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Comparison of Different Wheat Varieties Grown in Punjab for Leavened Flat Bread (Naan) Production

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Abstract: Seven wheat varieties i.e. Inqulab 91, Bhakkar 2002, AS 2002, Shafaq 2006, Sehar 2006, Auqab 2000 and GA 2002 collected from different locations of Punjab were subjected to physicochemical, rheological, minerals (copper, manganese, iron, zinc) and sensory analyses to determine their suitability for leavened flat bread (naan) preparation. Naans were prepared from different wheat flours and evaluated for colour, taste, flavor, texture, chewing ability, folding ability and overall acceptability. It was observed that Shafaq 2006 had the highest test weight (81.50 kg/hl), thousand kernel weight (41.20 g), zinc (8.50 mg kg^{-1}) and lowest broken/shrunken grains (0.79%), insect damaged grains (0.45%), moisture (12.92%) and dough stability (4.11%), Bhakkar 2002 had the maximum broken / shrunken grains (1.61%), ash (0.61%), falling number (432) and minimum water absorption (54.05%), dough development time (2.21 min) and manganese (5.29 mg kg^{-1}), whereas Sehar-2006 had the highest protein (10.84%), wet gluten (27.56%), dry gluten (9.35%), dough development time (4.12 min), copper (4.68 mg kg^{-1}) and lowest edible foreign matter (0.42%), tolerance index (35.00 BU) and iron (14.80 mg kg^{-1}). Naans prepared from Auqab 2000 were ranked highest and more acceptable than others.

Key words: Punjab, wheat varieties, physicochemical, farinographic properties, sensory evaluation, naan

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the largest grain crop and staple food of Pakistan. It occupies a central position in agriculture and economy (Shuaib *et al*., 2007). It contributes 13.1% to the agricultural value addition and 2.8% to GDP. Total wheat production during 2008-09 touched 23.4 million tons (GOP, 2009). Besides being a rich source of carbohydrates, wheat contains protein, essential amino acids except lysine, minerals such as phosphorus, magnesium, iron, copper and zinc and vitamins like thiamin, riboflavin, niacin and vitamin E (Khan and Zeb, 2007).

The term wheat quality is a complex of many factors depending on milling, chemical, baking and rheological dough properties. Wheat quality reflects suitability for a particular purpose or intended use. The major factors influencing wheat quality are cultivar, climatic conditions, cropping year, process of harvest and storage conditions (Pasha, 2006).

Wheat is unique among cereals since its milled product '' flour'' is capable of forming the dough due to its gluten content. The unique characteristics of wheat can be attributed to the ability of its proteins gliadin and glutenin, which upon hydration form viscoelastic network gluten: the actual substance that imparts gas retention property to dough (Shah *et al*., 2008). In Pakistan, the most commonly consumed and least expensive product of wheat flour is flat bread like chapattis, rotis and naan. Furthermore, wheat is used for various other bakery products like bread, cookies, cakes, buns, pastries etc. In Punjab and Sindh provinces chapatti and roti doughs are unleavened while in Baluchistan and NWFP provinces fermented rotis are prepared. Naan is flat leavened bread prepared from flour, water, salt and yeast (Aidoo *et al*., 2006). Fermented dough is used for making naan. Therefore, naan is made from finer granulation flour than that used for chapattis because finer the granulation, the more rapid is the process of fermentation (Qarooni, 1996). It has better digestibility and greater storage life than chapattis. It is mostly consumed at breakfast, while it is also available at lunch and dinner with specific dishes (Farooq *et al*., 2001). The present study was designed to evaluate wheat varieties grown in Punjab for various physico-chemical and rheological characteristics in order to assess their suitability for the production of leavened flat bread (naan).

MATERIALS AND METHODS

Collection of raw materials: Seventy eight wheat samples were collected randomly from nine regions of Northern, Central and Southern Punjab during 2008. Samples were drawn directly from farmers field. Wheat samples were packed airtight in polyethylene bags and

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taken to Food Quality and Nutrition Program (FQNP) Lab. National Agricultural Research Centre (NARC). Representative samples of each variety were prepared for physico-chemical analysis, farinographic studies and naan preparation by combining individual variety samples from different regions. Physico-chemical, farinographic analysis of composite samples and sensory evaluation of prepared naan were done in triplicate.

Physical characteristics of wheat: Wheat samples were uniformly divided through Boerner Divider and analyzed for physical quality characteristics such as thousand kernel weight, test weight, foreign matter, broken/shrunken grains and damaged grains according to standard procedures as described in AACC (2000).

Milling of wheat: Wheat grains were tempered and then milling was done using Quadrumate Senior Mill according to standard method (AACC, 2000). Four products were obtained i.e. reduction flour, break flour, shorts and bran. Reduction flour and break flour were mixed to get straight grade flour for further studies.

Chemical/general characteristics of wheat flour: Wheat flour of different varieties was subjected to determine its chemical/general characteristics such as moisture, ash, crude protein (N x 5.7), wet and dry gluten and falling number according to standard procedures of AACC (2000). Perten Glutomatic was used to determine wet and dry gluten whereas Falling Number system (Perten 1500) was used for the determination of alpha amylase activity in wheat flour. Trace elements (copper, manganese, iron, zinc) were analyzed using a Varian SpectrAA 220FS Atomic Absorption Spectrometer. The samples were prepared according to the standard methods of AOAC (2005).

Farinographic studies: Rheological behaviour of different wheat varieties flour was evaluated by running flour samples through Brabender Farinograph equipped with a bowl of 50 g capacity. The dough characteristics such as water absorption, dough development time, dough stability, tolerance index and softening of dough were determined according to standard procedure of AACC (2000).

Preparation of leavened flat bread (naans): Leavened Flat Bread (Naans) were prepared by taking 250 g straight grade flour, mixed with 50 g yoghurt and water for 10 min, kept in an incubator at 35°C overnight covered with wet cloth. It was then mixed with 750 g flour, 15 g sugar, 5 g salt, 5 g sodium bicarbonate and water (quantity as determined by farinograph water absorption) for dough preparation. Dough balls of 100 g each were made and sheeted into a disk of 7 inch diameter with rolling pins, pressed with fingertips in the centre and allowed to proof for 30 min. Then naans were prepared by baking in an oven at 315°C for 3 min.

Sensory evaluation: Sensory evaluation of naans was carried out by a panel of judges for colour, taste, flavour, texture, chewing ability and folding ability. Samples were presented in succession and panelists were asked to rate evaluation variables according to 9- point Hedonic scale as described by Land and Shepherd (1988).

Statistical analysis: The data obtained for each parameter was subjected to statistical analysis using Statistica 6.0 software according to methods described by Steel *et al.* (1996).

RESULTS AND DISCUSSION

Seven wheat varieties collected from different regions of Punjab were evaluated for physicochemical, rheological and sensory characteristics for leavened flat bread preparation.

Physical characteristics: Data regarding physical parameters of wheat grains reveals that Shafaq-2006 variety had the highest test weight (81.50 kg/hl) whereas AS 2002 samples possessed the lowest test weight (76.80 kg/hl) (Table 1). Test weight is considered as one of the important tool in wheat grading system (Pasha, 2006). It is imperative in the grain trade because most grains are sold at a certain test weight. Highest thousand kernel weight (41.20 g) was observed in Shafaq 2006 wheat and lowest value was recorded in Inqulab 91 (36.60 g). Thousand kernel weight as well as test weight is useful index for potential milling yield. The differences observed in test weight and thousand kernel weight among wheat varieties may partly be due to the differences in the genetic make up of the varieties and partly attributed due to different growing and environmental conditions prevailed during growing periods (Randhawa *et al.*, 2002).

In case of foreign matter, wheat grains of GA 2002 had the highest (1.19%) and Auqab 2000 had the lowest (0.25%) non-edible foreign matter. AS 2002 possessed the highest (1.29%) and Sehar-2006 had the lowest (0.42%) edible foreign matter. The differences in foreign matter may be due to varied climatic conditions of different locations, harvesting and threshing operations as well as planting time (Anjum *et al.*, 2003). Maximum broken/shrunken grains was observed in Bhakkar 2002 (1.61%) followed by Inqulab 91 (1.38%) samples whereas, Shafaq 2006 had the minimum (0.70%) broken/shrunken grains. As regards damaged grains, AS 2002 had the lowest (0.45%) and Inqulab-91 had the highest (0.92%) insect damaged grains, whereas GA 2002 had the lowest (0.54%) and Auqab-2000 had the highest (0.87%) other damaged grains (fungus/black tipped, heat damaged, immature grains etc).

Table 1: Physical characteristics of wheat grains

Varieties	Test weight (kg/hl)	Thousand kernel weight (g)	Foreign matter (%)		Broken/ shrunken grains (%)	Insect damaged grains (%)	Other damaged grains (%)
			Non-edible	Edible			
Inqulab 91	77.50±1.03	36.60±0.86	0.79±0.21	1.01±0.19	1.38±0.43	0.92±0.25	0.61±0.12
Bhakkar 2002	78.20±1.12	38.50±0.67	0.88±0.29	0.73±0.15	1.61±0.32	0.79±0.14	0.73±0.15
AS 2002	76.80±0.95	37.10±0.74	0.46±0.17	1.29±0.32	1.07±0.25	0.57±0.09	0.78±0.17
Shafaq 2006	81.50±0.73	41.20±0.57	0.37±0.13	0.64±0.17	0.79±0.15	0.45±0.11	0.64±0.08
Sehar 2006	79.30±0.86	39.00±0.78	0.54±0.16	0.42±0.09	0.94±0.27	0.66±0.14	0.58±0.13
Auqab 2000	78.60±0.67	38.00±0.51	0.25±0.10	0.87±0.21	1.16±0.28	0.52±0.10	0.87±0.19
GA 2002	80.00±0.54	40.60±0.65	1.19±0.24	1.13±0.28	1.32±0.19	0.73±0.17	0.54±0.10

*All values are means of three replications

Table 2: Chemical/general characteristics of wheat flour

Varieties	Moisture (%)	Ash (%)	Protein (%)	Wet gluten (%)	Dry gluten (%)	Falling No.
Inqulab 91	13.19±0.14	0.58±0.09	10.57±0.12	26.98±0.94	9.12±0.53	371±13.53
Bhakkar 2002	13.28±0.19	0.61±0.07	9.75±0.14	24.63±1.16	8.28±0.44	432±18.56
AS 2002	13.25±0.11	0.52±0.06	10.45±0.11	26.29±0.90	9.04±0.48	388±11.01
Shafaq 2006	12.92±0.15	0.57±0.03	9.98±0.16	25.55±0.61	8.67±0.39	364±8.82
Sehar 2006	13.07±0.08	0.56±0.05	10.84±0.10	27.56±0.67	9.35±0.50	406±10.44
Auqab 2000	13.16±0.17	0.54±0.04	10.36±0.18	26.64±0.72	9.21±0.32	352±9.49
GA 2002	13.32±0.10	0.53±0.02	9.32±0.23	24.17±0.55	7.84±0.21	417±9.88

*All values are means of three replications

Chemical/general characteristics: It is evident from the data on chemical characteristics of wheat flour that mean moisture content of different varieties were quite close to each other due to tempering of wheat grains before milling. Highest moisture content was observed in GA 2002 (13.32%) while Shafaq 2006 had the lowest moisture (12.92%) (Table 2). Moisture content is dependent on genetic makeup of wheat varieties and is largely influenced by agronomic and climatic conditions (Mahmood, 2004). In case of ash, highest value was observed in Bhakkar 2002 (0.61%) while lowest ash was recorded in AS 2002 (0.52%) samples. The ash content of flour is related to the amount of bran in the flour and therefore to flour yield.

As regards protein content, Sehar-2006 had the highest protein (10.84%) followed by Inqulab-91 (10.57%), while GA 2002 (9.32%) wheat had the lowest protein content. The protein content is an important criterion while considering the wheat quality. Protein content is an inherent characteristic but the quantity of protein depends on the growing conditions (Kent and Evers, 1994). Variation in protein content among wheat varieties is due to differences in their genetic makeup as well as differences in environmental and production conditions prevailed during growth stages (Randhawa, 2001).

Highest wet and dry gluten content was observed in Sehar 2006 (27.56% and 9.35%) whereas lowest value was observed in GA 2002 (24.17% and 7.84%). The differences in gluten content among different samples may be ascribed to the variation in genetic makeup of wheat varieties, climatic conditions and differences in cultural practices and growth locations (Randhawa *et al*., 2002).

In case of falling number, Bhakkar 2002 had the highest falling number (432) and conversely lower alpha amylase activity while Auqab 2000 had lowest falling number (352) and therefore higher amylase activity. Alpha amylase activity depends on weather conditions, especially precipitation and mineral fertilizer (Gyiri and Sipos, 2006). Similar results were reported by Pasha (2006) during his study on fifty different wheat varieties during 2004-05.

Data regarding mineral composition of wheat reveals that the concentration of copper ranged from 2.61-4.68 mg kg^{-1} (Table 3). Sehar-2006 had the highest value (4.68 mg $kg^{-1)}$ whereas, GA 2002 possessed the lowest copper content (2.61 mg kg^{-1}). Highest iron content was observed in Inqulab 91 (21.37 mg kg^{-1}) and lowest value was observed in Sehar 2006 (14.80 mg kg^{-1}). The concentration of manganese and zinc among different varieties varied from 5.29-9.16 and 4.67-8.50 mg kg^{-1} respectively. Highest manganese and zinc were detected in GA 2002 (9.16 mg kg^{-1}) and Shafaq 2006 (8.50 mg kg^{-1}) respectively. Similar findings were reported by Araujo *et al*. (2008) in their studies on mineral composition of wheat flour consumed in Brazil.

Farinographic studies: Farinographic studies were conducted to determine the rheological properties of wheat flour (Table 4). Highest water absorption (57.38%) was observed in Inqulab 91 followed by Sehar 2006 (57.02%) while Bhakkar 2002 had the lowest water absorption (54.05%). DMR test for water absorption reveals that all wheat flour samples were significantly different from each other except Sehar 2006 and Auqab 2000 which had non-significant differences. Water absorption is considered to be an important characteristic of wheat. Stronger wheat flours have the ability to absorb and retain more water as compared to weak flours. Higher water absorption is required for good flat bread characteristics which remain soft for a longer time (Simon, 1987).

Table 3: Mineral composition of wheat flour

Varieties	Copper (mg kg^{-1})	Iron (mg kg^{-1})	Manganese (mg kg^{-1})	Zinc (mg kg^{-1})
Inqulab 91	3.43±0.25	21.37±0.22	8.20±0.24	6.34±0.08
Bhakkar 2002	4.12±0.13	20.42±0.26	5.29±0.18	7.06±0.28
AS 2002	2.81±0.11	17.61±0.30	5.44±0.26	5.35±0.11
Shafaq 2006	3.26±0.16	17.30±0.34	5.88±0.22	8.50±0.15
Sehar 2006	4.68±0.19	14.80±0.20	7.18±0.13	7.60±0.19
Auqab 2000	3.75±0.13	20.40±0.20	6.72±0.24	7.17±0.04
GA 2002	2.61±0.26	18.79±0.32	9.16±0.20	4.67±0.33

*All values are means of three replications

Table 4: Farinographic characteristics of different wheat varieties

Varieties	WA (%)	DDT (min)	DS (min)	TI (BU)	SD (BU)
Inqulab 91	57.38a	3.63b	8.14c	46.67cd	70.00c
Bhakkar 2002	54.05f	2.21e	5.83e	86.67b	93.33b
AS 2002	55.87c	2.57de	9.17a	53.33c	60.00cd
Shafaq 2006	55.19d	3.08c	4.11g	60.00c	76.67bc
Sehar 2006	57.02b	4.12a	7.66d	35.00d	53.33d
Auqab 2000	56.78b	3.24bc	8.55b	43.33cd	46.67d
GA 2002	54.56e	2.70d	5.22f	110.00a	116.67a

*All values are means of three replication. *Means followed by same letters do not differ significantly ($p<0.05$).
WA = Water Absorption, DDT = Dough Development Time, DS = Dough Stability, TI = Tolerance Index, SD = Softening of Dough

Table 5: Sensory attributes of chapattis prepared from different wheat varieties

Varieties	Colour	Taste	Flavour	Texture	Chewing ability	Folding ability	Overall score
Inqulab 91	6.53e	7.00c	7.27bc	6.47c	6.13c	5.80c	6.53d
Bhakkar 2002	7.07d	6.27d	7.00c	5.60e	5.87cd	5.40d	6.21e
AS 2002	8.07a	7.47ab	7.40b	6.67bc	6.80b	6.73a	7.19b
Shafaq 2006	7.47c	7.33b	7.53b	7.00ab	6.07c	6.13b	6.92c
Sehar 2006	7.60b	7.60a	6.87cd	7.33a	6.93b	6.20b	7.09bc
Auqab 2000	7.87ab	7.80a	7.93a	6.80b	7.60a	6.27b	7.38a
GA 2000	7.20d	7.07c	6.60d	6.13d	5.67d	5.93bc	6.43d

*All values are means of three replication. *Means followed by same letters do not differ significantly ($p<0.05$)

In case of Dough Development Time (DDT), Sehar 2006 had the highest value (4.12 min) whereas Bhakkar 2002 had the lowest time (2.21 min). Higher dough development time reflects strong flour while its lower value is an indication of weak flour. Dough stability of different wheat varieties flour varied from 4.11 min (Shafaq, 2006) to 9.17 min (AS, 2002). DMR test for dough stability shows that wheat flours of all varieties were significantly different from each other. Dough stability is an indicator of flour strength. For Tolerance Index (TI), highest value was observed in GA 2002 (110 BU) whereas Sehar 2006 had the least tolerance index (35.00 BU). Generally, higher the tolerance index value, weaker is the flour. As regards Softening of Dough (SD), Auqab 2000 had the lowest value (46.67 BU) followed by Sehar 2006 (53.33 BU). Flours that have lower SD are stronger and the ones having higher SD values are weaker. Differences in farinographic characteristics among different wheat varieties may be due to variations in protein quantity and quality (Rehman *et al*., 2001).

Sensory evaluation: Naans prepared from different wheat varieties flour were subjected to sensory evaluation for colour, taste, flavour, texture, chewing ability and folding ability in triplicate and their scores were calculated (Table 5). Highest mean score for colour (8.07) was obtained by AS 2002 whereas Inqulab 91 got the lowest score (6.53). As regards taste, Auqab 2000 was at the top (7.80) followed by Sehar 2006 (7.60) and found to be least (6.27) for Bhakkar 2002. Maximum flavor score (7.93) was attained by Auqab 2000 whereas GA 2002 received the minimum score (6.60). The differences in colour, taste and flavour scores may be attributed to the differences in hardness/softness of wheat grains and other factors like wheat varieties and milling characteristics of wheat (Farooq, 2001). For texture, highest mean score (7.33) was obtained by Sehar 2006 and lowest (5.60) by Bhakkar 2002. In case of chewing ability, Auqab 2000 got the maximum score (7.60) and GA 2002 obtained the minimum score (5.67). For folding ability, Bhakkar 2002 obtained the least score (5.40) whereas AS 2002 received the highest score (6.73). With respect to overall acceptability of naans, highest score (7.38) was obtained by Auqab 2000 and thus regarded as more acceptable than other flour naans while lowest score (6.21) was obtained by Bhakkar 2002 thus considered least acceptable.

Conclusion: It was concluded that physic-chemical and rheological characteristics of wheat varieties affect the quality of the end product. Overall, quality of wheat varieties was good and comparable to International

standards. Wheat variety Auqab 2000 was ranked highest and most suitable for leavened flat bread (naan) preparation.

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