

RESEARCH PAPER

## Effect of Packaging Material and Storage Duration on Quality of Pomegranate Peel Powder: Rice Bran Slice Bread

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### ABSTRACT

In present investigation the slice bread prepared from pomegranate peel powder and rice bran stored in both packaging material i.e. P<sub>1</sub> paper bag (GSM 80) and P<sub>2</sub> polythene bag (Gauge 357). The quality parameter i.e., moisture content, protein, fat, fiber, ash carbohydrate and whiteness index of P<sub>1</sub> (paper bag) and P<sub>2</sub> (polythene bag) bread were observed during each day from 0 day to 4 days. Nutritional analysis indicated that both packaging material and storage period increases as in moisture content decrease from 33.072 to 31.061%, protein content decrease from 13.380 to 12.363%, fat content decrease from 1.523 to 1.280 %, fiber content decrease from 0.881 to 0.796 %, ash content decrease from 0.640 to 0.624%, whiteness index decrease from 51.718 to 48.031 and carbohydrate content increase from 50.504 to 53.893 %, and microbiological study depicted. The pomegranate peel powder, rice bran slice bread can be packed in polythene bag and stored in good condition upto 3 days.

**Keywords:** Packaging material, index, fiber, polythene bag, paper bag, carbohydrate

Pomegranate fruits peel is an inedible part obtained during processing of pomegranate juice. Inedible part contain antioxidant phenolic compounds and flavonoids high quantities (Li *et al.* 2006). Pomegranate peel is a rich source of tannins, flavonoids and other phenolic compounds, and antioxidant and antibacterial properties. The peel (outer thick skin or rind) provides a rich source of punicalins (PC), Punicalagins (PG) and elagic acids (EA), Punicalagins are reported their beneficial effects against dysentery, hemorrhage. Helminthiasis, diarrhea and acidosis. (Miguel, Neves and Anthnes, 2010.). Utilization of pomegranate peel powder and peel extracts has been successfully experienced in various food preparations including meat and meat products, edible oils, bakery products and jellies (Altunkaya *et al.* 2013; Devatkal *et al.* 2012; Iqbal *et al.* 2008; Kanatt *et al.* 2010; Naveena *et al.* 2008; Ventura *et al.* 2013).

Rice bran constitutes 8 per cent of the weight of the whole grain and contains most of the nutrients (65 per cent), such as vitamins, minerals, oils, trace elements, antioxidants, phytosterols and phytochemicals. It contains 12-22 per cent oil, 11-17 percent protein, 6-14 per cent Fiber, 10-15 per cent moisture and 8-17 per cent ash. It is rich in vitamins including vitamin E, thiamin, niacin and minerals like aluminum, calcium, chlorine, iron, magnesium, manganese, phosphorus, potassium, sodium and zinc (Qureshi *et al.* 2000). Increased intake of dietary Fiber can have beneficial effects against diseases, such as cardiovascular diseases, gastrointestinal disease, decreasing blood

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cholesterol, diverticulosis, and diabetes and colon cancer. In view of the therapeutic potential of dietary fiber, more fiber incorporated food products are being developed. Addition of dietary fiber to a wide range of products will contribute to the development of value-added foods or functional foods that currently are in high demand (Hu *et al.* 2009).

Bread has become one of the most widely consumed non-indigenous food item in India. Fresh bread is characterized by a soft and elastic crumb, a brownish crust, a pleasant aroma and a moist mouth feel (Giannou *et al.* 2003). Bread is one of the most popular staple foods in the world. In view of its nutritive value, low price, and its simplicity of usage, it has become the diets of all civilizations. Bread consumption provides energy (mainly from starch) and delivers dietary fibre and a wide range of vitamins and minerals (Dewettinck *et al.* 2008). Moreover, optional ingredients can be added to improve processing or produce specialty and novelty bread with enhanced nutritional and nutraceutical quality (Sivam *et al.* 2010).

Bread is generally a highly perishable item, which has a shelf life of maximum of 72 hours in a tropical country like India. It is fresh when just out of the oven but starting to age, firm up and become progressively stale thereafter. Packaging is the last step of production and food technologists have to select the most suitable type of packaging to ensure the longest shelf life. The success in the market is equally based on product intrinsic quality and packaging effectiveness in preserving, and communicating, this quality (Licciardello *et al.* 2016). Packaging provides the correct environmental conditions for food during the length of time it is stored and distributed to the consumer. Good package must keep the product clean and provide a barrier against dirt and other contaminants. The packaging must be of good quality, strong enough to withstand the shocks and loadings encountered during transport or mechanical handling. Packaging must be properly constructed and closed so as to prevent any loss of contents that might be caused under normal conditions of

transport, by vibration, or by changes in temperature, humidity or pressure (Pavithra, 2008).

Packaging and storage are the last stages of bread production. This stage is important in terms of its protection purpose. The time period from when the bread are packaged to consumption is influenced by packaging and storage methods, and the flavor, taste, and appearance of the bread should be protected during this time period. The packaging material should protect the bread from harmful environmental effects. The product must be protected from undue moisture change during its normal storage life as a primary requirement. When the packaging film protects against moisture transfer in an adequate manner, it likely excludes dirt, dust, mold spores, and other foreign particles, and in addition, it gives some protection against the absorption of off-odors. (Balaguer *et al.* 2013).

Polythene packages which emerged in the sliced bread industry in the year 2000, is the most commonly used package for the bread today (Thakkar, 2006). It is being used for local distribution as well as for distant markets. The prime purpose behind packaging of any food item is to protect the form, shape and texture of inner contents. A simple bread package has an important contribution to the packaging efficiency in the supply chain of bread. But during adverse weather conditions (hot and humid temperature) these packages make the bread to stale. Moreover, the atmosphere surrounding the bread also influences its shelf-life. For instance there may be passage of moisture or vapor from a humid atmosphere into bread (Anon, 2008).

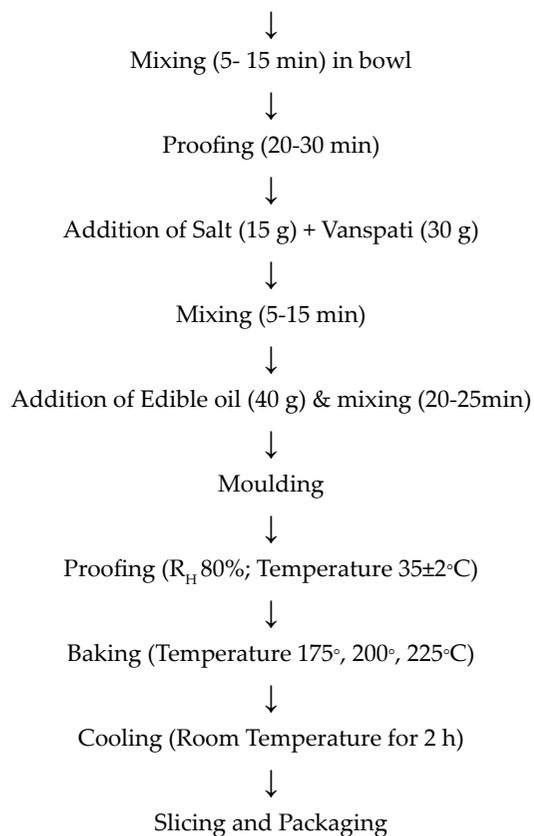
Bread has shelf life of 3-4 days. Shelf life of bakery product is mostly characterized by onset of staling and ropiness formed by microbial spoilage. The purpose of the present study was undertaken to study effect of two different packaging material i.e. paper bag and polythene bag and storage duration up to 0,1,2,3 and 4 days on developed slice bread from Pomegranates peel powder and rice bran in ambient temperature and its physicochemical and sensorial characteristics.

## MATERIALS AND METHODS

### Process for Preparation of Bread

Fig. 1 shows the process flow chart for preparation of slice bread. The bread was prepared by taking wheat flour (1 kg), sugar 100g, milk powder 20g, bread improver 3g, water 550 mL, yeast 15g along with pomegranate peel: rice bran i.e. (0.5:9.5%) was taken into a bowl. The ingredients were allowed to mix up to 5 – 15 minutes. The dough is allowed to keep as such for natural proofing in the same mixer at normal temperature  $35 \pm 2^\circ\text{C}$  and relative humidity 80-95% for 25 minutes. The dough was added with salt 15 g and Vanaspati 30 g and allowed to mix up to 5 minutes for proper mixing of salt and Vanaspati. The mixed dough was added with edible oil 40 g and allowed to mix for 20 -30 minutes.

Wheat flour (1 kg) + Sugar (100 g) + yeast (5g) + Milk powder (20 g) + Bread Improver (3g) + Water (550 mL) + Glycerol mono stearate (0.2g) + Calcium propionate (0.15g)



**Fig. 1:** Process Flow chart for preparation of slice bread

The dough was now ready for shaping. 400 g of above prepared dough was taken into the mould. The moulds were kept for proofing and allowed to raise at 80-95% RH and  $35^\circ\text{C}$  for 1 hr. The moulds were kept in the oven for temperature ( $225^\circ\text{C}$ ). The breads in the moulds were observed continuously for each 2 minutes upto 15 minutes interval from initial time. The breads should have yellowish colour developed on its crust. When the crust get yellowish colour the time for baking was recorded. The breads after achieving the yellowish colour was taken from the oven and allowed to cool at room temperature  $35 \pm 2^\circ\text{C}$  for 2 hrs.

### Packaging and storage study of Slice bread prepared from pomegranate peel powder and rice bran

The best treatment of slice bread prepared from pomegranate peel powder and rice bran of 0.5 % pomegranate peel powder and rice bran 9.5 % was prepared and was used for the packaging and storage study. 400 g of pomegranate peel powder and rice bran slices bread was prepared as discussed above and taken in two different packaging material i.e. paper bag ( $P_1$ ) and polythene bag ( $P_2$ ). The details of the packaging material as per treatment are given in Table 1. Fig. 2 (a) and 2 (b) shows the packaging material i.e.  $P_1$  (paper bag) and  $P_2$  (polythene bag) used for packaging and storage of pomegranate peel powder and rice bran slices bread for 4 days duration.

400 g of slice bread prepared from pomegranate peel powder and rice bran sample was filled separately in paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) and sealed properly. These packets were kept at ambient temperature up to 5 days. The stored samples were analyzed at every day interval up to 4 days. The observations for the sensory analysis, moisture content, protein, fat, fiber, carbohydrate, whiteness index and microbial analysis of stored sample were taken during 5 days (0, 1, 2, 3 and 4 days) i.e. total no. of samples for all the trials were, 5 duration  $\times$  2 packaging material  $\times$  3 replication = 30 samples of Slice bread prepared from pomegranate peel powder and rice bran were kept for storage study. The sensory analysis i.e. colour, flavor, texture, Taste and

microbial analysis i.e. colony forming unit (CFU/g of sample) for the stored samples were determined for each storage duration i.e. 0, 1, 2, 3 and 4 days.

**Table 1:** Specifications of packaging material for storage of pomegranate peel powder and rice bran slices bread

Sl. No.	Treatments	Packaging material	Size	Gauge	Capacity
1	P <sub>1</sub>	Paper bag	15.75 × 10.25"	GSM 80	1 kg
2	P <sub>2</sub>	Polythene bag	15.75 × 10.25"	375	1kg

### Storage studies

The slice bread prepared from pomegranate peel powder and rice bran packed in paper bags (P<sub>1</sub>) and polythene bag (P<sub>2</sub>) samples were subjected to storage studies at ambient temperature (32 ± 2°C). The samples stored at ambient temperature were analyzed each day upto 4 days for Physio-chemical properties moisture content, protein fat, fiber, carbohydrate, whiteness index and microbial analysis sensory qualities like colour, flavour, texture, taste, and daily analysis for microbial count.

### Evaluation of Quality Parameter for the pomegranate peel powder and rice bran slice bread

#### 1. Moisture content

The initial moisture content of slice bread prepared from pomegranate peel powder and rice bran was determined by AOAC (2010). For each packaging material P<sub>1</sub> and P<sub>2</sub> was determination during storage 0,1,2,3 and 4 days respectively. 10-15 g of the slice bread samples was taken for in to each three different moisture boxes. The initial weight of moisture box was recorded. The samples were exposed to 105°C ± 1°C for 24 hr. in a hot air oven (Make M/s: Aditi Associate, Mumbai. Model: ALO-136). The final weight was recorded. The moisture content of the sample were determined by equation (1) the experiment was repeated for three times for replication the average reading reported.

$$\text{Moisture content (\% db)} = \frac{W_2 - W_1}{W_3 - W_1} \times 100 \quad \dots(1)$$

Where,

W<sub>1</sub> = Weight of moisture box, g

W<sub>2</sub> = Weight of moisture box + sample g

W<sub>3</sub> = Weight of moisture box + oven dried sample, g

#### 2. Protein

Protein of slice bread prepared from pomegranate peel powder and rice bran packed in packaging material P<sub>1</sub> and P<sub>2</sub> was determination during storage 0,1,2,3 and 4 days interval respectively was determined by a micro-Kjeldahl distillation method (AOAC 1990). The slice bread were digested by heating with concentrated sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) in the presence of digestion mixture, potassium sulphate (K<sub>2</sub>SO<sub>4</sub>) and copper sulphate (CuSO<sub>4</sub>). The mixture was then made alkaline with 40% NaOH. Ammonium sulphate thus formed. Released ammonia which was collected in 4% boric acid solution and titrated again standard HCL. The percent nitrogen content of the sample was calculated the formula given below. Total protein was calculated by multiplying the amount of percent nitrogen with appropriate factor (6.25).The experiment was repeated three times and average reading was reported.

$$\% \text{ N} = \frac{(\text{Sample titre} - \text{Blank titre}) \times \text{N HCL} \times 1.4 \times 100}{\text{Weight of sample}} \times 100 \quad \dots(2)$$

$$\% \text{ Protein} = \% \text{ N} \times \text{Factor (6.25)}.$$

#### 3. Ash Content

The ash content of slice bread prepared from pomegranate peel powder and rice bran packed in packaging material P<sub>1</sub> and P<sub>2</sub> was determination during storage 0,1,2,3 and 4 days interval respectively was determined using the method of AOAC (1990) porcelain crucible were dried and cooled in desiccators before weighing. Five grams of the slice bread were weighed into the crucible and the weight

was taken. The crucible containing the samples were placed into the muffle furnace and muffle furnace at 500°C. This temperature was maintained for three hours. The muffle furnace was then allowed to cool; the crucibles were then brought out, cooled and weighed. The experiment was repeated three times and average reading was reported. The ash content was calculated as follows:

$$\% \text{ Ash} = \frac{W_2 - W_1}{\text{weight of sample}} \times 100 \quad \dots(3)$$

Where,

$W_1$  = weight of empty crucible,

$W_2$  = weight of crucible + ash.

#### 4. Fat Content

The fat content of slice bread prepared from pomegranate peel powder and rice bran packed in packaging material  $P_1$  and  $P_2$  was determination during storage 0,1,2,3 and 4 days interval respectively was determined using solvent extraction in a soxhlet apparatus as described by James, (1995) Two grams of each of the slice bread were wrapped in a filter paper and placed in a soxhlet reflux flask which is connected to a condenser on the upper side and to a weighed oil extraction flask full with two hundred ml petroleum ether. The ether was brought to its boiling point, the vapor condensed into the reflux flask immersing the samples completely for extraction to take place on filling up the reflux flask siphons over carrying the oil extract back to the boiling solvent in the flask. The process of boiling, condensation, and reflux was allowed to go on for four hours before the defatted samples were removed. The oil extract in the flux was dried in the oven at 60°C for thirty minutes and then weighed. The experiment was repeated three times and average reading was reported.

$$\% \text{ Fat} = \frac{W_4 - W_3}{W_2 - W_1} \times 100 \quad \dots(4)$$

Where:

$W_1$  = weight of oven dried thimble,

$W_2$  = weight of sample used,

$W_3$  = weight of round bottom flask,

$W_4$  = weight of round bottom flask with fat residue.

#### 5. Crude Fiber

About 2 g fat free residue of slice bread prepared from pomegranate peel powder and rice bran was packed in packaging material  $P_1$  and  $P_2$  was determination during storage 0,1,2,3 and 4 days interval respectively was taken and then transferred to the digestion flask. 200 ml boiling sulphuric acid was added and immediately the flask was connected to condenser. The flask was heated, boiled by frequently rotating for 30 min and the volume was maintained with hot water. Then filtered through filter cloth in a fluted funnel. The residue was washed on cloth with hot water or potassium sulphate solution. The residue was returned to digestion flask by washing with hot water. 200 ml boiling sodium hydroxide was added and boiled for 30 min. The volume was adjusted with boiling water, filtered it thorough the muslin cloth and the residue free of alkali was washed. The residue was transferred into crucible and washed with 15 ml alcohol and the crucible was dried at 110°C for 2 hrs. The crucible was cooled in desiccators and weighed the crucible was ignited in the furnace at 550° C for 30 min then cooled and weighed. The loss in weight represented the crude fiber. The experiment was repeated three times and average reading was reported.

$$\text{Crude fiber (\%)} = \frac{(W_1 - W_2)}{\text{Weight of sample (g)}} \times 100 \quad \dots(5)$$

Where,

$W_1$  = Weight of material before ashing (g)

$W_2$  = Weight of material after ashing (g)

#### 6. Carbohydrate Content

Carbohydrate content of slice bread prepared from pomegranate peel powder and rice bran were packed in packaging material  $P_1$  and  $P_2$  was determination during storage 0,1,2,3 and 4 days interval respectively determined by subtracting the total sum of protein, fiber, ash and fat from the total dry matter (James,

1995). The carbohydrate was calculated by using following equation (6);

$$\% \text{ Carbohydrate} = 100 - (\% \text{ protein} + \% \text{ fat} + \% \text{ fiber} + \% \text{ ash} + \% \text{ moisture content}) \quad \dots(6)$$

## 7. Colour

A colour of slice bread prepared from pomegranate peel powder and rice bran packed in packaging material  $P_1$  and  $P_2$  was determination during storage 0,1,2,3 and 4 days interval respectively of were measured by (Make: M/s Konica Minolta, Japan; Model: Meter CR-400) colour measuring device. The colour of slice bread prepared from pomegranate peel powder and rice bran were measured in dark room. The equipment was calibrated by placing on the white tile. After the calibration is over, the slice bread prepared from pomegranate peel powder and rice bran was placed in the pettry dish and keeping the colorimeter on the top of the product and colour was measured. The colour was measured as per  $10^\circ/D_{65}$  (ASTM) standard. It represents L, a and b value. Degree of lightness or darkness of the sample was represented by 'L' value, redness or greenness by 'a' and yellowness to blueness by 'b' value on hunter scale. The experiment was repeated five times and average values were reported. The whiteness index samples were measured in 4 no. replication for each sample to estimate the degree of lightness (L), redness/greenness (a) and yellowness/blueness (b) using a colorimeter. Whiteness index was calculated by the following equation (7) of Park, (1994):

$$\text{Whiteness} = (100 - L)^2 + a^2 + b^2]^{(1/2)} \quad \dots(7)$$

Where,

$L^*$  values, which indicate lightness of the product

$a^*$  represents redness (+ a) to greenness (- a) and

$b^*$  represents yellowness (+ b) to blueness (-b)

## 10. Sensory analysis

The slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and

polythene bag was determined for each storage period 0, 1, 2, 3, and 4 days with trained panelists as per nine point hedonic scale. The Panelists were trained for the product testing and were familiar with product sensory evaluation. The slice bread prepared from pomegranate peel powder and rice bran samples were placed into plate. The slice bread prepared from pomegranate peel powder and rice bran packed in paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) were coded as A and B for evaluation of sensory parameter i.e. colour, flavor, texture and taste. Code C was given to the market sample. The rating was based on nine-point hedonic scales. 09 scales for colour, 9 scales for flavor attribute 09 scales for texture attribute and 09 scales for Taste. The attribute were summed up for total score 36 for each panelist for each treatment. The average score for total 14 panelists have been reported. The data were analyzed statistically for the significance of each attributes by ANOVA.

## 11. Microbial analysis

The microbial analysis of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) was determined for storage period of 0, 1, 2, 3 and 4 day's i.e. each day of storage as per the procedure of APHA (1992).

### 11.1. Total plate count (TPC)

The total plate count of slice bread prepared from pomegranate peel powder and rice bran was determined by using simply a total plate count agar containing 10 % (w/w) salt. The pour plate technique was used for the isolation of bacteria. The dilutions were made up to  $10^{-5}$  and the 1 ml of aliquot was used for the isolation. All process was carried out in a strictly sterile area with the help of laminar air flow. Plates were incubated at  $37^\circ\text{C}$  for 48 hrs. and colonies were counted on colony counter. The results noted in cfu/ml.

$$\text{Total plate count (cfu/ml)} = \text{no. of colonies} \times \text{dilution factor} \quad \dots(8)$$

### 11.2. Yeast and mold count

Yeast and mold count of samples were determined by using potato dextrose agar (PDA), the pour plate technique was used for the isolation. The media was sterilized and poured into plates. The dilutions were made up to  $10^{-5}$  and the 1 ml of aliquot was used. All process was carried out in a strictly sterile area with the help of laminar air flow. Plates were incubated at  $37^{\circ}\text{C}$  for 48-72 hrs. and colonies were counted on colony counter. The results noted in cfu/ml.

$$\text{Yeast and mold count (cfu/ml)} = \text{no. of colonies} \times \text{dilution factor} \quad \dots(9)$$

### 12. Statistical analysis

Statistical analysis was performed using 2 Factorial completely randomized design (FCRD) for stored sample properties of moisture content, protein, fat, fiber, carbohydrate, whiteness index and microbial analysis sensory qualities like colour, flavour, texture, taste and microbial analysis packed in paper and polythene bag for 0, 1, 2, 3 and 4 days was carried out by Microsoft Excel 2007.

## RESULTS DISSUASION

### Moisture content (%)

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on moisture content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 3. The moisture content of slice bread prepared from pomegranate peel powder

and rice bran which was packed in paper bag ( $P_1$ ) was decreased from  $33.072 \pm 0.011$  to  $31.061 \pm 0.004$  (%) for 0 to 4 days of storage period respectively and the moisture content of slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag ( $P_2$ ) was decreased from  $33.072 \pm 0.011$  to  $31.199 \pm 0.001$  for 0 to 4 days of storage respectively. From Fig. 3 it is clear that as storage period increases, the moisture content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in  $P_1$  and  $P_2$  decreases.

Effect of packaging material on moisture content indicated that the better retention of 94.33 % was observed in  $P_2$  followed by  $P_1$  93.91 %. Table 3 shows the ANOVA for the effect of packaging material and storage duration on moisture content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 3 it is indicated that packaging material had non-significant influence on moisture content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$  and storage duration had significant influence on moisture content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also shows the non-significant influence on moisture content of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

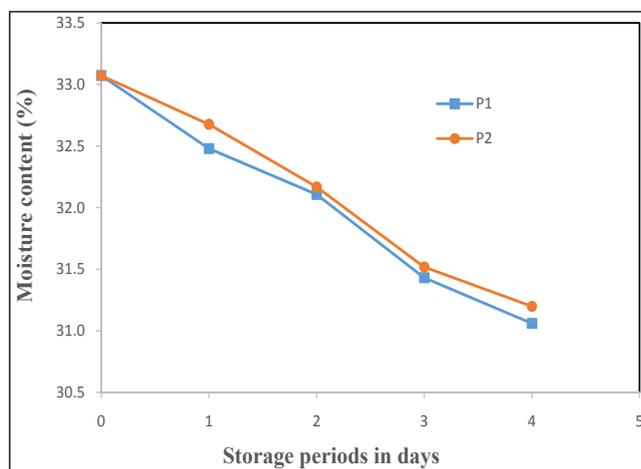
Karuppasamy *et al.* (2013) reported that the bread prepared from the small millet incorporated bread the moisture content of bread decreasing with increasing the storage period the moisture content

**Table 3:** f- test for effect of moisture on storage life of slice bread packed in different packaging material

Treatments	Storage duration (days)					Mean	% Retention
	0 days	1 days	2 days	3 days	4 days		
$P_1$	33.072±0.011	32.479±0.207	32.107±0.01	31.431±0.341	31.061±0.04	32.302	93.31
$P_2$	33.072±0.012	32.676±0.593	32.168±0.0168	31.518±0.106	31.199±0.01	32.127	94.33
<b>Mean</b>	33.072	32.578	32.138	31.475	31.130		
		<b>SEm(±)</b>			<b>CD<sub>at 1%</sub></b>		
Treatment(T)		0.040			0.114		
Storage (S)		0.075			0.214		
Interaction (T×S)		0.106			0.307		

was 10.33 % to 10.25 % from initial days (0) to final day (4) of storage period.

Patyal (2014) reported that the bread prepared from the mushroom fortified bread the moisture content was significantly decreasing with increasing storage period i.e. from 32.20 percent to 31.17 percent at ambient storage condition (upto 4 days).

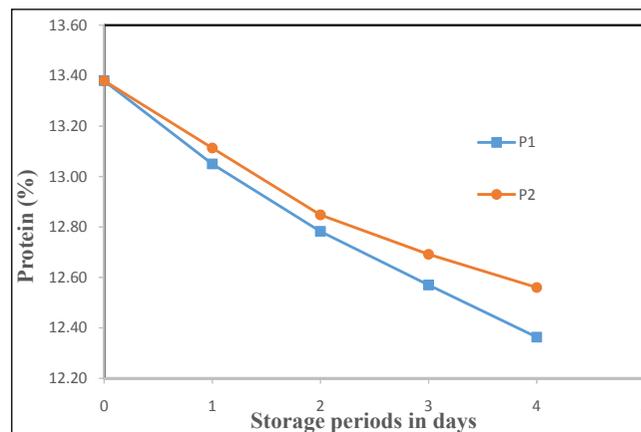


**Fig. 3:** Effect of packaging material and storage duration on Moisture content slice bread prepared from pomegranate peel powder and rice bran

### Protein

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on protein content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 4. The protein content of slice bread prepared from pomegranate peel powder and rice bran which was packed in paper bag ( $P_1$ ) was decreased from  $13.380 \pm 0.001$  to  $12.363 \pm 0.81$  (%) form 0 to 4 days of storage period respectively and the protein content of slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag ( $P_2$ ) were  $13.380 \pm 0.001$  to  $12.560 \pm 0.384$  for 0 to 4 days of storage respectively. From Fig. 4 it is clear that as storage period increases, the protein content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and polythene bag decreases. Effect of packaging material on protein content indicated that the better retention of 93.87% was observed in

polythene bag ( $P_2$ ) material followed by paper bag. ( $P_1$ ) 92.40 %.



**Fig. 4:** Effect of packaging material and storage duration on Protein (%) of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

Table 4 shows the ANOVA for the effect of packaging material and storage duration on protein content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 4 it indicated that packaging material had non-significant influence on protein content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$  and the effect of storage duration had significant influence on protein content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also shows the non-significant influence on protein content of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

Karuppasamy *et al.* (2013) reported that the bread prepared from the small millet incorporated bread the protein content of bread decreasing with increasing the storage period the protein content was 11.26 g to 11.14 g from initial days to final day 4 of storage period.

Patyal (2014) reported that the bread prepared from the mushroom fortified bread the protein content was significant decreasing with increasing storage period i.e. 11.27 percent to 11.14 percent at ambient condition (upto 4days).

**Table 4:** f– test for effect of protein on storage life of slice bread packed in different packaging material

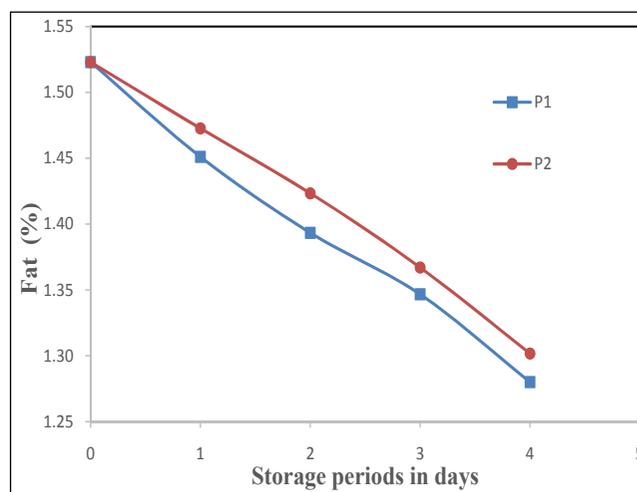
Treatments	Storage duration (days)					Mean	% Retention
	0 days	1 days	2 days	3 days	4 days		
P <sub>1</sub>	13.380±0.001	13.050±0.001	12.783±0.032	12.570±0.100	12.363±0.081	12.829	92.40
P <sub>2</sub>	13.380±0.001	13.113±0.180	12.848±0.080	12.692±0.363	12.560±0.384	12.919	93.87
Mean	13.380	13.085	12.828	12.631	12.462		
		SEm(±)			CD <sub>at 1%</sub>		
Treatment(T)		0.033			0.0958		
Storage (S)		0.062			0.179		
Interaction (T×S)		0.088			0.256		

### Fat

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on fat content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 5. The fat content of slice bread prepared from pomegranate peel powder and rice bran which was packed in paper bag (P<sub>1</sub>) was decreased  $1.523 \pm 0.001$  to  $1.280 \pm 0.180$  for 0 to 4 days of storage respectively and the fat content of slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag (P<sub>2</sub>) was decreased from  $1.523 \pm 0.001$  to  $1.302 \pm 0.008$  for 0 to 4 days of storage respectively. From Fig. 5 it is clear that as storage period increases, the fat content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and polythene bag decreases. Effect of packaging material on fat content indicated that the better retention of 85.46 % was observed in polythene bag (P<sub>2</sub>) material followed by paper bag (P<sub>1</sub>) 84.04%.

Table 5 shows the ANOVA for the effect of packaging material and storage duration on fat content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 5 it indicated that packaging material had non-significant influence on fat content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$  and the effect of storage duration had significant influence on fat content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also shows the non-

significant influence on fat content of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .


**Fig. 5:** Effect of packaging material and storage duration on Fat content (%) of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

Karuppasamy *et al* (2013) reported that the bread prepared from the small millet incorporated bread the fat content of bread decreasing with increasing the storage period. The fat content was 2.86 g to 2.81g from initial days to final day of storage period.

Patyal (2014) reported that the bread prepared from the mushroom fortified bread the fat content was non-significant decreasing with increasing storage period i.e. 1.39 percent to 1.38 percent at ambient condition (upto 4days).

**Table 5:** f- test for effect of fat on storage life of slice bread packed in different packaging material

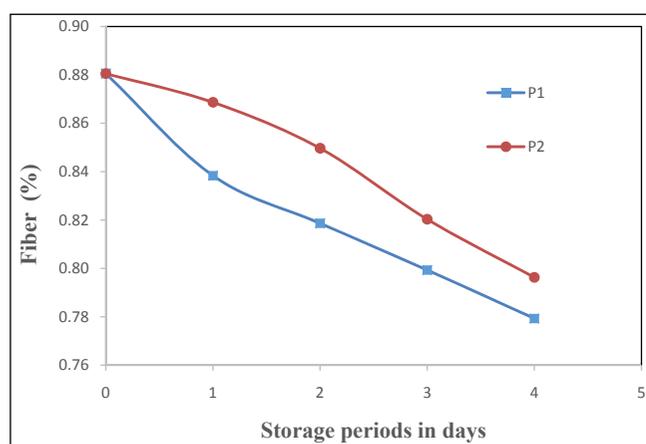


Mulani and Swami

Treatments	Storage duration (days)					Mean	% Retention
	0 days	1 days	2 days	3 days	4 days		
P <sub>1</sub>	1.523±0.01	1.451±0.02	1.393±0.006	1.347±0.030	1.280±0.18	1.413	84.04
P <sub>2</sub>	1.523±0.01	1.473±0.01	1.423±0.015	1.367±0.0260	1.302±0.08	1.403	85.46
Mean	1.523	1.462	1.408	1.357	1.291		
		SEm(±)			CD <sub>at 1%</sub>		
Treatment(T)		0.011			0.033		
Storage (S)		0.021			0.06		
Interaction (T×S)		0.030			0.088		

### Fiber

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on fiber content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 6. The fiber content of slice bread prepared from pomegranate peel powder and rice bran which was packed in paper bag (P<sub>1</sub>) was decreased from 0.881 ± 0.154 to 0.799 ± 0.009 % for 0 to 4 days of storage periods respectively and the fiber content of slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag (P<sub>2</sub>) were 0.881 ± 0.154 to 0.796 ± 0.166 for 0 to 4 days of storage respectively. From Fig. 6 it is clear that as storage period increases, the fiber content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and polythene bag decreases. Effect of packaging material on fiber content indicated that the better retention of 90.43% was observed in polythene bag (P<sub>2</sub>) material followed by paper bag (P<sub>1</sub>) 88.50 %.



**Fig. 6:** Effect of packaging material and storage duration on Fibre (%) of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

Table 6 shows the ANOVA for the effect of packaging material and storage duration on fiber content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 6 it indicated that packaging material had non-significant influence on fiber content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The effect of storage duration had significant influence on fiber content (%) of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also shows the non-significant influence on fiber content of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

Karuppasamy *et al.* (2013) reported that the bread prepared from the small millet incorporated bread the fiber content of bread decreasing with increasing the storage period the fiber content was 0.36 g to 0.33 g from initial days to final day of storage period.

Patyal (2014) reported that the bread prepared from the mushroom fortified bread the fiber content was significant decreasing with increasing storage period i.e. 0.72 percent to 0.70 percent at ambient condition (4days).

### Ash

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on ash content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 7. The ash content of slice bread prepared from pomegranate peel powder and rice bran which was packed in paper bag (P<sub>1</sub>) was decreased 0.640 ± 0.100 to 0.624 ± 0.009 % for 0 to 4 days of storage period respectively. The ash content of

**Table 6:** f- test for effect of fiber on storage life of slice bread packed in different packaging material

Treatments	Storage duration (days)					Mean	% Retention
	0 days	1 days	2 days	3 days	4 days		
P <sub>1</sub>	0.881±0.154	0.838±0.08	0.819±0.082	0.799±0.09	0.779±0.07	0.823	88.50
P <sub>2</sub>	0.881±0.154	0.809±0.022	0.850±0.166	0.820±0.03	0.796±0.03	0.843	90.43
<b>Mean</b>	0.881	0.854	0.834	0.810	0.788		
		<b>SEm(±)</b>			<b>CD<sub>at 1%</sub></b>		
Treatment(T)		0.018			0.052		
Storage (S)		0.034			0.098		
Interaction (T×S)		0.048			0.140		

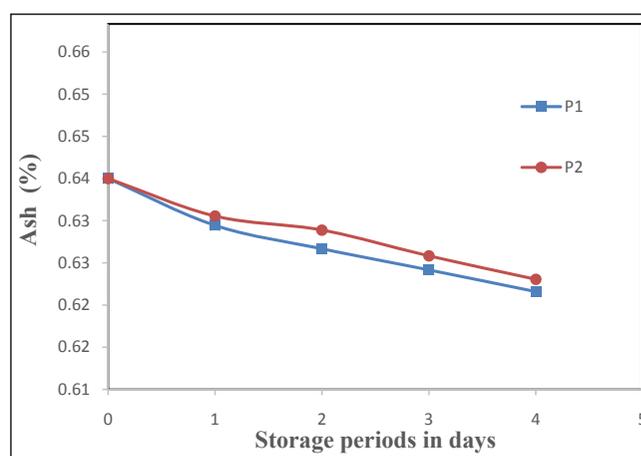
**Table 7:** f- test for effect of Ash on storage life of slice bread packed in different packaging material

Treatment	Storage duration (days)					Mean	% Retention
	0 days	1days	2 days	3days	4 days		
P <sub>1</sub>	0.640±0.1	0.633±0.009	0.630±0.07	0.627±0.03	0.624±0.07	0.451	97.48
P <sub>2</sub>	0.640±0.1	0.635±0.09	0.633±0.07	0.629±0.03	0.626±0.02	0.452	97.76
<b>Mean</b>	0.640	0.604	0.569	0.540	0.501	0.452	
		<b>SEm(±)</b>			<b>CD<sub>at 5%</sub></b>		
Treatment (T)		0.008			0.022		
Storage (S)		0.015			0.042		
Interaction (T×S)		0.021			0.061		

slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag (P<sub>2</sub>) were 0.640± 0.100 to 0.512 ± 0.02 for 0 to 4 days of storage respectively. From Fig. 7 it is clear that as storage period increases, the ash content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and polythene bag decreases. Effect of packaging material on ash content indicated that the better retention of 97.76% was observed in polythene bag (P<sub>2</sub>) material followed by paper bag (P<sub>1</sub>) 97.46%.

Table 7 shows the ANOVA for the effect of packaging material and storage duration on ash content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 7 it indicated that packaging material had non-significant influence on ash content (%) of slice bread prepared from pomegranate peel powder and rice bran at p≤0.05. The effect of storage duration had significant influence on ash content (%) of slice bread

prepared from pomegranate peel powder and rice bran at p≤0.05. The interaction also shows the non-significant influence on ash content of slice bread prepared from pomegranate peel powder and rice bran at p≤0.05.


**Fig. 7:** Effect of packaging material and storage duration on Ash (%) of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

Karuppasamy *et al.* (2013) reported that the bread prepared from the small millet incorporated bread the ash content of bread decreasing with increasing the storage period. The ash content was 1.29 g to 1.26 g from initial days to final day of storage period.

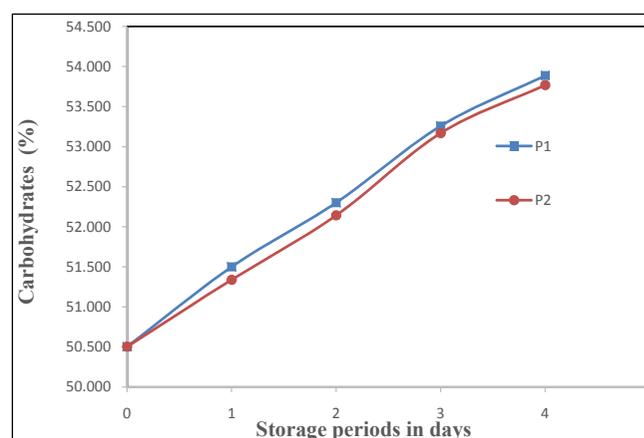
Patyal (2014) reported that the bread prepared from the mushroom fortified bread the ash content was significant decreasing with increasing storage period i.e. 0.91 percent to 0.87 percent at ambient condition (4days).

## 6. Carbohydrate

The effect of packaging material and storage duration (0, 1, 2, 3, and 4 days) on carbohydrate content (%) of slice bread prepared from pomegranate peel powder and rice bran is shown in Fig. 8. The carbohydrate content of slice bread prepared from pomegranate peel powder and rice bran which was packed in paper bag (P<sub>1</sub>) was increased from 50.504 ± 0.05 to 53.893 ± 0.006 % for 0 to 4 days of storage periods respectively. The carbohydrate content of slice bread prepared from pomegranate peel powder and rice bran which was packed in polythene bag (P<sub>2</sub>) was increased from 50.504 ± 0.05 to 53.769 ± 0.050 for 0 to 4 days of storage periods respectively. From Fig. 8 it is clear that as storage period increases, the carbohydrate content (%) of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag and polythene bag increases. Effect of packaging material on carbohydrate content indicated that the) better increase of 106.70% was observed in polythene bag (P<sub>2</sub>) material followed by paper bag (P<sub>1</sub>) 105.96%.

Table 2 (f) shows the ANOVA for the effect of packaging material and storage duration on carbohydrate content (%) of slice bread prepared from pomegranate peel powder and rice bran w.r.t packaging material, storage duration and their interaction. From Table 2 (f) it indicated that packaging material had non-significant influence on carbohydrate content (%) of slice bread prepared from pomegranate peel powder and rice bran at p≤0.05 and the effect of storage duration had significant influence on carbohydrate content (%) of slice bread prepared from pomegranate peel powder and rice

bran at p≤0.05.



**Fig. 8:** Effect of packaging material and storage duration on carbohydrate (%) of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

The interaction also shows the non-significant influence on carbohydrate content of slice bread prepared from pomegranate peel powder and rice bran at p≤0.05.

Patyal (2014) reported that the bread prepared from the mushroom fortified bread the carbohydrate content was significant by increasing with increasing storage period i.e. 54.22 percent to 55.45 percent at ambient condition (4 days).

## 7. Whiteness Index

The effect of storage duration (0, 1, 2, 3, and 4 days) and packaging material on whiteness Index of slice prepared from pomegranate peel powder and rice bran is shown in Fig. 9. The whiteness index of slice prepared from pomegranate peel powder and rice bran which was packed in paper bag (P<sub>1</sub>) was decreased from 51.718, to 48.031 for 1, 2, 3 and 4 days of storage and. The whiteness index of slice prepared from pomegranate peel powder and rice bran which was packed in polythene bag (P<sub>2</sub>) was decreased from 51.718 to 48.781 for 0, 1, 2, 3 and 4 days of storage From Fig. 9 it is clear that as storage period increases, the whiteness Index of slice prepared from pomegranate peel powder and rice bran packed in P<sub>1</sub> (paper bag) and P<sub>2</sub> (polythene bags) decreases.

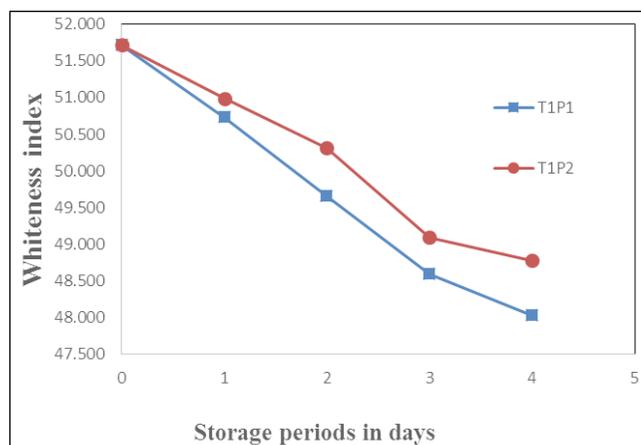
**Table 8:** f- test for effect of carbohydrate on storage life of slice bread packed in different packaging material

Treatment	Storage duration (days)					Mean	% increase
	0 days	1 days	2 days	3 days	4 days		
P <sub>1</sub>	50.504±0.01	51.548±0.001	52.268±0.01	53.226±0.01	53.893±0.01	52.288	106.70
P <sub>2</sub>	50.504±0.01	51.234±0.01	52.076±0.001	52.973±0.01	53.517±0.01	52.061	105.96
Mean	51.509	51.42	52.22	53.21	53.82		
	<b>SEm(±)</b>				<b>CD</b> <sub>at 5%</sub>		
Treatment (T)	0.052				0.198		
Storage (S)	0.097				0.372		
Interaction (T×S)	0.137				0.532		

**Table 9:** f- test for effect of whiteness index on storage life of slice bread packed in different packaging material

Treatments	Storage duration (days)					Mean	% increase
	0 days	1 days	2 days	3 days	4 days		
P <sub>1</sub>	51.718 ± 0.001	50.734±0.001	49.658±0.002	48.596±0.001	48.031±0.001	49.747	92.86
P <sub>2</sub>	51.718±0.001	50.988±0.001	50.312±0.351	49.091±0.001	48.781±0.231	50.178	94.32
Mean	51.718	50.861	49.985	48.844	48.406		
	<b>SEm(±)</b>				<b>CD</b> <sub>at 1%</sub>		
Treatment(T)	0.02				0.06		
Storage (S)	0.04				0.12		
Interaction (T×S)	0.06				0.18		

Table 2 (g) shows the ANOVA for the effect of packaging material and storage duration on whiteness index of slice bread prepared from pomegranate peel powder and rice bran at 0, 1, 2, 3, and 4 days of storage.


**Fig. 9:** Effect of packaging material and storage duration on whiteness index of slice bread prepared from pomegranate peel powder and rice bran stored upto 4 days

It indicated that packaging material had significant influence on whiteness index of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The storage duration had also significant influence on whiteness index of slice bread prepared from pomegranate peel powder and rice bran packed in both paper bag (P<sub>1</sub>) and polythene bag (P<sub>2</sub>) at  $p \leq 0.05$ . The interaction also showed significant influence on whiteness index slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

## Microbial analysis

### 1. Standard Plate Count

Microbial analysis is the perfect quality assessment protocol performed in food products quality analysis. However, in the fermented product it is mandatory one. In the study of microbial quality of pomegranate peel powder and rice bran slice bread, the study was undertaken examination of the total

plate count (TPC) and yeast and mold count or fungal count. The effect of packaging material paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) and storage duration on microbial characteristics of slice bread prepared from pomegranate peel powder and rice bran stored at ambient temperature were recorded and presented in Table 3. Out of total storage duration i.e. 0, 1, 2, 3 and 4 days, the microbial analysis was carried out after each day. Bacterial growth was detected for fifth analysis of 4 day for both the packaging material i.e. paper bag ( $P_1$ ) and polythene bag ( $P_2$ ). At 4 days analysis the standard plate count observed for slice bread packed in paper and polythene bag were and  $2.30 \times 10^2$  CFU/g and  $2.18 \times 10^2$  CFU/g respectively.

It was seen from Table 3 shows the ANOVA for the effect of packaging treatments and storage duration on standard plate count of pomegranate peel powder and rice bran slice bread. It indicated that packaging material and storage duration had significant influence on standard plate count of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also shows non-significant influence on standard plate count of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

According to Dun Lin and Ching Lee (2005), the total plate count in breads stored at  $25^\circ\text{C}$  increased from  $2.4 \times 10^5$  cfu/g to  $3.4 \times 10^5$  cfu/g after three days of storage

**Table 10:** Table Effect of packaging material and storage duration of slice bread prepared from pomegranate peel powder and rice bran on standard plate count

Duration	Paper bag	Polythene bag	
0 Day	Not Detected	Not detected	
1 Days	Not Detected	Not Detected	
2 Days	Not Detected	Not Detected	
3 Days	Not Detected	Not Detected	
4 Days	$2.30 \times 10^2$ CFU/g	$2.18 \times 10^2$ CFU/g	
	<b>Packaging material (P)</b>	<b>Storage Duration (S)</b>	<b>Interaction (P×S)</b>
SE	0.008	0.016	0.023
CD	0.025	0.047	0.68
Result	SIG 5%	SIG 5%	NON SIG

## 2. Yeast and Mold Count

The effect of packaging material paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) and storage duration on microbial characteristics of pomegranate peel powder and rice bran slice bread, stored at ambient temperature were recorded and presented in Table 4. Out of total storage duration i.e. 0, 1, 2, 3 and 4 days, the microbial analysis was carried out each day. No yeast and mold growth was detected up to analysis of 4 days for both the packaging material i.e. paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) at 4 days analysis the yeast and mold count observed for slice bread prepared from pomegranate peel powder and rice bran packed in paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) were  $1.31 \times 10^2$  and  $1.24 \times 10^2$  (CFU/g) respectively.

It was seen from Table 4 shows the ANOVA for the effect of packaging material and storage duration on yeast and mould count of pomegranate peel powder and rice bran slice bread. It indicated that packaging materials and storage duration had significant influence on yeast and mould count of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction also had significant influence on Yeast and mold count of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

**Table 11:** Effect of packaging material and storage duration of slice bread prepared from pomegranate peel powder and rice bran on yeast and mold count

Duration	Paper bag	Polythene bag	
0 Days	Not Detected	Not detected	
1Days	Not Detected	Not detected	
2 Days	Not Detected	Not detected	
3 Days	Not Detected	Not Detected	
4 Days	$1.31 \times 10^2$ CFU/g	$1.24 \times 10^2$ CFU/g	
	<b>Packaging material (P)</b>	<b>Storage Duration (S)</b>	<b>Interaction (P×S)</b>
SE	0.005	0.009	0.013
CD	0.014	0.027	0.039
Result	SIG 5%	SIG 5%	NON SIG

Standard plate count and yeast and mold count had shown increasing trend with extended storage. However, on storage at ambient temperature. The shelf life of slice bread prepared from pomegranate peel powder and rice bran packed in paper bag ( $P_1$ ) and packed in polythene bag ( $P_2$ ) was recorded as 4 days respectively. The variation in the standard plate count and yeast and mould count of slice bread prepared from pomegranate peel powder and rice bran stored at room temperature might be due to the packaging material used. Because the packaging material protect the contamination and growth of the SPC, number of microorganism and Yeast and Mould.

The microorganisms present in the bread samples were a reflection of the sanitary quality of the source of raw materials, processing and storage of the samples (Ray and Bhunia, 2007). The values obtained for the bread samples were within the acceptable International commission on microbiological specification (ICMSF) limits and recommendation for products of this nature ( $10^5$  cfu/ml) in good manufactured practice (ICMSF, 2009) for total plate count. The fungal counts were within acceptable limits for bread by ICMSF for good manufacturing practice ( $10^3$  cfu/ml) (ICMSF, 2009).

### Sensory analysis

The average sensory score viz. colour, flavor, texture, and taste of slice bread prepared from pomegranate peel powder and rice bran stored for 0, 1, 2, 3, and 4 days as per the nine point hedonic scale determined by trained panel for two packaging treatment paper bag ( $P_1$ ) and polythene bag ( $P_2$ ) are presented in Table 12. Sensory analysis was conducted at each days.

The average sensory colour scores was in the range 8.3 to 7.1. Highest colour score was observed at  $P_2$  and lowest was observed at  $P_1$ . The average colour scores for slice bread prepared from pomegranate peel powder and rice bran stored in paper bag for 0, 1, 2, 3, and 4 days was 7.7, 8.1, 7.5, 7.5, and 7.1, and polythene bag for 0, 1, 2, 3 and 4 days were 7.8, 8.3, 7.7, 7.7 and 7.5, respectively. Table 12 (a) shows ANOVA for colour of sensory analysis. The effect of

packaging material shows the non-significant effect at p. Similarly has storage duration had significant effect at p. The interaction effect of packaging material and storage decrease has non-significant effect at p.

The average sensory flavor scores was in the range 7.9 to 7.0. Highest flavor score was observed at  $P_2$  and lowest was observed at  $P_1$ . The average flavor score for of slice bread prepared from pomegranate peel powder and rice bran stored in paper bag for 0, 1, 2, 3 and 4 days were 7.4, 7.6, 7.6, 7.0, and 7.2 and polythene bag for 0, 1, 2, 3 and 4 days were 7.4, 7.9, 7.8, 7.8 and 7.5 respectively. It was seen from Table 12 (b) shows had that ANOVA for the effect of packaging material and storage duration on flavor of pomegranate peel powder and rice bran slice bread. It indicated that packaging material had significant influence  $p \leq 0.05$  and storage duration had significant influence on flavor of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The interaction shows no significant influence on flavor of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

The average sensory texture scores was in the range 7.9 to 7.1. Highest texture score was observed at  $P_2$  and lowest was observed at  $P_1$ . The average texture score for slice bread prepared from pomegranate peel powder and rice bran stored in paper bag for 0, 1, 2, 3 and 4 days were 7.6, 7.4, 7.3, 7.3 and 7.1 and polythene bag for 0, 1, 2, 3 and 4 days were 7.9, 7.7, 7.6, 7.4 and 7.3 It was seen from Table 12 (c) shows the ANOVA for the effect of packaging material and storage duration on texture of pomegranate peel powder and rice bran slice bread. It indicated that packaging material had no significant influence on texture of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$  but the storage duration shows the significant effect of the slice bread prepared from pomegranate peel powder and rice bran  $p \leq 0.05$ . The interaction shows the no significant influence on texture of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

The average sensory taste scores was in the range 7.9 to 7.0. Highest taste score was observed at  $P_2$  and

**Table 12:** Effect of packaging material and storage duration of slice bread prepared from pomegranate peel powder and rice bran

Source of Variance	Storage duration (days)					Mean
	0 days	1 days	2 days	3 days	4 days	
<b>Sensory Colour</b>						
P <sub>1</sub>	7.7±0.77	8.1±0.56	7.5±0.57	7.5±0.66	7.1±0.82	7.6
P <sub>2</sub>	7.8±0.73	8.3±0.52	7.7±0.61	7.7±0.89	7.5±0.90	7.8
<b>Mean</b>	7.7	8.2	7.6	7.6	7.3	
	<b>Treatment</b>		<b>Storage</b>		<b>Interaction (T × S)</b>	
SEm(±)	0.061		0.114		0.161	
CD <sub>at 1%</sub>	0.174		0.327		0.451	

Source of Variance	Storage duration (days)					Mean
	0 days	1 days	2 days	3 days	4 days	
<b>Sensory Flavour</b>						
P <sub>1</sub>	7.4±1.02	7.6±0.51	7.6±0.77	7±1.01	7.2±0.79	7.4
P <sub>2</sub>	7.4±0.69	7.9±0.77	7.8±0.85	7.8±0.99	7.5±0.84	7.7
<b>Mean</b>	7.4	7.8	7.7	7.4	7.4	
	<b>Treatment</b>		<b>Storage</b>		<b>Interaction (T × S)</b>	
SEm(±)	0.06		0.124		0.175	
CD <sub>at 1%</sub>	0.190		0.355		0.490	

Source of Variance	Storage duration (days)					Mean
	0 days	1 days	2 days	3 days	4 days	
<b>Sensory texture</b>						
P <sub>1</sub>	7.6±1.19	7.4±0.85	7±0.76.3	7.3±0.67	7.1±0.85	7.3
P <sub>2</sub>	7.9±0.70	7.7±1.00	7.6±0.83	7.4±0.70	7.3±0.66	7.5
<b>Mean</b>	7.7	7.6	7.5	7.3	7.2	
	<b>Treatment</b>		<b>Storage</b>		<b>Interaction (T × S)</b>	
SEm(±)	0.07		0.133		0.188	
CD <sub>at 1%</sub>	0.203		0.381		0.526	

Source of Variance	Storage duration (days)					Mean
	0 days	1 days	2 days	3 days	4 days	
<b>Sensory taste</b>						
P <sub>1</sub>	7.9±0.70	7.4±1.11	7.2±0.88	7.0±0.88	7±1.06	7.3
P <sub>2</sub>	7.9±0.63	7.7±0.54	7.6±0.84	7.6±1.22	7.3±0.95	7.6
<b>Mean</b>	7.9	7.6	7.4	7.3	7.2	
	<b>Treatment</b>		<b>Storage</b>		<b>Interaction (T × S)</b>	
SEm(±)	0.077		0.144		0.204	
CD <sub>at 1%</sub>	0.220		0.413		0.570	

lowest was observed at P<sub>1</sub>. The average Taste score for slice bread prepared from pomegranate peel powder and rice bran stored in paper bag for 0, 1, 2, 3 and 4 days were 7.9, 7.4, 7.2, 7.0 and 7.0 and polythene bag for 0, 1, 2, 3 and 4 days were 7.9, 7.7, 7.6, 7.6 and 7.3.

It was seen from Table 12 (d) shows the ANOVA for the effect of packaging material and storage duration on taste of slice bread prepared from pomegranate peel powder and rice bran  $p \leq 0.05$ . It indicated that packaging material had significant influence on

taste of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ . The storage duration also shows the significant effect on taste of the pomegranate peel powder and rice bran slice bread. The interaction shows the no significant influence on taste of slice bread prepared from pomegranate peel powder and rice bran at  $p \leq 0.05$ .

## CONCLUSION

During the storage period from the 0 to 4<sup>th</sup> days moisture content decreases from 33.072 to 31.199 % (db), protein content decreases from 13.380 to 12.560 %, fat decreases from 1.523 to 1.302 %, fiber content decreases from 0.881 to 0.796, ash content decreases from 0.640 to 0.512 %, carbohydrate increases from 50.504 to 53.769 and whiteness index decreases from 51.718 to 48.781 for polythene bag (P<sub>2</sub>). The best quality of pomegranate peel powder and rice bran slice bread, can be store for 4 days in polythene bags packaging material in good condition.

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