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Bread Wheat Quality: Physical, Nutritional and Techno-Functional Properties

Cherinet Kasahun

Food Science and Nutrition Research Directorate, Ethiopian Institute of Agricultural Research, Kulumsa Agricultural Research Center, Assela, Ethiopia

Email address:
Cherukas05@gmail.com

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Abstract: The grain physical quality, nutritional composition, milling process and technological characteristics of bread wheat is very important for end-use quality of bread. Many food processing industries utilizing bread wheat as a raw material are being established in Ethiopia. As a result, information on wheat grain physical, chemical and functional characteristics to match end use quality is very important. In line with this, the objective of this review is to characterize the physico-chemical and functional properties in relation to bread making quality and to review more classification of bread wheat cultivars considered as soft and hard wheat based on quality traits characterized. Currently there is an increasing demand among consumers for bread that contains not only traditional nutrients but also provides other compounds that are beneficial to health and well-being. Food systems that feed the world must be changed in ways that will insure that balanced nutrient supplies are available continuously to all people in adequate, accessible and affordable amounts. This paper reviews about the most important wheat grain quality, milling process and their nutritional value including product qualities indices. The opportunities of plant breeding and other technologies to improve the nutritional quality of wheat are also discussed. Different research papers, journals and other national and international resource were used during the review process including agricultural books, thesis, reports and other important scientific resources. According to the present review the bread wheat grain physical qualities, nutritional and technological properties is important quality indices for end-use quality of bread wheat grains. Therefore, working on wheat quality in addition to agronomic and disease resistance is critical issue. Further research work is recommended on wheat quality of landraces, old, newly released and promising bread genotypes for better grain physical qualities, nutritional and product making quality that helps famers, processors, millers and import substitution for the country.

Keywords: Bread Wheat, Quality, Nutritional

1. Introduction

Wheat is the most important cereal crop and staple food for about two billion people around the world. Today, it is widely grown cereal in Ethiopia, both as a source of food for consumers and as a source of income for farmers. The crop provides about 20% of all calories and proteins consumed by people around the globe [54]. It is the fourth most widely grown crop next to tef, maize, and sorghum, ranking 4th/5th in terms of the gross value of production following tef, enset, and maize in Ethiopia [16]. Wheat (*Triticum aestivum*) is one of the major cereals grown for use as food and industrial raw materials in Ethiopia. It is an important staple food in the diets of many Ethiopians, providing an estimated 12% of the daily per capita caloric intake for the country's over 90 million population [26]. Covering. The objective of this review is to address bread wheat quality in terms of physical, nutritional, and Technological properties in one reviewed document by using different research articles and other important sources.

2. Methods

Different research papers, journals, and other national and international resources were used during the review process including agricultural books, thesis, reports, and other

important scientific resources.

3. Literature Review and Discussions

3.1. Overview of Wheat Varieties

There are different species of wheat, however, *Triticum aestivum* (common or bread wheat) and Triticum durum (durum or macaroni wheat) are the most cultivated wheat varieties in the world [59]. Different wheat varieties have different characteristics that are more or less suited to different types of bakery products. Bread wheat (*Triticum aestivum*) is common wheat and the most common cultivated crop taking a share of up to 95 % of bread production in the world [28]. In Ethiopia, the bread wheat breeding program started with the establishment of the Ethiopian Institute of Agricultural Research in 1966. After that, the bread wheat breeding program moved to Kulumsa Agricultural Research Centre (KARC) with the wheat regional center of excellence [24].

The main aim of the wheat breeding program is to search for widely adapted high-yielding and disease-resistant varieties through selections from indigenous germplasm, by an introduction from abroad, and also through hybridization. However, they were not given attention to the wheat qualities. The program started with a mass selection from locals and introduced cultivars from abroad through FAO, USDA, and CIMMYT.

In Ethiopia, the national agricultural research system (NARS) is responsible for variety development and generation at the national level. Since the establishment of agricultural research centers in the country, about 100 wheat varieties (67 bread and 33 durum wheat varieties) are released, distributed, and produced [25]. The major research centers which were dedicated to wheat research and variety release are presented in Figure 1.

Kulumsa Research Agricultural Center focuses on bread wheat research, and so far it has released 37 varieties of bread wheat. On the other hand, Debrezeit Agricultural Research Center (DZARC) and Sinana Agricultural Research Centers focused on durum wheat research and generated 15 and 10 improved durum wheat varieties, respectively until [44].

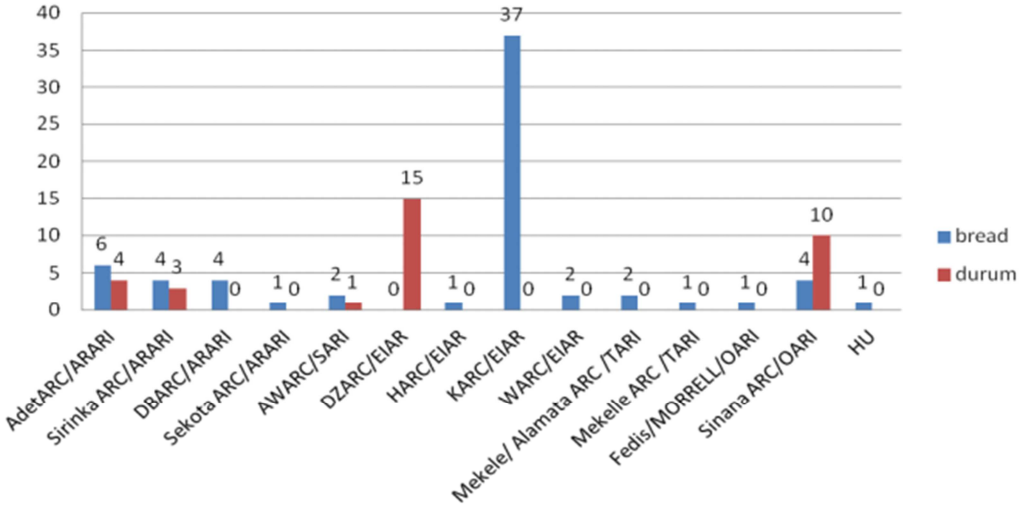

Figure 1. *Major research centers released wheat varieties [45].*

3.2. Wheat Production in Ethiopia

Wheat (Triticum aestivum. L) is one of the most important crops in the world in production and nutrition. Annually, wheat is produced on 224.53 million hectares of land, and 672.2 million metric tons of wheat is produced in the world [58]. In Ethiopia, wheat is one of the most important cereal crops widely cultivated. It is cultivated both in bi-modal and uni-modal rainfall areas. Bread wheat (Triticum aestivum. L) and durum wheat (Triticum durum) are the two species that are mainly cultivated by small-scale farmers in Ethiopia. It ranks fourth in area coverage next to tef, maize, and sorghum, respectively [16]. In Ethiopia, about 95.85% of land coverage and 99.29% of total productions accounted from the Amhara region in the 2017/18 cropping season and the Benishangul Gumz region is the second producer [14].

The most important wheat producing countries in SSA are Ethiopia, South Africa, Sudan, Kenya, Tanzania, Nigeria, Zimbabwe and Zambia in descending order [36]. Currently, the country produces more than 3 million tons of wheat on 1.7 million hectares. Since the introduction of wheat, more than 100 varieties have been released and more than 65 % of wheat farms planted with improved cultivars. The average national productivity of wheat is about 2.2 tons per ha while model farmers in the best wheat agro-ecologies of Arsi and the like managed to produce 5-6 tons per ha [24]. In Ethiopia wheat is one of the strategic cereal crops to attain food security although imports of wheat from the world market are still an ongoing event.

3.3. Consumption of Wheat in Ethiopia

The wheat consumption trend in Ethiopia is gradually

increasing in urban areas due to high population growth, migration of people to urban areas, and changes in lifestyles. In most parts of the country, families prefer to use tef to make injera (fermented thin bread) and sometimes to make porridge. Tef can also be used to produce local beer and liquor. Because of the price escalation of tef compared to wheat and of the ease of preparation of wheat and unique properties of wheat flour, most middle and lower-class populations are shifting to greater wheat consumption. Over 50% of the average daily caloric intake of an average household is from wheat, sorghum, and corn [26]. Cereals are staple foods for a large proportion of the world population. Millets are one of the economically important cereals in the world asides the major cereals wheat, rice, maize, and oat [17].

Wheat is milled into flour which is processed into various baked products and spaghetti. Unlike other staple grains, wheat is imported in large volumes [26]. Due to the importance of the crop and its growing import burden, the government of Ethiopia gives a high priority to efforts to increase wheat productivity and improve wheat marketing efficiency to stop wheat importation from abroad in the coming two years by using irrigated areas in the countries. Therefore, it is critical issue review bread wheat quality in terms of grain's physical, nutritional and technological characteristics during the milling process for industrial quality requirements.

3.4. Impact of Wheat Varieties on Product Quality

Wheat quality means different things, depending on whether you are in the wheat processing chain. These qualities are wheat's physical qualities, nutritional composition, techno-functional properties, rheology, baking quality and sensorial qualities of bread or pasta production, and consumers' acceptance of wheat-based food products. The physical and chemical characteristics of five Syrian durum wheat cultivars grown under varying environmental conditions were investigated and it had significant differences [13].

The variation in grain hardness is the single most important trait that determines the end-use quality of wheat and categories products. Grain hardness classification is based primarily on either the resistance of kernels to crushing or the particle size distribution of ground grain or flour [41].

Grain and flour protein are used as indicators of dough properties and processing performance. The impact of these characteristics on the quality of the produced bread is important. Wheat varieties should be classified and traded worldwide based on quality parameters and requirements specified by millers, bakers, and end-users [41].

3.5. Wheat Product and Quality

Among cereals, wheat is the most important crop in terms of production and consumption. World nutrition mostly depends on wheat and wheat products such as bread, chapatti, biscuit, pasta, and fermented products, as the people all over the world consume the wheat product(s) in one of these forms [5].

Wheat quality is a very wide subject that will be defined differently by the different stakeholders of the wheat value chains, which makes it an extremely complex and variable concept. For farmers in some countries, wheat quality is considered what allows them to allocate their harvested grain at the grain market and get the highest price for it. This is usually different among countries, where each one has different regulations that may prime farmers for producing better grain quality or not. Good morphological characteristics (grain size and density through test weight) and absence of grain kernel damage are some of the most common traits considered at grain markets to determine the grade and sometimes the price of the produced wheat.

In other countries such as Australia or Canada, there are more complex grading systems, in which protein content is usually an important trait [12]. In other countries, subsistence farmers will mill and process the wheat to feed their families and in these cases, farmers consider wheat quality which allows them to produce a good product with desirable organoleptic properties. For millers, wheat quality is the ability of a wheat variety to produce high levels of flour or semolina during the extraction process. In this process, the level of contamination of the flour/semolina with bran fractions is also important and is linked in most cases to undesirable characteristics for the end-use quality of the product.

For milling quality, the traits probably most important are morphology, grain density (test weight) ([40]., and grain hardness [22]. Millers prefer large grain with a plump shape that is filled and not shriveled. These characteristics are also targets for breeders to increase grain yield in the field. On the other hand, food manufacturers are more focused on processing quality, the ability of a wheat variety to be processed with minimum cost to give a uniform product, and end-use quality, the ability of a wheat variety to produce a specific product according to the consumers' preferences. For both types of quality, grain hardness and gluten quality and quantity are very important.

Nutritional quality, the ability of a food to supply nutrients for complete physical and mental development and a healthy life, is becoming also a big priority for food manufacturers due to the interest of consumers in that issue. Last, but not least, consumers could have very different ideas of what wheat quality means. Some of them will think about the end-use quality of the product, while others could think about the processing conditions (handmade vs mechanized or industrial) or the nutritional quality of food products. End-use consumers vary in terms of quality demands, although there are several traits well-identified among consumers as desired for specific products (soft crumb for bread, yellow color in pasta, the shelf life of products, etc.). The goal of increasing productivity and production of wheat will be realized if and only if the ultimate users, namely farmers, adopt the technologies that are developed by research. Wheat quality means different things, depending on that you are in the wheat processing chain.

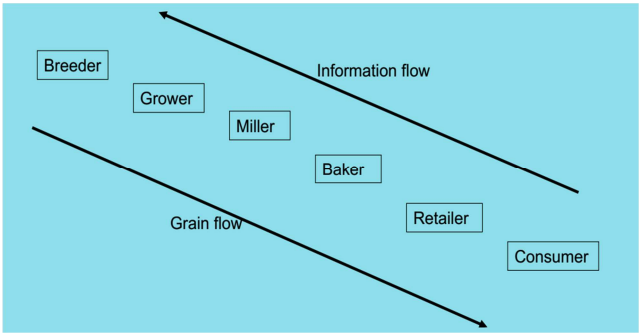

Figure 2. *Wheat value chain (Source: Trethowan et al., 2001).*

3.6. Bread Wheat Grain Quality

Grain quality is defined by a range of physicochemical characteristics with which threshold requirements are set according to end-use requirements. For staple grains such as wheat, whole grain physical properties such as size and shape influence milling yield and screening losses, which determine the processing efficiency and value of the grain. Whole grain quality incorporates the physical characteristics of grain, such as milling yield, screenings, and test weight which is influenced by both genotype and environment. The quality of wheat grain depends on several characteristics, among which grain hardness, grain size, grain weight, protein content, and composition of high molecular weight gluten subunits are the most important [51].

Test weight is one of the simplest criteria used to determine the quality of grain and measure of grain bulk density. The test weight of wheat is considered the most common and easiest way to quantify wheat grain physical quality. It is an indicator of general grain quality and primary grain specification, normally the higher the test weights the higher the quality, and the lower the test weight the lower. The grain quality decreases dramatically as grain deteriorates [11]. Therefore, grain physical qualities are important for end-products qualities.

3.7. Wheat Grain Kernel Size

The most significant indirect way of expressing grain size remains the thousand-kernel weight. However, knowing the size composition is very important. First, it helps in choosing cleaning screens that eliminate impurities larger than the largest kernel and impurities smaller than the smallest kernel. Second, the cylinder gap of the first grinding break roll can be diminished or enlarged depending on the lots‟ grain size. Third, the adjustment of the rate of grain feed at the beginning of the equipment chain can be changed accordingly. Wheat is generally oval-shaped, although different wheat has grains that range from almost spherical to long, narrow, and flattened shapes. The grain is usually between 5 and 9 mm in length, weighs between 35 and 50 mg. The wheat grain kernel contains 2-3% germ, 13-17% bran, and 80-85% mealy endosperm (Australia wheat grain quality standard).

Thousand kernel weight of any crop depends on its size. Usually grain weight increases with the increase of grain size. [53]. evaluated four wheat varieties and reported that thousand kernel weight from 33.0 to 42g. [37] reported that compared two wheat varieties and found that variety had thousand kernel weights 34 to 45g.

Dhingra S. and Jood, S. (2004) [19] Observed the physical characteristics of wheat and reported that 1000 kernel weight is 41g. [55] worked on 47 commercial wheat varieties and reported that 1000 kernel weight, grain length, and width ratio in the range of 30 to 57 g, 6.0 to 8.0 mm, and 2.9 to 3.7 mm respectively.

3.7.1. Hectoliter Weight

Hectoliter weight, which is dependent on both grain size and shape is considered to be one of the important physical criteria in all wheat grading systems as it highly influences flour yield and other quality parameters [56] Weight per unit volume, or test weight, is the quantity of grain that packs into a fixed volume. High values greater than (80kg/hl) indicate a good variety having plump kernels undamaged by disease or environmental stress. Hectoliter weight is widely used as primary wheat grading specification and milling quality indicator. Studies made by [18]. have shown that the test weight of Canadian wheat is strongly related to semolina yield.

3.7.2. Thousand and Kernel Weight

TKW is closely associated with test weight is the weight of 1000 kernels called thousand kernel weights Hectoliter weight was measured dockage-freeree samples using a standard laboratory hectoliter apparatus and electronic balance according to AACC method 55-10 [2]. Wheat test weight is a good predictor of flour milling potential because it exhibits a strong linear relationship to the kernel weight [18]. Generally considered as a guide to flour milling yield potential, test weight is a globally-used measurement of bulk density. It reflects the weight of kernels relative to their size and grain packing capacity [8]. Compared two Indian wheat varieties and found that variety HD-2733 had a higher total grain weight (42.47g) as compared to variety HD-2687 (35.21g) [7].

Wheat milling performance is related to kernel plumpness. Thin, shrunken, and damaged kernels because reduced yield of flour. In addition to specifying the minimum test weight, millers often will specify the minimum proportion of kernels that must be held on a sieve with a carefully defined aperture to avoid excessive amounts of thin kernels. Studies made show that the test weight of the Ethiopian released wheat cultivars ranges from 76kg/hl to 86 kg/hl and thousand kernel weight ranges from 33g to 50g [23]. [47] worked on five varieties of organic and inorganic wheat and found that inorganically grown varieties had higher 1000 kernel weight (42g) and [6] compared two Indian wheat varieties and found that a variety of grain weights ranged from to (35 g) to (42 g).

3.7.3. Wheat Grain Hardness

Wheat grain hardness is one of the most important characteristics of wheat quality. The hardness of the wheat

grain influences the ease with which the endosperm is separated from the bran during the milling process and also controls some of the properties of the flour produced. The wheat hardness is strongly associated with flour yields [35] Soft-textured wheat genotypes showed the least value for grain hardness and higher break flour and lesser reduction flour yield. Genotype, environment and their interaction play an important role in the final expression of grain yield and quality attributes [38]. Wheat grain hardness is an important parameter that is considered while determining milling and baking properties [9] of wheat. Two distinct categories of wheat varieties are based on grain hardness; namely, "hard" grains and "soft" grains. The kernels of hard grains generally have a dark, shiny appearance, whereas, soft grain kernels have an opaquer and floury look. During the milling process, starch damage is higher in hard wheat varieties and this damage is favorable as it contributes to the soft texture and mouth-feel of the crumb of bread. Hard wheat varieties grains are more suited for yeast-leavened bread-making due to their tolerance to fermentation [10].

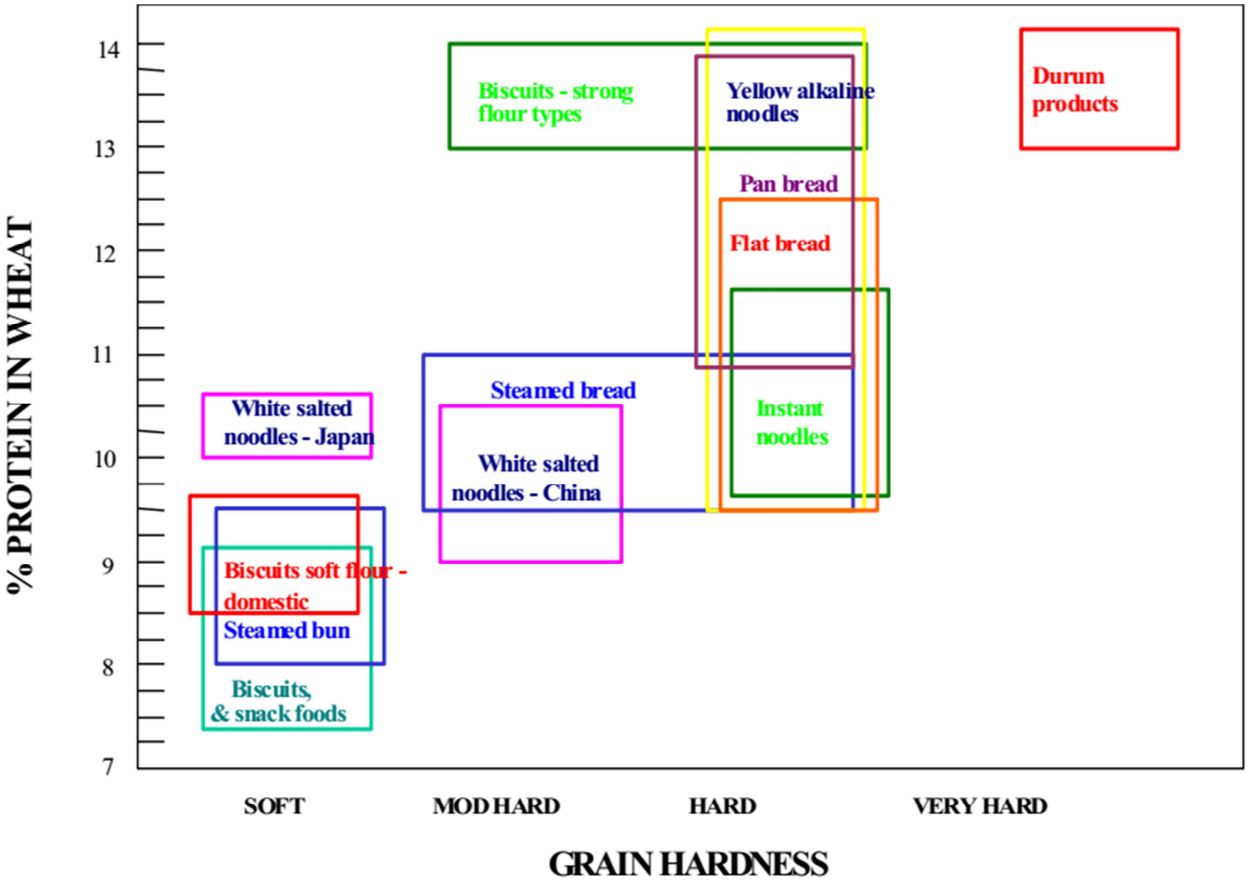

Figure 3. *Classification of wheat-based on the hardness.*

Starch damage is also known to retard the staling of bread [10] Soft wheat, on the other hand, does not undergo extensive starch damage and this property makes it suitable for making products like cakes, biscuits, etc. Hard wheat varieties grains have higher protein content than soft wheat varieties grains and hard wheat kernels have more resistance to grinding than soft kernels [10].

3.8. Wheat Flour Quality

The quality of wheat flours can be defined for several parameters including protein, moisture, gluten, enzyme activity, and techno-functional properties, none of which serves as adequate by itself and also the physicochemical tests like ash content, flour color, and falling numbers evaluate important characteristics for the pastry industry [46]. Physico-chemical and techno-functional properties of wheat flour are influenced either by genotype or by other non-genetic factors [6].

3.8.1. Wheat Flour Protein Content and Quality

Protein content and quality play a major role in the determination of the quality of the grain, flour, dough, and bread. In resolving of genetics base of grain quality in wheat the main investigations were focused on protein and gluten contents and quality, grain hardness characteristics, which are genetically controlled [42].

A combination of those parameters and the flour protein content can be used as a base for the estimation of the technological quality of selected materials. Protein is a primary quality component of cereal grains. The protein concentration is influenced by both environmental and genotypic factors that are difficult to separate. Protein content and protein quality have been also shown to be

significant for baking quality.

3.8.2. Gluten Content and Quality

Gluten is an important constituent of wheat because it provides strength and texture to baked wheat products and makes it capable to form lots of bakery products. Wet gluten content is a plastic-elastic substance consisting of the proteins gliadin and glutenin, obtained after washing out the starch from wheat flour dough.

Gluten-forming proteins are primarily responsible for the techno-functional properties of wheat flour. The amount of gluten in the flour is an index of the protein content and physical properties of the washed-out gluten (i.e. index of flour strength). Wet gluten and dry gluten criteria are as a primary test of flour quality. This is likely due to the simplicity of the test and the quantitative information obtained relating to both gluten content and quality. Wet gluten is highly correlated to the protein content which is the most desired quality test parameter [15]. The gluten index method provides information on both the quantity and quality of wet gluten. The gluten index value is a criterion defining whether the gluten quality is weak, strong, or normal.

3.8.3. Wheat Flour Ash Content

Ash is the residue that remains after the complete combustion of the organic compounds of the food products. The estimation of the ash content in cereals enables the classification of flours. Some specialty products requiring particularly white flour call for low ash content while other products, such as whole wheat flour, have high ash content. [26] reported that the ash content of different varieties of wheat flour was variable in the range from 0.52% to 0.68%.

Ash content shows the mineral content in the wheat. Bran has higher mineral content than the endosperm. Small shivered kernels have more crude fiber and ash than large, plump kernels and consequently yield less flour. Therefore, ash content can be used as a means in comparing the milling value of different cultivars. Previous researchers have reported that several European milling industries consider ash content as an important aspect of durum wheat quality for semolina milling. A highly significant correlation is also found between ash content and the brightness of flour. For any given wheat, higher extraction produces darker flour with higher ash content [18].

3.8.4. Color of Wheat Flour and Products

The color test on the flour sample indicates the whiteness, which is considered as a quality attribute as it affects the appearance of the final product. The color of the flour depends on the extraction rate of flour, amount of pigments, and flour particle size. The darkness or whiteness of the flour is due to the contamination of bran particles. Higher the flour extractions rate, darker the color of the flour, and vice versa. The coarse flour generally looks dull and darker than its finer counterpart due to the shadow effects of the larger particles.

To carry out a more objective color analysis, color standards (color spaces and numerical values) are often used as reference material which is used to create, represent and visualize colors in two and three-dimensional space. The RGB (red, green, and blue), the CMYK (cyan, magenta, yellow, black), and the L*a*b*color space are the three main color spaces that used to define the color.

According to Adobe system (2002), the L*a*b* model has the largest range encompassing all colors in the RGB and CMYK gamut. The L*a*b* values are often used in food research studies. The L*a*b* color space is an international standard for color measurement developed by the Commission Internationale d"Eclairage (CIE) in 1976. The L*a*b* color consists of a luminance or lightness component (L* value, ranging from 0 to 100), a* component (from green to red) and the b* component (from blue to yellow) along with two chromatic components (ranging from -120 to +120). The L*a*b* color is device independent, providing consistent color regardless of the input or output device [3].

3.8.5. Falling Number

The Falling Number test [1] provides an index of α-amylase activity 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.

It indicates the amount of sprout damage that has occurred within a wheat sample. Generally, a falling number value of 350 seconds or longer indicates a low enzyme activity and very sound wheat quality. As the amount of enzyme activity increases, the falling number decreases. Values below 200 seconds indicate high levels of enzyme activity. The falling number measures the viscosity of a mixture of water and ground wheat mixed in a tube and placed in a boiling water bath (100°C).

The falling number is the time in seconds required for stirring (60s) plus the time taken for the stirrer to fall through the heated flour suspension while it is being liquefied by the enzyme. The falling number test is a good indicator of sprout damage in durum wheat and it is used to assess to α-amylase activity in durum wheat. Factors encouraging germination will tend to result in an increased enzyme (α-amylase) activity, which breaks down starch and reduces viscosity and a corresponding drop in falling number. It is, therefore, the indirect measure of starch liquefaction.

Increased α-amylase activity (drop-in falling number) can develop in a standing crop of wheat with a high level of rainfall close to harvest at its physiological maturity or by moisture abuse after harvest. If the crop is lodged in a humid microclimate, germination can be encouraged within the mat of laid straw and ears. An increase in α-amylase activity in the grain is associated with the process of germination. Sprout-damaged wheat is considered undesirable because of inferior pasta-making potential and bread baking [1].

3.8.6. Nutritional Composition

Wheat is a rich source of carbohydrate, it also contains,

protein, fat, ash, fiber, and vitamins as well as minerals such as sodium, potassium, calcium, magnesium, iron, phosphorus, copper, zinc [39].

The nutritional content comparison of durum wheat (semolina) and bread wheat flours contain the percentage of protein (12.70, 10.60); damaged starch (11.50, 8.50); carbohydrate (77.80, 82.00); amylose (27.00, 23.00); fat (1.00, 0.50) and dietary fiber (1.19, 0.91), respectively [57]. The three main distinct parts of the wheat kernel are the bran, the endosperm, and the germ. The protein content is a key quality factor that determines the suitability of wheat for a particular type of product as it affects other factors including mixing tolerance, loaf volume, and water absorption Capacity [52]. Both protein quantity and quality are considered important in estimating the potential of flour for its end-use quality [27].

Quality improvement of wheat involves grain or flour quality, functional properties, and end-use product quality. In the past several decades, dough rheological properties have increased in importance in wheat breeding [21]. Perhaps, because they provide more direct information than grain or flour traits. Additionally, in wheat breeding programs, the end-use quality of many breeding materials can't be directly determined, owing to limited seed quantities, and is often predicted by the evaluation of dough properties (In in Chinese with English abstract, 2006). In recent years, wheat quality research has focused partly on correlations among flour and dough properties and end-use quality. The large variation in dough rheological properties among some wheat cultivars has been found in different end-use products.

The nutritional importance of wheat should not be underestimated, particularly in less developed countries where bread, noodles, and other products may provide a substantial proportion of the diet. According to [4] wheat provides 20% of the food calories. It contains 78.10% carbohydrate, 14.70% protein, 2.10% fat, 2.10% minerals, and considerable proportions of vitamins (thiamine and Vitamin-B) and minerals (zinc, iron).

Among all the nutrients in whole wheat, the bran contains a small amount of protein, larger quantities of the B-complex vitamins, trace minerals, and indigestible cellulose material called dietary fiber. Wheat germ is the embryo of the wheat kernel. The germ or embryo of the wheat is relatively rich in protein, fat, and several of the B-vitamins [4]. The outer layers of the endosperm and the bran contain a higher concentration of protein, vitamins, and phytic acid than the inner endosperm. The inner endosperm contains most of the starch and protein in the grain. [43] reported ash content, crude protein, crude fat, moisture, fiber, and total carbohydrate contents values as 0.46%, 12.86%, 1.40%, 11.31%, 0.82% and 73.15% of wheat flour respectively.

3.8.7. Minerals

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

Bran has been shown to have a detrimental effect on the quality of bakery products. [29] reported that higher amount of calcium, iron, phosphorus, zinc, magnesium, and manganese in wheat bran (76.0, 10.6, 108.0, 7.3, 61.10, and 11.5 mg/100g) and lower in wheat flour (15.0, 1.30, 101.30, 0.6, 20.0 and 0.6 mg/100g, respectively). Most of the seed-zinc is present in the embryo and aleurone layer, whereas the endosperm is very low in zinc concentration [49].

3.8.8. Anti-Nutritional Factors

Reducing anti-nutritional factors has become an important criterion of the breeding programs to improve wheat grain quality [31].

Minerals such as iron, zinc, and calcium is known to be significantly affected by the fiber, phytic acid, and tannin content of foods. Ant-nutritional factors cause negative impacts directly or indirectly to consumer's health and hence should be lowered down or removed from wheat grains to improve quality. The phytate interferes, iron, and zinc absorption in the gastrointestinal tract with the formation of insoluble phytate-mineral complexes [32]. Traditional processing technologies (decortications/ removal of the bran, soaking, germination, and fermentation) and milling technology are commonly applied to reduce or remove the levels of ant-nutritional factors (trypsin inhibitor, tannins, and phytates), denatures undesirable enzymes and retains natural colors and flavors of foods [32].

3.9. Wheat Milling Process

Cleaning removes large impurities and the very small and lightweight impurities. The second process is the conditioning. Wheat is tempered before milling to toughen the bran, thereby reducing the number of bran specks in the flour. The milling process contains breaker, reduction, and purification. The break system is the first step for the wheat milling process and it allows the gradual release of coarse endosperm particles with a minimum yield of flour. Passage through the rolling mills is alternated with sifting phases carried out by the plan sifters and the purifiers. The next step is a reduction process that helps to produce flour with finer granulation [1].

Wheat Millers want uniformity and consistency to meet wheat flour or semolina specifications demanded by their customers. End-users want uniformity and consistency to make products acceptable to consumers without continually changing processing conditions. Whole grain flours are produced by a variety of techniques and result in flours with widely different particle sizes and functionalities (Kilhberg et al., 2004). Wheat Flour is produced by separating the endosperm from the other components of the wheat kernel and reducing it to a fine powder.

Conventional milling reduces the nutritional content of

flour and concentrates them in the milling residues (Cubadda et al., 2009). The milling process indicated that at a low extraction rate (68%), the protein, fat, fiber, ash, iron, zinc, phosphorous, and antioxidant contents of the samples significantly decreased or removed by milling [33]. 2015Wheat flour milling is a grinding process that gives different fractions of wheat flour which affect the quality of bakery products. During wheat milling, a portion of the starch granules sustains mechanical damage, the level of which depends on the wheat hardness and milling technique. Millers believe that granulation is very important in the production of quality wheat flour. It has been suggested that flour particle size, damaged starch, and protein quality and quantity have adverse effects on baked products [30].

3.9.1. Bread Baking

The bread-making quality parameters measured for the pup loaf straight-dough procedures baking, water absorption, dough mix time, loaf volume, specific loaf volume, and loaf weight. The bread baking process involves a series of interactions of bread raw materials, equipment, and people in a certain environment. There are numerous activities taking place during the bread-making process. Such activities can be chemical, physical, and biological.

Chemistry of dough has shown that there is an interaction between carbohydrates, lipids, and proteins. The physical science in dough making is rheology and the biological activities involve the fermentation process by yeast [1]. The major ingredients of bread are wheat flour, water, yeast, and salt but, other ingredients also incorporated for different purposes based on the desired products. Water has functions in bread making. It makes possible the formation of gluten. Only when flour proteins are hydrated, gluten is formed. Water controls the consistency of dough and assists in the control of dough temperatures and warming or cooling of dough's can be regulated through the water. It dissolves salts; suspends and distributes non-flour ingredients uniformly.

Water activates enzyme activity and keeps bread palatable longer if sufficient water is allowed to remain in the finished loaf. In bread production, salt is mainly added for taste. It brings out the taste of other ingredients and helps to improve the flavor and characteristics of bread. Salt is toughened and without salt, the dough is wet. It, therefore, improves grain and texture of loaf by strengthening the dough, thus indirectly helping color, grain, and texture. The function of yeast in bread making is to lighten the dough and impart to it a characteristic aroma and flavor. This has been the function of yeast for centuries and remains so even though its activities have been improved over some time through scientific modifications in its manufacture and a broader understanding of bread making methods [1].

The straight dough baking method is a one-step process whereby all the dough ingredients are added together and mixed using a machine or manual mixing in a single batch. At the initial mixing stage, the mixture matrix lacks high cohesion while wet mass chumps appear. As mixing of the dough continues the elastic properties of the dough start to increase causing the chumps to start to pull away from the mixer walls. Adequate mixing is achieved when the dough exhibits smooth appearance, dry surface, and optimum elastic character. Over mixed dough exhibits sheen characteristic and stickiness thus becomes difficult to handle. Usually, mixing temperature during the straight dough method is 26 to 28°C. Although the higher temperature will accelerate the rate of yeast fermentation, control of fermentation become more difficult and may result in the fermented dough that lacks adequate stability.

Compared to the sponge, and other dough processing methods, the straight-dough method is advantageous because of lower processing time, power, equipment, and labor. Also, losses during fermentation are reduced since a shorter fermentation time is required. The product's flavor is also enhanced as a dough ingredient undergoes fermentation treatment. The straight dough method is a single-mix process of making bread. The dough is made from all fresh ingredients, and they are all placed together and combined in one kneading or mixing session. After mixing, bulk fermentation rest about 1 hour or longer occurs before division, [1].

After proofing the dough is subjected to heat in a baking oven. Baking temperature generally varies depending upon oven and product type but, it is generally kept in the range of 220-250°C. During baking, the temperature of the dough center reaches about 95°C to ensure that the product structure is fully set. When the dough is placed in the oven, heat is transferred through dough by several mechanisms such as convection, radiation, conduction, and condensation of steam and evaporation of water.

Heat transfer inside dough is said to occur through the mechanism of heat conduction and evaporation/condensation. The baking time of bread may range from 25 to 30 minutes depending upon the size of the bread loaf. After baking, bread is cooled before packaging to facilitate slicing and to prevent condensation of moisture in the wrapper. Bread is prepared as a common bread baking procedure [23]. And the final quality of bread is analyzed to select bread wheat varieties for preferred bread quality production (Straight dough method [1].

3.9.2. Bread Quality

The bread-making quality parameters measured for the pup loaf straight-dough procedures baking, water absorption, dough mix time, color, loaf volume, loaf weight, and specific loaf volume and bread products were subjected to organoleptic analysis [48]. Wheat and flour quality is expressed by a variety of chemical and physical properties of dough, none of which serves as adequate by itself or is independent of others variables [34]. The nutritional value of wheat is extremely important as it takes an important place among the few crop species being extensively grown as staple food sources. For the improvements in physical and sensory properties and shelf life of bread, product and quality are very important. The quality of bread is normally defined based on its volume, color, texture, and flavor of bread [50].

Bread sensory analysis demonstrated the effect of the kernel physical characteristics, flour chemical traits, and the dough functional properties on bread quality. Cut-out dough loses weight during the proofing and baking stages of bread making indicated that the bread baking losses. This may be due to both fermentation losses brought about by amylases of starch and utilization of soluble sugar by yeast and also by evaporation of moisture during baking. Loaf volume is used as criteria to measure the quality of fresh bread in research quality control in industry and by consumers. The chemical composition of the composite flours have been shown to affect both physico-chemical properties and nutritional quality of their products [20].

The specific volume of loaves of bread provides a uniform basis for comparing the results of various studies. Specific volume is an indication of the gluten content of the bread but, other constituents such as starch and fiber also contribute to the specific volume of bread. Gluten or more precisely glutenin is the main structure-forming protein in wheat flour that is responsible for the elastic and extensible properties needed to produce good quality wheat bread. Bread made from soft wheat flour usually yields lower loaf volume.

Baked product quality chain from field to fork

Figure 4. *Wheat product qualities.*

4. Conclusions and Recommendations

According to the present review the bread wheat grain physical qualities, nutritional and technological properties is important quality indices for end-use quality of bread wheat grains. Therefore, working on wheat quality in addition to agronomic and disease resistance breeding critical issues. Further research work is recommended on wheat quality of landraces, old, newly released and promising bread genotypes for better grain physical qualities, nutritional and product making quality that helps famers, processors, millers and import substitution for the country.

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