The Pharma Innovation Journal 2021; 10(5): 1226-1229

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(5): 1226-1229

www.thepharmajournal.com
Received: 03-02-2021
Accepted: 09-03-2021

Sukhjiwan Jeet Kaur
Department of Genetics and Plant Breeding, Lovely Professional University, Phagwara Jalandhar, Punjab, India

Nilesh Talekar
Department of Genetics and Plant Breeding, Lovely Professional University, Phagwara Jalandhar, Punjab, India

Corresponding Author:
Nilesh Talekar
Department of Genetics and Plant Breeding, Lovely Professional University, Phagwara Jalandhar, Punjab, India

Ascertaining diverse physical and chemical characteristics quality making traits of Indian wheat: A review

Sukhjiwan Jeet Kaur and Nilesh Talekar

Abstract
This review bestow the evidence about innovation done in wheat crop through various technologies for its ultimate use. Wheat is one of the major cereals across the world and is used mainly for the preparation of bread. Wheat in India is consumed mainly in the form of unleavened flat bread acknowledged as chapati. In Indian population mainly constitute on chapaties as important source of dietary proteins, calories, some of the vitamins and minerals for large section. Wheat has a special place in food security and economy of a big country like India. Wheat researchers had been successful to maintain steady growth in enhancing production and productivity. Wheat is substantially cultured for its seed and used as necessary food which contains proteins, nutrients and dietary fiber. In the days gone by numerous applied sciences has been used for quality improvement of wheat crop. For instance DNA sequencing, diverse strategies of breeding like wide hybridization are some of familiar methodologies used in evaluation of Triticum. Common wheat (T. *aestivum*) is heavily grown for the purpose of consumption.

Keywords: Wheat, proteins, vitamins, fiber, hybridization and DNA

Introduction
Wheat is widely and the oldest grown crop out of all food crops. After China, India records as the biggest end-user of wheat and approximately 12 percent of wheat production in the globe (FAO 2004). It is classified under the genus Triticum and belongs to Poaceae family. Furthermore, it comes under the category of self-pollinated crop, which proliferate by-way-of sexual reproduction. There are various utilization of wheat such as making pasta (T. *turgidum*. L. var. *durum*), flat bread (T. *aestivum*), noodles as well as used for animal feed (Shewry *et al*., 2015) [11]. Moreover, the standard of the wheat need to be upgraded for satisfying the demand of escalating population of the planet. Genetic attributes control the characters of the crop, which can be improved by plethora of procedures used in breeding programs. On-the-other-hand environment also plays a vital role in quality production of wheat for end-use. Wheat is acclimated to broad range of soil and climatic conditions plus its nutritional composition also varies in line with the area in which it's grown (Saini *et al*., 1984) [13]. Generally the wheat grain contains carbohydrates ranges from 70-78 percent, 12-15 percent of protein content, 2-3 percent of fat, 1-2 percent of minerals along with significant portion of vitamins (riboflavin, thiamine) and minerals (Shewry *et al*., 2002)
The attributes that can detect the wheat quality standards are grain weight, size and shape of grain, hardness. In addition, color can also be utilized as physical criteria for determining the quality. In spite of this chemical constitution of wheat also have crucial role for quality make-up that includes protein content, moisture content, nutrition, baking quality, essential vitamins. Hard wheat (T. *turgidum*) has high gluten content and excessive the protein content, more hard the wheat is and it can be utilized for making pasta, noodles. Soft wheat with low protein content is generally used for preparing bakery products Wheat flour impregnates unique visco-elastic properties to the dough when mixed with water. This provides special functional properties to dough to make it amenable to processing in to variety of food products such as bread, chapatti, biscuits and pasta (Garica and Barro 2017) [9].
Each product demands unique physical and chemical requirements in wheat grain. Therefore, wheat varieties have been classified in to different classes commercially in global wheat trade as per physical (hardness and bran colour) and chemical attributes (protein contents and quality). In India, no such commercial classes exist. However, it has been univocally reported that the both physical and chemical properties of wheat are inherently genotypic attributes,

though they have been found varying over different zones of the country (Xue *et al*. 2019) [15].

Evolution of wheat and breeding

Mutations are primarily presumed to be foremost grounds for the occurrence of changes however hybridization and selection also have major impact in evolution of the crops. In 1924, the centre of origin was first identified (Nikolai Vavilov). The centre of origin is a region where a group of species initially evolved and developed distinguished characters. The centre of origin for cultivated wheat is tracked down in the Old Mediterranean, which is illustrated in Vavilov's report (1940). The earliest evidence for domesticated wheat was noted in 9500 BCE. Wild Emmer (*Triticum dicoccoides*) was the first known cultivated species of wheat with chromosome number (2n=14). The morphological similarities that infer the relationship between the groups of species is studied through phylogenetics. In contrast to similarities there are irrefutable variations in surface structure of cultivated and wild wheat that are mentioned as "domestication syndrome" (Hammer 1984; Salamini *et al*. 2002; Kilian *et al* 2009). The domestication syndrome of wheat includes shattering, photoperiod, seed distribution, plant height, grain size and hardness.

Progression in-between century

In between 19th and 20th century after the rediscovery of Mendel's work by three botanists (Hugo DeVries, Carl Correns and Erich von Tschermak) the significant turn over took place in terms of scientific technologies with the advancement of genetics and extended information about DNA (Deoxyribonucleic acid) and its constitution. In addition to this various new breeding and selection approaches (Pure line selection, hybridization and gene transfer methods) came into existence for creating new genetic make-up of wheat for improving the quality. Pasta wheat (Triticum. durum) was first introduced by Ainsworth Emery Blount (1831-1911) as well as he was among the primary breeders to practice selection and hybridization. The interspecific hybridization gave rise to the modern day wheat (Triticum. aestivum).

Creation of modern day wheat

Around 10,000 years ago the earliest hybridization in wheat is reckoned to have been occurred amidst T. momococcum (wild diploid species) bearing genome (AA) and T. searssi (wild diploid species) carrying genome (BB). The F1 hybrid developed from these was T.turgidum (Tetraploid species) bearing genome of both parents (AABB). Furthermore, T. turgidum crossed with a wild diploid species (T. tauschi) carrying genome (DD). The hybrid originated from cross between these is a hexaploid wheat (T. aestivum) carrying genome (AABBDD), which is a modern day wheat and is superior in quality.

Concepts elaborated the improvement in wheat

Previous to the Third Agricultural Revolution, the various varieties of wheat were tall and susceptible to many diseases plus also problematic for cultivation for mass production (Kulshreshta and Jain 1982).

Selection using markers and genome

In the course of DNA era, two new technologies of DNA sequencing came into consideration in 1977 (Maxam & Gilbert, 1977); (Sanger, Nicklen & Coulson, 1977). Aforementioned methods assisted in genome sequencing and developing molecular markers. Additionally, number of markers rapidly came into utilization for enhancement of wheat quality including RFLPs (Restriction fragment length polymorphisms); PCR based markers (Mullis *et al* in 1987), which comprised of AFLP (Amplified fragment length polymorphisms); RAPD (Random amplification of polymorphism DNA). Subsequently, SSRs (Simple sequence repeats), well known as microsatellites came into use instead of RFLPs for identification of polygenic trait loci. Aforementioned techniques facilitated in recognizing and quantifying the traits standards of wheat along with improvement of characteristics (Sorrells, 2007)

At the start of twentieth century, the considerable change in the wheat was depletion in the length of Triticum through planned instigation of Rht (Reduced height genes) gene (Allan *et al*., 1959). In addition, dwarf varieties of wheat emerged as more advantageous and superior than taller varieties along with being resistant to lodging conditions. The shorter varieties were proved as helpful for growers also as it became much easier to handle as well as feasible for harvesting with machineries.

Genomic selection using markers has been proved successful for the grade enhancement of traits majorly protein content and for texture of kernel (Sorrells, 2007). The hard red winter wheat variety was developed by using MAS (Marker-Assisted Selection) by transferring Gpc-B1 gene. MAS (Marker-Assisted Selection) for the line with high gluten content were developed (Kocourkova *et al*., 2008) by using various PCR based markers. Genomic selection has been demonstrated as the superior and efficient method over phenotypic selection and Marker-Assisted Selection (MAS). This method utilizes complete set of genome for the purpose of selection instead of selecting sole marker (Huang *et al*., 2016).

Quality requirements in wheat grain

Several components together put up for the advancement in quality of grain whether it is physical quality, nutritional quality or bread-making quality of wheat. For the consumers, physical properties like shape, size and color are of foremost importance for assessing the standard of grains. Major constituents like type of the grain, soil, climate, handling, package and practices and genome contribute for the make-up of superior quality.

Physical quality

Copious factors bestow towards the quality of grain namely moisture content, protein content, and seed vigor, broken and damaged grains (Cornell *et al*., 1998) [8]. Moisture content is regarded as one of the major factor for storage purpose. In addition, damaged grain decline the standard of grain and can be detected visually. Several factors are responsible for damaging of grains including mechanical damage, diseases, insect-pest, climatic factors and poor grain filling. Moreover, foreign matters are unfamiliar matters present along with the main grain for instance- sand, plastic or gains of other crops. These need be removed manually or precaution must be taken while harvesting and processing.

Bread-making quality

The quality standards of wheat differ according to its end usage. To illustrate, soft wheat otherwise called as white wheat constitutes less gluten content and has more amount of starch (Richardson, 1884). The ultimate use of soft wheat is to

make pastries, sauces, cakes and many more bakery products. On the contrary, hard wheat has a lofty amount of gluten plus it is suited for making breads and pasta. Henceforth, gluten is regarded as a vital protein molecule, which forms a network of elastic that can be extended and is composed of proteins mainly glutenins and gliadins. It has a distinctive, cohesive and sticky property that assist in kneading process (Ktenioudaki *et al*., 2010) [10]

Nutritional quality

Wheat is an important cereal crop and contains adequate quantity of nutritional values. Individuals consume whet in the form of bread, pasta, chapatti, biscuits and as fermented product. It contains calories, proteins, essential nutrients, dietary fibers, vitamins (vitamin E; vitamin k; vitamin B6; thiamine; riboflavin) and minerals (phosphorous; potassium; magnesium; zinc; iron) which are crucial for maturation and buildup (Shewry PR, Hey SJ 2015) [11]

Physical properties

Weight per unit volume

This is also called as test weight and is one of the simplest and oldest criteria of wheat quality. It is generally expressed in terms of kg/hectoliter. More plump and matures grains with low moisture content and uniform kernel shape give higher test weight and more yield of flour.

Thousand kernel weight

It is a function of kernel size and kernel density. The average value of thousand kernel weight for hard red weight is about 28gm, while that for durum wheat is higher i.e. about 35 gm.

Kernel hardness

The kernel hardness is an important factor in milling quality of wheat. Hard wheats yield more flour with less starch damage. Hard wheat are larger and heavier and have higher specific gravity than the soft wheat.

Impurities

Impurities present in wheat grains adversely affect the quality. Generally, the impurities in wheat include weed seeds, other cereal grains, plant residues, rodent's excreta, insects, mites, mud, dust, nails, nuts (Escalante *et al*. 2017) [2].

Chemical properties

Moisture Content

Moisture content is one of the utmost precarious factor that define quality of wheat. Level of 14% moisture in wheat is desirable. Above this level, the grain are prone to attack by insects and microorganism and get damaged. And low moisture content, the grain tends to be brittle and break during commercial handling operations. The presence of broken kernels in large proportions reduce the quality. Moisture content is important while expressing the result of chemical analysis. The values for different constitute shoe considerable variations if the moisture content is not constant. It is therefore, more appropriate to express the results on moisture free on dry weight basis (Wani *et al*. 2016) [14].

Conclusion

Wheat quality is relative conception and is generally judged by its suitability for a particular end use. Wheat suitable for one type of product may be quite unsuitable for another. The quality of wheat be contingent upon a complex number of factors relating to growth, milling and the end-product. Wheat has a special place in food security and economy of a big country like India. Wheat researchers had been successful to maintain steady growth in enhancing production and productivity. The contentment of fulfilling food demand of a large and growing population has urged the researchers to target similar accomplishments in end-product quality of this staple crop. It has become imperative to improve grain quality of wheat not only for domestic food product of maximum usage i.e. chapati but also to meet requirements of baking industry and global trading to boost-up exchequer of the nation. End-product quality is highly complex in wheat and depends upon number of traits, genetic make-up and response to the environment.

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