

# 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 Anaj-17 aptness for bulgur preparation through 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 dimensions 40, 60, 80 min) at constant temperature. Bulgur was evaluated in various nutritional and quality attributes. Color analysis value 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 wheat carries (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 crude fiber). Mineral analysis revealed (Ca 367-534, Fe 49-33, Zn 23-18, Na 311-171, K 774-952 mg/kg-1). Consumers overall acceptance (sensory evaluation) recommends Anaj-17 and Punjab-11 among all varieties. Conclusively, there is a need to explore more indigenous wheat cultivars as this is the staple food and a value added product.

**Key words:** aflatoxin; brown rice; basmati; elisa; quality management

## 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 (Badawi et al., 2017). In Pakistan, wheat is consumed in form of flat bread and in cereals; contribution of wheat is 80% of food intake. In 2021, Pakistan's annual wheat production was 26 million tons (GOP, 2021). Consumers categorize wheat into its growth pattern, color and quality. Furthermore, the quality character is determined into hard and soft texture (Iftikhar and Ali, 2017). The large particle size was easily passes away from sieves (Haraszi et al., 2016). Durum kernel is considered as the hardest kernels among others which are usually radiant, large and golden amber (Fu et al., 2017).

Bulgur (pre-cooked wheat) is prepared from the variety (*Triticum 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 (Bayram, 2005). The consumer's choices are shifts from old cuisines to new and healthy products, so the demand of natural product has been increased by

health conscious societies (Vignola et al., 2018). 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 (Aune et al., 2016). 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 (Jensen et al., 2004). As compared to refined grain consumers, persons with high whole grain consumption reduce more weight and proved efficient against obesity (Katcher et al., 2008).

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 (Bayram, 2006). 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 serves as good source for bones health which affect low mineral deposition (Bayram, 2007).

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 evaluation and cooking of quick bulgur from different wheat cultivars and its nutritional and physiochemical assessment keeping in view the consumer's acceptability through sensory evaluation methods.

## Materials and Methods

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 Anaj-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. 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 55°C 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 5 minutes, 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. (2000) method later results were read on staining gel. Mineral composition in wheat flour was determined

through AOAC (2016) 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 (Meilgaard et al., 2007). 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 (Steel et al., 1997).

## Results and Discussions

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. (2010) 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., (2010) 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 (Ahmad et al., 2001). Similar results are summarized in research conducted by Pasha et al. (2009, 2010). 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 (2010), 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. (2004) 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 (2017). Bayram and Oner (2006) studied the effect of color sorting system in preparations of bulgur and reported that using color sorter, quality and product acceptability of bulgur increase.

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
Durum-97	47.08 <sup>a</sup>	7.38 <sup>a</sup>	3.54 <sup>a</sup>	3.08 <sup>a</sup>	16.56 <sup>d</sup>	74.36 <sup>a</sup>	36.56 <sup>c</sup>	10.12 <sup>b</sup>	2.86 <sup>b</sup>	3.45 <sup>c</sup>	51.4 <sup>a</sup>	25.01 <sup>c</sup>	58.60 <sup>b</sup>	-1.98 <sup>e</sup>	20.54 <sup>f</sup>
Faisalabad-8	41.01 <sup>d</sup>	6.80 <sup>b</sup>	3.23 <sup>ab</sup>	2.81 <sup>c</sup>	24.29 <sup>b</sup>	64.33 <sup>d</sup>	36.46 <sup>c</sup>	10.35 <sup>ab</sup>	2.80 <sup>b</sup>	3.41 <sup>b</sup>	49.13 <sup>a</sup>	26.2 <sup>c</sup>	57.37 <sup>b</sup>	-2.98 <sup>e</sup>	21.06 <sup>b</sup>
Punjab-11	43.58 <sup>c</sup>	6.36 <sup>ab</sup>	3.34 <sup>ab</sup>	2.95 <sup>d</sup>	21.47 <sup>bc</sup>	68.29 <sup>c</sup>	38.16 <sup>b</sup>	10.28 <sup>ab</sup>	2.97 <sup>b</sup>	3.61 <sup>b</sup>	50.16 <sup>a</sup>	26.06 <sup>c</sup>	56.94 <sup>d</sup>	-1.44 <sup>d</sup>	17.76 <sup>c</sup>
Galaxy-13	42.38 <sup>c</sup>	7.17 <sup>a</sup>	3.14 <sup>ab</sup>	2.99 <sup>bc</sup>	24.72 <sup>a</sup>	45.26 <sup>e</sup>	35.98 <sup>c</sup>	9.92 <sup>b</sup>	2.72 <sup>c</sup>	3.63 <sup>b</sup>	51.06 <sup>a</sup>	26.1 <sup>c</sup>	57.04 <sup>d</sup>	-1.13 <sup>d</sup>	18.23 <sup>d</sup>
Ujala-16	42.40 <sup>c</sup>	5.32 <sup>b</sup>	2.93 <sup>b</sup>	2.62 <sup>d</sup>	22.33 <sup>a</sup>	55.25 <sup>e</sup>	34.22 <sup>d</sup>	10.17 <sup>b</sup>	2.82 <sup>b</sup>	3.41 <sup>b</sup>	51.79 <sup>a</sup>	26.19 <sup>c</sup>	56.28 <sup>c</sup>	-2.40 <sup>d</sup>	17.22 <sup>d</sup>
Anaj-17	45.34 <sup>b</sup>	6.46 <sup>a</sup>	3.04 <sup>a</sup>	2.82 <sup>b</sup>	20.98 <sup>c</sup>	70.30 <sup>a</sup>	39.43 <sup>a</sup>	10.86 <sup>a</sup>	2.95 <sup>a</sup>	3.62 <sup>b</sup>	47.1 <sup>a</sup>	24.93 <sup>c</sup>	64.68 <sup>a</sup>	-3.02 <sup>e</sup>	21.91 <sup>a</sup>

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 1:** Physical properties of Pakistani Wheat cultivars for bulgur

Table-2 showed the detail of various chemical properties of Pakistani wheat varieties especially for cooking bulgur. Sodium Dodecyl 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., (2010) that sedimentation values distinguished due to different in wheat varieties and the crop years they were in grown. Iqbal et al. (2015) stated that sedimentation values ranges from (20 to 30 ml) when physical, chemical and rheological properties were analyzed. Randhawa et al. (2002) 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. (2007) concluded that mutation of puroidolines 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. (2013) 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. (2003) that cooking bulgur increases its overall acceptability and remained well on score up-to six months of storage period (Singh et al., 2014).

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

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 2:** Chemical properties of Pakistani wheat cultivars for cooking bulgur.

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., 2010 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 (Butt et al., 2001). 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 (2000) 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% (Ahmad et al., 2001). 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. 2015 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. (2003) in which fiber ranged from 1.60 to 2.00% between different wheat cultivars. Ikhtiar and Zeb (2007) 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. (2018).

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

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

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

**Table 3:** Nutritional Properties of Pakistani wheat cultivars for bulgur.

## Conclusion

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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