Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.7995

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2020) *8*(3), 378-387

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Effect of Various Pre Treatments on Physicochemical Quality of Flour Made From Three Banana Varieties

Bharathi Devi S.[1], Rajasekhar M.[2], Venkata Subbaiah K.[3*] and Uma Krishna K.[4]

[1, 2, 4]College of Horticulture, Venkataramannagudem [3]KVK, Venkataramannagudem

Dr. Y.S.R. Horticulture University, Venkataramannagudem

*Corresponding Author E-mail: venkathort@gmail.com

Received: 18.03.2020 | Revised: 25.04.2020 | Accepted: 3.05.2020

ABSTRACT

An experiment was conducted to investigate the physicochemical quality of flour made from three matured banana varieties using completely randomized block design with factorial concept. Banana fruits of Grand Naine (AAA), Monthan (ABB), Karpura Chakkerakeli (AAB) were used for preparing flour after treating the banana slices with blanching, KMS- 0.5%, KMS- 0.5% and $CaCl_2$- 0.5%, ascorbic acid - 0.2%, ascorbic acid - 0.2% and $CaCl_2$- 0.5% for 5 minutes. The pretreated slices were dried in a tray dryer and their physical and chemical characteristics were studied for period of 3 months. Recovery was found to be high in KMS - 0.5% treated banana flour (31.95%). The lowest moisture (9.66%) content was recorded in cv. Karpura Chakkerakeli and the highest reducing sugars (5.97%) were found in Karpura Chakkerakeli. With respect to non reducing sugars the highest count was observed as 1.88% in cv. Karpura Chakkerakeli and highest titratable acidity (0.15%) was recorded in cv. Monthan. The processing of banana flour reported in this study will enhance the utilization of mature green banana fruits.

Keywords: *Banana varieties, Banana flour, Storage study*

INTRODUCTION

Banana is one of the most consumed fruit in tropical and subtropical regions of Southeast Asia, belongs to family *Musaceae.*

In India banana is grown in an area of 8,41,200 ha with production of 29,13,480 metric tonnes and productivity of 34.6 metric tonnes/ha. Andhra Pradesh stands third in banana cultivation with an area of 75,720 ha producing 35,70,620 metric tonnes of fruits and productivity of 47.16 metric tonnes/ha.

According to Ramcharan and George (1999) the role of banana and plantain is becoming more important with the increasing emphasis on diets that are low in sodium but high in potassium and vitamins.

Cite this article: Bharathi Devi, S., Rajasekhar, M., Subbaiah, V.K., & Krishna, U.K. (2020). Effect of Various Pre Treatments on Physicochemical Quality of Flour Made From Three Banana Varieties, *Ind. J. Pure App. Biosci. 8*(3), 378-387. doi: http://dx.doi.org/10.18782/2582-2845.7995

Both banana and plantain are good sources of potassium, vitamin A, vitamin C, vitamin B6 and low in sodium. Banana fruit is having high initial moisture content of about 72 to 77 %, hence there is a more chance of spoilage due to loss of water, action of phenols in skin, microbial action, high ethylene production and it also has comparatively short shelf life and vulnerable to long distance transport.

The objective of the study is to prepare banana flour from different varieties using different treatments and to study their characteristics.

MATERIALS AND METHODS

Raw Materials

Three varieties *viz.,* Grand Naine (AAA), Monthan (ABB), Karpura Chakkerakeli (AAB) were used in the experiment. Monthan, Karpura Chakkerakeli were procured from College of Horticulture, Venkataramannagudem while Grand Naine was procured from Horticulture Research Station, Kovvur. The treatments blanching, KMS - 0.5%, KMS - 0.5% and $CaCl_2$ - 0.5%, ascorbic acid - 0.2%, ascorbic acid - 0.2% and $CaCl_2$ - 0.5% are used and replicated thrice using completely randomized block design with factorial concept.

Preparation of banana flour

Fresh mature fruits were peeled manually and cut into slices about 0.5 cm thickness of uniform size and shape. They were subjected to different pretreatments according to the experimental requirements and then dehydrated using tray drier. The dried slices were ground into flour and packaged in LDPE bags for subsequent use.

Determination of proximate composition

Proximate compositions of samples were determined according to the method of AOAC for reducing sugars. Moisture content of fresh banana was determined on percentage basis by infrared moisture analyzer (Make-Shimadzu; Model-MOC63u). Titratable acidity was determined by titration as per Ranganna (1986) method. All tests were average of triplicate analysis. The sensory quality of banana flour was evaluated by a panel of six judges using 9-point Hedonic rating scale (Ranganna, 1986).

RESULTS AND DISCUSSION

The data pertaining to recovery of banana flour were presented in Table 1. Among the treatments banana flour treated with KMS at 0.5% recorded the highest recovery (31.95) and lowest recovery (29.50%) was recorded with blanching treatment. Among the varieties highest recovery (38.28%) was recorded in cv. Grand Naine and lowest recovery (18.32%) was recorded in cv. Monthan.

The increase in recovery attributed to reduction in osmotic losses. Vaghini and Chundawat (1986), also reported increase in recovery due to KMS treatment in sapota. Maximum recovery percentage was reported with KMS at 0.1% in dehydrated aonla (Prajapati et al., 2011).

The data regarding dehydration ratio of banana flour was presented in Table 2. Among the treatments banana slices treated with blanching recorded the highest dehydration ratio (3.79) while lowest dehydration ratio (3.47) was recorded in treatment with KMS at 0.5%. Among the varieties highest dehydration ratio (5.47) was recorded in cv. Monthan and lowest dehydration ratio (2.61) was recorded in cv. Grand Naine.

This revealed inverse relationship between the per cent recovery and its dehydration ratio. These results were also found by Vaghini and Chundawat (1986) in sapota. KMS had an influence on dehydration ratio was reported by Manimegalai and Ramah (1998). The data on moisture content of flour was presented in Table 3. This revealed significant differences between treatments, varieties and storage period while no significant differences were observed among the interactions. Lowest moisture content (9.66%) was recorded in cv. Karpura Chakkerakeli while highest moisture content (13.10%) was recorded in cv. Monthan.

Among the different treatments, the flour obtained from slices treated with KMS at 0.5% recorded lowest moisture content

(10.49%) while highest moisture content (11.79%) was recorded in the treatment with ascorbic acid at 0.2%. Moisture content (9.38%) was found low on 0^{th} day of storage and high moisture content (12.80%) was found on 90^{th} day of storage. The data revealed that moisture content increased gradually over the storage period. Examination of the results revealed that moisture content increased gradually as storage period progressed from initial day to 90^{th} day of storage in the present study. This increase in the moisture content could be attributed to hygroscopic nature of banana flour and absorption of moisture from the atmosphere through LDPE films (Raleng et al., 2014). The data pertaining to reducing sugars of flour was presented in Table 4. Highest reducing sugars (5.97%) were recorded in Karpura Chakkerakeli variety, while lowest reducing sugars (4.37%) were recorded in Monthan variety. Among the different treatments, KMS at 0.5% and calcium chloride at 0.5% treatment recorded highest reducing sugars (5.45 while lowest reducing sugars (4.85%) were recorded in blanching treatment. Reducing sugars (6.65%) were found high on 90^{th} day of storage and low (3.69%) in 0^{th} day of storage. The data revealed that reducing sugars increased gradually over the storage period. Among the first order interaction between varieties and treatments, highest reducing sugars (6.12%) were recorded in Karpura Chakkerakeli variety with ascorbic acid at 0.2% and $CaCl_2$ at 0.5% treatment whereas lowest reducing sugars were recorded with blanching treatment in Monthan variety (3.80%).

In the interaction between treatments and storage period, highest reducing sugars (6.79%) were recorded in ascorbic acid at 0.2% treatment on 90^{th} day of storage and lowest reducing sugars were recorded in blanching treatment on 0^{th} day of storage (3.29%). In the interaction between varieties and storage period highest reducing sugars (7.58%) were recorded in Karpura Chakkerakeli variety on 90^{th} day of storage and lowest reducing sugars (2.42%) were recorded in Monthan variety on 0^{th} day of storage. Among the second order interaction between varieties, treatments and storage period, it was found that maximum reducing sugars (7.89%) were observed with KMS at 0.5% treatment in Karpura Chakkerakeli variety on 90^{th} day of storage where as minimum reducing sugars was recorded with blanching treatment in Monthan variety on 0^{th} day of storage (1.58%). The results revealed that reducing sugars gradually increased as storage period progressed from initial day to 90^{th} day. The increase in reducing sugars can be attributed to hydrolysis of sugars by acid, which might have resulted in degradation of disaccharides to monosaccharides (MuraliKrishna et al., 1969).

The increase in reducing sugars during storage period were also reported by Evelin et al. (2007) in banana powder, Mandalik et al. (2009) in banana flour, Dabhade and Khedkar (1980b) and by Teotia et al. (1987) in mango powder. The data analysed for non reducing sugars content of flour was presented in Table 5. Highest non reducing sugars (1.88%) were recorded in cv. Karpura Chakkerakeli, while lowest non reducing sugars (1.62%) were recorded in Grand Naine variety which was on par with (1.63%) cv. Monthan. Non reducing sugars (2.00%) were found high on 0^{th} day of storage and low non reducing sugars (1.38%) were found on 90^{th} day of storage. The data revealed that non reducing sugars decreased gradually over the storage period. Among the first order interaction between varieties and treatments, highest non reducing sugars (2.27%) were recorded in cv. Karpura Chakkerakeli with KMS at 0.5% treatment whereas lowest non reducing sugars (1.20%) was recorded with KMS at 0.5% treatment in cv. Monthan. The study revealed that non reducing sugars decreased as storage period increased from initial day to 90^{th} day. This might be due to significant increase in reducing sugars and also non reducing sugars are being converted into reducing sugars by hydrolysis (Roy & Singh, 1979). The data pertaining to titratable acidity of flour was presented in Table 6. Highest titratable acidity (0.15%) was recorded in cv. Monthan while lowest titratable acidity (0.14%) was recorded cv. Grand Naine. Titratable acidity was found high (0.19%) on 0th day of storage and low (0.09%) in 90th day of storage. The data revealed that titratable acidity decreased gradually over the storage period.

Among the different treatments, ascorbic acid at 0.2% treatment recorded highest titratable acidity (0.18%) while lowest titratable acidity (0.12%) recorded in potassium metabisulphite at 0.5% and calcium chloride at 0.5% treatment. Among the first order interaction between varieties and treatments, highest titratable acidity (0.20%) was recorded in cv. Grand Naine with ascorbic acid at 0.2% treatment while lowest titratable acidity (0.10%) was recorded in cv. Grand Naine with potassium meta bisulphite at 0.5% and calcium chloride at 0.5%. The study revealed that titratable acidity was decreased as storage period progressed from initial day to 90th day. The decrease in rate of acidity of the powder was influenced by various processing techniques during storage period. This might be due to reduction of organic acid by ascorbic acid degradation and increase in sugar content (Mandalik et al., 2009). The decreased titratable acidity content with advancement of storage period were recorded by Evelin et al. (2007) with banana powder and Dabhade and Khedkar (1980 b) and Teotia et al. (1987) with mango powder. The data pertaining to overall acceptability of flour was presented in Table 7. Highest overall acceptability (3.96) was recorded in cv. Karpura Chakkerakeli while lowest overall acceptability (3.56) was recorded in cv. Monthan. Among the different treatments, overall acceptability was maximum (4.31) with KMS at 0.5% treatment and minimum overall acceptability (2.92) was recorded with blanching treatment. Maximum overall acceptability (4.22) was found on 0th day of storage and minimum overall acceptability (3.35) was found on 90th day of storage. The data revealed that overall acceptability was decreased gradually over the storage period. Among the first order interaction between varieties and treatments, highest overall acceptability (4.53) was recorded with potassium metabisulphite at 0.5% treatment in cv. Karpura Chakkerakeli where as lowest overall acceptability (2.61) was recorded with blanching treatment in cv. Monthan. In the interaction between varieties and storage period, highest overall acceptability (4.41) was recorded in cv. Karpura Chakkerakeli on 0th day of storage and lowest overall acceptability (3.20) was recorded in cv. Monthan on 90th day of storage. The study revealed KMS at 0.5% might have improved the overall acceptability compared to other treatments. The results were in conformity with the findings of preservation and storage of mango pulp by Hussain et al. (2003) and Sakhale et al. (2012) in storage quality of mango pulp.

Table 1: Effect of different treatments on recovery (%) of banana slices

Varieties (V)	Treatments (T)					Mean V
	T_1	T_2	T_3	T_4	T_5	
Grand Naine (V_1)	2.70	2.56	2.58	2.62	2.58	**2.61**
Monthan (V_2)	5.73	5.20	5.51	5.32	5.57	**5.47**
Karpura Chakkerakeli (V_3)	2.95	2.65	2.85	2.77	2.87	**2.82**
Mean T	**3.79**	**3.47**	**3.65**	**3.57**	**3.68**	

Table 2: Effect of different treatments on dehydration ratio of banana slices

Varieties (V)	Treatments (T)					Mean V
	T_1	T_2	T_3	T_4	T_5	
Grand Naine (V_1)	37.00	39.00	38.70	38.06	38.66	**38.28**
Monthan (V_2)	17.50	19.25	18.14	18.78	17.94	**18.32**
Karpura Chakkerakeli (V_3)	34.00	37.62	35.00	36.06	34.73	**35.48**
Mean T	**29.50**	**31.95**	**30.61**	**30.97**	**30.44**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min.

Table 3: Effect of varieties and different treatments on moisture content (%) of banana flour during storage

Treatments (T)	Varieties (V)	Storage period (S)				
		0^{th} day (S_1)	30^{th} day (S_2)	60^{th} day (S_3)	90^{th} day (S_4)	**Mean T × V**
T_1	Grand Naine (V_1)	9.55	10.14	11.02	12.84	**10.89**
T_2		9.02	10.50	10.75	11.47	**10.43**
T_3		8.61	10.68	11.46	12.09	**10.71**
T_4		10.11	11.57	11.99	12.43	**11.52**
T_5		9.84	11.33	12.42	13.02	**11.65**
T_1	Monthan (V_2)	10.41	11.34	13.50	13.91	**12.29**
T_2		10.37	11.26	12.82	13.23	**11.92**
T_3		10.94	13.41	14.62	15.19	**13.54**
T_4		10.81	14.48	15.34	16.09	**14.18**
T_5		10.70	13.32	14.96	15.38	**13.59**
T_1	Karpura chakkerakeli (V_3)	7.90	9.80	10.22	11.25	**9.79**
T_2		7.36	8.45	10.08	10.65	**9.13**
T_3		8.78	9.15	10.11	11.04	**9.77**
T_4		8.00	8.75	9.30	12.62	**9.66**
T_5		8.33	10.21	10.39	10.76	**9.92**
Mean		**9.38**	**10.96**	**11.93**	**12.80**	

V X T X S Interaction

V X T Interaction

Varieties	Treatments					
	T_1	T_2	T_3	T_4	T_5	**Mean**
V_1	10.89	10.43	10.71	11.52	11.65	**11.04**
V_2	12.29	11.92	13.54	14.18	13.59	**13.10**
V_3	9.79	9.13	9.77	9.66	9.92	**9.66**
Mean	**10.99**	**10.49**	**11.34**	**11.79**	**11.72**	

T X S Interaction

Treatments	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
T_1	9.28	10.43	11.58	12.66	**10.99**
T_2	8.92	10.07	11.21	11.78	**10.49**
T_3	9.44	11.08	12.06	12.77	**11.34**
T_4	9.64	11.60	12.21	13.71	**11.79**
T_5	9.62	11.62	12.59	13.06	**11.72**
Mean	**9.38**	**10.96**	**11.93**	**12.80**	

V X S Interaction

Varieties	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
V_1	9.42	10.84	11.53	12.37	**11.04**
V_2	10.65	12.76	14.25	14.76	**13.10**
V_3	8.07	9.27	10.02	11.26	**9.66**
Mean	**9.38**	**10.96**	**11.93**	**12.80**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min

Table 4: Effect of varieties and different treatments on reducing sugars (%) of banana flour during storage

V X T X S Interaction

Treatments (T)	**Varieties (V)**	**Storage period (S)**				
		0^{th} day (S_1)	30^{th} day (S_2)	60^{th} day (S_3)	90^{th} day (S_4)	**Mean T × V**
T_1	Grand Naine (V_1)	3.93	4.53	5.35	6.36	**5.05**
T_2		4.49	4.93	5.63	6.1	**5.29**
T_3		4.59	5.66	6.00	6.42	**5.67**
T_4		4.63	4.87	6.24	6.57	**5.58**
T_5		4.51	5.34	5.70	6.22	**5.44**
T_1	Monthan (V_2)	1.58	3.18	4.84	5.63	**3.8**
T_2		2.61	4.21	5.77	6.13	**4.68**
T_3		2.77	4.26	5.55	6.28	**4.72**
T_4		2.69	4.08	5.46	6.16	**4.6**
T_5		2.44	2.86	4.88	5.93	**4.03**
T_1	Karpura chakkerakeli (V_3)	4.36	5.00	6.46	7.01	**5.71**
T_2		4.21	5.41	6.58	7.89	**6.02**
T_3		4.13	5.6	6.62	7.52	**5.97**
T_4		4.11	5.51	6.94	7.63	**6.05**
T_5		4.27	5.48	6.87	7.84	**6.12**
Mean		**3.69**	**4.73**	**5.93**	**6.65**	

V X T Interaction

Varieties	**Treatments**					
	T_1	T_2	T_3	T_4	T_5	**Mean**
V_1	5.05	5.29	5.67	5.58	5.44	**5.40**
V_2	3.80	4.68	4.72	4.60	4.03	**4.37**
V_3	5.71	6.02	5.97	6.05	6.12	**5.97**
Mean	**4.85**	**5.33**	**5.45**	**5.41**	**5.20**	

V X S Interaction

Varieties	**Storage period**				
	S_1	S_2	S_3	S_4	**Mean**
V_1	4.43	5.07	5.78	6.34	**5.40**
V_2	2.42	3.72	5.30	6.03	**4.37**
V_3	4.22	5.40	6.69	7.58	**5.97**
Mean	**3.69**	**4.73**	**5.93**	**6.65**	

V X S Interaction

Treatments	**Storage period**				
	S_1	S_2	S_3	S_4	**Mean**
T_1	**3.29**	4.24	5.55	6.33	**4.85**
T_2	3.77	4.85	5.60	6.71	**5.33**
T_3	3.83	5.17	6.06	6.74	**5.45**
T_4	3.81	4.82	6.21	6.79	**5.41**
T_5	3.74	4.56	5.81	6.66	**5.20**
Mean	**3.69**	**4.73**	**5.93**	**6.65**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min

Table 5: Effect of varieties and different treatments on non reducing sugars (%) of banana flour during storage

V X T X S Interaction

Treatments (T)	**Varieties (V)**	**Storage period (S)**				
		0^{th} day (S_1)	30^{th} day (S_2)	60^{th} day (S_3)	90^{th} day (S_4)	**Mean T × V**
T_1	Grand Naine (V_1)	2.42	2.25	2.01	1.81	**2.12**
T_2		1.72	1.62	1.31	1.22	**1.47**
T_3		1.84	1.36	1.30	1.16	**1.42**
T_4		1.96	1.82	0.93	0.90	**1.41**
T_5		2.16	1.73	1.54	1.30	**1.68**
T_1	Monthan (V_2)	1.73	1.68	1.20	0.57	**1.30**
T_2		1.41	1.24	1.16	0.99	**1.20**
T_3		1.81	1.78	1.71	1.48	**1.70**
T_4		2.13	2.10	1.97	1.81	**2.00**
T_5		2.32	2.24	1.66	1.52	**1.94**
T_1	Karpura chakkerakeli (V_3)	1.90	1.63	1.57	1.44	**1.64**
T_2		2.52	2.42	2.37	1.77	**2.27**
T_3		2.38	2.26	2.21	1.77	**2.16**
T_4		2.10	2.06	1.96	1.55	**1.92**
T_5		1.59	1.46	1.36	1.32	**1.44**
Mean		**2.00**	**1.84**	**1.62**	**1.38**	

V X T Interaction

Varieties	**Treatments**					
	T_1	T_2	T_3	T_4	T_5	**Mean**
V_1	2.12	1.47	1.42	1.41	1.68	**1.62**
V_2	1.29	1.20	1.69	2.00	1.94	**1.63**
V_3	1.64	2.27	2.16	1.92	1.44	**1.88**
Mean	**1.68**	**1.65**	**1.76**	**1.78**	**1.68**	

V X S Interaction

Varieties	**Storage period**				
	S_1	S_2	S_3	S_4	**Mean**
V_1	2.02	1.76	1.42	1.28	**1.62**
V_2	1.88	1.81	1.54	1.27	**1.63**
V_3	2.10	1.97	1.89	1.57	**1.88**
Mean	**2.00**	**1.84**	**1.62**	**1.38**	

T X S Interaction

Treatments	**Storage period**				
	S_1	S_2	S_3	S_4	**Mean**
T_1	2.02	1.85	1.60	1.27	**1.68**
T_2	1.88	1.76	1.61	1.33	**1.65**
T_3	2.01	1.80	1.74	1.47	**1.76**
T_4	2.06	2.00	1.62	1.42	**1.78**
T_5	2.02	1.81	1.52	1.38	**1.68**
Mean	**2.00**	**1.84**	**1.62**	**1.38**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min

Table 6: Effect of varieties and different treatments on titratable acidity (%) of banana flour during storage

V X T X S Interaction

Treatments (T)	Varieties (V)	Storage period (S)				
		0th day (S_1)	30th day (S_2)	60th day (S_3)	90th day (S_4)	**Mean T × V**
T_1	Grand Naine (V_1)	0.22	0.19	0.12	0.06	**0.15**
T_2		0.20	0.18	0.11	0.08	**0.14**
T_3		0.14	0.11	0.08	0.05	**0.10**
T_4		0.21	0.18	0.14	0.13	**0.16**
T_5		0.17	0.16	0.13	0.10	**0.14**
T_1	Monthan (V_2)	0.18	0.12	0.08	0.06	**0.11**
T_2		0.19	0.15	0.12	0.10	**0.14**
T_3		0.21	0.16	0.12	0.09	**0.15**
T_4		0.24	0.22	0.19	0.14	**0.20**
T_5		0.23	0.19	0.16	0.14	**0.18**
T_1	Karpura chakkerakeli (V_3)	0.16	0.12	0.11	0.08	**0.12**
T_2		0.20	0.17	0.15	0.09	**0.15**
T_3		0.14	0.11	0.09	0.07	**0.11**
T_4		0.22	0.20	0.18	0.13	**0.18**
T_5		0.21	0.18	0.16	0.10	**0.16**
Mean		**0.19**	**0.16**	**0.13**	**0.09**	

V X T Interaction

Varieties	Treatments					
	T_1	T_2	T_3	T_4	T_5	**Mean**
V_1	0.15	0.14	0.10	0.16	0.14	**0.14**
V_2	0.11	0.14	0.15	**0.20**	0.18	**0.15**
V_3	0.12	0.15	0.11	0.18	0.16	**0.14**
Mean	**0.13**	**0.14**	**0.12**	**0.18**	**0.16**	

T X S Interaction

Treatments	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
T_1	0.19	0.15	0.10	0.07	**0.13**
T_2	0.20	0.16	0.13	0.09	**0.14**
T_3	0.17	0.13	0.10	0.07	**0.12**
T_4	0.22	0.20	0.17	0.13	**0.18**
T_5	0.21	0.18	0.15	0.11	**0.16**
Mean	**0.19**	**0.16**	**0.13**	**0.09**	

V X S Interaction

Varieties	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
V_1	0.19	0.17	0.12	0.08	**0.14**
V_2	0.21	0.17	0.14	0.11	**0.15**
V_3	0.19	0.16	0.14	0.09	**0.14**
Mean	**0.19**	**0.16**	**0.13**	**0.09**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min

Table 7: Effect of varieties and different treatments on overall acceptability of banana flour during storage

V X T X S Interaction

Treatments (T)	Varieties (V)	Storage period (S)				
		0th day (S_1)	30th day (S_2)	60th day (S_3)	90th day (S_4)	**Mean T × V**
T_1	Grand Naine (V_1)	3.45	3.23	2.73	2.41	**2.95**
T_2		4.75	4.57	4.23	4.16	**4.43**
T_3		4.56	4.25	3.98	3.84	**4.16**
T_4		4.36	3.93	3.70	3.63	**3.90**
T_5		4.23	3.80	3.62	3.30	**3.73**
T_1	Monthan (V_2)	3.30	2.70	2.40	2.07	**2.61**
T_2		4.40	4.10	3.78	3.63	**3.98**
T_3		4.24	3.85	3.60	3.41	**3.77**
T_4		4.13	3.86	3.73	3.58	**3.82**
T_5		3.90	3.74	3.56	3.33	**3.63**
T_1	Karpura chakkerakeli (V_3)	3.60	3.40	3.03	2.80	**3.20**
T_2		4.95	4.66	4.43	4.08	**4.53**
T_3		4.68	4.45	3.90	3.25	**4.07**
T_4		4.48	4.30	4.13	3.73	**4.16**
T_5		4.35	4.13	3.73	3.06	**3.82**
Mean		**4.22**	**3.93**	**3.63**	**3.35**	

V X T Interaction

Varieties	Treatments					
	T_1	T_2	T_3	T_4	T_5	**Mean**
V_1	2.95	4.43	4.16	3.90	3.73	**3.84**
V_2	2.61	3.98	3.77	3.82	3.63	**3.56**
V_3	3.20	4.53	4.07	4.16	3.82	**3.96**
Mean	**2.92**	**4.31**	**4.00**	**3.96**	**3.73**	

T X S Interaction

Treatments	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
T_1	3.45	3.11	2.72	2.42	**2.92**
T_2	4.70	4.44	4.15	3.96	**4.31**
T_3	4.49	4.18	3.82	3.50	**4.00**
T_4	4.32	4.03	3.85	3.65	**3.96**
T_5	4.16	3.89	3.63	3.23	**3.73**
Mean	**4.22**	**3.93**	**3.63**	**3.35**	

V X S Interaction

Varieties	Storage period				
	S_1	S_2	S_3	S_4	**Mean**
V_1	4.27	3.95	3.65	3.47	**3.84**
V_2	3.99	3.65	3.41	3.20	**3.56**
V_3	4.41	4.19	3.84	3.38	**3.96**
Mean	**4.22**	**3.93**	**3.63**	**3.35**	

T_1: Blanching at 60 ^{O}C for 5 min, T_2: 0.5% KMS for 5 min, T_3: 0.5% KMS + 0.5% $CaCl_2$ for 5 min, T_4: 0.2% Ascorbic acid for 5 min, T_5: 0.2% Ascorbic acid+ 0.5% $CaCl_2$ for 5 min

CONCLUSION

The results suggest that there is unexplored potential to convert surplus green bananas into flour and put to various uses. Karpura Chakkerakeli variety with KMS at 0.5% was acceptable throughout the 90 days of storage period at ambient temperature recorded appreciable levels of moisture, sugars, as well as showed highest overall acceptability. Further research is necessary to investigate the other chemical properties like protein, starch, fibre, fat, minerals of green banana flour, before it can be substituted in food preparations.

REFERENCES

Dabhade, R.S., & Khedkar, D.M. (1980). Studies on drying and dehydration of raw mangoes for preparation of mango powder (Amchur) part VI. Changes in chemical constituents of raw mango powder during storage. *Indian Food packer*. *34*(3), 48-50.

Evelin, M.A, Jacob, J.P., & Vijayanand, D. (2007). Packaging and storage studies on spray dried ripe banana powder under ambient condition. *Journal of Food Science and Technology. 44*(1), 16-21.

Hussain, S., Rehman, M. S., Randhawa, A., & Iqbal, M. (2003). Studies on physico-chemical, microbiological and sensory evaluation of mango pulp storage with chemical preservatives . *Journal of Research (Science). 14*(1), 01-09.

Karthiayani, A., & Devdas, C. T. (2005). Biochemical changes in canned banana slices during storage. *Indian Food Packer 59*(6), 169-171.

MuraliKrishna, M., Najundaswamy, A.M, Siddappa, G.S. (1969). Guava powder-preparation, packaging and storage studies. *Journal of Food Science and Technology*. *6*, 93–98.

Mandalik, G.B, Naik, A.G, Arbat, S.S., & Mhetre, D.A. (2009). Nutritional Changes in Banana (Musa paradisiaca L.) flour during storage. *Indian Food Packer. 63*(3), 56 – 59.

Prajapati, V.K, Nema, P.K., & Rathore, S.S. (2011). Effect of pretreatment and drying methods on quality of value added dried aonla (*Emblica officinalis*) shreds. *Indian Food Packer*. *48*(1), 45-52.

Ramcharan, C., & George, C. (1999). Growing banana and plantain in Virgin Islands. Farmers Bulletins No. *11*, 13-14.

Ranganna, S., (1986). Handbook of analysis and quality control for the fruit and vegetable product. Tata McGraw Hill Publishing Company, New Delhi: 623-24.

Raleng, A., Manikantan, M.R., Mishra, A.A. (2016). Effect of Packaging Materials on Storage Stability of Protein rich flour from de oiled Sesame cake. *International Journal of Food Fermentation Technology. 6*(1), 103-110.

Roy, S.K., & Singh, R.N. (1979). Studies on utilization of bael fruit (*Aegle marmelos*) for processing. *Indian food packer*. *31*, 9-14.

Sakhale, B.K., Pawar, V.N., Ranveer, R.C. (2012). Studies on effect of chemical preservatives on keeping quality of kesar mango pulp. *1*, 184.

Teotia, M.S., Manan, J.K., & saxena, A.K. (1987). Green mango processing. A review. *Indian Food packer. 41*(6), 75-85.

Vaghani, S.N., Chundawat, B.S. (1986). Sundrying of sapota (*Achras sapota* L.) fruits. *Indian food packer 40*(2), 23-28.