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Standardization of banana peel based sauce

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Abstract
Banana peel is a major by product of banana processing industry and a throw away waste after consumtion as a table fruit. This peel is reported to be rich in fibre and various nutrients like poly unsaturated fatty acids, amino acids, micro nutrients and starch. This product is used by certain sections of our population as a vegetable. However, it has not been exploited commercially. This study utilized this raw material to standardize to a sauce with table applications. The product was evaluated for its sensory qualities, shelf life, nutrient and chemical composition. The product was rated as highly acceptable and profitable.

Keywords: banana peel, sauce, sensory qualities, shelf life, nutrient composition

Introduction
Banana, whether eaten raw or cooked, is a popular fruit consumed by all sections of people worldwide. The annual production of bananas was reported to be over 145 MT in 2011. The fruit is protected by its peel which is discarded as waste after the inner fleshy portion is eaten the main by-product of the banana processing industry is the peel, which represents approximately 40 per cent of the fruit. After consumption and processing, a significant amount of banana peel is being generated as waste. This by-product constitutes an environmental problem, because it contains large quantities of nitrogen and phosphorous. Besides its high water content makes it susceptible to attack by microorganisms.

Banana peels have significant nutritional qualities. They are rich sources of starch (3%), crude protein (6%), crude fat (3.8-11%) and dietary fibre (43.2-49.7%). It is a rich source of polyunsaturated fatty acids particularly linoleic acids and alpha linolenic acid. It contains essential amino acids such as leucine, valine, phenyl alanine and threonine and also the micronutrients like K, P, Ca, Mg, Fe and Zn. In the case of Zn and Fe, they are found in higher concentration in peels compared to pulp. Banana peels are also good sources of lignin (6-12%), pectin (10-21%), cellulose (7.6-9.6%), hemicelluloses (6.4-9.4%) and galactouronic acid. Pectin extracted from banana peel also contains glucose, galactose, arabinose, rhamnose and xylose (Emaga *et al*., 2007).

The total amount of phenolic compounds in banana peel ranges from 0.90 to 3.0g/100 (gDW). Phenolic compounds are the secondary metabolites produced by the plants. It has multiple biological effects. Gallocatechin is identified at a concentration of 160mg/100 g DW. Ripebanana peel also contains other compounds, such as bsitosterol, sigmasterol, campesterol, cycloeucalenol, cycloartenol and 24-methylene cycloartanol. Potassium content is found to be high in banana peel (78.10 mg/g).This mineral helps in the regulation of body fluids and maintain normal blood pressure. It also helps to control kidney failure, heart diseases and respiratory flaws (Nguyan *et al*. 2003) [2].

Despite the nutritional, economic and medicinal importance of banana peel, they still remain neglected. Not much work has been done to develop banana peel based processed foods. In this context, the present investigation on 'Development of value added products from banana peel' was selected with the objective of developing value added products from banana peel and to evaluate their organoleptic, functional, nutritional and shelf life qualities.

Materials and Methods
Selection of raw material
Ripe banana peel of *cv nendran* was utilized for the study. Nendran is a popular variety in Kerala. It is not only relished as a fruit but has also got wide applications in the processing industry, thus it ranks first in commercial value among all varieties. Banana chips is a flourishing cottage industry in Kerala. The characteristic flavor of banana chips fried in coconut oil is an exotic identity among the commercial food products of Kerala. Surplus amount of the peel of nendran is generated as waste from the banana chips industry which is found to have application only as cattle feed. Fresh peels of nendran were collected from chips making unit at East fort, Trivandrum.

The banana peel slices were blanched for 5mins and immersed in 0.4% citric acid.

Formulation for evaluation
The adjuncts in sauce namely coriander leaves, vinegar, garlic, chilli and sugar were mixed in different combinations and proportions. A spice bag was used to extract the flavor of spices. It comprised of 10g of crushed clove, cardamom, pepper, fennel seeds and cinnamon. All the ingredients were blended and processed to sauce consistency and subjected to organoleptic evaluation. The cooked volume of sauce obtained was noted.

Table 1: Formulations of banana peel based sauce

SL.NO	Treatments	Ingredients	Proportion of ingredients(g)
1.	S_1	Banana peel + coriander leaves + garlic + green chilli + sugar + spices	100:50:5:5:5:5
2	S_2	Banana peel + coriander leaves + garlic + green chilli + vinegar + spices	100:50:5:5:5:5
3.	S_3	Banana peel + coriander leaves + garlic + red chilli + sugar + spices	100:50:5:5:5:5
4.	S_4	Banana peel + coriander leaves + garlic + vinegar + red chilli + spices	100:50:5:5:5:5
5.	S_5	Banana peel + coriander leaves + garlic + vinegar + red chilli + sugar + spices	100:50:5:2.5:2.5:5:5

The ideal time duration needed for cooking of sauce was evaluated by 10 members of a sensory panel. The overall visual quality of the product was evaluated on a 9 point hedonic scale by 10 members.

Table 2: Variations in cooking time

Sl. no	Treatments	Time (min)
1	T_1	3
2	T_2	6
3	T_3	9
4	T_4	12
5	T_5	15

Preparation of banana peel based sauce (Flow chart)

Banana peel
↓
Pre preparation
↓
(Washing, blanching and pulping)
↓
Banana peel pulp
↓
Addition of blended coriander leaves, vinegar, garlic, chilli, salt and sugar
↓
Processing with spice bag
↓
Removal of spice bag
↓
Addition of preservatives
↓
Cooling
↓
Bottling and sealing
↓
Storing

Assessing the acceptability of the product

Selection of judges

A panel of 10 judges including the staff and students of the Department of Community Science were selected as sensory panel. Panel members were selected based on the result of the duo-trio test conducted to analyse their taste accuracy and consistency in evaluating the developed recipes.

The selected panel members were those who were aware about nutrition and health; who were not suffering from cold and had not ingested any other food for at least an hour before testing. They were non smokers, non colour blind and those who had no strong likes or dislikes for the food to be tested (Brown, 2000)

Organoleptic Evaluation

The numerical scoring test is generally used to evaluate a particular characteristic of one or more samples indicating the rating as either excellent or good or fair or poor. Acceptability of the developed products with respect to appearance, colour, flavor, texture and taste was estimated using a score card. A scale from 1-5 was used to rate the product, 5 corresponding to excellent quality and 1 for poor (Manay and Swamy).

Packaging and Storage

The sauce was stored in glass bottles kept in ambient conditions. The shelf life was assessed at periodic intervals for 3 months.

Results and Discussion

Quality evaluation of the product

1. Sensory quality of various formulations of sauce

Table 3

Treatments	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
S_1	19.1	18.6	18.3	19.0	20.2	19.5
S_2	22.0	20.5	22.5	23.4	22.3	26.3
S_3	21.0	25.3	22.5	25.9	24.5	23.9
S_4	23.5	27.7	24.9	21.0	22.3	21.5
S_5	41.0	35.4	39.3	38.1	38.1	36.3
K value	25.61	13.47	25.34	20.62	17.53	4.61
CD (0.05	18.07					

(Scores indicated as mean rank values)

The scores for 5 parameters namely, appearance, colour, flavor, texture, taste and overall acceptability of panel from the members were subjected to Kruskal Wallis test. The results are depicted in Table - 3

On the basis of mean rank values S5 was selected as the test formulation of sauce.

2. Optimization of cooking time of banana peel based sauce

The best cooking time was selected from the five timings namely 3 min, 6 min, 9 min, 12 min and 15 min. The OVQ of formulated sauce samples were evaluated by panel of 10 judges and the scores are presented in Table-4.

The mean rank values obtained ranged from 12.3-41.3.It was observed that T2 scored the minimum mean rank value (41.3) with 6 mts. cooking time, followed by T3 with the mean rank value (28.9) with a cooking time of 9 mts.T1 obtained the maximum mean rank value (12.3).The statistical analysis of data depicted that the difference in scores were significant. So T2 was selected as the optimum cooking time for banana peel based sauce.

Table 4: Overall Visual Quality (OVQ) of sauce processed in different time duration

Sl. No	Treatments	OVQ Scores
1	T1 (3 mts.)	12.3
2	T2 (6 mts.)	41.3
3	T3 (9 mts.)	28.9
4	T4 (12 mts.)	18.1
5	T5 (15 mts.)	26.9
	CD (0.05)	18.07

(OVQ scores indicate mean rank values)

Physical Quality

Yield- The yield of pulped and processed sauce was found to be 1.4

Chemical Composition

Chemical composition of the product was ascertained with respect to moisture, acidity, reducing sugar, fibre, pH and TSS.

The results are presented in Table-5

Table 5: Chemical composition of banana peel sauce

Constituents	Amount/100 g
Moisture (%)	72.2
Acidity (%)	1.75
Reducing sugar (g %)	1.01
TSS (% brix)	20
P^H	4.06
Fibre (g)	2.6

Values indicated are mean of 3 replications

Nutrient Composition of the sauce

The proximate composition was ascertained with respect to carbohydrate (g), protein (g) and calories using standardized methods.

Table 6: Nutrient Composition of the developed product

Nutrient	Amount/100g
Carbohydrate (g)	46.2
Protein (g)	6.0
Energy (k cal)	220

Storage Stability

The shelf life quality of the developed product was analysed by assessing moisture content, microbial profile and sensory parameters for 3 months at monthly intervals.

The moisture content in the initial period was found to 72.2 per cent which increased to 72.4, 72.7 & 72.7 per cent respectively after 1st, 2nd and 3rd month.

Microbial evaluation was done initially and at 30 days intervals up to 3 months. The growth of bacteria, fungi and e coli were determined using nutrient agar (NT), potato dextrose agar and rose Bengal (PDARB) and Eosin Methylene Blue (EMB) respectively. The evaluation was done by serial dilution of the sample followed by pour plating techniques suggested by Johnson and Curl (1972).

Two bacterial calories were seen in 10^{-5} dilution during the third month. However, this was within the permissible limits. No other pathogenic organism could be detected in the developed products.

When sensory attributes were evaluated over 3 months of storage, the ratings for colour, texture, flavor taste and overall

acceptability were found to decrease, but the product remained acceptable. When cost of the product was worked out, it was found to be Rs.80/kg. The cost included the individual cost of ingredients and 10 % overhead charges.

Conclusion

This study highlights the scope for value addition of banana peel of nendran variety. Although, banana peel has been used traditionally by many communities of Kerala and Karnataka as a vegetable, it has not been processed to commercial products. This study has confirmed the acceptability of banana peel based sauce, which is found to be convenient, nutritive and appealing to consumers.

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