Evaluation of the Nutritional Potential of *Sansevieria liberica* Gérôme and Labroy Leaf Meal using Wistar Albino Rats.

Catherine Chidinma Ikewuchi* **and Jude Chigozie Ikewuchi**

Department of Biochemistry, Faculty of Science, University of Port Harcourt, P.M.B. 5323, Choba, Rivers State, Nigeria.

E-mail: okaraonye@yahoo.com*

ABSTRACT

The nutritional quality of *Sansevieria liberica* leaf meal was investigated on Wistar albino rats. The reference group received the reference diet whose protein source was 100% from casein; the first test group received the test diet whose protein source was 100% from the test protein; the second test group received the diet whose protein source was 70% from the test protein and 30% from corn protein, while Basal group received the basal or non-protein diet. The net protein utilization of the test protein was significantly ($P<0.05$) higher than the reference diet. When combined with maize protein, the test protein produced significantly ($P<0.05$) higher net protein utilization, biological and net protein values than the test protein.

There were no significant differences in the mean daily weight gain and food intake, protein and nitrogen intake, faecal, carcass and absorbed nitrogen, feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein retention, relative net protein retention, protein retention efficiency, true digestibility, nitrogen efficiency ratio, protein rating, protein calories, heart weight, heart/body weight ratio, kidney/body weight ratio and lung/body weight ratio of all the groups. These results imply a great potency of *Sansevieria liberica* leaf protein as a source of high quality protein especially in the preparation of protein concentrates and formulation of new feeds for animals: and that the performance can possibly be improved by combining with maize protein.

(Keywords: biological value, net protein utilization, performance characteristics, protein quality, *Sansevieria liberica*, true digestibility)

INTRODUCTION

Livestock farmers in developing countries are faced with various problems mostly during the dry season of the year. These problems include feed shortage, high prices of feed ingredients, and climatic variations (Akinmutimi and Anakebe, 2008). The effects of these challenges have reflection on the quality and quantity of animal protein available for human consumption. To overcome these problems, attention must be paid on the utilization of unconventional feedstuff. One possible source of such cheap protein is the leaf meal of some tropical plants. Leaf meals not only serve as a protein source but also provide some necessary vitamins and minerals.

Sansevieria (family Agavaceae, Ruscaceae or Dracaenaceae), is a genus consisting about sixty plant species (Evans, 2005), commonly called bowstring hemp. *Sansevieria liberica* is one of the species in this genus. It has concave, short petioled leaves that are in part transversely banded with light and dark green, also linearly striated with whitish to light green and dark green striations (Reed, 1978). The leaves contain over 2% fiber (Osabohien, 2009). This plant has long rhizomes with long fibrous roots and a rapid rate of growth. They are grown as ornamental plants (USDA, 2008), are widely distributed throughout the tropics, and grows year round with no soil specifications. In traditional medicine, the leaves and roots of *Sansevieria liberica* are used for the treatment of asthma, abdominal pains, colic, diarrhea, eczema, gonorrhea, hemorrhoids, piles, hypertension, monorrhagia, sexual weakness, wounds of the foot, and alleviating the effects of snake bites (Gill, 1992; Osabohien and Egboh, 2008; Adeyemi *et al*., 2009).

A chemical profiling of the leaves revealed that they are rich in sodium, potassium, calcium, magnesium, vitamin C, biotin and riboflavin, and a

high quality protein that is rich in essential amino acids (with histidine, valine, and phenylalanine being very high), with a protein score of 61.90% (Ikewuchi and Ikewuchi, 2009; Ikewuchi *et al*., 2010). So, in the present study, the ability of *S. liberica* leaf protein to maintain the nitrogen balance, and promote the growth of Wistar rats was investigated.

MATERIALS AND METHODS

Procurement of Animals, Plant Samples, and Diet Components

Weanling Wistar albino rats were collected from the animal house of the Department of Physiology, University of Nigeria, Enugu Campus, Enugu, Nigeria. Fresh samples of *Sansevieria liberica* were procured from a horticultural garden by Air Force Gate, Aba Road, Port Harcourt, and another at the University of Port Harcourt's Abuja campus, University of Port Harcourt, in Port Harcourt, Nigeria. They were identified at the University of Port Harcourt Herbarium, Port Harcourt, Nigeria. Their identity was confirmed/authenticated by Dr. Michael C. Dike of Taxonomy Unit, Department of Forestry and Environmental Management, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria; and Mr. John Ibe, the Herbarium Manager of the Forestry Department, National Root Crops Research Institute (NRCRI), Umuahia, Nigeria. The corn flour, starch, palm oil, and sugar were bought from Mile 3 market Diobu, Rivers State, Nigeria. The mineral and vitamin mix, Optimix premix™ (product of Animal Care Services Konsult, Odere Remo, Ogun State, Nigeria), was purchased at African Regional Aquaculture Centre (ARAC) Aluu, Rivers State, Nigeria. Casein (product of BDH, UK) was collected from Plant Anatomy and Physiology Research Laboratory, University of Port Harcourt, Port Harcourt, Nigeria.

Preparation of the *Sanseviera liberica* leaf meal (SLM)

Fresh dirt free samples were oven-dried at 55 °C and ground in a hand mill to pass an 80 mm mesh screen. The resultant powder hereinafter referred to as *Sanseviera liberica* leaf meal (SLM), were stored and subsequently used in compounding the test diets.

Experimental Design

Studies were conducted in compliance with applicable laws and regulations. The animals were weighed, sorted into four treatment groups (Basal, Reference, Test ,1 and Test 2) of five rats each, and housed individually in plastic cages with wire mesh floor (to prevent coprophagia), and appropriate compartments to enable the collection of feces and determination of feed intake. Each treatment group was assigned one of four treatment diets, the composition of which is given in Table 1.

The Reference group received the reference diet whose protein source was 100% from casein; the first test group (Test 1) received the test diet whose protein source was 100% SLM, the second test group (Test 2) received the test diet whose protein source was 70% SLM and 30% corn flour, while Basal group received the basal or non-protein diet. All the diets (excluding the basal) were isoproteinic with protein contents of about 10% (9.996% for Reference, 9.999% for Test 1, and 10.002% for Test 2). The animals were allowed feed and water *ad libitum* and were weighed weekly. The daily feed intake was recorded, while the feces were collected daily, and dried for analysis. After a 3-day acclimatization period on their respective diets, they were weighed before commencing the collection of feces and after another 21 days were again weighed and sacrificed. The feed, fecal and carcass nitrogen contents were analyzed according to standard methods (AOAC, 2006). The absorbed nitrogen, retained nitrogen, feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein retention, relative NPR, protein retention efficiency, net protein utilization, true digestibility, biological value, nitrogen efficiency ratio, net protein value, protein calories and protein rating were all calculated as described by Pellett and Young (1980).

Statistical Analysis of Data

All values are quoted as the mean ± SD (standard deviation). The values of the various parameters were analyzed for statistical significant differences between the groups, using the Student's *t*-test, with the help of SPSS Statistics 17.0 package. $P<0.05$ was considered to be significant.

Table 1: Diet Composition Table.

Component	Composition (%)			
	Basal	Reference	Test 1	Test 2
Oil	5.00	5.00	5.00	5.00
Mineral and vitamin mix*	2.50	2.50	2.50	2.50
Sucrose	10.00	10.00	10.00	10.00
Starch	82.50	72.31	66.55	39.62
Corn flour	-	-	-	31.71
Casein	-	10.19	-	-
SLM	-	-	15.95	11.17

*Optimix premix^{TM} (from Animal Care Services Konsult, Odere Remo, Ogun State, Nigeria), whose composition/kg is: vitamin A 4000000 I.U., vitamin D_3 800000 I.U., vitamin E 4000 I.U., vitamin K 800 mg, thiamine B_1 600 mg, riboflavin, B2 1600 mg, pyridoxine, B6 600 mg, niacin 6000 mg, vitamin B_{12} 4 mg, pantothenic acid 2000 mg, folic acid 200 mg, biotin 8 mg, choline chloride 80 mg, antioxidant 50000 mg, manganese 32000 mg, zinc 20000 mg, iron 8000 mg, copper 2000 mg, iodine 480 mg, selenium 80 mg, cobalt 80 mg (Adapted from the product's label).

RESULTS

Table 2 shows the performance characteristics of Wistar albino rats fed *Sansevieria liberica* leaf meal. There were no significant differences in the mean daily weight gain and food intake, protein and nitrogen intake, faecal, carcass and absorbed nitrogen, feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein retention, relative net protein retention, protein retention efficiency, true digestibility, nitrogen efficiency ratio, protein rating, protein calories, heart weight, heart/body weight ratio, kidney/body weight ratio, and lung/body weight ratio of the test groups and reference group.

The net protein utilization of the test groups were significantly (P<0.05) higher than the reference group. The biological and net protein values of Test 2 were significantly (P<0.05) higher than reference group, but not different from Test 1. The kidney weights of the test groups were significantly (P<0.05) lower than the reference group. The liver weight and liver/body weight ratio of Test 1 were significantly (P<0.05) lower than reference, but not different from Test 2. The lungs weight of Test 2 was significantly (P<0.05) lower than reference, but not different from Test 1.

DISCUSSION

The feed intake, weight gain and organ weights of the animals across the groups did not differ significantly, thus showing the ability of the test protein to support weight gain and the growths and functions of the organs of the rats, at least to a level that is comparable to that of the reference protein. The true digestibility of the test protein was not different from those reported for pigeon peas, lima beans, lentils, groundnuts, cowpeas, velvet beans, chick-peas, bambarra groundnuts and soybean (FAO, 1981).

The biological values of Test 1 and Test 2 were higher than those of chick peas, bambarra groundnut, cowpeas, lima beans, soybean, pigeon peas, groundnut, velvet beans and lentils (FAO, 1981). The biological value was also found to be higher than that of egg protein considered to have the highest biological value of natural sources with a biological value of 97% for growing rats and 94% for adult rats (FAO/WHO, 1973). This of course shows the potential of the test protein for use in productive purposes in place of the reference diet which is expensive and not readily available.

The net protein utilization of the test protein was greater than those of bambarra groundnut, cowpea, groundnut, lentils, velvet beans, lima beans, soybean, pigeon pea (FAO, 1981), maize, millet, rice and wheat (FAO/WHO, 1973). The protein efficiency ratio of the test protein was not different from those reported for soybean, pigeon pea, lima beans, lentils, chick-peas and groundnut (FAO, 1981). The protein efficiency ratio, net protein retention, net protein utilization, true digestibility, relative net protein utilization, biological value, nitrogen efficiency ratio and net protein value of the test protein were higher than those of African yam bean (Onwuka *et al*., 2009) and fluted pumpkin (Ikewuchi *et al*., 2009).

Table 2: Performance Characteristics of Wistar Albino Rats Fed *Sansevieria liberica* Leaf Meal.

Parameter	Treatment		
	Reference	Test 1	Test 2
Mean daily food intake (g)	4.441±0.727[a]	4.028±0.405[a]	3.509±0.330[a]
Mean daily weight gain (g)	1.266±0.846[a]	1.406±0.055[a]	1.050±0.346[a]
Protein intake (g)	9.325±1.526[a]	8.458±0.851[a]	7.369±0.694[a]
Nitrogen intake (g)	1.493±0.243[a]	1.353±0.136[a]	1.179±0.1118[a]
Faecal Nitrogen (g)	4.288± 0.543[a,d]	3.220± 0.405[b,d]	3.878± 0.524[a,b,d]
Carcass Nitrogen (g)	7.998±0.661[a]	8.750±0.247[a,c]	9.188±0.381[b]
Absorbed Nitrogen (g)	1.003±0.605[a,b]	1.932±0.397[a]	1.100±0.502[a,b]
Feed conversion ratio	0.276±0.203[a]	0.353±0.029[a]	0.297±0.088[a]
Feed efficiency ratio	3.164±1.002[a]	2.862±0.251[a]	3.664±1.054[a]
Protein efficiency ratio	2.758±2.034[a]	3.528±0.290[a]	2.973±0.880[a]
Net protein retention	0.968±2.173[a]	1.583±0.138[a]	0.750±0.956[a]
Net protein utilization (%)	65.776±38.730[a]	137.533±26.422[b]	196.368±53.141[b]
Relative NPR (%)	100.000±224.536[a]	163.611±14.288[a]	77.555±98.824
Protein retention efficiency	15.482±34.762[a]	25.330±2.212[a]	12.007±15.299[a]
True digestibility (%)	65.761±38.331[a,c]	144.571±33.660[b,c]	94.806±45.402[a,b,c]
Biological value (%)	136.930±144.284[a,c,e]	104.988±39.639[a,b]	318.757±259.620[b,d,f]
Nitrogen efficiency ratio	17.239±12.710[a]	22.047±1.811[a]	18.580±5.501[a]
Net protein value	6446.038±3795.502[a]	8622.008±1656.404[a,c]	12310.389±3331.386[c,d]
Protein rating	139.289±102.698[a]	178.139±14.637[a]	150.122±44.448[a]
Protein calories (kcal)	37.304±6.109[a]	33.833±3.405[a]	29.476±2.774[a]
Heart (g)	0.233±0.039[a]	0.192±0.024[a,b]	0.186±0.054[a,b]
Kidney (g)	0.487±0.089[a]	0.334±0.031[b]	0.326±0.085[b]
Liver (g)	1.865±0.278[a]	1.215±0.108[b]	1.430±0.709[a,b]
Lungs (g)	0.405±0.083[a]	0.391±0.037[a,b]	0.298±0.081[b]
Heart/body weight ratio	0.003±0.001[a]	0.003±0.000[a]	0.003±0.000[a]
Kidney/body weight ratio	0.006±0.002[a]	0.005±0.000[a]	0.005±0.001[a]
Liver/body weight ratio	0.023±0.004[a,c]	0.016±0.001[b,d]	0.022±0.007[c,d]
Lung/body weight ratio	0.005±0.001[a]	0.005±0.001[a]	0.005±0.001[a]

Values are means ± S.D., n= 5 per group. Values in the same row with the different superscripts are significantly different at P<0.05.

CONCLUSION

In the growing global food crisis, where protein sources are becoming scarce in most countries, like Nigeria, this plant can be cultivated, and the protein extracted to help the growth of animals and humans. From this result, *Sansevieria liberica* leaf protein can be suggested as a model protein supplement to support growth and development, which is an advantage in the tropical region and Africa, where animal protein sources are increasingly becoming unavailable.

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