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Studies on physico-chemical characters and chapatti quality of different wheat varieties

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Abstract
The present investigation reports their variability in kernel and flour characteristics. The physical characteristics such as thousand kernel weight and grain hardness differed significantly among the wheat varieties. The chemical parameters such as starch content, ash content differed significantly for straight grade flour among different wheat varieties. Significantly the highest thousand kernel weight ranged from 35.84 to 46.27g in first year and in second year it was ranged from 36.34 to 45.48g. The grain hardness kg ranged from 9.50 to 14.30 kg in first year and in second year it was ranged from 9.68 to 14.40 kg. The starch content ranged from 62.29 to 74.35 per cent and 62.81 to 74.35 per cent during first and second year respectively. The ash content ranged from 2.3 to 3.7 per cent in from 2.3 to 3.7 per cent during first and second year respectively. The sensory attributes of chapatti varied significantly among different wheat. The highest palatability scores for different parameters were assigned to chapatti prepared from flour of K-9107 and K-8962 while significantly the lowest were given to the chapatti prepared from wheat variety K-68 during first year and second year respectively. The highest texture scores for different parameters were assigned to chapatti prepared from flour of K-9107 and K-8962 while significantly the lowest were given to the chapatti prepared from wheat variety K-68 while during first year and second year highest texture scores for different parameters were assigned to chapatti prepared from flour of K-1317 and K-9107 while significantly the lowest were given to the chapatti prepared from wheat variety K-68. It is clear from the results chewiness characteristics rank was obtain by variety K-9107 (1.4) followed by variety K-8962 (1.6), K-1317 (1.8), and K-1006 (2.0) in first year and in second year the variety K-9107 (1.6), K-8962 (1.8). It is clear from the results best pliability rank was gain by variety K-9107 (1.4) followed by variety K-8962 (1.6), K-1317 (1.8), and K-1006 (2.0) in first year and in second year the variety K-1317, K-9107 (1.6).

Keywords: Thousand kernel weight, grain hardness, starch content, ash content, sensory attributes

Introduction
Wheat (*Tritium aestivum* L.) belongs to the family *Poaceae* or *gramineae* and genus *tritium.* Wheat is an important agricultural commodity and a primary food ingredient worldwide. It contains important beneficial nutritional components. Among cereals, wheat is the most important crop in terms of production and consumption. World nutrition mostly depends on wheat and wheat products *viz*. chapati, bread, biscuits, pasta and fermented products, as the people all over the world consume wheat products in one of these forms (Agrawal and Gupta 2006) [2]. Wheat is one of the major grains worldwide, which provides nearly 20% calorie and protein per capita worldwide (Long DY, 2019). Wheat-based foods have been staple foods since wheat was domesticated about 10,000 years ago, and they constitute a major source of macro- and micronutrients and energy (15–20% of the required intake) for the world population, especially in developing countries (Balfourier *et al.*, 2019) [6]. Quality refers to the desirability of the product and may include various physical and chemical aspects depending on the intended purpose. The factors that influence the wheat grain quality have been broadly classified in two groups- physical and chemical characteristics. The physical characters include grain appearance score, kernel or grain hardness, virtuousness of kernel, 1000-kernel weight, hectoliter weight (test weight), and kernel size and shape whereas the chemical characters are protein content, protein quality and sedimentation test. The protein content of wheat may range from 7 to 22%, but mostly lies between 10 and 15%. The highest percentages of proteins within the grain are found in the germ (34%), followed by the aleurone (23%) and 5–6% in the outer layers. Consequently, the protein content of whole-grain flour is usually about 2% higher compared to white flour. Gluten is the main storage protein found in wheat, rye and barley and is important for dough formation.

Seed storage proteins constitute about 8–15 percent of total flour weight and can be classified into albumins, globulins, gliadins, and glutenins on the basis of their solubility. Of these fractions, gliadins and glutenins constitute the gluten proteins and are stored together with starch in endosperm of the seed. Both gliadins and glutenins are involved in building the gluten polymer and determining bread-making properties of wheat. The nutritional value of wheat proteins is determined by their relative contents of the essential amino acids valine, leucine, isoleucine, phenylalanine/tyrosine, tryptophan, threonine, methionine/cysteine, lysine, and the semi-essential arginine and histidine. (FAO/WHO/UNO, 2007) [9]. Lysine is the first limiting amino acid in wheat grains, whereas the other essential amino acids are present in adequate amounts (Shewry PR, and Hey 2019) [18]. The biological value of white wheat flour is estimated to be 52 and that of whole-grain wheat flour is 17–26% higher. This difference is due to the fact that white flour contains higher proportions of gluten proteins compared to whole-grain flour, and the amino acid composition of gluten is characterized by exceptionally high contents of non-essential glutamine (26–53%) and proline (10–29%). Gliadin and glutelin ensure dough elasticity and extensibility. Gluten determines softness, elasticity, and cohesion of bread both fresh and after storage. The baking value of grain and flour describes many traits, most importantly those which characterize its enzymatic complex (falling number) and protein complex (the content of total protein and wet gluten and sedimentation value). A comprehensive evaluation, however, is only provided by a baking test, including the bread volume evaluation. Gluten, the protein component of flour which gives the dough elasticity and strength, can be defined as the rubbery mass that remains when wheat dough is washed to remove starch granules and water-soluble constituents. Gluten plays a key role in determining the unique baking quality of wheat by conferring water absorption capacity, cohesiveness, viscosity, and elasticity on dough (Wieser, 2007).

Materials and Methods

Present investigation was conducted during 2018-19 and 2019-20 under the lab experiment in the laboratories of the Department of Agricultural Biochemistry at Chandra Shekhar Azad University of Agriculture & Technology, Kanpur - 208002 (Uttar Pradesh). Different twenty wheat varieties given in (Table A) used in the study were collected from the EBR Section of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. 200g grains of each variety were grinded with grinder mixer for wheat flour preparation. Representative samples of different varieties prepared for physico-chemical analysis and dough characteristics studies combined to make a composite sample of variety per year. Physico-chemical, dough characteristics analysis of composite samples and sensory evaluation of prepared chapatti were done in first year and second year.

Table A: Name of the wheat varieties

S. No.	Varietal Code	Nick name	Year of release
1	K-1317	Munna Bhaiya	2018
2	K-1006	Atal	2000
3	K-402	Mahi	2009
4	K-0307	Shatabdti	2006
5	K-9107	Deva	1996
6	K-607	Mamta	2011
7	K-7903	Halana	2002
8	K-9423	Unnat halana	2004
9	K-9162	Gangotri	2002
10	K-9533	Naina	2006
11	K-8027	Maghar	1989
12	K-9351	Mandakani	2006
13	K-9465	Gomti	1997
14	K-8962	Indra	1995
15	K-8434	Prasad	2006
16	HD-2733	VSM	2008
17	HD-2967	-	2011
18	DBW-187	Karan vandana	2019
19	K-68	-	-
20	PBW-343	-	1996

Physical properties

Thousand kernel weight

Thousand kernel weights were recorded in grams; it was recorded by counting and weighing the clean, unbroken and sound kernels.

Grain hardness

The grain hardness was measured by using the grain hardness tester supplied by O.S.K. 201 Grain Hardness Tester, Type-E, and capacity 50 kg. Taken ten grains one by one different sizes selected randomly, from each replication. Each grain was placed on the sample plate and pressure column was put down by means of the pressure handle till the grain was crushed. The press weight which is the crushing hardness strength was read on the scale attached with the instrument. The mean force (kg) required to crush the grain was recorded.

Chemical analysis

The whole meal wheat flour and straight grade flour of each wheat variety were tested for chemical characteristics as described below

Starch content (%)

Estimation of starch was done by Anthrone Reagent methods as described by (Hodge & Hofreiter, 1962) [13]. The sample is treated with 80% ethanol for removal soluble sugars and then starch is extracted with perchloric acid. In hot acidic medium, starch is hydrolyzed to glucose and dehydrated to hydroxyl

methyl- furfural. This compound forms a green coloured product with anthrone.

Ash content

Ash content was determined by the method as described by Hart and Fisher, (1971) [11]. Materials required for this estimation were silica crucible muffle furnace 600 ºC and desiccators with magnesium per chlorate desiccant. In this method the constant weight of silica crucible in muffle Furness at 600 ºC for one hours, transferring from furnace to desiccators weighing and repiting the above mentioned process till a constant weight of silica crucible were recorded, 0.2 g dried sample which was dried was transferred into ash less filter paper. The ignition of sample was carried out on non luminous flame in a pre weighed, teared silica crucible. The crucible was finally placed into muffle furnace which was maintained at 525-550ºC (± 2ºC) for about 5-6 hours to destroy the organic matter of the sample. After expiry of period, the crucible was transferred into desiccators for cooling to avoid absorption of moisture, by the ash. The cold ash along with silica crucible was weighed and the result was calculated and reported on moisture free basis into per cent.

Sensory evaluation

Organoleptic test

Chapatti was done according to the method of fractional pairs developed by a 9-point hedonic scale.

Preparation of Chapattis

Chapatti dough was prepared with whole wheat flour water, kneaded well and allowed to rest for 30 min. Small portions of the dough were rolled into round flat sheets and prepared into chapatti breads. Chapati prepared from whole wheat flour with no addition of date paste and control.

Sensory evaluation

After the preliminary screening of chapattis of different tried variants by a semi-trained panel of 5 judges, a consumer panel was recruited for expanded sensory evaluation, which was done using a 9-point hedonic scale (Amerine *et al*. 1965) [3].

Statistical analysis

All sample extracts were prepared and analysis done using a complete randomized design at 5% level of critical difference. Analysis of variance (ANOVA) for the design was carried out to determine the significance of differences among different treatment.

Results and Discussion

In the present study, the comparative nutritional profile was carried out and the obtained results are presented**.**

Thousand kernel weight

It was clear from the data that 1000-grain weight of all tested varieties of wheat varied significantly ranged from 35.84 to 46.27g in 2018-19 and in 2019-20 it was ranged from 36.34 to 45.48g presented in (Table 1). During 2018-19 wheat varieties K-8434 (46.27g), K-9351(45.59g), HD-2967 (43.64g) and K-9533 (43.63g) appeared to be superior and gave significantly higher grain weight while, variety K-7903 (35.84g) showed the lowest grain weight. During 2019-20 wheat varieties K-9351 (45.48g), K-8434 (44.21g), K-9162 (43.58g) and K-9533 (43.56g) appeared to be superior and gave significantly higher grain weight while, variety K-9423 (36.34g) showed the lowest grain weight. The highest level of test weight was observed for wheat variety K-9351. Similar results have also been reported by Kala and Singh (2011), Abaye *et al*. (2004) and Dziki *et al*. (2000) [14, 1, 8].

Grain hardness

Kernel hardness is a characteristics very often used in wheat classification. Very hard kernel texture affects milling, particle size, starch damage, and dough water absorption. Consequently, it is difficult to make direct comparisons between durum and soft durum. (Murray *et al*. 2017). Kernel hardness in the different varieties of wheat in ranged from 9.50 to 14.30 kg in first year and in second year it was ranged from 9.68 to 14.40 kg given in (Table 1). During first years wheat varieties K-8027 (14.30 kg) appeared to be superior and gave significantly higher grain hardness and varieties K-1006 (9.50 kg) showed the lowest grain hardness. During second years wheat variety K-9351 (14.40 kg) appeared to be superior and gave significantly higher grain hardness while, variety K-8434 (9.68 kg) showed the lowest kernel hardness. Variety K-8027 appeared best in respect of grain hardness. Similar results have also been reported by. Morris C F, Rose S P. (1996), Bettge *et al*., (1995) [15, 7].

Table 1: Thousand kernel weight (g) and Grain hardness (kg) in various varieties of wheat grain

Varieties	Thousand kernel weight (g)		Grain hardness (kg)	
	2018-19	2019-20	2018-19	2019-20
K-1317	42.59	42.91	11.50	12.50
K-1006	39.42	41.29	9.50	9.70
K-402	42.51	43.34	12.70	12.50
K-307	40.88	42.65	11.70	11.60
K-9107	41.49	41.17	10.50	10.50
K-607	39.31	41.51	10.30	10.50
K-7903	35.84	36.41	11.30	11.60
K-9423	36.35	36.34	13.50	13.40
K-9162	43.60	43.58	13.40	13.60
K-9533	43.63	43.56	12.30	12.20
K-8027	41.60	41.28	14.30	14.40
K-9351	45.59	45.48	12.60	10.60
K-9465	41.43	41.44	10.50	10.70
K-8962	39.57	39.49	12.60	12.60
K-8434	46.27	44.21	9.73	9.68
HD-2733	39.62	39.52	10.40	10.70
HD-2967	43.64	43.34	10.50	10.40

DBW-187	40.79	40.19	11.40	11.80
K-68	41.36	42.38	12.40	12.60
PBW-343	39.62	39.54	11.50	10.30
S.E. (d) ±	0.47	0.53	0.27	0.45
C.D. (5%)	0.95	1.07	0.55	0.92

Starch content

Wheat are described by millers as hard, medium, or soft, based on the grain's physical characteristics. Hard types tend to have higher protein quantity and quality, possessing a vitreous endosperm, with starch granules tightly packed in a protein matrix. It was observed that varieties ranged from 62.29 to 74.35 per cent and 62.81 to 74.35 per cent during first and second year respectively present in (Table-no.2). Variety HD-2967 appeared best in respect of starch content percent in wheat flour. These results may be supported by the findings of Goesaert *et al.* (2005) and Hemalatha *et al.* (2007) [10, 12].

Ash content: Ash content and moisture can serve as important indicators of the wheat flour's quality and use, but the routinely applied assessment methods are laborious. Ash is one of the major indicators of wheat flour's quality and use. Therefore, ash is a widely used index of flour purity and its extraction rate during milling. Reveled that of which highest ash content wheat varieties range in 2.3 to 3.7 per cent in first year. During second year in wheat varieties it ranges from 2.3 to 3.7 per cent given in (Table 2). DBW-187 appeared best in respect of ash content in wheat flour. Similar variety variations in wheat have been also reported earlier in the literature by Obert *et al*. (2004) and Apprich *et al*. (2014) [16, 4].

Table 2: Starch content and ash content (%) in various varieties of wheat flour

Varieties	Starch content (%)		Ash content (%)	
	2018-19	2019-20	2018-19	2019-20
K-1317	70.32	70.77	3.30	3.50
K-1006	69.55	69.19	3.40	3.60
K-402	67.50	67.23	3.30	3.60
K-307	69.36	69.77	3.70	3.30
K-9107	65.32	65.85	3.30	3.50
K-607	62.29	62.81	3.40	3.70
K-7903	67.35	67.80	2.50	3.30
K-9423	69.39	69.72	3.30	3.50
K-9162	70.26	70.77	2.60	2.70
K-9533	68.60	68.87	3.20	3.40
K-8027	71.38	71.72	3.70	2.70
K-9351	72.40	72.85	2.30	2.60
K-9465	69.38	69.82	3.70	3.60
K-8962	70.35	70.93	2.60	2.30
K-8434	69.29	69.74	3.40	3.40
HD-2733	73.41	73.77	2.60	3.40
HD-2967	74.35	74.75	2.40	3.30
DBW-187	67.71	67.77	3.70	3.70
K-68	65.34	65.72	2.50	2.70
PBW-343	70.52	70.81	3.30	3.70
S.E. (d) ±	0.42	0.50	0.05	0.07
C.D. (5%)	0.85	1.02	0.11	0.14

Chapati characteristics

The chapati characteristics i.e., palatability and texture of wheat varieties slightly difference during both years.

Palatability

The chapattis prepared from various wheat varieties. The sensory evaluation of chapattis based on scoring of texture showed significant ($p< 0.05$) differences among all wheat varieties/cultivars. The results pertaining to sensory evaluation of chapatti prepared from wheat varieties are presented in (Table 3). Palatability rank for the chapattis was ranged from 1.4 to 4.0 ranks best palatability rank gain (1.6) was observed for chapattis prepared from variety K-9107 followed by K-8962 (1.7), K-1317 (1.9) rank. Variety K-9107 appeared best in respect of chapatti palatability rank. Similar results were also found by Asim *et al.* (2018) [5].

Texture

The results pertaining to sensory evaluation of chapatti prepared from wheat varieties are presented in. Texture rank was gain by variety K-9107 (1.4) followed by variety K-8962 (1.6), K-1317 (1.8), and K-1006 (2.0) in first year and in second year the variety K-1317 (1.6) gain best texture rank followed by K-9107, K-8962 (1.8), and K-307, K-9107, K-8027, HD-2733, DBW-187 (2.2).There is slightly difference in both varieties K-1317 and K-9107 in texture characteristics. Similar results were also found by Asim *et al.* (2018) [5].

Chewiness characteristics

Chewiness characteristics on varieties varied from 1.4 to 4.0 ranges in the first year, and from 1.6 to 3.8 ranges in the second year. It is clear from the results chewiness characteristics rank was obtain by variety K-9107 (1.4) followed by variety K-8962 (1.6), K-1317 (1.8), and K-1006 (2.0) in first year and in second year the variety K-9107 (1.6), K-8962 (1.8) obtain best chewiness characteristics rank followed by K-9107 (1.6), K-7903 (2.0) and K-8027(2.2). There is slightly difference in both varieties K-1317 and K-9107 in chewiness characteristics. Similar results were also

found by Asim *et al.* (2018) [5].

Pliability characteristics

Pliability rank was gain by variety K-9107 (1.4) followed by variety K-8962 (1.6), K-1317 (1.8), and K-1006 (2.0) in first year and in second year the variety K-1317, K-9107 (1.6) obtain best pliability rank followed by K-8962 (1.8), and K-307, K-607 (2.2).There is slightly difference in both varieties K-1317 and K-9107 in pliability characteristics. Similar results were also found by Asim *et al*. (2018) [5].

Table 3: Palatability, Texture, Chewiness characteristics and Pliability in various varieties of wheat flour

Varieties	Palatability		Texture		Chewiness characteristics		Pliability	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
K-1317	1.8	2.0	1.8	1.6	1.8	2.0	1.8	1.6
K-1006	2.0	2.2	2.0	2.4	2.0	2.4	2.0	2.4
K-402	2.4	2.6	2.6	3.4	2.4	2.6	2.4	3.2
K-307	2.6	2.8	2.6	2.2	2.6	3.0	2.6	2.2
K-9107	1.4	1.8	1.4	1.8	1.4	1.6	1.4	1.6
K-607	2.6	2.8	2.6	2.2	2.6	2.8	2.6	2.2
K-7903	2.2	2.0	2.2	2.8	2.2	2.4	2.2	2.8
K-9423	3.2	3.4	3.2	2.6	3.2	2.8	3.2	2.8
K-9162	3.6	3.2	3.6	3.2	3.6	3.2	3.6	3.2
K-9533	3.2	3.4	3.2	2.8	3.2	2.8	3.2	3.0
K-8027	2.8	2.2	2.8	2.2	2.8	2.2	2.8	3.0
K-9351	3.0	3.2	3.0	3.4	3.0	3.6	3.0	3.6
K-9465	3.8	3.4	3.8	3.4	3.8	3.4	3.8	3.4
K-8962	1.6	1.8	1.6	1.8	1.6	1.8	1.6	1.8
K-8434	3.0	3.2	3.0	3.0	3.0	2.8	3.0	2.8
HD-2733	2.8	2.2	2.8	2.2	2.8	2.6	2.8	2.6
HD-2967	3.6	2.8	3.6	3.4	3.6	2.8	3.6	3.8
DBW-187	2.4	2.2	2.4	2.2	2.4	2.2	2.4	2.8
K-68	4.0	3.6	4.0	3.6	4.0	3.6	4.0	3.6
S.E. (d) ±	1.28	1.31	1.29	1.31	3.4	3.8	3.4	3.2
C.D. (5%)	1.8	2.0	1.8	1.6	0.64	0.75	0.64	0.70

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