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UTILISATION OF YELLOW NUTSEDGE TUBER FOR COMPOSITE FLOUR

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Composite flour made up of yellow nutsedge tuber, wheat, and soybean has been employed in the baking of cake and biscuit samples. These confectionery products were subjected to quality tests and taste panel evaluation. Results obtained showed that acceptable cake and biscuit could be baked from a recipe containing up to 50% yellow nutsedge tuber flour, 40% wheat flour and 10% soybean flour. Considerable interest was generated by the chocolate appearance and cake quality of 100% yellow nutsedge flour from the taste panelists, even though, the 100% yellow nutsedge flour cake ranked lowest in the average task panel scores. Cake and biscuits samples baked from up to 20% and 40% substitution with yellow nutsedge flour were preferred and ranked superior among others. Availability of yellow nutsedge tuber in its areas of distribution and factors which might work against its utilisation for confectionery products is discussed.

Key words: Cyperus esculentus, Yellow nutsedge and Composite flour.

Introduction

Consumption of bread, biscuit, cake and other confectionery products is very common in developing countries which Nigeria belongs. These food products are manufactured almost exclusively from wheat imported from the growing Western nations to the tune of several millions dollars. As a result of huge sum of foreign currency being expended on the importation of wheat, many of these nations are in debt and above all are at the mercy of these producer's nations. To this end, researchers in the developing nations have increasingly focused on the development of composite flour technology for bread and other confectionery production [1-3]. Rodriguezsosa *et. al.*, [4] baked an acceptable cake samples from composite flour of wheat and green banana. Also acceptable biscuit have been produced by Kim and De Ruiter [3] from a recipe containing 100% cassava starch and soy flour mixture. Adeyemi and Omolayo baked acceptable biscuit and cake samples from cocoyam flour and starch.

Cereals, tubers and legumes such as rice, cassava, soybean banana and cocoyam used in compounding the composite flour by the previous workers formed the staple food sources of most Nigerians.

Research is in progress to find alternative source of confectionery flour, preferably a lesser-known tuber, cereal or legume that would replace or at least supplement the sources listed above so that production of composite flour in the developing countries and indeed Nigeria could be enhanced. One appropriate lesser-known tuber is yellow nutsedge (*Cyperus esculentus*).

Yellow nutsedge (*Cyperus esculentus*), a perennial plant, is widely distributed throughout the world and constitutes one of the worst known weeds [5]; it is a native of Africa and Southern Europe*. The tuber, which is also known as Chufa, is grown and harvested during the rainy season. It thrives well on damp, sandy, extremely acidic soils. The tuber is known by various local names such as "Atangbe" in Ghana; "Uintjie" in South Africa; "Amande De Terre" in France and "Esculenti Kukenth" in Latin America [6, 7]. In South Western Nigeria it is commonly called "Imumu", while in the East it is called "Oofio" and in the Northern Nigeria it is called "Aki Aaya" [8].

The plant has been in cultivation in Nigeria since early times for the sake of edible tubers and is also used to cure the effect of dysentry and malaria fever [9]. Chemical investigation of the tuber indicated that the tuber is rich in starch (about 80%) and the amino acid components of the tuber protein resembles that of hen egg [10].

Soybean used to supplement the protein level of the wheat/yellow nutsedge tuber is a native of East Asia it ranks high among the leguminous crops of the world, both in its content of protein and its nutritional quality [11].

At present, there is no available information in the literature on the utilisation of yellow nutsedge as a flour source for either bread or any confectionery product in Nigeria or elsewhere. This study is conducted to present yellow nutsedge as a confectionary flour source and to assess the quality and acceptability of cake and biscuit samples baked from a composite flour containing yellow nutsedge and soybean flour.

Materials and Methods

Yellow nutsedge flour and soybean flour were laboratory prepared as described below.

Yellow nutsedge flour. Fresh samples of yellow nutsedge tubers were procured from local markets and identified by the Botany Department of the University of Ibadan. The tubers were washed, air dried and crushed in a laboratory grinder to pass through a 100 mesh sieve before being subjected to solvent extraction in an aspirator with food

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grade *n*-hexane for 6 hours. The defatted tubers were milled on Alpine pin mill Model 250 CW, at a rotor speed of 6,000 rpm on the door side of the mill and a counter rotation speed of 11,500 rpm on the opposing pins.

Soybean flour. Cleaned soy-beans were purchased and defatted as described above before being milled into flour on an Alpine pin mill.

Methods for the determination of protein content (Nx6.25), residual fat, crude fibre, moisture and ash were those recommended by either Association of Official Analytical Chemists [12], American Oil Chemists Society [13], or American Association of Cereal Chemists [14] in their official tentative methods. Factors other than moisture are expressed on a dry weight basis.

Biscuit samples were baked by the method described by Adeyemi and Omilayo [3] using 100% wheat flour or mixture of wheat flour and 20, 40, 50, 60 or 80% yellow nutsedge flour and 10% soybean flour to supplement the protein content of yellow nutsedge flour. Recipe for the biscuit manufacture is given in Table 2.

TABLE 1. DEFATTED YELLOW NUTSEDGE AND SOYBEAN FLOUR STANDARDS.

Parameter*	Yellow nutsedge flour	Soybean flour
Protein (6.25xN)	12.1 ± 0.1	47.0 ± 0.3
Fat	2.2 ± 0.1	3.0 ± 0.1
Moisture	12.0 ± 0.1	12.0 ± 0.1
Ash	3.3 ± 0.1	6.0 ± 0.1
Fibre	2.9 ± 0.1	3.5 ± 0.1
Carbohydrate	57.0 ± 0.2	—

*All values represent mean ± S.D.

Cake making. The procedure developed for baking of cake made with composite flour by a Technical Compendium on Composite Flour was adopted [15], recipe for the preparation is given in Table 2.

Both biscuit and cake samples were evaluated for the following parameters, height, diameter and specific volume. Organoleptic test was also conducted on the biscuit and cake samples among 10 students of the Department of Chemistry, University of Ibadan. Quality factors examined were firmness of product, aroma, colour, sponginess (for cake only), crumpyness, and sweetness, appearance internal structure and eating quality. The panelist were asked to indicate their preference for the product, using a 5-point hedonic scale where 1 is dislike extremely and 5 is like extremely. The results were then subjected to statistical analysis according to Krammer's rank technique [16].

Results and Discussions

Table 1 summarises the proximate chemical composition of defatted flour of yellow nutsedge and soybean with respective standard error of analysis. Carbohydrates constitute 56 ± 0.2% of yellow nutsedge tuber dry weight, starch being the most abundant, fructose, glucose and sucrose were the saccharrides detected in the free sugar content of the tuber [10]. Protein content of the defatted flour is 47 ± 0.3% while oil contents in both yellow nutsedge flour and soybean flour are 2.2 ± 0.1 and 3.0 ± 0.1% respectively. Oil contents of yellow nutsedge tuber and soybean are 23 and 18% respectively [5, 11]. Ash and crude fibre contents for both substrates were fairly high, this could be attributed to the hard outer layer surrounding the soyabean and yellow nutsedge tuber. From this preliminary proximate analysis and by proper adjustment of other ingredient, it should be possible to bake cake and biscuit samples from defatted

TABLE 2. RECEIPES FOR BISCUIT AND CAKE SAMPLES**.

	Composition of batches											
	1st Baking		2nd Baking		3rd Baking		4th Baking		5th Baking		6th Baking	
Ingredient	B	C*	B	C*	B	C*	B	C*	B	C*	B	C*
Wheat flour (g)	500	100	400	80	300	60	100	20	0	–	200	40
Yellow nutsedge flour (g)	–	–	100	20	200	40	400	80	500	100	250	50
Soybean flour (g)	–	–	–	–	–	–	–	–	–	–	50	10
Fat (g)	250	70	250	70	250	70	250	70	250	70	250	70
Sugar (g)	125	100	125	100	125	100	125	100	125	100	125	100
Egg (g)	2	80	2	80	2	80	2	80	2	80	2	80
Baking powder (g)	4.45	2.7	4.45	2.27	4.45	2.7	4.45	2.7	4.45	2.7	4.45	2.7
Salt (g)	0.5	–	0.5	–	0.5	–	0.5	–	0.5	–	0.5	–
Water (ml)	–	20	–	20	–	20	–	20	–	20	–	20
Milk (ml)	50	–	50	–	50	–	50	–	50	–	50	–

*Percentage total flour weight; + Receipe developed at the Institute for Cereals, Flour and Bread TNO, Wageningen, The Netherlands [3]; ** Receipe developed by Technical Compendium on Composite Flours UNEC [11].

TABLE 3. EFFECT OF YELLOW NUTSEDGE FLOUR ON CAKE SAMPLES.

Quality parameters[+]	Level of substitution (%)*					
	100:0:0	80:200:0	60:40:0	20:80:0	0:100:0	40:50:10
Specific volume of batter, cc/g	1.10 ± 0.01	1.10 ± 0.01	1.08 ± 0.15	1.23 ± 0.13	1.31 ± 0.01	1.14 ± 0.02
Specific volume of product cc/g	2.73 ± 0.01	2.56 ± 0.01	2.33 ± 0.02	2.21 ± 0.17	2.01 ± 0.01	2.30 ± 0.01
Symmetry of form	4.48 ± 0.15	4.32 ± 0.20	4.44 ± 0.20	3.12 ± 0.14	3.00 ± 0.13	4.12 ± 0.20
Outside/slice appearance	4.28 ± 0.20	4.36 ± 0.13	4.28 ± 0.20	3.96 ± 0.20	3.92 ± 0.13	4.04 ± 0.15
Flour	3.96 ± 0.21	3.84 ± 0.21	3.76 ± 0.20	3.42 ± 0.20	3.39 ± 0.21	3.70 ± 0.21
Texture	4.08 ± 0.21	4.00 ± 0.20	3.84 ± 0.20	3.73 ± 0.20	3.56 ± 0.22	3.68 ± 0.20
Overall eating quality	4.01 ± 0.20	4.04 ± 0.23	3.96 ± 0.20	3.71 ± 0.22	2.67 ± 0.20	3.88 ± 0.22

[+] Values represent mean± standard error. Sample size = 12; * Wheat flour: Yellow nutsedge flour: Soyabean flour.

TABLE 4. EFFECT OF YELLOW NUTSEDGE FLOUR ON BISCUIT SAMPLES.

Quality Parameter [+]	Level of substitution (%)*					
	100:0:0	80:20:0	60:40:0	20:0:0	0:100:0	40:50:10
Height (mm)	9.0 ± 0.1	8.9 ± 0.3	8.0 ± 0.1	7.8 ± 0.1	7.0 ± 0.2	8.0 ± 0.1
Diameter (mm)*	80	80	80	80	80	80
Specific volum, cc/g	1.60 ± 0.1	1.50 ± 0.1	1.44 ± 0.13	1.32 ± 0.13	1.30 ± 0.01	1.41 ± 0.01
Average of taste panel score	3.095 ± 0.21	3.97 ± 0.22	3.80 ± 0.21	3.00 ± 0.21	2.70 ± 0.22	3.04 ± 0.21

[+] Values represent mean ± standard error; *Wheat flour: Yellow nutsedge flour: Soybean flour.

TABLE 5. EVALUATION OF CONSUMERS PREFERENCE FOR YELLOW NUTSEDGE FLOUR CAKE AND BISCUIT SAMPLES.

	Level of substitution (%)*					
	100:0:0	80:20:0	60:40:0	20:80:0	0:100:0	40:50:10
Like it very much	90	80	74	30	22	12
Like it	5	5	20	10	10	8
Don't know	3	8	2	18	8	20
Don't like it	2	7	3	40	45	45
Don't like it at all	0	0	1	2	15	15
Total	100	100	100	100	100	100

*Ratio of wheat flour: Yellow nutsedge: Soyabean flour.

yellow nutsedge flour and when supplemented with protein rich soybean flour.

Mean scores for the cake and biscuit samples baked from all purpose wheat flour, yellow nutsedge flour and that supplemented with soybean flour with respect to symmetry of form, outside appearance, flavour, texture and overall eating quality is given in Tables 3 and 4. Overall eating quality and acceptability correlated positively with outside/slice appearance, flavour and texture for the 80:20:0; 60:40:0 and 40:50:10 level of substitution ($P < 0.001$). There was a general acceptance for all the cake and biscuit samples baked with composite flour of all purpose wheat and yellow nutsedge flour. Cake and biscuit samples supplemented with soybean flour suffer the disadvantage of having a slight objectionable beany flavour characteristic of soybeans. However flour with 100% and 80% level of substitution of yellow nutsedge produced cake and biscuit samples that were inferior to other mixtures. Table 3 and 4. Height of biscuit samples with 100% yellow nutsedge flour decreased to 7.0 mm when compared with 100% wheat flour 9.0 mm which is the baseline for comparisons.

Overall eating quality for the 80:20:0 and 60:40:0 level of substitution is similar to the 100% wheat flour when cake sample is taken into consideration. Although there was great variability in the scoring of the cakes baked from non-soybean flour supplemented ones and samples supplemented with soybean flour, this may be a normal phenomenon when one considers the odour of the different products. Positive correlations between appearance and eating quality reinforce the belief that these confectionery might first be chosen because of their appearance, but chosen the second time because of their flavour and overall acceptability.

From the evaluation of consumers preference for yellow nutsedge flour cake and biscuit samples, it is evident (Table 5) that a larger percentage of the consumer liked products from 20 and 40% substitutions.

It was observed that only about 5% of the consumer will not want to buy any of the product from the composite

flour; more than 70% will buy either the biscuit or cake samples baked from the composite flour of yellow nutsedge while 40% will buy biscuit and cake baked from soybean supplemented composite flour.

In conclusion, yellow nutsedge flour (*Cyperus esculentus*) was substituted for wheat flour in cake and biscuit samples at 20, 40, 80 and 100% levels and at 50% supplemented further by 10% soybean flour. All the products were generally accepted with preference for the 20 and 40% level of substitutions. It is hoped that with the supplementation of soybean flour, the level of protein in the confectionery products will be increased because soybean is a protein rich source. This experiment illustrates the creative use of an indigenous lesser known food source which may enhance the nutritional quality of the diet and full utilisation of our raw materials.

Efforts are on in our laboratories in monitoring the protein level of various products baked from composite flour of yellow nutsedge flour and other plant protein sources. Also the possibilities of substituting yellow nutsedge flour in the baking of bread samples is being investigated, details of which will be communicated shortly.

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