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Effect of Moisture on the Shelf Life of Wheat Flour

MUHAMMAD NASIR, MASOOD S. BUTT, FAQIR M. ANJUM, KAMRAN SHARIF AND RASHID MINHAS
Institute of Food Science and Technology, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

Flour treatments having different moisture levels i.e. 13.5, 13,12,11,10 and 9% were packed in polypropylene bags. During the storage period of 60 days, each treatment was evaluated for proximate composition, insect infestation, mould growth and total iron. Moisture has significant effect on crude protein, crude fat, mould growth and insect infestation. Protein and fat content were decreased with storage period and this trend was more in treatments of higher moisture content. Changes in ash and fiber were non-significant with regard to treatments and storage period. Mould growth and insect infestation was more in treatments having higher moisture during storage while the treatments with lower moisture content (9%) showed no infestation. It is concluded that 9 and 10% moisture content is suitable for storage stability and longer shelf life of wheat flour.

Key Words: Wheat flour; Storage; Moisture content; Mould; Shelf life

INTRODUCTION

In Pakistan, wheat is mainly milled to whole-wheat flour for the production of unleavened flat bread locally known as "*Chapati*" while rest is used for other bakery products like bread, biscuits, cakes, pastries, pizzas etc. Moisture content of flour is very important regarding its shelf life, lower the flour moisture, the better its storage stability. The deterioration of baking quality will also be lower which can be credited to retarded respiration and activity of microorganisms at lower moisture content (Staudt & Zeigler, 1973). Moisture is also of great importance for the safe storage of cereals and their products regarding microorganisms, particularly certain species of fungi (Hoseney, 1994). In climate like Pakistan, the shelf life of flour is a serious problem and due to weather conditions, it is inevitable to explore proper moisture content to over come existing dilemma. The present study was carried out to extend the shelf life of flour by determining the proper moisture content suitable for safe storage.

MATERIALS AND METHODS

Wheat (Inqlab-91) was procured from Ayub Agricultural Research Institute, Faisalabad. Wheat flour having different levels of moisture content i.e. 13.5, 13, 12, 11, 10 and 9% was packed in polyethylene bags (Table I). Each treatment of whole-wheat flour was analyzed fortnightly up to 60 days for moisture, crude protein, crude fat, crude fiber, total ash, NFE and insect infestation by following their respective procedures described in AACC (2000). Visual observation was also carried out to observe insect larvae and adults. Counting of moulds in whole-wheat flour samples was done by serial dilution on Sabouraud agar medium at 0, 15, 30, 45 and 60 days as described by Beneke (1962). The data obtained from each treatment were subjected to statistical analysis to determine analysis of variance as described by Steel *et al.* (1997).

Table I. Different treatments used in study

Treatments	Moisture content of wheat (%)	Moisture content of tempered wheat (%)	Polypropylene bags
T_1	8.4	17.50	13.51
T_2	8.4	17.00	13.02
T_3	8.4	16.00	12.01
T_4	8.4	15.00	11.01
T_5	8.4	14.00	10.02
T_6	8.4	13.00	9.00

RESULTS AND DISCUSSION

Proximate composition of whole-wheat flour during storage. The analysis of variance (Table II) for the moisture content of different treatments of flour shows that the moisture content was affected significantly due to storage and treatments and interaction between storage intervals and treatments.

The moisture content of T_1, T_2, T_3, and T_4 decreased with storage period upto 45 days and increased afterwards (Table III & IV). The initial decrease was due to relatively low relative humidity in atmosphere. After 45 days of storage, higher relative humidity in atmosphere caused the flour moisture to increase upto end of storage. However, the changes were more in samples having higher initial moisture content. The moisture in T_5 and T_6 increased throughout the storage period. This increase was due to their lower initial moisture content, which rendered them to absorb moisture from the atmosphere. The results regarding the moisture content during storage supported the earlier findings of Rehman and Shah (1999), Samuels and Modgil (1999), and Kirk and Sawyer (1991). The crude protein content decreased (12.21-12.01) with storage period. Among the treatments, the changes were more in treatments having higher moisture because higher moisture content in wheat flour favored proteolytic activity. These results are in

Table II. Analysis of variance for proximate composition and colonies of moulds

S. O. V	F-Value for Moisture	F-Value for Crude Protein	F-Value for Crude Fat	F-Value for Crude Fiber	F-Value for Ash	F-Value for Colony Count of Moulds
Storage Period	49.557**	4.442**	7.918**	0.118^{NS}	0.758^{NS}	6082.34**
Treatments	329.19**	0.077^{NS}	1.249^{NS}	0.391^{NS}	1.251^{NS}	1085.65**
Storage X Treatments	44.681**	0.038^{NS}	0.052^{NS}	0.050^{NS}	0.150^{NS}	168.334**

Table III. Effect of treatments on proximate composition and colonies of moulds

Treatments	Moisture content (%)	Crude protein (%)	Crude Fat (%)	Crude Fiber (%)	Total Ash (%)	NFE (%)	Colonies of Moulds
T_1	11.84	12.07	2.07	2.49	1.72	69.78	709
T_2	11.67	12.07	2.08	2.48	1.71	69.94	641
T_3	11.33	11.9	2.08	2.49	1.71	70.27	560
T_4	10.95	12.07	2.09	2.49	1.70	70.72	463
T_5	10.57	12.1	2.09	2.50	1.7	71.03	390

close agreement with the results obtained by Leelavathi *et al.* (1984) and Upadhyay (1994). The crude fat of whole-wheat flour during the storage period of 60 days was significantly affected due to storage. The decrease 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). Treatments and storage had no effect on crude fiber and ash.

Colony count of moulds. The colony count of moulds differed significantly ((Table III & IV) with respect to treatments, storage period and interaction. Higher moisture content favored mould growth. So, T_6 having lowest moisture content showed maximum resistance against fungal growth during storage. Results of present investigation are comparable with those of Bothast *et al.* (1991) and Upadhyay (1994).

Insect infestation. The insect infestation was favored by higher moisture in flour. Infestation was observed in T_1 (13.5%) and T2 (13.02%) after 30 days of storage and insect larvae after 60 days while infestation was not observed in T_5 and T_6 even after two months storage (Table V). Similar results were found by Leelavathi (1984) and Upadhyay (1994).

Table V. Effect of treatments and storage on the insect infestation in wheat flour

Treatment	Storage Period				
	0 days	15 Days	30 Days	45 Days	60 Days
T_1	-	-	+	++	+++
T_2	-	-	+	++	+++
T_3	-	-	-	+	++
T_4	-	-	-	-	+
T_5	-	-	-	-	--
T_6	-	-	-	-	-

+++ = Infestation with the presence of live insects; ++ = Infestation with the formation of lumps; + = Slight infestation with the formation of lumps; - = No Infestation

CONCLUSION

The flour having 9% moisture content followed by flour having 10% moisture content are suitable for extended shelf life.

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