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Research Paper

Evaluation of Defatted soybean flour Inclusion on the properties of Rice based Biscuits

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Abstract. Rice grains from local (Abakalike) and foreign (Mama Gold) varieties were processed into flour using semi-dry and wet grinding methods, and used as substitute for wheat. Rice flour and defatted soy flour were formulated into varying levels of substitution, ranging from 0 to 30% defatted soy flour. The chemical, physical and sensory properties of wheat and rice/ defatted soy composite biscuit were determined using standard methods. Rice and defatted soy composite biscuits had significantly ($P < 0.05$) higher moisture content than 100% wheat biscuit. There were no significant difference in the ash content of rice/defatted soy biscuits and 100% wheat biscuit, but a significant difference ($P < 0.05$) in the fat and fiber content of rice/defatted soy composite biscuits of up to 80:20 level of substitution, with significant difference ($P < 0.05$) in texture and overall acceptability of rice/defatted soy composite biscuits and 100% wheat biscuit. There were no significant difference ($P > 0.05$) in the weight of rice/ defatted soy composite biscuits and 100% wheat biscuits but differed significantly ($P < 0.05$) in height and spread ratio.

Key words: Rice, defatted soybean, composite flour, biscuit, properties.

INTRODUCTION

Biscuits are ready to eat, convenient and inexpensive food product containing digestive and dietary principles of vital importance (Kulkarni, 1997). It is any of various hard or crisp dry baked products or a small quick bread made from dough that has been rolled out and cut or dropped from a spoon (Davidson, 1999). It is also said to be an essential bakery confectionery, dried down to low moisture content and mostly rich in fat and sugar and consequently of high energy content. They are cherished by people of all ages and are used at all times as snacks, eaten with butter and or jam. Flour is a powder which is made by grinding cereal grains, beans, or other seeds or roots (like cassava). It is the main ingredient for biscuit, which is a staple snack food for many cultures, making the availability of adequate supplies of flour a major economic and political issue at various times throughout history (Palmatier, 2000). Wheat (*Triticum aestivum*) is a cereal grain, originally from the Levant region of the Near East but now cultivated worldwide (Belderok *et al*., 2000). Globally, wheat is the leading source of plant protein in human food, having a higher protein than other major cereals, such as maize (corn) or rice (Curtis *et al*., 2002). Wheat grain is a staple food used to make flour for leavened, flat and steamed breads, biscuits, cookies, cakes, breakfast cereal, pasta, noodles couscous (Palmer *et al.*, 2003).It is also used for fermentation to make beer (Palmer, 2001), other alcoholic beverages (Neill, 2002) and bio fuel. Wheat flour is a powder made from the grinding of wheat used for human consumption. More wheat flour is produced than any other flour. Wheat

varieties are called “soft” or “hard” “hard” depending on the quality of gluten content. Soft flour is usually divided into cake flour which is the lowest in gluten and pastry flour, which has slightly more gluten than cake flour (Chu, 2004).

Rice is the seed of the grass species *Oryza sativa* (Asian Rice) or *Oryza glaberrima* (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world’s human population especially in Asia. It is the agricultural commodity with the third highest worldwide production, after sugar cane and maize, according to FAOSTAT, (2010). Rice is the most important grain with regard to human nutrition and calorie intake, providing more than one fifth of the calories consumed worldwide by humans. Its flour is a good substitute for wheat flour, which causes irritation in the digestive systems of those who are gluten intolerant. Rice flour is also used as a thickening agent and for making rice bread (Hosking, 1997).

Soybean (Glycine max) is a species of legume widely grown for its edible bean, which has numerous uses. Soy protein is essentially identical to the protein of other legume seeds and pulse (Wolf, 2012). It is one of the most important leguminous species because of its functionality, high nutritional value, and health benefits. (Rostagno *et al.*, 2005; Ren *et al.,* 2006). Defatted soybean flour is a significant and cheap source of protein for animal feeds and many prepackaged meals.

In most parts of the world, the consumption of wheat based products and other cereals containing gluten present problems for a large number of populations who are allergic to gluten; characterized by an inflammation of the small intestine, a disease known as celiac. This calls for an alternative to wheat flour. Furthermore, increase in population as well as increase in consumption rate of wheat based products has posed huge burden on the importation, price, utilization and availability of wheat. The high cost of wheat flour in non-wheat producing countries such as Nigeria poses a problem to bakery industries and consumers of baked products. In Nigeria, the consumption of ready to eat baked products like biscuit is continually on the increase and finds greater relevance amongst women and children, with production dependent on wheat. Research efforts had been made and are still on going to partially or completely replace wheat flour with flour from other underutilized and readily available grains. Fortunately, in Nigeria, there are locally grown rice varieties as well as imported once that are low priced.

Research has shown the use of non-wheat flour in biscuit making, as it does not require significant volume increase (Bean *et al.,* 1983; Sae-eaw *et al.*, 2007). Therefore, a composite blend of rice flour and defatted soybean flour may be found desirable in reducing the usage of wheat, and further enhance product development as well as increase the potential and utilization of rice and soybean. Therefore, the objective of the study is to evaluate the performance of rice and defatted soybean flour composite through its utilization in biscuit productions.

MATERIALS AND METHODS

Raw Materials

Rice (*Oryza Sativa*) varieties both local and foreign used for this study were purchased from Mile One market, and processed according to the method of Eke-Ejiofor and Nwiganale (2016). Commercial defatted soy flour was purchased from a supermarket in Port Harcourt, other ingredients such as Margarine, sugar, fresh eggs, salt, milk, flavor and baking powder were purchased form Mile three market in Diobu, Port Harcourt, Rivers State Nigeria.

Biscuit Formulation and Preparation

Rice and defatted soy flour blend were prepared in various proportions ranging from 10, 20 and 30% substitution levels. The biscuits were formulated from the standard biscuit recipe using 200g flour,100g margarine, 50g sugar, 20g salt, 2g baking powder, 1 medium fresh egg, 10g milk and 2ml flavor and produced according to the method described by (Oyewole *et al.*, 1996) with some modifications.

Physical Properties of Biscuit

The measurement of biscuits weight, height, diameter and spread ratio were done using the procedure outlined by Oyewole *et al*., (1996).

Chemical Analysis of Biscuit

Proximate analysis were carried out using the AOAC (1990) method to determine the moisture, fat, ash, crude fiber and crude protein contents. The total available carbohydrate was determined by the difference in protein, fat, ash, moisture and crude fiber.

Sensory Evaluation

Sensory analysis was conducted to determine the optimum level of inclusion and acceptability of composite product. Rice/defatted soybean flour biscuit samples were subjected to sensory evaluation within 24 hours after production. The following attributes namely; taste, aroma, texture, appearance and overall acceptability were assessed on biscuit samples using a 9-point hedonic scale with 9 as like extremely and 1 as dislike extremely (Ihekoronye and Ngoddy, 1985). Twenty panelists

Method for Preparation of Biscuit (Rubbing in Method)

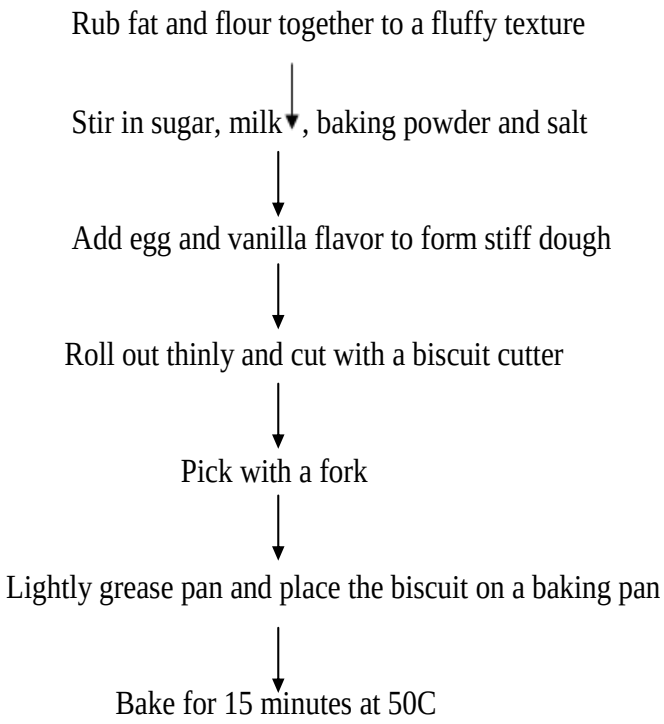

Figure 1: flow chart for the preparation of rice/defatted soybean biscuit. Source: Oyewole *et al.*, (1996)

from the Department of Food Science and Technology, Rivers State University of Science and Technology, who were familiar with biscuit and who were neither sick nor allergic to baked products at the time of this evaluation were involved in the assessment. The panelists were instructed to rinse their mouth with water after tasting each biscuit sample.

Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) using statistical package for social science (SPSS) version 20.0 software 2007. All analysis was done in duplicate using Duncan Multiple Range Test (DMR) to separate the mean.

RESULTS AND DISCUSSION

Physical Properties of Biscuit Produced from Wheat, Rice and Defatted Soybean flour

Table 1 and 2 shows the physical properties of biscuit produced from rice/defatted soybean flour composite blend. Weight of biscuit ranged from 5.41g to 7.51g and from 6.18g to 8.5g with sample B (100% Local rice flour semi dry) and D (Local rice flour wet grinding) as the lowest and samples A and C_2 as the highest for semi-dry and wet grinding methods respectively. Biscuit weight in the present study is lower than the findings of kiin-kabari and Giami (2015) and Chinma *et al.* (2012), who reported a value of (12.40g – 14.70g) and (8.70g – 11.40g) respectively.

Height ranged from 0.38cm to 0.66cm and from 0.40cm to 0.66cm with sample B_3 and D as the lowest and sample O as the highest respectively. The height of biscuits falls within the findings of Ikujenlola and Giwa (2010) who reported a value of 0.05cm – 0.63cm for biscuits produced from composite flours of wheat and quality protein maize.

Diameter ranged from 3.73cm to 4.03cm and from 3.72cm to 3.95cm with sample B and C_1 (3.73cm) as the lowest and sample D and B_3 as the highest. Biscuits diameter is in close agreement with the findings of Oluwamukom *et al*., (2011) with a value of 3.12cm – 4.47cm for wheat – cassava composite biscuit enriched with soybean flour and lower than the findings of Ikujenlola *et al.*, (2010) who reported a diameter value of 5.38cm – 6.43cm for biscuit produced from composite flours of wheat and quality protein maize.

Table 1: Physical Properties of Biscuit Produced from rice and defatted soybean flour Using Semi-Dry Grinding Method

Sample	Weight (g)	Height (cm)	Diameter (cm)	Spread Ratio
O	7.31[a] ±0.83	0.66 [a] ±0.13	3.87 [a] ±0.06	6.95[c] ±1.17
A	7.26 [a] ±0.63	0.49 [b] ±0.06	4.02 [a] ±0.03	8.76[b] ±1.43
A1	7.51 [a] ±0.93	0.52 [b] ±0.13	3.83 [a] ±0.08	7.69[c] ±1.69
A2	6.22 [a] ±0.75	0.42 [b] ±0.03	3.87 [a] ±0.03	9.29[a] ±0.38
A3	7.10 [a] ±0.75	0.55 [b] ±0.00	3.87 [a] ±0.0	7.03[c] ±0.05
B	6.82 [a] ±0.29	0.50 [b] ±0.05	3.73 [a] ±0.03	7.52[c] ±0.81
B1	5.41 [b] ±0.55	0.48 [b] ±0.08	3.87 [a] ±0.10	8.15[b] ±1.50
B2	7.47 [a] ±1.37	0.47 [b] ±0.12	4.00 [a] ±0.09	8.86[b] ±1.76
B3	6.40 [a] ±0.63	0.38 [c] ±0.03	4.03 [a] ±0.10	10.2[a] ±0.69

Values are mean of triplicate determination ±Standard deviation
Means having different superscript in the same column are significantly different ($p<0.05$).
KEY
O = 100% Wheat Flour
A = 100% Foreign Rice Flour
A1 = 90% Foreign Rice Flour: 10% Defatted Soybean Flour
A2 = 80% Foreign Rice Flour: 20% Defatted Soybean Flour
A3 = 70% Foreign Rice Flour: 30% Defatted Soybean Flour
B = 100% Local Rice Flour
B1 = 90%Local Rice Flour: 10% Defatted Soybean Flour
B2 = 80%Local Rice Flour: 20% Defatted Soybean Flour
B3 = 70%Local Rice Flour: 30% Defatted Soybean Flour

Table 2: Physical Properties of Biscuit Produced from Wheat, Rice and Defatted Soybean flour using the Wet Grinding Method

Sample	Weight (g)	Height (cm)	Diameter (cm)	Spread Ratio
O	7.31[a] ± 0.83	0.66[a]±0.13	3.87[a]±0.06	6.95[c]±1.17
C	4.30[c] ±0.58	0.50[b]±0.05	3.80[a]±0.05	7.65[b]±0.73
C1	7.36[a] ±0.79	0.45[b]±0.09	3.72[a]±0.03	8.44[b]±1.41
C2	8.59[a] ±1.11	0.51[b]±0.08	3.77[a]±0.03	7.39[b]±1.06
C3	8.55[a] ±0.80	0.50[b]±0.05	3.85[a]±0.13	7.74[b]±0.75
D	6.18[b]±0.90	0.40[b]±0.09	3.73[a]±0.19	9.53[a]±1.28
D1	8.03[a] ±0.68	0.47[b]±0.06	3.87[a]±0.08	9.49[a]±1.28
D2	7.33[a]±0.51	0.40[b]±0.05	3.83[a]±0.03	9.27[a]±1.15
D3	7.54[a]±0.47	0.43[b]±0.03	3.95[a]±0.05	9.14[a]±0.74

Means having different superscript in the same column are significantly different ($p< 0.05$)
Values are mean of triplicate determination ±Standard deviation.
Key
O = 100% Wheat Flour
C = 100% Foreign Rice Flour
C1 = 90% Foreign Rice Flour10% Defatted Soybean Flour
C2 = 80% Foreign Rice Flour: 20% Defatted Soybean Flour
C3 = 70% Foreign Rice Flour: 30% Defatted Soybean Flour
D = 100% Local Rice Flour
D1 = 90% Foreign Rice Flour10% Defatted Soybean Flour
D2 = 80% Local Rice Flour: 20% Defatted Soybean Flour
D3 = 70% Local Rice Flour: 30% Defatted Soybean Flour

Spread ratio ranged from 6.95cm to 10.21cm and from 6.95cm to 9.50cm with sample O as the lowest and sample B_3 and D as the highest. Spread ratio of biscuits produced by semi-dry grinding method ranging from 6.95cm – 10.21cm and those produced by wet grinding method ranging from 6.95cm – 9.53cm is lower than the findings of Ikujenola *et al.* (2010) who reported a value of 9.25cm – 12.56cm. There were no significant differences

Table 3: Proximate Composition of Biscuit Produced from Rice and Defatted Soybean Flour using the Semi-Dry Grinding Method

Sample	Moisture (%)	Ash (%)	Fat (%)	Fibre (%)	Protein (%)	Carbohydrate
O = 100% WF	6.13^{a} ± 0.29	2.09^{a} ± 0.08	6.63^{a} ± 0.43	6.30^{a} ±0.03	19.12^{a} ±0.76	59.72^{d} ±0.01
A= 100% FRF	6.16^{a} ±0.23	1.94^{a} ±0.17	3.66^{b} ±0.22	3.35^{d} ±0.17	14.37^{b} ±0.22	70.59^{a} ±0.04
A1= 90%FRF:10%DSF	6.17^{a} ±0.58	1.90^{a} ±0.17	4.78^{b} ±0.08	4.84^{c} ±0.05	15.62^{b} ±0.54	67.17^{b} ±0.53
A2= 80% FRF:20%DSF	6.97^{b} ±0.72	2.31^{a} ±0.17	4.46^{a} ±0.22	4.58^{c} ±0.17	17.68^{c} ±0.16	62.80^{d} ±0.24
A3=70%FRF:30%DSF	7.03^{b} ±0.06	2.72^{b} ±0.09	3.99^{c} ±0.02	6.07^{a} ±0.03	21.75^{d} ±0.55	60.44^{c}±0.71
B= 100% LRF	5.83^{a} ±0.12	1.50^{c} ±0.31	4.33^{b} ±0.42	6.24^{a} ±0.27	15.56^{b} ±1.20	65.37^{b} ±0.46
B1=90%LRF:10%DSF	5.93^{a} ±0.12	2.00^{a} ±0.05	4.48^{b} ±0.27	6.94^{a} ±0.06	16.50^{b} ±0.36	64.65^{b} ±0.21
B2=80%LRF:20%DSF	8.93^{c} ±0.29	2.01^{a} ±0.07	4.56^{b} ±0.58	5.53^{b} ±0.40	18.58^{a} ±1.87	62.38^{c} ±0.67
B3=70%LRF:30%DSF	9.57c ±0.40	2.39a ±0.18	4.23 b ±0.13	6.33a ±0.11	20.21 d ±1.55	61.27c ±1.09

Values are mean of duplicate determination ±Standard deviation
Means having different superscript in the same column are significantly different ($p<0.05$).
Key:
WF = Wheat Flour
FRF = Foreign Rice Flour
LRF = Local Rice Flour
DSF = Defatted Soybean Flour

($P > 0.05$) in the weight, height, diameter and spread ratio of biscuits produced from semi-dry and wet grinding methods.

Proximate Composition of Biscuits produced from Wheat and Rice/ Defatted Soybean flour

Tables 3 and 4 shows the proximate composition of biscuits produced from wheat, rice and defatted soybean flour. Moisture content ranged from 5.83% to 9.57% and from 6.13% to 11.23% with sample B and O as the lowest and sample B_3 and C_2 as the highest. The biscuits showed an increased moisture content as level of defatted soybean flour increased. Moisture content of rice flour biscuits produced by semi-dry grinding method ranging from 6.13% - 9.57% is lower than the findings of Onabanjo and Ighere (2014) with a value of 9.34% - 12.71% for biscuits produced from wheat–sweet potato composite, while moisture content of biscuit produced using the wet grinding method ranging from 6.13% - 11.23% is in close agreement with the findings of Julianti *et al.* (2014) for biscuits produced from cassava, rice, potato, soybean and xanthan composite flour as alternative of wheat flour. Sanni *et al.* (2006) reported that the lower the moisture of a product to be stored the better the shelf stability of such product. The result of the present study showed that moisture content increased with an increase in the substitution level of defatted soybean flour, with the semi-dry grinding method having lower moisture than wet grinding method; hence, semi-dry grinding method with low moisture content would have better shelf life.

Ash content ranged from 1.50% to 2.72% and from 1.74% to 2.82%, with sample B and C as the lowest and sample A_3 and C_3 as the highest. Ash content of biscuit produced from semi-dry grinding method ranging from 1.50% to 2.72%, is in agreement with the findings of Oluwamukomi *et al.*, (2011) with a value of 1.06% to 2.78% for wheat – cassava composite biscuits enriched with soybean flour, while ash content of biscuit produced from wet grinding method ranging from 1.74% - 2.82% agrees with the findings of Yusufu *et al*., (2014) with a value of 1.88% to 2.80%. The result of this study revealed that ash content increased with an increase in the level of substitution of defatted soybean flour. The ash content of a food material could be used as an index of mineral constituents of the food because ash is the inorganic residue remaining, after the water and organic matter have been removed by heating in the presence of an oxidizing agent (Sanni *et al.,* 2008). The rice flour biscuit produced by the wet grinding method contained higher ash content than semi-dry grinding method.

Fat content ranged from 2.00% to 6.63% and

Table 4: Proximate Composition of Biscuit Produced from Wheat, Rice and Defatted Soybean flour.

Sample	Moisture (%)	Ash (%)	Fat (%)	Fibre (%)	Protein (%)	Carbohydrate (%)
O = 100% WF	6.13^{a}± 0.29	2.09^{a}± 0.08	6.63^{a}± 0.43	6.30^{a}±0.03	19.12^{a}±0.76	59.72^{c}±0.01
C= 100% FRF	9.37^{b}±0.23	1.74^{b}±0.63	1.68^{b}±0.23	2.87^{b}±0.39	15.02^{c}±0.50	69.31^{a}±0.16
C1= 90%FRF:10%DSF	9.96^{b}±1.10	2.03^{a}±0.14	2.24^{c}±0.49	2.81^{b}±0.09	16.85^{b}±0.25	66.09^{a}±0.63
C2= 80% FRF:20%DSF	11.23^{c}±0.56	2.39^{a}±0.03	1.09^{b}±0.04	3.35^{c}±0.33	19.47^{a} ±2.78	63.92^{a}±0.00
C3=70%FRF:30%DSF	10.93^{c}±0.23	2.82^{a}±0.02	2.15^{c}±0.42	3.47^{c}±0.10	21.39^{a}±2.31	57.53^{c}±2.00
D= 100% LRF	7.07^{a}±0.58	1.89^{b}±0.06	2.10^{c}±0.10	3.78^{c}±0.15	16.65^{c}±0.04	68.51^{a}±0.22
D1=90%LRF:10%DSF	7.93^{a}±0.98	1.95^{b}±0.08	2.20^{c}±0.25	2.71^{b}±0.08	18.56^{b}±0.43	67.76^{a}±0.20
D2=80%LRF:20%DSF	7.27^{a}±0.46	2.15^{a}±0.02	2.62^{c}±0.24	2.08^{b}±0.09	19.89^{a}±0.63	65.98^{a}±0.96
D3=70%LRF:30%DSF	9.30^{b}±0.17	2.58^{a}±0.11	2.75^{c}±0.21	2.15^{b}±0.21	23.90^{d}±0.55	59.98^{a}±0.65

Values are mean of duplicate determination ±Standard deviation Means having different superscript in the same column are significantly different ($p<0.05$)
Key:
WF = Wheat Flour
FRF = Foreign Rice Flour
LRF = Local Rice Flour
DSF = Defatted Soybean Flour

Table 5: Sensory Evaluation of Biscuit Produced from wheat, Rice and Defatted Soybean Flour using the Semi-Dry Grinding Method.

Sample Attributes Score	Color	Texture	Crispness	Taste	Aroma	Overall Acceptability
O = 100% WF	7.90^{a} ± 0.97	7.65^{a} ± 1.46	7.40^{a} ± 1.47	7.45^{a} ± 1.61	6.45^{a} ±1.99	8.25^{a} ± 1.16
A= 100% FRF	6.25^{a} ±1.45	6.10^{b} ± 1.25	5.80^{b} ± 1.54	5.90^{b} ± 1.69	5.80^{b} ± 1.77	6.60^{b} ± 1.43
A1= 90%FRF:10%DSF	6.45^{a} ±1.43	6.20^{b} ± 1.67	5.95^{b} ± 1.54	6.20^{a} ± 1.88	6.15^{a} ± 1.79	6.35^{b} ± 1.63
A2= 80% FRF:20%DSF	5.30^{a} ±1.81	5.60^{c} ± 2.11	5.30^{b} ± 1.66	5.70^{b} ± 1.72	4.55^{b} ± 1.23	5.75^{c} ± 1.74
A3=70%FRF:30%DSF	6.05^{b} ±1.82	5.60^{c} ± 2.26	5.75^{b} ± 2.20	5.25^{b} ± 2.20	4.95^{b} ± 2.28	5.15^{c} ± 2.30
B= 100% LRF	5.65^{a} ± 2.06	4.60^{c} ± 1.93	4.30^{c}± 2.16	4.85^{c} ± 2.30	4.95^{c} ± 2.04	5.50^{c} ± 1.73
B1=90%LRF:10%DSF	6.40^{a} ± 2.21	6.10^{b} ± 1.86	6 .10^{a} ± 2.61	5.85^{b} ±2.50	5.65^{b} ± 1.89	6.10^{b} ±1.65
B2=80%LRF:20%DSF	6.^{75a} ± 1.52	6.05^{b} ± 2.19	5.95^{b} ± 1.76	5.70^{b} ±1.66	5.60^{b} ± 1.82	6.05^{b} ±1.82
B3=70%LRF:30%DSF	7.05a ± 2.42	5.50c ± 2.01	4.75c ± 2.75	4.85c ±1.93	4.75c ± 1.83	5.45c ± 2.59

Values are mean of triplicate determination ±Standard deviation Means having different superscript in the same column are significantly different ($p<0.05$
Key:
WF = Wheat Flour
FRF = Foreign Rice Flour
LRF = Local Rice Flour
DSF = Defatted Soybean Flour

Table 6: Sensory Evaluation of Biscuit Produced from Wheat, Rice and Defatted Soybean flour using the Wet Grinding Method.

Sample	Color	Texture	Crispness	Taste	Aroma	Overall Acceptability
O = 100% WF	7.90^{a}± 0.97	7.65^{a} ± 1.46	7.40^{a} ± 1.47	7.45^{a} ± 1.61	6.45^{a} ± 1.99	8.25^{a} ± 1.16
C= 100% FRF	5.65^{a}± 2.25	5.20^{b}± 2.04	4.95^{b} ± 2.21	4.95^{b} ± 2.21	4.30^{b} ± 2.20	5.30^{b} ± 2.22
C1= 90%FRF:10%DSF	5.95^{a}± 1.82	5.70^{b}± 1.63	5.25^{a} ± 1.74	5.25^{a} ± 1.74	5.35^{a} ± 2.06	5.95^{b} ± 2.09
C2= 80% FRF:20%DSF	6.35^{a}± 2.43	5.20^{b} ± 1.82	4.75^{b} ± 1.92	4.75^{b} ± 1.92	5.70^{a} ± 2.18	6.25^{a} ± 1.83
C3=70%FRF:30%DSF	6.05^{a}± 1.64	4.70^{b} ± 1.90	4.45^{b} ± 1.57	4.45^{b} ± 1.57	4.75^{b} ± 2.20	5.30^{b} ± 1.26
D= 100% LRF	6.15^{a}± 1.63	6.50^{a} ± 1.82	6.70^{a} ± 2.08	6.70^{a} ± 2.08	5.15^{a} ± 2.25	6.65^{a} ± 1.42
D1=90%LRF:10%DSF	6.40^{a}± 2.04	6.35^{a} ± 1.57	5.80^{a} ± 1.96	5.80^{a} ± 1.96	4.45^{b} ± 2.14	5.95^{b} ± 2.21
D2=80%LRF:20%DSF	5.40^{b}± 2.50	5.95^{a} ± 2.06	5.75^{a} ± 2.17	5.75^{a} ± 2.17	4.50^{b} ± 2.24	5.90^{b} ± 2.61
D3=70%LRF:30%DSF	6.90^{a}± 1.65	5.25^{b}± 1.80	5.20^{a} ± 2.14	5.20^{b} ± 2.14	5.50^{a} ± 2.32	6.45^{a} ± 1.82

from 1.09% to 6.66%, with sample A_3 and C_2 having the lowest and sample O (6.63%) as the highest in all cases. Fat content of rice biscuit produced by semi-dry grinding and wet grinding methods ranging from 2.00 – 6.63% and 2.57 – 6.00% respectively agrees with the findings of Yusufu *et al.* (2014) who reported a value of 2.57% - 6.00% for biscuits produced from African yam bean and plantain fruit flour. The result showed that fat content increase with an increase in substitution level. Semi-dry grinding methods contain a higher fat content than wet grinding method.

Fiber content ranged from 2.33% to 7.24% and from 2.08% to 6.30% with sample B_3 and D_2 as the lowest and samples B and O as the highest. Fiber content of biscuit produced by semi-dry grinding method ranging from 2.33% -7.24%, agrees with the findings of Genitha *et al*., (2012) with a value of 1.94% - 8.50%, while fibre content of biscuits produced by wet grinding method ranging from 2.08% - 6.30% falls within the range reported by Yusufu *et al*., (2014) with a value of 2.31% - 6.70%. Fiber content increased with substitution level in foreign rice but decreased in local rice. Semi-dry grinding method contains higher fiber content than wet grinding method.

Protein content ranged from 14.37% to 21.75% and from 15.02% to 25.39%, with sample A and C as the least and sample A_3 as the highest value for flour produced by semi-dry and wet grinding method. Protein content of biscuits produced by semi-dry grinding method ranging from 14.37% - 21.75% and wet grinding method ranging from 15.02% -25.39% is higher than the findings of Kiin-Kabari and Giami (2015) for non-wheat cookies prepared from plantain flour and bambara groundnut protein concentrate. There was a significant difference ($P < 0.05$) in the protein content of the biscuit samples of both methods. Protein increased with an increase in the level of substitution of the defatted soybean flour. Juliano and Hicks (1996) also concluded that some soluble protein, sugars and non-starch lipids were washed away during soaking of rice kernels which were subjected to semi-dry and wet grinding methods. Thus, higher amount of protein was washed away from semi-dry grinding method as a result of soaking that lasted for 16 hours; hence the protein content of the semi-dry grinding method was lower than the wet grinding method. Carbohydrate content ranged from 59.72% to 70.59% and from 57.53% to 69.31% with sample O (control) and C_3 as the lowest and sample A and C as the highest. The carbohydrate content of biscuits produced by semi-dry grinding method and wet grinding method ranging from 59.72% - 70.59% and 57.53% - 69.31% agrees with the findings of Agu *et al*., (2007) with a value of56.38% - 73.21% for biscuit produced from wheat and African bread fruit. The result of this study showed that increase in substitution levels increased the protein content and decreased the carbohydrate content. However, low carbohydrate content of composite biscuits is an indication that the biscuits may serve as a functional food for groups with special caloric and glycemic requirements such as obese or diabetic people.

Sensory Evaluation of Biscuits Produced from Wheat, Rice and Defatted Soybean flour

Tables 5 and 6 shows the sensory evaluation results of biscuits produced from wheat, rice and defatted soybean flour composite. Color and appearance of biscuit produced by semi-dry grinding method ranged from 5.30 to 7.90 and

from 5.40 to 7.90 for wet grinding method.

Biscuit texture for semi-dry grinding method ranged from 4.60 to 7.65 while wet grinding method ranged from 4.70 to 7.65 with sample O (100% wheat flour) as most preferred, Crispness of biscuit from rice produced by semi-dry grinding method and wet grinding method ranged from 4.30 to 7.40 and 4.45 to 7.40 with sample O (100% wheat flour) as most preferred, Biscuit taste for semi-dry grinding method and wet grinding method ranged from 4.85 to 7.45 and 4.45 and 7.45 with sample O as most preferred,

Biscuit aroma produced by semi-dry grinding method and wet grinding method ranged from 4.55 to 6.45 and 4.30 to 6.45 with sample O as most preferred. Biscuits overall acceptability for semi-dry grinding method and wet grinding method ranging from 5.45 to 8.25 and 5.30 to 8.25 with sample O as most acceptable. The color, texture, crispness, taste, aroma and overall acceptability scores of biscuits produced by semi-dry grinding and wet grinding methods agreed with the findings of Nwosu (2013).There were significant differences in the color, texture, crispness, taste and overall acceptability of biscuits produced by semi-dry grinding method and wet grinding methods ranging from 4.85 to 7.45 and 4.45 to 7.45 respectively.

CONCLUSIONS

The findings of the study have shown clear potential for the production of biscuit from rice (foreign and local) and defatted soy flour. Rice flour could be supplemented with soybean flour up to 30% level in biscuit without altering the color, aroma, taste and texture of the biscuit. Rice and defatted soy biscuit samples were acceptable nutritionally as they contain more fibre, ash and protein. It was concluded that supplementation level up to 10% (foreign rice) and 20% (local rice) using semi-dry grinding method and supplementation level up to 10% (foreign rice) and 30% (local rice) using wet grinding method in biscuit gave the best product as well as acceptability, based on the Physico-Chemical and proximate composition of biscuits.

REFERENCES

Agu HO, Ayo JA, Paul AM, Folorunsho F (2007). Quality characteristics of biscuits made from Wheat and African bread fruit (*Treculia Africana*). Niger. Food J. 25(2):19-27.

AOAC (1990). Association of Official Analytical Chemists, 15th Edition. Washington, D. C.

Bean MM, Euiston-Hoops EA, Nishita KD (1983). Rice flour treatment for cake baking applications. Cereal Chem. 60(6):445-9.

Belderok R, 'Bob M, Hans D, Dingena A (2000). Bread-Making Quality of Wheat, Springer, p. 3, ISBN 0-7923-6383-3

Chinma CE, Igbabul BD, Omotayo OO (2012). "Quality characteristics of cookies prepared from unripe plantain and defatted sesame flour blends". Niger. J. Nutr. Sci. 33(1):7-11

Chu M (2004). "Wheat flour, cooking for engineers, retrieved 2004-08-14.

Curtis BC, Rajaram S, Macpherson HG (2002). "Bread Wheat". Food and Agriculture Organization of the United Nations. Achieved from the original on 10 June, 2015.

Kiin-Kabari DB, Giami SY (2015). Physico-Chemical Properties and in – vitro protein digestibility of non-wheat cookies prepared from plantain flour and bambara groundnut concentrate. J. Food Res. 4(2):78-86

Davidson A (1996). Oxford companion to food. Oxford University Press. Department of Agriculture Appropriations for 1957: Hearings . 84th Congress.2d Session. United States House Committee on Appropriations. p. 242.

Eke-Ejiofor J, Nwiganale L (2016). The Effect of Variety and Processing methods on the Functional and Chemical properties of Rice Flour. Int. J. Nutr. Food Sci. 5(1):80-84

"FAOSTAT: Production, Crops, Cassava, (2010). data". Food and Agriculture Organization of the United Nations, 2011. Retrieved February 18, 2012.

Genitha TR, Sneha S, Vrijesh Y (2012). "Preparation and Quality evaluation of flour and biscuit from sweet potato".J. Food Process Technol. 3:192. doi: 10. 4172/2157-7110. 1000192.

Hosking R (1997). A dictionary of Japanese food, Tuttle publishing, p. 191. ISB 9780804820424.

Ihekoronye AI, Ngoddy PO (1985). Integrated food science and Technology for the tropics. Macmillan Education Ltd., ISBN 0-333-38883-6

Ikujenlola AV, Giwe EO (2010). "Quality characteristics of biscuits produced from composite flours of wheat and quality protein maize". Afr. J. Food Sci. Technol. 1(5):116-119, ISSN: 2141- 5455.

Juliano BO, Hicks PA (1996). Rice functional properties and rice food products. Food Rev. Int. 12:71-103.

Julianti E, Tharise N, Nurminah M (2014). "Evaluation of physicochemical and functional properties of composite flour from cassava, rice, potato, soybean and xanthan gum as alternative of wheat flour". Int. Food Res. J. 21(4):1641-1649.

Kulkarni SD (1997). Roasted soybean in cookies. Influence on product quality. J. Food Sci. Technol. 34:503-505.

Neill R (2002). Booze: The Drinks Bible for the 21st Century. Octopus Publishing Group – Cassell Illustrated. p. 112. ISBN 1-84188-196-1.

Nwosu JN (2013). Production and evaluation of biscuits from blends of Bambara groundnut (*Vigna subterramae*) and wheat (*Triticum asestivum*) flour. Int. J. food Nutr. Sci. 2(1) 305-308.

Oluwamukomi MI, Oluwalana IB, Akinbowale OF (2011). "Physicochemical and sensory properties of wheat cassava composite biscuit enriched with soy flour." Afr. J. Food Sci. 5(2):50 - 56.

Onabanjo OO, Ighere DA (2014). "Nutritional, functional and sensory properties of Biscuit produced from Wheat sweet potato composites". J. Food Technol. Res. 1(3):111-121.

Oyewole OB, Sanni LO, Ogunjobi MA (1996). "Production of biscuits using cassava flour". Niger. Food J. 14:24-29.

Palmatier RA (2000). Food: A dictionary of literal and non-literal terms. Greenwood Press, 88. Post Road West, Westport USA.

Palmer JJ (2001). How to Brew. : Ingredients, methods, recipes and equipment specialty of Can Thocity. Defenestrative Pub Co. p. 233.

Palmer LE, Rabinowicz PDO, Shaughnessy AL, Balija VS, Nascimento LU, Dike S, de la Bastide M, Martienssen RA, McCombie WR (2003). Maize genome sequencing by methylation filteration. Science 302: 2115-2117(Pub Med)

Ren H, Liu H, Endo H, Takagi Y, Hayashi T (2006). Anti-mutagenic and anti oxidative activities fumd in Chinese Traditional Soybean fermented products Furu. Food Chem. 95.71-76

Rostagno HS, Albino LFT, Donzele JL, Gomes PC, Oliveira RF, Lopes DE, Ferreira AS, Barreto SLT (2005). Tabelas brasileira para aves esuinos: composiccio de alimentos e exigencias nutricionais. 2ed. Vicisa: UFV, Repartamento de Zootecnia p. 186

Sae-Eaw A, Chompreeda P, Prinyawiwalkul W, Haruthaithansan V, Suwonsichon P, Saidu JE, Xu Z (2007). "Acceptance and purchase intent of US consumers for non-Wheat rice butter", J. Food Sci. 72(2):92-97.

Sanni OL, Adebowale AA, Filani TA, Oyewole OB, Westby A (2006). Quality of flash and rotary dried fufu flour. J. Food Agric. Environ. 4: 74-78.

Sanni OL, Adebowale AA, Olayiwole IO, Maziya-Dixon B (2008). Chemical composition and pasting properties of iron fortified maize flour. J. Food Agric. Environ. 6:172-175.

Wolf WJ (2012). "Legumes: Seed Composition and Structure, Processing Into Protein Products and Protein Properties" (PDF). United States Department of Agriculture. Retrieved February 17, pp. 291-314.

Yusufu PA, Egwujeh SID, Damak A, Netala J (2014). "Enrichment of 'Apula' – A roasted maize meal with African Yam Bean and Plantain Fruit flour". Pak. J. Nutr. 13(7):377-380, ISSN 1680-5194.