Nutritive Quality of Blends of Sprouted Corn with Germinated, Fermented and Dried Jackbean (*Canavalia ensiformis), Mucuna vulgaris*, Pigeon Pea (*Cajanus cajan*) and 'akidi'*(Sesquipedalis*)

Folusho Ugwu[1], Sunday Ugwu[2]
[1]EBSU Abakaliki, Food Sience and Tech., Nigeria
[2]Enugu State University, Chemical Engineering, Nigeria

Abstract
Legumes have been found to be an important source of protein in human and animal nutrition. The usefulness of most legumes is limited by the antinutritional factors that curtail their nutritional utilization. However, various workers have reported the possibility of total or partial elimination of the deleterious effects by various processing methods. This study was carried out to evaluate the protein quality of four legumes namely, Jackbean(*Canavalia ensiformis*), *Mucuna vulgaris*, Pigeon pea (*Cajanus cajan*) and 'Akidi' processed under previously determined optimum conditions of germination, fermentation and drying. Forty-(40) (130–250g) albino rats were divided into eight groups of five rats each. The rats were weighed and housed in individual well labeled metabolic cages. Five rats of each group were assigned to a diet formulated from the blends of processed legumes and sprouted corn. The diets were formulated to provide 1.6gN/100g diet daily for the entire study period. The recorded feed intakes were used to estimate Nitrogen Intake and Nitrogen balance of the rats. There were no significant differences in the maintenance weight of the rats at $p > 0.05$. The rats fed diets from *Cajanus cajan* ate more than others (63.29g) while the least intake (37.50g) was)observed for the rats fed Mucuna diets. The highest Biological value (BV)(88%) and Net Protein Utilisation (NPU) (83 %) were observed in rats fed diets from Cajanus cajan and these were significantly different ($p < 0.05$) from that of Mucuna blends (40 %, 37 %) for BV and NPU respectively. It could be concluded from the study that the blends from the tested legumes with the exception of Mucuna gave diets of high nutritive quality that can be used in formulation of complimentary food for children.
Keywords: Animal studies, legumes, nutritive value

INTRODUCTION

Legumes are a common class of food consumed by a large of population living in developing countries. The world production of legume seed "the poor man's meat" as they are called was about 58million tons in 1994 by FAO's estimations (Adebowale *et al.,* 2005)..Legumes are the major sources of additional protein in cereals and starchy food based diets in developing countries. Food legumes have an average of twice as much protein as cereals and the nutritive value of their protein is generally of high quality (Singh, 2000) .They are particularly important in developing countries like Nigeria where the majority cannot afford adequate intake of animal protein due to cost. The high content of lysine in legumes also makes them a ready complement to cereal foods, which are usually low in lysine (Mehta and Singh, 1989). They are thus used in improving the quality of infant and adult nutrition. However, the utilization of legumes is generally impaired by some factors such as low protein digestibility, presence of some anti-nutritional factors and hard to cook phenomenon.. Most of the legumes in raw form contain a wide range of such factors. (Tarek, 2002).

Consequently, most legumes are generally subjected to various forms of food processing manipulations such as cooking using different methods; dehulling, germination and fermentation. Nutritive studies have shown that inclusion of various processed legumes in the cereal based diets can solve the calorific malnutrition and promote growth especially of under – weight children (Bressani, 1993). Most of those studies have been on the utilization of major legumes such as the common beans (*Phaseolus vulgaris*), cowpea (*Vigna sinenisis*), soyabeans (*Glycine max.*) among others. While majority of the legumes in developed countries are not widely used and underutilized (Wanjekeche et al., 2003, Obizoba, 1981). There is therefore the need to evaluate nutritional status of some processed underutilized legumes that could be described as lesser known legumes with a view to promote the use of such in food formulations especially in infant feedings.

MATERIALS AND METHODS

The legumes studied in this work are *Mucuna vulgaris* purchased from local market in Edem, Nsukka, and Enugu State. Nigeria Red variety of Pigeon pea (*Cajanus cajan*) Jack bean (*Canavalia* *enisformis*) was purchased from a farmer in Agubia, Ikwo Ebonyi State while Akidi (*Vigna unguiculata – sesquipedalis* specie) was bought from Eke Obiagu in Enugu. The yellow maize was from a farm in Abakaliki Ebonyi State.

The legumes were processed as described in previous work (Ugwu and Okaka,2009).The crude protein value of each of the processed legume was used to formulate test diet. The eight test diets had 70% of their dietary protein from cereals and 30% from legume. The diets were formulated to provide 10% level of protein while oil, mineral and vitamin mix, corn and cornstarch were added to balance the diet. Each of these diets was mixed thoroughly and stored in a plastic container labeled and frozen until used. The composition of diet ingredients are shown in Table (1) and the diets were formulated with processed legumes as described below.

Diet I: Mucuna germinated for 72 hours, fermented for 72 hours and dried at 65^{o}C. (GFM7)
Diet II: Mucuna germinated for 72 hours, fermented for 42 hours and dried at 65^{o}C. (GFM4)
Diet III: "Akidi" germinated for 48 hours, fermented for 72 hours and dried at 65^{o}C. (GFA7)
Diet IV: "Akidi" germinated for 48 hours, fermented for 42 hours and dried at 65^{o}C. (GFA4)
Diet V: Jackbean germinated and fermented for 72 hours and dried at 65^{o}C. (GFJB7)
Diet VI: Jackbean germinated for 72 hours, fermented for 42 hours and dried at 65^{o}C (GFJB4)
Diet VII: Pigeon pea germinated for 60 hours and fermented for 72 hours and dried at 65^{o}C. (GFPP7)
Diet VIII: Pigeon pea germinated for 60 hours and fermented for 57 hours. (GFPP5)
Germinated corn, mineral and vitamin mix, oil and corn starch were added to all the diets.

Table 1: Composition of Experimental Diets

Source of N	1	2	3	4	5	6	7	8
Ratio	70.30	70.30	70.30	70.30	70.30	70.30	70.30	70.30
Corn	808.2	808.2	808.2	808.2	808.2	808.2	808.2	808.2
GFM7	128.23	00	00	00	00	00	00	00
GFM4	00	137.14	00	00	00	00	00	00
GFA7	00	00	159.23	00	00	00	00	00
GFA5	00	00	00	154.29	00	00	00	00
GFJB7	00	00	00	00	180.0	00	00	00
GFJB4	00	00	00	00	00	183.2	00	00
GFPP7	00	00	00	00	00	00	163.3	00
GFPP5	00	00	00	00	00	00	00	154.0
OIL	72	72	72	72	72	72	72	72
Mineral and Vitamin	3.60	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Corn Starch	428.2	419.3	396.97	401.9	396.2	396.2	393.0	410.7

Animal studies were carried out using rats
A 12-day study consisted of a five – day adjustment and seven – day Nitrogen (N) and balance periods were carried out. Forty (40) albino adult rats (130 – 250g) were used for the feeding studies. All the procedures for collection,treatment,and storage of faeces and urine; estimation of N content of foods, diets,faeces and urine is as described by Obizoba (1981).The diets, urine and faecal samples were analysed for Nitrogen (N) content by micro-kjeldahl method (AOAC, 1995).The food intake, Nitrogen values for urine, faecal samples and N intake obtained during the N balance period were used for calculating, N retention, Net protein utilization (NPU) and biological values. The results were subjected to various statistical analysis. Duncan's multiple range tests of Steel and Toriee (1981) was used to determine the significant differences among diets.

RESULT AND DISCUSSION

The proximate compositions of the diet are presented in Table 2. The protein content ranged from (15.9-17.02)%. The highest protein content was observed in cajanus cajan germinated for 60hours and fermented for 72hours. The proteins content of the diets were in agreement with that reported from some other test diets. (Udensi *et al.,* 2005). The values are comparable to that reported for commercial weaning formula in Nigeria such as (Nutrends, 16.00%, Cerelac 15.5%,and Babeena 17.00%) (Onurah and Akinjede, 2005). Although lower than recommended for weaning food (FAO/WHO, 1966).

The maintenance body weight, food and nitrogen intake, faecal and urinary nitrogen, digested and retained nitrogen, nitrogen balance, biological value and net protein utilization of rats fed with the formulated diet are presented into Table 3.

The results show that the rat fed diets from *cajanus cajan* ate more than others (63.29g) while the least intake (37.05g) was observed for rats fed Mucuna (GFR 7) diet. The low food intake could be due to poor palatability and aroma. Food intake is associated with Nitrogen source, palatability, flavor, and essential amino acid profile (Chikwendu and Obizoba, 2003). The food intakes for all the groups were lower than 71% reported for casein (Ugwu et al., 2002). The higher food intake in GFPP diets reflected in the higher weight observed in the rats. The gain in weight observed in the diets show proper protein utilization. The N retention of the animals varied widely with animals fed GFPP diets retaining more.The biological value(BV) and net protein utilization(NPU) follow the same trend. The highest biological value (88%) and Net protein utilization 83% were observed in rats fed diets from *Cajanus cajan* (GFPP7). These were significantly different ($p<0.05$) from that of Mucuna (GFR4)(40%, 37%) and 'Akidi' (GFA7)(62.9%, 66%) respectively.The biological values of most of the diet are higher than the recommended value of 75% for children (PAG, 1971).

In conclusion, the combination of the germination and fermentation produce legume flours of high biological value and net protein utilization values. The studied legumes therefore could be used in formulating diet for children.

Table 2: Proximate composition of the experimental diets

Diets	CHO	Protein	Fat	Ash	Fibre	MC
GFM7	63.3	16.88	2.24	5.64	3.12	6.75
GFM4	65.9	16.45	2.49	4.84	3.25	7.12
GFA7	65	15.92	2.59	5.03	3.38	8.1
GFA4	66.3	15.9	2.58	4.94	3.42	6.88
GFJB7	63	16.98	3.15	4.96	3.66	8.12
GFJB4	64	16.45	2.88	5.12	3.75	7.98
GFPP7	64	17.02	2.46	4.88	3.48	8.05
GFPP5	64	16.88	2.65	4.79	3.44	8.10

Table 3: Maintenance Body Wt, Food and Nitrogen Intake, Feacal and Urinary Nitrogen, Digested and retained Nitrogen, Nitrogen Balance, BV and N.P.U of rats fed with the formulated diets.

	GFM7	GFM4	GFA7	GFA4	GFJB7	GFJB4	GFPP7	GFPP5
Maintenance wt(g)	2.42±2.07	10.75±2.19	2.26±3.40	8.47±2.17	6.24±2.11	10.80±4.3	13.67±2.78	13.5±3.89
Food Intake (g)	$37.5^{c}\pm0.04$	$47.13^{bc}\pm0.04$	$42.5^{bc}\pm0.05$	$40.8^{bc}\pm0.02$	$48.16^{bc}\pm4.00$	$51.29^{abc}\pm4.00$	$63.29^{a}\pm4.4$	$56.22^{ab}\pm2.15$
Nitrogen Intake (g)	0.5996±0.09	0.7540±0.06	0.680±0.06	0.652±0.016	0.770±0.06	0.820±0.06	1.01±0.07	0.908±0.03
Faecal Nitrogen (g)	0.015	0.023	0.023	0.016	0.029	0.029	0.034	0.03
Digested Nitrogen(g)	$0.5981^{c}\pm0.05$	$0.7517^{cd}\pm0.06$	$0.657^{cde}\pm0.06$	$0.636^{de}\pm0.02$	$0.741^{bed}\pm0.07$	$0.792^{bc}\pm0.08$	$0.964^{a}\pm0.08$	$0.878^{ab}\pm0.04$
Urinary Nitrogen (g)	0.13	0.51	0.21	0.095	0.2055	0.12	0.124	0.17
Nitrogen Balance (g)	$0.4667^{b}\pm0.05$	$0.2407^{c}\pm0.11$	$0.448^{b}\pm0.06$	$0.5410^{b}\pm0.02$	$0.5355^{b}\pm0.07$	$0.6718^{a}\pm0.08$	$0.8454^{a}\pm0.14$	$0.7081^{a}\pm0.036$
BV%	80.4^{ab}	40^{c}	62.9^{b}	86^{ab}	72^{ab}	85^{ab}	88^{a}	81^{ab}
NPU	78^{ab}	32^{c}	66^{b}	80^{a}	70^{b}	82^{a}	83^{a}	78^{ab}

REFERENCES

Adebowale, Y.A., Adeyemi, A and Oshodi, A.A (2005). Variability in the physiochemical, Nutritional and Antinutritional Attributes of Six *Mucuna* Species. *Food Chemistry* 89(1): 37-48.

AOAC, (1995) Official Methods of Analysis (15th edition) Association of Official Analytical Chemists, Washington DC.

Bessanni, R, (1993) Grain quality of Common Beans. *Food Reviews International* 9: 237-297.

Chikwendu, N.J and Obizoba J.C (2003) Nutritional Evaluation of Protein quality of Ground bean *(Kershngiella geocarpa*) based diets, *Nigeria Journal of Nutritional Science* Vol 24: 64-67.

FAO/WHO (1966) Protein requirements meeting on Nutrition and Advances FAO: Rome: No37.

Mehta, S.L and Singh, S.P (1989). Nutritional Quality of grain legumes-present status. National Symposium on New Frontiers in Grain Legumes Research and Development, Directorate of Pulses, Research Indian Society of Pulse Research and development (ISPRM, kampur).

Obizoba I.C (1981) Effects of germination, dehulling and cooking on the Nutritive Value of Cowpea (*Vigna unguiculata*) flour. *Food Science* 54: 1371-1372.

Onuora, G.E and Akinjede, F.A (2004) Camparative Evaluation of Four Formulated Weaning Foods and Commercial Product. *Nigeria Food Journal* 22: 48-53.

PAG, (1971) Protein advisory Group guideline, No 8 Protein-rich mixtures for use as weaning foods. New York FAO/WHO/UNICEF

Singh, J (2000). Seminar on Processing and Utilization of Legumes Asian Productivity Organization, Japan 106-115.

Steel,R.G.D and Toriee,J.H (1981). Principles and Procedures of Statistics. A Biomedical approach 2nd edition. Mcgraw-hill International.

Tarek,A.E (2003) Nutritional Composition and Anti nutritional Factors of Chick peas (Undergoing different cooking methods and germination. *Plant foods for Human Nutrition* 57:83-97.

Udensi,E.A and Onuora, J.O (1996) Chemical and functional properties of Commercial Soybean Flours in Enugu *Journal of.Sc Tech* 2:106-110.

Ugwu,F.M, Ekwu,F.C and Okoye, I.C (2002) Protein quality Indices and Food Intake Pattern of Parboiled and Roasted Breadfruit-Corn diets.*Journal of Science of Agric., Food Tech and Environment,* 2:97-100

Ugwu F.M and Okaka J.C (2009). "Effect of germination,fermentation and drying on the riboflavin, thiamine and Niacin Content of Jackbean (*Canavalia ensiformis*. *Nigeria Food Journal* Vol 27:(2): 249-257.