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Functional properties of jackfruit seed flour

Ankur M. Arya, B. R. Singh, Samsher, Suresh Chandra, Neelesh Chauhan, Vaishali and Sweta Singh

In the current experiments functional properties of jackfruit seed flour stored in HDPE and Aluminium foil pouches was evaluated during storage of 0 to 90 days. From the experiment it was concluded that the water absorption capacity decreases from 2.02 ± 0.042 to 1.22 ± 0.046 ml/g and from 2.02 ± 0.042 to 1.28± 0.046 ml/g for jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. The oil absorption capacity increases as 2.10 ± 0.045 to 2.40 ± 0.047 ml/g and 2.10 ± 0.045 to 2.85 ± 0.047 ml/g jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. The flour dispersibility decreases from 32.67 ± 0.092 to 27.25 ± 0.921% and from 32.67 ± 0.092 to 28.82 ± 0.468% for jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. The foaming capacity decreases from 7.10 ± 0.202 to 6.42 ± 0.122 g/ml and from 7.10 ± 0.202 to 6.56 ± 0.071 g/ml for jackfruit seed flour in HDPE and Aluminium foil pouches, respectively.

Key Words : Functional properties, Jackfruit seed flour, Water absorption capacity, Oil absorption capacity, Flour dispersibility, Foaming capacity

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INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae, is one of the most significant and widely grown fruit trees in tropical region. Jackfruit is a nutritious fruit, rich in vitamins A, B and C, potassium, calcium, iron, proteins and carbohydrates. The value of its versatility is enhanced by its availability during the monsoon period, when the supply of other fruits and vegetables is small (Singh, 1986). The jackfruit seed contains moisture content 61.8% (w.b.), protein (11.85 %), fibre (3.19%) and carbohydrate (26.20%). The calorific value is 382.79 kcal/100g. It contains ash and fat content (dry matter basis) is 0.15 per cent and 1.006 per cent, respectively (Gupta *et al.,* 2011). The seed is 2-4 cm in length and 1.5- 2.5 cm in diameter. Upto 500 seeds can be found in a single fruit (Islam *et al.,* 2015). Jackfruit seed contains (54mg/100g) magnesium elements. It is a nutrient important in the absorption of calcium and works with calcium to help strengthen the bone and prevents bone-related disorders such as osteoporosis. Jackfruit seeds are a good source of starch (22%) and fibre (3.19%). Jackfruit seed starch is to be useful in relieving biliousness. Extract from jackfruit seed helps indigestion (Swami *et al.*, 2012). The jackfruit seed flour contains an appreciable value of calcium (3087 mg/kg), iron (130.74 mg/kg), potassium (14781 mg/kg),

MEMBERS OF RESEARCH FORUM

Author for correspondence :
Ankur M. Arya, Department of Agricultural Engineering, S.V.P. University of Agriculture and Technology, **Meerut (U.P.) India**
Email: arya.ankur76@gmail.com

Associate Authors' :
B.R. Singh, Samsher, Suresh Chandra and Neelesh Chauhan, Department of Agricultural Engineering, S.V.P. University of Agriculture and Technology, **Meerut (U.P.) India**

Vaishali, Department of Agriculture Biotechnology, S.V.P. University of Agriculture and Technology, **Meerut (U.P.) India**

Sweta Singh, S.K.N. Agriculture University, Jobner, **Jaipur (Rajsthan) India**

sodium (60.66 mg/kg), copper (10.45 mg/kg) and manganese (1.12 mg/kg).

Functional properties of flour are greatly affecting the behaviour of food system and its acceptability for consumption and during storage. The functional properties *i.e.* bulk density, water absorption capacity, oil absorption capacity are the intrinsic physico-chemical characteristics which may affect the behaviour of food systems during storage. Water absorption capacity is an important functional characteristic in the development of ready to eat food from cereal grains and high water absorption capacity may assure product cohesiveness. The oil absorption capacity is a critical assessment of flavour retention and increases the palatability of foods (Shobha *et al.*, 2007). Foaming capacity is important for flour used in many leavening food products such as baked food items, cakes and biscuits (Nithiyanantham *et al.*, 2013). Ocloo *et al.* (2010) reported that he jackfruit seed flour has high water absorption capacity (25 %), fat absorption capacity (17.0%) and bulk density (0.80 g/cm^3). Chowdhury *et al.* (2012) studied functional properties of raw and blended jackfruit seed flour for food application. From this they concluded that jackfruit seed flour has great formulation along with wheat flour, blending could be suggested to use in developing bread as protein supplements.

METHODOLOGY

This study was conducted at the Food Analysis Laboratory in the Department of Agricultural Engineering, SVPUA and T, Meerut, Uttar Pradesh, India, during 2019 to determine the functional properties of jackfruit seed flour. Functional properties are those qualities in food that provides additional health benefits to consumers and have great impact on its utilization beyond satisfying the basic nutritional requirements (Otegbayo *et al*., 2013).

Water/oil absorption capacity (ml/g):

Water and oil absorption capacity of jackfruit seed flour was determined using methods described by Odoemelam (2005). One gram jackfruit seed flour sample was weighed into 25 ml graduated conical tubes of centrifuge and about 10 ml of water/oil was added to it. The suspensions were allowed to stand at room temperature (30 ± 2 °C) for 1 h. The suspension was centrifuged at 2000 rpm for 30 minutes. The volume of water/oil on the sediment was measured and the water/oil absorbed was expressed as ml of water/oil absorbed by 1 g of flour.

Flour dispersibility (%):

Dispersibility of jackfruit seed flour was measure by the method of Airani (2007). 10 grams of jackfruit seed flour sample was taken in 100 ml measuring cylinder. Distilled water was added to make the volume of 100 ml, stirred vigorously and allowed to settle for three hours. The volume of settled particles was subtracted from 100 and the difference was reported as percentage dispersibility.

Foaming capacity (g/ml):

Foaming capacity of jackfruit seed flour was determined by the method suggested by Odoemelam (2005). 2 g jackfruit seed flour was taken in a beaker and 100 ml water was added to it and mixture of water and sample was allowed to stir at room temperature for 5 minutes using a magnetic stirrer. The contents along with foam were immediately poured into a 250 ml measuring cylinder. Volume of foam (ml) after pouring will expressed as the foam capacity (g/ml).

Foam stability (ml):

The foaming capacity of the jackfruit seed flour for 16, 19 and 22 minutes steaming duration and 60 °C drying was performed and the volume of the foam for the time period of 20-80 min was expressed as foam stability for the respective time periods.

OBSERVATIONS AND ASSESSMENT

Jackfruit seed flour was developed and stored in HDPE and Aluminium foil pouches. Various functional properties of jackfruit seed flour were determined upto 3 months of storage duration.

Water absorption capacity (ml/g):

The higher dispersibility of meal in water indicated its ability to reconstitute (Jolaoso *et al*., 2012).

Table 1 shows the water absorption capacity of jackfruit seed flour. The water absorption capacity decreases from 2.02 $\pm$ 0.042 to 1.22 $\pm$ 0.046 ml/g and from 2.02 $\pm$ 0.042 to 1.28 $\pm$ 0.046 ml/g for jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. Table 1(a) shows the ANOVA for change in water absorption capacity in 90 days storage duration of jackfruit

seed flour. Decrease in water absorption capacity with increase in storage period from 0 - 90 days is higher in HDPE than Aluminium foil pouches for jackfruit seed flour. This decrease in water absorption capacity with increase in storage period was significant at $p \leq 0.05$ for the jackfruit seed flour. Maximum water absorption capacity is recorded at 0 days which was significantly higher than other days; all the day intervals are significantly different for jackfruit seed flour.

Oil absorption capacity (ml/g):

Table 2 shows the oil absorption capacity of jackfruit seed flour stored in HDPE and Aluminium foil pouches over a period of 90 days at ambient condition. The oil absorption capacity increases as 2.10 ± 0.045 to 2.40 ± 0.047 ml/g and 2.10 ± 0.045 to 2.85 ± 0.047 ml/g jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. Table 2(a) shows the ANOVA for change in oil absorption capacity in 90 days storage duration of jackfruit seed flour. Increase in oil absorption capacity with increase in storage period from 0 - 90 days is higher in HDPE than Aluminium foil pouches for jackfruit seed flour. This increase in oil absorption capacity with increase in storage period was significant at $p \leq 0.05$ for jackfruit seed flour. Maximum oil absorption capacity is recorded at 60 days which was significantly higher than other days in HDPE. At 90 days for Aluminium foil pouches maximum oil absorption capacity is recorded, all the day intervals are significantly different for jack seed flour.

Flour dispersibility (%):

Table 3 shows the flour dispersibility of jackfruit seed flour stored in HDPE and Aluminium foil pouches over a period of 90 days ambient condition. The flour dispersibility decreases from 32.67 ± 0.092 to $27.25 \pm 0.921\%$ and from 32.67 ± 0.092 to $28.82 \pm 0.468\%$ for

Table 1: Effect of packaging material and storage duration of jackfruit seed flour on water absorption capacity

Packaging material	Storage duration (Days)			
	0	30	60	90
HDPE	2.02 ± 0.042	1.62 ± 0.044	1.32 ± 0.045	1.22 ± 0.046
Aluminium foil	2.02 ± 0.042	1.79 ± 0.044	1.42 ± 0.085	1.28 ± 0.046

Table 1(a): ANOVA for effect of packaging material and storage duration of jackfruit seed flour on water absorption capacity

Source of variation	ANOVA					
	SS	df	MS	F	P-value	F crit
Rows	0.013613	1	0.013613	5.346972	0.103807	10.12796
Columns	0.724138	3	0.241379	94.81342	0.001804	9.276628
Error	0.007637	3	0.002546			
Total	0.745388	7				

Table 2: Effect of packaging material and storage duration of jackfruit seed flour on oil absorption capacity

Packaging material	Storage duration (Days)			
	0	30	60	90
HDPE	2.10 ± 0.045	2.35 ± 0.04	2.66 ± 0.046	2.40 ± 0.047
Aluminium foil	2.10 ± 0.045	2.50 ± 0.042	2.82 ± 0.0003	2.85 ± 0.047

Table 2(a): ANOVA for effect of packaging material and storage duration of Jackfruit seed flour on oil absorption capacity

Source of variation	ANOVA					
	SS	df	MS	F	P-value	F crit
Rows	0.0722	1	0.0722	4.079096	0.136699	10.12796
Columns	0.47165	3	0.157217	8.882298	0.052956	9.276628
Error	0.0531	3	0.0177			
Total	0.59695	7				

jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. Table 3(a) shows the ANOVA for change in flour dispersibility in 90 days storage duration of jackfruit seed flour. Decrease in flour dispersibility with increase in storage period from 0-90 days is more in HDPE than Aluminium foil pouches for jackfruit seed flour. This decrease in flour dispersibility with increase in storage period was significant at $p \leq 0.05$ for jackfruit seed flour. Maximum flour dispersibility is recorded at 0 days which was significantly higher than other days, flour dispersibility at all the day intervals are significantly different for jack seed flour.

Foaming capacity (g/ml):

Table 4 shows the foaming capacity of jackfruit seed flour stored in HDPE and Aluminium foil pouches over a period of 90 days at ambient condition. The foaming capacity decreases from 7.10 ± 0.202 to 6.42 ± 0.122 g/ml and from 7.10 ± 0.202 to 6.56 ± 0.071 g/ml for jackfruit seed flour in HDPE and Aluminium foil pouches, respectively. Table 4(a) shows the ANOVA for change in foaming capacity in 90 days storage duration of jackfruit seed flour. Decrease in foaming capacity with increase in storage period is higher in HDPE than Aluminium foil pouches of jackfruit seed flour. This decrease in foaming capacity with increase in storage period was significant at $p \leq 0.05$ for jackfruit seed flour. Maximum foaming capacity is recorded at 0 days which was significantly higher than other days hence, all the day intervals are significantly different for jack seed flour.

Conclusion:

Flour developed from tray dried jackfruit seeds at 60°C were selected for packaging and storage study. Seed flour sample was filled separately in HDPE and aluminium foil pouches and sealed properly. These packets were kept at ambient temperature upto 90 days. The observations for the functional properties of stored sample were taken during 0, 30, 60, and 90 days. The functional properties like water absorption capacity, flour

Table 3: Effect of packaging material and storage duration of jackfruit seed flour on flour dispersibility

Packaging material	Storage duration (Days)			
	0	30	60	90
HDPE	32.67 ± 0.092	29.47 ± 0.010	28.72 ± 0.460	27.25 ± 0.921
Aluminium foil	32.67 ± 0.092	31.02 ± 0.42	29.49 ± 0.003	28.82 ± 0.468

Table 3(a): ANOVA for effect of packaging material and storage duration of jackfruit seed flour on flour dispersibility

Source of variation	ANOVA					
	SS	df	MS	F	P-value	F crit
Rows	1.891513	1	1.891513	6.766377	0.080291	10.12796
Columns	23.70084	3	7.900279	28.26112	0.010615	9.276628
Error	0.838638	3	0.279546			
Total	26.43099	7				

Table 4: Effect of packaging material and storage duration of jackfruit seed flour on foaming capacity

Packaging material	Storage duration (Days)			
	0	30	60	90
HDPE	7.10 ± 0.202	6.90 ± 0.006	6.74 ± 0.092	6.42 ± 0.122
Aluminium foil	7.10 ± 0.202	6.98 ± 0.061	6.88 ± 0.078	6.56 ± 0.071

Table 4(a): ANOVA for effect of packaging material and storage duration of jackfruit seed flour on foaming capacity

Source of variation	ANOVA					
	SS	df	MS	F	P-value	F crit
Rows	0.0162	1	0.0162	7.363636	0.072942	10.12796
Columns	0.4018	3	0.133933	60.87879	0.003471	9.276628
Error	0.0066	3	0.0022			
Total	0.4246	7				

dispersibility, foaming capacity decreases while oil absorption increases as storage duration increases from 0 to 90 days for jackfruit seed flour.

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