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Evaluation of Nutritional, Physicochemical Properties and Acceptability of Undehulled 'Ofada' Rice and Soybean Flour Blends

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Abstract

The study was carried out to evaluate the effect of soy flour fortification on the nutritional, physicochemical and acceptability of rice flour paste (local name: tuwo). Ofada rice was cleaned, sorted and soaked in water for 12hrs and dried at 60^0C for 12hrs to produce four blends with soy-bean flour. Ofada rice was fortified with soybean flour at 10, 20 and 30% (w/w) with the aim of producing more nutritionally balanced product (tuwo). The crude protein, crude fibre, and ash content of the soybean flour supplemented cereal (SBF) increased with progressive increase in the proportion of soy flour, with the 30% soy flour inclusion having higher values of 22.4%; 6.2% and 2.2% respectively, while lowest values we recorded for 100% Ofada rice (ORF). The carbohydrate content was observed to decrease with corresponding increase in the percentage of soybean flour in cereal from 67.85% to 58.63%, swelling power (5.6 to 5.1%) and water absorption capacity(10.28 to 5.03%). Microbial analysis showed low mould and plate counts which invariably made it fit for consumption. The data obtained from the study clearly show the nutritional potentials of the as alternative food ingredient for protein supplementation and its reliability as a good source of amino acids for school children and adults.

Keywords: Ofada rice, Soybean, Functional properties, Fortification, Microbial analysis.

Introduction

In many developing countries such as Nigeria, malnutrition is a common dietary problem that is said to be endemic[1, 2]. It is characterized by micronutrient-deficiency [2 and protein-energy malnutrition[3]. Inadequate intake of protein in developing countries has led to various forms of malnutrition in both children and adults. It has been reported that in developing countries, protein malnutrition persists as a principal health problem among children below the age of five in Nigeria[4]. Animal protein products are quite expensive and above the reach of low-income family can to afford such protein source. As a result, dietary diversification has been employed as a solution to malnutrition challenges[5]. The need to find inexpensive sources of protein of good quality as dependency on plant proteins is however very high and it is pertinent to combine these plant proteins in proportions that will improve the protein intake of the consumers[6]. Studies have been carried out to find other ways of enriching our locally prepared cereal dishes with indigenous plant legumes[7, 8]. This involves the use of commonly consumed grains and/or legumes in more than one form to meet the dietary need of the targeted people. Some raw materials like soybean and maize are amply being used[9, 10, 11, 12] but they are not sufficiently available to meet the high demand of the populace due to their excessive industrials uses. Other good alternative like Ofada rice and soybean which possesses interesting food potentials and large production ratio have not been fully exploited.

Although the cereal grains (including Ofada rice) provide the bulk of the energy requirement because of its low cost, they are reach in the essential sulphur-containing amino acids, methionine and cystine but deficient in lysine. Therefore the combination of cereal grains and legumes (such as soy bean) in traditional food preparation complement each other since the latter are found to be rich in lysine but deficient in both methionine and cystine[13]. Thus, the cereal-legume blends could serve as major sources of calorie, proteins, minerals and vitamins. Consequently, the supplementation of the grain legumes has been suggested as one way of improving the protein quality of cereal based diets[14]. Legumes are rich and economic dietary source of good quantity protein, carbohydrates, soluble and insoluble fibre components and a variety of minerals and vitamins[15]. Therefore, the research was aimed at evaluating the effect of soybean fortification on physicochemical properties and consumer acceptability of Ofada rice.

Materials and Methods

Materials

"Ofada" rice and Soybean were purchased from a local market in Lagos, State, Nigeria and transported to Food Technology laboratory, Yaba College of Technology in clean polyethylene bags for later use.

Processing of Ofada Rice Flour

Ofada rice was cleaned, sorted and soaked in water for 12hrs. The Ofada rice was then washed and dried in oven for 12hrs at 60^0C and cooled. It was then dried again at 70% for 15mins. After cooling, it was then milled in a disc attrition mill (Hunt No. 2A premier mill, Hunt and Co, UK) and then packaged in a plastic container.

Processing of Soybean flour

The soybean seeds were sorted and soaked in water for 12hrs and germinated for 2days. It was then dehulled and washed, dried in the oven at 60^0C for 24hrs and then milled and sieved.

Preparation of the Flour Blends

Ofada rice flour and soy flour were mixed in various proportions ranging from 10 to 30% (w/w) substitution level (Table 1). The various mixes obtained were thoroughly blended using a vortex mixer, packed and sealed in polythene bags and kept until required.

Chemical Analysis

Proximate composition of the blend was determined by the method of [16]. Carbohydrate was determined by difference. Energy value was determined. The total nitrogen content was determined by multiplying with a factor of 6.25. The gross energy values were estimated by multiply the values of crude protein, fat and carbohydrate by their respective physiological fuel value of 4, 9 and 4 respectively. The minerals were determined is Atomic Absorption Spectrophotometer, (Ass) Indel 703. Phosphorus was estimated colorimetrically by the ammonium molybdate methods. Water absorption capacity was determined using [17]. Swelling power and bulk density was determined by the method of [18]. Reconstitution index was determined by the method of [19], Thiamine and Riboflavin were determined using the High Pressure Liquid Chromatography (HPLC) equipment.

Table 1: Level of Substitution of Ofada rice- Soybean Flour Mixes

Flour	%	%	%	%
Ofada rice	100	90	80	70
Soy-bean	0	10	20	30

Microbiological Analysis

The pour plate technique was adopted using standard plate count agar (Nutrient Agar) and sabraud dextrose Agar was used for the mould count. One gram of each of the five formulations was serially diluted to 10-5.1ml of each dilution was plated in corresponding duplicate plates. Incubation was done at 37°C for 24 hrs. The colonies were counted manually.

Sensory Evaluation

The resulted flour paste was assessed organoleptically for texture, taste, colour and overall acceptability using 25 panelists that are familiar with tuwo. Statistical analysis was carried out for all result by general linear model procedure using SAS packages. Differences between means were calculated by Duncan Multiple range .Significant difference was at 0.05.

Results and Discussion

Proximate Composition of Composite Flour

The proximate composition of Ofada Rice Flour (ORF) supplemented with Soybean Flour (SBF) is presented in table 2. The table showed that protein, fat and ash increased as the proportion of soy flour increased ranging from 15.6-21.10%, 4.8-6.1% and 1.6-2.0% respectively. The Ofada rice flour produced from 30% soy flour substitution had the highest crude protein content of 21.10%. This shows that supplementing of Ofada rice with soy flour would greatly improve the protein nutritional quality of tuwo produced from the flour. This could obviously be due to the significant quantity of protein in soy bean seeds[20, 21, 22]. The high protein content in the soy supplementation Ofada rice flour would be of nutritional importance in most developing countries like Nigeria where many people can hardly afford high proteinous foods because of their high cost. This similar observation was made in a research study by[23] who showed an increase in the protein content with corresponding increase in the proportion of soy flour supplementation in maize flour during the production of Agidi a fermented cereal product. Also, the work is in agreement with the work of[24] who recorded an increase in the protein content

with corresponding increase in the proportion of soy flour supplementation in yam flour.

A decrease was observed in the level of carbohydrate from 67.85%-58.85% as well as the moisture content of fortified samples from 985-8.85% as the proportion of soy flour increased (Table 2). The decrease in moisture level with increase in level of substitution might serve as an indication of increasing storage stability. This result indicates that the aim of fortification was to increase the protein content while producing a more shelf stable product due its lower moisture content. These findings were in agreement with the work of[21]. The carbohydrate content decreased with increase proportion of the soy flour supporting the claims of [23, 24]. Other research workers have reported similar findings [8, 10, 11, 12]. The ash and fat content of the soy supplemented Ofada flour were noted to assume the same trend as the protein content. The highest fat and ash content of 5.24% and 3.12%were recorded for the 30%. Soybean seeds have been reported to contain appreciable amount of minerals and fat [10, 11, 22, 23, 24, 25].

Table 2: Proximate Composition of Ofada Rice – Soybean Flour Mixes

Samples	Components (%)										
ORF:SPF	Moisture	Protein	Fat	Ash	Fibre	CHO	Energy	Vit. B1	Vit. B2	P	Fe
100:0	9.85	15.6	4.0	1.5	1.20	67.85	377.3	0.8	0.38	8	14
90:10	9.60	19.5	4.8	1.7	1.35	63.05	382.6	1.10	0.40	158	15.2
80:20	9.00	20.1	5.3	1.9	1.50	62.20	399.9	1.22	0.44	162	17.2
70:30	8.85	22.4	6.2	2.2	1.72	58.63	410.8	1.50	0.49	169	19.3

ORF: "Ofada rice flour SBF: Soybean flour values are means of three determined
CHO: Carbohydrate content

Table 3: Functional Properties of Ofada rice – Soybean Flour Mixes

Samples ORF:SBF	Bulk Density	Water Absorption Capacity	Swelling Capacity
100:0	0.66	10.28	5.06
90:10	0.69	8.24	7.05
80:20	0.72	6.25	6.48
70:30	0.78	5.03	5.10

ORF: Ofada rice flour

SBF: Soybean flour

Olaoye[22] who recorded increase in the protein content with corresponding increase in the proportion of soy flour supplementation in bread produced from composite flour of wheat, plantain and soybean.

Functional Properties of Composite Flour

Table 3 shows the result of the functional properties of Ofada rice-soybean mixes which were significantly different ($p \leq 0.05$).The water binding capacity (WBC) and swelling power of Ofada-rice flour decreased progressively as the proportion of soy flour increased in the mixture. This effect could probably due to loose association of amylose and amylopectin in the native granules of starch and weaker associative forces maintaining the granules structure[26]. The decreasing value of the water binding capacity are in consonance with corresponding decrease in the level of protein in the sample as indicated in table 2. The decreasing level of both water binding capacity and swelling power are a reflection of the level of damaged starch and hemicelluloses[27].

Sensory Evaluation of Ofada-Rice Soy-Bean Paste

Table 4 shows the result of the sensory evaluation of fortified and unfortified Ofada rice flour paste (Tuwo) showed no significant variation in the texture, taste and colour below 10% and above 20% soy bean flour composition. Samples with 20% level of substitution ranked equally with unsubstituted samples (100% Ofada-rice flour) in all the attributes evaluated. This implies that fortifying Ofada-rice flour with soy flour at 20% did not affect acceptability of Tuwo.

Table 4: Sensory Evaluation of Paste Made from Blend of Ofada-Rice Mixes Soybean Flour

(%)	Colour	Taste	Aroma	Texture	General Acceptability
Zero	7.6a	7.1a	6.5a	6.7a	7.0a
10	7.1a	6.8a	6.2a	6.0a	6.1b
20	7.4a	7.1a	6.2a	6.5a	6.8ab
30	6.6b	5.5b	6.0a	5.8b	5.8b

Values are means of triplicates tests. Within column, values with different superscripts are statistically different (P< 0.05) according to Duncan's Multiple Ranges test.

The panelist noted that the composite flour was easier to prepare than Ofada-rice flour alone which may as a result of the decrease in the viscosity of the paste. They also commented that meal prepared from the composite flour was not as white as that from Ofada-rice flour alone which may be due to the characteristics yellow pigment in the soybean flour and browning reaction during processing.

Microbiological Characteristics

Data on the microbiological characteristics of the sample are presented in table 5. There were no microorganism detected in the unsubstituted sample, the total viable bacterial count increased from 15 to 35 in the samples with 10% and 30% level of supplementation respectively. The trend in mold population was similar. No coliform were detected in any of the samples suggesting that all the samples might be free of faecal contamination. The relatively presence of other bacteria and molds might be due to the processing which the raw materials are subjected to. However, the high temperature at which the paste is prepared is expected to destroy all microorganisms present.

Table 5: Microbiological Analysis of Ofada –Rice Soy-Bean Flour

Sample Soybean Flour (%)	Total Viable Count (x10)	Coliform Count (x10)	Mould Count (x10)
0(100% Ofada rice)	00	00	00
10	15	00	18
20	21	00	22
30	35	00	25

Conclusion

The results of this investigation have demonstrated that it possible and also it may desirable to partially substitute Ofada-rice flour with soy-bean flour for food. This will increase the awareness and the utilization of 'Ofada' rice and also provide the needed vitamins and minerals for human nourishment. It has shown that substituting up to 20% did not significantly affect the physicochemical

properties of the flour. Soy bean is cheaper and readily available hence fortifying Ofada-rice with soybean would have little or no effect on the price of the product.

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