MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Food Science and Technology (ISSN: 2354-2527) Vol. 3(1) pp. 001-005, January, 2015
Available online http://www.meritresearchjournals.org/fst/index.htm

Original Research Article

Effects of feeding a complementary diet formulated from rice, Banjara beans and sesame on *in vivo* studies in weaning rats

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Abstract

A complementary weaning food was formulated in a 70:20:10 ratio using Rice, Bajara Beans and sesame, they were fermented and roasted respectively and were fed to Rats at weaning age. A total of twenty white albino rats of the winster strain weighing between 35-40 grammes were used for the study. They were divided into four groups of five rats each. With group 1serving as the normal control and fed growers mash, group 2 were fed rice and Banjara beans in a (RB) 70:30 ratio group 3 were fed rice (RS) with sesame in a 70:30 ratio respectively group 4, were fed Rice, Banjara beans and Sesame in (RBS) 70:30:10 ratio (Test diet). The feeding regime lasted for twenty eight (28) days. Starting from the 21st day, feacal and urine samples were collected on daily basis up to the 28th day and later pooled together, for analysis. Processing of the weaning food blend (RBS) resulted in increase *in vitro* protein digestibility (96.35±0.009) at six hours. Results form the Biologcial value studies recorded (97.6±0.009) and Apparent protein digestibility (96.6±0.033) of the weaning food blend (RBS) were significantly (P<0.05) higher than the GW, RB and RS fed groups. The PER of the weaning food blend (RBS) was higher (6.57±0.009) than the GW group (2.60±0.009) RB group (2.87±0.009) RS group (2.91±0.009). Low level of net protein utilization also followed the same trend. The weaning food blend (RBS) was found to be adequate in protein quality, thus it can be recommended in the management of protein energy malnutrition in infants at weaning age.

Keywords: Apparent digestibility, Biologcial value, Energy malnutrition, Protein, Weaning food

INTRODUCTION

The growth of the infant in the first or second years is very crucial and rapid, breast feeding alone will not meet the child nutritional requirement. (Elemo *et al,* 2011). Recent findings have shown that malnutrition is increasing in some part of the world particularly in developing countries, infections and unsatisfactory feeding practices or more often a combination of the two, are the major causative factors (WHO, 2000, UNICEF, 1979). In developing countries like Nigeria, one of the greatest problems affecting millions of people particularly infants are lack of adequate protein in terms of quality and quantity. Evidence has shown that protein deficiency is a major nutritional problem among the children and has hindered their health, especially mental capability, School performance and productivity, thus affecting the countries economic growth (Ijarotimi and Famurwa, 2006). Weaning is a gradual process of introducing solid foods to an infant's diet alongside breast milk from the age of three to four months, at this stage, breast feeding along can not meet the infant nutritional requirement. Most often poverty and lack of nutritional knowledge are some of the major factors attributed to this low protein intake, resulting to child not getting adequate nutritional requirement (Berkman and Kawach, 2000). Traditional weaning food in Nigeria and in most developing countries is made from mono cereal gruel such as maize, millet, guinea corn, rice, sorghum and is highly deficient in some of the essential Amin Acids, particularly lysine. There is therefore the need for strategic use of inexpensive high protein sources that complement the protein quality of these staple food crops in order to enhance their nutrition value (Nkama, 2002). Traditional weaning foods could be improved upon by combining locally available foods that complement each other in such a way that new pattern of protein quality created by this combination is similar to that recommended for infants (Okafor *et al.,* 2008). Rice is a staple food in many developing countries. Rice is rich in carbohydrate but deficient in essential amino acids such as lysine thus making their protein quality poorer than that of animals. Legumes such as banjara beans, cowpea, sesame and groundnut represent a major source of valuable but incompletely balance protein because of the deficient sulphur containing amino acids methionine crytein (Akande and Fabiyi, 2010).

The objective of this research work is to prepare complementary weaning food from locally available foods such as rice banjara beans and sesame that will meet the nutritional requirement of infants of weaning age and evaluate the protein quality of the weaning foods.

MATERIALS AND METHODS

Source of raw materials

Rice, Banjara beans and sesame were used to formulate composite blends (diets) used in this study, were obtained from Maiduguri Monday Market, Nigeria. Also for the control, growers mash was used vita feeds Maiduguri, Nigeria. The grain and legumes were authenticated by a seed breeder at Lake Chad Research Institute (LCRI) Borno State.

METHODS

Sample preparation

Preparation of Rice

The rice was processed according to the method described by Kulkarn *et al,* 1999. One hundred grams (100g) of cleaned rice was steepled in 200mls of distilled water (1:2 w/v ratios for 24 hours. At the end of the 24 hours the rice was washed and sun-dried. The dried rice was ground into a fine powder and sieved using a 1 nm pore sieve.

Preparation of Banjara Beans

About 100g of Banjara beans seed was cleaned washed and then soaked in dsitiled water for twenty minutes. The seeds were dehulled washed to remove the husk, after which it was sun-dried to a constant weight. The dried Banjara beans seed was roasted and then milled into fine powdered flour. (Theodore et al, 2007).

Preparation of Sesame Seed

About 100g of sesame seed was washed by using calabash to remove sand and other impurities and sun-died. The dried sesame seed was milled into a fine powder (Ray, 2011).

Formulation of the weaning food blends

The weaning food was formulated in a 70:20:10 ratios. Thus 70 parts of fermented rice, 20 parts of roasted banjara beans and 10 parts of sesame (70g Rice: 20g Banjara Beans: 10g Sesame)

Determination of Protein *In Vitro* Digestibility (Nills, 1979)

One milliliter (1ml) of 11% trypsin was introduced into 3 test tubes and 1ml of 0.1 NaCl was added and allowed to stand to equilibrate. 1ml of composite mixture was added to all the test tubes (labeled as digestibility at 1 hour and 6 hours). The reaction in each of the test tube was stopped with 5ml of neutralized formalin at 60 minutes and 6 hours. The content of the test tube was then filtered using filter paper. The filter paper was dried in an oven at 108^0C for 3 hours. The nitrogen of the undigested sample was determined by the Kjedalh method. The procedure described was patterned after that of NIlls (1979).

$$\% \text{ in vitro protein digestibility} = \frac{CP_1 - CP_2}{CP_1} \times 100$$

Where

CP_1 = Total protein of unprocessed grain

CP_2 = Total protein after digestion with trypsin.

Determination of Protein Quality

Protein quality indices were determined using standard methods. The nitrogen content of the faeces and urine

Table 1. *In vitro* protein digestibility of unprocessed and processed rice, banjara bean, sesame and weaning food blend (RBS)

Time	Rice (%)		Banjara beans (%)		Sesame (%)		RBS (%)
	Unprocessed	Processed	Unprocessed	Processed	Unprocessed	Processed	
1 hour	74.33±0.015	87.19±0.006[a]	71.28±0.009	80.63±0.009[a]	70.66±0.015	80.52±0.012[a]	86.76±0.012
6 hours	75.89±0.009	87.78±0.012[a]	80.09±0.006	92.03±0.015[a]	80.09±0.006	89.92±0.009[a]	96.35±0.009[a]

Values are recorded as mean ± SD of three determination, value with different superscript are significantly different (P<0.05)

Table 2. Biological value Apparent digestibility net protein utilization and protein efficiency ratio of weaning food blend from rice, banjara beans and sesame

Parameter	Control (GW)	Group 1 (RB) 70:30	Group 2 (RS) 70:30	Group 3 (RBS) 70:20:10
Urinary Nitrogen	0.62±0.009	0.64±0.009[a]	0.67±0.009[a]	0.41±0.009[b]
Feacal Nitrogen	1.15±0.009	1.19±0.009[b]	1.21±0.009[a]	1.10±0.009[a]
Biological Value	90.9±0.035[a]	92.5±0.088[a]	93.1±0.009[a]	97.6±0.009[a]
Apparent Digestibility	91.6±0.009[a]	94.2±0.058[a]	95.3±0.058[a]	96.6±0.033[a]
Net Protein Utilization	47.0±0.577[a]	51.6±0.882[a]	53.7±0.882[a]	61.0±0.577[a]
Protein Efficiency Ratio	2.60±0.009	2.87±0.009[a]	2.91±0.009[a]	6.57±0.009[a]

Values are recorded as mean ± SD of three determinations
GW: Growers Mash; **RB:** 70 parts of rice to 30 parts of Banjara beans; **RS:** 70 parts of rice to 30 parts of sesame; **RBS:** 70 parts of rice, 20 parts of Banjara beans, 10 parts of sesame

was determined by micro Khjedahl method (AOAC, 2000). From the values of mean daily feed intake and mean weekly weight gain obtained Biologcial value (BV), Apparent protein digestibility (APD), Net protein utilization (NPU) and protein efficiency ratio were calculated by method of (Gupta *et al,* 2001).

Animal feeding experiment

Experimental Design

Twenty albino rats of 21 – 25 days of age weighing 35±5g supplied by the animal house of the Department of Biochemistry University of Maiduguri were used. The rats were divided into four (4) groups consisting of five (5) rats.

Group 1 is the normal control group fed growers mash, group 2 were fed rice and Banjara beans in a (RB) 70:30 ratio group 3 were fed rice (RS) with sesame in a 70:30 ratio respectively group 4 were fed Rice, Banjara beans and Sesame in (RBS) 70:30:10 ratio (Test diet). The feeding regime lasted for twenty eight (28) days on the 21st day feacal and urine samples were collected on daily basis and later pooled together, the volume of urine and feaces were recorded and used for the determination of nitrogen by micro-khjedahl method.

The weaning rats were weighed weekly. A weighed diet was given daily and unconsumed food of was collected, dried and weighed.

Biological value (BV), Apparent digestibility Net protein utilization (NPU) and Protein efficiency ratio (PER) were assessed using the following formulas described by Gupta *et al* (1979).

Biological value (BV) _

$$= \frac{\text{Nintake} - (\text{FN} - \text{MFN}) - (\text{UN-EUN})}{\text{Nintake} - (\text{FN} - \text{MFN})} \times 100$$

Apparent protein digestibility (APD)

$$= \frac{(\text{Nintake} - \text{FN})}{\text{Nintake}} \times 100$$

Net protein utilization (NPU)

$$= \frac{(\text{Nintake} - \text{FN} - \text{UN})}{\text{Nintake}} \times 100$$

Protein efficiency ratio (PER)

$$= \frac{\text{Changes in body weigh}}{\text{Protein intake}} \times 100$$

Where;
FN = faecal nitrogen
UN = Urianry nitrogen
MFN = Metabolic faecal nitrogen
EUN = Endogenous urinary nitrogen

Statistical analysis

Data obtained form the research were analyzed using analysis of variance (ANOVA) Duncan multiple range test was used to compare the deficiencies between the means significance was accepted at $P \leq 0.05$

RESULTS

Table 1 presents the results of the *in vitro* protein digestibility of raw and processed rice, banjara beans and sesame and the weaning food blends (test diet). The protein *in vitro* digestibility at 6 hours of digestibility are significantly (P≥0.05) higher indicating that it is time dependent. The *in vitro* protein digestibility of the weaning food blend (Test diet) was found to significantly increase with time at 1 hour the IVPD of the test diet was found to be 86% but there was a significant increase at 6 hours of 96%.

Table 2 shows the results of the urinary nitrogen feacal nitrogen Biological value (BV), Apparent digestibility (AD), Net protein utilization (NPU) and protein efficiency ratio (PER) of the processed fortified rice banjara beans (RB) rice sesame (RS) and rice, banjara beans and sesame (RBS). There was no significant difference in the Biologcial value (BV) Apparent digestibility (AD) Net protein utilization (NPU) and protein efficiency ratio (PER) in the RB, RS and RBS Groups. The control group had lower levels of Biologcial value (BV) and Apparent Digestibility (AD) as compared to the RB, RS and RBS groups. The results of the BV and apparent digestibility (AD) of the test group (RBS) recorded higher with 97% and 96% respectively followed by the RS group 93% and 95% respectively. The RBS group had a high PER level compared to other group. The group of rats that were fe4d with RBS had lower urinary nitrogen. The RS group had higher feacal nitrogen. The RBS group had lower feacal nitrogen as compared with the other groups.

DISCUSSION

The processing process helps in improving the *in vitro* protein digestibility of the weaning food blend (RBS) and this could be due to the activities of protecolytic enzymes during fermentation of the rice, absence of the bran on the rice allowed for a good digestion. Our results are within the range of those reported by Philip *et al* (2009). The heat treatment of the banjara beans helps in increasing the digestibility of the weaning food (RBS) which leads to reduction in anti-nutritional factors during processing. Supplementation of the rice with banjara beans and sesame may also be partly responsible for the increase in protein digestibility of the weaning food blend (RBS). This results a greed with the findings of Falmata *et al* (2014).

Nitrogen balance studies

There was no significance (P<0.05) differences in the Biologcial values (BV) and apparent digestibility (AD) of all the diets. The higher BV and AD of the weaning food blend 97% and 96% indicated adequate complementation of protein in the test diet (RBS) supplemented with banjara beans and sesame. The formulated weaning food blend RBS had high PER comparable to that of other groups. The high PER exhibited by the weaning food blends indicates that the improved pattern of amino acid was utilized by the rats for the synthesis of tissue protein. The weaning food blend (RBS) group had lower levels of urinary and faecal nitiorgen. Faecal nitrogen affects digestibility. High feacal nitrogen losses indicate low nitrogen digestibility and utilization (Onweluzo and Nwabugwu, 2009)

CONCLUSION

The results have shown that the formulated weaning food prepared from rice, banjara beans and sesame had protein content which is nutritionally desirable to the high Biological value and Apparent digestibility of the weaning food blend indicate that the weaning food blend can promote growth and can be recommended for infants at weaning age.

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