International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Utilization Of Fruit Wastes by Preparing Cakes and Cookies - A Budget Friendly Application in Food Industry

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Abstract
A large number of fruit wastes are generated from fruit processing industries in both solid and liquid form, which are rich in nutrients and have health benefits also. Utilizing fruit wastes, food product development is an innovative way to reduce the fruit wastes in environment. In this study, mixture of watermelon rind and orange peel in the ratio 1:1 (w/w) was used to make cake and cookies. Both the bakery products are very nutritious as well as pocket-friendly. It is also used as the source for gluten free which is beneficial for gluten sensitive people and is also eco-friendly. From the result, it was observed that, the lower percentage of moisture content is best accepted for cookies. For cakes, the moisture content increased from 12.62% to 17.43%. The higher percentage of moisture content is best accepted for cakes.

Keywords: Bakery products, fruit wastes, gluten free cakes, orange peel, watermelon rind.

INTRODUCTION

The usage of the waste materials of fruits for the developing of food products is an innovative way to reduce environmental pollution [1]. During the processing of fruits and vegetables, large quantities of solid and liquid waste are generated. The waste obtained from fruits and processing industry is extremely diverse due to the use of wide variety of fruits and vegetables [2]. The by- products of fruits are rich sources of bioactive compounds like phenolic and antioxidant compounds can be used in increasing the stability of foods by preventing lipid peroxidation [3].

Watermelon (*Citrullus lanatus)* from the family of cucumber (Cucurbitacea), is a large, oval, round or oblong tropical fruit [4]. The most useful, edible and popular part of the watermelon is the red flesh. The rind part of the watermelon is discarded and known as the waste part of the fruit which contains 50% of the weight of watermelon. The citrulline in watermelon rinds gives it antioxidant effects that protect you from free-radical damage. Additionally, citrulline converts to arginine, an amino acid vital to the heart, circulatory system and immune system [5]. Watermelon rind powder (WRP) is a rich source of dietary fiber and bioactive compounds; hence it could be used in the development of bakery products such as

cookies, cakes. Different replacement levels of wheat flour with either WRP or hi-maize starch (HMS) (10-30%) on the quality of the cookies and cakes made were studied [6].

Citrus peel may provide health benefit beyond the traditional nutrients contain, as well as prevent diet related diseases, e.g. metabolic syndrome, type II diabetes coronary heart disease, obesity, hypertension, certain types of cancer gastrointestinal disease and osteoporosis [7]. Orange peel is a good source of natural flavonoids and contain also higher amount of phenolics compared to the edible portions. Therefore, the utilization of orange peel powder in bakery products particularly in cookies can be done. Therefore an attempt have been made to utilize characteristics of cookies identifying maximum level of incorporation without adversely affecting the quality of cookies and improving the nutritional characteristics of cookies [8].

In recent years, demand for gluten-free (GF) food products have increased with nutritive and sensory properties for partial replacement of traditional cereal-based products [9]. Rice flour is often formulated with flours, starches and proteins from cereals, pulses and other plant materials to achieve dough properties and bakery product's quality [10]. The waste part of the watermelon rind can also be used for bakery purpose.

Sweet potatoes (*Ipmoea batatus*) are another of the world's most important food crops and an important staple. Processing sweet potato would increase its utilization and it can serve as a source of nutrients such as carbohydrates, beta-carotene (pro vitamin A), vitamin-C, vitamin-B6 minerals such as calcium, phosphorus, iron, potassium, magnesium and zinc [11]. The boiled sweet potato is used as a binding agent instead of egg in producing cookies that will play a major role in raising awareness of the potential of the crop.

OBJECTIVES

The objectives of this study are:

- To utilize fruit waste products as the main ingredient.
- To study the physiochemical properties of cookies and cakes prepared from fruit wastes.
- To assess the overall acceptability of the product by sensory evaluation.

MATERIALS AND METHODS

a) Raw Materials

Watermelon (*Citrullus lanatus*) and Orange (*Citrus sinesis*) fruits were purchased from railway market, Barrackpore, Kolkata. While coconut flour, rice flour and the other baking products such as icing sugar, baking powder, baking soda, salt, butter, egg, honey, vanilla essence were purchased from nearest shopping mall. Sweet potato was purchased from local market of Barrackpore.

b) Preparation of watermelon rind powder

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. The rinds were cleansed and sliced into smaller size by knife for easy drying. The sliced rinds were sun dried for 1-2 days. The dried rind was ground into powder by using an electric grinder and sieved through a scientific sieve. Then the dehydrated powder was packed and used for further purpose.

c) Preparation of Orange peel powder

Orange peel was obtained after peeling and further washed with tap water. Orange peel was then carried out for sun drying for 1-2 days. Dried peel was ground into powder by using an electric grinder and then sieves are used to obtain a powder having particle size less than 0.2 mm.

d) Preparation of cookies

Cookies were prepared according to the method of Jan et al. (2016) [12] with slight modification. Butter (40 g) and icing sugar (40 g) were mixed until creaming and fluffy. Then boiled sweet potato (25 g) was mixed as a binding agent. Then different ratio of watermelon rind powder, orange peel powder, coconut powder and rice flour were added and mixed for 2-3 min. then baking powder(5 g), baking soda(one pinch), salt(one pinch), vanilla essence(1 tbsp) and honey(10 g) were also added and mixed. The dough was sheeted to uniform thickness on greased baking tray. Cookies were baked at 160°C for 10-15 min. The cookies were cooled at room temperature for 2 h prior to further analyses.

e) Preparation of cakes

Cakes were prepared using the standardized recipe and method given by Sharoba et al. (2013) [13]. The fat was beaten thoroughly, the icing sugar (40 g) was added to butter (40 g) and mixed until got smooth like cream and then a well blended egg (60 g) with vanilla essence (10 gm) were added and mixed together. Then watermelon rind powder, orange peel powder, coconut powder and rice flour were added in 1:0.5::1:3 ratio. Then baking powder, honey was added and continues to stirring the batter until fluffy appearance. Then the batters pour into a previously greased baking pan and baked at 160 °C temperature for 25-30 min and allow to cooling the cake at room temperature.

Table-1: Ratio of formulated watermelon rind powder (WRP), orange peels powder (OPP), coconut powder (CP) and rice flour (RF) in cookies and cake formation

Sample	Ingredients	Ratio	Amount of weight
Sample-1	WRP:OPP:CP:RF	1:0.5:1:6	WRP= 10 gm OPP= 5 gm CP= 10 gm RF= 60 gm
Sample-1(A)	WRP:OPP:CP:RF	1:0.5:1:3	WRP= 10 gm OPP= 5 gm CP= 10 gm RF= 30 gm
Sample-1(B)	WRP:OPP:CP:RF	2:0.5:2:3	WRP= 20 gm OPP= 5 gm CP= 20 gm RF= 30 gm

I. Determination of physicochemical properties

a) Moisture content

Moisture content was determined by the direct method include mainly thermo gravimetric methods. For cookies, the food sample is weighed near about 5 g and for cake, the food sample is weighed near about 2 g by the weigh machine. Moisture content was determined by heating the samples to constant weight in a Petri dish placed in a hot air oven maintained at 105°C for 15-20 min. Then it was allowed to cool in desiccator and weighed by weight machine, calculate the moisture content percentage by the AOAC method [14].

$$\text{Moisture content} = \frac{(W3 - W2) \times 100}{(W2 - W1)}$$

Whereas,

W1 = Weight of empty Petri plate with lid

W2 = Weight of sample before drying with Petri plate and lid

W3= Weight of sample after drying with Petri plate and lid

a) **Ash content**

Ash content was determined by incineration of 1.5 g sample for cookies and 2 g sample for cakes in a crucible with lid placed in Muffle furnace maintained at 550°C for 5 h. according to AOAC method [14]. The ash formed was white. It was cooled and weighed.

$$\text{Ash content} = \frac{(W3 - W2) \times 100}{(W2 - W1)}$$

Whereas,

W1 = Weight of empty crucible with lid

W2 = Weight of sample before ashing with crucible and lid

W3= Weight of residue after ashing with crucible and lid

II. **Sensory evaluation**

The products were subjected to sensory evaluation. Sensory quality attributes were evaluated by a panel of 30 semi-trained members using a nine-point hedonic scale. The products were evaluated for their taste, aroma, color, appearance, texture and general evaluation according to the method of B. Srilakshmi [15].

RESULTS AND DISCUSSION

Table – 2. Physicochemical properties of gluten free cookies and cakes

Sample	Moisture (%)	Ash (%)	Acid insoluble ash (%)
Sample 1	8.91	2.97	1.38
Sample 1A	3.40	2.73	0.22
Sample 1B	5.29	3.12	1.23

The experiment was carried out in triplicate.

The moisture content of Sample -1 and Sample -1A of cookies and cakes were showed in **Table-2,** for cookies, the result showed that the moisture content decrease from 8.91 %(Sample-1) to 3.40 %(

Sample-1A). The lower moisture content for cookies could be the higher chances for acceptance and the higher moisture content for cakes could be the higher chances for acceptance. So, the composition of Sample-1(A) is the best for gluten free cakes and cookies.

The ash content the Sample -1 and Sample -1A of cookies and cakes from **Table-2,** for cookies, the result showed that the ash content slightly decrease from 2.97 %(Sample-1) to 2.73 %(Sample-1A. For cakes, in Sample-1A, the presence of minerals is much in low amount.

The acid insoluble ash content percentage of the Sample -1 and Sample -1 (A) of cookies and cakes were showed in **Table-2,** the result showed that the acid insoluble ash content decrease in a big difference from 1.38 %(Sample-1) to 0.22 %(Sample-1A).

From the organoleptic analyses, Sample 1B was not acceptable from consumer's point of view.

The results of **Table-3** showed that in the sensory evaluation, there was a decrease in the general evaluation, taste, aroma, colour, appearance, texture of the cookies with the gradually increasing the amount of watermelon rind powder. Sample – 1 and Sample – 1(A) is most acceptable by sensory evaluation. The parameters are given below-

[9- Extremely Good, 8- Very Good, 7- Moderately good, 6- Slightly Good, 5- Neither liked or disliked, 4- Slightly disgusted, 3- Moderately disgusted, 2- Very much disgusted, 1- Extremely disgusted]

Table – 3. Comparative study on sensory evaluation of gluten free cookies and cakes

Sample	Taste	Aroma	Color	Texture	General Evaluation
Sample 1	9	9	9	7	7
Sample 1A	8	7	9	6	7
Sample 1B	5	5	5	4	5

From the sensory evaluation we evaluated that the best samples were Sample – 1 and Sample – 1(A), so we analyzed the moisture content percentage, ash content percentage and acid insoluble content percentage of Sample – 1 and Sample - 1A cookies and cakes.

Table-4. Nutrient composition of best accepted composition of gluten free cookies and cakes (per 100 g)

Products	Sample	Energy (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Dietary Fiber (g)
Cookies	Sample-1(A)	655.13	85.205	4.341	33.14	6.01
Cake	Sample-1(A)	733.13	85.805	10.341	38.14	6.01

The result showed that the most accepted composition of WRF containing gluten free cookies contains energy (655.13 kcal), carbohydrate (85.205 g), protein (4.341 g), fat (33.14 g), dietary fiber (6.01 g) and WRF containing gluten free cake contains energy (733.13 kcal), carbohydrate (85.805gm), protein (10.341gm), fat (38.14gm), dietary fiber (6.01gm) for per 100 gm of cookies and cake.

Table-5. Production cost of gluten free cookies (per 100gm)

Sl.no.	Ingredients	Amount(Rs.)	Quantity(gm)	Cost (Rs.)
1.	Rice flour	50/1kg.	30gm	1.50

2.	Orange peel powder	140/100gm.	5gm	7.00
3.	Watermelon rind powder	80/100gm.	10gm	8.00
4.	Coconut flour	105/100gm.	10gm	10.50
5.	Sweet potato	80/1kg.	25gm	2.00
6.	Icing sugar	112.50/500gm.	40gm	9.00
7.	Butter	50/100gm.	40gm.	20.00
8.	Honey	65/100gm.	10gm	6.50
9.	Vanilla essence	22/20ml	2.5ml	2.75
10.	Baking powder	20/50gm.	1 gm.	0.50
		Total cost =		67.75

The cost of preparation for watermelon rind gluten free cookies with many other ingredients was calculated per 100gm of the product. It indicated that the cost of cookies was Rs.67.75 per 100gm. The weight of each cookie is 9.50gm. So the cost price of per piece cookie is Rs.6.43 which is pocket-friendly for all categories of people.

Table-6. Production cost of gluten free cakes (per 100gm)

Sl.no.	Ingredients	Amount(Rs.)	Quantity(gm)	Cost (Rs.)
1.	Rice flour	50/1kg.	30gm	1.50
2.	Orange peel powder	140/100gm.	5gm	7.00
3.	Watermelon rind powder	80/100gm.	10gm	8.00
4.	Coconut flour	105/100gm.	10gm	10.50
5.	Egg	5/50gm.	50gm	5.00
6.	Icing sugar	112.50/500gm.	40gm	9.00
7.	Butter	50/100gm.	40gm.	20.00
8.	Honey	65/100gm.	10gm	6.50
9.	Vanilla essence	22/20ml	2.5ml	2.75
10.	Baking powder	20/50gm.	1 gm.	0.50
		Total cost =		70.75

The cost of preparation for watermelon rind gluten free cakes with many other ingredients was calculated per 100 g of the product. It indicated that the cost of cake was Rs.70.75 per 100 g. The weight of a muffin like cake is 29.5 g. So the price of a muffin is Rs. 20.87 which is pocket-friendly.

DISCUSSION

Table-3 showed that the result of sensory evaluation between Sample-1, Sample- 1(A) and Sample-1(B), according to taste, aroma, color, texture, appearance and general evaluation. The sensory evaluation is done by 30 semi-trained students using 9 point hedonic scale and the maximum accepted values are showed in Table-3. Increasing the amount of watermelon rind powder can lead to decreasing the acceptance according to taste, aroma, color, texture, appearance also. So, the perfect ratio according to sensory evaluation was Sample-1 and Sample-1A.

The result showed that in cookies and cakes, the increase in moisture content of sample-1 and sample-1A could be increased in fiber content as dietary fiber bind water molecules and promote retention of water but prevent evaporation during baking. According to Md. M. Hoque and A. Iqbal (2015) [16], the moisture content of watermelon rind powder is 10.72 and according to O. Jongsutjarittam and S.Charoenrein (2014) [17], the moisture content of rice flour is11.88%. [18, 19] Water is major constituent of most of the food products. The approximate, expected moisture content of a food can affect the choice of the method of measurement. The dietary fiber can also help to improve blood sugar levels, lower the cholesterol level, and promote regular bowel movement. The presence of coconut flour might help improve digestion due to its high fiber content and the presence of orange peel powders also rich in fiber.

Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. In watermelon rind powder there is full of vitamin-C, vitamin-B6, vitamin- A. and decent amount of potassium, zinc also. The citrulline present in watermelon rind powder can help fight free radical damage and boost immune system. The presence of orange peel powders also rich in fiber, Vitamin-C, folate, vitamin-B6 and other essential nutrients such as zinc, potassium, selenium also.

Many gluten free bakery type products provide less protein, fiber and mineral content than some foods that contain gluten. However, by adding the rice flour and coconut flour, nutritional value can be enhanced. The taste is also enhanced by adding the coconut flour also. Anyone with celiac disease suffers from a digestive condition that disrupts the immune system when coming contact with gluten, the bakery products containing rice flour and coconut flour can help by offering an alternative. Based on the physical and chemical properties, the cookies and cakes are very nutritious for health and environment friendly. It can be easily affordable for consumers of bakery products who are very health conscious.

CONCLUSION

From the above study, it is concluded that the use of watermelon rind and orange peel can save the environment through the huge utilization of the powder form of watermelon rind and orange peel. It is possible to make cake and cookies from the watermelon rind powder and orange peel powder. Both the bakery products are very nutritious as well as pocket-friendly. It is also used as the source for gluten free which is very useful for gluten sensitive people. It is also environment friendly. Further development of these products, taste should be better as per sensory evaluation and should increase in nutrition area also.

ACKNOWLEDGEMENT

We acknowledge our college authority to carry on our research work properly.

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