Investigation of Suitable Pakistani Wheat Cultivars for Preparation of Quick Cooking Bulgur

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ABSTRACT

The purpose of this research was to evaluate the aptness of Pakistani commercial wheat cultivars Durum-97, Faisalabad-8, Punjab-11, Galaxy-13, Ujala-16 and Annaj-17 aptnessfor bulgur preparationthrough thousand kernel weight (43-47 g), grain size (length 5-7, width 2-3, thickness 2-3 mm), particle size index (16-24 %), single kernel characterization system (hardness 45-74 HI, weight 34-36 mg, moisture 9-10 %, diameter in-between 2mm) respectively. All varieties were parboiled for 3 suitable periods (regarding in dimensions40, 60, 80 min) at constant temperature. Bulgur was evaluated in various nutritional and quality attributes. Color analysisvalue was (L* 56-64, a* -1- -3, b* 17-21 of colorimeter).SDS-sedimentation test (19-25 mL), zeleny value (46-60 mL) and SDS-PAGE friabilin protein (presence and absence) while Durum-97 and Anaj-17 lack these proteins.Proximate analysis of wheatcarries (ash 0-1, crude protein 12-15, crude fiber 1-2, and crude fat 1-3 %). Likewise proximate analysis of bulgur shows (0-1 ash, 12-15 crude protein, 1-2 crude fat and 1-3 % crude fiber). Mineral analysis revealed (Ca 367-534, Fe 49-33, Zn 23-18, Na 311-171, K 774-952 mgkg-1). Consumers overall acceptance (sensory evaluation) recommends Anaj-17 and Punjab-11 among allvarieties. Conclusively, there is a need to explore more indigenous wheat cultivars as this is the staple food and a value added product.

Keywords: Bulgur Preparation, Wheat Nutrition, Cultivar Proximate, Sensory Evaluation.

INTRODUCTION

Cereals are vital product concerning humans. Among cereals, wheat is the most leading crop which is produced, traded and consumed worldwide and remains staple food throughout the history [1]. In Pakistan the contribution of wheat in food consumption is 80% which is mostly consumed in form of flat bread and in combination with other cereals. In 2021, Pakistan's annual wheat production was 26 million tons

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[2]. Consumers categorize wheat into its growth pattern, color and quality. Furthermore, the quality character is determined into hard and soft texture [3]. The large particle size was easily passes away from sieves [4]. Durum kernel is considered as the hardest kernels among others which are usually radiant, large and golden amber [5].

Bulgur a (pre-cooked wheat) is prepared from the variety (Tritium durum) which is an appealing product. It is a popular and trendy cuisine due to its high nutritional value and shelf life resistant to microorganisms and radiation includes mites and insects at a very affordable price [6]. As the consumer choice is shifted from old cuisines to new healthy products, the demand of vital cereal has been increased by health conscious societies [7]. Coating of bran grain comprises on 14 to 15 % which protects the germ comprised of Vitamins B some other minerals including iron (Fe), magnesium (Mg), zinc (Zn) and other dietary fibers. Unsaturated fats, antioxidants, Vitamin B and E in the sprouting section of grain germ i.e. 2-3 % provides nutrition to the seeds while 83 % endosperm provides minerals (macro and micro), proteins and carbohydrates [8].Thus the whole grain proven against many minor and severe maladies. Due to presence of minerals and very low crude fat contents, the whole bran grain protects and promotes the many heart conditions [9]. As compared to refined grain consumers, persons with high whole grain consumption reduce more weight and proved efficient against obesity [10].

Bulgur is already accepted as nutritious diet because it contains an adequate amount of dietary fibers which is 18.3g per 100 grams. As we compared it with rice and wheat flour, the dietary fiber content is 3.5 times greater in amount and 1.1 times than barley [6]. With high levels of protein and less percentage of fats, carbohydrates in bulgur provide enormous energy. Major mineral like potassium who act as vasodilator that release out the nerve pressure which ultimately promotes heart health are a part of bulgur. The presence of iron content avoids anemia which is helpful in producing red blood cells. The zinc helps in synthesis of protein and divisions of cells which ultimately increases immunity. Bulgur contains folic acid (B complex) as B9 and B3 niacin promotes sex hormones and releases energy making desirable for babies and also for pregnant women because it is stimulator for brain formation with the breakdown of fats and proteins. High amounts of minerals in bulgur serve as good source for bones health which affects low mineral deposition [6].

Realizing all the local and international attributes of whole wheat kernels in balanced diet sheets, the work aimed to highlight the commercial Pakistani wheat cultivars for the preparations of quick cooking bulgur for diversification in diet charts and value additions. The major objectives of the research study are to evaluate wheat bulgur through different wheat cultivars and analyze their nutritional and physiochemical properties by keeping in view the consumer's acceptability through sensory evaluation methods.

MATERIALS

Experiment was performed in (NIFSAT) Faculty of Food, Nutrition and Home Sciences, University of Agriculture; Faisalabad.Wheat varieties (Durum-97, Faisalabad-8, Punjab-11, Galaxy-13, Ujala-16 and Annaj-17) were obtained from Ayub Agricultural Research Institute (AARI), Faisalabad, Pakistan in 2018. All healthy and selected wheat samples were analyzed. Thousand kernels weight was determined by using AACC (2006) on electric balance. Grain size was measured in length, width and thickness with micrometer. Particle size index were sifted through sieves aperture (200-mesh) to measure and quantifies grains. The single kernel characterization system is measured by following method of AACC (2006) method no 55-31.01 in an automatic manner of the properties like moisture, weight, diameter and hardness. Dimension of best cooking time (60 min) was selected for evaluation of quick cooking bulgur in comparison with (40, 60 and 80 min) with a short side test. Different samples of bulgur were analyzed for color analysis by colorimeter in which L* value (positive value indicates lightness while negative darkness), a* value indicates difference in red and green color while b* value determines yellow and blue color.

METHODS

All wheat varieties seeds were soaked overnight in water (1L) followed by cooking for various durations until starch gelatinization. Afterwards, wheat samples were dried in hot air oven at 55ºC upto 10% moisture. Dried samples were crushed into coarse fractions.Samples were marked and percent change in dimensions was measured before and after cooking following standard method.Sedimentation test is to check hardness by holding wheat into acidic solution for swelling of proteins. 3.2g of wheat sample added in 100ml graduated cylinder which already contains 50ml of water were mixed for 5minutes, later record the SDS value according to the method No. 56-70 of AACC (2006). Each cultivar's Zeleny value was observed through omega analyzer in which the sample poured in the instrument and with the help of computer operating beam it determines different values and characters of whole grain. For gel electrophoresis,

each sample of variety was according to the Richard et al. [11] method later results were read-on staining gel. Mineral composition in wheat flour was determined through AOAC [12] method of wet digestion. Bulgur's overall acceptance was evaluated by panel of judges NIFSAT department comprised on 15 members using 9 points agenda of Hedonic scale [13]. To measure ash content of wheat flour, method No. 08-01 was used. Crude fat was measured according to (30-25) method however, fat measured by Soxhlet's apparatus. Crude fiber estimated by Labcono Fiber tech

given in standard procedure mentioned in No. 32-10 of AACC 2006. The NFE calculated all parameters; protein, crude fat and fiber, ash by subtracting from 100. The results of data collected were subjected to analysis of variance under Complete Randomized Design and Factorial Design for the evaluation of means square and mean values of analysis [14].

RESULTS AND DISCUSSIONS

The first two tables i.e., Table 1 and Table 2 are the selection of wheat cultivar before cooking a bulgur while Table 3 signifies the contents after cooking a bulgur.

Table 1. Physical properties of Pakistani Wheat cultivars for Bulgur

Catal.	TK	GS (mm)			PSI		SKCS			D (60 min)			CA value		
Varieties	Weight (g)	L	W	Th	%	H(HI)	W(mg)	M (%)	D(mm)	L	CW	W	L*	a*	b*
Durum-97	47.08[a]	7.38[a]	3.54[a]	3.08[a]	16.56[d]	74.36[a]	36.56[c]	10.12[b]	2.86[b]	3.45[b]	51.4[a]	25.01[c]	58.60[b]	-1.98[c]	20.54[c]
Faisalabad-8	41.01[d]	6.80[a]	3.23[ab]	2.81[c]	24.29[b]	64.33[d]	36.46[c]	10.35[ab]	2.80[b]	3.41[b]	49.13[a]	26.2[c]	57.37[c]	-2.98[e]	21.06[b]
Punjab-11	43.58[c]	6.36[ab]	3.34[ab]	2.95[d]	21.47[bc]	68.29[c]	38.16[b]	10.28[ab]	2.97[a]	3.61[b]	50.16[a]	26.06[c]	56.94[d]	-1.44[b]	17.76[e]
Galaxy-13	42.38[c]	7.17[a]	3.14[ab]	2.99[bc]	24.72[a]	45.26[f]	35.98[c]	9.92[b]	2.72[c]	3.63[b]	51.06[a]	26.1[c]	57.04[d]	-1.13[a]	18.23[d]
Ujala-16	42.40[c]	5.32[b]	2.93[b]	2.62[d]	22.33[a]	55.25[e]	34.22[d]	10.17[b]	2.82[b]	3.41[b]	51.79[a]	26.19[c]	56.28[e]	-2.40[d]	17.22[f]
Anaj-17	45.34[b]	6.46[a]	3.04[b]	2.82[b]	20.98[c]	70.30[b]	39.43[a]	10.86[a]	2.95[a]	3.62[b]	47.1[a]	24.93[c]	64.68[a]	-3.02[e]	21.91[a]

Means with different letters are significantly different at 5% level of probability.

TK= Thousand Kernel, GS= Grain Size (length, width, thickness), PSI= Particle Size Index, SKCS= Single Kernel

Characterization System (hardness, weight, moisture, diameter), D= Dimensions (length, crease width, width), CA= Color Analysis (L* lightness - darkness, a* greenness - redness, b* yellowness - blueness).

Table 2. Chemical properties of Pakistani wheat cultivars for cooking bulgur

Catal.	SDS Value (mL)		SDS - PAGE		Mineral Analysis(mgkg⁻¹)					SE
Varieties	S	Z	FP	BI	Ca	Fe	Zn	Na	K	OA
Durum-97	19.83[c]	56[b]	Absent	Absent	534[a]	33.66[d]	19.83[a]	208[ab]	813[a]	7.18[ab]
Faisalabad-8	21.83[bc]	48.40[e]	Present	Light	442[b]	42.0[bc]	18.75[a]	207[b]	774[ab]	7.10[ab]
Punjab-11	23.93[ab]	51[d]	Present	Light	367[ab]	43.66[abc]	18.74[a]	171[ab]	852[ab]	7.30[a]
Galaxy-13	25.02[a]	54.16[c]	Present	Dark	422[ab]	36.66[cd]	18.33[a]	280[ab]	910[ab]	6.20[bc]
Ujala-16	25.35[a]	60.46[a]	Present	Light	424[ab]	49.33[a]	21.84[a]	311[a]	831[ab]	6.02[c]
Anaj-17	20.66[c]	46.16[f]	Absent	Absent	535[a]	45.2[ab]	23.33[a]	270[ab]	952[b]	8.00[a]

Means with different letters are significantly different at 5% level of probability.

SDS= Sodium Dodecyl Sulfate (sedimentation, zeleny), PAGE= Polyacrylamide Gel Electrophoresis (friable protein, band intensity), Mineral Analysis=(calcium, iron, zinc, sodium, potassium), SE= Sensory Evaluation (overall acceptability).

Table 3. Nutritional Properties of Pakistani wheat cultivars for bulgur

Catal.	Wheat Proximate				Bulgur Proximate			
Varieties	Ash	CP	CFt	CF	Ash	CP	CFt	CF
Durum-97	1.67[a]	14.60[ab]	2.96[a]	2.08[b]	1.66[a]	13.90[b]	2.94[a]	2.07[b]
Faisalabad-8	0.843[c]	12.80[cd]	1.55[b]	1.63[d]	0.84[c]	12.60[c]	1.53[b]	1.61[d]
Punjab-11	0.99[b]	12.58[d]	1.74[b]	1.70[cd]	0.97[b]	12.79[c]	1.72[b]	1.69[cd]
Galaxy-13	0.85[c]	13.24b[cd]	2.84[a]	1.45[e]	0.86[bc]	12.83[c]	2.86[a]	1.45[e]
Ujala-16	0.93[c]	15.18[a]	1.99[b]	1.78[a]	0.94[bc]	15.01[a]	1.98[b]	2.24[a]
Anaj-17	1.57[a]	14.30[abc]	3.01[a]	2.28[c]	1.56[a]	14.03[b]	2.95[a]	1.76[c]

Means with different letters are significantly different at 5% level of probability.

CP= Crude Protein, CFt= Crude Fat, CF= Crude Fiber

Table-1 indicated the physical properties of Pakistani wheat varieties for the preparation of cooking bulgur. Highest thousand kernel weight value (47.08g) attained by Durum-97 while the lowest gained in Faisalabad-8 (41.01g).Variations due to agronomic, environmental and genetic factors. Ramya et al. [15] proposed, by selecting heavier kernels indirectly picks larger seeds resulting higher yield. Grain size is also very important parameter in bulgur formation. Durum-97 got the maximum grain size (7.38mm) while lowest in Ujala-16 (5.32mm). Highest width value (3.08mm) was recorded in Durum-97, whereas lowest in Ujala-16 (2.93mm). Highest thickness value (3.08mm) was measured in Durum-97 and the lowest in Ujala-16 (2.62mm). Pasha et al. [16] reported that length, width, thickness of grain affect due to wheat cultivars.

In particle size index value Galaxy-13 was the top to get (24.70%), however lowest (16.56%) was in Durum-97. Differences in PSI are due to environmental and genetic conditions of wheat cultivars. Similar results are summarized in research conducted by Pasha et al. [16,17]. The parameter of hardness through single characterization system (SKCS) is the most important feature of bulgur. Highest hardness value (74.36%) was determined by Durum-97, while Galaxy-13 attained the minimum (45.26%). Anaj-17 got the highest weight value (39.43mg) and lowest in Ujala-16 (34.22mg). (10.86%) was the highest moisture value in Anaj-17 cultivar but the lowest in Galaxy-13 (9.92%). Punjab-11 ranked

first position in diameter (2.97mm) and lowest position in Galaxy-13(2.72mm). Results differed due to various genetic characters and wheat cultivars. According to AACC [18], SKCS of Pakistani wheat cultivars were ranged from semi hard to hard wheat. Best cooking time (60 min) was selected for wheat cultivars based on percent change in dimensions. Length, width and crease width; Durum-97 decreased (3.45%),(51.4%) and (25.01%) respectively. Other treatments showed similar pattern regarding to this. Bayram et al. [6] explained the dimensions of kernels effect by time and temperature significantly while cooking bulgur which increased the weight and volume of the kernels. Highest L* color analysis value got Anaj-17 (64.280) and lowest Ujala-16(56.287). Highest negative a* value Anaj-17 (-3.0200), lowest Galaxy-13 (-1.1333). Highest b* value Anaj-17(21.913) while lowest in Ujala-16 (17.223). Mentioned ranges of L*, a* and b* are similar with findings by Ertas [19]. Bayram and Oner [6] studied the effect of color sorting system in preparations of bulgur and reported that using color sorter, quality and product acceptability of bulgur increase.

Table-2 showed the detail of various chemical properties of Pakistani wheat varieties especially for cooking bulgur. Sodium Dodeyl Sulfate (SDS) was found highest in Ujala-16 (25.35 ml) whereas lowest SDS-sedimentation was observed in Durum-97(19.83 ml). Higher zeleny value in Ujala-16 (60.46 ml) and lowest in Faisalabad (46.16 ml). Pasha et

al. [15] that sedimentation values distinguished due to different in wheat varieties and the crop years they were in grown. Iqbal et al. [20] stated that sedimentation values ranges from (20 to 30 ml) when physical, chemical and rheological properties were analyzed. Randhawa et al. [21] found the SDS- sedimentation values ranging from 18.17 to 28.33 ml. The results shows that Durum-97 and Anaj-17 lack the friabilin protein i.e. 15kDa polypeptide band whereas Galaxy-13 shows intense 15kDa band. Results indicated that wheat varieties lacking friabilin proteins are inflexible while those having friabilin protein were soft textured wheat. Presence and absence of the friabilin protein in different wheat varieties were because of genetic variation and not influenced by any other factor. Morris et al. [22] concluded that mutation of puroindolines results in wheat hardness. Highest Ca concentration observed in Anaj-17 (535mg/kg) whereas lowest in Punjab-11(367mgkg-1). Highest Fe value observed in Ujala-16 (49.33mg/kg) whereas lowest was in Durum-97 (33.66 mgkg-1). Highest mean value depicts Annaj-17(23.33) and lowest observed in Galaxy-13. Highest mean value of Na observed in Ujala-16(311 mgkg-1) whereas lowest was in Punjab-11(171 mgkg-1). Mean value of K highest observed in Anaj-17(952 mgkg-1) while lowest in Faisalabad-08 (774 mgkg-1). Lamhamdi et al. [23] studied the effect of lead (Pb) on mineral profile of wheat and testified that reduce level of Na, K, Ca, Fe and Zn are due to lead (Pb) concentrations in soil. Maximum acceptance of bulgur by panelist was prepared from Anaj-17(8.00±0.98) however lowest acceptance was observed in Ujala-16 bulgur (6.00±0.70). Panelist reported that overall wheat samples are suitable for bulgur although cooking of wheat for up-to 60 mins when all starch gelatinized and grains coarse particles after milling of bulgur enhanced its overall acceptability. These results are similar to the findings of Hayta et al. [24] that cooking bulgur increases its overall acceptability and remained well on score up-to six months of storage period [25].

Nutritional properties of wheat varieties and wheat bulgur were presented in table-3. Ash contents were the maximum in Durum-97 (1.67%) whereas lowest in Faisalabad-08 (0.84%), Pasha et al. [15] checked the significance of ash content on different wheat varieties as well as the crop years they were grown. The higher ash content also had relationship with kernel size, lower the kernel size resulted in higher bran portion and lower endosperm and relatively higher ash content [26]. Protein value in wheat varieties is one of the best criteria of bulgur preparation. The highest value observed in Ujala-16 (15.18%) and lowest protein

content by Punjab-11 (12.58%), The present study results were supported by Anjum and Walker [27] where protein range from 6 to 20% influenced by edaphic factors like environment, soil conditions and application of fertilizers. The result was similar to studies who reported protein content to be 10.31-15.41% [28]. The highest fat content was determined in Anaj-17(3.01%) whereas lowest was in Faisalabad-08 (1.74%), The similar results were reported by Iqbal et al. [29] in which they studied fat contents difference in varieties due to genetic variability, climatic condition or difference in crop years growth. Durum-97 got the highest value of fiber content (2.08%) whereas lowest by Galaxy-13 (1.45%). The difference in crude fiber among wheat varieties might be due to their genetic diversity, Similar findings reported by Qazi et al. [30] in which fiber ranged from 1.60 to 2.00% between different wheat cultivars. Ikhtiar and Zeb [31] studied nutritional composition of wheat varieties where fiber ranged from 1.73 to 1.85%.

Highest value of ash was in durum-97 is (1.66%) and the lowest value obtained from Faisalabad-08(0.84%). Highest value of crude protein was in Ujala-16 (15.01%) and the lowest value obtained from Faisalabad-08 (12.60%). Highest value of crude fat in Anaj-17 determined (2.95%) and lowest value was noted in Faisalabad-08 (1.53%). Highest value of crude fiber analyzed in Ujala-16 (2.24%) and lowest value in Galaxy-13 (1.45%). The difference in bulgur ash, protein, fat and fiber detected due to cultivar difference and cultivars used to prepare bulgur, however the proximate values are in line with study conducted by Yousif et al. [32].

CONCLUSION

The present research has been attempted to increase the share of whole wheat in the diets through the developments of value-added products. Currently, wheat is mainly used in the form of whole wheat and white flours. Bulgur is prepared from hard wheat due to high protein content. In Pakistan, soft wheat varieties with better protein content are commercially cultivated. The core objective of the study was to screen out the potential cultivars (n=14) through various parameters for their bulgur making suitability. The sensory evaluation was performed according to consumer likeness and acceptability. The preferred quick cooking bulgur was Anaj-17 and Punjab-11 due to attractive color and texture, appealing taste. Anaj-17 and Punjab-11 which are superior to other wheat cultivar's bulgur and their sensory evaluation was performed according to consumer likeness and acceptability due to their attractive color, texture and appealing taste. There are significant differences

among wheat cultivars while there are no as such differences between them which are notable in bulgur form.Wheat bulgur is deliberated and claimed as a whole grain product. It is mostly consumed in many forms and in bakery products which are usually prepared from flour. There is a need to enhance whole grain diet to benefit the mass and diet diversification.

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