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Acceptability of Fibre Rich Cake Prepared Using Cassava Residue Flour, Blended With Wheat, Trifoliate Yam and Cocoyam Flour in Nigeria

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Abstract Cake can be made from flour samples of low protein content, that include soft wheat, corn and root and tuber crops. This study is aimed at evaluating the acceptability of cake prepared using cassava *gari* residue flour (R), blended with wheat flour (W), trifoliate yam flour (T) and cocoyam flour(C) at different ratio. The samples were 100% cassava *gari* residue flour (R100), 100% wheat flour (W100), residue flour: trifoliate flour (R90:T10 and R80:T20), residue flour: cocoyam flour (R90:C10 and R80:C20), residue flour: wheat flour (R90:W10 and R80:W20) respectively. A 9-point Hedonic scale of 1-9 was used to evaluate the sensory attributes of the cake samples prepared. The cassava *gar*i residue flour and all the blends were found to have good sensory qualities and were well accepted as the conventional cupcake (100% wheat flour). Overall acceptability was determined using the overall means score of the sensory attributes (taste, colour, aroma. chewable and texture). The overall acceptability means scores were 6.50 (R90:T10), 6.54 (R80T:20), 7.47(R90:C10), 7.80 (R80:C20) 7.65 (R90:W10), 7.80 (R80:W20), 7.50 (R100) and 8.03 (W100). The proximate composition of the residue flour (R100) had the lowest moisture content of 7.5835% and fat content of 0.1835%, the highest percentage crude fibre (2.8160%) and total carbohydrate (87.5665). While the cake samples had percentage moisture from 30.0625 to 36.6445%; ash from 3.4580 to 5.4935%; crude fibre from 0.2700 to 2.9500%; fat from 4.2885 to 18.9300%; Protein from 5.9175 to 16.9610% and total carbohydrates from 28.4610 to 54.0380% contents respectively.

Keywords: *cake, root and tuber crops flour, wheat flour, postharvest, food security*

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1. Introduction

Cake of all kinds prepared with different types of flour and composites flours are consumed by people throughout history. The word cake is from the Viking language, old Norse Kaka [1]. Cake is used at ceremonial occasions and in household setting. The recipe of cake from 19th century includes wheat flour and baking powder instead of yeast [2]. Cake can be prepared as large, small, plain light or rich form. They are mostly prepared from low protein such as low protein wheat, cereal, root and tuber crops. Flours for baking cake can be produced from grains, cereals, roots and tubers [3]. Composite flour is the binary or ternary mixtures of flours from other flour samples with or without wheat flour. Blends of two or more flour samples have been utilized in most part of the world and these include: flour blends of wheat and other cereals [5]; wheat and legumes [6]; wheat and cassava [7]; wheat, chickpea soy and methi [8] and so on. Cassava, a staple food in Africa, cultivated in most parts of the continent [9] is considered to be a food crop with great potential for industrial use [10]. Cassava plays a major role in alleviating food crises, not only due to its production of energy but also to its variety of usage of its processed forms. Cassava flour and its composite flour had been utilized in baking products like bread making, different types of pastries, household food and manufacturing of industrial products [11,12], hence it has been considered as a partial replacement of wheat for use in baking [13,14].

Processing Cassava root into useful products may result into a lot waste [15] that lead to post harvest losses. One of the ways to reduce the waste is to convert it into useable product for sustainable food security [16]. Waste from the processing of cassava root can be in liquid form or solid form. Fibre waste from cassava *gari* processing can be the fibre waste from peeling or sieving operation. This study is aimed at evaluating the acceptability of cake prepared using cassava *gari* residue flour (solid waste incurred from the sieving operation of the dewatered mesh), blended with wheat, trifoliate yam and cocoyam flour at different ratio.

2. Material and Methods

2.1. Source of Materials

Cassava root (*Manihot esculent*) and cocoyam (*Xanthosoma spp*) were obtained from National Root Crops Research Institute Umudike Abia State Nigeria. Trifoliate yam (*Dioscorea dumutorum*), wheat flour and cake ingredients were purchased from Warukum market Makurdi Benue state Nigeria.

2.2. Preparation of Flour Samples

Cassava roots (15kg) were washed, peeled and processed into *gari* to obtain the residue flour. Tubers of cocoyam (1KG) and trifoliate yam (1KG) were also washed, peeled and processed into flour, Figure 1 and Figure 2 show the flow chart of the production of cassava residue flour, cocoyam flour and trifoliate yam flour.

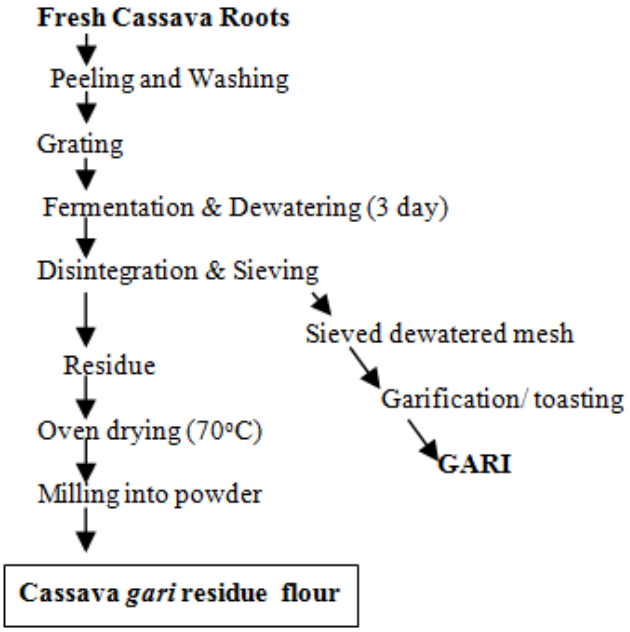

Figure 1. Flow chart for production of cassava residue flour obtained from *gari* processing operation. Source: [16]

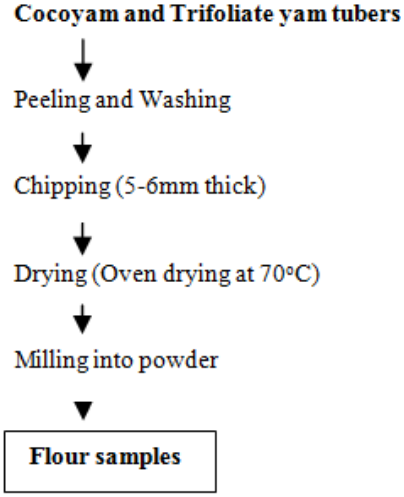

Figure 2. Flow chart for the production of cocoyamflour and trifoliate flour. Source: [17]

Table 1. Formulation of the flour blends of cassava residue flour, cocoyam flour wheat flour and trifoliate yam flour

Samples	Cassava Residue Flour(R) (%)	Wheat flour (W) (%)	Cocoyam flour (C)(%)	Trifoliate flour (T) (%)
R100	100	0	0	0
W100	0	100	0	0
R90T10	90	0	0	10
R80T20	80	0	0	20
R90C10	90	0	10	0
R80C20	80	0	20	0
R90W10	90	10	0	0
R80W20	80	20	0	0

2.2.1. Recipe for Vanilla Cupcakes [18]

2.2.1a. Ingredients

- 1 and 1/3 cup (165 grams) flour.
- 1 and ¼ teaspoon of baking powder.
- ½ teaspoon of salt.
- ½ cup (115 grams) unsalted butter.
- 1 cup (200 grams) granulated sugar.
- 2 large eggs.
- 2 teaspoon vanilla extract.
- ½ cup (120 grams) full fat sour cream.

2.2.1b. Method

The experimental oven (scarchtech electrothermal oven model DHG) was preheated to 380°F (180°C). The vanilla extract, flour baking powder and salt were whisked together in a large stainless bowl. In another stainless bowl, butter and sugar were beaten until mixture became light and fluffy. The eggs one at a time were beaten in the same bowl and then sour cream is added and mixed until everything was combined. The mixed dried ingredients (vanilla extract, flour, baking, powder and salt) were slowly added to the mixture of wet ingredients mentioned above and mixed. The batter was scooped into greased cupcakes pan, baked at the pre-heated temperature for 22 minutes. Completion of the baking of the cake was signified when a long fork with a wooden handle used at the center of the cake in the pan, could come out very smooth without any stain. The cupcakes were removed from the oven, placed on a wooden cake flat board and allowed to cool. They were further removed from the pan and coded R90T10, R80T20, R90C10, R80C20, R90W10, R80W20, R100 and W100.

Figure 3. Cassava *gari* residue flour

Figure 4. Cupcakes samples. R100 = 100% cassava *gari* residue flour. R80W20 = 80% cassava *gari* residue flour and 20% wheat flour

2.3. Proximate Composition Analysis

The chemical proximate composition (moisture, crude fiber, ash, crude protein, fat) of the residues flour, blends and cupcake samples were determined in triplicates using the standard method described by Association of Official Analytical Chemistry [19].

2.4. Sensory Evaluation

The sensory evaluation of the cupcakes was determined using a twenty member panelists. The panelists were instructed to evaluate the coded cupcakes samples for taste, colour, aroma. chewable texture, and overall acceptability using a nine (9) point Hedonic scale which ranged from 1 (dislike extremely) to 9 (like extremely) [16,20]. Bottled water was provided to rinse the mouth between evaluations.

2.5. Data Analysis

The obtained data for the chemical analysis and the sensory attributes were Statistically Analysed with computer software SAS (Statistical Analysis System).

The proximate composition of the cassava *gari* residue flour and its blend with trifoliate flour, cocoyam flour and wheat flour are presented in Table 2. There was an increase in moisture, ash, fat and protein contents as trifoliate yam, cocoyam and wheat flours were included in the formulation. However there was an observed decrease in crude fibre content. Results also showed that 100% cassava *gari* residue flour (R100) had highest crude fibre (2.8160%), dry matter (92.4155%) and total carbohydrate (87.5665%) contents. The moisture content of the cassava residue flour and its blends ranged from 7.5835 to 9.0025%, this is lower than wheat flour value of 11.2375%. The results of the residue flour and its blend are also lower than the reported values of 11 – 13% moisture content in the work by Bankole et al [21]. Low moisture content is an indication that the cassava *gar*i residue flour will have a long shelf life if properly stored under good conditions [16]. The results as recorded infer that the experimental flour samples when blended can complement each other in terms of nutrients.

The mean sensory evaluation scores of the cupcakes samples are shown in Table 3. There were significant differences at $p<0.05$ for parameters evaluated. The cakes sample coded R90T10 and R80T20 seem to be the least accepted. However in the overall acceptable means scores, there were no significant differences ($p<0.05$) between R80W20 (80%residue flour: 20%wheat flour) and R80C20 (80%residue flour: 20%cocoyam flour). The overall acceptable means scores of this work is comparable to the cake baked by Okorie and Onyeneke [22] from blend of sweet potatoes and wheat flour. The obtained results are also comparable to Abegunde *et al* [23] on Quality Evaluation of Baked Cake from Wheat Breadfruit Composite flour.

Table 2. Proximate composition of the cassava *gari* residue flour and its blend, with wheat flour, cocoyam flour and trifoliate flour

Sample names	%Dry matter	% Moisture	% Ash	%Crude fibre	% Fat	% Protein	% Carbohydrate
R90T10	91.0830^{e}	8.9220^{c}	1.1800^{c}	2.5940^{f}	0.1845^{e}	1.1165^{g}	86.0065^{b}
R80T20	90.9925^{f}	9.0025^{b}	1.4860^{a}	2.3720^{h}	0.1905^{d}	1.2710^{f}	85.6850^{d}
R90C10	91.1175^{d}	8.8825^{d}	0.9955^{e}	2.6640^{e}	0.1940^{d}	1.4075^{e}	85.8515^{c}
R80C20	91.0785^{e}	8.9205^{c}	1.0865^{d}	2.5130^{g}	0.1960^{d}	1.8790^{c}	85.4050^{f}
R90W10	91.3610^{b}	8.4385^{f}	0.9230^{g}	2.8050^{b}	0.5075^{c}	1.6750^{d}	85.6505^{e}
R80W20	91.3415^{c}	8.6585^{e}	0.9650^{f}	2.7910^{c}	0.8210^{b}	2.3430^{b}	84.4215^{g}
R100	92.4155^{a}	7.5835^{g}	0.8835^{h}	2.8160^{a}	0.1835^{e}	0. .9600^{h}	87.5665^{a}
W100	88.7625^{g}	11.2375^{a}	1.3115^{b}	2.6925^{d}	3.3520^{a}	7.8710^{a}	73.5355^{h}

Samples with the same letter in the columns are not significantly different ($p<0.05$).

Table 3. Sensory evaluation of cupcake samples prepared from Cassava *gari* residue flour and its blend with wheat flour, cocoyam flour and trifoliate flour

Coded samples	Taste	Colour	Aroma	Chewable	Texture	Overall acceptability
R90T10	5.65^{f}	5.65^{e}	5.85^{g}	8.05^{f}	6.85^{f}	6.50^{g}
R80T20	6.70^{e}	5.50^{f}	5.75^{h}	8.00^{g}	6.75^{g}	6.54^{f}
R90C10	7.00^{d}	7.65^{d}	7.50^{e}	8.10^{e}	7.10^{e}	7.47^{e}
R80C20	7.35^{b}	8.20^{b}	7.70^{b}	8.15^{d}	7.60^{d}	7.80^{b}
R90W10	7.20^{c}	7.65^{d}	7.55^{d}	8.20^{c}	7.65^{c}	7.65^{c}
R80W20	7.35^{b}	8.00^{c}	7.65^{c}	8.25^{b}	7.75^{b}	7.80^{b}
R100	7.00^{d}	7.65^{d}	7.15^{f}	8.20^{c}	7.65^{c}	7.53^{d}
W100	7.550^{a}	8.30^{a}	8.00^{a}	8.30^{a}	8.00^{a}	8.03^{a}

Samples with the same letter in the columns are not significantly different ($p<0.05$) using Duncan Multiple Range Test.

Table 4. Proximate composition of the cupcake samples

Sample names	% Dry matter	% Moisture	% Ash	% Crude fibre	% Fat	% Protein	% Carbohydrate
R90T10	63.3555^{h}	36.3175^{b}	4.5410^{b}	2.7305^{b}	4.2885^{g}	5.9175^{g}	50.4900^{f}
R80T20	63.6820^{g}	36.6445^{a}	5.4935^{a}	2.4960^{d}	4.1745^{h}	6.7445^{f}	42.3600^{d}
R90C10	63.6870^{f}	36.1540^{d}	3.9170^{d}	0.2750^{g}	4.4450^{c}	11.8530^{d}	43.3560^{d}
R80C20	63.8430^{e}	36.3130^{c}	4.2550^{c}	2.6455^{c}	4.4905^{b}	15.8270^{a}	36.4690^{h}
R90W10	63.9230^{d}	34.0770^{f}	3.5950^{f}	0.2700^{g}	4.4040^{e}	10.4755^{e}	47.1785^{c}
R80W20	64.7520^{c}	35.2480^{e}	3.7705^{e}	2.2450^{e}	4.4130^{d}	12.3950^{b}	41.4585^{d}
R100	69.9375^{a}	30.0625^{h}	3.4580^{h}	2.9500^{a}	4.4010^{f}	5.0905^{h}	54.0380^{a}
W100	69.1170^{b}	30.8830^{g}	3.5350^{g}	1.2300^{f}	18.930^{a}	16.9610^{a}	28.4610^{e}

Samples with the same letter in the columns are not significantly different ($p<0.05$).

Proximate composition of cupcakes prepared from cassava *gari* residue and its blend with triofolate yam flour, cocoyam flour and wheat flour result is presented in Table 4. Cupcakes sample R100 (100% cassava *gari* residue flour) recorded the highest score in percentage dry matter (69.9375), crude fiber (2.9500) and total carbohydrate (54.0380) contents. Cupcakes sample R80T20 (80% cassava *gari* residue flour; 20% trifoliate yam flour) ranked the highest score of 5.4935% in ash content. However 100% wheat flour (W100) had the highest percentage of fat (18.9300) and protein (16.9610) content.

The trends in the proximate composition results of the cupcakes samples show that the nutrients contents of the cake samples can be altered by blending of flours. Cassava *gar*i residue flour could be used to blend with flour samples lower in crude fibre content to obtain higher fibre content. The crude fibre, ash and protein results recorded in this study were higher than the ones obtained in Eke-Ejiofor work with breadfruit, sweet potato and wheat composite flour cake [24]. These result recorded in crude fibre of the cupcakes (Table 4) is higher than 100% wheat flour (W100). These result also showed higher crude fibre content than cake prepared with wheat and cocoyam composite flour in the work of Yehunde and Chima [25].

3. Conclusion

This study shows that cupcake can be prepared from cassava residue flour, and its blends with flour of wheat, cocoyam and trifoliate yam. The overall acceptability of the sensory attributes of the cake samples prepared with cassava residue flour and all the blends were found to have good qualities and were all accepted as the hundred percent (100%) wheat flour. The successful utilization of cassava *gari* residue flour and its blend with cocoyam and trifoliate yam in baked cake making could help in reducing the postharvest losses of these crops in Nigeria and enhancing the fibre contents of cake.

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