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Effect of Watermelon *(Citrullus lanatus)* Rind Flour Incorporation on Nutritional and Organoleptic Attributes of Cakes

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Abstract

Bakery products have become popular among different cross-sections of the population in India in recent years due to increased demand for convenient foods. The sponge cakes and fruit cakes were prepared by replacing only refined wheat flour with different levels of watermelon rind flour (WRF). WRF has a moisture of 12.17 per cent, protein 10.18 g, fat 2.37 g, crude fibre 17.44 g, ash 11.82 g and carbohydrates 46.02 g, respectively. Three variations of sponge cakes and fruit cakes were prepared by incorporating WRF at 10, 20 and 30 per cent levels, respectively. Among sponge cakes, T_1 (10 % incorporation) was found to be most accepted with scores for appearance 8.57, colour 8.42, texture 8.09, aroma 8.33, taste 8.54 and overall acceptability 8.23. The nutritional value of sponge cake indicated fibre (2.70 g), fat (3.73 g), calcium (47.68 mg), iron (1.98 mg) and phosphorus (87.07 mg), respectively. The sensory scores of fruit cake with 10 per cent WRF incorporation (T_1) was found to be best accepted with values for appearance 8.19, colour 8.26, texture 8.07, flavour 8.33, taste 8.19 and overall acceptability 8.09. The nutritional composition indicated fibre (2.76 g), fat (11.49 g), calcium (46.36 mg), iron (1.90 mg) and phosphorus (149.90 mg), respectively which is higher than that of control. Therefore, it can be observed that cakes enriched with watermelon rind flour increased the nutrient composition especially fat, fibre and mineral content of the cakes. Hence, watermelon rind flour, the byproduct of watermelon can be utilized effectively for enhancing the nutritional composition of cakes.

Keywords : Bakery products, Byproduct utilisation, Fruit cake, Sponge cake, Watermelon rind

Fruits and vegetables being perishable in nature undergo spoilage at various stages of their harvesting, handling, transport, storage, marketing, processing. The spoilt produce is not fit for marketing and is a virtual loss. Some fruits do not find much suitability for processing and are mostly used for direct consumption, one such fruit is watermelon (Bhatnagar, 1991). Red coloured watermelon pulp is used normally discarding the watermelon rind that has protein, fat, carbohydrates, crude fiber and ash content decently (Koocheki *et al*., 2007). The nutrient composition of watermelon rind flour has a moisture of 12.17 per cent, protein 10.18 g, fat 2.37 g, crude fibre 17.44 g, ash 11.82 g and carbohydrates 46.02 g, respectively (Ashoka,–2019). Some work on the 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, 1991). Currently, the food sector has to deal with a high rate of food waste produced by industrial fruit processing of various products such as jams, wines, juices, ice cream, sweets and others. The use of waste from the industrial processing of fruits is an important new step for the food industry (Bertagnolli *et al.,* 2014). The bakery industries are one of the largest organized food industries all over the world and particularly cakes are one of the most popular products (Sindhuja *et al.,* 2005). Bakery products are generally used as a source for the incorporation of different nutritionally rich ingredients for their diversification (Sudha *et al.,* 2007).

Numerous studies have been carried out to replace wheat flour with the flour from the fruit residues in the preparation of bakery products such as biscuits and cookies because of the economic constraints, business requirements, new consumption trends, and specific eating habits (Aquino *et al.,* 2010 and Perez

& Germani, 2007). Fruit residues can be important sources of nutrients and to satisfy consumer demand for healthier products, many food industries are finding ways to add functional ingredients to their products (Assis *et al.,* 2009).

The cake is one of the relished and palatable baked products prepared from flour, sugar, shortening, baking powder, egg and essence as principal ingredients. The variation in these constituents causes changes in the textural properties of cakes. Cakes are highly popular among the large segment of the population in urban and rural places and their demand and consumption are increasing day by day [Hoque and Iqbal (2015)]. The present investigation was carried out at the Department of Food Science and Nutrition, University of Agricultural Sciences, Bangalore with the objective of the effect of watermelon *(citrullus lanatus)* rind flour incorporation on nutritional and organoleptic attributes of cakes.

Material and Methods

Selection and Collection of Sample

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

Processing and Dehydration

The watermelon fruits were washed under running tap water and they were wiped with using a clean dry cloth. All the watermelon fruits were peeled separately by using a peeler and the pulp was separated from the watermelon rind by using a knife and the remaining portion of seeds was separated by cutting the pulp into small cubes. After weighing the watermelon rind, the pieces were kept for dehydration at 60 °C until they dried properly. The dried rind was ground into powder by using an electric grinder and sieved through a scientific sieve (mesh size 60). Then, the dehydrated powder was packed and used for further purposes.

Formulation of Watermelon Rind Sponge Cake

The sponge cakes and fruit cakes were prepared by replacing refined wheat flour with different levels of watermelon rind flour in the basic formulation of cakes. The replacement of refined wheat flour by watermelon rind powder was at 10 , 20 and 30 per cent substitutional levels and they were compared with control. The procedure for preparation has been mentioned in Fig. 1 and 2.

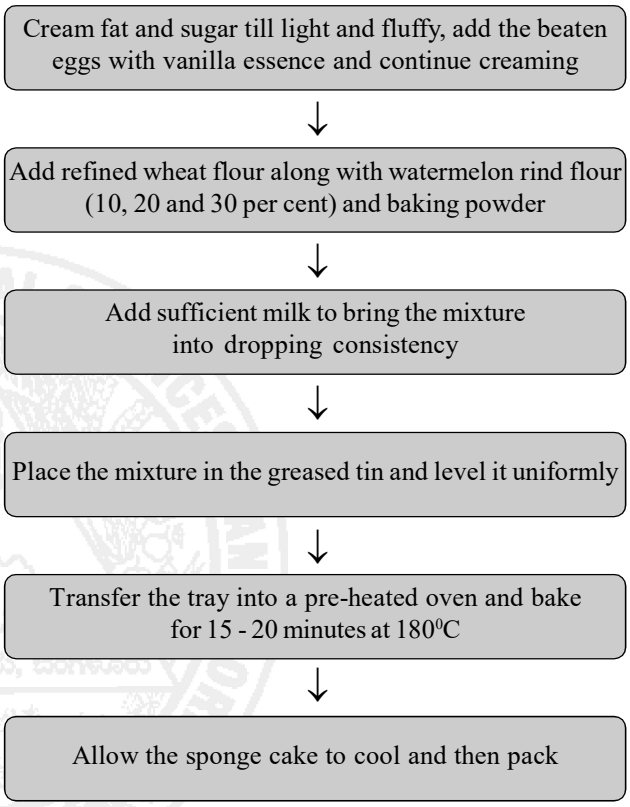

Fig. 1: Procedure for preparation of watermelon rind flour Sponge cake

Organoleptic Evaluation of the Developed Products

The products were subjected to sensory evaluation. Sensory quality attributes were evaluated by a semi-trained panel of 21 members using a nine-point hedonic scale [Amerine *et al.* (1965)].

Computation of Nutritional Composition for Best-Accepted Cookies

The nutrient composition for the best-accepted products was computed by using the Indian food composition table [Longvah *et al*. (2017).

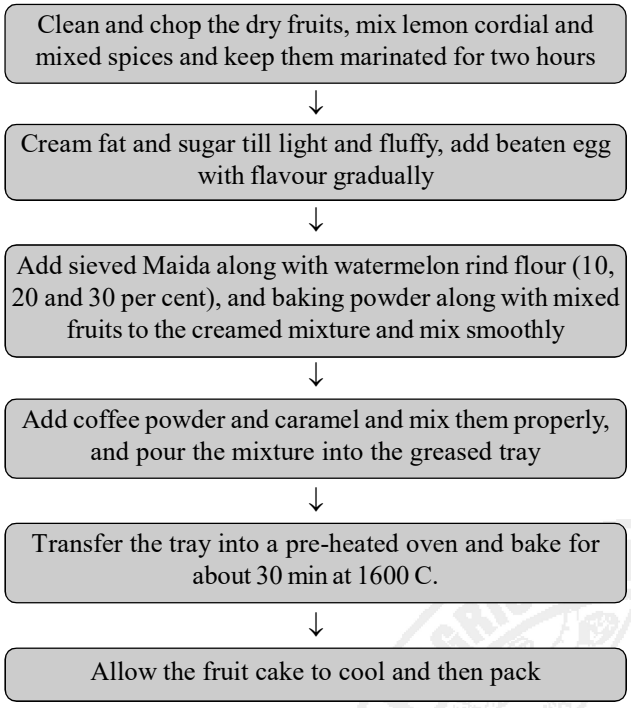

Fig. 2: Procedure for preparation of fruit cake with watermelon rind flour

Statistical Analysis

The data were subjected to analysis of variance (ANOVA) for testing the significance of variation of sensory evaluation of developed products by using software Statistical Package for Social Sciences (SPSS) version 12.0 (Sabine and Brian, 2004).

Results and Discussion

Sensory Evaluation of the Sponge Cake

Sponge cake formulated with different levels of incorporation of watermelon rind flour and subjected to sensory evaluation and mean scores are presented in Table 1. It shows appearance, colour, and taste had highly significant differences whereas texture and overall acceptability were non-significant. Control had high scores for all sensory attributes when compared to sponge cake prepared from different variations of WRF. Wherein sponge cake with 30 per cent incorporation *i.e.,* (T_3) had a comparatively lower score for appearance (7.80), colour (7.78), flavour

Table 1

Sensory evaluation of watermelon rind flour sponge cake and fruit cake

	Variation	Appearance	Texture	Colour	Flavour	Taste	OA
WRF Sponge cake	C	8.23 ± 0.88	8.38 ± 0.58	8.19 ± 0.67	8.21 ± 0.60	8.35 ± 0.57	8.30 ± 0.55
	T_1	8.57 ± 0.59	8.09 ± 0.60	8.42 ± 0.65	8.33 ± 0.65	8.54 ± 0.58	8.23 ± 0.53
	T_2	8.04 ± 0.58	7.94 ± 0.59	7.76 ± 0.53	7.88 ± 0.54	7.88 ± 0.63	8.11 ± 0.49
	T_3	7.80 ± 0.87	8.07 ± 0.84	7.78 ± 0.78	7.76 ± 0.88	7.88 ± 0.89	7.92 ± 0.92
	Mean ± SD	8.16 ± 0.78	8.12 ± 0.67	8.04 ± 0.71	8.04 ± 0.71	8.16 ± 0.73	8.14 ± 0.65
	F value	*	NS	*	*	*	NS
	CD	0.46	-	0.41	0.42	0.42	-
	SEM	0.16	0.14	0.14	0.14	0.14	0.14
WRF Fruit cake	C	8.23 ± 0.53	8.38 ± 0.58	8.19 ± 0.67	8.21 ± 0.60	8.35 ± 0.57	8.30 ± 0.55
	T 1	8.19 ± 0.66	8.07 ± 0.59	8.26 ± 0.73	8.33 ± 0.65	8.19 ± 0.74	8.09 ± 0.53
	T_2	8.00 ± 0.63	7.97 ± 0.55	7.80 ± 0.51	7.80 ± 0.60	7.80 ± 0.60	7.95 ± 0.49
	T_3	7.85 ± 0.79	7.90 ± 0.76	7.80 ± 0.74	7.80 ± 0.87	7.80 ± 0.87	7.85 ± 0.85
	Mean ± SD	8.07 ± 0.66	8.08 ± 0.64	8.01 ± 0.69	8.04 ± 0.72	8.04 ± 0.73	8.05 ± 0.64
	F value	NS	NS	NS	*	*	NS
	CD	-	-	-	0.42	0.43	-
	SEM	0.14	0.13	0.14	0.15	0.15	0.13

Note : C- Plain or control cookies, T_1 = 10% WRF, T_2 = 20%WRF, T_3 = 30%WRF
OA-Overall acceptability, NS-Non significant, *-Significant

(7.76), taste (7.88) and overall acceptability (7.92). However, the overall acceptability of sponge cake revealed that control was best when compared to all (8.30) followed by 10 percent incorporation *i.e.*, (T_1) (8.2) and 20 per cent incorporation *i.e.,* (T_2) (8.11). A statistical decrease in scores was observed when compared to control.

The results obtained from the present study were similar to that recorded by Hoque *et al.* (2015) about the incorporation of watermelon rind flour with refined wheat flour to develop cakes and the results revealed that overall acceptability of the cake sample incorporating 10 per cent watermelon rinds flour *i.e.,* (T_1) was more accepted than 20 per cent (T_2) and 30 per cent (T_3). As the substitutional level of rind flour increased the acceptability level decreased however, T_1 was accepted among all variations.

Sensory Evaluation of the Fruit Cake

The mean sensory scores of fruit cake prepared with different levels of incorporation of watermelon rind flour are indicated in Table 1. It revealed that flavour and taste differed significantly whereas appearance, texture, colour and overall acceptability were non-significant. The results from Table 1 showed that in the sensory evaluation, there was a decrease in the appearance, texture, colour, flavour and overall acceptability of the fruit cake with the gradual increase in the watermelon rind flour. The fruit cake incorporated with 10 per cent supplementation of watermelon rind flour is the most acceptable among experimental variations when compared with the control. It could be concluded that WF can be supplemented (up to 10 %) during the preparation of cakes.

Nutrient Composition of Best Accepted Watermelon Rind Flour-Based Baked Products (per 100g)

The nutrient composition for the best-accepted products was computed by using the Indian food composition table [Longvah *et al*. (2017)]. The nutrient composition of best-accepted WRF cookies, sponge cake, and fruit cake are represented in Table 2.

Moisture, protein, fat, crude fibre, total ash, carbohydrates, ascorbic acid, and mineral composition of control and 10 per cent WRF incorporated sponge cake was analyzed and results revealed that, except protein (5.61g) and carbohydrate (42.20 g), 10 per cent WRF incorporated sponge cake had a higher amount of moisture (26.20 %), fat (3.73 g), ash (1.42 g), crude fibre (2.70 g), calcium (47.68 mg), iron (1.98 mg) and phosphorous (87.07 mg) per 100g. While control sponge cake had moisture (26.11 %), protein (5.63 g), fat (3.57 g), ash (0.28 g), crude fibre (2.70 g), carbohydrate (45.03 g), calcium (24.29 mg), iron (0.88 mg) and phosphorous (71.25 mg) per 100g.

Also, similar results were detected by Al-Sayed and Ahmed (2013) where they noticed that proximate analysis of cake containing substituted flour with different levels of watermelon rind powder and results revealed that 27.04 per cent, 13.40 g, 1.48 g, 9.49 g, and 48.58 g (control) and 25.24 per cent, 13.49 g, 2.11

TABLE 2

Nutrient composition of best-accepted watermelon rind flour-based baked products (per 100g)

Products	Moisture (%)	Protein (g)	Fat (g)	Ash (g)	Crude fibre (g)	CHO (g)	Ca (mg)	Fe (mg)	P (mg)
Control	26.11	5.63	3.57	0.28	1.23	45.03	24.29	0.88	71.25
Experimental (10% WRF)	26.20	5.61	3.73	1.42	2.70	42.20	47.68	1.98	87.07
Control	20.59	7.82	11.45	0.66	2.39	42.04	40.51	1.62	145.95
Experimental (10% WRF)	20.66	7.81	11.49	0.94	2.76	41.33	46.36	1.90	149.90

g, 7.50 g and 51.64 g (7.5 % WRP) of moisture, fat, ash, protein and total carbohydrates, respectively which was higher than the control. Similarly, the moisture, fat, ash, crude fibre, and minerals were increased in the present study whereas, carbohydrates and proteins were decreased.

Ten per cent WRF fruit cake had higher amount of moisture (20.66 %), protein (7.81g), fat (11.49g), total ash (0.94g), crude fibre (2.76g), carbohydrate (41.33g), calcium (46.36mg), iron (1.90mg) and phosphorous (149.90mg) compared to control fruit cake *i.e.,* it had moisture (20.59 %), protein (7.82g), fat (11.45g), total ash (0.66), crude fibre (2.39g), carbohydrate (42.04g), calcium (40.51mg),iron (1.62mg) and phosphorous (145.95mg). As watermelon rind flour was added to the product the nutrient composition was increased because the rind flour contained more amount of minerals and other macronutrients like fibre.

Watermelon rind which is usually a waste after the consumption of the pulp has good functional and nutritional properties and thus the dehydrated watermelon rind flour can be used for food formulations. The cakes enriched with the watermelon rind flour indicated adequate increase in protein, fibre and minerals like calcium, iron and phosphorous with also a slight increase in fat. Hence it can be a good option for incorporating WRF in bakery products like cakes that are very popular snack item so as to enhance the nutritional composition.

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