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VALUE ADDITION TO BITTERGOURD (*MOMORDICA CHARANTIA*) BY PREPARING A LOW BITTERNESS SPREAD

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ABSTRACT

A study was conducted to find a suitable processing method to make low bitterness bitter gourd spread. Better gourd variety Thinnawelli was selected to prepare the product considering the availability and consumer preference. Bitter gourd was sliced and blanched in water for two minutes. These were blended thoroughly and paste was prepared. Prepared bitter gourd paste was mixed with 0%, 20%, 40% and 60% tomato paste separately and bottled .Sensory evaluation data revealed that bitter gourd spread consisting 40% tomato paste which had good appearance was highly accepted by consumers. This product had 90.7%mosture, 6.3 total soluble solids (TSS), 4.4 pH and orange in colour. Thus this ratio was selected to make a low bitterness spread. Five pre-treatment experiments were carried out to reduce the bitterness in pre prepared bitter gourd spread. Each treatment consisted washing bitter gourd slices in different liquids for 10 minutes and blanching slices for 2 minutes. Conducted treatments were water wash followed by hot water blanching, water wash followed by 2% brine blanch,2% brine wash followed by 2% brine blanch, coconut water wash followed by 2% brine blanch, 2% brine in coconut water washed followed by 2% brine blanch .These treated samples were used to prepare bitter gourd spread. Physico-chemical properties were determined in all samples one month intervals up to three months. Sensory evaluation and micro biological test were carried out after three months for all five samples. Within the samples pH and ascorbic acid content were declined during the storage while TSS and total acidity were increased. There were no product colour changes observed in all samples after one month of storage. Least number of colonies was observed in bitter gourd slices washed in 2% brine and blanched in 2%brine solution. Sensory data revealed that bitter gourd spread prepared by 2%brine washed and 2%brine blanched had lowest bitterness and highly accepted by consumers. Thus 2% brine washing and 2% brine blanching can be recommended as the best pre-treatment to get low bitterness bitter gourd spread by mixing with 40% tomato paste

KEYWORDS: Blanching, Bitter gourd, Bitterness, Physico-chemical, Pre-treatments, Tomato, Sensory, spread.

INTRODUCTION

Bitter gourd (*Momordica charantia* Linn.) is a nutritionally and commercially valuable vegetable due to its culinary taste and therapeutic value (Wickramanayake, 1998). The Fruit is a good source of iron, calcium, phosphorus and vitamin B (Jayasinghe, 1999). Bitterness in the bitter gourd is attributed to the non-toxic alkaloid

momordicine and also fruit contains the hypo-glycemic principle charantia (Siemonsma *et al.*, 1993). In Sri Lanka bitter gourd is grown from sea level up to about 1,200 m on elevation. It is cultivated in low country and mid country during both *yala* and *maha* seasons. Thinnawelli white, MC-43 and Matale Green are the recommended bitter gourd varieties by the Department of Agriculture, Sri Lanka. In the world bitter gourd products have been developed, such as canned products backed or stuffed products with meat, pickles, dehydrated bitter gourd, herbal drink and capsules filled with powder are some of them (Siemonsa, 1993). Though the bitter gourd is a nutritionally valued vegetable consumers reluctant to utilize this valuable vegetable due to its bitterness. Development of low bitterness, bitter gourd spread is impotent to upgrade the commercial value of raw bitter gourd and improve the consumer preference. Therefore, the study was undertaken to develop a low bitterness bitter gourd product.

MATERIAL AND METHODS

Physico-chemical properties such as fruit size, shape, colour of peel, fruit weight, moisture content, pH, total soluble solids (TSS), ascorbic acid content (Rangana, 1986) of Thinnawelli white, G -1 bitter gourd varieties were determined. Thinnawelli white bitter gourd verity was selected for this study considering higher market availability and the consumer preference.

Determination of optimum blanching time

Fresh bitter gourd fruit was washed and cut into slices and blanched in different time intervals. Optimum blanching time for the Thinnawelli variety and G-1 variety was determined by conducting catalase and peroxidase test. From the results of the above tests it was noticed that optimum blanching time was two minutes for the Thinnawelli verity.

Preparation of tomato mixed bitter gourd spread.

Tomatos mixed bitter gourd spreads were prepared by incorporating 0%, 20%, 40%, 60% (Wt/Wt), tomato paste with bitter gourd paste. These were bottled and kept for evaluation.

Determination of the best ratio of tomato paste

Sensory evolution test using Hedonic scale (Rangana,1986) was conducted for bottled tomato mixed bitter gourd spreads to find out best proportion of tomato paste, to be added to the bitter gourd paste. TSS, pH, moisture content were determined for tomato

paste mixed products. Preliminary sensory study showed that bitter gourd spread prepared using 40% tomato paste was highly accepted by the panellists. This ratio was selected to prepare low bitterness bitter gourd spread.

Determination of the best pre-treatment to prepare the low bitterness bitter gourd spread.

Different washing and blanching pre-treatments were conducted to reduce bitterness of raw bitter gourd prior to prepare bitter gourd spread. Bitter gourd slices were subjected to water wash followed by hot water blanching, water wash followed by 2% brine solution blanching, 2% brine wash followed by 2% brine blanching, coconut water wash followed by 2% brine blanching and 2% brine in coconut water wash followed by 2% brine blanching.

Forty percent tomato mixed bitter gourd spreads were prepared using differently washing and blanching treated slices and were bottled. Physico-chemical properties such as ascorbic acid content, pH, moisture content, TSS, colour of the products were checked in all prepared samples, every one month interval for three months. Microbial colony count was conducted after one month and three months of storage. Sensory evolution test using a Hedonic scale was conducted after three month of storage to find out the best pre-treatment to reduce bitterness of bitter gourd spread.

RESULT AND DISCUSSION

Bitter gourd variety Thinnawelli White had high amount of ascorbic acid content when compared to variety G-1 (Table 1).

Table 1. Physico-chemical properties of bitter gourd verities Thinnawelli white and G-1.

Verity	Fruit size	Shape	Color	Fruit weight (g)	Moisture content (%) (wb)	pH	TSS	Ascorbic acid (mg /100 g)
Thinnawelli White	Large to medium	Oblong	Whitish Green	181.6	92.2	5.7	4.1	70.93
G -1	Large to medium	Cylindr -ical	Dark green	165.0	93.8	4.8	4.2	63.29

Optimum blanching time

Catalase and Peroxidase tests conducted to Thinnawelli white and G-1 variety confirmed that two minutes blanching was sufficient to inactivate catalase and peroxidase enzymes for Thinnaweli White variety (Table 2).

Table 2. Catalyze and peroxides enzymes tests for Thinnawelli white and G-1 variety.

Verity	Enzymes	Blanching Time Minutes			
		1	2	3	4
Thinnaweli white	Catalase	+	-	-	-
	Peroxidase	+	-	-	-
G-1	Catalase	+	+	-	-
	Peroxidase	+	-	-	-

Note: + and – represent presence and absence of enzymes, respectively.

Catalase is the most heat resistant enzyme, therefore blanching time depends on the inactivation of catalaze enzyme. When both catalase and peroxidase enzyme are inactivated, it is the optimum blanching time for a given vegetable. Therefore, optimum blanching time for the Thinnawelli white variety was two minutes in boiling water. G-1 variety had higher blanching time period.

Percentage of tomato paste to be added to bitter gourd paste to improve colour

Physico-chemical properties of various proportions of tomato mixed bitter gourd pastes are given Table 3.

Table 3: Physico Chemical properties of Tomato mixed Bitter Gourd paste.

Treatment Tomato : bitter gourd	MC (%)	pH	TSS (%)	Colour of products. Ref. RHS colour chart.
T_1 (0:100)	91.6 ^{a}	5.35 ^{a}	4.6 ^{d}	Yellow Green Group 145-C
T_2 (20:80)	90.9 ^{b}	4.50 ^{b}	5.9 ^{c}	Yellow Orange Group 22-B
T_3 (40:60)	90.7 ^{bc}	4.47 ^{b}	6.3 ^{b}	Orange Group 25-C
T_4 (60:40)	90.3 ^{c}	4.42 ^{c}	8.0 ^{a}	Orange Red Group 34-C

Note: Means in each column with different letters are significantly different at p=0.05 probability.
T_1(100% bitter gourd paste), T_2 (20% tomato: 80% bitter gourd) , T_3 (40% tomato: 60% bitter gourd), T_4 (60% tomato: 40% bitter gourd)

According to the Table 3, it is observed that pH value of the prepared products was decrease with the addition of more tomato paste. It may be due to the lesser quantity of citric acid in bitter gourd compared to citric acid quantity of tomatoes. TSS content

was increased in all products when tomato paste quantity was increased. The gradual decrease of moisture content in T_1 to T_4 samples may be due to the decreased level of bitter gourd paste added into the spread. There was a visual difference among products colour as shown in Table 3.

Sensory data on Table 4 shows that there was a significant difference among four treatments in taste, colour and overall accessibility in all treatments but there was no significant difference among mouth feel in all four treatments at the 5% probability level. The highest sum of rank for taste and overall accessibility was recorded in T_3 (40 tomato: 60 bitter gourd), where as lowest sum of rank for taste and overall accessibility was recorded in T_1 (0 tomato: 100 bitter gourd). It was found that by analyzing all results, 40% tomato paste should be added to prepare bitter gourd spread to get acceptable product. This ratio was used to prepare low bitterness bitter gourd spread.

Table 4. Sum of ranks of the sensory evaluation data of tomato mixed bitter gourd spread.

Sensory character	T_1 (T0:B100)	T_2 (T20:B80)	T_3 (T40:B60)	T_4 (T60: B40)	Probability
Taste	10.5	26.5	38.5	24.5	P=0.000
Color	17.0	18.5	27.5	37.0	P=0.000
Mouth feel	26.5	28.0	25.5	20.0	P=0.385
Overall accessibility	11.0	21.5	37.5	3.0	P=0.000

Note: T= Tomato paste; B= Bitter gourd paste.

Best pre-treatment to reduce bitterness

Prior to preparation of bitter gourd spread slices of bitter gourd were subjected to different washing and blanching treatment to reduce bitterness. Physico-chemical properties of prepared stored bitter gourd spreads using different pre-treatments is shown in Table 5. It was observed that pH value decreased in all samples during storage. This may be due to the chemical reaction occurring in the prepared bitter gourd spreads during storage. Lower pH value and higher acidity help to increase the TSS content in prepared bitter gourd spread during storage (Askar and Treptow, 1993). Ascorbic acid content in all prepared samples was decreased during storage. Bitter gourd contains higher amount of ascorbic acid. Ascorbic acid mainly destroyed by the oxidation especially in high temperature, processing and storage, reacting with metal catalyst and presence of oxygen. During oxidation of ascorbic acid it is converted to dehydroascorbic acid (Klra *et al.*, 1988).

Table 5. Physico chemical properties of the pre-treated bitter gourd spreads during storage.

Treatment	pH			TSS			Ascorbic acid g per 100g			Color Ref RHS color chart			
	1	2	3	1	2	3	1	2	3	Initial	1	2	3
		Months			Months		Months				Months		
T1	5.10^{abs}	4.70^{cd}	6.68^{d}	5.7^{ni}	5.8^{i}	5.9^{gh}	45.47e	40.91k	38.56p	OG25-B	OG25-C	OG25-C	OG25-C
T2	5.18^{a}	4.59^{cd}	4.56^{d}	6.1^{et}	6.1^{et}	6.0^{tg}	43.23i	41.79i	39.12o	OG25-C	OG25-C	OG25-C	OG25-C
T3	5.12^{abc}	4.62^{d}	4.57^{d}	6.2^{de}	6.3^{cd}	6.6^{c}	43.91g	39.62l	38.42	OG25-C	OG25-C	OG25-C	OG25-C
T4	5.13^{ab}	4.63^{bcd}	4.59^{d}	6.1^{et}	6.2^{de}	6.5^{ab}	43.33h	39.26h	37.78s	OG25-C	OG25-C	OG25-C	OG25-C
T5	5.19^{abcd}	4.67^{d}	4.58^{d}	$6.0t^{g}$	6.2^{d}	6.4^{bc}	44.30j	39.45m	48.45g	OG25-C	OG25-C	OG25-C	OG25-C

Notes: Means in each column with the same letters are not significantly different.T1 = Water wash, Water blanch, T2 = Water wash,2% brine blanch, T3 = 2% brine wash, 2% brine blanch, T4 = Coconut water wash, 2%brine blanch, T5 = 2% brine in coconut water wash, 2% brine blanch, OG = Orange group

According to Table 5, it is noticed that colour of the products changed very significantly over the first month of storage and thereafter no colour changes were observed in the products. Added tomato paste is mainly responsible for the orange colour of the products.

Microbial colony counts

Observed microbial colony counts of the products were shown in Table 6. Lowest microbial colonies was presented in brine treated prepared products even after three month of storage. It may be due to the brine solution treatment prior to the spread preparation. Salt is an effective curing agent and suppress the growth of the microorganisms.

Table 6. Number of bacterial colonies per g on prepared products.

Treatment	Bacterial colonies (per g) during storage	
	1st month	3rd month
T_1	$1,050.1^{c}$	$2,319.9^{a}$
T_2	311.0^{e}	340.0^{d}
T_3	15.7^{h}	22.5^{g}
T_4	300.0^{f}	$1,420.0^{b}$
T_5	1.6^{i}	2.4^{i}

Note: Means in each column with the same letters are not significantly different.

T_1 = Water wash, Water blanch, T_2 = Water wash, 2% brine blanch, T_3 = 2% brine wash, 2% brine blanch, T_4 = Coconut water wash, 2% brine blanch, T_5 = 2% brine in coconut water wash, 2% brine blanch.

Sensory evaluation of pre treated bitter gourd spread

Summary of sensory evaluation data are presented in Table 7. The results of the sensory evaluation data show that there was a significant difference among five treatments in taste and overall accessibility. But there was no significant difference in colour and mouth feel among five treatments at 5% probability level. Taste and overall accessibility are the main sensory characters that were expected to be significantly different due to the different pre-treatment methods. Presented data shows that the taste and overall acceptability are significantly different in different pre-treatments at 5% probability level. T_3 got higher percentage sum of rank for taste and overall accessibility than other treatments. Colour and mouth feel did not show great variation among five treatments. This study shows that 2% brine wash and 2% brine blanching for two minutes reduce the bitterness of bitter gourd prior to preparation of 40% tomato paste mixed bitter gourd spread.

Table 7. Sum of rank of the pre-treated bitter gourd spread.

Sensory property	Treatments					
	T_1	T2	T3	T4	T5	Probability
Taste	50.5	76.0	125.5	103.0	95.0	P=0.000
Color	91.0	94.5	91.0	89.0	84.5	P=0.888
Mouth feel	85.5	80.5	91.5	99.0	93.5	P=0.383
Overall accessibility	51.5	82.0	131.0	78.0	107.5	P=0.000

CONCLUSIONS

This study shows that bitter gourd variety Thinnaweli white is better than hybrid G-1 to prepare value added products as it has lesser blanching time and higher and ascorbic acid content. To get better acceptability of the product 40% tomato paste should be incorporated to the bitter gourd paste. Washing in 2% brine solution for 10 minutes and blanching bitter gourd slices for 2 minutes in 2% brine solution is recommended to reduce the bitterness of bitter gourd prior to preparation of bitter gourd spread.

REFERENCES

Askar, A. and H. Trptow. (1993). Quality assurance in tropical fruit processing. Springer-Vrleg, Berlin, Heidelbery, New York. pp. 10-114.

Jayasingha, P. (1999). *Momordica charantia* literature survey. National Science Foundation Information Service Center, Industrial Technology Institute, Colombo. pp. 1-19.

Kalra, C.L., S.K. Berry and S.G. Kakkarini. (1988). The bitter gourd (*Momordica charantia* Linn.): a unique vegetable. Indian Food Packs, 42(2): 35-44.

Rangana, S. (1986). Hand book of analysis and quality control for fruit and vegetable products. Tata McGraw Hill Publishing Company Ltd, New Delhi, India.

Siemonsma, J.S. and H. Piluek. (1993). Plant resources of south-east Asia: vegetables. Paddock Scientific Publishes. pp. 206-210.

Wickramanayake, T.W. (1998). Diabetes mellitus in food and nutrition. Trumpet Publishes, Colombo, Sri Lanka. pp. 340-348.