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Storage of under reduced specifications of wheat (*Triticum aestivum*)

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ABSTRACT

Climate changes are bringing variations in precipitations of rains. It has become usual for the last couple of seasons that during the harvest timing of wheat (*Triticum aestivum* L.), unexpected rains bring various problems not only for farmers but also for storage organizations such as Food Corporation of India (FCI), Central Warehousing Corporation (CWC) or State Warehousing Corporation (SWC). In order to sort out the distress of farmers, the storage organizations are procuring wheat which is termed as Under Reduced Specifications (URS). A study was conducted when URS wheat was stored under covered godowns, to assess the gain/loss dynamics of weight loss in the stacks. Moisture variations were recorded in the stored wheat samples and the variations in proximate composition (fat, protein, carbohydrate, ash, gluten), and refraction analysis of the wheat samples were assessed during the storage.

Key words: Moisture, Proximate composition, Refraction analysis, Storage, Under reduced specifications, Weight loss, Wheat

Wheat (*Triticum aestivum* L.) is one of the significant staple grains with worldwide production being 2,544 million tonnes in 2016, 0.6% (15.3 million tonnes) higher than the 2015 estimate (FAOSTAT, 2016). Wheat is widely consumed by humans in the countries of primary production (over 100 in the FAO production statistics for 2004) and in other countries where wheat cannot be grown. In India, wheat is mainly milled to whole-wheat flour for the production of unleavened flat bread locally known as 'Chapati' while the rest is used for other bakery products like bread, biscuits, cakes, pastries, pizzas etc. Moisture content of flour is very important quality indicator for predicting its shelf life, and the lower the flour moisture, the better its storage stability (Nasir et al., 2003). Increasing environmental stress on wheat production associated with climate change will affect both the yield and quality of wheat during storage. Thus the quality of wheat grains is defined by a range of physical and compositional properties where threshold requirements are set according to end-use requirements (Nuttall et al., 2016). There is also requirement to ensure the organoleptic quality of wheat grains to ensure good commercial returns and safety (Evans et al., 2000).

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Wheat also produces different volatiles with the changing storage time. Grain quality maintenance has traditionally been the responsibility of grain storekeepers who rely on measurements of grain or its milled products and on implicit knowledge gained through scientific results, common sense and job experience. It has a good adaptability, and it has a lot of variety, and the demand of these varieties is widespread. The consumption of it is huge, the confectionary, the baking, etc use it. The wheat is good fodder also, and the secondary products are valued, the wheat bran contains a lot of protein. The straw is a good litter (Nuttall et al., 2016).

The conservation of grain quality now-a-days is the real concern throughout the world. Deterioration of grain quality may begin in fields before harvesting, which further aggravates during improper storage (Kent and Evers, 1993). High quality grain is that which is rich in nutrients and free from pathogens, physical and chemical contaminants (Weinberg et al., 2008). A few studies have shown that a significant part of the grain quality deterioration has been connected with insufficient storage systems and climatic conditions such as high moisture content, dampness and temperatures (Gourama and Bullerman, 1995; Ahmad et al., 1998; Williams, 2004). Fluctuations in temperature, humidity and prolonged storage result

in considerable nutrients loss (South et al., 1991; Shah et al., 2002; Naoufal et al., 2012). In addition, the storage of the cereals is a very complex exercise, because it is an active material and is not in the full ripe state, but the microorganism, the insects can also infect it. (Chattha et al., 2015).

Thus, the first aim of the storage is to keep the quality of the wheat. If the storage is safe, the wheat quality will be in a good condition (physical, chemical state, technological behaviours, nutritive, hygiene). The quality of the wheat includes the external and the internal component of the kernel (Hrušková and Machová, 2002). The internal component is the protein, starch, lipid, cellulose, minerals, etc. Hence present investigation was undertaken with the objective to study the effect of the storage conditions on moisture, proximate compositional aspects and refraction analysis of the under reduced specifications (URS) wheat grains.

MATERIALS AND METHODS

The samples of the URS wheat grains were collected from the Central Warehousing Corporation, Karnal (Haryana), and Food Storage Depot-Food Corporation of India (FCI), Barwala (Haryana). The URS wheat grains study was conducted for a four-month period. Two chambers were selected for wheat grains each at Karnal (12 B and 12 C) and Barwala (1-B and 1-C) and thus storing the stacks of wheat grains in each selected depot for a four-month storage period for selected URS wheat commodity (Table 1).

The URS wheat grains were stored in chambers (12 B -replica first and 12C-1-replica second) at the CWC, Karnal, FCI Dist. Karnal (Haryana) in the month of May 2015 for the quantitative and qualitative analysis of URS wheat grains. Similarly, the URS wheat grains which were stored in chambers (1B- replica first and 1C- replica second) at Food Storage Depot (FSD), Barwala, FCI Dist.-Hisar (Haryana) in the month of May 2015 for the quantitative and qualitative analysis of URS wheat grains.

Table 1 Under reduced specifications wheat study for four months at CWC, Karnal and FSD, Barwala

Name of Depots	Storage type	Wheat grains stacks used
CWC Karnal	Warehouse	12 B and 12 C
FSD-FCI, Barwala	Warehouse	1 B and 1 C

The samples were collected from all the four lateral sides and from the top of the stack at fortnightly. The samples were taken from the stacks. Two kg samples of each stack were mixed thoroughly. The 2 kg sample was then divided into four subsamples of 500 g with the help of sample divider. The m.c. of each sub-sample was determined. The subsample of 500 g grains were spread into a plate and then the sample were taken from the nine random places. The total 20 g sample was taken for proximate analysis from the subsamples.

The proximate analysis of the wheat grains was carried out in the Food Analysis Laboratory, Department of Processing and Food Engineering, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India. The wheat grain samples were processed into whole wheat flour with mini flour mill for the proximate analysis while the refraction analysis was carried out with the wheat grains samples. The samples were sealed in moisture proof bags and stored at room temperature. The samples were analysed as

Table 2 Under reduced specifications wheat study for four months at CWC, Karnal

Commodity	Godown storage							
Wheat grains	Total number of stack liquidated	Liquidated stack number	Date of constitution	Date of liquidation	Initial weight of the stack, Qty	Final weight of the stack, Qty	Initial moisture content, % wb	Final moisture content, % wb
Replica First	12-B	1	6 May 2015	6 August 2015	1,343.10	1,345.20	10.60	10.80
Replica Second	12-C	1	6 May 2015	6 August 2015	1,342.44	1,344.69	10.60	10.80

Table 3 Under reduced specifications wheat study for four months at FSD, Barwala

Commodity	Godown storage							
Wheat grains	Total number of stack liquidated	Liquidated stack number	Date of constitution	Date of liquidation	Initial weight of the stack, Qty	Final weight of the stack, Qty	Initial moisture content, % wb	Final moisture content, % wb
Replica First	1-B	15	6 May 2015	5 August 2015	1,537.9	1,548.6	8.90	10.30
Replica Second	1-C	34	6 May 2015	5 August 2015	1,532.2	1,543.7	8.90	10.50

Table 4 Quantitative analysis of under reduced specifications wheat stored for four months at CWC, Karnal

Quantitative analysis	12 B-Replica First		12 C-Replica Second	
Refraction analysis	6 May 2015	6 August 2015	6 May 2015	6 August 2015
Foreign matter (%)	0.50	0.50	0.50	0.50
Other food grains (%)	1.20	1.20	1.20	1.20
Damage (%)	2.40	2.40	2.50	2.50
Slightly damage (%)	1.70	1.70	1.30	1.30
Shriveled broken (%)	9.00	9.00	9.20	9.20
Luster loss grain (%)	72.3	72.3	73.0	73.0
Sound grains (%)	12.9	12.9	12.3	12.3

Table 5 Qualitative analysis of under reduced specifications wheat stored for four months at CWC, Karnal

Quantitative analysis	12 B-Replica First		12 C-Replica Second	
Proximate analysis	6 May 2015	6 August 2015	6 May 2015	6 August 2015
Moisture Content, (%) w.b.	10.60	10.80	10.60	10.80
Fat (%) 2.44	2.15	2.10	2.00	
Protein (%)	12.40	12.00	11.67	11.50
Total carbohydrate (%)	72.81	73.35	74.13	74.22
Ash (%) 1.75	1.70	1.50	1.48	
Wet gluten (%)	32	30	30	30
Dry gluten (%)	14.4	13.9	14	13

Table 6 Quantitative analysis of under reduced specifications wheat stored for four months at FSD, Barwala

Quantitative analysis	1 B-Replica First		1 C-Replica Second	
Refraction analysis	6 May 2015	11 August 2015	6 May 2015	11 August 2015
Foreign matter (%)	0.50	0.50	0.25	0.25
Other food grains (%)	0.50	0.50	0.50	0.50
Damage (%)	1.80	1.80	1.75	1.75
Slightly damage (%)	9.25	9.25	8.25	8.25
Shriveled broken (%)	70.0	70.0	60.0	60.0
Luster loss grain (%)	17.95	17.95	29.25	29.25
Sound grains (%)	08.90	10.30	08.90	10.50

rapidly as possible to minimize the changes that might occur during storage. Moisture, protein and ash were determined on the ground whole wheat samples in triplicate using AOAC (1995) methods. Carbohydrates were calculated by differences method. Wet and dry gluten was determined with AACC (2000) method.

All data were computed with the software application programmers (Microsoft Excel 2007). All the reported values are the mean of three replicates

Table 7 Qualitative analysis of under reduced specifications wheat stored for four months at FSD, Barwala

Quantitative analysis	1 B-Replica First		1 C-Replica Second	
Proximate analysis	6 May 2015	11 August 2015	6 May 2015	11 August 2015
Moisture content (%) w.b.	8.90	10.30	8.90	10.30
Fat (%) 2.30	2.20	2.00	1.98	
Protein (%)	13.54	13.00	13.00	12.90
Total carbohydrate (%)	73.46	72.75	74.60	73.40
Ash (%) 1.80	1.75	1.50	1.42	
Wet gluten (%)	32	31	31	30
Dry gluten (%)	14	13	12	11

and experimental data were subjected to analysis of variance (ANOVA) technique and thus analyzed according to two factorials completely randomized design. The critical difference value at 5% level was used for making comparison during storage.

RESULTS AND DISCUSSION

The initial m.c. of wheat grains stored in CWC Karnal was 10.60% in May and it was increased up to 10.80% in August (Table 2), while no significant ($P > 0.05$) change in refractions was found. While the initial m.c. of wheat grains stored in FSD, Barwala was 8.90% in May and it was increased up to 10.40% in August (Table 3). The change in the m.c. in the URS wheat grains may be attributed to the variations in the relative humidity and the storage temperature.

The results of quantitative and qualitative analysis of URS wheat grains at CWC, Karnal and FSD, Barwala are presented in Tables 4, 5, 6 and 7. There was no significant ($P > 0.05$) change in the refraction and proximate analysis of the URS wheat grain samples during the 4- month storage period at the above-mentioned locations. The crude fat and crude protein (Table 5 and 7) of whole wheat flour was slightly decreased during the storage period of 4 months. The changes in the m.c. in wheat flour favoured proteolytic activity, thus crude protein content got affected slightly. The decrease in crude fat may be attributed to the lipolytic activity of enzymes, i.e. lipase and lipoxidase, as reported earlier (Haridas et al., 1983; Leelavathi et al., 1984) while there was no effect on the ash content. The results were in a close agreement with the results obtained by Nasir et al. (2003) and Chattha et al. (2015).

CONCLUSION

The URS wheat grains stored in the godowns had slight variations in the quantitative and qualitative

attributes of the wheat grains. However, the major factor affecting the quality of the grains is the moisture and thus under controlled storage conditions the quality of the wheat grains could be maintained.

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