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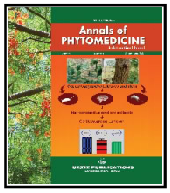

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Quality evaluation of fruit peel waste incorporated products

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Abstract

Fruit peel waste as secondary by-product is generated from food industries and household kitchen. Even though, fruit peels embedded with wide spectrum of nutrients and bioactive compounds, fruit peel huge wastage is at food industrial level is increasing day-by-day, which is the major concern which need to be addressed. Because of health benefiting property, demand for the innovation in the field of fruit peel incorporation in products has gain importance. The present study was undertaken with the aim of development and quality evaluation. Milkshake mix and chocos were prepared by incorporating 8 per cent of dehydrated watermelon and banana peels in combination with other ingredients. Nine point hedonic scale was applied for sensory evaluation with 50 panel members. Proximate and minerals were assessed by using Association of Official Analytical Chemists (AOAC) standard protocols. It was revealed that milkshake mix prepared from incorporating watermelon rind was highly acceptable with maximum mean score (8.10 ± 0.7). Watermelon rind milkshake mix had maximum moisture (4.65 ± 0.40 g), protein (13.98 ± 0.9 g), ash (2.62 ± 0.6 g), iron (5 ± 0.2 mg) and zinc (2.5 ± 0.03 mg) content for per 100 g of sample. Watermelon rind chocos had maximum amount of fat (13.7 ± 0.12 g) and carbohydrate (72.8 ± 0.16 g) and energy (443 ± 22 kcal). Present study revealed that the products prepared from incorporating fruit peel waste can improve the nutritional quality and also add variety to the diet.

1. Introduction

India is the second highest producer of fruits and vegetables in the world next to China. According to the second advance estimate of National Horticulture Database (NHD), 2019-20, India alone has grown around 99.07 million metric tonnes of fruits which in turn contributed the considerable share in the world food basket with the increase rate of export (APEDA, 2022). Most of food industries use fruits and vegetables as major ingredient in the preparation of jam, jelly, pickle, juice, squash and other products. Where, these kind of industries are experiencing a huge wastage of secondary products; among which fruit peel wastage is the major concern which need to be addressed through effective strategy (Kumar *et al.*, 2020). Fruit peel waste as secondary by-product is generated from food industries and household kitchen. Fruit peel represent between 50 to 65 per cent of total fruit weight as by product (Gunwantrao *et al*., 2016). Most of fruit products are prepared by leaving the fruit peel as wastage or consumed as such by leaving the peel as waste. The usage of fruit and vegetable waste in new product development is gaining popularity since the residues of peel wastes are the important sources of polyphenols (Al-Sayed and Ahmed, 2013). Fruit peel is also recognized as one of the nutritionally important component in our diet as it contains many important essential nutrients which play important role in the wellbeing of human. Consumer's preference towards the purchase of new product is slightly shifting towards healthy pattern. Due to changing perception of consumers towards health, nutritional awareness within the public, new product development with optimum nutritional quality is gaining importance. Certain fruit peels have more phytochemical contents than endocarp as orange peel contain more ascorbic than pulp juice. Likewise, the orange peel is also embedded with B-complex vitamins, vitamin A as well as minerals such as calcium, manganese and zinc (Zn) which all are several folds more than pulp. Hence, it is necessary to reduce the fruit peel wastage through incorporation in product to gain the nutritional benefits (Vinaya *et al*., 2012). Incorporation of fruits peels in new products development helps in effective utilisation peel as well as complete use of nutrients. This idea of utilizing fruit peels have slowly gaining popularity because fruit peels are the good source of bioactive compounds (Yamini, 2018). Because of high nutritional value of fruit peel and health benefiting property, demand for the innovation in the field of development of fruit peel waste incorporated products is increasing day-by-day. Therefore, sustainable utilization of these fruit peels in the development value-added products in food industrial applications provides an opportunity for reducing peel wastage even also enhances the nutritional quality of product along with additional income for the dependent industrial sector. Therefore, as a sustainable approach, present work is undertaken with aim to develop fruit peel waste incorporated products along with their quality evaluation.

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2. Materials and Methods

2.1 Product development

For the development of the fruit peels incorporated products ingredients were purchased from the local market of Mysore, India. Milkshake mix was prepared by using fruit peels powder, oats, little millet, jaggery powder, milk powder, sugar powder, pumpkin seeds. Two variations were prepared, one is 'banana peel milkshake mix' and the other one is 'watermelon rind milkshake mix'. Chocos were prepared by using finger millet, little millet, watermelon rind powder, jaggery powder, cocoa powder, butter, milk, vanilla essence and baking powder. Watermelon rind chocos is the second product of fruit peel waste incorporated products and the study design is represented in Figure 1.

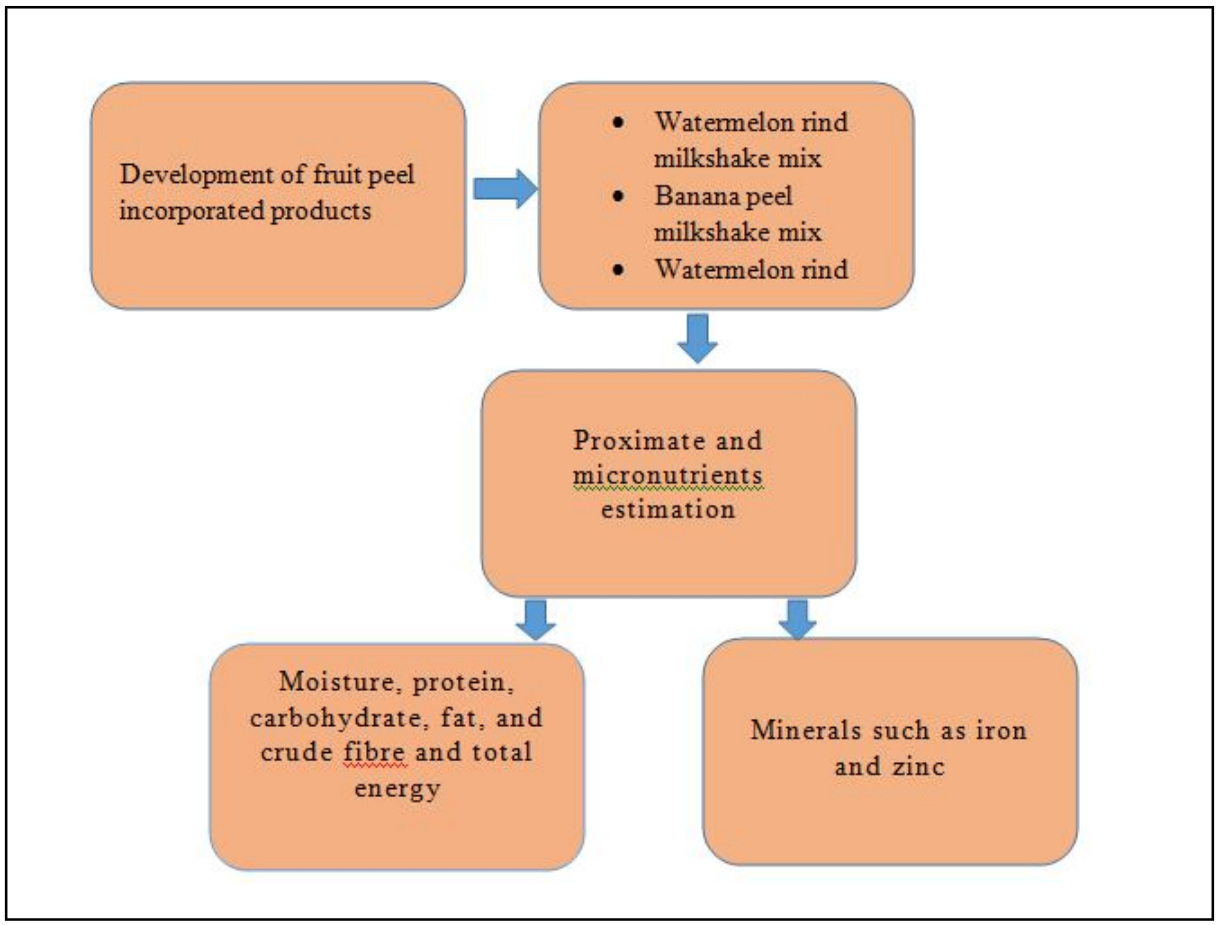

Figure 1: Study design.

2.2 Selection of panel members and sensory evaluation

2.2.1 Selection of panel members

Interested semi trained panel (n = 50) from the Department of Food Nutrition and Dietetics, Mysuru were selected for the sensory evaluation study. Panel members who are interested in sensory evaluation were preferred. Since study was only related with organoleptic parameters evaluation, only consent form was taken from the members who agreed for the sensory evaluation. Panel members with good health condition were included in the study. The selected panel members were briefed about the product and were instructed individually to evaluate the product.

2.2.2 Sensory evaluation

Nine points Hedonic scale was used for organoleptic evaluation of developed products. Sensory parameters such as appearance and colour, taste, texture/consistency, aroma and overall acceptability were evaluated in the developed products. During sensory evaluation, samples were coded with numbers and given to the panel members. Glass of water was given to rinse the mouth. The panel members were made to sit comfortably in the chamber while evaluating all the products. Further, panel members were asked to give the score for each presented product according to their wish. The mean score was obtained for all the sensory features for each parameter and standard deviation was calculated.

2.3 Nutrient evaluation of developed products

Developed products were subjected to nutrient evaluation. Macronutrients like moisture, ash, protein, fat, carbohydrate, crude fiber and energy were estimated. Mineral composition like zinc, iron are also estimated from mineral solution prepared out of prepared food samples. Nutrients and mineral contents were estimated by using standard AOAC protocols. All the samples were estimated for macro and micronutrients were done in triplicate.

2.3.1 Macronutrient evaluation

In all the developed products, proximate components as carbohydrate, protein, fat and ash were estimated by using the protocols given by Association of Official Analytical Chemists (AOAC 2005). Carbohydrate and energy values were obtained by calculation method. Gravimetric moisture values for all products were obtained by drying of each sample in an oven at 100°C until constant weight, as indication of complete moisture deletion. Further, moisture content of each sample was expressed in g per 100 g of sample. The crude protein content was estimated in dried sample and was estimated as per cent total nitrogen. Protein per cent was calculated by multiplying the per cent nitrogen with the factor of 6.25 in accordance with the (AOAC 2005) protocol of Kjeldahl method (Protocol No. 978.04). Fat content was estimated by extracting fat by using petroleum ether (60-80°C) in the moisture free sample. The solvent was removed by evaporation and the residue of fat was weighed to check the total fat content. The method followed for fat estimation was according to the Protocol No. 930.09 given in (AOAC 2005). Ash content in each sample was analysed using the protocol No. 930.05, (AOAC 2005). In brief, each known sample was incinerated at 550°C in Muffle furnace and ash content was calculated.

Carbohydrate and energy values were determined by calculation method. In this study, carbohydrate content in gram and energy value in in kcal were derived from the formulas as given below:

Carbohydrate (g /100 g) = 100 – [Protein (g) + Fat (g) + Fiber (g) + Ash (g) + Moisture (g)]

Energy (kcal) = [Protein (g) x 4] + [Carbohydrate (g) x 4] + [Fat (g) x 9]

2.3.2 Micronutrient evaluation

For micronutrient estimation, each sample was incinerated in Muffle furnace at 550°C, followed by burning. Ash solution was prepared out of ash by using diluted hydrochloric acid of 1:1 ratio. Further, iron (Fe) and zinc (Zn) were determined by using an atomic absorption spectrophotometer (Aras and Ataman, 2006).

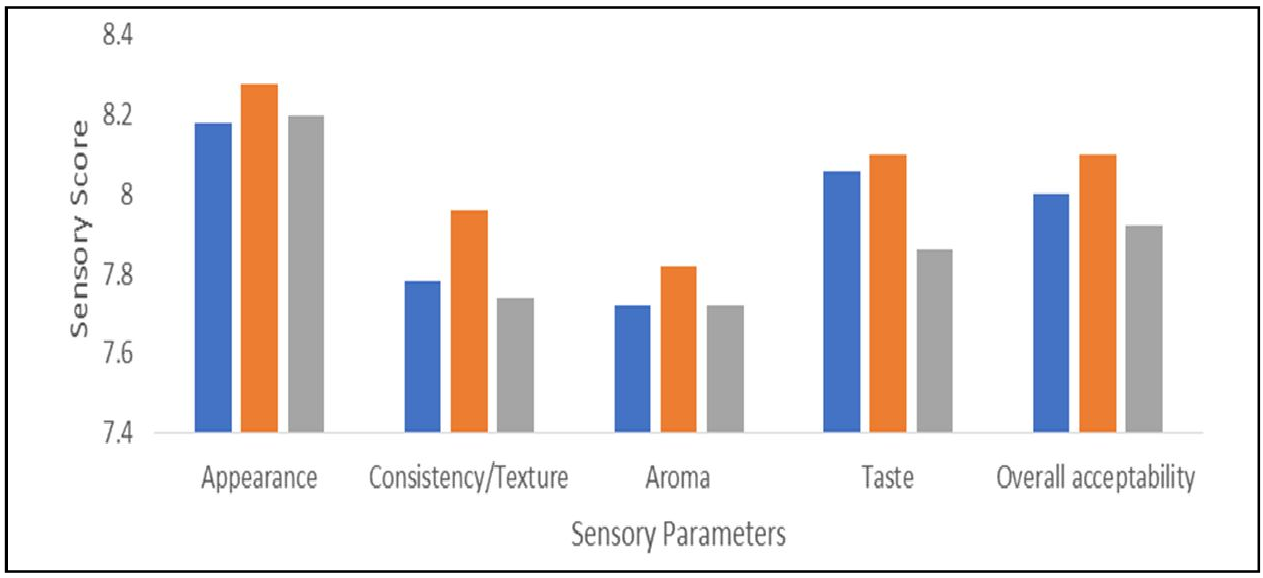

Figure 2: Mean score for sensory characteristics of fruit peel waste incorporated products.

Note: BPM: Banana peel milkshake mix; WRM: Water melon rind milkshake mix and WRC: Water melon rind chocos.

3. Results

From the sensory evaluation, it was revealed that, all products prepared from fruit peel waste such as banana peel milkshake mix, watermelon rind milkshake mix and watermelon rind chocos recorded the acceptable scores (Table 1 and Figure 2). Overall acceptability of banana peel milkshake mix was 8 ± 09, watermelon rind milk shake mix was 8.1 ± 0.7 and watermelon rind chocos scored 7.92 ± 0.9. All the developed products were in the acceptable range. However, watermelon rind chocos scored less sensory scores than other two products.

Macronutrient content in the banana peel milkshake mix, watermelon rind milkshake mix and watermelon rind chocos are presented in Table 2. From the proximate analysis, it was revealed that moisture, protein and fat of three products ranged from 3.6 ± 0.09 g to 4.65 ± 0.40 g, 7.02 ± 1.3 g to 13.98 ± 0.9 g, 7.8 ± 0.98 to 13.7 ± 0.12 g per 100 g, respectively. Other proximate components such as ash ranged from 2.54 ± 0.8 to 2.62 ± 0.6 g, crude fibre ranged from 0.22 ± 0.4 g to 0.82 ± 0.4 g, carbohydrate ranged from 69.6 ± 08 g to 72 ± 0.16 g per 100 g. Total energy of all three products ranged with highest value of 410 ± 29 to 443 ± 22 kcal per 100 g. Similar, studies on fruit peel incorporation to reduce the wastage and to enhance the nutritional quality of products were documented by other researchers. Yamini Devi (2018), documented the different products development with incorporation of banana peel. Macronutrients are essential for the body to build muscles and give energy to the body. This study concluded that the pomegranate peel has the good nutrient property and can be utilize for enhancing nutritional quality of food and also add variety to the diet.

Micronutrients content in developed products is presented in the Table 3. Banana peel milkshake mix has iron 3 mg and zinc 1.7 mg per 100 g. Watermelon incorporation has showed the highest iron content. Watermelon rind milkshake mix has iron content of 5 mg and zinc of 2.5 mg 100 g, while watermelon rind chocos also showed the presence of iron (1 mg) and zinc (3 mg).

Table 1: Mean score for sensory characteristics of fruit peel products (Mean ± SD)

Products names	Appearance	Consistency/ texture	Aroma	Taste	Overall acceptability
Banana peel milkshake mix	8.18 ± 0.8	7.78 ± 1.09	7.72 ± 1.5	8.06 ± 0.6	8.00 ± 0.9
Watermelon rind milkshake mix	8.28 ± 0.7	7.96 ± 0.9	7.82 ± 1.0	8.10 ± 0.6	8.10 ± 0.7
Watermelon rind chocos	8.20 ± 0.8	7.74 ± 1.1	7.72 ± 1.5	7.86 ± 0.8	7.92 ± 0.9

Table: 2. Macronutrient composition of fruit peel incorporated products (Mean ± SD)

Products names	Moisture (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Crude fiber (g/100 g)	Carbohydrate (g/100 g)	Energy (kcal/100 g)
Banana peel milkshake mix	3.6 ± 0.09	12.9 ± 0.8	11.18 ± 0.19	2.60 ± 0.04	0.82 ± 0.40	69.6 ± 08	431 ± 26
Watermelon rind milkshake mix	4.65 ± 0.40	13.98 ± 0.9	7.8 ± 0.98	2.62 ± 0.6	0.22 ± 0.40	70.9 ± 0.11	410 ± 29
Watermelon rind chocos	3.8 ± 0.48	7.02 ± 1.3	13.7 ± 0.12	2.54 ± 0.8	0.20 ± 0.35	72.8 ± 0.16	443 ± 22

Table 3: Micronutrient composition of fruit peel incorporated products (Mean ± SD)

Products name	Iron(mg/100 g)	Zinc(mg/100 g)
Banana peel milkshake mix	3 ± 0.5	1.7 ± 0.05
Watermelon rind milkshake mix	5 ± 0.2	2.5 ± 03
Watermelon rind chocos	1 ± 0.3	3 ± 0.05

4. Discussion

Present study reveals that the fruit peel incorporated products have both macronutrient and micronutrient in an appreciable amount. Similarly, Ashoka *et al.* (2021) conducted a study on by product utilization of watermelon to develop watermelon rind flour-based cookies. In this study, incorporation of watermelon rind flour in cookies can improve the nutritional quality of crude fibre, calcium, iron and other nutrients and also add variety to the diet. Some of the micronutrients are also present like zinc and iron which is essential for the cellular replication, development of immunity, carrying oxygen and for collagen synthesis (Wessels *et al.*, 2017). Another study was conducted on the development and standardization of pomegranate peel powder incorporated instant idly mix by Vijayarani *et al.* (2018) also reported the good nutritional quality with higher acceptability.

In spite of all these good nutritional property, fruit peels also possess antimicrobial property due to their phytochemical property where Gunwantrao *et al.* (2016) reported the antibacterial property in different extracts of orange and pineapple fruits peel wastes. In general, our daily diet can be enriched with phytochemicals by incorporation fruit peels in commonly consumed food products. Where these phytochemicals including polyphenol compounds with higher inclusion of micronutrients in our diet, play an important role in the prevention of various health problems associated with oxidative stress, such as cardiovascular diseases, cancer, and neurodegenerative diseases (Rajeshwari *et al.*, 2014).

5. Conclusion

Because of high nutritional value of fruit peel and health benefiting property, demand for the innovation in the field of development of fruit peel waste incorporated products is increasing day-by-day. The prepared products were found to be acceptable in both sensory and nutritional quality. The present study revealed that the products prepared from incorporating fruit peel waste can improve the nutritional quality and also add variety to the diet. In spite of these nutrients, most fruit peels also contains good amounts of essential minerals such as selenium, manganese and zinc in several folds and are more than their pulp along with nutritionally important vitamins such as vitamin C, B-complex vitamins and other. Therefore, it is advised to incorporate fruit peels in different products, which in turn reduce the fruit peel wastage along with extra nutritional benefit.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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