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Nutritional Evaluation of Watermelon (*Citrullus lanatus*) Rind Petha for Its Sensory, Shelf-life and Consumer Acceptability

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ABSTRACT

Background: Petha is a translucent soft candy historically and geographically originated from Agra that is usually rectangular or cylindrical made from the ash gourd. With growing demand and innovation, more varieties of the original preparation are available in the market. Watermelon is most relished fruit and people just eat reddish pulpy portion and discard the rind. But watermelon rind is by product with good amounts of protein, fat, carbohydrates, crude fiber and ash.

Methods: The present study was carried out to develop petha from watermelon rind by osmotic dehydration with varied concentrations of Sugar *viz.,* 50°Brix (T_1), 60°Brix (T_2) and 70°Brix (T_3) and the sensory evaluation was carried out from initial to 45 days of storage at both room as well as refrigerated temperature and further evaluated microbial load, texture analysis and consumer acceptability of petha.

Result: Among the three variations T_2 was more acceptable than T_1 and T_3 after 45 days of sensory evaluation. The nutrient composition for the best accepted watermelon rind petha indicated low fat with adequate amount of crude fibre (0.6 g), carbohydrate (52.49 g), calcium (18.68 mg) and phosphorous (9.28 mg). Hence, it can be concluded that watermelon rinds can be better option for byproduct utilization for development of petha with good nutritional profile that is economical too.

Key words: Byproduct, Osmotic dehydration, Petha, Sensory evaluation, Watermelon rind.

INTRODUCTION

Watermelon belongs to the family of cucumber (*Cucurbitaceae*) with a large, oval, round or oblong shape. The Cultivation of watermelon has significantly increased beyond the traditionally confined river beds of the Yamuna, the Ganges and the Narmada in North and Kaveri, Krishna and Godavari in the South because of the increased demand of fresh watermelon and its juice both in the domestic as well as international markets (Aguiló-Aguayo *et al*., 2010). During hot and dry summer this fruit has preferred attraction of common man on an account of its cool-refreshing and pleasing taste and attractive red colour. Watermelon is an excellent source of vitamin C and a very good source of vitamin A and a significant amount of vitamin B_6 and vitamin B_1 and minerals like iron, potassium, magnesium and phosphorus. People consume reddish pulpy portion and discard the rind that is having good nutritional benefits. However, Watermelon rind has many health benefits due to the presence of important amino acid citrulline, fibre, minerals and phenolic compounds. Watermelon rind has protein, fat, carbohydrates, crude fiber and ash content decently (Koocheki *et al.,* 2007). Also, the nutrient composition of watermelon rind flour has protein 10.18 g, fat 2.37 g, crude fibre 17.44 g, ash 11.82 g, Calcium 254 mg and carbohydrates 46.02 g respectively (Ashoka S, 2019). Some work on utilization of watermelon peel in preparation of value-added products is done but there is scope for trying out some more products with this material (Bhatnagar *et al.,* 1991).

Recently, byproduct utilization has taken a boom focusing the use of fruit and vegetable waste to reduce environmental pollution. Taking this into account that these residues are important sources of polyphenols, agricultural and industrial residues are attractive sources of natural antioxidants and dietary fiber.

Petha is a translucent soft candy that is rectangular or cylindrical usually made from the ash gourd vegetable and are commercially utilized for manufacturing petha in Agra city of Uttar Pradesh and India has become a renowned business centre for production and processing of petha (Pandey *et al.,* 2014). With the growing demand of this Indian dessert, there are wide varieties of petha available including

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kesar and angoori petha. Based on the appearance, texture, nutritional and health benefits of watermelon rind, the present research study had been undertaken with the main objective to study the Processing and product development of watermelon (*Citrullus lanatus*) rind Petha and further to evaluate its acceptability via sensory attributes, shelf-life and Consumer acceptability.

MATERIALS AND METHODS

The present study on "Nutritional evaluation of watermelon (*Citrullus lanatus*) rind petha for its sensory, shelf-life and consumer acceptability" was carried out at Department of Food Science and Nutrition, University of Agricultural Sciences, Bangalore during the year 2019.

Selection and collection of samples

The fresh and matured watermelon fruits were procured from the local markets of Bengaluru, Karnataka, India.

Processing of watermelon to get watermelon rinds

The watermelon fruits were washed under running tap water and they were wiped using a clean dry cloth. All the watermelon fruits were peeled separately by using a peeler and the pulp was separated from watermelon rind by using a knife. The rind was cut into uniform slices.

Formulation of watermelon rind petha

Petha was formulated by using a watermelon rind slices that were again weighed to record the yield recovery of fresh slices for osmotic dehydration. Sugar syrup of three different concentrations *viz.* 50°, 60° and 70°Brix was prepared. The procedure for preparation is mentioned in Fig 1.

Organoleptic evaluation of the developed products

The products were subjected to sensory evaluation on a nine-point hedonic scale and the Sensory quality attributes, *viz.*, appearance, color, texture, flavor, taste and overall acceptability (Amerine *et al.,* 1965).

Storage study of watermelon rind petha

Storage study was conducted for the best accepted watermelon rind petha. It was prepared and stored in air tight glass jars at room and refrigerator conditions. The products were evaluated initially followed by 15th, 30th and 45th day for sensory and microbial analysis.The microbial analysis was carried out by standard plate count method using Eosin Methylene Blue Agar (EMBA) for coliforms, Nutrient Agar (NA) for bacteria, Martin's Rose Bengal Agar (MRBA) for fungi and YEPDA for yeast (Tate, 1995).

Analysis of Textural profile of watermelon rindpetha

Stable Micro System *TAXT plus* Texture Analyzer was used for texture profile analysis (TPA) of watermelon rind petha. TPA is the "two-bite" test, which includes the first and second compression cycles. The first and second compression cycles indicate the force vs. time data during the first and second compression of the product by the instrument probe (Kalyankar Chetan and Chandrakant, 2016) (Muhamad *et al*., 2015)

Consumer acceptability of watermelon rind petha

The consumer acceptability of watermelon rind petha was assessed by using the FACT scale Deepa Madalageri (2015) by the consumers (n=50) at UAS, Bengaluru.

Statistical analysis

The data was tabulated in excel sheets and subjected to analysis of variance (ANOVA) for testing the significance of variation in sensory evaluation of developed product by using the statistical tools as Statistical Package for Social Sciences (SPSS) version 12.0.

Nutritional composition

The nutrient composition for the best accepted products was computed (Longvah *et al.,* 2015).

RESULTS AND DISCUSSION

Sensory evaluation of watermelon rind petha on storage at room temperature

The sensory evaluation of watermelon rind petha stored at room temperature is presented in Table 1. Formulated

Cut the watermelon rind into uniform pieces and prick each piece with a fork all over

↓

Soak the pieces in lime stones or CaOH water (0.8%) up to 2 hours

↓

Drain the water and wash the pieces thoroughly under running tap water and boil the rinds for 15 minutes

↓

Add the boiled rind pieces to the sugar syrup of three different concentrations *viz*. 50, 60 and 70°Brix, add KMS and food colour and boil them again for 10-15 minutes till they become transparent (15-20 minutes)

↓

Keep the pieces overnight in the sugar syrup and adjust the brix everyday up to 3 days till brix level is constant

↓

Drain the pieces from sugar syrup on third day and allow them for drying

↓

After dehydration, watermelon rind pethas were packed

Fig 1: Procedure for preparation of watermelon rind petha.

watermelon rind petha was packed in glass jars and kept for storage study at room condition. Further petha was subjected to sensory evaluation on 0, 15th, 30th and 45th day intervals. It was observed that T_1 sample had scores of 7.28, 7.23, 7.28, 7.07, 7.45 and 7.38 for appearance, texture, colour, flavour, taste and overall acceptability respectively. Whereas T_2 and T_3 samples have scores ranging from 7.50-7.33 (appearance), 7.38-7.42 (texture), 7.38-7.11 (colour), 7.33-7.02 (flavour), 7.28-7.19 (taste) and 7.47-7.21 (overall acceptability) at the end of the 45th day. It was observed that T_2 was more acceptable than the other two variations after 45 days of sensory evaluation with a score of 7.47 for overall acceptability, which was found comparatively high than the other two variations. Hence, the results indicated that as the storage period increased sensory scores of the watermelon rind petha decreased. A statistically significant difference was found in sensory attributes of T_1, T_2 and T_3 sample from the initial day to 45th day of storage.

Sensory evaluation of watermelon rind petha on storage at refrigerated temperature

The results of mean sensory scores evaluation of watermelon rind petha from initial to 45 days of storage period were presented in Table 2. The decrease in sensory scores was observed from the initial to 45th day of evaluation with a gradual fall in sensory scores during the storage period. Statistically decrease in sensory scores was observed during storage of products, wherein T_1 had the appearance (7.38), texture (7.28), 7.35 (colour), 7.33 (flavour), 7.45 (taste) and 7.42 (overall acceptability). Whereas T_2 and T_3 had scores ranging from 7.56-7.47 (appearance), 7.42-7.52 (texture), 7.47-7.31 (color), 7.40-7.19 (flavour), 7.52-7.31 (taste) and 7.57-7.33 (overall acceptability). A highly significant difference was observed in petha prepared with watermelon rind. Among three variations T_2 had good sensory scores even at 45 days of storage *viz*, appearance (7.50), texture (7.42), colour (7.47), flavour (7.40), taste (7.52) and overall acceptability (7.57) when compared to the other two variations.

Microbial analysis of best accepted petha on storage

The microbial load of bacteria, yeast, fungi and *E. coli* for best accepted petha stored in glass jars at room temperature as well as refrigerator temperature is depicted in Table 3. The microbial profile was tested at the intervals of the initial, 15th day, 30th and 45th days after storage. Initially, the microbial count for bacteria was (2×10^6 cfu/g) whereas yeast, fungi and *E.coli* was nil at room and refrigerated temperature. As the storage days increased the bacteria, yeast and fungi counts were also increased. At the 45th day's interval, there was a significant increase in all the microbial counts whereas *E. coli* was found to be absent in all the intervals.

The bacteria, yeast and fungi population were (3.5×10^6 cfu/g), (3×10^2cfu/g) (3.5×10^3 cfu/g) and (3.5×10^6 cfu/g), (2×10^2cfu/g) and (2×10^3 cfu/g) both at room temperature as well as refrigerator temperature respectively on 45th day interval. The results revealed that the refrigerator temperature was found to be good for storage of petha when

Table 1: Sensory evaluation of watermelon rind petha at room temperature on storage.

Product	Duration	Appearance	Texture	Colour	Flavour	Taste	OA
T_1	Initial	8.25	8.04	8.13	8.07	8.09	8.27
	15th day	7.95	7.71	7.85	7.69	7.71	7.81
	30th day	7.66	7.42	7.47	7.42	7.59	7.50
	45th day	7.28	7.23	7.28	7.07	7.45	7.38
	F value	*	*	*	*	*	*
	SEm±	0.10	0.11	0.12	0.13	0.11	0.12
	CD at 5%	0.28	0.32	0.35	0.37	0.33	0.34
T_2	Initial	8.38	8.09	8.28	8.09	8.19	8.47
	15th day	8.02	7.92	7.92	7.61	7.89	8.03
	30th day	7.66	7.73	7.61	7.40	7.64	7.83
	45th day	7.50	7.38	7.38	7.33	7.28	7.47
	F value	*	*	*	*	*	*
	SEm±	0.12	0.16	0.13	0.12	0.14	0.12
	CD at 5%	0.34	0.47	0.36	0.35	0.40	0.33
T_3	Initial	8.09	8.04	7.81	7.76	7.90	8.04
	15th day	7.66	7.71	7.47	7.38	7.71	7.81
	30th day	7.35	7.61	7.35	7.19	7.33	7.47
	45th day	7.33	7.42	7.11	7.02	7.19	7.21
	F value	*	*	*	*	*	*
	SEm±	0.13	0.13	0.12	0.16	0.13	0.14
	CD at 5%	0.37	0.36	0.35	0.45	0.37	0.39

Note: T_1- 50°Brix, T_2- 60°Brix and T_3- 70°Brix.

OA: Overall acceptability, NS: Non significant, *- Significant.

compared to room temperature. However, consumption of petha is safe up to 45 days of storage especially when petha placed in a refrigerated condition.

The results were almost similar with the study of Deepa Madalageri (2015) wherein there was significantly higher bacterial count (2.50 cfu/g candy) when the candy was stored for 30 days compared to the initial (2.00 cfu/g candy) and 15 days (2.23 cfu/g candy). The *E.coli* was not detected in the candy stored in different packaging material and throughout the storage period.

The results of the present study were in par with the study of Pandey *et al.* (2014) where there had been increasing trend in bacterial (4.8-7.8 cfu/g), yeast (3.3-5.4 cfu/g) and moulds population (3.4-5.9 cfu/g) in crystallised petha. In Kashi petha, a significant increase in bacterial growth was found at last count as compared to the initial stage.

Texture profile analysis of watermelon rind petha

The texture profile analyzed by using a TAXT plus Texture Analyzer and the results were presented in Table 4. The watermelon rind petha was tested for textural analysis parameters such as Hardness, Adhesiveness, Springiness, Cohesiveness, Gumminess and Chewiness were analyzed for three variations *viz.*, T_1 (50°Brix), T_2 (60°Brix) and T_3 (70°Brix). Sample T_3 (70°Brix) showed higher hardness (g), adhesiveness (g.sec), springiness, cohesiveness, gumminess and chewiness, 17553.64 (g), -1.521 (g.sec), 0.066, 0.044, 560.957 and 29.304 respectively when compared to T_1 (50°Brix) and T_2 (60°Brix). The lowest values were found in T_1 (50°Brix). As the sugar concentration or brix increases, the textural properties like hardness, springiness, gumminess and chewiness were also increased.

Table 2: Sensory evaluation of watermelon rind petha at refrigerated condition on storage.

Product	Duration	Appearance	Texture	Colour	Flavour	Taste	OA
T_1	Initial	8.25	8.04	8.13	8.07	8.09	8.27
	15th day	8.02	7.85	7.90	7.71	7.83	7.92
	30th day	7.76	7.52	7.64	7.52	7.76	7.71
	45th day	7.38	7.28	7.35	7.33	7.45	7.42
	F value	*	*		*	*	*
	SEm±	0.11	0.12	0.13	0.13	0.13	0.11
	CD at 5%	0.31	0.36	0.36	0.37	0.37	0.31
T_2	Initial	8.38	8.09	8.28	8.09	8.19	8.47
	15th day	8.09	8.02	8.09	7.83	8.02	8.22
	30th day	7.76	7.73	7.76	7.50	7.78	7.83
	45th day	7.50	7.42	7.47	7.40	7.52	7.57
	F value	*	*	*	*	*	*
	SEm±	0.12	0.17	0.14	0.12	0.14	0.12
	CD at 5%	0.34	0.47	0.39	0.36	0.41	0.34
T_3	Initial	8.09	8.04	7.81	7.76	7.90	8.04
	15th day	7.78	7.85	7.71	7.52	7.71	7.88
	30th day	7.52	7.70	7.52	7.28	7.45	7.52
	45th day	7.47	7.52	7.31	7.19	7.31	7.33
	F value	*	*	*	NS	*	*
	SEm±	0.13	0.13	0.13	0.16	0.13	0.13
	CD at 5%	0.37	0.37	0.37	-	0.38	0.38

Note: T_1- 50°Brix, T_2- 60°Brix and T_3- 70°Brix.

OA: Overall acceptability, NS: Non significant, *- Significant.

Table 3: Microbial profile of best accepted petha on storage.

Petha	Duration (Days)	Bacteria ($\times 10^6$cfu/g)	Yeast ($\times 10^2$cfu/g)	Fungi ($\times 10^3$cfu/g)	*E.coli* ($\times 10^4$cfu/g)
Room temperature	Initial	2	Nil	Nil	Nil
	15 days	3	0.5	Nil	Nil
	30 days	3.5	2.5	2.5	Nil
	45 days	3.5	3	3.5	Nil
Refrigerator temperature	Initial	2	Nil	Nil	Nil
	15 days	2	Nil	Nil	Nil
	30 days	3	1.5	2	Nil
	45 days	3.5	2	2	Nil

Consumer acceptability of watermelon rind petha

Petha was subjected to consumer acceptance for respondents (n=50) to know the extent of likability. Table 5, represents the consumer's acceptability using FACT scale of watermelon rind petha. Nine statements were provided to test the acceptability was noticed that (40%) of the consumers "would eat every opportunity they had". Also, 14% of the consumers quoted that, they 'would eat this very often' and then 16% 'would frequently eat this' (Fig 2). The respondents also preferred the statements *viz,* 4% I like this and would eat it now and then and 4% respondents I don't like this but would eat this on an occasion and I would hardly ever eat this.However, most of the students were had a willingness to eat watermelon rind petha whenever it is available.

Nutritional composition of watermelon rind petha

The nutritional compositionof watermelon rind petha indicated nutrients like protein (0.38 g), fat (0.05 g), total ash (0.4 g), crude fibre (0.6 g), carbohydrate (52.49 g) and minerals like calcium, iron, phosphorous 18.68 mg, 0.31 mg and 9.28 mg respectively (Fig 3). The calcoium content was more and the reason can also be attributed to the usage of calcium hydroxide in the petha. The results obtained from the present study indicated that moisture and protein content was decreased slightly. However,the other nutrients like fat, crude fibre and minerals content was similar as with the results of Deepa Madalageri (2015) for water melonrind petha with fat (0.10 g), crude fibre (0.65 g), carbohydrate (63.38 g) and minerals like calcium, iron, phosphorous 25.83 mg,

Table 4: Textural profile of watermelon rind petha.

Samples	Hardness (g)	Adhesiveness (g.sec)	Springiness	Cohesiveness	Gumminess	Chewiness
T_1 (50°Brix)	13955.64	-7.374	0.052	0.04	560.957	29.304
T_2 (60°Brix)	14494.22	-3.25	0.04	0.046	667.909	26.583
T_3 (70°Brix)	17553.64	-1.521	0.066	0.044	780.651	51.461
Average	11500.252	-3.489	0.039	-0.064	502.621	26.837
S.D.	7830.484	3.365	0.028	0.216	346.256	21.077
Coef. of variation	68.09	-96.457	71.931	-335.3	68.89	78.537

Table 5: Consumer acceptability using FACT scale of watermelon rind petha (n=50).

Opinion	Consumers	Percentage of total
I would eat every opportunity that I had	20	40.00
I would eat this very often	7	14.00
I would frequently eat this	8	16.00
I like this and would eat it now and then	6	12.00
I would eat if available but would not go out of my way	4	8.00
I doesn't like this but would eat this on an occasion	2	4.00
I would hardly ever eat this	2	4.00
I would eat this if there were no other food choices	1	2.00
I would eat this only if forced	0	0.00
Total	50	100.00

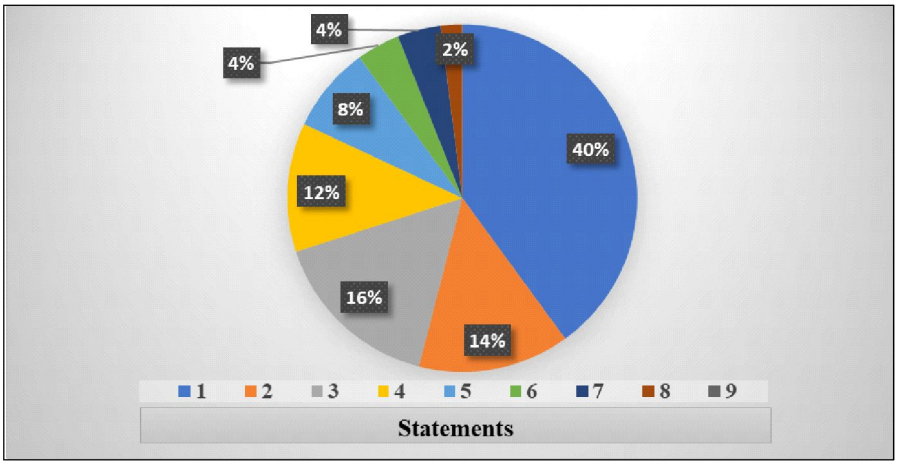

Fig 2: Consumer acceptability of best accepted watermelon rind petha.

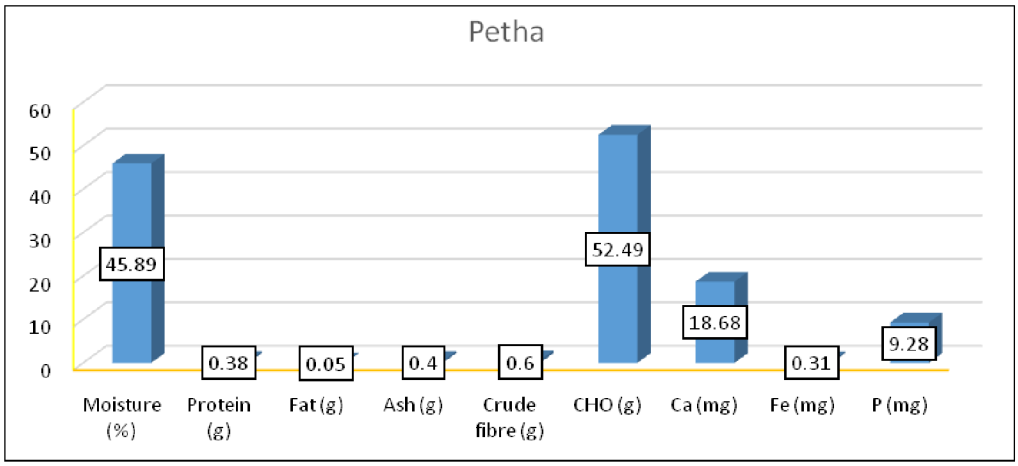

Fig 3: Nutrient composition of best accepted watermelon rind petha (per 100 g).

0.33 mg and 12.30 mg respectively. Hence, watermelon rind petha preparation is simple and it provides a good amount of nutrients to the body.

CONCLUSION

Watermelon rind petha had good acceptability by the consumers and it could be stored both at room temperature as well as at refrigerated temperature for the period of maximum 30 and 45 days respectively on the basis of consumer acceptability, microbiological and sensory parameters. Hence, it can be best utilised and can be a novel product which can be economically fair with high nutritional quality and good health benefits with an option for byproduct utilisation also.

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