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Evaluation of Nutritional Quality and Sensory Attribute of Home Processed Complementary Diet from Locally Available Food Materials (Sorghum Bicolor and Sphenostylis Stenocarpa)

Ijarotimi O. Steve
Department of Food Science and Technology (Human Nutrition Division),
Federal University of Technology, Akure, Ondo State, Nigeria

Abstract: A potential weaning diet prepared from sorghum and African yam bean have been previously reported. The diet blends were prepared in five different ratios: 90:10, 80:20, 70:30, 60:40 and 50:50% of sorghum and African yam bean and fed to weaning rats for a period of 35 days. The biological performance of the developed product was determined and compared with cerelac (a commercial weaning food). The results showed the following ranges: PER 0.26-0.43, NPU 79.8-83.1, BV 0.62 -0.73, TND 59.3-65.3. These calculated attributes of developed products were rated in term of percentage with the control sample and it was observed that SA-2 and SA-3 values were either equal or above the control values for the determined attributes. Also, it was observed that there was no significant difference between SA-2 and SA-3 in terms of overall acceptability, weight gained by the animals, calculated PER, NPU, BV and TND. This suggests that supplementation above 20% African yam protein only causes minimal alteration in the nutritive value of sorghum-african yam bean.

Key words: Nutritional quality and sensory attribute of sorghum-african yam bean blends

INTRODUCTION

Poverty and malnutrition are the major socio-environmental factors facing many families in developing countries. Evidences have shown that over 85% of children born in the world live in developing countries and of these children 4% die of malnutrition and other diseases before they are five years old[1]. The most affected of these children are usually the children of illiterate parents in low-income groups who have low purchasing power in the economy. Strong evidences have shown that socio-economic level of a family determined the quality of food intake and health status of family members[2,3,4]. In many developing countries, rural diets are based predominantly on cereals and starchy roots and tubers, which are low in protein and those children of these families, are usually weaned on these low quality diets. These preparations have been reported to be deficient in protein and thus being the major cause of Protein Energy Malnutrition (PEM) among infants that received the diets[5,6]. This led to the development of various improved weaning foods from cereals and vegetable proteins (legumes)[7,8,9,10].

Weaning is the transition from exclusive breastfeeding to family diets and is a vulnerable period. It is the time when malnutrition starts in many infants, contributing significantly to high prevalence of malnutrition in children less than five years of age worldwide. The adequacy of complementary feeding, in term of timely, adequate, safe and appropriate, not only depends on the availability of a variety of foods in the household, but also on the feeding practices of caregivers. In Nigeria the local weaning foods are low in quality protein and the available commercial weaning foods are in short supply in rural communities, thus making it expensive and out of reach of the low-income families. To reduce the cost of these weaning foods and increase their affordability, there is a need to develop weaning food from locally available food materials, such as sorghum and African yam bean, as an alternative ways of solving the problem of expensive commercial weaning formulas. The present study was therefore aimed at comparing the nutritional qualities of formulated weaning diet from sorghum and African yam beans and cost of formulated food materials with those of commercial weaning foods.

MATERIALS AND METHODS

Sample collection: The sorghum biocolour (L) moench) and African yam beans (Sphenostylis Stenocarpa) were obtained from the local in Akure, Ondo state. From the

bulk collection of the seeds under study, about 10 kg of each were thoroughly rinsed with distilled water before subjecting them to the different processing methods.

Food formulation: The sorghum bicolor and fermented African yam beans were mixed in five different ratios and designated as A, B, C, D and E. The detail of preparation of the infant formula has been described in a previous paper and the formulation of sorghum bicolor and fermented African yam beans is shown in Table 1.

Biological evaluation of protein quality: The experimental animal for the bioassay test were clinically healthy weaning albino rats of Wister strain (age 21days old) and they were obtained from the animal unit of Drug research and production unit of faculty of pharmacy, Obafemi Awolowo University (O.A.U), Ile-Ife, Osun state. The rats were randomly selected and divided into seven groups of four rats in each group; and two of the groups were control and nitrogen free basal diet group respectively, while others were experimental groups. The rats were individually housed in separate cubicles in a metabolic cage with adequate facilities for separate feacal and urinary collection. The nutritional composition of the diet was sorghum bicolor and fermented African yam beans in the ratio shown in Table 1 for the experimental rat groups, cerelac (a commercial weaning food) for the control group and N-free basal diet. The rats were offered water and diets ad libitum for 35 days. Records were kept of the weight changes and total food intake. The last seven days of the experimental periods were used to collect urine and faece of the rats from each group. The urine from each cage was collected in small urine cups containing 1 cm^3 of 0.1M H_2SO_4 acids as preservative and each day collection was stored in screw-capped bottles and stored at -18°C. Faecal samples were collected from each group daily, dried and stored. Duplicate samples of urine, faeces and diets were taken for nitrogen determination and the obtained values were used to determine the Protein Efficiency Ratio (PER), Net Protein Utilization (NPU), Biological Value (BV) and True Nitrogen Digestibility (TND) parameters.

Sensory and economic evaluation: The sensory evaluation was carried out on the following attributes: taste, appearance, aroma, mouth (texture), colour and overall acceptability by a panel of ten members using a 9-point hedonic scale. The rating of the samples ranged from 1 (Dislike extremely) to 9 (Like extremely). The costs of the diets were estimated using the prevailing prices of the component food materials and the commercial infant foods at the time of the experiment.

Table 1: Formulation of sorghum bicolor and African yam beans

Samples	Sorghum (%)	African yam beans (%)
SA-1	90	10
SA-2	80	20
SA-3	70	30
SA-4	60	40
SA-5	50	50
SA-6	-	100

Statistical analysis: The statistical significance of the observed differences among the means of triplicate readings of experimental results were evaluated by analysis of variance (ANOVA), while means were separated using Duncan's Range Test. These analyses were carried out using GenStat 6.1 [2002] computer program.

RESULTS AND DISCUSSION

Figure 1 shows the mean weight gained by the animals from each group fed with formulated diet and cerelac (control). It was observed that animals fed with SA-2 SA-3 and SA-1 gained more weight in that order than the animals fed with control diet, while other animals from the formulated diet groups SA-4 and SA-5 gained less weight than the control animals. This observation could be attributed to the increased in concentration of anti-nutritional factors, particularly trypsin, tannins, phytates, lectin, etc, as the percentage of African yam bean in the mix increased. Evidences have shown that legume consumption has various deleterious effects, such as growth retardation, lowered digestibility and absorption of dietary nutrients[12] and other physiological, metabolic and immunological disturbances[14] and that these effects have been variously attributed to the presence of antinutritional factors.

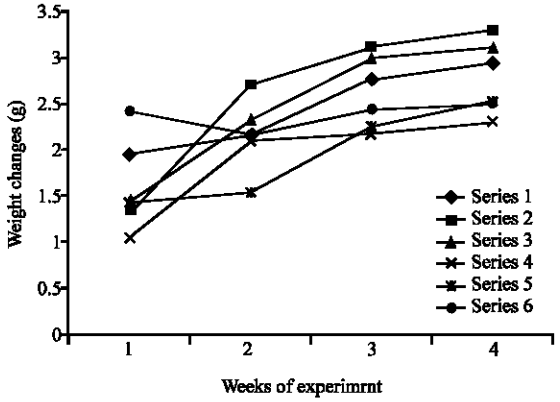

Fig. 1: Average weight changes of animals during experimental period SA-1 (Series 1), SA-2 (Series 2), SA-3 (Series 3), SA-4 (Series4), SA-5 (Series 5) and Control (Series 6)

Table 2: Sensory evaluation scores for reconstituted sorghum bicolor and fermented African yam beans infant mixes and a reference infant food (cerelac)

Sample	Colour	Taste	Flavour	Overall Acceptability
SA- 1	1.6[d]	2.9[b]	1.9[d]	4.7[b] (59.5%)
SA- 2	2.4[c]	1.7[a]	2.2[d]	4.2[b] (53.2%)
SA- 3	2.5[c]	2.1[b]	2.6[c]	3.2[c] (40.5%)
SA- 4	3.2[a]	2.0[b]	2.6[c]	2.1[d] (26.6%)
SA- 5	4.3[b]	1.7[c]	3.9[b]	1.9[d] (24.1%)
Control (cerelac)	7.6[a]	7.1[a]	6.3[a]	7.9[a] (100%)

Means with similar alphabets belong to the same homogenous subset and are not significantly different from each other at the 5% statistical level

The sensory evaluation scores for the formulated diet (sorghum bicolor and fermented African yam beans) and control sample (cerelac) is given in Table 2. The result of sensory evaluation showed that the overall acceptability assessment of the developed product and control sample showed that the control sample was significantly rated best above the developed products. It was also observed that there was no significant difference between SA- 1 and SA- 2 and also between SA-4 and SA-5, but there was significant difference between SA- 3 and other food samples. This result also showed that, there was a decrease in the preference of the panelist as the percentage of fermented African yam bean increased in the developed product. This could be attributed to the fact that consumers have been used to control sample, which consists of maize and soybeans. This observation has also been reported by other investigator[8]. The SA- 2 sample was rated second to the control food sample, but there was no significant difference between it and SA- 1 sample in overall acceptability and in term of meeting the RDA requirement of the weaning children, but animals fed with SA- 2 gained more weight than animals fed with SA- 1. It is, therefore, suggested that SA-2 sample (which can be obtained by mixing two parts of fermented African yam bean flour to eight parts of sorghum flour) could be used for sorghum-african yam bean weaning diet formulation.

The biological performance of animals fed on sorghum-african yam beans flour mixed is shown in Table 3a and b. The results showed that protein efficiency ratio ranges between 0.26-0.43 and it decreases as the percentage composition of African yam bean increases. The net protein utilization of the formulated products and control ranges between 79.8-83.1 and SA-3 was the highest while SA-4 had the least value. The biological values of the formulated product and control ranges between 0.62 -0.73 and SA-2, SA-3 and control had equal and highest values while SA-5 had the least value. The True Nitrogen Digestibility (TND) values range between 59.3-65.3 and SA-3 had the highest value while SA-5 had the least value. These attributes were rated relatively with the control sample Table 3b, it was observed that SA-2 and SA-3 values were either equal or above the control values for the determined attributes and also it was observed that there was no significant difference between SA-2 and SA-3. This suggests that supplementation above 20% African yam protein only causes minimal alteration in the nutritive value of sorghum-african yam bean. The higher biological performances of samples SA-1, SA-2 and SA-3 than SA-4 and SA-5 could be attributed to the low quantity of african yam bean, hence low anti-nutritional factors. This reason could therefore be responsible for effective digestion and absorption of nutrients in the tissues. This observation was similar to other finding[15].

Table 3a: Biological performances of rats fed on sorghum bicolor and fermented African yam bean mixes

Attribute	SA- 1	SA-2	SA-3	SA-4	SA-5	Control
PER	0.43	0.39	0.35	0.24	0.23	0.26
NPU	81.50	82.20	83.10	79.80	82.00	81.50
BV	0.70	0.73	0.73	0.67	0.62	0.73
TND	62.80	64.50	65.30	60.00	59.30	64.00

Control = Cerelac

Table 3b: Summary of the improvement in the nutritive value of Sorghum bicolour and fermented African yam beans diet

Attribute	Control	SA-1	SA-2	SA-3	SA-4	SA-5
PER (%)	100	165.4	150.0	134.6	92.3	88.5
NPU	100	99.9	100.7	101.9	97.9	100.6
BV	100	95.9	100.0	100.0	91.8	84.9
TND	100	98.1	100.7	101.9	93.6	92.6

PER, Protein efficiency ratio; NPU, Apparent Nitrogen protein utilization, BV, Biological value; TND, True nitrogen digestibility

In respect to sample SA- 2 (20% African yam bean flour and 80% sorghum flour), the amount of sorghum-african yam bean flour that could adequately meet the RDAs of children (1-3 years) were calculated Table 4 and the amount required were: energy 1447 g, protein 134.5 g, carbohydrate 190 g and fibers 1144 g; while the mineral composition range between 0.07-89.3 g. The cost of production of sorghum-african yam bean supplemented diet was = N = 320:00 ($2:1) and that of commercial formulas ranges between = N = 650-1450 ($4:2-9:35) Table 5. It is apparent that there was wide variation in the cost of developed formula and the commercial formulas; and based on this fact, many of the low-income family cannot afford to purchase these commercial weaning foods and to those who can afford to purchase these commercial formulas evidence has shown that it was usually diluted with large volume of water during preparation[16]. One of the factors limiting the use of commercial weaning foods is their cost, which are above the purchasing power of many low-income families[17] and or such people an alternative low cost weaning formula is warranted.

Table 4: Amount of sorghum-African yam bean needed to meet RDA of infant with reference to sample A (90% sorghum and 10% African yam bean)

Nutrient	Infant's RDA (1-3 years)	SA-2 (90:20)	Amount needed to meet RDA (g)
Energy (MJ)	5.5	0.38	1447
Protein (g)	16	11.9	134.5
Carbohydrate(g)	130	68.4	190
Fiber (g)	19	1.66	1144
Magnesium (mg)	80.0	144	55.6
Zinc (mg)	3.0	10	30
Calcium (mg)	500	560	89.3
Phosphorous (mg)	460	3242	14.2
Iron (mg)	15	145	10.3
Copper (mg)	0.5	1.96	25.5
Sodium (g)	1.0	1420	0.07
Potassium (g)	3.0	2560	0.12
Lead	NR	ND	NR
Aluminum	NR	ND	NR

NR (No requirement), ND (Not detected)

Table 5: Comparative cost of developed supplement and some commercial formulae

Product name	Cost =N=	K
Developed product (500 g)	320:	00($2.1)
Nutrend (400 g)	650:	00($4.2)
Cerelac (450 g)	850:	00($5.48)
SMA Gold (450 g)	1450:	00($9.35)
SMA (450 g)	800:	00($5.16)

=N= Naira, K = Kobo (US Dollar $1 = = N = 155)

CONCLUSION

This study showed that the biological performance of complementary diet formulated from 80% sorghum and 20% African yam bean was compared favourably with the control diet in term of overall acceptability and enhancing growth and development of animals from the control group. Therefore, it could be inferred that it would support the growth and development of young children. Thus, this would serve as alternative diet supplying adequate protein from cheap and locally available vegetable sources.

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