Quality of Wheat Flour - How We Test it (AACC)

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Parameter	Limit	Importance	Method	Results
MOISTURE	15% max.	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 percent 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 (greater than 14.5 percent) attracts mold, bacteria, and insects, all of which cause deterioration during storage. Wheat or flour with low moisture content is more stable during storage. Moisture content can be an indicator of profitability in milling. Flour is sold by weight, grain is bought by weight, and water is added to reach the standard moisture level before milling. The more water added, the more weight and profitability gained from the wheat. Wheat with too low moisture, however, may require special equipment or processes before milling to reach the standard moisture level. Other methods of determining moisture content are used in the industry.	1. A small sample of flour or ground wheat (2 to 3 grams) is weighed and placed in a moisture dish. 2. The sample is heated at 130 degrees Celsius in an air oven for 1 hour. 3. The sample is cooled to room temperature and the residue is weighed.	• 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.
ASH CONTENT	Max 0.55% For extra Max 0.74% For 1st grade	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 a high ash content. Acid insoluble ash indicates silica contamination.	1. A sample of flour or ground wheat (3 to 5 grams) is weighed and placed in an ash cup. 2. The sample is heated at 585 degrees Celsius in an ash oven until its weight is stable (usually overnight). 3. The residue is cooled to room temperature and then weighed. ACID INSOLUBLE ASH 1. Ash obtained above is boiled with 25 ml HCl (1:2.5) for 5 minutes in water bath, covering the dish with watch glass. 2. It is then filtered through ashless fliter paper No. 40. 3. The residue is washed with water until free of acid. 4. It is then ignited at 6000C for 20 min. 5. It is then cooled and weighed.	• 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. Wheat or flour ash is usually expressed on a common moisture basis of 14 percent.
PROTEIN	10-15%	The flour protein content is an important parameter for bread flour. Flours containing higher protein contents are more expensive than flours of lower protein content. Likewise, flours with very low proteins for cakes are also more expensive. There is usually, but not always, a good correlation between protein content and bakery performance of a flour.	The amount of protein in a food material is determined by measuring the nitrogen content of the material and multiplying that value by a factor. The nitrogen content of a given protein varies depending on its source for wheat products the factor is 5.70. The classic procedure to determine the nitrogen was the Kjeldahl procedure. The Kjeldahl procedure has been replaced by the Dumas combustion procedure. Sample is mixed with cupric oxide and heated in a stream of carbon dioxide in a combustion tube packed with cupric oxide and copper metal. The organic material is converted to carbon dioxide, water and nitrogen. The gas stream is led into 50% potassium hydroxide. This absorbs the carbon dioxide and any oxides of sulfur, leaving only nitrogen as a gas. The volume of nitrogen is then determined. Analysis is carred out automatically. The percent nitrogen is then converted to protein. Both the Dumas combustion and the Kjeldahl procedures estimate the quantity (total amount) of protein and not the protein quality.	

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GLUTEN	22-30% wet 8-14% dry	It helps to understand the gluten content in flour and thereby selection of flour as per the product to be manufactured.	1. 25 gram flour is kneaded with about 15 ml water to make a dough ball. 2. The dough ball is allowed to immersed in water for one hour to ensure hydration. 3. After this the starch is washed out by kneading gently in a gentle stream of water over a fine sieve of silk till the washed liquid is clear. 4. The cohesive gluten obtained is pressed as dry as possible & then weighed. 5. The wet gluten so obtained is then dried at 1000 C for 24 hr. and weighed again to get the value for dry gluten.	Gluten in a sample can be estimated by washing the dough free of starch, sugars, water soluble proteins, and other minor components. The wet cohesive mass obtained is wet gluten while the dried product obtained from it is called dry gluten. High Gluten is not always good -
FALLING NUMBER	250-450	The level of enzyme activity measured by the falling number test affects product quality. 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.	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 a slurry. When grinding a wheat sample to perform a falling number test, it should be at least 300 grams to assure a representative sample 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. 3. The time it takes the stirrer to drop through the paste is recorded as the falling number value.	The falling number instrument analyzes viscosity by measuring the resistance of a flour-and water paste to a 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 flour. • A low falling number (for example, below 200 seconds) indicates substantial enzyme activity and indicated sprout damaged wheat flour.
Acidity %	0.08% or less	The Acidity due to the presence of acidic Organic materials in the flour-expressed as H2SO4. Higher alcoholic acidity is an indication of higher acidity of the germ oil in the flour though there is no direct relationship or equivalence between the two.	1. About 8-10g sample is weighed in & flask & freshly prepared 50ml of 90% neutralized ethylalcohol is poured in sample & allowed to stand overnight with occasional shaking. 2. The alcoholic extract is filtered through Whatman Filter paper no. 1 in a conical flask 3. Initial 10 ml extract is rejected and balance quantity is rejected. 4. 10 ml of extract is then titrated against 0.05 N Sodium hydroxide solution using phenolphthalein as indicator.	It is expressed as % H2SO4
GERM OIL CONTENT AND ACIDITY		During wheat milling, irrespective of the care taken by millers, a small amount of Germ is bound to be mixed with the endosperm. Germ, with its high content of fat is prone to deterioration. While the higher content of germ oil in flour is an indication of poor milling/higher extraction rate. Higher acidity of the germ oil is an indication of the age & storage of wheat/flour. The acidity of extracted fat in biscuits is greatly influenced by the germ oil content & acidity in the flour.	1. The flask with the extracted germ oil is treated with 50 ml of benzene-alcohol-phenolphthalein mixture. 2. Contents are mixed thoroughly & then titrated against 0.05 N Sodium hydroxide. 3. End point is the appearance of pale permanent pink colour.	
SEDIMENTATION VALUE		• The sedimentation test provides information on the protein quantity and the quality of ground wheat and flour samples. Positive correlations were observed between sedimentation volume and gluten strength or loaf volume attributes. The sedimentation test is used as a screening tool in wheat breeding as well as in milling applications.	1. A small sample of flour or ground wheat (3.2 grams) is weighed and placed in 100-milliliter glass-stoppered graduated cylinder. 2. Water (50 milliliter) is added to the cylinder and mixed for 5 minutes. 3. Lactic acid solution is added to the cylinder and mixed for 5 minutes. 4. The cylinder is removed from the mixer and kept in upright position for 5 minutes. 5. The sedimentation volume is recorded.	• The sedimentation test is conducted by holding the ground wheat or flour sample in an acid solution. • During the sedimentation test gluten proteins of ground wheat or flour swells and precipitate as a sediment. • Sedimentation values can be in the range of 20 or less for low-protein wheat with weak gluten to as high as 70 or more for high-protein wheat with

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				strong gluten.
CRUDE FIBER	2.5% or less	crude-fiber test has been criticized for not truly representing the nondigestible fraction of foods. Acid and neutral detergent fiber, cellulose, andlignin values provide more meaningful information about the digestibility of the material. Nevertheless, the crude-fiber test remains the industry's only official method for the reporting of nondigestible carbohydrates. In some countries suppliers are obliged to meet legal specifications regarding the crude fiber content of their merchandise. Wheat flour is not routinely tested for fibrous components, because the level of these in white flour is too low to significantly affect the digestibility.	To determine crude fiber in flours, feeds, and feedstuffs. Crude fiber is the loss on ignition of the dried residue remaining after digestion of the sample with 1.25% H_2SO_4 and 1.25% NaOH solutions under specific conditions. This method utilizes the Oklahoma State filter screen or the Modified California State Buchner funnel for filtration and uses prepared ceramic fiber as a filtration aid instead of asbestos. This method is applicable to grains, meals, flours, feeds, and fiber-bearing material from which fat can be extracted to leave workable residue.	
HEAVY METALS	Pb,Cu,Zn - TBC			
FLOUR COLOR		Flour color is important because it affects the crumb color of the finished product. The color of the flour used for variety breads, that have a dark color because of non-wheat components in the formula, is not important. Unbleached flours have a creamy color because of the presence of carotenoid pigments in the endosperm. The level of these pigments and therefore the color of the flour will vary from one flour to another. The level of pigments is under genetic control. The pigments can be readily bleached with benzoyl peroxide (mixed with the dry flour at the mill) or by enzyme active soy flour in the bread formula. number of instruments have been developed to measure the color of solids and foods. Although the may be useful with flour and baked products, they have not been readily accepted by the milling or baking industries.	Flour color can be judged by visual comparison with a standard patent flour. In the Pekar (slick test), the sample flour is slicked alongside the standard sample and their colors compared visually. This procedure is also useful to determine if the sample is contaminated with bran. In the procedure, 10-15 grams of the flour to be tested is placed on a glass, plastic, or metal plate. The surface of the flour is smoothed with a clean flour slick to a wedge approximately one-fourth inch thick at the top end of the flour sample down to a thin film at the bottom edge of the plate. The sides of the flour sample are trimmed so they form a straight edge. Next, similarly slick a second flour beside the first making certain that the two flours join and a straight edge forms between the two samples. If addition flours are to be compared, they can be placed on the plate next to the other flours and “slicked” so that there is one continuous wedge of all the flours, with a distinct line of demarcation between them. Any color differences between the samples can then be readily evaluated.	Color difference attributable to bran can be further accentuated by submerging the same samples at an angle into fresh clean water until air bubbles cease to rise (1-2 minutes). The plate is then carefully removed and placed in a warm place for the surface to dry. The relative intensity of the sample colors can then be noted after the surface has dried. The above experiment can also be carried out by dripping the glass plate containing freshly prepared flour wedges into a solution containing pyrocatechin. The bran contains the enzyme polyphenol oxidase that will convert the pyrocatechin into brown pigments. After the surface has dried, the samples are inspected for the presence of bran specks.
MYCOTOXINS	15PPB max	Mycotoxins are produced by certain fungi (e.g.,Aspergillus ssp., Penicillium ssp., and Fusarium ssp.)that grow on human food and animal feed ingredients such as corn, sorghum, wheat, barley, peanuts, and other legumes and oilseeds. Five broad groups of mycotoxins—aflatoxin, vomitoxin, ochratoxin A,fumonisin, and zearalenone—are commonly found in food and feed grains Although humans face health risks stemming from the contamination of grains with other naturally occurring substances, mycotoxins are unique in that they are produced naturally on the grain, and their presence (at least initially) is usually associated with uncontrollable factors such as climatic conditions.Consuming foodproducts that contain high levels of certain mycotoxins can cause the rapid onset of mycotoxicosis and other long term health problems	Measured by test system in Parts per billion PPB	The standard for aflatoxins for human food is 20 ppb . In Ukrainian grain and thereafter flour levels are historically lower. Nevertheless we test wheat grain used for flour production and insure best storage conditions of the later. Mycotoxins level is also checked by random checks throughout the production