Original Article

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Quality Parameters of Fruit Cheese Developed Using Pineapple Pomace

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Abstract

Fruit pomace, a byproduct of fruit juice industry is a rich source of nutrients and bioactive components hence, the study explored the utilization potential of pomace from pineapple for chemical composition and product formulation. Results revealed that pineapple fruit pomace had fair amounts of nutrients and was rich in dietary fiber (insoluble fiber: 29.45% and soluble fiber: 2.27% on dry weight basis). Pomace was also an excellent source of antioxidant components such as total carotenoids, β-carotene and polyphenols. Pineapple fruit cheese prepared using pineapple pomace was a good source of carotenoids and it could be stored for a period of 30 days both at low and refrigerated temperature. The products had acceptable organoleptic quality. Hence, it can be concluded that pineapple pomace, a byproduct of pineapple juice industry can be used as a potential source of antioxidants rich ingredient for value added product.

Keywords: Nutritional Composition; Antioxidants; Carotenoids; Dietary Fiber; Sensory Quality.

Introduction

India is a very large producer of fruits and vegetables, second only to China and Brazil. The current production of fruits in India is estimated to be more than 85million tons, of which pineapple accounts for nearly 3 lakh tons [1]. Fruits and vegetables are good dietary sources of several nutrients. Fruit and vegetable pomace or residue left after the extraction of juice is inexpensive, easily available waste material which comprises of bioactive molecules. Earlier studies have indicated that fruit and vegetable peels or residues can be rich source of dietary fiber, antioxidant components and exhibit bioactive potential [2,3,4]. Hence, such bio-waste materials need to be explored for their possible utilization in product formulations. Studies reported in this area include the incorporation of cauliflower trimmings into ready-to-eat expanded products and their effect on the textural and functional properties of extrudates by Stojceska et al [5], utilization potential of feijoa fruit wastes as ingredients for functional foods [6] and juices, and fibers and skin waste extracts from white, pink or red-fleshed apple genotypes as potential food ingredients [7]. Nassar et al,[8] prepared biscuits from blends containing different proportion of orange peel or pulp as it contained high amount of dietary fiber. In another study by Shyamala et al, [9] dehydrated peels of ridge gourd (*LuffaAcutangula*) was used for development of a high fiber snack product. Furthermore, fiber-rich byproducts can be incorporated into food products as inexpensive, non-caloric bulking agents for partial replacement of flour, fat or sugar, as enhancers of water and oil retention and to improve oxidative stabilities [10]. Accordingly agricultural wastes of plant origin have attracted considerable attention as potential sources of bioactive phenolics, which can be used for various purposes in the food ingredients and other value added bio-products. Thus functional foods represent an important part of the overall food market. Hence, in the present study, pineapple pomace was screened for its proximate composition, antioxidant components and utilization for a shelf stable product development. The formulated product was also evaluated for nutritional quality, sensory parameters and storage stability.

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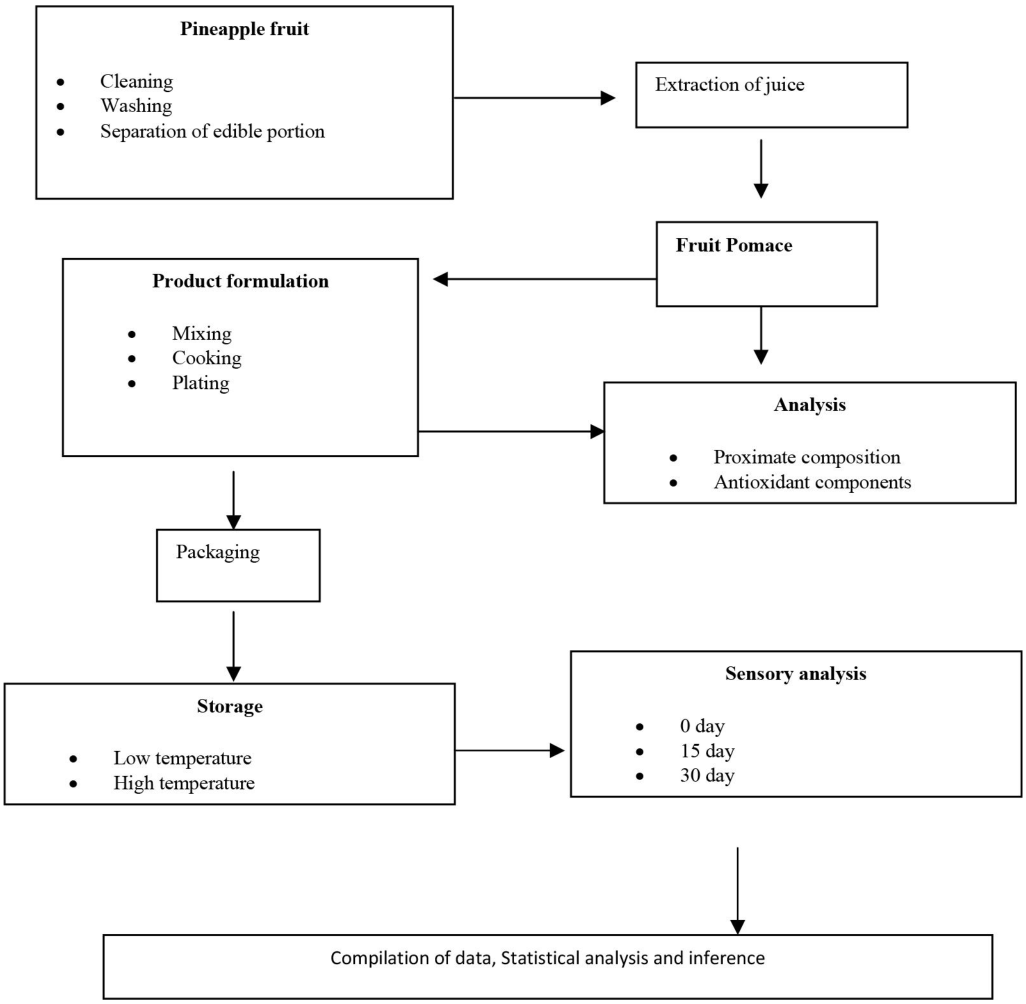
Materials and Methods

Material Procurement and Preparation

Ripe pineapple (*Ananas comosus*) for the study were purchased from local market, Mysore, India in one lot. Fruits were washed, cleaned and edible portion was separated manually using a sharp knife. Fruit pomace was obtained in the laboratory by extracting the juice from the edible portion and the left over pomace i.e. the pulp left after juice extraction was taken for further analysis as well as product development. A record of yield was maintained. An overall study design is presented in Fig. 1.

Fig. 1: Study Design



Chemical Reagents

Chemicals used for the study; L-Ascorbic acid and β-carotene were from Sigma (Sigma-Aldrich, USA) Chemical Co, and all others were obtained from E-Merck, Mumbai or Qualigens Fine Chemicals, Mumbai, India. All chemicals were of analytical grade. Double glass distilled water was used for all analysis. All analysis were run in triplicates and averaged.

Determination of Proximate Composition

Pineapple pomace and the formulated product were analyzed for proximate composition by standard methods described below. Moisture was estimated by vacuum oven (method 926.12, 41.1.02) procedure. Total ether extractives were estimated by Soxhlet apparatus using petroleum ether for extraction (method 948.22, 40.1.05) with the solvent being evaporated and the residue weighed to determine the fat content. Protein was determined by Kjeldahl nitrogen determination and conversion to protein using a factor of 6.25 (method 960.52, 12.1.07). Ash by direct analysis (method 942.05,4.1.10) was determined according to the

Association of Official Analytical Chemists. [11] Dietary fiber consisting of insoluble (IDF) and soluble fractions (SDF) was estimated by the enzymatic gravimetric method of Asp et al, which is equivalent to physiologically indigestible fiber residue [12]. Carbohydrate was computed by difference. While naturally pineapple is rich in sugar, fruit cheese had more of carbohydrate content both on fresh and dry weight basis due to added sugar.

Estimation of Antioxidant Components

Ascorbic acid was estimated by 2, 6-dichlorophenol indophenol visual titration method, which is based on reduction of the dye color from blue to pale pink by ascorbic acid [13]. For estimation of carotenoids, the powdered samples were extracted in acetone and transferred to petroleum ether phase. Total carotene was read colorimetrically using petroleum ether for baseline correction. β-carotene was separated by column chromatography and read colorimetrically [13]. Samples were analyzed for total polyphenol content as tannic acid equivalent (TAE) / 100 g of sample according to the Folin-Ciocalteu method. [14] The total flavonoid content was determined using the Dowd method using a standard curve with quercetin as the standard and expressed as mg of quercetin equivalent / 100 g of sample [15].

Product Development, Sensory and Storage Studies

The pineapple cheese was prepared using fruit pomace (1 kg), sugar (1.5 kg), butter (125 g) and citric acid (a pinch). All the ingredients were heated in a pan with constant stirring and a pinch of citric acid dissolved in water was added at about 100º C. The formulation was heated till the mass fell in the form of flakes when dropped from the wooden ladle (110-120ºC). The thick mass was then allowed to set on a plate greased with butter after which it was cut into uniform pieces and wrapped in butter paper. The products were stored both at room temperature and low temperature (fridge) in airtight PET (polyethylene terephthalate) containers. These were evaluated for sensory parameters on initial day, 15th day and 30th day as detailed below.

Pineapple cheese was subjected to sensory analysis by semi-trained panel members (n=30) who were familiar with sensory analysis techniques. A score card was developed specifically for the product based on qualitative descriptive analysis of Stone and Sidel [16]. This particular method of sensory evaluation is a combination of the descriptive profiling and scoring method to get an overall assessment of the product profile and this does not require a trained panel like other descriptive methods. The score card carries a 15 cm scale for each of the quality attribute namely, appearance, color, texture, taste and overall quality. The scale is denoted by lower and higher quality description of each attribute at both ends. The respondents indicated their choice by marking on a scale which was converted to numerical score later.

Statistical Analysis

The data were analyzed for mean and standard deviation. Data on sensory analysis of products were subjected to ANOVA and a further post-test (Tukey's) to determine significant differences in samples, if any.

Results and Discussion

Proximate Composition

For utilization of fruit pomace, pineapple fruit cheese was prepared using the leftover pulp after

Table 1: Proximate Composition of Pineapple Pomace and Fruit Cheese

Constituents	Pineapple residue	Fruit Cheese	Pineapple residue	Fruit Cheese
	Fresh weight basis (g/per 100g)		Dry weight basis (g/per 100g)	
Moisture	83.06±0.00	8.76±0.12	-	-
Protein	0.74±0.03	1.64±0.09	4.36	1.79
Ash	0.46±0.03	0.12±0.00	2.71	0.13
Ether extractives	0.22±0.28	5.91±0.08	1.35	6.47
Insoluble dietary fiber	4.99±0.06	2.08±0.02	29.45	2.27
Soluble dietary fiber	0.11±0.07	0.18±0.00	0.64	0.19
Carbohydrate (by difference)	10.42	81.31	61.49	89.15

juice extraction. Fresh pineapple pomace as well as the product was analyzed for its proximate composition and the results are presented in Table 1. Pineapple pomace had high moisture content of 83%. Insoluble fiber (29.45 g/100g) was high in pomace compared to the soluble fiber (0.64 g/100g). Protein content was 4.36 g/100g. Ether extractive was high in pomace i.e. 2.29 g/100g. Moisture content of the formulated product was 8.76 g/100g, protein 1.79 g/100g, total fiber 2.46 g/100g, ether extractives 5.91 g/100g and ash content was low i.e. 0.13 g/100 g. The moisture content was low due to added dry ingredients and processing. Low moisture content contributed to shelf stability of product. A higher fat content can be attributed to butter, which was added during reparation. Butter is known to enhance the texture of dishes by providing lubricity and it also adds to the flavor of product.

Antioxidant Components

Selected antioxidant components were analyzed in fruit pomace and product and results are compiled in Table 2. Ascorbic acid was estimated to be 10.74 mg/100g in the pomace and 8.19 mg/100g in the prepared product. Percentage loss of ascorbic acid was marginal in the product as it retained up to 70% even after heat processing, hence fruit cheese was a fair source of ascorbic acid. Pineapple pomace was a rich source of carotenoids, with total and β-carotene values of 6189 and 4082 µg/100g respectively. As a result, even product exhibited fair amounts of total (247 µg/100g) and β-carotene (101 µg/100g). Total flavonoid was 7 mg QE/100g in pomace and 2.17 mg QE/100g in the product. Total polyphenols was also high in pomace (87.0mg TAE/100g) whereas the product had around 20.0 mg TAE/100g of total polyphenols. Fruit cheese are products which provide many nutrients other than plain energy unlike other sugar candies, hence, these can be safely given to children. Nida and Prakash reported formulation of iron fortified fruit cheese with pineapple and guava fruit which were highly acceptable and exhibited high iron bio-accessibility [17]. Recent research also shows that many antioxidant components are bound to dietary fiber and they get released in the gastrointestinal tract on account of enzyme action. This is especially true for fruits as they are rich in fiber and contain many bioactive components [18].

Table 2: Antioxidant Components of Pineapple Pomace and Fruit Cheese

Constituents	Pineapple residue	Fruit Cheese	Pineapple residue	Fruit Cheese
	Fresh weight basis (per 100g)		Dry weight basis (per 100g)	
Ascorbic acid (mg)	1.82±0.01	7.48±0.26	10.74	8.19
Total Carotene (µg)	1048±53.41	225±6.88	6189	247
β-Carotene (µg)	694±9.04	92±5.60	4082	101
Total Flavonoid (mg QE)	1.19±0.07	1.98±0.14	7.02	2.17
Total Polyphenol (mg TAE)	14.76±0.06	18.25±0.35	87.13	20.00

Sensory and Storage Studies

Sensory analysis was carried out using 30 semi-trained panel members. Product was evaluated at 0, 15 and 30 day's storage period. The product was kept in PET at both low and room temperatures. As explained earlier, a 15 cm scale was used for sensory scores (Stone and Sidel 1993) [15]. The results of sensory analysis conducted for product throughout the storage period are presented in Table 1. There was no difference for the sensory quality and appearance in the fresh and stored samples with the scores in the range of 8.88 to 9.60. In case of color there was a slight difference between the fresh and stored product, though the low temperature stored product retained the original color for 15 days. Taste quality was given a significantly higher score for the fresh sample in comparison to all stored ones, which could have been due to smaller flavor changes on account of storage. Texture showed a slight difference only in the 30 day stored samples compared to fresh and 15 day stored products. In case of fibrous texture there was no significant difference observed. Since the product was prepared using only the pomace, this quality was also judged separately, and it was uniformly liked by all panel members. Overall acceptability of the product was 12 for the 0 day and it was around 10 for the 15 days stored products both at RT and LT storage. However the mean score was around 9 for the products stored up to 30 days at both RT and LT. Thus, it can be said that fruit cheese could be stored for a period of 15 days with no major differences in the organoleptic quality, after which there were lower scores for some of the sensory attributes. It may be noted that this drawback can be overcome by selecting a better packaging material. Since this was an initial trial, only butter paper was

Table 3: Sensory Attributes of Fruit Cheese (Mean Scores ± S.D)

Treatments	0 day	15 day Room temperature	15 day Low temperature	30 day Room temperature	30 day Low temperature
Appearance	9.60 ±1.91 [a]	9.60±1.43 [a]	9.41±1.60 [a]	8.88±1.50 [a]	8.96±1.61 [a]
Color	9.89±1.76 [a]	9.04±1.39 [b]	9.55±1.74 [a]	8.79±1.65 [b]	8.85±1.34 [b]
Taste	12.27±1.06 [a]	9.98±1.59 [b]	10.50±1.77 [b]	9.62±2.18 [b]	10.12±2.05[b]
Texture	9.44±2.23 [a]	9.50±1.57 [a]	9.40±1.47 [a]	8.24±1.40 [b]	8.56±1.44 [b]
Texture (fibrous)	6.10±2.61 [a]	7.21±2.67 [a]	7.28±2.59 [a]	6.68±2.98 [a]	7.28 ±2.43 [a]
Aroma	11.90±1.31 [a]	9.71±1.98 [b]	10.41±1.78 [b]	10.43±1.54 [b]	10.01±1.66 [b]
Overall acceptability	12.20±1.48 [a]	10.07±1.97[b]	10.90±1.69 [b]	9.86±2.01 [b]	9.94±1.77 [b]

Figures with different superscripts in a row are significantly different from each other on application of Turkey's test.

used to wrap the cheese, this gives room for water vapor transmission and air ingress causing texture and flavor changes in the product on storage.

Conclusion

A higher intake of fruits and vegetables is advised for the innumerable benefits they impart to maintain health and prevent diseases. While fresh fruits can be consumed on a daily basis, they are perishable commodity and need to be converted to many processed products to increase the shelf stability. The process of conversion results in many byproducts which have a utilization potential. The nutritional compositional analysis of fruit pomace indicated that they were good source of protein, dietary fiber in particular, the soluble fiber, ascorbic acid and carotenoids. It can be concluded that the pomace from fruits of the juice industry could be utilized as a source for value addition as these were rich in phenolic components. Hence, this study indicates the potential of utilizing fruit pomace in product formulation.

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