POST GRADUATE DIPLOMA
IN
BAKERY SCIENCE AND TECHNOLOGY

PGDBST – 03

QUALITY TESTING OF WHEAT FLOUR AND BAKERY INGREDIENTS

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UNIT I: PHYSICOCHEMICAL TESTS

STRUCTURE

1.0 OBJECTIVES

Thorough study of this unit will enable the reader to analyze:

- Proximate components of wheat grains such as moisture, protein, fat, and ash contents.
- Diastatic activity and maltose value
- Starch damage content
- Flour colour grade value

1.1 QUALITY TESTING

The raw material of foremost importance in bakery product is the wheat flour. Bakery units prefer the flour obtained by milling in roller flourmill with 70-72 percent extraction. Flour quality may be defined as the ability of the flour to produce an attractive end product at competitive cost, under conditions imposed by the end product manufacturing unit. The concept of quality differs from producer and consumer point of view. However, in general, the term quality may refer to fitness of a raw material or a product for a particular process or consumer. For a consumer, the following parameters are important criteria of a product quality.

1. Uniformity and consistency of quality
2. Health safety of the product and
3. Price

The tests most commonly used to predict the quality of wheat flour and bakery products are described as follows.

1.2 MOISTURE CONTENT

Principle

The moisture content is the loss in weight of a sample when heated under specified conditions.

Scope and objective

It is applicable to flour, farina, semolina, bread and wheat grain. Flour moisture is influenced by weather and environmental or storage conditions such as humidity and storage temperature. Such conditions affect the keeping quality of a flour. Higher moisture may lead to spoilage and lump formation during storage. Lower moisture content, on the other hand, cause loss to the baker in terms of low dry matter. Several methods are available to determine moisture content e.g. air oven method, direct distillation, chemical and electrical methods. In air over method 5 gm sample is kept in a dish for one hour at 130°C. Electrical method could also be used satisfactorily provided they are accurately calibrated.

Apparatus

1. Wiley Laboratory Mill, intermediate model, equipped with 18 or 20-mesh screen or any other mill that will grind to same degree of fineness without under exposure to atmosphere and without appreciable heating.

2. Oven (either gravity-convection or mechanical convection). Capable of being maintained at 130°C (+1°) and provided with good ventilation. Thermometer shall be so situated in oven that tip of bulb is level with top of moisture dishes but not directly over any dish.

3. Moisture dishes having diameter of 55 mm. and height of 15 mm. They should be of heavy-gauge aluminum with slightly tapered sides and

provided with tightly fitting slop in covers. Before using, dry for 1 hr. at 130°C, cool in desiccator, and obtain tare weight.

4. Airtight desiccator containing activated alumina.

5. Balance, accurate to at least 1 mg.

Method

1. Grind a 30 to 40 g sample in mill, leaving minimum possible amount in mill. Mix rapidly with spoon or spatula and transfer immediately a 5g portion to tared moisture dishes. Cover and weigh dishes at once. Subtract tare weight. And record weight of sample. Dismantle and clean mill between samples.

2. Uncover dishes and place them with covers beneath on shelf of oven. Insert shelf in oven at level of thermometer bulb. Heat for exactly 60 min. after oven recovers its temperature of 130°C.

3. Remove shelf and dishes from oven, cover rapidly (using rubber finger insulators), and transfer to desiccator as quickly as possible. Weigh dishes after they reach room temp. (45-60 min, usually). Determine loss in weight as moisture (see equation 1). Replicate determination must check within 0.2% moisture.

Calculation

$$\text{Moisture (\%)} = \frac{(A - B)}{(A - C)} \times 100$$

Where, A = wt. of flour + Aluminium dish before drying

B = wt. of flour + Aluminium dish after drying

C = wt. of aluminium dish

Standard values in flour

ISI … 13.0%

PFA … 14.0%

1.3 PROTEIN CONTENT

Principle

Protein in wheat flour and bakery products is generally measured using the Kjeldahl method. This method estimates the total nitrogen in a sample and assumes a constant relationship between total nitrogen and the protein in wheat. The results are expressed by multiplying the nitrogen content by 5.7 factor and hence this method is reported to measure ‘crude protein’. More recently, methods have been developed to determine protein quantity by near-infrared reflectance (NIR) technique. Wheat flour protein quality is difficult to estimate, as there is no standard method available so far. However, some methods such as sodium dodecyl sulfate sedimentation test, Pelshenke test and extensibility test on wet gluten using Texture analyser are employed to assess the quality of wheat flour for specific product.

Method

1. Place 1g sample in digestion flask. Add 0.7g HgO or 0.65g metallic Hg, 15g powdered K_2SO_4 or anhydrous Na_2SO_4, and 25 ml H_2SO_4.

2. Place flask in inclined position and heat gently until frothing ceases. If necessary, add small amount of paraffin to reduce frothing. Boil until solution becomes clear.

3. Cool to 25°C and add 200ml distilled water. Then add 25 ml of sulfide or thiosulfate solution and mix to precipitate Hg. Also add few Zn granules to avoid bumping, tilt flask and add NaOH without agitation.

4. Immediately connect flask to distilling bulb on condenser and with tip of condenser immersed in standard acid and 5-7 drops indicator in receiver. Rotate flask to mix contents, then heat until all NH_3 had distilled.

5. Remove receiver, wash tip of condenser and titrate excess standard acid in distillate with standard NaOH solution. Correct for blank determination on reagent.

Calculation

% Nitrogen (N) = [(ml standard acid normality acid) – (ml standard NaOH normality NaOH)] × 1.4007/g sample

Multiple % N by 5.7 to get % protein.

1.4 ASH CONTENT

Principle

Total ash is the inorganic residual remaining on incineration in a muffle furnace. This reflects the quantity of mineral matter present in the flour. Acid insoluble ash reflects added mineral matter in milled products such as dirt, sand, etc.

Objective

Ash, an index of the mineral content of the flour, gives an indication of the grade or the extraction rate of the flour. This is because the mineral content of the endosperm is very low, as compared to the outer bran layers. Thus, low-grade flours, rich in powdered bran give higher ash contents as compared to more refined or patent flours.

General method

Weigh 10 g of the sample into a weighed silica dish. Incinerate it over a burner or in the muffle. Keep the dish in a muffle furnace maintained at 550-600°C until light grey ash results or to a constant weight, cool in a desiccator and weigh.

Rapid method

Reagent:

Alcoholic Magnesium Acetate Solution

Dissolve 15 g Magnesium Acetate Tetra Hydrate (Mg $(C_2H_3O_2)$ 4 H_2O) in alcohol and make up to 1 litre.

Determination

Weight 10 g of flour into a weighed silica dish. Add 10 ml. of the reagent. Let the mixture stand for about 2 minutes. Evaporate the excess alcohol in a water bath and keep in muffle furnace maintained at 750°C-850°C for 30-45 minutes. Remove the dish, cool in a desiccator and weigh. Determine the blank on 10 ml of the solution. Deduct blank from ash.

Acid insoluble Ash

Boil ash obtained in method 1 with 25 ml HCl (1: 2.5) for 5 minutes on a water bath, covering the dish with watch glass. Filter through ashless filter paper (No. 40). Wash the residue with water until free of acid. Ignite at 600°C for 20 min, cool and weigh.

Calculation

$$\text{Ash} = \frac{W_3 - W_1}{} \times 100$$

$$W_2 - W_1$$

Where, W_1 = Wt. of silica dish

W_2 = Wt. of silica dish + sample

W_3 = Wt. of silica dish + ash

$$\text{Acid insoluble ash (\%)} = \frac{W_4 - W_1}{W_2 - W_1} \times 100$$

Where, W_4 = Wt. of silica dish + acid insoluble ash.

PFA limits:

On dry basis	***Atta***	***Maida***
Ash (%)	2.00	1.00
Acid insoluble ash (%)	0.15	0.10

1.5 MINERALS ESTIMATION

Principle

The mineral content of flour as such is not related to quality of a final product, but is does affect the appearance of flour and the product. The minerals are concentrated on the outer part of wheat grain, which is removed during milling. However, some contamination does occur in flour. Flour that contains higher proportion of minerals will have more ash content and it will be darker in colour and it may also contain more fine bran particles. Bran has been shown to have detrimental effect on the quality of bakery products.

1.6 FAT CONTENT

1.7 DIASTATIC ACTIVITY AND MALTOSE VALUE

Principle

The diastatic activity is the test, which reveals the extent to which the diastatic enzyme alpha-and beta-amylases produce sugars while acting on starch present in the flour. Normally, wheats have sufficient beta-amylase activity but lack in alpha-amylase activity. However, amylase activity increased thousand folds during wet harvest or germination. The diastatic activity is expressed as mg maltose produced/10 g of flour in one hour at 30°C. The optimum level is between 2.5 to 3.5 (150 to 350 mg/10.0 g flour). It has been reported that the flours with maltose figure of less than 1.5% or 150 mg maltose/10g may tend to be deficient in gassing power. On the other hand, when the maltose figure is over 2.5% (250 mg per 10 g. flour), there is a danger of excess gas production so certain amount of diastatic activity in flour is most essential for bread making. For cookie and biscuit making, high diastatic activity is not desirable and the flour unfit for bread-making purposes due to low diastatic activity can easily be used for cookie/biscuit making.

Reagents

1. 1: 5 Sulphuric acid (200 ml concentrated sulphuric acid made unto 1 litre).
2. 15% solution of sodium tungstate
3. Fehling’s Solution A: Weigh accurately 69.28 g of copper sulphate and make up the volume to 1 litre with distilled water and filter.

4. Fehling's Solution B: Weigh accurately 346g of sodium potassium tartrate and 106g of sodium hydroxide pellets and make up the volume to 1 litre with distilled water. The solution is kept overnight and filtered through glass wood.

5. Methylene blue: 1% solution in distilled water.

Method

Place 15g of flour in a 250 ml dry bottle and add 15 ml of water at 27°C. Keep the bottle with the contents at 27°C for one hour, the contents of the bottle being mixed by shaking once every 15 minutes during this time. At the end of the digestion period, add 1.5 ml of 1: 5 H_2SO_4 (Reagent No. 1) and 3.5 ml of sodium tungstate (Reagent No. 2) to stop the reaction. Filter immediately through No 1 filter paper and the clear filtrate is used for the determination of sugar content.

Take Fehling's solution A (5 ml) and Fehling's solution B (6 ml) in a 250ml conical flask. Place the flour extract in a 50ml burette. Heat the mixed Fehling's solution on a burner and run at least 15-20ml of flour extract into the flask. Add 5 drops of methylene blue, heat to boiling and continue boiling for one minute, then add additional extract slowly at a time while still boiling until the blue colour disappears. An extra drop of indicator is helpful at the end. Repeat the titration. Calculate the maltose value from the Table 1.

The maltose figure of flour sample should preferably be between 1.5 and 2.3.

Table 3.1. Maltose figures corresponding to various titration levels

Flour extract (ml)	Maltose	Flour extract (ml)	Maltose
15	3.61	33	1.61
16	3.38	34	1.56
17	3.18	35	1.52
18	3.00	36	1.47
19	2.84	37	1.45
20	2.60	38	1.40
21	2.56	39	1.36
22	2.44	40	1.32
23	2.33	41	1.29
24	2.33	42	1.26
25	2.14	43	1.23
26	2.06	44	1.20
27	1.99	45	1.17
28	1.91	46	1.15
29	1.84	47	1.12
30	1.77	48	1.10
31	1.72	49	1.08
32	1.66	50	1.05

1.8 STARCH DAMAGE CONTENT

Principle

Wheat flour contains about 70-80% starch and it is the largest component of flour. Damaged starch is one, which has been physically damaged during the milling process. Starch damage also influences water absorption capacity and dough handling of flour. Damaged starch is readily susceptible to action by amylolytic enzymes as compared undamaged starch resulting in the formation of dextrin. Desired level of damaged starch in bread flour should be 7-9%. Higher damaged starch is not advisable. Approved AACC Method use to determine starch damaged. This method determines the percentage of starch granules in flour or starch preparations, which are susceptible to hydrolysis by alpha-amylase.

Apparatus

1. Constant temperature water bath regulated at 30° + 1°C.

2. Micro burette 10ml capacity

3. Pyrex test tubes 25×200mm

4. Boiling water bath and holder for large test tube.

Reagents

1. Acetate buffer: Dilute 4.g anhydrous sodium acetate and 3.0 ml glacial acetic acid to 1 liter with water and adjust pH to 4.6-4.8.

2. Sulfuric acid solution: Add 100ml reagent grade concentrated sulfuric acid to approximately 700ml water; dilute to 1 liter. Final solution should be 3.68N + 0.05.

3. Sodium tungstate solution: Dissolve 18.0g sodium tungstate in water and dilute to 100ml.

4. Alpha-amylase solution: Dissolve a suitable fungal alpha-amylase preparation (containing 5000 SKB units/g) in reagent No. 1 in proportion of 1.0g enzyme preparation per 450ml buffer. Filter rapidly using three course filter paper. This solution should be used with in 2 hr.

Method

1. Bring reagent 4 to 30°C. Weigh 1.0g of flour into 100ml stopped conical flask and add 45 ml of reagent 4. Keep it in water bath at 30°C for exactly 15 minutes.

2. At the end of 15 minutes, add 3.0ml of reagent 2 and 2.0ml of reagent 3. Mix thoroughly, let it stand for 2 minutes and filter through whatman No. 4 filter paper, discarding first 8-10 drops of filtrate.

3. Immediately pipette 5.0ml of filtrate into 25×200mm Pyrex test tube having 10ml of pot ferric acids solution. Immerse test tubes into vigorously boiling water for 20 minutes.

4. Cool test tubes contents under running tap water and pour at once into 100 or 125ml conical flask. Rinse the test tube with 25 ml of acetic acid salt solution. Add 1 ml of soluble starch-KI solution. Mix thoroughly and titrate with 0.IN sodium thiosulfate to complete disappearance of blue colour. Run a blank without sample.

Calculations

1. Subtract mg maltose equivalent found from Blank-sample.

2. Result of calculations multiplied by 0.092 equals % damaged starch.

% Damaged starch = mg maltose equivalent (B-S) × 0.082. from table.

B = ml of thiosulphate used for Blank

S = ml of thiosulphate used for sample.

1.9 FLOUR COLOUR GRADE VALUE

Principle

The colour test on flour sample indicate the whiteness, which is considered as a quality attribute as it affects appearance of final product. The colour of the flour depends on extraction rate of flour, amount of pigments and flour particle size. The darkness or whiteness of the flour is due to contamination of bran particles. Higher the flour extractions rate, darker the colour of the flour and vice versa. The coarse flour generally looks dull and darker than its finer counter part due to the shadow effects of the larger particles. Kent-Jones and Martin flour colour grader measures the colour of the flour based on the principle of reflectance.

Method

Develop a flour paste using a standard technique and place the paste in a glass cell in the instrument. The paste will reflect light at a wavelength of 540nm. The light spectrum is filtered and measurement gives a single number –the Flour Colour Grade (FCG). Low values of FCG correspond to a white flour. The flour colour is influenced by variety, microbial contamination, grain conditioning prior to milling, grinding and sieving conditions.

1.10 FLOUR PARTICLE SIZE DISTRIBUTION

Principle

Particle size distribution of flour indicates friability of wheat endosperm under conditions of milling. Hard wheat generally yields larger particle flour, whereas soft wheat generally gives flour with finer particles. Fisher Units (FU) represent particle size of flour. Stack of sieves is generally used to determine the particle size distribution of flour. Fisher Units (FU) is the average diameter as measured by Fisher Subsieve analyzer. Flour coarser than 22 FU will be granular, dark in colour and will have low water absorption capacity. Flours finer than 16 FU will look extremely white but will be difficult to move through pneumatic systems and may have higher than normal starch damage. The finer fraction have low protein content and give greater cookies spread that the coarser fractions. Stokes Effective Diameter (SED) referred to as the Sedimentation Method of particle size analysis is also used.

1.11 SUMMARY

The raw material of foremost importance in bakery product is the wheat flour. Bakery units prefer the flour obtained by milling in roller flourmill with 70-72 percent extraction. The composition of four must have the optimum proportion of its constituents like protein, lipids, enzymes, starch, etc for processing of flour into a suitable and acceptable product. The protein content in the range of 10 to 12 per cent is considered suitable for fermented bakery products. On the contrary, wheat flour with lower protein contents is recommended for softer products such as biscuits, cakes and cookies. Similarly, enzymatic activity of flour should be moderate for fermented bakery products. However, low enzymatic activity of flour is preferred for soft wheat products.

1.12 KEY WORDS

Flour quality: It is defined as the ability of the flour to produce an attractive end product at competitive cost, under conditions imposed by the end product manufacturing unit.

The diastatic activity: This term is expressed as mg maltose produced/10 g of flour in one hour at 30°C. The optimum level is between 2.5 to 3.5 (150 to 350 mg/10.0 g flour).

Damaged starch: The starch, which has been physically damaged during the milling, is called damaged starch. Starch damage also influences water absorption capacity and dough handling of flour. Damaged starch is readily susceptible to action by amylolytic enzymes as compared undamaged starch resulting in the formation of dextrin.

Ash: It is the inorganic residual remaining on incineration in a muffle furnace.

Acid insoluble ash: It reflects added mineral matter in milled products such as dirt, sand, etc.

1.13 SELF ASSESSMENT QUESTIONS

1. Describe principle and method of estimation of protein content in flour.

2. How does moisture content of flour affects its storage stability?

3. In what way ash and minerals are related.

4. What is the importance of ash content in flour quality and how can we measure it?

5. Describe principle and method of estimation of fat/lipids in flour and bakery products.

6. Indicate the relationship of diastatic activity and maltose value.

7. Discuss principle and procedure of estimation of starch damage content in flour.

8. What is the relationship between colour and particle size distribution of flour?

9. How can we determine the flour colour grade value and its particle size distribution?

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UNIT II: FUNCTIONAL TESTS

STRUCTURE

2.0 OBJECTIVES

Thorough study of this unit will enable the reader to conduct following functional tests:

- SDS-sedimentation volume test
- Falling number test
- Dough raising capacity
- Alkaline water retention capacity

2.1 ESTIMATION OF GLUTEN QUANTITY

Principle

To separate gluten from other constituents, the wheat flour is mixed with water. The native proteins of flour interact to form a chewing gum type of wet mass, which is called wet gluten. The wet gluten can be washed out using potable water using automatic gluten washer. The wet gluten is dried to form a free flowing light coloured powder. Depending upon the variety, it has been noticed that wide variation in the quality of extracted gluten occurs.

Scope and objectives

The procedure is applicable to whole-wheat meal and refined flour. The dough developed by mixing wheat flour with water possesses the viscoelastic characteristics vital for dough handling and final product quality. The viscoelsatic nature of dough is attributed to gluten proteins namely gliadins and glutenins. The gliadins impart extensibility to dough, whereas glutenin is held responsible for strength and elastic character of gluten and dough.

Method

Quantity of wet gluten is estimated using automatic gluten washer. The equipment has a mixing chamber. The bottom of the chamber holds an 80μm sieve. The sieve is moistened before use to achieve a capillary water bridge that prevents flour loss. A 10g flour sample is developed into dough using 5.2 ml of 2% sodium chloride solution and the dough is introduced into the plastic chamber of the gluten washer. Washing is started and after 10 min of washing cycle with 2% sodium chloride solution the washing cycle completes. The wet gluten so obtained is weighed and it is flattened between twin hot plates of the drier, where it is heated for 4 min. The dried, thin sheet of gluten is then weighed and recorded as dry gluten. The wet gluten can also be dried in oven at 100°C for 24 hours to get value of dry gluten.

Calculation

$$\text{Wet gluten (\%)} = \frac{A}{C} \times 100$$

$$\text{Dry gluten (\%)} = \frac{B}{C} \times 100$$

Where, A = wt. of wet gluten; B = wt. of dry gluten and
C = wt. of flour.

2.2 SDS-SEDIMENTATION VOLUME TEST

Principle

The wheat flour is treated with lactic acid and sodium dodecyl sufate (SDS) solution. SDS neutralises the charge of proteins and lactic acid makes the protein strands swell in the solution. Depending upon the quantity and composition of gluten proteins the flour gives some value of sediment. The volume of sediment formed when flour is suspended in water containing lactic acid and SDS is referred to as SDS-sedimentation volume.

Reagents

1. Lactic acid solution: 3 ml of 88% lactic acid is diluted (1: 8 v/v) to 27 ml with distilled water.

2. SDS solution (2%): Dissolve 20 g SDS (Sodium dodecyl sulphate "Specially pure") in distilled water to make 1 litre.

3. Lactic acid-SDS stock solution: Add 20 ml of Reagent (1) to (2).

Procedure

The sodium dodecyl sulphate (SDS) sedimentation volume of flour samples is estimated according to the method of Axford (1978). Flour (5g, 14% moisture basis) is added to water (50ml) in a cylinder, a stopclock is started and the material dispersed by rapid shaking for 15s. The contents are re-shaken for 15s at 2min and 4min. Immediately following the last shake, SDS-lactic acid reagent (50ml) is added, and mixed by inverting the cylinder four times before re-starting the clock from zero time. The SDS-lactic acid reagent is prepared by dissolving SDS (20g) in distilled water (1L) and then adding a stock diluted lactic acid solution (20ml; 1 part lactic acid plus 8 parts distilled water by volume). Inversion (four times) is repeated at 2, 4 and

6min before finally starting the clock once again from zero time. The contents of the cylinder are allowed to settle for 40min before reading the sedimentation volume.

2.3 FALLING NUMBER TEST

Principle

The Falling Number test (AACC Approved Method 56-81B) provides an index of α-amylase in a flour or ground-wheat sample. The procedure relies on the reduction in viscosity of starch paste caused by the action of α-amylase. The method is based on the unique ability of alpha-amylase to liquefy a starch suspension. Gelatinization strength is measured by falling number as “time in seconds” required stirring and allowing the stirrer to fall a measured distance through hot aqueous flour gel undergoing liquefaction.

Method

1. The distilled water in bath is brought to boil.

2. Weigh 7 gm of flour, transfer it to viscometric tube, and add 25 ml of distilled water, rubber the tube and shake vigorously for obtaining a uniform suspension.

3. Remove stopper and push down flour adhering to sides with the viscometer stirrer.

4. Place the tube with stirrer in the boiling water bath. Start the timer.

5. After 5 seconds, automatic stirring starts at the rate of 2 stirs/seconds for 60 seconds. After a total of 60 seconds stirring automatically stops releasing the stirrer at its uppermost position and allows falling by its weight at a fixed distance and time is recorded in seconds.

The starch gelatinizes, and the α-amylase liquefies the resultant paste. The time it takes (in seconds) for the viscometer stirring rod to fall through the starch paste is the Falling Number. Flour made from sprout-damaged wheat can have a Falling Number of 100 sec or less. Bread wheat with average α-amylase activity has a falling Number of approximately 250sec. The upper limit for the Falling Number test is approximately 400 sec, which occurs for flour devoid of α-amylase.

Interpretation of results

Falling number (in seconds)

Below 150	-	sprouted wheat, high alpha-amylase activity.
200-250	-	normal alpha-amylase activity.
300 and above	-	amylase activity too low.

2.4 DOUGH RAISING CAPACITY

Principle

Yeast is a biological material, and thus its activity is affected by many factors such as storage temperature, relative humidity and moisture content, etc. Such conditions affect the number of viable cells per unit mass and hence the dough raising capacity. In order to produce good quality fermented product it is important to add the optimum quantity of yeast. Therefore, it becomes necessary to check the dough raising capacity of each batch and also periodically for satisfactory gas production during fermentation of the product.

Method

Yeast (2.5g) is dissolved in water (45ml) having 40°C temperature. Wheat flour (35g) is taken in a beaker, 1g sugar is added to it and then mixed with the yeast suspension. This mass is made into smooth batter and transferred to a 250 ml graduated cylinder and base volume of the batter is noted down. The rise in the level of dough is noted at 15 minutes interval for one hour. A graph between time and the rise in dough volume is plotted to estimate the dough raising capacity of yeast.

Calculation

$$\text{Dough raising capacity} = \frac{(B - A)}{A} \times 100$$

Where, A = volume of the dough before fermentation.

B = volume of dough after one hour fermentation.

2.5 ALKALINE WATER RETENTION CAPACITY

Principle

The alkaline water retention capacity (AWRC) is the amount of alkaline water retained by flour at 14% moisture under controlled centrifugation condition. The test is actually the weight of the 0.1 N sodium bicarbonate held by a flour sample following centrifugation. The gain in weight is expressed as per cent alkaline water retention capacity of flour.

Method

Flour (1 g) is slurried with 0.1 N sodium bicarbonate (5ml). It is then shaken, allowed to hydrate for 20 min, and centrifuged under specified and constant time and centrifugal force conditions. The supernatant is decanted, the weight of the wet flour is determined, and AWRC is calculated. This parameter is important when the water relationships in a product are critical to product quality. One specific application of this test (AACC Approved Method 56-10) is as a flour specification to predict cookie spread. As AWRC increases, cookie spread decreases.

2.6 SIGNIFICANCE OF FUNCTIONAL TESTS IN RELATION TO BREAD, BISCUITS AND CAKES

Several tests are carried out to predict the end use quality of flour. These tests are classified as physiochemical, functional and rheological tests. The functional tests such as gluten quantity, SDS-sedimentation volume, falling number, dough raising capacity of yeast and alkaline water retention test are performed to judge the quality of raw material particularly flour to get best potential of a flour when processed at industrial scale. These tests are useful in making compatible application of a flour for a specific product. This avoids processing losses and helps in improving the overall quality of product. Various classes and varieties of wheat with diverse technological significance are grown in India. Thus, functional tests are carried out for using the right variety for a specific product. The technological potential of wheat is attributed mainly to its gluten proteins. Thus, quantity and quality of gluten proteins are assessed for the industrial application of wheat variety. The supplementation of wheat gluten in weak flour has potential to transform poor quality wheat into good quality, which can be processed into any value added bakery product. Wet gluten for good bread flour falls in the range of 30-36%. Flour having wet gluten of 22-25% is suitable for biscuit and cookies production. Dry gluten for good bread flour falls in the range of 10-12%. For soft wheat products the range of dry gluten should be 8-9%.

SDS-sedimentation volume test gives indirect measure of quantity and composition of gluten proteins. Higher sedimentation volume reflects appreciable quantity of high molecular weight glutenin proteins in the flour. Such flour is recommended for the bread making. Flour with lower sedimentation volume, on the other hand, is preferred for biscuit/cookie or cake production. Sedimentation value for different application of flour is as follows:

1. Soft wheat flour having sedimentation volume less than 20 ml should be used for sweet biscuit/cookie/cakes.
2. Medium strong wheat flour having sedimentation volume from 20 to 40 ml is preferred for fermented biscuits.
3. Hard wheat flour having sedimentation volume more than 40 ml is found useful for bread formulations.

Falling number indicates activity of amylolytic enzymes of a flour. Flour should have desirable enzymatic activity for superior quality of a product. Wheat flour should have different enzymatic activity for processing flour in to different product. Because α-amylase hydrolyses starch link-ages, more free sugars are liberated and lower starch paste viscosity results when enzyme activity is high. The implications of this for a baked product can be very significant because of the functional roles that starch plays in most products. High α-amylase activity can lead to excessive browning because the reducing sugars liberated are available for Maillard browning reacting. Reduced viscosity caused by α-amylase can have devastating effects on batter products, reducing volume and producing an undesirable crumb structure. In bread products, hydrolysis of starch can lead to sticky crumbs and reduced volumes as well. Falling number of Indian wheat flour are very high with a mean value of 571 which indicate no alpha-amylase activity. The bread produced from such flour will have diminished bread volume and dry crumb. On the other hand, rain soaked wheat contains a very high alpha-amylase with falling number value even less than 100 which produce bread with sticky crumb, dark crumb colour and low volume. Ideal falling number value for bread making should be 175 to 275.

The dough raising capacity of yeast is useful observation for fermented products such as bread, buns and fermented biscuits. The yeast being a biological material is affected by storage conditions. Dough raising capacity indicates viability of yeast and hence helps in assessing the optimum quantity of yeast to be used for a product. In dough raising capacity test, the yeast (compressed) shall be deemed to have satisfied the test, if the rise in dough level is at least 110% of the original dough level. For dry yeast and the rise in dough level should be at least 80% of the original dough level.

Alkaline water retention capacity (AWRC) test is useful for cookies. The results of alkaline water retention capacity directly correlate with cookie diameter, since the test is done at pH 8.0 to 8.1, the conditions that actually exist in cookie doughs. It is much more informative, when combined with baking. The higher AWRC value indicates smaller cookie diameter and vice-versa.

2.7 SUMMARY

Many tests are carried out to predict the end use quality of wheat flour. These tests are classified as physiochemical, functional and rheological tests. The functional tests such as gluten quantity, SDS-sedimentation volume, falling number, dough raising capacity of yeast and alkaline water retention test are performed to judge the quality of wheat flour to get best potential of flour when processed at industrial scale. These tests are useful in making compatible application of flour for a specific product. This avoids processing losses and helps in improving the overall quality of product. Various classes and varieties of wheat with diverse technological significance are grown in India. Thus, functional tests are carried out for using the right variety for a specific product. The technological potential of wheat is attributed mainly to its gluten proteins. Thus, quantity and quality of gluten proteins are assessed for the industrial application of wheat variety. SDS-sedimentation volume test gives indirect measure of quantity and composition of gluten proteins. Higher sedimentation volume reflects appreciable quantity of high molecular weight glutenin proteins in the flour. Such flour is recommended for the bread making. Flour with lower sedimentation volume, on the other hand, is preferred for biscuit/cookie or cake production.

2.8 KEY WORDS

Wheat gluten**:** The native proteins of flour interact to form a chewing gum type of wet mass, which is called wet gluten. The wet gluten can be washed out using potable water using automatic gluten washer.

Alkaline water retention capacity (AWRC): It is the amount of alkaline water retained by flour at 14% moisture under controlled centrifugation condition.

Falling number: It indicates activity of amylolytic enzymes of a flour. Flour should have desirable enzymatic activity for superior quality of a product.

SDS-sedimentation volume test: This test gives indirect measure of quantity and composition of gluten proteins.

Dough raising capacity of yeast: It indicates viability of yeast and hence helps in assessing the optimum quantity of yeast to be used for a product.

2.9 SELF ASSESSMENT QUESTIONS

1. Describe method and principle of estimation of gluten quantity.

2. How gluten quantity is related to end use quality of bakery products?

3. What is basis of differential sedimentation volume of flours from different wheat varieties?

4. How does a flour sample develop sediment when treated with lactic acid-SDS solution?

5. Discuss the importance of falling number test in influencing the quality of bakery products.

6. Describe principle and method of falling number test.

7. Why dough raising capacity of yeast is assessed?

8. Describe the method and principle of alkaline water retention test.

2.10 SUGGESTED READINGS

1. AACC 1983. Approved methods of Analysis. 8^{th} edn, American Association of Cereal Chemists. St. Paul, MN

2. Rasper VF, Preston KR (1991). The Extensograph Handbook. AACC, St Paul MN
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PGDBST- 03 **B.S.Khatkar**

UNITIII: RHEOLOGICAL TESTS

STRUCTURE

3.0 OBJECTIVES

Thorough study of this unit will enable the reader to conduct and understand the importance of the following rheological instruments and tests conducted using them:

- Recording dough mixers
- Extensograph
- Viscoamylograph

3.1 RHEOLOGICAL INSTUMENTS

Rheology is the study of deformation and flow of matter. Flow relates to liquids and deformation relates to solids. Dough rheology is a complex system, which involves a number of properties. Wheat dough demonstrates property of viscous flow and elastic recovery. When dough is stretched it will recover only partly. It has the flow property, as it will take the shape of the container, which it occupies. Moreover, a certain minimum force is required before flow can begin i.e. it has the property of yield value and this type of behaviour of dough resembles solids. Thus, dough has viscoelastic properties.

The properties of dough have great influence on dough handling and processing of dough in a plant. The instruments used to determine dough rheological properties can broadly be classified into three categories:

1. Recording dough Mixers: These instruments measure the power needed to mix dough and measure the resistance of dough to mixing

blades. The important instruments in this category are farinograph and mixograph.

2. Load extension meters: This type of instrument measures extensibility and resistance to extension of dough. The extensograph and alveograph belong to this category.

3. Viscometers: this category of instruments measures viscosity of a suspension under standard condition of heating and cooling. Example of instrument in this category is viscoamylograph.

3.2 RECORDING DOUGH MIXERS

3.2.1 MIXOGRAPH

The Mixograph was originally designed by Swanson and Working (1933) to provide cereal chemists with a simple tool to assess wheat end use quality. Later in 1939, the National Manufacturing Company of Lincoln, NE, USA assumed the commercial manufacturing of the Mixograph capable of assessing wheat flour quality requiring a 35g flour sample. Finney and Shogren introduced the 10g Mixograph in 1972. According to them, the 10g Mixograph was mechanically simple, highly standardized and more useful than the 35g version. More recently, a computerized direct drive Mixograph suitable for analysing dough properties from a 2g flour sample has been evolved. This recent version of the Mixograph is supported by software known as ‘Mixsmart’ for automated collection of data and interpretation of the results.

The mixing action of the Mixograph is provided by four vertical planetary pins revolving normally at a speed of 88 rpm around three stationary pins in the bottom of the bowl. The mixing action in the Mixograph is that of pull-fold-repull type, and the dough receives much more vigorous treatment than in the Farinograph. In this type of mixer the power or torque required to mix the dough is recorded. The process of mixing begins with hydration of the flour particles. The mixing, whilst the flour is hydrating, brings about development of the gluten network, which is evidenced as an ascending part of the mixing curve. The dough system subsequently becomes more coherent, losing its wet and lumpy appearance, and the height of the curve gradually increases to a peak, i.e. a point of maximum consistency or minimum mobility. This is the point to which a dough should be mixed for producing a bread of superior loaf quality. If mixing is continued beyond this point, mechanical degradation of the dough occurs resulting in the curve sloping downward and tailing off. Eventually the dough becomes wet, sticky and extremely extensible, and is capable of being drawn out into long strands. This is generally referred to as the dough being 'broken down'. Parameters recorded using mixograph are discussed below:

Mixing Time (MT) — is the time required for the mixing curve to reach the maximum height or peak. It is measured from the mid line (centre line) of the curve. A mixing time of 3 to 5 minutes is normally considered suitable for the bread flours. Flour having mixing time less than 3 minutes is considered suitable for biscuit and cookie making.

Peak Dough Resistance (PDR) — is the peak height from the base line to the centre of the curve. The PDR and MT provide information concerning the strength and baking performance of the flour. PDR has direct relationship with bread making quality of flour. Biscuit flour generally has lower PDR value.

Bandwidth at Peak Dough Resistance (BWPR) — is the maximum width of the mixing curve at PDR. A narrow width is often taken as an indication of dough 'weakness'. Weak flour is recommended for biscuits and strong flour is recommended for bread making.

Resistance and Bandwidth Breakdowns (RBD and BWBD) — are defined as the decrease in dough resistance and bandwidth measured 2 min after PDR. Very steep left or right slopes of the PDR are undesirable. This indicates a flour with low mixing tolerance and high sensitivity to mixing time.

Mixing Stability (MS) — The value of mixing stability is obtained by determining the bandwidth of the mixing curve 2 min after PDR.

Work Input (WI) — is calculated by integrating the area under the mid line of the curve from time zero to the PDR, and is expressed in arbitrary units (% torque·min).

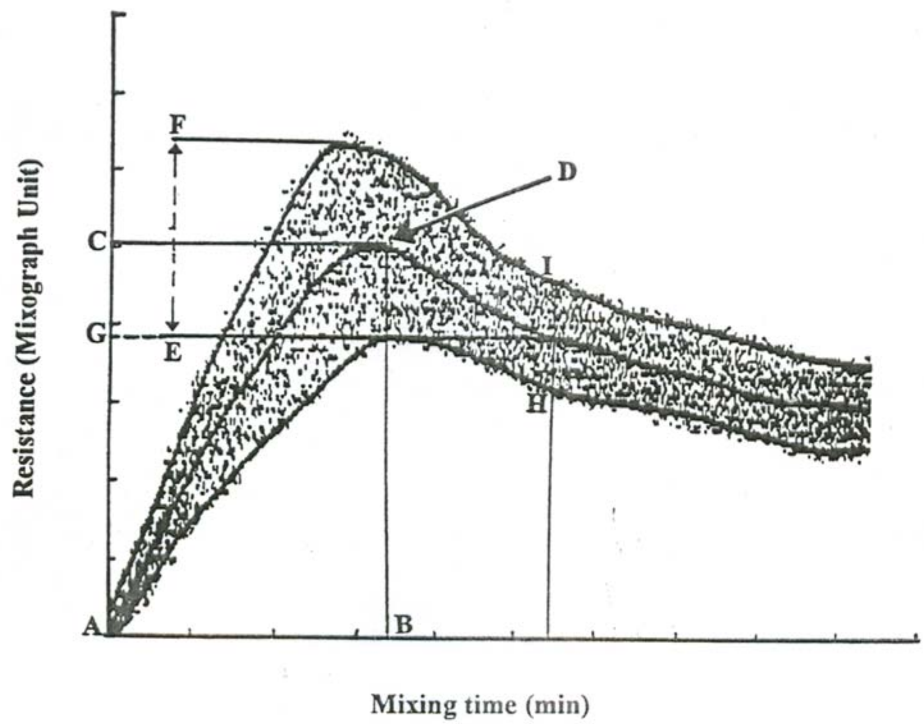
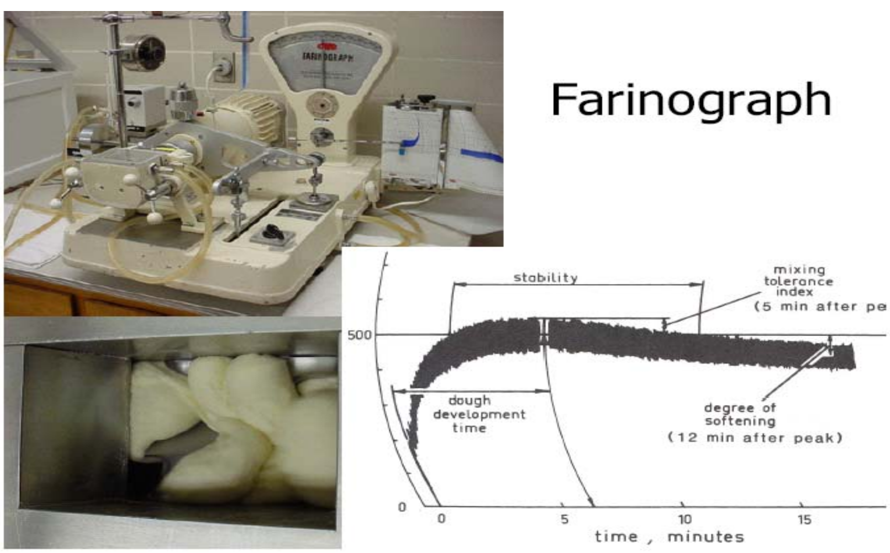


Figure 3.1 A typical mixing curve showing Mixograph parameters used in interpreting a Mixogram: Mixing time (MT) = AB; Peak dough resistance (PDR) = AC; Bandwidth at peak dough resistance (BWPR) = EF; Resistance breakdown (RBD) = GC; Mixing stability (MS) = HI; Bandwidth breakdown (BWBD) = EF-HI; ; Work input = ADB.

3.2.2 FARINOGRAPH

A Farinograph is a recording dough mixer. It measures and records the resistance offered by dough against mixing blades operating at a constant speed and temperature. Parameters obtained from the resulting curve (i.e., resistance in Brabender units [BU] versus time in minutes) relate to the amount of water required to reach a desired peak consistency. The weighed quantity (2g to 300g) of flour (14% moisture basis) is placed in the Farinograph bowl. The instrument is turned on, and water is added from a burette. As the flour hydrates and the dough develops, the resistance on the mixing blades increases, and the pen on the chart recorder or the curve on the computer screen rises. The mixing curve obtained generally rises to a maximum and then slowly falls from that peak consistency point. To ensure that Farinograph bandwidth at maximum resistance is always centred on the 500-BU line. This is accomplished by adjusting the amount of flour and water used. An experienced operator can generally achieve this during the second or third run for any given flour sample. Following parameters can be derived from a Farinograph curve.



Interpretation of Farinograph Curve

1. Farinograph water absorption value: The amount of water added to balance the curve on the 500-BU line, expressed as a percentage of the flour (14% mb), is known as Farinograph absorption. Water absorption value varies from about 50% for cookie and biscuit flour and around 60% for bread flour.

2 Dough development time or mixing time or peak time: This is the time between the origin of the curve and its maximum. The maximum of the Farinogram curve, or any mixing curve, is commonly considered the point at which the dough is optimally developed and best able to retain gas.

3. Mixing tolerance index: It is measured as the difference (in Brabender units) between the top of the curve at the maximum and the point on the curve 5 minute later.

4. Stability: It is defined as the difference in minutes between the arrival time and the time the top of the curve falls below the time 500 BU line (i.e. the departure time).

Generally, flour with good bread making characteristics has higher absorption, takes longer to mix, and is more tolerant to over mixing than biscuit quality flour.

3.3 EXTENSOGRAPH

The extensograph measures the extensibility and resistance to extension of fully mixed, relaxed flour-water dough. It measures the resistance to stretching offered by a molded piece of dough. The force required to stretch the dough is automatically plotted against the distance it stretches to give extensograph curve. Dough is stretched under constant load and there is constant speed of moving hook, which stretches the dough.

Procedure

1. Prepare dough in farinograph using 150g or 300 g of flour on 14% moisture basis, water and 6g salt dissolved in a part of water at 30° C. Amount of water taken is equal to farinograph water absorption less 2% to compensate for the effect of salt. Mix for 1 min. then allow the dough to rest for 5 min in the covered mixing bowl. Again mix for 2 more minutes.

2. Weigh 150 g dough and give it 20 revolutions in extensograph rounder. Roll it into a cylindrical piece in a shaping unit.

3. Each dough cylinder is clamped in a cradle and allowed to rest for 45 min in a compartment maintained at 30°C. Then, it is loaded on to extensograph and stretched.

4. After the test the same dough is reshaped as before, allowed resting for 45 min and stretched again. Generally three stretching curves are obtained by repeating the same procedure. Extensograph gives following information:

    a) Extensibility (E): Length of the curve in millimeters.

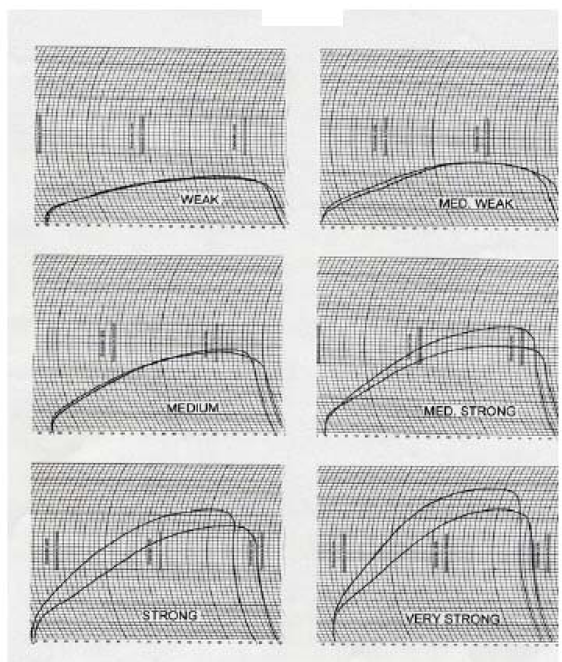
    b) Resistance to extension ®: Height of extensogram in B.U. measured 5 cm after the curve has started.

    c) Ratio figure: Ratio between resistance and extensibility i.e. R/E

d) Strength value: Area of curve - Measured by Planimeter. More the area, strong is the dough. Relationship of area under the extensograph curve with dough strength is indicted below.

Area under the curve (cm^2)	**Dough strength**
80	Weak
80-120	Medium strong
120-200	Strong
>200	Extra strong

Extensograph



3.4 VISCOAMYLOGRAPH

This instrument described measures amylase activity by physical measurement of paste viscosity. The instrument consists of heating system and a bowl of 500 ml capacity. It has thermometer which is very sensitive and has mechanism for temperature rise at the rate of 1.5° C/min. Bowl has sensing element to monitor temperature. As the temperature rises, starch granules swell and viscosity begins to increase rapidly. The maximum paste consistency obtained during the gelatinization is used as a criterion of amylase activity of flour.

Procedure

1. Adjust kymograph pen to read zero on graph paper with empty bowl.

2. Place 100g flour in 500ml beaker. Add 360ml water and make smooth slurry.

3. Pour flour slurry into viscoamylograph bowl. Rinse beaker with remaining 100ml water and add this to amylograph bowl. Adjust starting temperature to 30° C by hand, with clutch in natural position. Set clutch on increase temperature position and start amylograph bowl in motion. The viscosity of slurry is recorded on a graph paper as the temperature rises from 30°C - 95°C. Read maximum viscosity in B.U. at the centers of peak.

4. Cooling system may also be provided in viscoamylograph when temperature reaches to 95° C, give holding period of 15 min. and let the temperature down to 50° C so record viscosity at different temperatures.

3.5 SUMMARY

Rheology deals with deformation and flow of matter. Flow relates to liquids and deformation relates to solids. Dough rheology is a complex system, which involves a number of properties. Wheat dough demonstrates both viscous and elastic properties so it is referred as viscoelatsic material. When dough is stretched it will recover only partly. It has the flow property, as it will take the shape of the container, which it occupies. Moreover, a certain minimum force is required before flow can begin i.e. it has the property of yield value and this type of behavior of dough resembles solids. Thus, dough has viscoelastic properties. The properties of dough have great influence on dough handling and processing of dough in a plant. The instruments used to determine dough rheological properties can broadly be classified into three categories namely recording dough mixers, load extension meters and viscometers.

3.6 KEY WORDS

Rheology: It is the study of deformation and flow of matter. Flow relates to liquids and deformation relates to solids.

Dough rheology: Dough is a complex system, which involves a number of properties. Rheological study on dough is put under dough rheology.

Recording dough Mixers: These instruments measure the power needed to mix dough and measure the resistance of dough to mixing blades.

Load extension meters: This type of instrument measures extensibility and resistance to extension of dough.

Viscometers: This category of instruments measures viscosity of a suspension under standard condition of heating and cooling.

Peak Dough Resistance (PDR): It is the peak height from the base line to the centre of the curve.

3.7 SELF ASSESSMENT QUESTIONS

1. Classify dough rheological instruments and indicate principle of operation of each category of instrument.
2. Which instruments are known as recording dough mixers? How these instruments are different from other category of instruments?
3. Describe procedure of farinograph to run a test on flour dough.
4. Discuss the rheological parameters recorded using farinograph.
5. Describe procedure of mixograph to run a test on flour dough.
6. Discuss the rheological parameters recorded using mixograph.
7. Which rheological measurements are recorded on extensograph and what is the importance of these measurements in assessing flour quality?
8. Discuss application of viscoamylograph in assessing dough properties.

3.8 SUGGESTED READINGS

1. Rasper VF, Preston KR (1991). The Extensograph Handbook. AACC, St Paul MN
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UNIT IV: SPECIFICATIONS FOR BAKERY INGREDIENTS AND PRODUCTS

STRUCTURE

4.0 OBJECTIVES

Thorough study of this unit will enable the reader to understand:

- BIS /PFA standards for ingredients and products
- Important Acts/Orders
- ISI and PFA specification for bread

4.1 BIS/PFA STANDARDS FOR INGREDIENTS AND PRODUCTS

It is essential on the part of the Government and manufactures to supply hygienic, wholesome and standard quality food product to the consumers. This becomes possible by adopting total quality management concept by manufacturer and strict control by Government.

Quality control and food standards always go together and play a vital role in supplying hygienic, wholesome and standard quality food products to the consumers. In the broader sense, quality control may be defined as the maintenance of quality and composition at levels and tolerances acceptable to the buyer while minimizing the cost of production as far as possible. Food standards are the various rules & regulations concerning the food products. These standards may be:

1. Official
2. Semi-official (voluntary) and
3. Factory norms

Food standards are mainly required:

1. To prevent the transmission or the cause of disease
2. To limit the sale of unfair products
3. To regulate production and marketing of food products

In India, Government of India has several departments and agencies for enforcing the quality control of different types of food products under the provisions of some important acts/orders (Table 4.1). The standards specified for atta, protein rich (paushtik) atta, maida, fortified maida, protein such (paushtik) maida, suji or rava (Semolina), wheat flour bread/biscuits, limits for heavy metal contaminants in food grains and pesticides/insecticide residues in food grains/milled food are given as follows.

4.2 IMPORTANT ACTS/ORDERS

1.	Agricultural produce (Grading & Marketing) Act, 1937	Directorate of Marketing and Inspection, Ministry of Agriculture and Irrigation.
2.	Fruit Products Order, 1955	Department of Food, Ministry of Food and Civil Supplies
3.	Sugar (Control Order, 1966	Directorate of Sugar, Ministry of Agriculture and Irrigation.
4.	a) Vegetable Oil Products (control) Order, 1947 b) The Solvent Extracted Oil, Deoiled Meal and Edible Flour (control) Order, 1967 c) Vanaspati Control Order, 1975	Directorate of Vanaspati, Ministry of Civil Supplies and Cooperation.
5.	Technical Standardisation Committee (TSC), 1944	Army Purchase Organization, Department of Food.
6.	Export (Quality Control and Inspection) Act, 1963 and Rules 1954.	Export Inspection Council of India, Ministry of Commerce.
7.	Indian standards Institution	ISI, Department of Industrial Development, Ministry of Industries & Civil Supplies.
8.	Meat Food Products Order, 1075	Directorate of Marketing and Inspection, Ministry of Food and Civil Supplies.
9.	Prevention of Food Adulteration Act, 1954 Rules 1955	Directorate General Health Services, Ministry of Health and Family Welfare.
10.	The Standards of Weights and Measures Act, 1976	Department of Civil Supplies and Cooperation, Ministry of Commerce.

4.3 STANDARD REQUIREMENTS OF ATTA

Sl. No.	Characteristic	PFA Rule A. 18.01	IS : 1155-1968 Low gluten	IS : 1155-1968 High gluten
1.	Definition	Means coarse product obtained by milling or grinding wheat	Means obtained by milling sound & clean wheat, free from rancidity, insect, rodent, fungus, fermentation, musty odour and other extraneous matter.	
2.	Moisture % by weight maximum	14.0	13.0	13.0
3.	Total ash % by weight (dry basis) maximum	2.0	2.5	2.5
4.	Ash insoluble in dil. HCl %, by weight (dry basis) maximum	0.15	0.1	0.1
5.	Gluten % by weight (dry basis) minimum	6.0	7.0-9.0	above 9.0
6.	Acidity of fat as H_2SO_4%, by weight maximum	0.18	0.10	0.10
7.	Rodent hair and excreta	< 2 pieces/kg	-	-
8.	Granularity	-	To satisfy IS test	

4.4 STANDARD REQUIREMENTS FOR PROTEIN RICH ATTA

Sl. No.	Characteristics	PFA Rule A. 18.03.02	ISI Specification
1.	Definition	Means the product obtained by mixing wheat atta with 10% groundnut flour	
2.	Moisture % by weights Max.	14.00	
3.	Total ash % by weight (dry basis) Max.	2.75	
4.	Ash insoluble in dil. HCl% by weight (dry basis) Max.	0.10	
5.	Total protein % by weight (dry basis) Min.	12.50	
6.	Crude fibre % by weight (dry basis) Max.	2.50	
7.	Alcoholic acidity % by weight as H_2SO_4 Max.	0.12	
8.		Free from insect fungus, infestation and rancid taste; shall not contain any added flavour and colouring matter.	

4.5 STANDARD REQUIREMENTS FOR MAIDA

Sl. No.	Characteristics	PFA Rule No. A 18.02	IS : 1009-1979
1.	Definition	Means fine product made by milling or grinding wheat bolting or dressing the wheat meal.	Means product obtained by milling hard or soft wheat in a roller flour mill and bolting. Free flowing dry to touch, cream in colour, free from bran, shall be free from insect & fungus infestation, rodent contamination and other extraneous matter.
2.	Moisture % by weight max.	14.00	13.00
3.	Total ash % by weight (dry basis) max.	1.0	0.7
4.	Ash insoluble in dil. HCl (Dry basis)% by wt. max.	0.10	0.05
5.	Gluten % by weight (dry basis) min.	7.50	7.50
6.	Alcoholic acidity % by wt. as H_2SO_4 (dry basis) max.	0.12	0.10
7.	If used in bakery purposes flour treatment agents used are :		
	a) Benzyl peroxide, max	40.0 ppm	
	b) Potassium bromate, max.	20.0 ppm	
	c) Ascorbic acid, max.	200.0 ppm	
8.	Granularity	-	To satisfy IS test (to pass 180 micron sieve IS)
9.	Uric acid mg/100 g max.	-	10.0

4.6 STANDARD REQUIREMENTS FOR FORTIFIED MAIDA

Sl. No. Characteristics	PFA Rule A. 18.02.01	IS: specification
1.Definition	Means the product obtained by adding one or more of the following to maida a) Calcium carbonate b) Iron c) Thiamin d) Riboflavin e) Niacin	

The calcium carbonate shall be in such amount that 100 parts by weight of fortified maida shall contain not less than 0.30 and not more than 0.35 parts by weight.

4.7 STANDARD REQUIREMENT FOR PROTEIN RICH MAIDA

Sl. No.	Characteristics	PFA Rule A. 18.03.02	IS specification
1.	Definition	Means the product obtained by mixing maida (wheat flour) with groundnut flour up to 10.0%) Free from insect, or fungus infestation, odour and rancid taste Shall not contain added flavouring and colouring agents or other extraneous matter.	
2.	Moisture % by weight max.	14.00	
3.	Total ash % by weight max.	1.40	
4.	Ash insoluble in dil. HCl (dry basis) % by weight max.	0.10	
5.	Total protein (% N x 6.25)% by weight (dry basis) min.	12.50	
6.	Crude fibre % by weight (dry basis) max.	0.53	
7.	Alcoholic acidity% by weight (as H_2SO_4) max.	0.12	
8.	Gluten% by weight (dry basis) Min.	7.00	

4.8 STANDARD REQUIREMENTS FOR SUJI OR RAWA (SEMOLINA)

Sl. No.	Characteristics	PFA Rule A. 18.03	IS : 1010-1968
1.	Definition	Means product obtained from sound & clean wheat by processing of grinding and bolting. Free from musty smell, off odour and creamy yellowish colour	Means product obtained from sound & clean wheat, with characteristic taste and flavour, free from musty smell, odour, free from fungus, infestation, rodent contamination and other extraneous matter. Large particle means: 90% particles retained on a sieve of IS: 710 microns. Small particle means: 10% of the material shall be retained on IS sieve of 710 microns.
2.	Moisture % by wt. max.	14.5	13.5
3.	Total ash (on dry basis) % by weight max.	1.0	1.0
4.	Ash insoluble in dilute HCl % by weight (on dry basis) max.	0.2	0.05
5.	Gluten % by weight (on dry basis) min.	6.0	6.0
6.	Alcoholic acidity expressed as H_2SO_4 (dry basis) % by weight max.	0.18	0.10
7.	Rodent hair and excreta max.	5 pieces/kg	-

4.9 STANDARD REQUIREMENTS FOR WHEAT FLOUR-BREAD/BISCUIT INDUSTRY

Sl. No.	Characteristics	PFA Rule	IS : 7464-1974
1.	Definition	No	Product obtained by milling wheat in a roller flourmill and bolting. Shall have characteristic taste and smell. Free from insect and fungus infestation, rodent contamination, dirt and extraneous matter. Free from musty and rancid taste.
2.	Moisture % by wt. max.	13.0	13.0
3.	Protein (N×5.7) % by wt. (dry basis) min.	9.0	11.0
4.	Gluten % by wt. (dry basis) min.	7.5	8.0
5.	Total ash (dry basis) % by wt. (dry basis) max.	0.5	0.5
6.	Acid insoluble ash % by wt. (dry basis), max.	0.05	0.05
7.	alcoholic acidity % by wt. (dry basis)	0.10	0.10
8.	Water absorption % by wt.	55.0	60.0
9.	Maltose % by wt.	-	2.0-3.5
10.	Sedimentation value, min.	22.0	30.0
11.	Granularity	To satisfy the IS test	To satisfy the IS test
12.	Uric acid mg/100 gm. max.	10	10

4.10 LIMITS FOR HEAVY METAL CONTAMINANTS IN FOOD GRAINS UNDER PFA RULES, 1955

Sl. No.	Characteristics	Limits (ppm)
1.	Lead	2.5
2.	Copper	30.0
3.	Arsenic	1.1
4.	Zinc	50.0
5.	Cadmium Provisional	1.5
6.	Mercury	1.0

4.11 LIMITS OF PESTICIDES/INSECTICIDE RESIDUES IN FOOD GRAINS/MILLED FOOD GRAINS PFA RULES 1955

Sl. No.	Characteristics	Food grains (ppm)	Milled food grains (ppm)
1.	Aldrin, dieldrin, singly or in combination, expressed as dieldrin	0.01	-
2.	Carbaryl	1.50	-
3.	Chlordane CIS+TRANS	0.05	-
4.	Diazinon	0.05	-
5.	Dichlorovos	1.00	0.25
6.	Fenitrothion	0.02	0.05
7.	Heptachlor	0.01	0.02
8.	Hydrogen cyanide	37.50	3.0
9.	Hydrogen phosphide	0.05	0.01
10.	Inorganic bromide	25.0	25.0
11.	Lindane	0.25	-
12.	Malathion	4.0	1.0
13.	Phosphamidon	0.05	-
14.	Pyrethins	1.50	0.5

4.12 ISI AND PFA SPECIFICATION FOR BREAD

Sl. No.	Parameter	ISI wheat meal bread IS: 1960-1974	White bread IS:1483-1961	PFA Bread A. 18.14
1.	Total solid content % min	60.0	60.0	-
2.	pH	5.5-6.0	5.3-6.0	-
3.	Acid insoluble ash (on dry wt. basis) % max.	0.2	0.1	0.1
4.	Alcoholic acidity (90% alcohol)	-	-	Shall not be more than the equivalent of 7.5 ml N NaOH/100 g substance
5.	Crude fibre, % max. (on dry wt. basis)	1.8	0.5	0.5 (for white bread)
6.	Improvers: % max. a)Ammonium persulphate	0.25% of the mass of the cereal mix	0.25% of the mass of the cereal mix	0.25%
	b) Calcium phosphate	0.25 "	0.25 "	0.25
	c) $CaCO_3$	0.5 "	0.5 "	0.5
	d) NH_4Cl	0.05 "	-	-
	e) Potassium bromate	0.005 "	0.0075 "	0.005
	f) Sodium stearoyl-2-lactylate, calcium stearoy l-2-lactylate (single or in combination)	-	-	0.5
7.	Mould inhibitors: % max.			
	a) Ca or Na propionate	0.5% of the cereal mix.	0.3% of the mass of the maida	0.5
	b) Acetic acid (glacial)	0.25% "	0.2% "	0.25
	c) Vinegar	0.5% "	3.0% "	0.5
	d) Acid Ca Phosphate	1.0% "	0.6% "	1.0
	e) Sodium diacetate	0.4% "	0.3% "	0.4
	f) Acid sodium pyrophosphate	0.5% "	0.3% "	0.5

4.13 SUMMARY

There are a number of food laws being implemented by various Ministries/Departments. These are primarily meant for two purposes namely (1)

Regulation of Specifications of food and (2) Regulation of Hygienic condition of Processing/Manufacturing. Some of these food laws are mandatory and some are voluntary. The details of various food laws in operation in India are as under:-

1. Prevention of Food Adulteration Act (Ministry of Health)

The Act lays down specifications for various food products and is mandatory. The Ministry of Health in 1995 had constituted a Task Force under the Chairmanship of Shri E.S. Venkataramaiah, Chief Justice of India (retired). The Task Force recommended that there should be emphasis on good manufacturing practices instead of detection of adulteration and prosecution. It also expresses concern about lack of laboratory equipments and quantified persons. In addition it also suggested that the name of PFA Act be changed to Food Safety Act.

2. Agriculture Produce (Grading & Marking) Act (Ministry of Rural Development)

This Act is commonly known as AGMARK and is voluntary. The Act lays down the specifications for various agricultural commodities including some processed foods.

3. Laws being operated by Bureau of Indian Standards (BIS)

BIS is the largest body for formulating standards for various food items. These standards are also voluntary.

4. Essential Commodities Act

A number of quality control orders have been issued under Essential Commodities Act such as FPO, MMPO, Meat Product Order and Vegetable Oils Control Order. These orders are mandatory and primarily meant for regulating the hygienic conditions. They need to be clubbed under one order which may be called Food Products Order.

4.14 KEY WORDS

Quality: It is conformance to requirements or specifications. Quality is fitness for use.

Specification: a set of conditions and requirements of specific and limited application that provide a detailed description of the procedure, process, material, product, or service for use primarily in procurement and manufacturing.

Standard: a prescribed set of conditions and requirements, of general or broad application, established by authority or agreement, to be satisfied by a material, product, process, procedure, convention, test method; and/or the physical, functional, performance, or conformance characteristics thereof.

Quality control: It may generally be defined as a system that is used to maintain a desired level of quality in a product or service.

Quality assurance: all those planned or systematic actions necessary to provide confidence that a product or service will satisfy given needs.

4.15 SELF ASSESSMENT QUESTIONS

1. Explain the importance of BIS/PFA standards for bakery ingredients and products.
2. Specify standards for atta, maida and semolina.
3. Specify ISI and PFA specifications for bread.
4. What are the limits fixed for pesticides/insecticide residues in food grains/milled food grains according to PFA rules 1955.

5. Enlist the limits for heavy metal contaminants in food grains under PFA rules, 1955.
6. Enlist the important Acts/Orders applicable for wheat and wheat products.

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