the characteristics fingerprint spectra for different cereals will provide necessary data and theoretical basis for the processing products.

3.1.1 Sensory characteristics

Sensory characteristics of cereals and oilseeds mainly focus on colors and luster, shapes, smell and hardness. The relationship between the sensory characteristics of wheat mainly include thousand-kernel weight, volume weight, the hardness of kernel, the percentage of vitreous kernels,

3.1.2 Physicochemical properties

Physicochemical properties refer to the chemical composition of raw materials of cereals It is a key factor which affects the quality of processed products.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I choose best answer from given alternative (each 2pts)

1. Which of the following includes the characteristics of raw materials of cereals
   A/ sensory characteristics C/ processing characteristics
   B/ physicochemical properties D/ All
2. Sensory characteristics of cereals mainly focuses on _____
   A/ colors and luster
   B/ shapes
   C/smell and hardness
   D/ All
3. Which of the following is NOT includes the sensory characteristics of wheat?
   A/ Thousand-kernel weight C/ Hardness of kernel
   B/ Volume weight D/ None
4. Physicochemical properties are referring to the chemical composition of raw materials of cereals.
   A/ True B/ False

Note: Satisfactory rating – 8 points Unsatisfactory - below 8 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Selecting evaluation of methodology to ensure standardized approach

4.1 methodologies to standardized approach of cereal products

- **Moisture content**

Moisture content is determined by heating a flour or ground wheat sample in an air oven and comparing the weight of the sample before and after heating. The amount of weight loss is the moisture content. Moisture content results are expressed as a percentage. An example of wheat moisture content is 14 percent.

Sample dishes in moisture oven.

Figure 1.sample dishes in moisture

- **Ash contents**

• Ash content is determined by high temperature incineration in an electric muffle furnace.

• When a sample is incinerated in an ash oven, the high temperature drives out the moisture and burns away all the organic materials (starch, protein, and oil), leaving only the ash. The residue (ash) is composed of the noncombustible, inorganic minerals that are concentrated in the bran layer. Ash content results for wheat or flour ash are expressed as

a percentage of the initial sample weight; for example, wheat ash of 1.58 percent or flour ash of 0.52 percent. Wheat or flour ash is usually expressed on a common moisture basis of 14 percent.

Ash crucibles and furnace.

Figure 2. Ash crucible and furnace

- **Protein contents**

Combustion Nitrogen Analyses (CNA) is one of several methods used to determine protein content in flour or wheat. Protein content is determined through high temperature combustion in a protein analyzer. Since protein is the major wheat compound that contains nitrogen, the protein content can be determined by measuring the amount of nitrogen released during burning. Protein content results are expressed as a percentage of the total sample weight; for example, 10 percent protein content on 12 percent moisture basis for wheat or 8.5 percent on 14 percent moisture basis for flour.

Combustion Nitrogen Analysis machine.

Figure 3. Combustion Nitrogen Analyser

- **Falling number**

The falling number instrument analyzes viscosity by measuring the resistance of a flour-and-water paste to falling stirrer. Falling number results are recorded as an index of enzyme activity in a wheat or flour sample and the results are expressed in time as seconds. A high falling number (for example, above 300 seconds) indicates minimal enzyme activity and sound quality wheat or flour. A low falling number (for example, below 250 seconds) indicates substantial enzyme activity and sprout damaged wheat or flour.

Falling number apparatus.

Figure 4. Falling number analyzer

- **Minolta Chroma Meter**

Flour color is determined by measuring the whiteness of a flour sample with the Minolta Chroma Meter. Flour color results are reported in terms of 3-dimensional color values based on the following rating scale:

L* value	whiteness	100 white
		0 black
a* value	positive values	+60 red color
	negative values	–60 green color
b* value	positive values	+60 yellow color
	negative values	–60 blue color

• The color values of a typical white flour, for example:

L* value +92.5 whiteness

a* value –2.4 green color

b* value +6.9 yellow color

Minolta color meter and color chart.

Figure 5.Minolta color meter

- **Farinograph**

The farinograph determines dough and gluten properties of a flour sample by measuring the resistance of dough against the mixing action of paddles (blades). Farinograph results include absorption, arrival time, stability time, peak time, departure time, and mixing tolerance index. It measures flour water absorption and dough strength.

Farinograph mixer and apparatus.

Figure 6. Farinograph

- **Extensigraph**

The extensigraph determines the resistance and extensibility of dough by measuring the force required to stretch the dough with a hook until it breaks. Extensigraph results include resistance to extension, extensibility, and area under the curve. Resistance to extension is a measure of dough strength. A higher resistance to extension requires more force to stretch the dough. Extensibility indicates the amount of elasticity in the dough and its ability to stretch without breaking. It is Visco-elastic recorder, Measures dough extensibility and resistance to extension.

Dough stretched by the extensigraph hook.

Figure 7:. Dough stretched by extensigraph book

- **Glutomatic**

Wet gluten content is determined by washing the flour or ground wheat sample with a salt solution to remove the starch and other soluble from the sample. The residue remaining after washing is the wet gluten. During centrifugation, the gluten is forced through a sieve. The percentage of gluten remaining on the sieve is defined as the Gluten Index, which is an indication of gluten strength. A high gluten index indicates strong gluten. Wet gluten content results are expressed as a percentage on a 14 percent moisture basis; for

example, 35 percent for high protein, strong gluten wheat or 23 percent for low protein, weak gluten wheat. It is also gluten washing and measures wet gluten content.

Glutomatic mixer.

Figure 8. Glutamatic mixer

- **Amylograph**

The amylograph analyzes viscosity by measuring the resistance of flour-and-water slurry to the stirring action of pins or paddles. When the slurry is heated, the starch granules swell and the slurry becomes a paste. Thicker slurry has more resistance to the pins during stirring and has a higher peak viscosity. Generally, thicker slurry indicates less enzyme activity and makes better products. Amylograph results include peak viscosity. It is also Viscosity analysis measures flour starch properties

Amylogrpah mixer.

Figure 9. Amylograph mixer

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I choose the best answer from given alternative

1. _____is determined by high temperature incineration in an electric muffle furnace.

   A/ Ash content C/ Elasticity

   B/ Moisture content D/ All

2. Which of the following NOT includes Farinograph results of products?

   A/ stability time C / Departure time E/ None

   B/ Peak time D/ mixing tolerance index

Test: II Short Answer Question

1. List and explain each methodologies to standardized approach of cereal products(10pts)

Note: Satisfactory rating – 14 points Unsatisfactory - below 14 points

You can ask you teacher for the copy of the correct answers.

Operation sheet 1: Procedures of moisture content determination

Objective: To determine moisture contents

- **Apparatus**

(a) Grinding Mill - 1.0 mm I.S sieve.

(b) Moisture dishes

(c) Electric oven

(d) Desiccators

- **Procedure**

Step 1 Mix the test sample and grind suitable quantity to give sufficient ground material for replicate determination. Ensure that the sample is neither too coarse nor too fine and passes through the 1.0 mm sieve.

Step 2 Weigh accurately about 5 gm of sample in a previously dried and tared dish and place the dish with its lid underneath in the oven for 2 hours. The time should be reckoned from the moment the oven attains 130°C after the dishes have been placed.

Step 3 Remove the dish after 2 hours, cool in the desiccator and weigh. The dish should be placed back in the oven at half hour intervals till constant weight is achieved. The specification for the size of the dish should also be included.

Step 4 Calculation the result

$$\text{Moisture \%} = \frac{(W1 - W2) \times 100}{W1 - W}$$

Where,

W1 = Weight in gms of the dish with the material before drying

W2 = Weight in gms of the dish with the material after drying

W = Weight in gms of the empty dish

Operation sheet 2: Procedures of Protein content determination

Objective: To determine protein contents

Combustion Nitrogen Analyses (CNA) is one of several methods used to determine protein content in flour or wheat.

Procedures

Step 1 A sample of flour or ground wheat (0.15 to 0.20 grams) is weighed and placed into a CNA protein analyzer.

Step 2 This process is fully automated and begins by dropping the sample into a hot oven where it is burned at 952 degrees Celsius.

Step 3 The amount of nitrogen gas released during burning is measured and a formula is applied to convert this measurement to protein content in the sample.

Operation sheet 3: Procedures of ash content determination

Objective: To determine ash content

Producer

Step 1.A sample of flour or ground wheat (3 to 5 grams) is weighed and placed in an ash cup.

Step 2 The sample is heated at 585 degrees Celsius in an ash oven until its weight is stable (usually overnight).

Step 3 The residue is cooled to room temperature and then weighed.

$$\textbf{Total ash on dry basis (\% by weight)} = \frac{(W2 - W) \times 100}{W1 - W}$$

Where,

W2 = Weight in gm. of the dish with the ash

W = Weight in gm. of empty dish

W1 = Weight in gm. of the dish with the dried material taken for test

Operation sheet 4: Procedures of falling number determination

Objective: To determine Falling number

Procedure

Step 1 A 7-gram sample of ground wheat or flour is weighed and combined with 25 milliliter of distilled water in a glass falling number tube with a stirrer and shaken to form slurry. When grinding a wheat sample to perform a falling number test, it should be at least 300 grams to assure a representative sample

Step 2 As the slurry is heated in a boiling water bath at 100 degrees Celsius and stirred constantly, the starch gelatinizes and forms a thick paste.

Step 3 The time it takes the stirrer to drop through the paste is recorded as the falling number value.

Operation sheet 5: Procedures of Flour color determination

Objective: To determine Flour Color Analysis

One method used to measure flour color is the Minolta Chroma Meter Test.

Procedure

Step 1 A sample of flour is placed on the granular materials attachment and compacted.

Step 2 The Minolta Chroma Meter is inserted into the granular materials attachment.

Step 3 Measurements are taken and recorded.

Operation sheet -6: Procedures of wet gluten determination

Objective: To determine wet gluten

Procedure

Step 1 A 10-gram sample of flour or ground wheat is weighed and placed into the glutomatic washing chamber on top of the polyester screen.

Step 2 The sample is mixed and washed with a 2 percent salt solution for 5 minutes.

Step 3 The wet gluten is removed from the washing chamber, placed in the centrifuge holder, and centrifuged.

Step 4 The residue retained on top of the screen and through the screen is weighed.

LAP Test	Performance Test

Name…….. Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within given time. The project is expected from each student to do it.

Task-1 Analyze the moisture contents of wheat flour. (3hour)

Task-2 Analyze the protein contents of wheat flour. (2 hour)

Task-3 Analyze the ash contents of wheat flour. (2day)

Task-4 Analyze the Falling number of wheat flour. (2 hour)

Task-5 Analyze the wheat flour color.(2hour)

Task- 6 Analyze the wet gluten of wheat flour. (2hour)

LG #45	LO #4: Apply evaluation methodology

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Assessing volume and general appearance of product standards
- Assessing sensory attribute of product standards
- Assessing technical difficulty and originality of product
- Conducting other tests
- Comparing product quality with other class products
- Making recommendation for quality rate and commercial positioning of product
- Specifying process with workplace environmental guidelines

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Assess volume and general appearance of product standards
- Assess sensory attribute of product standards
- Assess technical difficulty and originality of product
- Conduct other tests
- Compare product quality with other class products
- Make recommendation for quality rate and commercial positioning of product
- Specify process with workplace environmental guidelines

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1- Assessing volume and general appearance of product standards

1.1 Quality determination and standards

The term 'quality' has different meanings for those who are concerned with the handling, storage, processing and utilization of cereal, even though all will be looking for cereal of 'good quality'. For example, cereal -handling agencies will want dry, insect-free, undamaged grain which will store well; millers will want a grain which will yield a high percentage of finished produce; and consumers will be concerned with flavor, appearance or cooking qualities of grain.

1.1.1 Assessment of cereal quality

Many assessments are commodity-, product- or end user-specific. Of the wide range of properties, bulk density and foreign matter are commonly assessed for most types of grain. In addition, the influence of moisture content on other grain qualities, as well as the simple economic fact, makes it important for quantification.

(i) Bulk Density

All equipment for the determination of bulk density has features is:

(a) Causing the sample material to fall from a standard container through a standard height into a standard volume weighing bucket

(b) Leveling the surface of the material in the weighing bucket in such a way as not to influence its packing and

(c) Weighing the loaded bucket. However, differences in equipment design and procedural detail can result in very different values for bulk density, even when the same grain sample is used. It is essential; therefore, that only one type of apparatus is used for determining bulk density. ISO 7971 is a standard reference method with results expressed as **mass per hectoliter**.

(ii) Foreign Matter

Most cereal quality standards state that the screens in sieves used for the assessment of foreign matter content should consist of perforated metal plate conforming to specifications laid down by national or international standards organizations. Such specifications cover the composition and thickness of the metal plate, the shape and dimensions of the perforations, and the arrangement of the perforations on the plate

(iii) Operating Capacity of Sieves

The efficiency of a sieve is dependent upon two factors: the dimensions of the apertures in the screen, and the proportional volume of material which will not pass through the apertures. As a general rule, the percentage sieving area' of a screen with small perforations is less than that of a screen with larger holes, and its capacity for sieving efficiently is correspondingly reduced. Also, for a perforated metal screen of fixed specifications the sieving efficiency falls off markedly if the volume of material which will not pass through the apertures exceeds a certain quantity

(IV) Moisture Content

The standard test method (ISO 712) for the determination of mc in cereals is by mass loss in a hot-air oven. The method is time-consuming and a variety of rapid methods have been developed for day-to-day use. These range through accelerated heating by infra-red source gravimetric tests to almost instantaneous readout by electronic moisture meter.

1.1.2 Measuring physical characteristics of wheat

The physical characteristics of grain are important as they are indicative of potential processing quality. In Australia, physical characteristics are used to determine how a parcel of wheat will be segregated and stored. Measures test weight, grain size, screening and visual appearance.

(a) Test weight

Test weight is the weight of a specific volume of grain and is an indication of the bulk density of the grain test weight is influenced by grain shape and packing efficiency: test weight is usually measured with a Schopper chondrometer.

In test weight is used to separate milling grade wheat (test weights >74 kg/hl) from feed grade wheat (test weights <74 kg/hl).

b) Grain size/kernel weight

Grain or kernel weight is the mass of a given number of kernels and is a useful measure of grain size. Several techniques have been developed to determine kernel weight, and the most common technique involves the counting of 1,000 grains and weighing them and then expressing the result as the 1,000-kernel weight (TKW).

c) Grain hardness

Grain hardness, which is largely genetically determined, maybe measured by the ease with which outer layers of the grain can be removed by abrading, by the amount of energy required or noise emitted in grinding a given weight of sample, or by the amount of damage which occurs to starch granules during flour milling. A common method of measurement is the particle size index (PSI) test.

d) Falling Number

Sound wheat is required for most food processes. Sprouting is the germination of grains in the wheat head prior to harvesting and results from rain events. Rain damage leads to the development of the enzyme α-amylase that breaks down starch into sugars.

e) Protein content

Protein content is a fundamental quality test of wheat used by the international wheat trade as indicating potential end-use quality. The protein content of Australian wheat varies from 8 to 16%, depending on variety and environmental factors such as soil type and where the wheat is grown.

f) Moisture content

Moisture levels in harvested grain gradually decrease during the ripening process. Moisture content is an important consideration at harvest as excessive moisture reduces the safe storage period of the grain and may lead to deterioration in grain quality.

1.2 Laboratory milling

Laboratory milling, sometimes referred to as test milling, is used to prepare as reproducibly as possible flours from small quantities of grain for assessment of milling yield. Those flours are subsequently used for analytical, dough quality, and end-use evaluations. Test milling is routinely used by commercial flour mills for wheat intake quality control and by wheat breeding programs as part of breeding for improved wheat quality

1.3 Flour appearance

Flour appearance can be divided into 2 components – the purity of the flour and flour color. Ash is the term used to describe the mineral content of grain or flour and is concentrated in the outer layers of each kernel. The ash levels of wheat (on a weight basis) generally do not exceed 1.6% and in Australian commercial flour mills, flour ash levels are generally around 0.65%.

The determination of ash involves incinerating a sample and weighing the resultant mass. In addition to dulling flour appearance, bran particles and excessive levels of ash, can lead to discoloration of, and spikiness in end products. The acceptability of such contamination varies with each end product. Flour users know that whiteness or yellowness is a key point of differentiation between good and bad quality flour. The general preference is for white and bright flour because it is more versatile across a range of end products.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Write True, if the statement is correct and False, if the statement is incorrect (2pts)

1. The standard test method (ISO 712) for the determination of mc in cereals is by mass loss in a hot-air oven.
2. Test weight is the weight of a specific volume of grain and is an indication of the bulk density of the grain
3. Contamination of flour from ash and bran particles dulls the appearance of the flour.
4. Protein content is a fundamental quality test of wheat used by the international wheat trade as indicating potential end-use quality.

Test: II Short Answer Questions

1. List and explain measuring physical characteristics wheat?(7pts)

Note: Satisfactory rating – 15 points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Assessing sensory attribute of product standards

2.1 Sensory test

Sensory properties are usually measured through sensory methods (descriptive analyses) as instrumental techniques are still limited to predict human perception. The influence of, milling and baking technique including flour type and fermentation and genetic structure on baker product sensory properties have been investigated. In order of importance the identified factors are milling technique, baking practice (fermentation type and time, kneading intensity, etc.), general structure and finally farming system The quantity and quality of cereal protein is a first parameter that defines the textural properties of the cereal product .Among wheat protein the gliadin is implicated in the dough extensibility. Moreover gliadin is suspected to play a role in gluten sensitivity by acting as inhibitors of alpha-amylase activity.

Smell

- Smell can indicate the presence of fungal or insect contaminants
- Smell is highly subjective. Because people vary in response to odor or taints
- Electronic nose can be used if affordable

Virtuousness

- Vitreous grains have greater density, hardness and protein content than mealy grains
- For bread and pasta vitreous but for biscuits and cookies mealy grains are preferred

Color

Flour color is important because it affects the crumb color of the finished product. The color of the flour used for variety bread, that has a dark color because of non-wheat components in the formula, is not important.

The most important quality parameters are percent impurity, moisture content and hectoliter weight.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Short Answer Questions

1. List most important quality parameters of products (5pts)

Note: Satisfactory rating – 5 points Unsatisfactory - below 5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Assessing technical difficulty/ originality of product

3.1 Assessing products

The majority of bakery products are assessed by simple visual examination as they are produced.

3.1.1 Loaf volume measurement

Loaf volume is an important characteristic that customers look for and a baker can assess this using a device that measures. A given weight of seed always occupies the same volume. The measuring equipment can be constructed locally and consists of two rectangular compartments, connected by a graduated glass or transparent plastic cylinder

3.1.2 Crumb firmness and springiness

A method of checking the freshness of bread is a squeeze test to measure crumb recovery (i.e. degree of crumb springiness or resilience). An assessment is made of how much the loaf returns to normal after squeezing it. A good quality loaf should have >50% recovery.

3.1.3 Crust and crumb color

This is assessed against color standards (e.g. painted cards) to indicate golden brown, pale crust, burnt crust uniformly white crumb etc.

3.1.4 Crumb structure and stability

The size and shape of cells, thickness of the cell walls and the evenness of the cells are assessed. A baker's judgment of these characteristics relies on experience and knowledge of the product.

3.1.5 Rope and Mould

"Rope" is a sticky material that can be pulled into strings when a loaf is broken open. The microorganism that causes rope can be present in flour, water and yeast.

It can be controlled by using good quality ingredients, thorough baking and followed by rapid cooling of the loaves on slatted shelves to allow air to dry the bottom of the loaves.

Different types of Mould also spoil bread. They grow in damp conditions and bakery products should therefore always be stored in a cool dry place.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Short Answer Questions

1. List and discuss the assessing way products property?(10pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4 - Conducting other tests

4.1 Introduction

The unique functional properties of wheat dough are due to the gluten proteins. After flour is mixed with water, these proteins form a rubbery mass (gluten), possessing a three dimensional structure that imparts plasticity and viscosity to the dough. Mixing significantly alters the rheological properties of dough. Mixing rapidly hydrates the flour particles, develops the gluten matrix, and incorporates air into the system. The rheological characterization of dough gives valuable information concerning flour quality. Many rheological studies has been done trying to understand how this properties change with ingredients or other process conditions. Baker making process and points out the necessity of knowing how process conditions, like temperature or mixing time, can affect these properties and the final quality of the product.

4.2 Wheat flour dough standards

Wheat flour is unique in its ability to form viscoelastic dough when mixed with water. The properties of dough are largely due to interactions between hydrated gluten proteins. Dough properties are largely determined by variations in protein content and protein quality, which, in turn, are dependent upon the wheat varieties selected to be milled into the flour. Protein content and dough properties are, therefore, important in the manufacture of most wheat-based foods. For example, in bread dough, hydrated gluten when mixed forms a continuous elastic network which allows retention of air and gases formed during the fermentation stage, thus providing structure to the loaf during the baking phase.

4.2.1 Dough properties

In order to assess the functionality of wheat flour in dough, it is necessary first to be able to measure the quantity of water needed to make standard dough and the energy taken by

the mixer to make the dough. Once the dough is formed, assessment of its strength, Measuring dough properties.

The two most common laboratory scale recording dough mixers are the Bra bender Farinograph (mixing done with blades) and the Mixograph (mixing done with pins). Both record the resistance forces encountered by the mixing blades or pins as they mix dough. Interpretation of the Farinograph mixing curve gives a measure of dough strength, stability, mixing time and flour water absorption as the amount of water required to develop the dough to a standard consistency.

The Mixograph can be operated using either:

(a) Standardized water absorption levels set separately by hard versus soft wheat, or

(b) Based on protein content.

4.2.2 Water absorption

Flour water absorption is one of the most important flour quality parameters to end-product manufacturers, as it has a significant effect on the yield of finished products. Water absorption is influenced by the protein content of the flour, the proportion of starch granules damaged during milling and the quantity of non-starch polysaccharides (cell wall material, mainly pentose's).Protein content is a major contributor to flour water absorption as wheat protein absorbs around 2 to 3 times its weight in water during the dough making process.

The quantity of damaged starch in a flour depends on the hardness of the original grain, the way that it has been conditioned (water added) prior to milling, and the way that the wheat has been milled. By controlling starch damage, commercial millers endeavor to standardize the water absorption capacity of their flours in order to provide an optimum and consistent bakery absorption for their customers. Damaged starch absorbs approximately 3 times its own weight of water.

4.2.3 Starch

Starch is the major component of wheat, being 53 to 62% of the grain and 62 to 71% of flour. Starch is composed of amylose and amylopectin. Amylose is a linear polymer of glucose subunits, whereas amylopectin is a branched polymer of glucose subunits.

4.3 Finished products

The majority of the quality measurements previously described is predictive measures of end product quality. The critical and ultimate test of the suitability of wheat for any end product is to manufacture the end product, using either full scale or laboratory scale test methods. Establishing links between various quality measurements and measured end product traits is challenging, time consuming and usually requires a fairly large sample of material for testing.

Therefore, considerable quality has focused on predicting end product performance using dough rheological measurements and small-scale laboratory tests. Wheat breeding programs generally only have small quantities of grain available for testing and large numbers of breeding lines to evaluate, so have a suite of small-scale, rapid and predictive tests that they use. Flour mills require rapid tests to monitor the quality of wheat being utilized in their wheat grist, so use rapid, small-scale tests supported by end product tests to predict flour performance

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Short Answer Questions

1. List and explain the method of dough properties characteristics(10pts)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 5- Comparing product quality with other class products

5.1 Quality of processed products of cereals other products

The sensory characteristics, physicochemical characteristics and processing characteristics of cereals and other product directly affect the, nutritional and processing qualities of processed products. Therefore, identification of the relationship between characteristics of raw materials and qualities of processed products, thereby establishing the correlation model will provide a theoretical basis for the establishment of standards for suitable processing assessment and screening of varieties for processing.

To evaluate the effect of particle size distribution on composition, properties rheological, pasting, microstructural and baking properties of whole grain wheat flour (WGWF) of three different particles sizes (194.9 µm, 609.4 µm and 830.0 µm).

The quantification of free sulfhydryl groups of WGWF samples, together with the effects observed in the behavior of the dough and bread showed that particle size influences the functionality of the gluten network in a differentiated way.

Firmer and lower breads volume compared to refined wheat flour (RF) were correlated with the quality of the gluten network. In the sample of finer particles, more pronounced adverse effects in quality (dough rheology, bread volume and texture) compared to the medium and coarse particle size sample suggests that the larger contact surface and the increased release of reactive compounds due to cell rupture interact with the gluten-forming proteins changing their functionality. Particle size distribution profile of refined flour and whole grain wheat flour with different particle sizes. Results expressed as mean of three determinations ± standard deviation. RF: refined flour (82.67 mm). FWGWF: fine whole grain wheat flour (194.98 mm). MWGWF: medium whole grain wheat flour (608.44 mm). CWGWF: coarse whole grain wheat flour (830.00 mm).. Scanning Electron Microscopy (SEM) images of dough made from refined flour and whole grain wheat flour with different particle sizes. (A): micrograph of refined flour (82.67 mm.) (B): micrograph of fine whole grain wheat flour (194.98 mm.) (C): micrograph of medium whole grain wheat flour (608.44 mm.) (D): micrograph of coarse whole grain wheat flour (830.00 mm.) SG.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Short Answer Questions

1. Discuss about the quality of processed products of cereals?(5pts)

Note: Satisfactory rating – 5 points Unsatisfactory - below 5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 6- Making recommendation for quality rate and commercial positioning of product

6.1 Introduction

Cereal grains and germs are good sources of various phytochemicals. The major phytochemicals present in cereal grains are: phenolic acids, flavones, phytic acid, flavonoids, coumarone, and trepans. Cereal germs are good sources of ferulic acid, phytic acid, glutathione, and phyto sterols. In addition, the cereal germ contains the vitamins E, B1, B2, and B3, the minerals P, K, Mg, Ca, Zn, and S, and fiber. Because of its rich nutrient content, cereal germ would be a valuable ingredient for production of functional foods.

6.2 Commercial Quality of cereal products

Wheat flour is powder obtained from the milling of wheat grains, which is the main raw material for cereal-based food products. The quality of wheat flour, which will directly affect the appearance, taste, and texture of flour foods, is a function of many factors including wheat variety, processing technology, and storage conditions. Currently, flour quality is typically evaluated by measuring the chemical compositions (protein, gluten, starch, and damaged starch content), dough rheological properties (viscoelasticity and extensibility), or directly investigating the performance in food making (steaming, boiling, and baking).

The quality of wheat flour is fundamentally determined by its chemical composition. The major components of wheat flour are protein (approximately 10%–12%) and starch (approximately 70–75%), and the minor components are polysaccharides (approximately 2-3%) and lipids (approximately 2%).

Chemical compositions may affect the flour properties of dough kneading (water absorption rate), gluten network formation, dough properties (hardness, viscosity, elasticity, extensibility, plasticity, water retention, etc.,) and cooking characteristics (shape retention, chewing viscosity, hardness, shrinkage, etc.,), Particle size is also an important

parameter of wheat flour. During flour milling, the different processing technologies (grinding strength, separation, and recombination technologies) will produce wheat flour with varying particles (different in particle size and distribution).

These particles, which may come from the different part of wheat endosperm, inducing significant difference in the chemical compositions, will have different devotion to the whole quality of flour. However, due to the heterogeneous structure of the wheat endosperm, particles of different sizes do not necessarily have the same chemical compositions, so the relationship between the chemical composition of wheat flour particles of different size and flour quality cannot be established.

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Write True if the statement is correct and False, if the statement is incorrect (each 2pts)

1. Cereal grains and germs are not sources of various phytochemicals.
2. Cereal germ not contains the vitamins E, B1, B2, and B3, the minerals P, K, Mg, Zn, and S, and fiber.
3. Flour quality is typically evaluated by measuring the chemical compositions.
4. Particle size is also an important parameter of wheat flour.

Note: Satisfactory rating – 8 points Unsatisfactory - below 8 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 7- Specifying process with workplace environmental guidelines

7.1 Work place environmental guidelines

Cereal products should be conducted according food standards code, including labeling, weights and measures legislation covering food safety, environmental management,OHS, anti-discrimination and equal opportunity. Every laboratory operator has a legal and moral responsibility to ensure that good manufacturing practices. Risks to food safety can be minimized if basic good processing and good hygiene practices are followed in processing and throughout the postharvest handling operations.

7.2 Environment Conditions, Safety and Related Requirements

7.2.1 Environmental Control

Adequate control of temperature, humidity and dust is important to staff comfort, instrumental performance and safe working (e.g. with flammable solvents). If they are to perform properly optical instruments often require stable temperature conditions.

Electronic equipment may have prescribed operating ranges for environmental temperature and humidity. Cooling water, either from mains supplies or localized refrigeration may be necessary for the proper functioning of some equipment.

Test materials, reagents, standards may need to be stored under controlled conditions. Some substances are affected by sunlight or fluorescent lights and must be protected from it. Delicate balances and optical instruments may need to be protected from vibration (e.g. from blenders, shakers and centrifuges) or may even need stabilized supports All these needs have to be identified and documented so that proper procedures for monitoring them and taking necessary action can be included in the quality assurance system.

Records will be needed which show that: samples are received, stored, handled and analyzed under environmental conditions that will not adversely affect analyses temperature, humidity and light controls are adequate in sensitive areas to protect samples,

extracts from them, personnel and equipment; the results of environmental sampling in laboratory areas are recorded; these should include records of air-flow rates across fume cupboard apertures.

7.2.2 Housekeeping Control

As with any other aspect of the laboratory's activities, the responsibility for housekeeping activities must be clearly defined.

Cleaning staff and laboratory staff must each have clear instructions as to their respective duties in relation to:

- Cleaning of floors, vertical surfaces (e.g. cupboards, walls, windows and doors),
- horizontal surfaces (e.g. work surfaces, shelves), equipment, interiors of refrigerators, freezers, fume cupboards, controlled environment stores
- control of the contents of refrigerators, freezers, fume cupboards, controlled environment stores
- checking the performance of air-conditioning and dust extraction equipment and fume-cupboards
- pest control

7.2.3 GOOD FOOD LABORATORY PRACTICES (GFLPs)

The quality assurance programmed will include work schedules, records of observations and of action required/taken covering housekeeping activities of this nature.

Safety Features

The building and laboratory design should include a number of safety features including:

- The fire areas of corridors should be formed of concrete blocks.
- Services should include a shower sprinkler system near each doorway so that a worker can take an immediate shower, clothes and all, in the case of accidental general contact with corrosive or poisonous liquids or fire.

- There should be built-in eye wash fountains or at least portable eyewash stations (obtainable from most chemical supply firms).
- The traffic flow, the egress pattern and the proportions of the laboratory are all safety considerations. It must always be possible to leave the laboratory safely irrespective of the initial site of a fire. Serious thought must be given to the number and location of fire extinguishers and stand pipe systems, and to the availability of sprinkler systems.
- Laboratories should be well-lit so that the operator does not have to peer too closely over potentially hazardous material in order to see what he is doing. There should be ample working space and bench tops and other surfaces should be kept clear of all material except that in current use.
- Benches are best without shelves, only services, these being operated from the front so that the operator does not have to stretch across the bench. It is still common to see reagents on shelving at the back of benches (or above the center of double-width benches) but it is probably safer if such reagents can be kept on side shelve or in trays which are brought to the bench as required.
- Flooring needs to be of a non – slip material, resistant to acids and solvents, but not
- The building must be planned for security. Restriction of access is of considerable importance because of the extremely valuable and sensitive equipment used in th laboratory work as well as to protect the integrity of official samples.
- It is very advisable to have an efficient fire and smoke detection system with appropriate alarms. Common fire detection equipment is usually either rate-of temperature-rise or fixed-temperature detector using a substance of known

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: I Write True if the statement is correct and False if the statement incorrect (each2pts)

1. Every laboratory operator has a legal and moral responsibility to ensure that good manufacturing practices
2. Adequate control of temperature, humidity and dust is important to staff comfort, instrumental performance and safe working.
3. Electronic equipment may have prescribed operating ranges for environmental temperature and humidity
4. The quality assurance programmed will include work schedules, records of observations

Test: II Short Answer Questions

1. Discuss about the environment conditions, safety and related requirements?(7pts)

Note: Satisfactory rating – 15 points Unsatisfactory - below 15 points

You can ask you teacher for the copy of the correct answers.

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Book:

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The trainers who developed this learning guide

No	Name	Qualification	Educational background	Institution	Region	E-mail
1.	Mulugeta Mangsitu	B	Food Science and Post-Harvest Technology	Hawassa Tegibared TVET Collage	Sidama	mulugetamangsitu@gmail.com
2.	Adamu Bekena	B	Food Technology and Process Engineering	Yeka Industrial College	Addis Ababa	adamuberkana2@gmail.com
3.	Teresa Negassa	B	Food Technology and Process Engineering	Kolfe Industrial College	Addis Ababa	teresanegasa78@gmail.com
4.	Tesfaye Mekuria	B	Food Science and Technology	Kolfe Industrial College	Addis Ababa	tesfayemekuriyaw48@gmail.com
5.	Yared Mulugeta	B	Food Science and Post-Harvest Technology (BSc) and Food Process and Preservation Technology (MSc)	Butajura Poly Technic Collage	SNNPR	yayaet84@gmail.com

Federal TVET Coordinator

Full Name	Organization	Position	E-mail
Fitsum Tilahun	Federal TVET Agency	TVET Curriculum TTLM Expert	**tilahun.fitsum@gmail.com**