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# Quality of Bulgur Wheat in Relation to Storage

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## ABSTRACT

Bulgur preparation is not common in our country, despite it is known as man's first processed food. Therefore, by making a stable nutritious product from wheat i.e., bulgur, a value can be added in consumer's diet. Potential utilization of rain affected wheat can also be achieved by converting it into bulgur. The main purpose of this study was to standardize the process of bulgur preparation and to assess the suitability of wheat class/variety for bulgur production. Wheat of three different classes (durum, aestivum, triticale) were used for preparation of bulgur by soaking for 3.5 h at 60°C followed by pressure cooking at 15 psi 15 $min^{-1}$ and drying to 10% moisture at 40°C. Pearling (8% degree of polish) and cracking operations were carried out to yield coarse, medium and fine bulgur. Sensory quality data revealed that bulgur of all fractions remained highly acceptable up to 6 months of storage at 37°C with respect to different sensory attributes. Microbial load in terms of total plate count remained well within limits during storage. The lower moisture content, ERH values and absence of aflatoxins collectively supported the increased shelf-life of bulgur. Among coarse, medium and fine fraction of bulgur from different wheat, fine fraction received high likeness followed by medium and coarser ones.

**Key words:** Wheat, bulgur, ERH, aflatoxins, sensory quality, microbial quality

## INTRODUCTION

Bulgur, an ancient wheat product around the world, Arab, Israeli, Egyptian and Roman civilizations record eating dried cooked wheat as early as 1,000 B.C. Bulgur is generally produced from *Triticum durum* and considered as man's first 'processed food'. It is basically prepared by cooking, drying, dehulling, grinding and classifying wheat into different fractions (Haley *et al*., 1960). Processing steps during the bulgur production cause the gaining of the some functional characteristics on the finished product such as resistance against mold contamination and insect infestation. More stable product than wheat are developed because wheat has respiration activity and enzyme that are active in the kernel. Bulgar wheat has low-fat, high protein, appealing taste and does not absorb radiation and is good source of folic acid. Parbioling of wheat is best processing method to decrease the phytic acid content in contrast to increasing the bran content (cellulose part, high mineral) (Bayram, 2000) and there are no evidence of aflatoxin formation in bulgur (Coksoeyler *et al*., 1993). Lower equilibrium relative humidity of bulgur also contributes in higher shelf life of bulgur. Consumption of bulgur has been found in variety of dishes like falafel, kishk, pilaf etc in different countries viz., Syria, Lebanon, Egypt, Turkey and other Middle Eastern

countries. Besides long shelf life and popularity of bulgur in many countries, there were only few systemized studies available on storage stability of bulgur. Therefore, an attempt was made to study changes in bulgur quality during storage at 37°C.

## MATERIALS AND METHODS

**Raw material:** Wheat of three different classes ('Durum', 'PDW 233'; Aestivum, 'PBW 343' and Triticale 'TL 2908') were used.

**Preparation of bulgur:** Samples were soaked for 3.5 h at 60°C followed by ressure cooking at 15 psi 15 $min^{-1}$ and then drying to 10% moisture content in hot air cabinet dryer (Singh *et al.*, 2007). The dried bulgur wheat were pearled in barley pearler ( Strong Scott U.K) upto 8% degree of polish and cracked into Coarse (overs 10;1.65 mm), Medium (overs 20;0.833 mm) and Fine (overs 30;0.589 mm, ISI mesh sieve) fraction in Cemotac Mill. Different fractions of bulgur from different wheat class was then packed in polyethyene bags (guage 200) and kept at room temperature (37°C) for storage studies.

**Equilibrium relative humidity (ERH) studies:** ERH of freshly stored bulgur (coarse and medium fraction) of different wheat classes were analyzed using static method, where an acid ($H_2SO_4$) solution was used for maintaining the desired RH (Hall, 1970).

**Aflatoxins estimation:** Pressure-minicolumn (PMC) was employed as a rapid and simple method for screening raw and bulgur wheat samples for quantitative estimation of aflatoxins (Sashidhar *et al.*, 1989).

**Sensory quality evaluation:** Bulgur was converted into porridge for sensory evaluation. Porridge was prepared by adding water in varied quantities (For durum 150 mL, aestivum 100 mL and for triticale 200 mL) to bulgur fractions of each wheat class (100 g) and cooked in two stages. In first cooking a uniform time of 5 min was given to all samples irrespective of class and fraction. The 2nd cooking was done after adding 80 g sugar in all samples along with milk which varied from 300 mL for course, 350 mL for medium and 400 mL for fine fractions in all the wheat classes. The porridge was cooked to doneness where course fractions required 20 min, medium 12 min and fine 6 min for durum, aestivum and triricale samples. Evaluation of porridge was rated on 9 point Hedonic Scale (Larmond, 1970).

**Microbial quality:** Total plate count of bulgur (coarse fraction) of different wheat class was analyzed by standard method (Hobbs and Greene, 1984).

**Statistical analysis:** All values reported are an average of 2 replicates. Data were analyzed using the analysis of variance technique (Snedecor and Cochran, 1968). The means were compared using Duncan's multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

**Equilibrium relative humidity (ERH) of bulgur wheat:** Figure 1 depicts the ERH of coarse and medium fraction of bulgur of 3 different wheat classes. Bulgur of different fractions

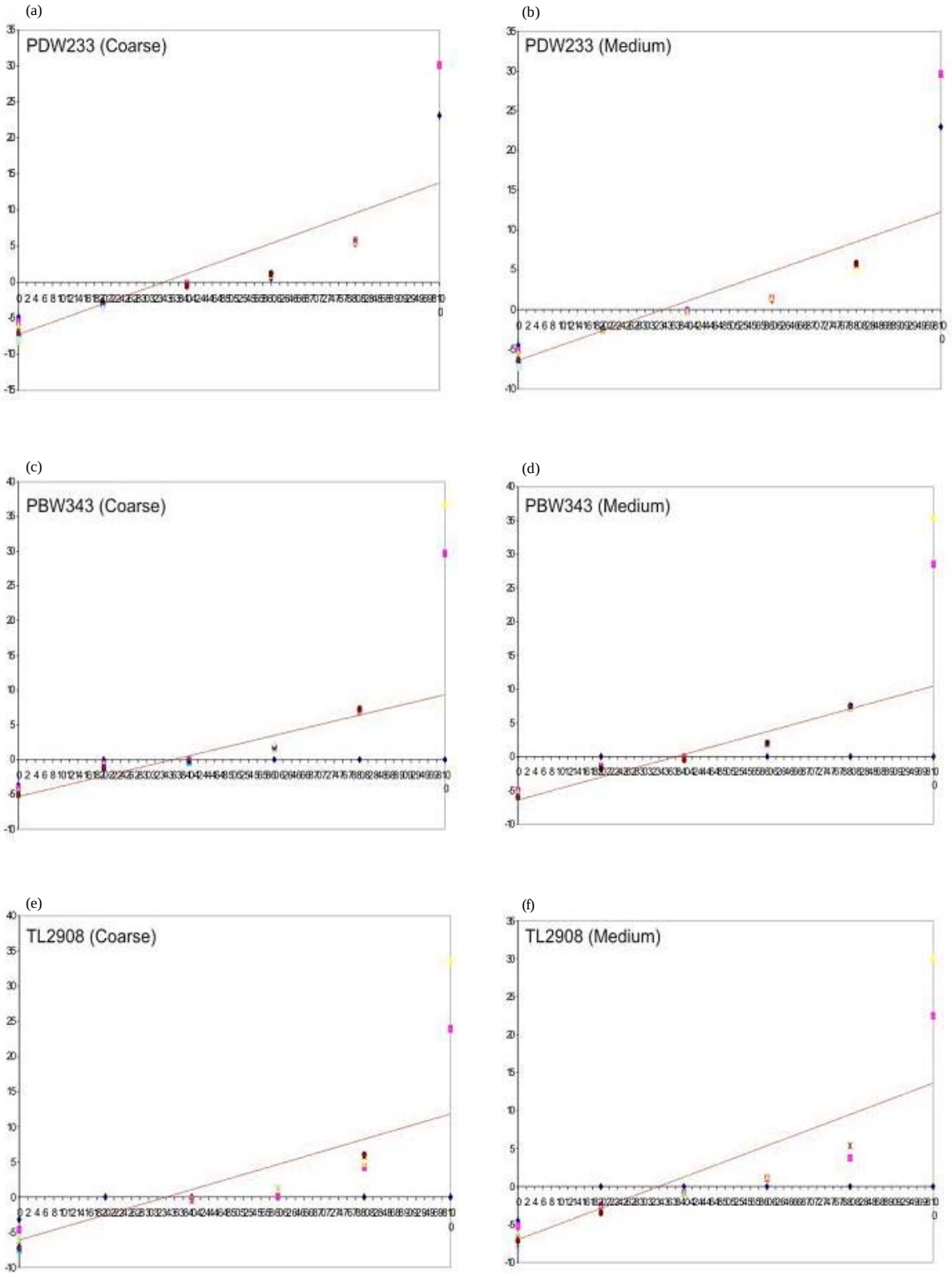


Fig. 1(a-f): Equilibrium relative humidity of bulgur wheat of coarse and medium fractions, (a) PDW233 (Coarse), (b) PDW233 (Medium), (c) PBW343 (Coarse), (d) PBW343 (Medium), (e) TL2908 (Coarse) and (f) TL2908 (Medium)

from all wheat classes had no effect on ERH values. Durum and triticale wheat classes had similar behavior of ERH, values being 34%, whereas, slightly higher values of ERH were observed for aestivum wheat bulgur (37%). Almost similar type of observations was made by other author (Ferrel *et al*., 1966). They reported that during the study of ERH of bulgur, neither the type of wheat nor the state of subdivision influenced the EMC of bulgur to any great extent.

**Aflatoxin in bulgur wheat:** There was no evidence of production of aflatoxins during bulgur manufacturing and none of the 3 wheat classes of bulgur examined contained aflatoxins. The results were in conformity with other authors (Coksoeyler *et al*., 1993).

**Effect of storage period on the sensory quality of bulgur wheat:** Significant effect of storage period was observed on different sensory attributes (color, texture, flavour, taste and overall acceptability) of all bulgur (Table 1). Color score of freshly prepared product (coarse fraction) was in the range of high acceptability up to 6 months of storage. Other sensory parameters for stored product varied from freshly prepared product. However, the product remained acceptable even after 6 months of storage as the overall acceptability score was in range of 7.7-7.8. Significant differences were also observed for different sensory attributes of bulgur prepared from different wheat classes (Table 2). Triticale bulgur wheat gained maximum score for overall acceptability followed by aestivum and durum wheat bulgur.

Values of effect of storage on sensory quality of medium fraction bulgur depicted that colour score of freshly prepared product was 8.1 and 7.7 after 6 month storage and was in the range of high likeness. Similar trend was followed for other sensory parameters also. Overall acceptability of fresh product was 8.3, not affected even after 6 month storage (7.8).

Bulgur produced from durum wheat class showed better appearance/colour than aestivum and triticale. However, other sensory parameters for triticale class was liked most. Bulgur of all medium fractions from three wheat classes were in high acceptability range as non-significant variation was observed in all overall acceptability scores.

Data regarding the storage period and class effect on different sensory attributes of fine fraction bulgur revealed that colour score of freshly prepared product was 8.4 and at the end of 6 month of storage was 7.8. Overall acceptability score of fine fraction was remained well within high acceptability range on storage. The porridge prepared from fine fraction had retained quality for body, texture and taste during storage period. Maximum score for texture was obtained by fine fraction of triticale bulgur (8.5) followed by aestivum (8.4) and durum bulgur (8.2). Although, colour of durum bulgur was liked most (8.2) than aestivum (8.1) and triticale bulgur wheat (7.2).

**Microbial quality:** As the storage period progressed, the microbial load of the product increased (Table 3), however, remained within permissible limits as the quantitative range of aerobic plate count in processed cereal grain should be $10^2$-$10^6$ cfu $g^{-1}$ (Hobbs and Greene, 1984). Among classes, maximum microbial load was seen for triticale ($6\times10^2$ cfu $g^{-1}$) wheat followed by aestivum ($5\times10^2$ cfu $g^{-1}$) and durum ($4\times10^2$ cfu $g^{-1}$) but differences in microbial load was non-significant.

Table 1: Effect of storage period on the sensory quality* of coarse, medium and fine bulgur from wheat of all classes

| | Coarse fraction | | | | | Medium fraction | | | | | Fine fraction | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Storage period month | Colour | Texture | Flavour | Taste | Overall acceptability | Colour | Texture | Flavour | Taste | Overall acceptability | Colour | Texture | Flavour | Taste | Overall acceptability |
| 0 | 8.00$^{c}$ | 8.40$^{d}$ | 8.10$^{d}$ | 8.20$^{c}$ | 8.20$^{d}$ | 8.10$^{e}$ | 8.50$^{d}$ | 8.20$^{e}$ | 8.30$^{d}$ | 8.30$^{e}$ | 8.10$^{e}$ | 8.60$^{e}$ | 8.30$^{e}$ | 8.40$^{e}$ | 8.40$^{d}$ |
| 1 | 7.90$^{bc}$ | 8.40$^{cd}$ | 8.10$^{d}$ | 8.20$^{c}$ | 8.10$^{d}$ | 8.00$^{de}$ | 8.50$^{d}$ | 8.10$^{de}$ | 8.20$^{d}$ | 8.20$^{de}$ | 8.00$^{e}$ | 8.50$^{de}$ | 8.30$^{de}$ | 8.30$^{de}$ | 8.30$^{d}$ |
| 2 | 7.90$^{b}$ | 8.30$^{bcd}$ | 8.10$^{cd}$ | 8.10$^{c}$ | 8.10$^{cd}$ | 7.90$^{cd}$ | 8.40$^{cd}$ | 8.10$^{cde}$ | 8.10$^{d}$ | 8.10$^{d}$ | 7.90$^{d}$ | 8.40$^{cd}$ | 8.20$^{de}$ | 8.20$^{de}$ | 8.20$^{cd}$ |
| 3 | 7.80$^{b}$ | 8.20$^{bc}$ | 8.00$^{bcd}$ | 8.00$^{c}$ | 8.00$^{bd}$ | 7.90$^{bcd}$ | 8.30$^{cd}$ | 8.00$^{bcd}$ | 8.10$^{cd}$ | 8.10$^{c}$ | 7.80$^{cd}$ | 8.40$^{bc}$ | 8.20$^{d}$ | 8.10$^{cd}$ | 8.10$^{bd}$ |
| 4 | 7.60$^{a}$ | 8.10$^{b}$ | 7.90$^{abc}$ | 7.90$^{bc}$ | 7.90$^{ac}$ | 7.80$^{bc}$ | 8.20$^{bc}$ | 8.00$^{abc}$ | 7.90$^{bc}$ | 8.00$^{b}$ | 7.80$^{bc}$ | 8.30$^{ab}$ | 8.10$^{cd}$ | 8.00$^{bc}$ | 8.00$^{abc}$ |
| 5 | 7.70$^{ab}$ | 8.10$^{ab}$ | 7.90$^{ab}$ | 7.80$^{ab}$ | 7.80$^{ab}$ | 7.70$^{ab}$ | 8.10$^{ab}$ | 7.90$^{ab}$ | 7.80$^{b}$ | 7.90$^{a}$ | 7.70$^{ab}$ | 8.20$^{a}$ | 8.00$^{b}$ | 7.80$^{ab}$ | 7.90$^{ab}$ |
| 6 | 7.60$^{ab}$ | 7.90$^{a}$ | 7.80$^{a}$ | 7.60$^{a}$ | 7.70$^{a}$ | 7.70$^{a}$ | 8.00$^{a}$ | 7.80$^{a}$ | 7.60$^{a}$ | 7.80$^{a}$ | 7.60$^{a}$ | 8.10$^{a}$ | 7.80$^{a}$ | 7.70$^{a}$ | 7.80$^{a}$ |
| CD (p≤0.05) | 0.17 | 0.17 | 0.16 | 0.19 | 0.21 | 0.14 | 0.16 | 0.16 | 0.14 | 0.11 | 0.11 | 0.16 | 0.10 | 0.20 | 0.23 |

Values having same superscript do not vary significantly. NS: Non significant, *Score out of 9.0, CD: Critical difference

Table 2: Effect of class of wheat on the sensory quality* of coarse, medium and fine fraction of bulgur during storage

| | Coarse fraction | | | | | Medium fraction | | | | | Fine fraction | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat class | Colour | Texture | Flavour | Taste | Overall acceptability | Colour | Texture | Flavour | Taste | Overall acceptability | Colour | Texture | Flavour | Taste | Overall acceptability |
| Durum 'PDW 233' | 8.1$^{c}$ | 8.1$^{a}$ | 7.9$^{a}$ | 7.9$^{a}$ | 8.0$^{a}$ | 8.2$^{c}$ | 8.2$^{a}$ | 7.9$^{a}$ | 7.9$^{a}$ | 8.1$^{a}$ | 8.2$^{c}$ | 8.2$^{a}$ | 8.0$^{a}$ | 8.0$^{a}$ | 8.1$^{a}$ |
| Aestivum 'PBW 343' | 8.0$^{b}$ | 8.2$^{b}$ | 8.0$^{ab}$ | 7.9$^{a}$ | 8.0$^{a}$ | 8.0$^{b}$ | 8.3$^{b}$ | 8.0$^{ab}$ | 8.0$^{a}$ | 8.1$^{a}$ | 8.1$^{b}$ | 8.4$^{b}$ | 8.1$^{b}$ | 8.0$^{a}$ | 8.2$^{a}$ |
| Triticale 'TL 2908' | 7.4$^{a}$ | 8.2$^{b}$ | 8.1$^{b}$ | 8.1$^{b}$ | 7.9$^{a}$ | 7.4$^{a}$ | 8.4$^{c}$ | 8.1$^{b}$ | 8.1$^{b}$ | 8.0$^{a}$ | 7.2$^{a}$ | 8.5$^{b}$ | 8.3$^{c}$ | 8.2$^{b}$ | 8.1$^{a}$ |
| CD (p≤0.05) | 0.11 | 0.11 | 0.10 | 0.12 | NS | 0.09 | 0.10 | 0.10 | 0.09 | NS | 0.07 | 0.11 | 0.06 | 0.13 | NS |

Values having same superscript do not vary significantly. NS: Non significant, *Score out of 9.0, CD: Critical difference

Table 3: Microbial quality of bulgur wheat as affected by storage period

| Storage period, months | Bacterial count (cfu $g^{-1}$) |
|---|---|
| 0 | $1\times10^{2a}$ |
| 1 | $3\times10^{2ab}$ |
| 2 | $5\times10^{2bc}$ |
| 3 | $6\times10^{2bc}$ |
| 4 | $7\times10^{2c}$ |
| 5 | $7\times10^{2c}$ |
| 6 | $8\times10^{2c}$ |
| CD ($p\leq0.05$) | 3×10 |

Values having same superscript do not vary significantly from each other. CD: Critical difference

## CONCLUSION

Good quality bulgur can be prepared from all wheat classes having at least 6 months of shelf live at room temperature of 37°C. The product was highly acceptable through out and had appreciable microbial stability which ultimately contributed to its acceptability.

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