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Proximate composition, micronutrient contents and acceptability of "Ojojo" from the blends of water yam and Ricebean flours

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Abstract
This work was done to investigate the performance of blends of water yam and ricebean flours for water yam ball (ojojo) preparation. Water yam and ricebean were processed into flours and 100% water yam mash served as the control sample. However, ojojo was produced using lends of water yam and ricebean flours at the ratios of 90:10, 80:20, 70:30, 60:40 and 50:50 respectively, coded as WRB, WRC, WRD, WRE, WRF while the control (100:0) was produced from water yam mash coded as WA. The proximate composition, micronutrients and sensory properties of the sample were determined. There was a significant ($p < 0.05$) increase in the crude protein, fat, ash, crude fibre contents of the samples from 2.43 to 10.84%, 13.00 to 14.78%, 2.17 to 2.81%, 2.25 to 2.92% respectively. The moisture and carbohydrate contents decreased from 27.72 to 25.41% and 52.31 to 43.25% respectively due to the decrease in the level of the water yam flour. There was a significant increase ($p < 0.05$) in the minerals and vitamin contents of the fortified samples when compared with the control. It was observed from the sensory scores that in terms of the overall acceptability, sample WRF had the highest mean value of 7.20 whereas sample WA (control) had the least mean value of 3.70. Thus, there was a significant ($p < 0.05$) difference between sample WA and other fortified samples. Hence, sample WRF was the most preferred of all the samples by the panellists.

Keywords: ojojo, proximate composition, sensory properties, micronutrients, flour, water yam, ricebean

1. Introduction

Protein deficiency is a major global problem particularly in developing countries like Nigeria. Protein-energy malnutrition (PEM) results from prolonged deprivation of essential amino acids and total nitrogen and energy substrates [1]. In most developing countries including Nigeria, the low income earners cannot afford protein rich foods from animal source to meet recommended dietary allowance hence, most of their diets consists predominantly of cereals and roots which do not provide good quality protein in diet. Thus, PEM can be alleviated through food enrichment of plant origin [2].

"Ojojo" is a fried food product, produced from water yam. Traditionally, ojojo is prepared by grating edible portions of water yam then adding salt and spices such as onion and pepper. It is then mixed thoroughly, scooped with spoon and fried in hot oil, which gives it a striking resemblance with akara balls. One of the main reasons for this popularity is the "textural dichotomy of the food; dry and crispy crust, tender inside" [3]. Water yam from which ojojo is produce is high in starch content of 75-84% but low in protein (7.4%) thus, there is need to supplement ojojo with ricebean- a protein rich legume.

Water yam (*Dioscorea alata*) is one of the oldest food crops so far. It belongs to the family of Monocotyledonous plants. They are known for their high nutritional content, with crude protein content of 7.4%, starch content of 75-84%, and vitamin C content ranging from 13.0 to 24.7 mg/100 g. It is called Ji Abana in Igbo, Agbo in Tiv and Ewura in Yoruba land. It is the main staple food in Ijebu area - Western Nigeria. Due to high starch content of the tubers, water yam provides a good source of dietary carbohydrates in tropical and subtropical regions [4]. The tubers vary considerably in shape and size, depending on the soil and how deep the ground is when planting. They may occur singly or in groups, straight or branched. This yam contains a higher proportion of water than either the white or yellow yam. Its loose or watery texture is readily noticeable when the tuber is cut or grated. The tuber may be purple, white, yellow, light brown or almost red in colour when peeled. The leaves are distinctively different from others, being heart-shaped, long, broad and winged at the petiode. The stems usually have no spines and they climb round the stakes in a counter-clockwise direction [5]. Water yam can be eaten boiled, mashed, fried, or mixed with palm-oil or groundnut oil and steamed. Flour can also be made from it. Dishes such as 'Isikolo', 'Ojojo', pounded yam, 'Ikokore', pottage and fritters can be made from it. It can also be cooked with beans. Dishes such as Queen Cakes, Biscuits and pastries can be prepared from water yam flour.

Rice bean (*Vigna umbellata*) is a neglected legume high in nutrients. The dry seeds of rice bean are good sources of carbohydrates, proteins, minerals and vitamins. Protein in rice bean is rich in limiting amino acids, methionine and trytophan [6]. According to Buergelt *et al.*, [7], the biochemical components of rice bean include carbohydrate 58.2 - 72.0 %, crude protein 18.3 - 32.2 %, ash 3.5 - 4.9 %, soluble ether extract 0.1 - 0.5 %, crude fibre 3.6 - 5.5 %. The seeds are also rich in other amino acids including valine, tyrosine and lysine [8]. The seeds contain vitamins such as thiamine, riboflavin, niacin and ascorbic acid [9]. This study however, evaluated the proximate composition, micronutrient contents and acceptability of “ojojo” from the blends of water yam and Ricebean flours.

2 Materials

Rice bean was purchased from Ogige market in Nsukka Local Government Area of Enugu State. Water yam tubers were purchased from Orba market in Udenu Local Government Area, Enugu State.

2.1 Preparation of raw materials

Ten (10) tubers of water yam were peeled manually using a sharp stainless steel knife, washed and cut into thin slices to ensure efficient heat circulation during drying. The sliced water yam was then placed in a basket to drain and then oven dried at 60 ºC for 12 hours using a JKL Rotary Rack Oven. The dried samples were milled using a hammer mill, then sieved using a muslin cloth.

2.2 Preparation of rice bean flour

On the other hand, the rice bean seeds were cleaned to remove extraneous materials and soaked in cold water for 10 minutes. This was followed by dehulling, washing and drying at 60 º C for 3 hours using a JKL Rotary Rack Oven, after where it was milled in a hammer mill and sieved using a muslin cloth to obtain the flour. The flour was packaged in a high density polyethylene bag (HDPE) bucket or polyethylene bags and kept for further analysis.

2.3 Preparation of blends of water yam and rice bean

Different ratios of water yam and rice bean flours were formulated ranging from 90:10, 80:20, 70:30, 60:40 and 50:50 respectively coded as WRB, WRC, WRD, WRE, WRF while 100:0 from water yam mash served as the control sample (WA).

2.4 Preparation of ojojo from the blends of water yam and rice bean flour

Water yam mash (100:0) was used to prepare the ojojo (control). But varying proportions of the composite flours were used to prepare ojojo with ratios of water yam and rice bean flour of 50:50, 60:40, 70:30, 80:20, 90:10 respectively. Water was then added to reconstitute and form a paste of soft consistency. The paste was mixed with the appropriate ingredients for preparing ojojo as stated in Figure 1. A deep spoon was used to drop the mixture into hot groundnut oil, thereby forming ball shapes. The mixture was then deep fried in hot oil until light brown.

Firstly, 100g of each blend of flour was reconstituted with 200 ml water and mixed together to form a thick paste while the control sample was made from water yam mash. Fresh pepper, onions (chopped or ground), seasoning cube, garlic (ground) and salt were added to each paste at specified proportions as shown in Table 2 and mixed thoroughly. Groundnut oil was poured into the pot ready for a deep fry. Then, the mixture was scooped into the oil and fried until golden brown after which balls were put in a sieve to drain off oil and then ready to be served.

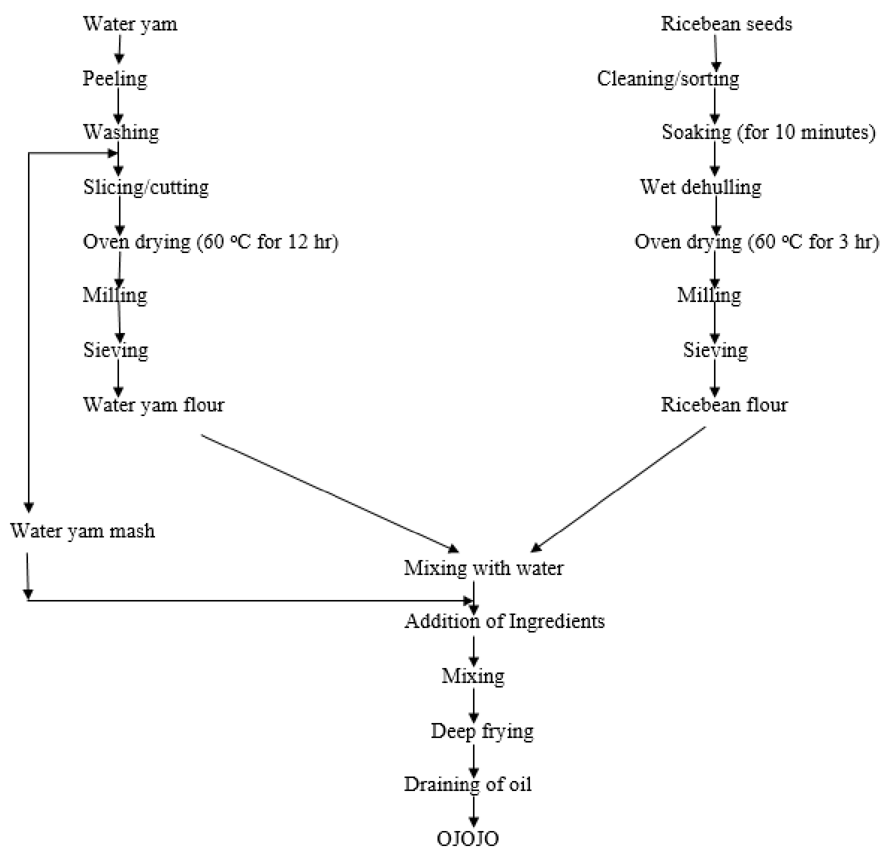

Fig 1: Production of ojojo from blends of water yam and ricebean Flours

Table 1: Formulation of composite flour from water yam and rice bean flours for the production of ojojo Samples

Samples	WYF (%)	RBF (%)
WA	100	-
WRB	90	10
WRC	80	20
WRD	70	30
WRE	60	40
WRF	50	50

*WYF = Water yam flour, RBF = Yam bean flour, WA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70%water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour.

Table 2: Recipes for the production of ojojo

Ingredients/samples	WA	WRB	WRC	WRD	WRE	WRF
Water yam flour (g)	100	90	80	70	60	50
Rice bean flour (g)	0	10	20	30	40	50
Pepper (g)	2.5	2.5	2.5	2.5	2.5	2.5
Onions (g)	2.0	2.0	2.0	2.0		2.0
Maggi (g)	2.0	2.0	2.0	2.0	2.0	2.0
Salt (g)	2.5	2.5	2.5	2.5	2.5	2.5
Water (ml)	65	65	65	65	65	65

WA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70%water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour.

3. Methods

The moisture, fat, protein, ash, and crude fibre contents were determined following the methods described in AOAC [10]. Carbohydrate was calculated by difference. Mineral elements (Ca, Mg and P) and vitamins (Vitamin C and B_{12}) were determined using atomic absorption spectrophotometer as described in AOAC [10].

3.1 Sensory evaluation

Sensory evaluation was carried out according to Ihekoronye and Ngoddy [11] using a 20 man panelists based on the sensory attributes of ojojo such as colour, flavour, taste, aroma, texture and overall acceptability using a 9-point Hedonic scale, where 9 was the highest score and 1 the lowest score.

3.2 Statistical analysis

The experiment adopted was complete randomization design (CRD). The data generated from all analyses and sensory evaluation were subjected to statistical analysis of variance (ANOVA) using the Statistical Package for Service Solutions (SPSS) version 20. Means were separated using the Duncan's Multiple Range Test and significance was accepted at $p < 0.05$ [12].

4. Results and discussion

4.1 Proximate composition of water yam based "ojojo" supplemented with rice bean flour (%)

The proximate composition of ojojo samples produced from water yam-rice bean flour blends in the ratios of 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50 coded as WA, WRB, WRC, WRD, WRE and WRF were determined and presented in Table 3.

The protein content of the samples ranged from 2.43-10.84 %. Sample with 100% water yam (WA) had the lowest protein content of 2.43 %, while sample WRF (with 50% ricebean flour inclusion) had the highest protein content of 10.84 %. However, there was a significant ($p < 0.05$) difference between sample WA and all other fortified samples. Expectedly, increase in the level of inclusion of ricebean substitution, caused a significant ($p < 0.05$) increase in the protein content of the all the fortified samples hence, more nutrients. This is due to the level of protein contained in the ricebean used for the substitution of water yam. FAO [13] also reported increase in protein content with corresponding increase in soy flour supplementation in yam flour.

The ash content of the samples ranged from 2.17-2.81 %. Sample with 100% water yam (WA) had the lowest ash content of 2.17 %, while sample WRF (with 50% ricebean flour inclusion) had the highest ash content of 2.81 %. Ash content increased with increase in the inclusion of ricebean flour. It was observed that there was no significant ($p > 0.05$) difference between sample WA and samples WRB and WRC but there was a significant ($p < 0.05$) difference between sample WA and samples WRD, WRE and WRF. The high ash content of samples could be an indication of increase in the principal mineral content which could be of vital importance to the body [14]. Also, Ayo, *et al*. [15] reported similar findings where bambara groundnut flour was supplemented showed improvement in ash content.

The fat content of the samples ranged from 13.00-14.78 %. Sample with 100% water yam (WA) had the lowest ash content of 13.00 %, while sample WRF (with 50% ricebean flour inclusion) had the highest ash content of 14.78 %. An increase in the fat content was observed as the level of addition of ricebean flour increased. A similar result was reported by Ayo, *et al*. [15] who observed an increase in fat content from 3.0-4.8% as the percentage (0-25%) of bambara groundnut flour in "acha" based "fura" increased. There was no significant ($p > 0.05$) difference between sample WA and samples WRB, WRC and WRD but there was a significant ($p < 0.05$) difference between sample WA and samples WRE and WRF. This suggests being due to the ricebean added and also the oil absorbed by the samples during frying.

Table 3: Proximate composition of ojojo from the blends of water yam and ricebean flours

Samples	Protein (%)	Ash (%)	Fat (%)	Moisture (%)	Fiber (%)	CHO (%)
WA	$2.43^{f}\pm0.28$	$2.17^{c}\pm0.92$	$13.00^{c}\pm0.14$	$27.27^{a}\pm1.12$	$2.25^{c}\pm0.37$	$52.43^{a}\pm0.82$
WRB	$3.86^{e}\pm0.42$	$2.24^{bc}\pm0.18$	$13.06^{b}\pm0.22$	$26.64^{b}\pm0.51$	$2.83^{c}\pm0.04$	$51.82^{b}\pm0.78$
WRC	5.67 ± 0.07	2.56 ± 0.42	13.11 ± 0.07	$25.41^{bc}\pm0.01$	$2.76^{bc}\pm0.21$	$50.50^{c}\pm2.06$
WRD	$7.36^{c}\pm0.14$	$2.61^{b}\pm0.01$	$13.30^{a}\pm0.01$	$25.53^{bc}\pm0.13$	2.78^{bc}	$50.09^{c}\pm0.57$

WRE	9.06^b±0.42	2.77^a±0.78	13.65^a±0.21	24.89^c±0.45	2.91^a±0.92	48.42^d±0.35
WRF	10.84^a±0.92	2.81^a±0.14	14.78^a±0.04	18.56^d±0.02	2.92^a±0.14	43.25^d±

Values are the means ± SD triplicate determination. Values with different superscripts within the same column are significantly ($p < 0.05$) different. WA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70%water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour. CHO = Carbohydrate

The moisture content of the samples decreased from 27.72-18.56 %. Sample with 100% water yam (WA) had the highest moisture content of 27.72 %, while sample WRF (with 50% ricebean flour inclusion) had the lowest content of 18.56 %. Thus, there was a significant ($p < 0.05$) difference between sample WA and all other fortified samples. It was observed that increase in the level of ricebean inclusion caused a decrease in moisture content. The low moisture content observed especially in the fortified sample indicates that it is a more shelf stable product, which may be attributed to low content of water yam flour. The decrease in the moisture content of the samples may be attributed to the functional properties protein. It was reported according to Sunful [16] and Dixit [17] that protein has some functional attributes such as water sorption, foam stability, viscosity, foamability among others which affect moisture content. Although there was a decrease in the moisture content of the fortified samples, it is enough to encourage microbial growth and spoilage during storage thus short shelf-life.

The crude fibre content of the samples increased from 2.25% to 2.92% as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest fibre content of 2.25 %, while sample WRF (with 50% ricebean flour inclusion) had the highest fibre content of 2.92 %. However, there was no significant ($p > 0.05$) different between sample WA and samples WRB, WRC and WRD, but there was a significant ($p < 0.05$) difference between sample WA and samples WRE and WRF.

Expectedly, there was a decrease in the carbohydrate content of the fortified samples as the level of ricebean flour inclusion increased from 52.43-43.25 %. Sample with 100% water yam (WA) had the highest carbohydrate content of 52.43%, while sample WRF (with 50% ricebean flour inclusion) had the least value (43.25 %). Thus, there was a significant ($p < 0.05$) difference between sample WA and all other fortified samples. The decrease suggests being due to the supplementation of water yam with ricebean in the production of ojojo which reduced the proportions of water yam thus reduced the carbohydrate content. Oyeleke *et al.* [18] also reported a decrease in the carbohydrate content of water yam as a result as of the addition of bambara groundnut [5].

4.2 Micronutrient composition of ojojo from the blends of water yam and Ricebean flours

The results of the micronutrient composition of the ojojo samples are presented in Table 4. From the results showed in Table 4, it was observed that the values of selected minerals and vitamins increased in the ojojo samples as the level of inclusion of ricebean flour increased although, the values were lower when compared with the water yam- ricebean flour blends. This may be attributed to processing losses and thermal processing (frying) which the ojojo samples undergone during preparation.

The Phosphorus content of the ojojo samples increased from 27.37- 83.04 % as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest phosphorus content of 27.37 %, while sample WRF (with 50% ricebean flour inclusion) had the highest value of 83.04 %. However, there was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

Table 4: Micronutrient composition of ojojo from the blends water yam and rice bean flours

Samples	Phosporus	Calcium	Magnesium	Vitamin B_{12}	Vitamin C	Overall Acceptability
WA	27.37^f + 0.31	30.33^f+0.58	56.06^a+0.03	10.12^f+0.02	17.08^f+0.06	3.70^a+0.45
WRB	50.50^e + 0.30	37.33^e+1.53	88.00^b+0.01	22.10^e+0.06	20.98^e+0.01	4.60^a+0.32
WRC	59.40^d+ 0.20	42.67^d+1.15	101.05^c+0.03	29.25^d+0.01	22.16^d+0.02	5.80^b+0.36
WRD	70.60 ^{c}+0.30	48.67^c+0.58	112.67^d+0.25	31.07^c+0.02	28.04^c+0.06	5.75^b+0.30
WRE	77.04^b+0.02	51.00^b+1.00	185.40^e+0.30	35.34^b+0.01	30.91^b+0.32	6.85^c+0.28
WRF	83.04^a+0.03	75.05^a+0.04	191.01^f+0.02	35.51^a+0.01	39.26^a+0.37	7.2^d+0.33

Values are the means ± SD. Values with different superscripts in the same column are significantly ($p < 0.05$) different. WA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70% water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour.

The Calcium content of the ojojo samples increased from 30.33-75.05 % as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest calcium content of 30.33 %, while sample WRF (with 50% ricebean flour inclusion) had the highest value of 75.05 %. There was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

The Magnesium content of the ojojo samples increased from 56.06- 191.01 % as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest calcium content of 56.06 %, while sample WRF (with 50% ricebean flour inclusion) had the highest value of 191.01 %. There was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

The vitamin B_{12} content of the ojojo samples increased from 10.12- 38.51 % as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest calcium content of 10.12%, while sample WRF (with 50%

ricebean flour inclusion) had the highest value of 38.51 %. There was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

The vitamin C content of the ojojo samples increased from 17.08- 39.26 % as the level of the ricebean flour inclusion increased. Sample with 100% water yam (WA) had the lowest calcium content of 17.08%, while sample WRF (with 50% ricebean flour inclusion) had the highest value of 39.26 %. It was observed that there was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

However, it was observed from the results that sample WRF which had the highest level of ash content in Table 4 also has the highest values of phosphorus, calcium and magnesium. The high ash content of samples could be an indication of increase in the principal mineral content which could be of vital importance to the body [5].

4.3 Sensory scores of ojojo from the blends of water yam and ricebean flours

The results of the sensory scores of ojojo samples are shown in Table 5 and the picture of the samples is also shown in fig 1. Sensory attributes such as appearance, flavour, texture, taste, tenderness and overall acceptability of each of these samples include; sample WA had 3.85, 3.70, 4.20, 4.30, 3.40, 3.85 and 3.70 respectively, sample WRB had 4.95, 4.50, 5.00, 5.10, 4.45, 5.1 and 4.60 respectively, sample WRC had 6.20, 5.80, 5.65, 5.70, 5.05, 5.85 and 5.80 respectively, sample WRD had 6.05, 5.85, 5.70, 5.85, 5.55, 5.50 and 5.75 respectively, sample WRE had 6.90, 6.45, 7.30, 7.00, 6.80, 6.75 and 6.85 respectively and sample WRF had 6.95, 7.05, 7.25, 7.00, 7.10, 7.05 and 7.2.

Table 5: Sensory scores of ojojo from the blends of water yam and ricebean flours

Samples	Appearance	Flavour	Colour	Texture	Taste	Tenderness OA	Overall Acceptability
WA	3.85^{c} + 0.42	3.70^{b}+0.52	4.20^{c}+0.53	4.30^{c}+0.47	3.40^{c}+0.51	3.85^{d}+0.55 3.70^{d}+0.45	3.70^{a}+0.45
WRB	4.95^{c} + 0.34	4.5^{b}+1.93	5.00^{c}+0.43	5.10^{c}+0.40	4.45^{c}0.41	5.1^{cd}+0.41 4.60^{c}+0.32	4.60^{a}+0.32
WRC	6.20^{c}+ 0.34	5.8 ^{b}+1.88	5.65^{b}+0.38	5.7^{b}+0.39	5.05^{b}+0.49	5.85^{bcd}+0.42 5.80^{b}+0.36	5.80^{b}+0.36
WRD	6.05^{c}+0.33	5.85^{b}+1.57	5.70^{b}+0.28	5.85^{b}+0.36	5.55^{b}+0.31	5.50^{bc}+0.42 5.75^{b}+0.30	5.75^{b}+0.30
WRE	6.90^{b}+0.31	6.45^{a}+1.70	7.30^{ab}+0.27	7.00^{ab}+0.28	6.80^{ab}+0.32	6.75^{b}+0.30 6.85^{a}+0.28	6.85^{c}+0.28
WRF	6.95^{a}+0.32	7.05^{a}+1.70	7.25^{a} +0.41	7.00^{a}+0.30	7.10^{a}+0.37	7.05^{a}+0.44 7.2^{a}+0.33	7.2^{d}+0.33

Values are the means ± SD. Values with different superscripts in the same column are significantly ($p < 0.05$) different. WA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70% water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour. OA = Overall acceptability

Sample WRF was the most acceptable in terms of appearance with mean value of 6.95, while sample WA had the least acceptable appearance with a mean value of 3.85. It was observed that the higher the level of rice bean paste added, the darker the colour (golden brown) of the ojojo samples. This observation was in line with Olapade [19] who reported changes in colours from cream to golden brown with supplementation with Bambara groundnut. However, there was no significant ($p > 0.05$) difference between sample WA and samples WRB, WRC, WRD but there was a significant ($p < 0.05$) difference between sample WA and samples WRE and WRF.

Sample WRF had the most acceptable flavour with a mean value of 7.05, while sample WA had the least acceptable flavour with a mean value of 3.70. Thus, there was a significant ($p > 0.05$) difference between sample WA and samples WRB, WRC and WRD but there was a significant ($p < 0.05$) difference between samples WA and samples WRE and WRF.

The taste of sample WRF was the most acceptable with mean value of 7.10, while sample WA had the least value of 3.40. Therefore, sample WA was significantly ($p < 0.05$) different from samples WRC, WRD, WRE and WRF but was not significantly ($p > 0.05$) different from sample WRB.

Sample WRE had the most acceptable colour with a mean Value of 7.30, while sample WA had the least acceptable colour with a mean value of 4.20. Sample WA was significantly ($p < 0.05$) different from samples WRC, WRD, WRE and WRF but was not significantly ($p > 0.05$) different from sample WRB. The pictures of the samples are shown in fig 2.

The texture of samples WRE and WRF was the most acceptable with mean values of 7.00 and 7.00 respectively, while sample WA had the least acceptable texture with a mean value of 4.30. There was a significant ($p < 0.05$) difference between sample WA and samples WRC, WRD WRE and WRF but there was no significant ($p > 0.05$) difference between samples WA and WRB.

The tenderness of sample F was the most acceptable with a mean value of 7.10, while sample WA had the least acceptable mean value of 3.85. Therefore, there was a significant ($p < 0.05$) difference between sample WA and samples WRD and WRF, but there was no significant ($p > 0.05$) difference between samples WA and samples WRB and WRC.

In terms of the overall acceptability, sample WRF had the highest mean value of 7.20 whereas sample WA had the least mean value of 3.70. There was a significant ($p < 0.05$) difference between sample WA and samples WRB, WRC, WRD, WRE and WRF.

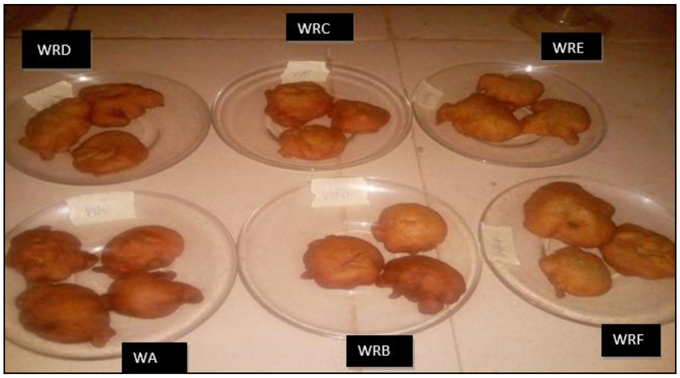

Fig 2: Samples of ojojo made from water yam flour supplemented with ricebean flourWA= 100% water yam flour, WRB=90% water yam flour + 10% ricebean flour, WRC = 80% water yam flour + 20% ricebean flour, WRD =70% water yam flour + 30% ricebean flour, WRE= 60% water yam flour + 40% ricebean flour, WRF = 50% water yam flour + 50% ricebean flour.

5. Conclusion

Addition of ricebean to ojojo (usually made from 100 % water yam) and the level of addition increased the protein, crude fibre, ash and fat content of water yam-ricebean based ojojo. Thus, continuous consumption of water yam-ricebean ojojo will help to alleviate protein-energy malnutrition. Also, sample WRF (which had 50% of the ricebean flour) had the highest mean values in terms of appearance, flavour, texture, taste, tenderness and overall acceptability. Hence, it was the most preferred sample by the panellists. These attributes could be as a result of the sensory characteristics impacted by the ricebean used for the fortification.

6. References

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