Determination of nutritional content of Sorghum-Ogi weaning food mixed with Crayfish (*Paranephrops planifrons)*

Kolawole Oluseyi Ajanaku, and Olubusola Oluwole

***Abstract*—** There is much deficiency in the nourishment of neonate's food in developing countries which has resulted in untimely death of young ones and stunted growth by virtue of malnutrition. The utilization of crayfish (*Paranephrops planifrons)* in enhancing the nutrient value of the commonly used sorghum grain as weaning food for infancy in Nigeria was examined. The study was carried out using a 10 – 50 wt% mixture of sorghum grain and crayfish in two categories of de-hulled roasted sorghum grains with roasted crayfish (SRSR) and de-hulled, un-roasted sorghum grain with un-roasted crayfish (DUSU). The proximate analysis, functional and pasting properties in addition to taste panel evaluation of the batch composition were determined. The result depicted beneficial use of both categories in enhancing both fat and protein contents of the blend in solving malnutrition deficiency. The organoleptic evaluation identified SRSR with 72% acceptance value (5% confidence level), and amylograph pasting analysis signified crayfish inclusion in improving the stability of sorghum-ogi. The results therefore proffered solution that will enhance the nutritional status of sorghum-ogi for infancy as weaning food.

***Keywords*—** Crayfish, sorghum-ogi, organoleptic test, amylograph pasting.

I. Introduction

IN fant growth and development is a direct function of adequate and appropriate diet taken during the first few months of their life. This is always reflective in the early twenty four months when exclusive breast feeding is always encouraged in line with the World Health Organization (WHO) campaign [1]**.** It was discovered that breast milk contains several immune components that aids modulating potentials and have said to have a clear role in immune mediated disease resistance later in life. From research findings, most diseases that neonates are predisposed to after weaning are mostly as a result of lack of appropriate nutrients that assist in the fortification of their immune system [2], [3]. Introduction of solid food on and after weaning is always a factor that that increases susceptibility to infectious diseases and affects child mortality from diseases such as diarrhea, whooping cough, and acute respiratory infection [4], [5]. Good nutrition at this age is crucial, as unavailability of certain key nutrients for a given age could result in physical and mental retardation that may be irreversible. This also reduces the capacity of the host to resist the consequences of such infection, thereby making death inevitable for some.

The common weaning food called *Ogi* in Nigeria, is made from maize (*Zea mays*), millet (*Pennisetum americanum*), or guinea corn (*Sorghum*), which most mothers introduce at three to six months of age [6], which contains only 310 kcal/100g of Energy, 1.8% protein and less than 1% fat, as compared with 9% protein and 4% fat obtained from original corn. The main reason is that considerable loss has occurred during the fermentation process. Therefore, as cereals that are generally low in protein and are limiting in some essential amino acids, supplementation of cereals with protein sources becomes inevitable to increase protein content of weaning food. The present study was conducted to evaluate the nutritional value of complementary feeding using crayfish (*Paranephrops planifrons*) as supplements to enhance the popular weaning food (ogi) for babies in Nigeria.

Kolawole Oluseyi Ajanaku is with Covenant University, Department of Industrial Chemistry, College of Science & Technology, P.M.B. 1023, Ota, Nigeria (corresponding author's phone: +2348033575624; e-mail: kola.ajanaku@covenantuniversity.edu.ng).

Firstname2. SurnameAuthor2, was a graduate of Covenant University, Department of Industrial Chemistry, College of Science & Technology, P.M.B. 1023, Ota, Nigeria.

II. Sample Preparation

Sorghum grain, obtained at Nigerian Brewery Plc, Lagos and Fresh crayfish from Institute of oceanography, Lagos were mixed in ratio 90:10, 80:20, 70:30, 60:40, and 50:50 weight %. The sorghum grain (1000 g) was processed in two categories of de-hulled and roasted at 65^{o}C and milled to 100 mesh (SRSR); and the second category was de-hulled, unroasted and passed through 100 mesh BS size (DUSU). The sorghum grain was prepared by soaking in 5 litre of water for 72 hrs, milled using Hobart mixer at medium speed for 7 min and the slurry passed through 100 mesh. The suspension obtained was left to stand for 1 hr for the ogi to settle. The supernatant was decanted and the ogi collected was sieved and oven dried at 70^{o}C for 2 days and stored in an airtight container. The crayfish was also processed in two categories of roasted and un-roasted. Fresh weighed crayfish (200 g) was slightly roasted at 75^{o}C to edible state without allowing it to burn. The grains were grounded in Hobart mixer, afterwards sieved with 100 mesh BS and kept in an airtight container.

A. Preparation of the sorghum-ogi blends

100 weight % of sorghum-ogi (dry basis) was mixed with 10 - 50 g of crayfish (dry basis) as shown in **Table I** while 0 g of crayfish was used as control based on the two batch formulations: SRSR- de-hulled and roasted sorghum with

roasted crayfish and DUSU– de-hulled and un-roasted sorghum with un-roasted crayfish. The recipe was mixed in a Hobart mixer for 5 min after adding 20 ml of distilled water. Hot, boiling distilled water was added to each blend and thoroughly mixed to obtain ogi-slurry, cooled to room temperature and analysed.

TABLE I
PROPORTION OF BATCH COMPOSITION (WT%)

Sample	A	B	C	D	E	F
Crayfish (g)	0	10	20	30	40	50
Sorghum (g)	100	90	80	70	60	50

B. Experimental

Moisture content, ash content, crude fat and total nitrogen by the standard micro-kjeldahl method were determined using the AOAC method [7], [8]. The percent nitrogen was converted to crude protein using 6.25 factor while the carbohydrate content was determined by difference. The pH of the sample blends were measured on a unican model pH meter which had been previously standardized with buffer solutions of pH 4 and 9. Titratable acidity was determined by method reported elsewhere [9]. Diastatic activity was determined using Blish and Sandstedt method [10]. Sugar analysis was determined using the AOAC method [8]. Vitamin C (ascorbic acid) was determined by the oxidation - reduction method based on the reduction of indophenol dye by an acid extract of the ascorbic acid. The bulk density of the samples was determined by method described elsewhere [11] while Water Absorption Capacity was calculated by another method [12]. Pasting viscosity was determined on a brabender Amylograph [13], [14]. Assessment by a ten-man panelist comprising of tasters who were familiar with the product was carried out on the sorghum-ogi-crayfish porridge batch samples. The assessment was based on a 7-point Hedonic scale for taste, appearance, texture, colour and acceptability. The data obtained were in triplicates and are subjected to analysis of variance.

III. RESULT AND DISCUSSION

A. Effect of crayfish blending on the proximate analysis of ogi recipe

The microbial stability of food samples is always a function of the moisture content of such food sample. It can either be below or above critical level which is an indication of the safety of the food. In Table II, the moisture content of the two blends against the batch compositions are shown. An high value of moisture was observed as the content of crayfish increases in the blends with batch F having the highst value of 13.63 %. Roasting has always helped in achieving minimal moisture content, as well as adding value to texture, taste, appearance and stability of the foods. Effect of roasting was observed with DUSU preffered over SRSR in Table II. This result is comparable with the results reported earlier [15] on the effect of both roasting temperature and storage period having significant effect on moisture content, textural changes and sensory attributes of food samples.

TABLE II
EFFECT OF MOISTURE CONTENT WITH BLEND COMPOSITION

Blend Composition	Moisture Content (%)	
	SRSR	DUSU
A	5.1920 ± 1.021	5.1920 ± 1.02
B	9.2800 ± 1.560	11.4240 ± 2.232
C	11.1160 ± 2.102	11.7420 ± 2.402
D	9.6360 ± 1.020	13.1360 ± 3.516
E	10.3960 ± 2.806	13.9540 ± 2.932
F	12.6360 ± 2.114	13.6360 ± 3.780

The result of protein content of all blend composition is shown in Table III. It was observed that the protein content increases with increase in the content of crayfish with DUSU having highest value in batch F. Protein is the building block of life, necessary for repairs and maintenance of the body system. It becomes necessary for neonates to have enough content of such for development and growth once weaning begins. A closer observation revealed Batch F with highest value and DUSU with high protein content in all cases observed in this work. This infers that DUSU composition is suitable to supply the required essential amino acid that is needed for the nutritional formulation.

TABLE III
EFFECT OF PROTEIN CONTENT WITH BLEND COMPOSITION

Blend Composition	Protein Content (%)	
	SRSR	DUSU
A	2.8890 ± 0.02	2.8890 ± 0.02
B	2.6700 ± 0.45	3.2390 ± 0.22
C	3.1280 ± 1.11	6.8520 ± 2.24
D	5.6030 ± 1.02	7.3540 ± 2.33
E	7.8350 ± 2.00	7.4410 ± 2.01
F	8.4040 ± 2.10	9.3670 ± 3.05

Table IV revealed the fat content of the blend samples with batch composition. Fat requirement is very essential for the development of brain especially for infancy, though the nutritional recommendation for adults is much differs. It was observed that crayfish introduction increased the fat content of all the batches when compared with the control, with SRSR having good value in batches B and C while DUSU was higher in batches D, E and F.

TABLE IV
EFFECT OF FAT CONTENT WITH BLEND COMPOSITION

Blend Composition	Fat Content (%)	
	SRSR	DUSU
A	4.3520 ± 1.52	4.3520 ± 1.52
B	13.0570 ± 3.22	11.2780 ± 2.02
C	11.4310 ± 3.67	11.2250 ± 2.89
D	8.1310 ± 1.46	12.0760 ± 3.30
E	7.7950 ± 1.52	9.4420 ± 2.11
F	10.5040 ± 3.49	10.7830 ± 2.47

B. Taste panel assessment of crayfish-ogi blends

The taste panel assessment of the blends is shown in Table

V for quality attribute for all the samples. The results were in triplicates and were treated with analysis of variance method. The results analysed for taste, texture and sweetness indicated Control and SRSR blends to be significantly different from the other sample at 5% confidence level with the control. This implied that SRSR is preferred after the control sample. However, the two blends are preferred for sweetness but SRSR still has the highest preference than DUSU. For overall acceptability, SRSR has value above 70% while DUSU is less than 70%.

TABLE V
RESULT OF ANALYSIS OF TASTE PANEL SCORES

Parameters (%)	SRSR	DUSU
Taste	66	62
Texture	78	69
Colour	69	66
Flavor	68	68
Sweetness	79	71
Appearance	72	69
Overall acceptance	72	68

TABLE VI
AMYLOGRAPH CHARACTERISTICS OF CRAYFISH-OGI BLENDS

Sample	Tp (mins)	Mg (mins)	Tvp (°C)	Vp (B.U)	Mn (min)	Vi (B.U)	Vr (B.U)	Ve (B.U)	Mn-Mg (B.U)	Vp-Vr (B.U)	Ve-Vp (B.U)	Ve-Vr (B.U)
A	78	37	91	320	45	270	200	790	8	100	470	590
B	81	36	92	330	41	285	210	820	5	120	490	610
C	81	34	93	325	38	310	220	810	4	105	485	590
D	85	34	95	340	36	325	240	835	2	100	495	595
E	86	36	95	310	37	340	250	855	1	60	545	605
F	89	36	96	320	37	348	270	850	1	50	530	580

C. Amylograph pasting viscosity of crayfish-Ogi Blends

The amylograph pasting characteristics of the samples is presented in Table VI. The peak viscosity (Vp) ranged between 320 for control and 340 B.U for 50%wt substitution with temperature at peak viscosity in the range of 91 – 96 °C; indicating that addition of crayfish has not significantly alter the swelling property of ogi. The stability value of the starch (Vp – Vr) decreased from 100 B.U to 50 B.U at 50%wt level of crayfish addition which is an indication that crayfish tends to improve the stability of sorghum ogi. Set back values (ve – vp) ranged between 470 and 530 B.U. while the gelatinization index (ve – vr) was in 590 and 610 B.U range. Therefore, it could be inferred that the all other factors affecting pasting characteristic being equal, the pasting characteristics of the blends are not significantly different from the normal sorghum ogi.

IV. CONCLUSION

Fortification of the popular sorghum-ogi weaning food in Nigeria with crayfish has been carried out. It was strongly observed and suggested in as much as crayfish is a good source of protein, essential minerals required as immediate nourishment when babies reach weaning stage, to utilize this blending result in feeding formulation for neonates.

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