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PHYSICOCHEMICAL QUALITIES AND NUTRITIONAL ATTRIBUTES OF STABLE BREAD WHEAT VARIETIES REPRESENTING DIVERSE GENETIC ORIGINS

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Abstract

Ten commercial genetically improved wheat varieties namely: Punjab-96, Kiran-95, Mehran-89, Shahkar-87, Pirsabak-85, Parwaz-94, Tandojam-83, Abadgar-93, Chakwal-86 and Anmol-91, representing diverse genetic origins were investigated for physicochemical properties and nutritional attributes including moisture content, protein content, wet and dry gluten, gluten index, water binding in wet gluten content, near infrared reflectance (NIR), hardness and falling number, for assessing their end-product suitability and consumer's preference. Protein contents of all genotypes were found in the range 12.2% to 15.6%. Moisture contents of all genotypes ranged from 9.2% to 10.2%. Hardness of all samples ranged from score 48 to 58. Gluten index ranged from 38.8 to 75.3, depicting wide range of strength. Falling number of all genotypes was more than 400 seconds. This proved the absence of alpha-amylase activity. The results revealed that all the studied varieties are suitable for all types of breads including flat leavened and un-leavened bread.

Keywords: Investigation of for physicochemical properties, moisture contents, protein contents, wet and dry Gluten, water binding, hardness and falling number.

1. Introduction

Bread wheat (*Triticum aestivum* L.) has remained the central theme of self- sufficiency programme in Pakistan. Although, Pakistan was the first country in Asia to achieve self-sufficiency in wheat after the advent of Green Revolution, the situation in 2008 has altogether changed in respect of supply and demand of bread wheat. (Hussain and Qamar, 2007). Experimental endeavours to develop efficient and sustainable wheat production have been highly successful (Siddiqui, 2002).

Most of the wheat is grown for human food and about 10 % is retained for seed and industrial use (for production of starch, paste, malt, dextrose, gluten). Wheat grains contain all essential nutrients; kernel contains about 12 % water, including carbohydrates (60-80% mainly as starch), protein (8-15%), containing adequate amount of all essential amino acids (except lysine, tryptophan and methionine, fats (1.5-2%), minerals (1.5-2%), vitamins (such as B complex, vitamin E) and 2.2% crude fibers (Hussain and Qamar, 2007).

Siddiqui, (1997), has provided programmatic solutions to the major problems of food and agriculture in the environmental context of 21st century. Nevertheless, new problems are also emerging in the wake of green biotechnology, nanobiotechnology, globalization, poverty alleviation and food sovereignty.

Wheat is the first important and strategic cereal crop for the majority of world's population. It is the most important staple food of about two billion people (36% of the world population), (Siddiqui, 2007). Worldwide, wheat

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Table – 1. The Physicochemical Characteristics and properties of different wheat varieties

Name of Genotype	Moisture Content (%)	Protein Content (%)	Wet Gluten (%)	Gluten Index	Dry Gluten (%)	Water Binding in Wet Gluten (%)	Hardness	Falling Number (sec.)
Punjab-96	9.4±0.05	14.4±0.05	32.5±0.51	75.3±0.57	10±0.57	22.5±0.47	51±0.57	650±5
Kiran-95	10±0.05	12.4±0.25	27.4±0.45	41±1	8±0.11	19.4±0.45	54±0.57	551±2
Mehran-89	9.2±0.15	12.6±0.15	26±0.11	64±1	9.8±0.28	16.2±0.25	50±0.57	630±10
Shahkar-87	10±0.11	14.15±0.11	38.5±0.5	44±0.57	12.1±0.17	26.4±0.54	50±0.57	552±9
Pirsabak-85	10.2±0.05	12.2±0.05	24.5±0.5	54.9±1.52	8±0.11	16.4±0.51	57±±0.57	670±4
Parwaz-94	9.4±0.11	15.4±0.05	30±0.11	56.7±1	10.1±0.17	19.9±0.05	52±0.57	615±3
TandoJam-83	10±0.05	15.2±0.05	35.5±0.05	45.5±1	12±0.05	23.4±0.5	53±0.57	606±4
Abadgar-93	9.5±0.05	15.6±0.05	30.5±0.5	60.2±1.73	10.1±0.15	20.3±0.47	58±0.57	408±5
Chakwal-86	10±0.11	14.3±0.11	28.5±0.5	45.2±1	8.6±0.57	19.8±0.28	56±0.57	450±5
Anmol-91	9.2±0.05	15.6±0.05	39.5±0.5	38.8±0.57	12.3±0.57	27.2±0.34	48±0.57	556±5

Average of triplicate analysis, ± Denote Standard Deviation

Protein Content of Parwaz-94, TandoJam-83, Abadgar-93, and Anmol-91 were ranged from 15.2% to 15.6% which was higher than other wheat varieties. This indicated their stability for hard wheat products like yeast-leavened bread. The dough made from this type of varieties had greater dough strength, resulting in increased loaf volume after baking (Inone and Bushuk, 1992). High protein levels are related to undesirable cookie texture (Posner and Hibbes, 1997). Protein content of Punjab-96, Kiran-95, Mehran-89, Shahkar-87, Pirsabak-85 and Chakwal-86 ranged from 12.2% to 14.4% and characterize as semi-hard wheat. Dough from these varieties were strong, stretchable, elastic and non-sticky that were suitable for un-leavened bread like chapati. All varieties used in this study were found to have medium to very strong gluten. High gluten index, interpreted strong gluten matrix, which increases the viscosity of cookie dough during baking, Thus is un-desirable because cookie spread is restricted (Hoseney, 1994), but it is good for bread. Variety Punjab-96 ·the highest gluten index, which enabled it to form the strongest gluten network suitable for very hard wheat products like pasta. Variety Punjab-96 had 14.4% protein content and 75.3% gluten index, while Abadgar-93 had 15.6% protein content and 60.2 gluten index. This revealed the highest protein content of flour is indicative of its strongest gluten strength. Thus, quantities of protein as well as quality are both important parameters for evaluation of their end product suitability.

Hardness of tested varieties ranged from 48-58 score. Hard wheat flour is suitable for bread and very hard for products like pasta. Grain hardness is negatively correlated with cookie diameter because damage starch increases water absorption capacity and viscosity, which hinders cookie spread (Monsalve-Gonzalex and Pomeranz, 1993).

Falling Number of all varieties was found more than 400 seconds, which implied that the wheat varieties included in this investigation are free of sprout damage that is a desirable character (Bushuk and Rasper, 1994).

The wheat varieties showing better quality can be used by the wheat breeders in the future wheat improvement programmes. The information obtained from this study will be useful for different stake-holders such as plant breeders, farmers as well as the end-users.

4. Conclusion

The physiochemical characteristics of wheat vary considerably with wheat variety, which in turn influences their quality with respect to their end product suitability. All seed samples used in the study were found to be hard to very hard. So they are all suitable for hard wheat products like traditional bread i.e. chapati as well as yeast leavened bread. As no wheat genotype was found to fall into soft wheat category, so none of them is suitable for products like biscuits and cookies. Protein

provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally. It exceeds in acreage and production than every other grain crop (including rice, maize, etc.) and is therefore, the most important cereal crop of the world, which is cultivated over a wide range of climatic conditions.

Generally wheat quality refers to its suitability for a particular end-use. Botanical, subjective and objective criteria are used to assess the quality. Objective criteria are based on physical, chemical and nutritional properties of wheat grain and are more reliable in evaluation of wheat quality, hardness; protein content and gluten strength are the basic quality attributes. Protein content is a key quality factor (Siddiqui, 1972; Siddiqui and Doll, 1973, Siddiqui, *et .al*, 1975 and Siddiqui, 2005), that determined the suitability of wheat for a particular type of product as it affects other factors including mixing tolerance, loaf volume and water absorption capacity.

Wheat is unique among cereals and other protienaceous plants since its milled product "flour" alone is capable of forming the dough due to its gluten content. The dough retains the gas evolved during fermentation (Bushuk and Wrigley, 1974; Hoseney, 1998), and on baking yields a light, well-aerated loaf of bread. This unique characteristic of wheat is derived from its proteins that are gliadin and glutenin and upon hydration results in gluten; the actual substance that imparts the property of gas retention to dough. Bread (or hard wheat) flour has high gluten content, and is therefore good for yeast raised bread, which requires an elastic framework. On the other hand, weak wheat flour is best suited for cakes and for biscuit making (Gaines, 1991 and Souza *et al.* 1994).

Moisture content of wheat flour is very important in relation to storage, milling and handling properties of wheat. Hardness score is an important criterion for conformity to the market place. Falling number (FN) test gives an indication of the amount of sprout damage that has occurred within a wheat sample. The falling number test does not directly measure amylase activity, but measures changes in the physical properties of the starch protein of the wheat kernel caused by the enzymes during the test. As the enzyme activity increases, the FN value decreases. The objective of the present study is to evaluate the physicochemical qualities at nutritional attributes of stable bread wheat varieties representing diverse genetic origins.

2. Materials and Methods

Seeds of ten wheat varieties were collected from four Research Institutes viz. Ayub Agricultural Research Institute Faisalabad, Cereal Crop Research Institute Pirsabak (NWFP), NIA Tando Jam and Wheat Research Institute Sakrand. The individual samples were cleaned manually and mixed through precisian Electronic Divider. These samples were then milled to whole wheat flour using Perten Laboratory Mill 3100, installed with 0.8 Sieve and then mixed thoroughly. Protein content, moisture content and hardness were determined through near infrared reflectance (NIR). Gluten contents on wet as well as dry weight basis and water binding in wet gluten were determined according to AACC (2000) method No.38-12. Falling number was determined according to AACC (2000) method No.56-81 B. All the studied parameters were taken in triplicate and with standard deviation that was statistically analyzed in accordance with (Zar, 1974).

3. Results and Discussions

Ten wheat approved varieties by Federal Seed Certification and Registration Department, Government of Pakistan, Islamabad were grown across different agro-ecological locations viz. TandoJam, Sakrand, Sukkur, Rahimyar Khan, Khanewal, Sahiwal, Dokri, Jacobabad and Quetta during the Crop Year (1999-2000). The selected varieties were evaluated for following physicochemical characteristics.

Moisture Contents of these wheat varieties ranged from 9.2% to 10.2% **(Table-1).** This indicated that these wheat varieties can be easily stored due to low moisture content, and being less prone to microbial attack. At low moisture content the grains tended to be brittle and could break during the commercial handling operations. However this is usually the case for wheat, which is artificially dried to lower the moisture content (Zenleny, 1991).

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content, gluten index, falling number and hardness score were found to be the basic physiochemical characteristics to evaluate their end product suitability.

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