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Influence of Storage Life on Nutritional Quality of Banana Flour Made from Three Varieties

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ABSTRACT

A study was conducted to find out the nutritional quality of banana flour made from three varieties viz.,Grand Naine (AAA), Monthan (ABB), Karpura Chakkerakeli (AAB) which were pre-treated with different pretreatments such as 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% using Factorial Completely Randomized Block Design (FCRD). The nutritional parameters (Crude protein, Crude fiber, Calcium and Potassium) of the flours prepared from three varieties were recorded during storage period of 90 days at 30 days intervals. Crude Protein content of banana florwas the highest in cv Grand Naine (24.68 mg) while crude fiber content was the highest in Karpura Chakkerakeli (3.34%). The highest calcium content was observed in cv Karpura Chakkerakeli (25.73 mg) and the highest potassium content was observed in Grand Naine (240.21 mg).

Keywords Banana varieties, Banana flour, Nutritional studies.

INTRODUCTION

In India, banana is (appropriately) also referred as 'Kalpatharu', by virtue of its multiple uses. It is one of the rare fruits which contain ample proportion of nutritive constituents which are easily digestible and available at reasonable cost. In view of its nutritive value, it is considered as Poor Man's Apple as it is cheaper than any other fruits in the country. Banana is easy to digest, low in fat and cholesterol.

According to Ramcharan and George (1999) the role of banana and plantain is becoming more important with the increasing emphasis today on diets that are low in sodium but high in potassium and vitamins. Both banana and plantains are good source of potassium, vitamin A, vitamin C, vitamin B_6 and low in sodium. Bananas contribute about 2.7% of the total potassium and fiber consumed by the average adult. The green bananas are peeled, sliced and then either dehydrated, fried, cooked or boiled before consumption. Whole green fruits can also be dried and ground into flour. The use of green banana in the production of gluten-free food could help improving nutritional, sensorial and technological quality of

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Table 1. Effect of varieties and different treatments on crude protein content (mg) of banana flour during storage. 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. V×T×S Inter action, V×T Interaction, V×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)	31.71	26.65	24.69	21.56	26.15
T_2		32.81	32.53	29.19	27.13	30.41
T_3		26.23	23.97	20.59	19.62	22.60
T_4		24.27	23.30	20.08	17.47	21.28
T_5		25.85	22.64	22.48	20.84	22.95
T_1	Monthan (V_2)	25.46	23.16	21.57	16.77	21.74
T_2		26.59	24.46	22.12	18.61	22.94
T_3		30.17	26.89	24.15	22.61	25.96
T_4		29.08	25.21	23.18	19.98	24.36
T_5		25.80	22.47	20.29	19.41	21.99
T_1	Karpura	23.88	21.39	19.81	17.07	20.54
T_2	Chakkerakeli	26.89	23.94	19.95	18.24	22.26
T_3	(V_3)	25.52	22.78	20.15	18.90	21.84
T_4		23.26	20.58	18.53	17.98	20.09
T_5		25.20	21.96	20.32	18.49	21.49
	Mean	26.85	24.13	21.80	19.64	

Table 1. Continued.

Varieties	Treatments T_1	T_2	T_3	T_4	T_5	Mean
V_1	26.15	30.41	22.60	21.28	22.95	24.68
V_2	21.74	22.94	25.96	24.36	21.99	23.40
V_3	20.54	22.26	21.84	20.09	21.49	21.24
Mean	22.81	25.20	23.47	21.91	22.14	

Table 1. Continued.

Treatments	Storage period S_1	S_2	S_3	S_4	Mean
T_1	27.01	23.73	22.02	18.47	22.81
T_2	28.76	26.98	23.75	21.32	25.20
T_3	27.31	24.55	21.63	20.38	23.47
T_4	25.54	23.03	20.59	18.47	21.91
T_5	25.61	22.36	21.03	19.58	22.14
Mean	26.85	24.13	21.80	19.64	

Table 1. Continued.

Varieties	Storage period S_1	S_2	S_3	S_4	Mean
V_1	28.18	25.82	23.40	21.32	24.68
V_2	27.42	24.44	22.26	19.47	23.40
V_3	24.95	22.13	19.75	18.14	21.24
Mean	26.85	24.13	21.80	19.64	

Table 1. Continued.

	V	T	S	V×T	V×S	T×S	V× T×S
SE(m)	0.35	0.45	0.40	0.79	0.70	0.91	1.58
CD at 5%	0.99	1.27	1.14	2.21	NS	NS	NS

these products, as well as providing more accessible products with a lower cost to the intended public (Zandonadi *et al.* 2012). The aim of this study is to prepare banana flour from different varieties and to study their nutritional quality.

MATERIALS AND METHODS

Raw materials

Mature fruits of banana varieties viz., Grand Naine, Monthan and Karpura Chakkerakeli were peeled, cut into slices and blanched or pre-treated with 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 the study. The statistical design used is completely randomized Block Design with factorial concept.

Preparation of banana flour

Fresh mature fruits were peeled manually and cut

Table 2. Effect of varieties and different treatments on crude fiber content (%) of banana flour during storage. 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. V×T×S Interaction, V×T Interaction, T×S Interaction, V×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)	3.71	3.60	3.15	2.60	3.26
T_2		3.84	3.46	3.16	2.79	3.31
T_3		3.65	3.52	3.31	3.10	3.40
T_4		3.72	3.63	3.07	2.85	3.31
T_5		3.86	3.40	3.20	2.97	3.36
T_1	Monthan (V_2)	3.53	3.36	2.63	2.52	3.01
T_2		3.61	3.17	2.92	2.80	3.12
T_3		3.55	3.11	2.97	2.64	3.07
T_4		3.54	3.21	2.65	2.46	2.96
T_5		3.44	3.06	2.65	2.55	2.92
T_1	Karpura	3.80	3.24	2.91	2.72	3.17
T_2	Chakkerakeli	3.97	3.88	3.64	3.03	3.63
T_3	(V_3)	3.85	3.18	2.80	2.63	3.12
T_4		3.88	3.72	3.05	2.76	3.35
T_5		3.94	3.78	3.24	2.87	3.45
Mean		3.72	3.42	3.02	2.75	

Table 2. Continued.

Varieties	Treatments T_1	T_2	T_3	T_4	T_5	Mean
V_1	3.26	3.31	3.40	3.31	3.36	3.333
V_2	3.01	3.12	3.07	2.96	2.92	3.022
V_3	3.17	3.63	3.12	3.35	3.45	3.348
Mean	3.15	3.35	3.19	3.21	3.24	

Table 2. Continued.

Varieties	Storage period S_1	S_2	S_3	S_4	Mean
V_1	3.75	3.52	3.18	2.86	3.33
V_2	3.53	3.18	2.76	2.59	3.02
V_3	3.89	3.56	3.13	2.80	3.34
Mean	3.72	3.42	3.02	2.75	

Table 2. Continued.

Treatments	Storage period S_1	S_2	S_3	S_4	Mean
T_1	3.68	3.40	2.89	2.61	3.15
T_2	3.81	3.50	3.24	2.87	3.35
T_3	3.68	3.27	3.03	2.79	3.19
T_4	3.71	3.52	2.92	2.69	3.21
T_5	3.74	3.41	3.03	2.79	3.24
Mean	3.72	3.42	3.02	2.75	

Table 2. Continued.

	V	T	S	V×T	V×S	T×S	V× T×S
SE(m)	0.05	0.07	0.06	0.12	0.10	0.14	0.23
CD at 5%	0.15	NS	0.17	NS	NS	NS	NS

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 packed in LDPE bags for subsequent use.

Determination of proximate composition

Protein, calcium and potassium content in banana flour was estimated as per the method suggested by Sadasivam and Manickam (2008). The fiber content was estimated using the procedure described in

Table 3. Effect of varieties and different treatments on calcium content (mg) of banana flour during storage. 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. V×T×S Interaction, V×T Interaction, T×S Interaction, V×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)	21.93	18.03	16.80	12.73	17.37
T_2		23.63	19.96	18.16	15.86	19.40
T_3		27.90	23.30	21.63	19.23	23.01
T_4		26.46	24.86	22.53	18.16	23.00
T_5		28.63	25.90	23.60	18.96	24.27
T_1	Monthan (V_2)	17.70	15.26	13.33	12.48	14.69
T_2		19.60	16.03	14.75	12.38	15.69
T_3		22.60	19.43	16.53	14.10	18.16
T_4		18.06	16.86	15.00	13.50	15.86
T_5		24.26	20.93	19.26	17.40	20.46
T_1	Karpura	26.93	21.60	20.36	19.26	22.04
T_2	Chakkerakeli	30.36	28.60	24.76	22.70	26.60
T_3	(V_3)	32.30	29.20	25.40	23.06	27.49
T_4		29.26	26.70	21.73	18.76	24.11
T_5		33.76	28.13	27.16	24.56	28.40
Mean		25.56	22.32	20.07	17.54	

Table 3. Continued.

Varieties	Treatments T_1	T_2	T_3	T_4	T_5	Mean
V_1	17.37	19.40	23.01	23.00	24.27	21.41
V_2	14.69	15.69	18.16	15.86	20.46	16.97
V_3	22.04	26.60	27.49	24.11	28.40	25.73
Mean	18.03	20.57	22.89	20.99	24.38	

Table 3. Continued.

Treatments	Storage period S_1	S_2	S_3	S_4	Mean
T_1	22.18	18.30	16.83	14.82	18.03
T_2	24.53	21.53	19.23	16.98	20.57
T_3	27.60	23.97	21.18	18.80	22.89
T_4	24.60	22.81	19.75	16.81	20.99
T_5	28.88	24.98	23.34	20.31	24.38
Mean	25.56	22.32	20.07	17.54	

Table 3. Continued.

Varieties	Storage period S_1	S_2	S_3	S_4	Mean
V_1	25.71	22.41	20.54	16.99	21.41
V_2	20.44	17.70	15.77	13.97	16.97
V_3	30.52	26.84	23.88	21.67	25.73
Mean	25.56	22.32	20.07	17.54	

Table 3. Continued.

	V	T	S	V×T	V×S	T×S	V× T×S
SE(m)	0.53	0.69	0.61	1.19	1.06	1.37	2.37
CD at 5%	1.49	1.92	1.72	NS	NS	NS	NS

AOAC (1965).

Statistical analysis : Which software you used or which method you used mention it.

RESULTS AND DISCUSSION

The data pertaining to crude protein content of flour was presented in Table 1. Highest protein content (24.68 mg) was recorded in cv Grand Naine while lowest protein content (21.24 mg) was recorded in cv Karpura Chakkerakeli.

Among the different treatments the flour obtained from slices treated with KMS at 0.5% highest crude protein content (25.20 mg) and lowest crude protein

Table 4. Effect of varieties and different treatments on potassium content (mg) of banana flour during storage. 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. V × T × S Interaction, T×S Interaction. V×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)	206.60	189.40	178.63	167.37	185.5
T_2		282.17	277.30	256.10	240.40	263.99
T_3		330.33	325.20	313.60	228.33	299.37
T_4		241.90	238.23	231.77	226.80	234.68
T_5		226.23	222.93	214.80	206.00	217.49
T_1	Monthan (V_2)	194.87	175.40	167.37	164.73	175.59
T_2		222.32	210.33	205.37	192.93	207.74
T_3		200.87	196.40	184.87	178.77	190.23
T_4		285.58	282.43	266.77	262.33	274.28
T_5		261.00	240.10	237.80	227.03	241.48
T_1	Karpura	198.70	192.83	188.47	175.17	188.79
T_2	Chakkerakeli	277.57	256.20	249.93	245.00	257.18
T_3	(V_3)	252.57	237.34	230.13	225.33	236.34
T_4		208.10	197.83	182.77	176.87	191.39
T_5		313.67	296.00	287.33	271.67	292.17
Mean		246.83	235.86	226.38	212.58	

Table 4. Continued.

Varieties	Treatments T_1	T_2	T_3	T_4	T_5	Mean
V_1	185.50	263.99	299.37	234.68	217.49	240.21
V_2	175.59	207.74	190.23	274.28	241.48	217.86
V_3	188.79	257.18	236.34	191.39	292.17	233.17
Mean	183.29	242.97	241.98	233.45	250.38	

Table 4. Continued.

Varieties	Storage period S_1	S_2	S_3	S_4	Mean
V_1	257.45	250.61	238.98	213.78	240.21
V_2	232.93	220.93	212.43	205.16	217.86
V_3	250.12	236.04	227.73	218.81	233.17
Mean	246.83	235.86	226.38	212.58	

Table 4. Continued.

Treatments	Storage period S_1	S_2	S_3	S_4	Mean
T_1	200.06	185.88	178.16	169.09	183.29
T_2	260.68	247.94	237.13	226.11	242.97
T_3	261.26	252.98	242.87	210.81	241.98
T_4	245.19	239.50	227.10	222.00	233.45
T_5	266.97	253.01	246.65	234.90	250.38
Mean	246.83	235.86	226.38	212.58	

Table 4. Continued.

	V	T	S	V×T	V×S	T×S	V × T×S
SE(m)	3.16	4.08	3.65	7.06	6.32	8.16	14.13
CD at 5%	8.85	11.42	10.22	19.78	NS	NS	NS

content (21.91 mg) was recorded with ascorbic acid at 0.2% treatment. Crude protein content (26.85 mg) was high on 0th day of storage and minimum crude protein content (19.64 mg) was observed on 90th day of storage. The data revealed that crude protein content decreased gradually as the storage period progressed.

Decrease in crude protein content may be due to breakdown of peptide bonds and conversion into amino acids during processing (Najundaswamy 1989). The decreasing trend in protein through breakdown of protein into amino acids during processing were reported by Lal *et al.* (2004), Masood *et al*. (2005) in whole wheat flour and by Dipika *et al.* (2011) in soya flour.

The data regarding crude fiber content of flour was presented in Table 2 which revealed significant differences among varieties and storage period and there was no significant difference among the interactions.

Highest crude fiber content (3.34%) was recorded in cv Karpura Chakkerakeli variety while lowest crude fiber content was recorded in Monthan (3.02%). Maximum crude fiber content (3.72%) was observed on 0th day of storage and minimum crude fiber content (2.75%) was found on 90th day of storage. The data revealed that crude fiber content decreased slightly over the storage period. The decrease in fiber content might be due to higher temperature in processing which degrades pectic and cellulose substances. These degradation of fiber into pectic and cellulose substances were also reported by Butt *et al*. (2004).

The analyzed data regarding calcium content of flour was presented in Table 3 which revealed there was a significant difference among varieties, treatments and storage period while no significant difference among the interactions.

Highest calcium content (25.73 mg) was recorded in cv Karpura Chakkerakeli while lowest calcium content (16.97 mg) was recorded in cv Monthan.

Among the different treatments, the flour obtained from slices treated with ascorbic acid at 0.2% and calcium chloride at 0.5% treatment recorded highest calcium content (24.38 mg) and lowest calcium content was recorded in blanching treatment (18.05 mg).Calcium content (25.56 mg) was high on 0th day of storage and calcium content (17.54 mg) was low in 90th day of storage. The data revealed that calcium content decreased slightly over the storage period. Similar decreasing trend in calcium was observed by Ukhun and Ukpebor (1999) in plantain flour during storage.

The data pertaining to potassium content of flour was presented in Table 4 which revealed significant differences among varieties, treatments and storage period while there was no significant difference among interaction. Highest potassium content (240.21 mg) was recorded in cv Grand Naine while lowest potassium content (217.86 mg) was recorded in cv Monthan.

Among the different treatments, the flour obtained from slices treated with ascorbic acid at 0.2% and calcium chloride at 0.5% treatment recorded highest potassium content (250.38 mg) and lowest potassium content was recorded with blanching treatment (183.29 mg).

Maximum potassium content (246.83 mg) was found on 0th day of storage and minimum potassium content (212.58 mg) was found on 90th day of storage. The data revealed that potassium content decreased slightly over the storage period. Decrease in potassium content during storage was also observed by Ukhun and Ukpebor (1991) in plantain flour during storage.

CONCLUSION

The results suggested that quality parameters were easily discerned and maintained even after three months of storage. Banana flour can be potentially used for incorporation and fortification into different products while preparation of banana flour could increase the utilization of the fruit with reduction in post-harvest losses which would be of great significance to growers and consumers. Further research is necessary to develop different value added products from the banana flour.

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