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Effect of grain protectants on the storage quality of brown rice (*Oryza sativa*) and its by product

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ABSTRACT

In the present study, brown rice (*Oryza sativa* L.) and brown rice flour (pulverized brown rice) were subjected to different packaging materials and grain protectants in order to study the shelf life of it. The grain protectants were packed in a thin cloth sachet and were placed along with the brown rice and brown rice flour inside the packaging material.The packaging material that did not contain the grain protectant served as the control. The study period was six months. After six months, it was observed that samples that were packed in white canvas were very effective in increasing the shelf life and maintaining the quality of the brown rice and brown rice flour for six months. Among the natural grain protectants used in the study, dill (*Anethum graveolens* L.) seed was more effective when compared to carum or *omum* [*Trachyspermum ammi* (L.) Sprague] seed.

Key words: BHT, Brown rice, Dill seed, Gunny bags, Moisture, Omum seed, Packaging, Polypropylene and white canvas bags, Storage

Brown rice (*Oryza sativa* L.) is defined as whole or broken kernels of rice from which the hulls have been removed; in other words the dehusked rice. The process that produces brown rice removes only the outermost layer, the hull, of the rice kernel and is the least damaging to its nutritional value. The complete milling and polishing that converts brown rice into white rice destroys 67% of the vitamin B_3, 80% of the vitamin B_1, 90% of the vitamin B_6, 50% of the manganese, 60% of the iron, dietary fibre and essential fatty acids (Babu et al., 2009).

Though the health benefits of brown rice are significant, the presence of nutrient dense bran layer found on the surface of brown rice, makes it prone to infestation by insects, microbes and the lipase enzyme released during the hulling process, catalyses the breakdown of oil in the bran layer causing rancidity. Both of these factors are responsible for the short shelf life and poor acceptability of brown rice and its products among the masses (Das et al., 2012). Therefore optimizing the storage condition is a primary requisite in promoting the utilization of brown rice.

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MATERIALS AND METHODS

Selection of paddy

Two varieties, viz. ASD 16 and ADT 45, were procured from the local modern rice mill and were milled to brown rice, i.e. dehusked unpolished rice and were also pulverized into flour.

Grain protectants

The grain protectants such as carum or *omum* [*Trachyspermum ammi* (L.) Sprague] seeds (T_1), dill [*Anethum graveolens* (L.)] seed (T_2) were purchased from the local Siddha Medical Store and Butylated Hydroxy Toluene (BHT) (T_3) was purchased from the local food grade chemical and essence mart.

Packaging materials

Polypropylene bags, white canvas bags and gunny bags were purchased from the local market.

Milling and pulverizing of paddy

The paddy was cleaned to remove the dust, dirt, chaff and stones by winnowing and sieving and was milled in a local rice mill (Qusai Modernized Mill). The paddy was passed through destoner to remove the left over dust, dirt, chaff and stones. Through elevator the paddy was taken to the sheller for shelling. The husk was aspirated through fan box. The brown rice and unshelled paddy were collected separately. The collected brown rice was further subjected to pulverizer to obtain the brown rice flour. Details of treatments and the packaging materials used for storage of brown rice and its product are given in Table 1.

Table 1 Treatment and packaging materials used for storage of brown rice and brown rice flour

Variety	Packaging material	T_0	T_1 (Dill seed) %	T_2 (carum seed) %	T_3 (BHT) %
ASD 16 (V_1) : 25 kg	Poly propylene bags (P_1)	-	1	1	1
	White canvas bag (P_2)	-	1	1	1
	Gunny bag (P_3)	-	1	1	1
ADT 45 (V_2) : 25 kg	Poly propylene bags (P_1)	-	1	1	1
	White canvas bag (P_2)	-	1	1	1
	Gunny bag (P_3)	-	1	1	1

The grain protectants were packed separately in a cloth bag and put into the packaging material along with the raw brown rice and brown rice flour sealed and stored at room temperature for shelf life studies. The rice and flour packed material without any grain protectants served as the control (T_0)

The raw brown rice and brown rice flour stored in different packaging materials with various treatments were analyzed for physical, chemical, cooking, microbial and sensory qualities during storage at regular intervals.

Statistical analysis

The experiments were conducted with three factors namely treatment, variety and packaging, and completely randomized design (CRD) was adopted to calculate the statistical significance using AgresAgdata software (Gomez and Gomez, 1982).

RESULTS AND DISCUSSION

Physical characteristics of brown rice and flour

The changes in the physical characteristics of brown rice, viz. length, breadth, 1000- grain weight, bulk density and insect count were assessed at 0 and 180 days of storage. The physical characteristic of brown rice flour includes the assessment of bulk density and insect counts. The results of each category showed only negligible change except for 1000- grain weight of brown rice which showed a slight varietal difference which continued during storage. No insects were seen in the varieties of rice and flour with exception to the control which had insect infestation and it is shown in Table 2 and 3.

Chemical constituents

Moisture: The samples packed in white canvas bags with dill seed as grain protectants showed the minimum moisture pick up for both brown rice and its flour. Among the packaging materials used P_3 (gunny bag) absorbed more moisture followed by P_1 and P_2, irrespective of treatment. A moisture permeability nature of P_3 could have contributed to the high m.c. The statistical analysis indicated that a highly significant differences existed among the storage, packaging, treatments individually and the combined effect of storage packaging and treatments.

Heinemann et al. (2005) reported that the m.c. of non-parboiled white rice as 12.84 and non-parboiled brown rice as 13.50% respectively. Results of Oghbaei and Prakash (2010) indicated that m.c. of polished white rice as 15.7%. These studies support the values of the present investigation (Table 4).

Protein: The samples packed in gunny bags showed the maximum reduction in protein, followed by the samples packed in polypropylene bag and white canvas bag in both the varieties. Similarly, the samples that had carum seed as the grain protectants exhibited the maximum reduction in the protein content followed by BHT and dill seed for both the varieties. The statistical analysis also revealed that the reduction of protein was highly significant.

The protein content of raw rice was 8.7% as given by Otegbayo (2001), while Lamberts et al. (2008) reported that protein content of raw rice ranged from 7.5 to 11.1%. In the present study, the values for protein were more or less equal to the values reported by these workers (Table 4).

Starch: The samples packed in P_2 showed the minimum changes in the starch content, while those in P_3 had the maximum change. Of the treatments, T_2 samples recorded the minimum changes in the starch content, irrespective of the variety. A significant difference was observed between the treatment, packaging materials and storage period.

The raw milled rice had a starch content of 76.8%

Table 2 Changes in the physical characteristics of brown rice during storage

Storage days	T and V	Length (cm)			Breadth (cm)			1000-grain weight (g)			Bulk density (g/ml)			Insect count (nos)		
		P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
Initial	$T_0 V_1$	0.50	0.50	0.50	0.24	0.24	0.24	14.73	14.73	14.73	0.76	0.76	0.76	0	0	0
	$T_1 V_1$	0.50	0.50	0.50	0.24	0.24	0.24	14.73	14.73	14.73	0.76	0.76	0.76	0	0	0
	$T_2 V_1$	0.50	0.50	0.50	0.24	0.24	0.24	14.73	14.73	14.73	0.76	0.76	0.76	0	0	0
	$T_3 V_1$	0.50	0.50	0.50	0.24	0.24	0.24	14.73	14.73	14.73	0.76	0.76	0.76	0	0	0
	$T_0 V_2$	0.48	0.48	0.48	0.23	0.23	0.23	14.71	14.71	14.71	0.74	0.74	0.74	0	0	0
	$T_1 V_2$	0.48	0.48	0.48	0.23	0.23	0.23	14.71	14.71	14.71	0.74	0.74	0.74	0	0	0
	$T_2 V_2$	0.48	0.48	0.48	0.23	0.23	0.23	14.71	14.71	14.71	0.74	0.74	0.74	0	0	0
	$T_3 V_2$	0.48	0.48	0.48	0.23	0.23	0.23	14.71	14.71	14.71	0.74	0.74	0.74	0	0	0
Final	$T_0 V_1$	0.49	0.48	0.48	0.23	0.22	0.22	14.71	14.71	14.70	0.73	0.72	0.72	1	1	1
	$T_1 V_1$	0.50	0.49	0.49	0.24	0.23	0.23	14.72	14.72	14.71	0.75	0.74	0.74	0	0	0
	$T_2 V_1$	0.50	0.49	0.49	0.24	0.23	0.22	14.72	14.71	14.71	0.74	0.74	0.73	0	0	0
	$T_3 V_1$	0.49	0.49	0.48	0.23	0.23	0.22	14.72	14.70	14.70	0.74	0.72	0.72	0	0	0
	$T_0 V_2$	0.47	0.46	0.45	0.21	0.21	0.20	14.69	14.68	14.68	0.71	0.71	0.70	1	1	1
	$T_1 V_2$	0.48	0.47	0.47	0.23	0.22	0.21	14.70	14.70	14.69	0.73	0.72	0.71	0	0	0
	$T_2 V_2$	0.47	0.47	0.46	0.22	0.22	0.21	14.70	14.69	14.69	0.72	0.72	0.71	0	0	0
	$T_3 V_2$	0.47	0.46	0.46	0.22	0.21	0.21	14.69	14.69	14.68	0.72	0.71	0.71	0	0	0

P_1, Poly propylene bag; P_2, white canvas bag; P_3, gunny bag; V_1, ASD 16; V_2, ADT 45; T_0, control; T_1, omum seed T_2, dill seed; T_3, BHT; T, treatment, V, variety

Table 3 Changes in the physical characteristics of brown rice flour during storage

Storage days	T and V	Bulk density (g/ml)			Insect count (nos)		
		P1	P2	P3	P1	P2	P3
Initial	$T_0 V_1$	0.78	0.78	0.78	0	0	0
	$T_1 V_1$	0.78	0.78	0.78	0	0	0
	$T_2 V_1$	0.78	0.78	0.78	0	0	0
	$T_3 V_1$	0.78	0.78	0.78	0	0	0
	$T_0 V_2$	0.76	0.76	0.76	0	0	0
	$T_1 V_2$	0.76	0.76	0.76	0	0	0
	$T_2 V_2$	0.76	0.76	0.76	0	0	0
	$T_3 V_2$	0.76	0.76	0.76	0	0	0
Final	$T_0 V_1$	0.75	0.74	0.74	1	1	1
	$T_1 V_1$	0.75	0.74	0.74	0	0	0
	$T_2 V_1$	0.74	0.74	0.73	0	0	0
	$T_3 V_1$	0.74	0.72	0.72	0	0	0
	$T_0 V_2$	0.71	0.71	0.70	1	1	1
	$T_1 V_2$	0.73	0.72	0.71	0	0	0
	$T_2 V_2$	0.72	0.72	0.71	0	0	0
	$T_3 V_2$	0.72	0.71	0.71	0	0	0

P_1, Poly propylene bag; P_2, white canvas bag; P_3, gunny bag; V_1, ASD 16; V_2, ADT 45; T_0, control; T_1, omum seed; T_2, dill seed; T_3, BHT; T, treatment, V, variety

as given by Chitra et al. (2010). The starch content recorded in the present study was slightly lower which might be due to the difference in the degree of polishing (Table 4).

Fat: A notable change in the fat content was observed; the samples packed in P_2 exhibited the minimum change in fat content irrespective of the treatments. The reduction was more predominant in the sample packed in P_3. A highly significant difference for fat was observed.

Begum and Bhattacharyya (2000) showed that the cooked rice had lower levels of fat content than raw grains. Ether extractives ranged from 1.63 to 2.74% in raw rice and from 0.17 to 0.38% in cooked rice (Table 4).

Free fatty acid: An increasing trend was noted in the free fatty acid content, being minimum in T_2P_2 samples for both brown rice and flour. The control samples of V_1 and V_2 revealed the highest change in the free fatty acid content. The increase in free fatty acid might be due to depolymerisation of lipids. The free fatty acid content showed a significant difference among the storage, packaging, treatments and interaction between these factors (Table 4).

Harmeet et al. (2011) showed that free fatty acid content of parboiled white rice as 1.5 milliequivalent/

Table 4 Changes in the chemical constituents of brown rice and flour during storage

Treatment and variety	*Moisture (g/100 g)*											
	Brown rice						Brown rice flour					
	Initial			90 days of storage			Initial			90 days of storage		
	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
$T_0 V_1$	12.10	12.10	12.10	12.17	12.18	12.18	12.13	12.14	12.14	12.15	12.14	12.15
$T_1 V_1$	12.10	12.10	12.10	12.13	12.14	12.15	12.10	12.10	12.11	12.12	12.11	12.11
$T_2 V_1$	12.10	12.10	12.10	12.14	12.15	12.16	12.11	12.12	12.12	12.13	12.12	12.13
$T_3 V_1$	12.10	12.10	12.10	12.15	12.17	12.17	12.12	12.13	12.13	12.14	12.14	12.14
$T_0 V_2$	12.13	12.13	12.13	12.19	12.20	12.20	12.17	12.18	12.18	12.19	12.17	12.18
$T_1 V_2$	12.13	12.13	12.13	12.15	12.16	12.17	12.14	12.14	12.15	12.16	12.14	12.15
$T_2 V_2$	12.13	12.13	12.13	12.17	12.17	12.18	12.14	12.15	12.16	12.17	12.15	12.16
$T_3 V_2$	12.13	12.13	12.13	12.18	12.18	12.19	12.15	12.16	12.17	12.18	12.17	12.18
	Protein (g/100 g)											
$T_0 V_1$	8.3	8.3	8.3	8.3	8.2	8.1	8.2	8.1	8.2	8.1	7.8	7.8
$T_1 V_1$	8.3	8.3	8.3	8.3	8.3	8.2	8.2	8. 3	8.2	8.3	8.2	8.1
$T_2 V_1$	8.3	8.3	8.3	8.3	8.2	8.3	8.3	8.2	8.3	8.2	8.1	8.0
$T_3 V_1$	8.3	8.3	8.3	8.2	8.3	8.2	8.2	8.3	8.1	8.3	8.0	7.9
$T_0 V_2$	8.2	8.2	8.2	8.2	8.1	8.0	8.0	8.2	8.0	8.0	7.8	7.7
$T_1 V_2$	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.1	8.2	8.1	8.1	8.0
$T_2 V_2$	8.2	8.2	8.2	8.2	8.2	8.1	8.2	8.2	8.1	8.0	8.0	7.9
$T_3 V_2$	8.2	8.2	8.2	8.3	8.2	8.1	8.1	8.2	8.1	8.0	7.9	7.9
	Starch (g/100 g)											
$T_0 V_1$	69.7	69.7	69.7	69.7	69.5	69.5	69.3	69.2	69.2	69.1	69.3	69.2
$T_1 V_1$	69.7	69.7	69.7	69.7	69.7	69.7	69.6	69.6	69.5	69.5	69.5	69.4
$T_2 V_1$	69.7	69.7	69.7	69.7	69.7	69.6	69.6	69.5	69.4	69.4	69.4	69.4
$T_3 V_1$	69.7	69.7	69.7	69.7	69.6	69.5	69.5	69.4	69.3	69.3	69.3	69.3
$T_0 V_2$	69.5	69.5	69.5	69.5	69.4	69.3	69.2	69.1	69.0	59.8	69.1	69.0
$T_1 V_2$	69.5	69.5	69.5	69.5	69.5	69.5	69.4	69.4	69.3	69.2	69.3	69.3
$T_2 V_2$	69.5	69.5	69.5	69.5	69.5	69.4	69.4	69.3	69.2	69.1	69.3	69.2
$T_3 V_2$	69.5	69.5	69.5	69.5	69.4	69.4	69.3	69.2	69.1	69.0	69.2	69.1
	Fat (g/100 g)											
$T_0 V_1$	1.6	1.6	1.6	1.6	1.4	1.3	1.4	1.3	1.2	1.2	1.2	1.2
$T_1 V_1$	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.4	1.4	1.3	1.4	1.4
$T_2 V_1$	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.4	1.3	1.3	1.4	1.3
$T_3 V_1$	1.6	1.6	1.6	1.6	1.5	1.4	1.4	1.3	1.3	1.2	1.3	1.2
$T_0 V_2$	1.5	1.5	1.5	1.5	1.4	1.3	1.2	1.2	1.0	1.0	1.2	1.0
$T_1 V_2$	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.3	1.3	1.3	1.3
$T_2 V_2$	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.3	1.3	1.2	1.3	1.2
$T_3 V_2$	1.5	1.5	1.5	1.5	1.4	1.3	1.3	1.2	1.2	1.0	1.2	1.0
	Fatty acid (mg KOH/g)											
$T_0 V_1$	2.03	2.03	2.03	2.03	2.45	2.46	2.57	2.58	2.58	2.59	2.65	2.66
$T_1 V_1$	2.03	2.03	2.03	2.03	2.41	2.41	2.50	2.51	2.51	2.52	2.61	2.61
$T_2 V_1$	2.03	2.03	2.03	2.03	2.41	2.42	2.50	2.52	2.53	2.54	2.61	2.62
$T_3 V_1$	2.03	2.03	2.03	2.03	2.44	2.44	2.54	2.56	2.57	2.57	2.63	264
$T_0 V_2$	2.05	2.05	2.05	2.05	2.45	2.45	2.58	2.59	2.59	2.60	2.67	2.68
$T_1 V_2$	2.05	2.05	2.05	2.05	2.43	2.43	2.53	2.53	2.54	2.55	2.63	2.63
$T_2 V_2$	2.05	2.05	2.05	2.05	2.43	2.44	2.54	2.55	2.55	2.56	2.64	2.65
$T_3 V_2$	2.05	2.05	2.05	2.05	2.44	2.45	2.56	2.57	2.57	2.58	2.66	2.66

Continued

(Table 4 concluded)

Treatment and variety	*Moisture (g/100 g)*											
	Brown rice						Brown rice flour					
	Initial			90 days of storage			Initial			90 days of storage		
	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3	P_1	P_2	P_3
	Peroxide value (meq/kg)											
$T_0 V_1$	3.09	3.09	3.09	3.09	3.27	3.28	3.28	3.29	3.35	3.36	3.36	3.37
$T_1 V_1$	3.09	3.09	3.09	3.09	3.25	3.25	3.26	3.26	3.32	3.32	3.33	3.33
$T_2 V_1$	3.09	3.09	3.09	3.09	3.25	3.26	3.26	3.27	3.32	3.33	3.34	3.34
$T_3 V_1$	3.09	3.09	3.09	3.09	3.26	3.27	3.27	3.28	3.36	3.336	3.37	3.38
$T_0 V_2$	3.11	3.11	3.11	3.11	3.30	3.31	3.31	3.32	3.34	3.34	3.34	3.34
$T_1 V_2$	3.11	3.11	3.11	3.11	3.27	3.27	3.28	3.28	3.34	3.34	3.35	3.35
$T_2 V_2$	3.11	3.11	3.11	3.11	3.28	3.28	3.29	3.29	3.35	3.35	3.36	3.36
$T_3 V_2$	3.11	3.11	3.11	3.11	3.39	3.30	3.30	3.31	3.35	3.36	3.36	3.37
	Crude fibre (g/100g)											
$T_0 V_1$	3.3	3.3	3.3	3.3	3.2	3.2	3.1	3.1	3.2	3.1	3.1	3.1
$T_1 V_1$	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.2	3.3	3.3	3.2	3.2
$T_2 V_1$	3.3	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.3	3.3	3.2	3.1
$T_3 V_1$	3.3	3.3	3.3	3.3	3.3	3.2	3.2	3.1	3.3	3.2	3.1	3.1
$T_0 V_2$	3.2	3.2	3.2	3.2	3.1	3.1	3.0	3.0	3.1	3.0	3.0	2.9
$T_1 V_2$	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.2	3.2	3.1	3.0
$T_2 V_2$	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.0	3.2	3.1	3.1	3.0
$T_3 V_2$	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.0	3.1	3.1	3.0	3.0

Factors	*SEd*	*CD (P =0.05)*	*CD (P = 0.01)*
S	0.00059	0.06506	0.08574**
P	0.00184	0.06506	0.08574**
T	0.00201	0.09201	0.12126**
SP	0.00400	0.13013	0.17149**
PT	0.00697	0.18403	0.24252**
ST	0.10926	0.18403	0.24252**
SPT	1.00090	0.36806	0.48504**

**Significant

kilogram. The free fatty acid content of brown rice ranged from 2.49 to 3.7 as given by Das (2012) which is close to the present investigation.

Peroxide value: As the free fatty acid increased, corresponding changes was noticed in the peroxide value of both brown rice and flour and the values increased after 180 days of storage (Table 4).

Crude fibre: Although a slight decline in the crude fibre was observed during storage, non-significant difference was observed between different packaging materials, treatments and storage period (Table 4).

Vitamins: The B-complex vitamins thiamine, riboflavin and fat-soluble vitamin – Vitamin E were analyzed in the samples that were packed in white canvas bag with dill seed as the grain protectant. These samples showed very minimum changes in the other chemical constituents analyzed during storage.

Cooking quality: The changes in the cooking quality of the brown rice and flour, namely cooking time, cooked weight, volume expansion ratio, water absorption ratio and solid loss in the gruel, were assessed during the initial and final period of storage. A slight increase in the cooking time was noticed after 90 days of storage. Negligible difference occurred in the cooking time between the treatments, packaging material during the final storage period.

The cooked weight of the rice samples after 90 days of storage showed a mild reduction irrespective of treatment and packaging materials. As there was a reduction in the cooked weight a reduction in the volume expansion ratio was also observed in the rice samples. Consequent to the reduction in the volume expansion ratio, there was a decrease in the water absorption ratio and the brown rice and flour did not

absorb more of water during cooking. Roy (2010) studied that cooking process to determine the cooking time of different forms of rice as, well milled rice (WMR), partially-milled rice (PMR), germinated brown rice (GBR) and brown rice (BR) and reported that cooking time was 22.6, 28.8, 21.4 and 25.3 min for WMR, PMR, GBR and BR respectively.

Microbial load: A gradual increase in the microbial load was observed in the brown rice and flour packed in different packaging materials during storage. The initial value of bacteria, yeast and fungi was below detectable level (BDL). A slight increase in microbial load on storage was observed and the microbial load of $T_2V_1P_2$ and $T_2V_2P_2$ samples had the minimum increase in storage. The bacteria, yeast and fungi count of the samples were 1.5×10^6, 1.7×10^6, 1.5×10^3, 1.7×10^3, 1.5×10^4 and 2.2×10^4cfu/g respectively.

Sensory quality: Organoleptic evaluation of the brown rice and flour packed in different packaging materials along with grain protectants were evaluated for its sensory qualities such as colour, flavour, texture, taste and overall acceptability by a panel of 15 semi-trained judges using 9-point hedonic scale.

The brown rice and flour samples recorded the maximum value for the sensory quality at the initial storage period. After 180 days of storage, there was a slight decrease in the scores in all the treatments and packaging materials. The samples packed in white canvas bag with dill seed grain protectants showed the high value for colour. The characteristic feature of brown rice was the nutty flavour and was present in both the varieties. However, this flavour was highly acceptable. After storage period of 180 days, there was a slight reduction in nutty flavour but no off-flavours had developed.

The texture of the rice during initial period of storage was hard and brittle. After 180 days of storage due to slight moisture pick up, a very slight reduction in the hardness of the rice was observed. The overall acceptability scores of brown rice was in tune with the scores of colour, flavour, texture and taste raw and parboiled brown rice samples and were highly acceptable during the initial storage period.

Jordao et al. (2006) indicated that the raw milled rice were highly acceptable because of colour, flavour, texture and taste and the scores were 9.0, and in the present study raw brown rice also obtained similar scores.

CONCLUSION

Among the natural grain protectants for brown rice used in the study, dill seed (1%) was more effective in enhancing the shelf life of rice of both the varieties. The most suitable packaging material was found to be white canvas bag, as they had a storage stability of 180 days under ambient condition with minimum changes in the physico-chemical, microbial and sensory qualities.

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