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RESEARCH PAPER

Influence of packaging materials on lipid oxidation of instant dal

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***Abstract* :** The extent of lipid oxidation for instant pigeonpea dal was studied in PE (Poly ethylene), PP (Poly propylene) and PFP (Polyester-Al.foil-Polyethene) pouches. The evaluation was done at three weeks interval by measuring the changes in thiobarbituric acid (TBA), free fatty acid (FFA) and peroxide value (PV). During the whole storage period of 105 days, it was found that the NaCl treated instant dal stored in PFP (Polyester-Al.foil-Polyethene) packets showed the minimum degradation in quality parameters.

Key Words **:** Instant-dal, Quality, Lipid, Pigeonpea, Storage

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INTRODUCTION

Pulses are very rich source of proteins and constitute the major source of dietary proteins in developing countries. Besides proteins, pulses are rich in minerals like phosphorus (230 – 414 mg/ 100g), calcium (5 – 30 mg/100 g), iron (2.7 –11.5 mg/100 g), vitamins like thiamine (0.3 – 0.5 mg/100g), riboflavin (0.09- 0.27 mg /100 g) and niacin (1.3 – 3.5mg /100 g). Though protein quality of pulses are slightly inferior to animal proteins, cereal and pulse proteins are complementary in nature and, therefore, highly useful in meeting the dietary needs of millions of people living in the developing countries.

Normally pulses are consumed in the form of dal gruel. However, instant dal with cooking time less than ten minutes is gaining acceptance all over the world because of the convenience they provide to the consumers.

The expectation and aspirations of the urban society and the changes in the day to day life style have made packaging an essential component in sustaining the quality of life. Packaging has contributed a lot to the growing needs of the society in a number of different ways. Packaging protects the products during transport from one place to another, preserves their quality of acceptance, reduces food loss and provides the convenience required by the urban consumer, ensuring the product integrity. Packaging also provides the important information to the consumers with respect of the product packaged and a useful marketing tool.

The selection of the food package is governed by many different facts namely, type of food product, storage conditions, transportations distribution etc. Patki and Arya (1997) prepared *Khichdi* mix from the precooked dehydrated rice, whole legume grain, spices and vanaspati and studied its storability in PFP (paper-aluminium foil- polyethylene) laminate pouches and polypropylene bags at 0^0C and room temperature, 37^0C. They found that the product remained stable for 18, 12 and 6 months, respectively for pp pouches and 18, 18, 12 months in PFP pouches. The study also revealed that peroxide value (PV), thiobarbituric acid value (TBA) and free fatty acid (FFA) increased in storage where as total carotenoids decreased. In the above product the off flavour resulting from the lipid degradation were the major cause of decreased sensory acceptance. Texture and the reconstitution characteristics did not change in storage. Sernwal *et al.* (2001) have studied the storage stability of instant vegetable

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'pulavmix' prepared from the freeze thaw dehydrated rice, fried peas, fried potatoes, spices and vanaspati. They have taken the packages PP pouches and the PFP pouches in their experiment. The study revealed that, pulav mix packed in PP pouches can remain stable for 12, 9, and 6 months at 0^0C, room temperature and 37^0C, respectively. While in PFP (paper aluminiumfoil polyethylene) pouches it remained stable for 12, 12, 9 months, respectively. During the whole storage period, peroxide value, thiobarbituric acid value and the free fatty acid value increased. Total carotenoids and chlorophylly value decreased. Off flavour resulting from the lipid degradation and losses in carotenoids and chlorophyll content were the major causes of the decreased acceptance score.

In the present study, the storage stability of instant dal was studied in PE (Poly ethylene), PP (Poly propylene) and PFP (Polyester-Al. foil- polyethylene) pouches.

MATERIALS AND METHODS

Estimation of thiobarbituric acid (TBA) value:

Thiobarbituric acid (TBA) value is the spectrophotometric reading of the red pigment, that is formed due to the reaction of 2 – thiobarbituric acid (TBA) with the oxidation product of unsaturated fatty acids present in the stored sample. It is expressed in TBA number defined as mg of malonaldehyde per 1000 g of sample (Ohkawa *et al.*, 1979)

Determination of free fatty acid:

Free fatty acids value was calculated as percentage oleic acid, after determination of the oil content. Acid value is the number of milligrams of potassium hydroxide required to neutralize the free fatty acid present in 1 g of fat or oil (A.O.A.C., 1975).

Determination of peroxide value:

The peroxide value of fat is the amount of peroxides present and expressed as mili eqivalents of peroxides per 1000g of sample (Ranganna, 1986).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Changes in TBA value:

The TBA values measured, followed an increasing trend with time of storage. The maximum increase in TBA value (0.14 – 0.68) was found in the case of polyethylene packaets both for the sodium bicarbonate ($NaHCO_3$) and sodium carbonate (Na_2CO_3) treatments, where as the minimum value of increase (0.12 – 0.48) was found in the case of PFP laminate packets in NaCl treatment. (Table 1). This confirms the findings of Patki and Arya (1994). Analysis of variance (ANOVA) for TBA shows that, both salt treatment and packaging material were significant at 5 per cent and 1 per cent level of significance, respectively (Table 2). Considering the salt treatment, sodium chloride (NaCl) was significantly different in comparison to sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$), whereas, there was no significant difference between the sodium bicarbonate and sodium carbonate treatment (Table 5). Considering the effect of packaging material (Table 6), polyethylene and polypropylene packaging was significantly different than PFP laminate, where as there was no significant difference between polyethylene and polypropylene.

Change in FFA value:

The increase in FFA content in stored instant dal results from the lipolysis of lipids. However, the lipase activity was completely destroyed during cooking and therefore increase in FFA content during storage have resulted mainly from secondary degradation products of lipid oxidation. This confirms the findings of Patki and Arya (1994).

During the whole storage period of 105 days, the FFA content increased from 1.78 per cent to 5.83 per cent, 2.01 per cent to 6.32 per cent and 2.39 per cent to 5.85 per cent for (NaCl), ($NaHCO_3$) and (Na_2CO_3) treatments, respectively (Table 1). It is evident that the FFA value for all the salt treatments after 105 days of storage were greater in the case of samples in polyethylene packaging than those in polypropylene and PFP laminate. The analysis of variance (ANOVA) for FFA value shows that, both salt treatment, packaging material and their interaction are significant at 1 per cent, 10 per cent and 5 per cent level of significance, respectively (Table 3). There was no significant difference between the salt treatments NaCl and Na_2CO_3 but both the salts had the significant difference with that of ($NaHCO_3$) treatment (Table 5). Considering the effect of packaging material on FFA content, polyethylene was significantly different than that of polypropylene and PFP laminate (Table 6).

Change in PV:

The change in peroxide value (PV) was similar to that of change in free fatty acid suggesting the formation of FFA from the decomposition of hydroperoxide rather by than the hydrolysis of the tryglycerides. Similar pattern of changes has been observed by other researchers during the storage of processed foods (Premavalli *et al.*, 1987). The maximum increase in PV (0 to 148) was found in the case of sodium bicarbonate ($NaHCO_3$) treatment in polyethylene packaging and the minimum value (0 to 85) was found in the case of PFP laminate pouches, both for the NaCl and Na_2CO_3 treatments (Table 1). ANOVA table for the peroxide value shows that, both salt treatment and packaging material were significant at 1 per cent and 5 per cent level of significane (Table 4). No significant effect of the interaction of salt treatment and

Table 1 : Quality parameter scores of instant pigeonpea dal after different days of storage

	Salt treatment	Packaging material	Period of storage (Days)					
			0	21	42	63	84	105
TBA value	Sodium chloride	Polyethylene	0.12	0.22	0.27	0.35	0.48	0.58
		Polypropylene	0.12	0.19	0.24	0.33	0.46	0.58
		PFP Laminate	0.12	0.18	0.22	0.31	0.42	0.48
	Sodium bicarbonate	Polyethylene	0.14	0.26	0.35	0.43	0.63	0.68
		Polypropylene	0.14	0.22	0.31	0.48	0.61	0.61
		PFP Laminate	0.14	0.20	0.30	0.40	0.50	0.55
	Sodium carbonate	Polyethylene	0.14	0.23	0.37	0.48	0.49	0.68
		Polypropylene	0.14	0.23	0.32	0.46	0.46	0.62
		PFP Laminate	0.14	0.21	0.30	0.44	0.48	0.52
FFA value	Sodium chloride	Polyethylene	1.78	2.54	2.79	3.71	4.80	5.23
		Polypropylene	1.78	2.32	3.01	3.54	4.67	5.01
		PFP Laminate	1.78	2.04	2.75	3.48	4.27	4.94
	Sodium bicarbonate	Polyethylene	2.01	3.03	3.98	4.32	4.75	5.83
		Polypropylene	2.01	3.17	3.65	4.02	5.34	6.32
		PFP Laminate	2.01	2.85	3.43	3.85	4.55	5.65
	Sodium carbonate	Polyethylene	2.39	3.01	3.76	4.48	4.57	5.85
		Polypropylene	2.39	2.79	3.52	3.99	4.23	4.57
		PFP Laminate	2.39	3.01	3.89	4.32	4.62	4.86
PV value	Sodium chloride	Polyethylene	0	39	45	62	88	106
		Polypropylene	0	34	45	39	78	78
		PFP Laminate	0	30	42	57	84	85
	Sodium bicarbonate	Polyethylene	0	42	65	82	88	148
		Polypropylene	0	38	68	72	75	112
		PFP Laminate	0	32	37	47	68	105
	Sodium carbonate	Polyethylene	0	38	48	67	85	100
		Polypropylene	0	28	54	67	84	89
		PFP Laminate	0	25	48	59	79	85

Table 2 : ANOVA for the TBA value after 105 days of storage

Sources of variation	DF	Sum of squares	F-value	P (Prob > F)
ST	2	0.0242	3.85	0.0407**
PM	2	0.0788	12.50	0.0004*
ST x PM	4	0.0057	0.45	0.7681
Error	18	0.0568		
Total	26	0.1656		

Table 3 : ANOVA for the FFA value after 105 days of storage

Sources of variation	DF	Sum of squares	F-value	P (Prob > F)
ST	2	5.6245	20.25	0.0001*
PM	2	0.7676	2.76	0.0898***
ST x PM	4	2.4492	4.41	0.0117**
Error	18	2.5000		
Total	26	11.3415		

Table 4 : ANOVA for the peroxide value after 105 days of storage

Sources of variation	DF	Sum of squares	F-value	P (Prob > F)
ST	2	5840.6666	6.44	0.0078*
PM	2	3960.666	4.37	0.0285**
ST x PM	4	869.3333	0.48	0.7506
Error	18	8164.0000		
Total	26	18834.6666		

ST=Salt treatment, PM=Packaging material * and ** indicate significance of values at P=0.01 and 0.05, respectively

Table 5 : Effect of salt treatment on quality parameters

Salt treatments	TBA	FFA	PV
NaCl	0.546 B	5.06 A	89.67 B
$NaHCO_3$	0.613 A	6.04 A	121.67 A
Na_2CO_3	0.606 A	5.09 B	91.33 B
LSD at 5% level of significance	0.055	0.369	21.09

Table 6 : Effect of packaging material on quality parameters

Packaging materials	TBA	FFA	PV
Polyethylene	0.646 A	5.63 A	118.00 A
Polypropylene	0.603 A	5.30 AB	93.00 B
PFP laminate	0.516 B	5.26 B	91.67 B
LSD at 5% level of significance	0.055	0.369	21.09

Note : The same letters are not significantly different Values shows the mean score of parameter

packaging material was found on the peroxide value. Both NaCl and Na_2CO_3 treatment were significantly different in comparison to $NaHCO_3$ (Table5). Considering the effect of packaging material, polyethylene packaging was significantly different to that of the polypropylene and PFP laminate (Table 6).

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