STORAGE STUDIES ON PACKAGED WHEAT

INTRODUCTION

Wheat is a staple food in India and the present production of wheat is estimated at 68 million tonnes. Since late sixties, when the green revolution was most effective in raising wheat output, the output ratio of wheat to rice has steadily increased from 1:3 to 4:5. Since 1991, the Ministry of Agriculture has been giving massive thrust to boost its output in the country. At present, UP, Punjab, Haryana and M.P. account for the major output of wheat in the country. Its output in non-traditional states is also being popularized by improving irrigation facilities and developing seeds suitable for cultivation in these regions.

India is the second largest wheat producing country in the world next only to China. The present production of wheat in India is about 67.99 MMT indicating six fold increase in the last two and a half decades. This has been possible due to on-set of green revolution in 1967 as a result of importing Mexican high yielding drawf wheat varieties and its cultivation in India. Improved agricultural practices as well as increased area under cultivation have also contributed to the increased production.

At present wheat is stored in jute sacks. Plastic woven sacks being cheaper the sponsors are interested in using these materials for bulk storage of wheat. Accordingly, the feasibility study of replacing jute sacks with plastic woven sacks was undertaken on bulk storage of wheat.

MATERIALS AND METHODS

Materials: The packaging materials viz., Jute sacks, HDPE and PP woven sacks as well as Wheat were supplied by the sponsor.

Methods: Moisture, Gluten, SDS Sedimentation value, Zeleny sediementation value, Falling number, Alcoholic acidity and Fat acidity were determined as per AACC procedures. All the procedures are given in Annexure-I.

Wheat was stored in Jute sacks, HDPE and PP woven sacks for six months. It was analysed for various physico-chemical characteristics at monthly intervals.

Statistical analysis: The samples were subjected to two-way analysis of variance.

RESULTS AND DISCUSSION

Hectoliter weight

The data on the effect of storage period and different packaging materials on the hectoliter weight of wheat is presented in Table 1. There was no significant change till three months of storage in hectoliter weight. There was slight decrease in hectoliter weight after three months of storage in all the three packaging materials. However there was no significant difference in hectoliter weight of wheat stored in three different packaging materials up to six months storage.

Thousand-kernel weight

The data on the effect of storage period and different packaging materials on the thousand-kernel weight of wheat is given in Table 2. There was no significant change in the thousand-kernel weight during the entire period of six months of storage in all the three different packaging materials.

Percent damaged wheat

The data on the effect of storage period and different packaging materials on the percent damaged wheat is given in Table 3. There was no significant change during the first five months of storage in percent damaged wheat. However, slight increase in damaged kernels was noticed after the six month of storage. There was no significant difference in percent damaged wheat stored in three different packaging materials.

Black spotted wheat

The data on the effect of storage period and different packaging materials on the black spotted wheat is given in Table 4. There was no significant change in black spotted wheat during the entire period of six months of storage in all the three packaging materials.

Moisture

The data on the effect of storage period and different packaging materials on the moisture of wheat is presented in Table 5. There was slight increase in moisture during initial two months of storage. Further storage period has no influence on the moisture content of wheat. There was no significant difference in the moisture of wheat stored in three different packaging materials.

Falling Number

The data on the effect of storage period and different packaging materials on the falling number of wheat is given in Table 6. The falling number indicates the alpha amylase activity. It is inversely proportional to alpha amylase activity. There was no significant change in alpha amylose activity of wheat during four months of storage. There was no significant difference in the falling number of wheat stored in three different packaging materials. This has indicated that there was no influence of storage or packaging material on the alpha amylase activity.

SDS sedimentation value

The data on the effect of storage period and different packaging materials on the SDS sedimentation value of wheat is presented in Table 7. SDS Sedimentation value is an index of quality and quantity of protein. The test is conducted on the whole-wheat flour. The value is directly proportional to the quantity and quality of protein. There was no significant change during the entire period of six months of storage in the SDS sedimentation value. Further, there was no significant difference in SDS sedimentation value of wheat stored in three different packaging materials.

Zeleny's sedimentation value

The data on the effect of storage period and different packaging materials on the Zeleny's sedimentation value of wheat is given in Table 8. Zeleny's sedimentation value is an index of quantity and quality of protein. The test is conducted on crude flour obtained by sieving the whole meal. The value is directly

proportional to quantity and quality of protein. There was no significant change in Zeleny's sedimentation value during the entire period of six months of storage. There was no significant difference in Zeleny's sedimentation value of wheat stored in three different packaging materials.

Alcoholic acidity

The data on the effect of storage period and different packaging materials on the alcoholic acidity of wheat is presented in Table 9. Alcoholic acidity represents total acidity contributed by free fatty acids, amino acids and acid salts. Generally the value increases in wheat on storage. There was slight increase during the storage period of six months in alcoholic acidity. However, there was no significant change in alcoholic acidity between two and five months stored sample in all the three different packaging materials.

Fat acidity

The data on the effect of storage period and different packaging materials on the fat acidity of wheat is given in Table 10. Fat acidity represents the acidity contributed by free fatty acids formed by the action of lipase on fat in the grain. Generally, the value increases on storage of wheat. There was significant increase in fat acidity during zero to six months storage period of wheat irrespective of the packaging material. However, there was no significant difference in fat acidity after four months to six months of storage in the three different packaging materials.

Peleshenke value

The data on the effect of storage period and different packaging materials on the Peleshenke value of wheat is given in Table 11. The Peleshenke value is an index of quantity and quality of protein and it is directly related. There was no significant change in peleshenke value of wheat till four months of storage. On further storage after this period, there was slight increase in Peleshenke value of wheat irrespective of the packaging material. There was significant difference in Peleshenke value of wheat stored in three different packaging materials. Slightly higher values were observed for wheat stored in HDPE and PP woven sacks.

Gluten

The data on the effect of storage period and different packaging materials on the gluten of wheat is presented in Table 12. Gluten is formed on hydration. The protein fractions gliadins and glutenins impart viscous and elastic properties by forming gluten on hydration. There was no significant change in gluten content during the six months period storage in all the three packaging materials.

Table 1. Effect of storage in different packaging materials on the hectoliter weight* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Hectoliter weight (Kg/hl)			
0	84.75	84.75	84.75	84.75a
1	84.75	84.75	84.75	84.75a
2	84.0	84.0	84.75	84.25a
3	82.50	82.50	84.50	83.17bc
4	82.50	82.25	82.50	82.42c
5	81.50	82.50	82.50	82.17c
6	81.50	82.50	82.75	82.25c
Mean	83.07a	83.32a	83.79a	83.39

* Means of values followed by different letters differ significantly in the same column or row

Table 2. Effect of storage in different packaging materials on the thousand kernel* weight of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Thousand kernel weight (g)			
0	61.81	61.81	61.81	61.81a
1	60.65	60.61	60.80	60.69a
2	61.26	61.24	61.80	61.43a
3	60.36	60.56	60.53	60.49a
4	60.58	60.48	60.83	60.63a
5	61.46	60.81	60.94	61.07a
6	61.18	61.68	60.20	61.02a
Mean	61.04a	61.03a	60.99a	61.02

* Means of values followed by different letters differ significantly in the same column or row

Table 3. Effect of storage in different packaging materials on percentage damaged wheat*

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Damaged wheat (%)			
0	0.21	0.21	0.21	0.21a
1	0.22	0.20	0.25	0.22a
2	0.47	0.40	0.27	0.38a
3	0.25	0.62	0.52	0.47a
4	0.44	0.60	0.53	0.52a
5	0.32	0.66	0.50	0.49a
6	0.75	0.77	0.56	0.70b
Mean	0.38a	0.50a	0.41a	0.43

* Means of values followed by different letters differ significantly in the same column or row

Table 4. Effect of storage in different packaging materials on black spotted wheat*

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Black spotted wheat (%)			
0	0.93	0.93	0.93	0.93a
1	0.78	0.64	0.97	0.80a
2	0.75	0.65	0.86	0.75a
3	0.91	0.70	0.94	0.85a
4	0.86	0.72	0.96	0.85a
5	0.51	0.70	0.67	0.63a
6	0.76	0.77	0.90	0.81a
Mean	0.79a	0.73a	0.89a	0.803

*Means of values followed by different letters differ significantly in the same column or row

Table 5. Effect of storage in different packaging materials on the moisture* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Moisture (%)			
0	8.56	8.56	8.56	8.56a
1	9.05	8.99	9.24	9.09b
2	9.75	9.38	9.79	9.64c
3	9.94	9.82	9.92	9.89c
4	10.02	10.12	10.11	10.08c
5	9.69	9.60	9.69	9.66c
6	9.73	10.16	9.50	9.80c
Mean	9.53a	9.52a	9.54a	9.53

* Means of values followed by different letters differ significantly in the same column or row

Table 6. Effect of storage in different packaging materials on the falling number* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Falling number (secs)			
0	463	463	463	463.0a
1	468.5	471.75	491	477.1a
2	481	491.75	478	483.6a
3	484	479	477.5	480.2a
4	479.75	482	489.25	483.7a
5	548	549.75	556.75	551.5b
6	544	535.5	542	540.5b
Mean	495.4a	496a	499.6a	497

* Means of values followed by different letters differ significantly in the same column or row

Table 7. Effect of storage in different packaging materials on the SDS sedimentation value* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	SDS sedimentation value (ml)			
0	79	79	79	79.0a
1	80	79	80	79.67a
2	80	80	80	80.0a
3	80	80	80	80.0a
4	80	80	80	80.0a
5	80	80	80	80.0.a
6	80	80	80	80.0a
Mean	79.86a	79.71a	79.86a	79.81

* Means of values followed by different letters differ significantly in the same column or row

Table 8. Effect of storage in different packaging materials on the zeleny's sedimentation value* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Zeleny's sedimentation value (ml)			
0	25.0	25.0	25.0	25.0a
1	25.0	25.0	25.0	25.0a
2	25.0	25.0	26.0	25.33a
3	26.0	26.0	26.0	26.00a
4	25.0	25.0	25.0	25.0a
5	24.0	25.0	26.0	25.0a
6	25.0	25.0	25.0	25.67a
Mean	25.14a	25.29a	25.43a	25.29

* Means of values followed by different letters differ significantly in the same column or row

Table 9. Effect of storage in different packaging materials on the alcoholic acidity* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Alcoholic acidity (% by weight of H_2SO_4)			
0	0.05	0.05	0.05	0.05a
1	0.05	0.05	0.05	0.05a
2	0.07	0.06	0.06	0.06ab
3	0.07	0.07	0.07	0.07c
4	0.07	0.07	0.08	0.07c
5	0.07	0.08	0.07	0.07c
6	0.08	0.07	0.08	0.08c
Mean	0.07a	0.06a	0.07a	0.065

* Means of values followed by different letters differ significantly in the same column or row

Table 10. Effect of storage in different packaging materials on the fat acidity* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Fat acidity (mg KOH)			
0	18.37	18.37	18.37	18.37a
1	18.47	18.45	18.51	18.48a
2	31.02	27.80	31.12	29.98b
3	34.18	34.58	31.14	33.30b
4	65.66	68.94	68.97	67.86c
5	55.80	55.75	61.99	57.85c
6	55.83	68.66	55.72	60.07c
Mean	39.91a	41.79a	40.83a	40.84

* Means of values followed by different letters differ significantly in the same column or row

Table 11. Effect of storage in different packaging materials on the Peleshenke value* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Peleshenke value (min)			
0	169.3	169.3	169.3	169.3a
1	170.0	173.0	172.0	171.7a
2	173.8	172.5	166.3	170.8a
3	165.0	170.0	170.0	168.3a
4	165.0	170.0	170.0	168.3a
5	190.0	195.0	195.0	193.3b
6	195.0	200.0	195.0	196.7b
Mean	173.9a	176.7b	175.7b	176.1

* Means of values followed by different letters differ significantly in the same column or row

Table 12. Effect of storage in different packaging materials on the gluten* of wheat

Wheat Storage Period (months)	Packaging Material			Mean
	JUTE	HDPE	PP	
	Gluten (%)			
0	9.53	9.53	9.53	9.53a
1	9.33	9.16	9.21	9.23a
2	9.48	9.56	9.72	9.59a
3	9.41	9.61	9.58	9.53a
4	9.07	9.49	9.48	9.35a
5	9.55	9.31	9.42	9.43a
6	9.69	9.51	9.80	9.67a
Mean	9.44a	9.46a	9.54a	9.48

* Means of values followed by different letters differ significantly in the same column or row