NUTRITIONAL EVALUATION OF *PARKIA BIGOLOSA* (AFRICAN LOCUST BEAN) PULP – SUPPLEMENTED LABORATORY ANIMAL FEED

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ABSTRACT

The yellow mealy pulp of ***Parkia bigolosa*** was used to formulate laboratory animal feeds and the nutritional value evaluated.

The proximate nutrient composition of pulp-based feed showed carbohydrate content of 63.28%, protein 17.56%, fat 7.02% and appreciable amounts of Ca, Mg, Na, Zn, Fe and P, which compared well with maize – based feed. Result of feeding experimentation also indicated that the pulp formulation was well tolerated and supported growth in weanling laboratory rats as assessed by the growth rate, haematological and biochemical indices.

The potential of ***Parkia bigolosa*** pulp as source of feeding stuff for the formulation of laboratory animal feed is discussed.

Key words: ***Parkia bigolosa***, pulp, laboratory animal.

INTRODUCTION

Under the artificial conditions of the laboratory, most of the animal species commonly in use have become adapted to the omnivorous state (Coates et al, 1969). The need for uniformity among experimental animals demands that they be fed on a nutritionally adequate diet of known and repeatable composition (Clarke et al, 1977). In consequence, standardized diets based on cereals, with supplements of good quality proteins, vitamins and minerals have come into general use (UFAW, 1987).

According to ILAR, (1995), selection of the most appropriate type of diet will depend among other factors: diet acceptability by the animal, availability and cost. In other words, the diet must be sufficiently palatable to ensure adequate food consumption, and must be nutritionally balanced so that the nutrients essential for the objective are provided.

In Nigeria, various types of formulated commercial diets are available for use. Unfortunately, the unfavourable economic situation has made such feeds expensive for daily maintenance of laboratory animals in most animal breeding houses. The use of locally available foodstuff to formulate diets has been adopted as a coping strategy. The local formulations are usually cereal-based as recommended by UFAW. Some of the cereals used are maize, wheat, sorghum, millet, rice etc. depending on the most available in various communities.

In Jos University Animal House, laboratory rats and mice are fed with maize or sorghum-based local feed, supplemented with Soya bean, fish meal, groundnut meal, and some vitamin and mineral mixes. However, the cereals are also highly consumed by humans and other domesticated animals. There is therefore the tendency that their high cost would again be a constraint.

It has become necessary that other lesser-known or underutilized sources of carbohydrates – dense foodstuff that could be cheaper, be exploited and used to replace the cereals.

The yellow mealy sweet pulp of ***Parkia bigolosa*** has been found to be a valuable source of carbohydrate (Oyenuga, 1968), and which has been underutilized.

This research work is therefore an attempt to compound a Parkia pulp-based laboratory animal feed, and evaluate its nutritional values.

MATERIALS AND METHODS

Preparation of Experimental Diets

Parkia bigolosa mealy powder pulp was bought from a Jos local market into a clean dry polythene bag and transferred to the laboratory. Other food ingredients were obtained from the University of Jos Animal House as specified by them.

Composition of the Experimental Diets

Diet 1 composed of Parkia pulp, protein concentrate and vitamins/minerals mixes in the ratio 70:25:5%.

Diet 2 contained 35% Parkia pulp, 35% maize, 25% protein concentrate and 5% vitamin/mineral mixes.

- Protein concentrate includes fish meal, Soya bean and groundnut meal.

CHEMICAL ANALYSIS

The standard methods of AOAC (1990) were used to determine the moisture, crude fat, and fiber and protein contents. Nitrogen Free Extract (NFE) was calculated by "the difference" method of AOAC, 1990, while energy values were calculated base on the energy values of 4,4,9 Kcal for protein, carbohydrate and fat respectively. Elemental analysis was carried out using the PYE UNICAM SP9 Atomic Absorption Spectrophotometer for Ca, Mg, Na, K, Fe, Zn and Cu, while SP6 – 450 UNICAM Spectrophotometer for phosphorous.

Rat bioassay

Male Wister-strain weanling laboratory rats weighing between 100-120g were used. The rats were randomly distributed into four groups (A-D) (3 rats per group) and kept in metabolic cages. The rats were allowed to stabilize on the normal laboratory feed for three days thereafter, starved for 24 hours before feeding with the experimental diets as follows:

Group A were fed diet 1
Group B were fed diet 2
Group C were fed diet 3
Group D were fed diet 4 (control group)

Known amount of each feed was supplied to the rats at 7:00 am and 6:00 pm everyday, while remains of feeds were weighed before discarding. Feed and water were provided ***ad Libatum*** for 28 days. During the feeding period, daily records of fed and weights of rats per group were kept.

At the end of the feeding period, blood was collected per group by cardiac puncture after ether anesthesia. Portions of whole blood were collected into sample bottles containing EDTA (1mg/ml) for haematological parameters, while the serum samples were prepared from the remaining portions of blood by allowing the blood to clot for 20 minutes and centrifuged at 3000 rpm for 15 minutes. Parameters that required serum were then determined.

Results were expressed as means of each group ±. SD student t-test was used to establish any significant difference. Values of $P< 0.05$ were considered to be significant.

RESULTS AND DISCUSSION

The results of proximate nutrient composition of the experimental diets are shown in Table 1.

TABLE 1: PROXIMATE NUTRIENT COMPOSITION OF THE EXPERIMENTAL DIETS (% dry matter)

DIET	MOISTURE CONTENT	CRUDE FAT	CRUDE PROTEIN	NFE	CRUDE FIBER	ENERGY VALUE (Kcal)	TOTAL ASH
Diet 1 (Parkia pulp + Supplements)	16.47 ± 0.0^{b}	5.07 ± 0.04^{a}	17.56 ± 0.007^{a}	63.28 ± 0.0^{a}	7.02 ± 0.02^{b}	368.99 ± 0.47^{a}	2.33 ± 0.02^{b}
Diet 2 (Pulp/maize + supplement)	15.01 ± 0.0^{b}	4.41 ± 0.02^{c}	14.66 ± 0.01^{c}	75.60 ± 0.011^{a}	6.71 ± 0.02^{b}	$398.73 \pm 0.0.26^{a}$	3.41 ± 0.02^{ab}
Diet 3 (Pulp alone)	15.14 ± 0.3^{b}	1.83 ± 0.14^{b}	8.34 ± 0.21^{b}	78.20 ± 0.01^{a}	7.87 ± 0.13^{b}	358.63 ± 0.56^{a}	4.48 ± 0.01^{a}
Diet 4 (Control)	13.43 ± 0.14^{a}	7.88 ± 0.02^{a}	16.15 ± 0.12^{a}	66.97 ± 0.01^{a}	4.42 ± 0.02^{a}	403.40 ± 0.17^{a}	4.52 ± 0.02^{a}

Means ± SD for triplicate determinations
Means with different letters in a column are significantly different at the 5% level

The high NFE content (78.20%) obtained for diet 3 (Parkia pulp alone) agrees with the report of Oyenuga (1968) that ***Parkia bigolosa*** pulp is a carbohydrate-dense feed and can be used as concentrate in animal feeding. Other Parkia pulp supplemented diets (diets 1 and 2) also showed high NFE contents, and which values are comparable to the control.

Crude fat and protein in diet 3 are significantly lower ($P < 0.05$) than in other pulp – supplemented diets and the control. This indicates that supplementation of Parkia pulp with oil and protein – dense foodstuff such as Soya beans; groundnuts and fish meals increased the fat and protein contents. This is also evidenced by the growth rate of rats fed the diets as shown in Figure 2.

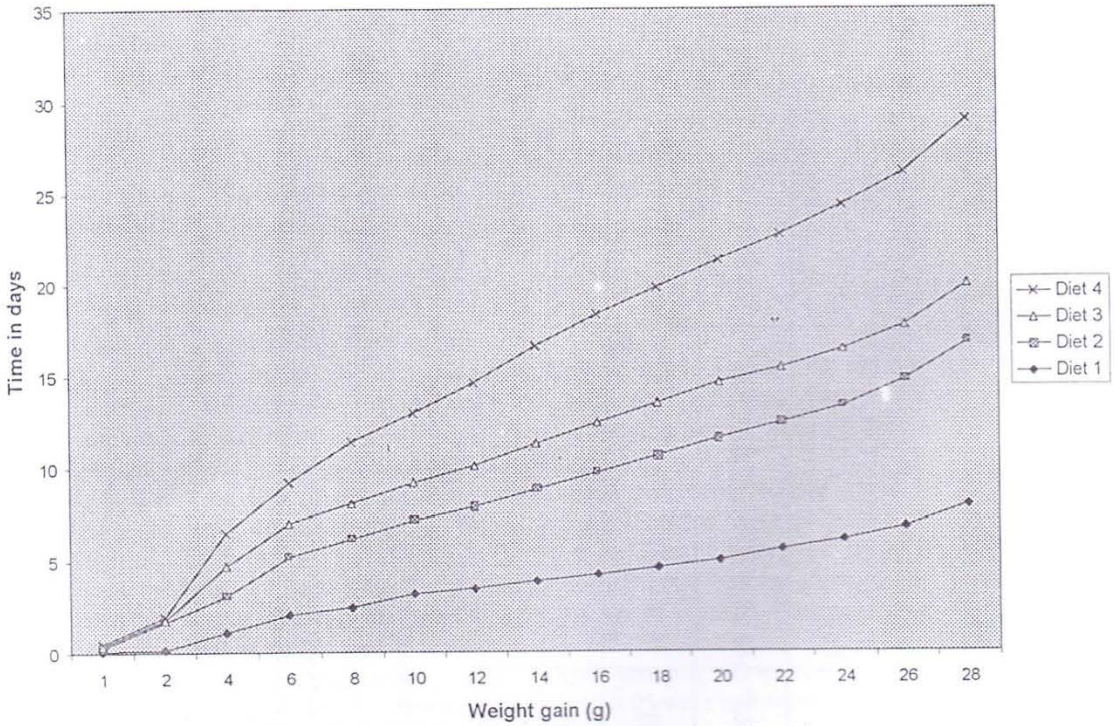

Figure 2: Change in weight of rats per group (growth rate)

Moisture content is comparable in all the experimental diets ranging between 13.34 to 16.47%. Five percent moisture content has been recommended by Temple *et al* (1996) for dry foods to increase their shelf life. The high moisture content obtained for the experimental formulas could be attributed to the fact that the feeds were prepared during the raining season, and could have been affected by the high atmospheric humidity. This would certainly affect the shelf life and keeping quality of the feeds. It is therefore suggested that the feeds be prepared in small quantities at a time. The high crude fiber obtained for diet 3 (pulp alone) and other pulp – supplemented diets is expected because Parkia pulp has been shown to be high in fiber content. Calorie value of the control diet is significantly higher ($P< 0.05$) than the other diets. This could be due to the higher crude fat observed in the control. Fat is known to contribute significantly to the caloric value of feeds. On the whole, all the diets are high in energy content which can meet the desired energy needs of animals. Result of elemental composition is shown in Table 2.

TABLE 2: ELEMENTAL COMPOSITION OF THE EXPERIMENTAL DIETS (mg/100g dry matter)

DIET	Ca	Mg	Na	K	Fe	Zn	Cu	P
Diet 1 (Parkia pulp + Supplements)	109.40 ± 0.8[a]	118.80 ± 0.03[a]	126.80 ± 0.00[a]	260.030 ± 0.03[a]	2.80 ± 0.49[c]	4.30 ± 0.05[a]	0.01 ± 0.02[a]	446.70 ± 7.1[c]
Diet 2 (Pulp/maize + supplement)	100.20 ± 0.16[a]	149.70 ± 0.16[a]	124.20 ± 0.02[a]	280.20 ± 0.41[a]	3.41 ± 0.02[ac]	433 ± 0.03[a]	0.90 ± 0.01[a]	306.70 ± 2.40[a]
Diet 3 (Pulp alone)	27.7 ± 0.03[b]	55.30 ± 0.16[b]	19.9 ± 0.16[b]	91.00 ± 0.040[b]	1.03 ± 0.03[a]	1.43 ± 0.01[b]	0.87 ± 0.01[a]	159.00 ± 1.90[b]
Diet 4 (Control)	98.03 ± 0.03[a]	126.14 ± 0.16[a]	139.60 ± 0.02[a]	293.68 ± 0.46[a]	4.16 ± 0.25[a]	5.33 ± 0.01[a]	0.80 ± 0.01[a]	384.30 ± 1.17[a]

Means ± SD for triplicate determinations
Values with different letters in the same column are significantly different at the 5% level

Diet 3 (pulp alone) showed significantly lower levels of Ca, Mg, Zn, Cu, Fe, Na and P but higher in K. The pulp-supplemented diets showed values that are comparable to the control. This may suggest why rats fed on the supplemented diets performed better than those fed on the pulp alone.

The result of feeding experimentation is as shown in Figure 1.

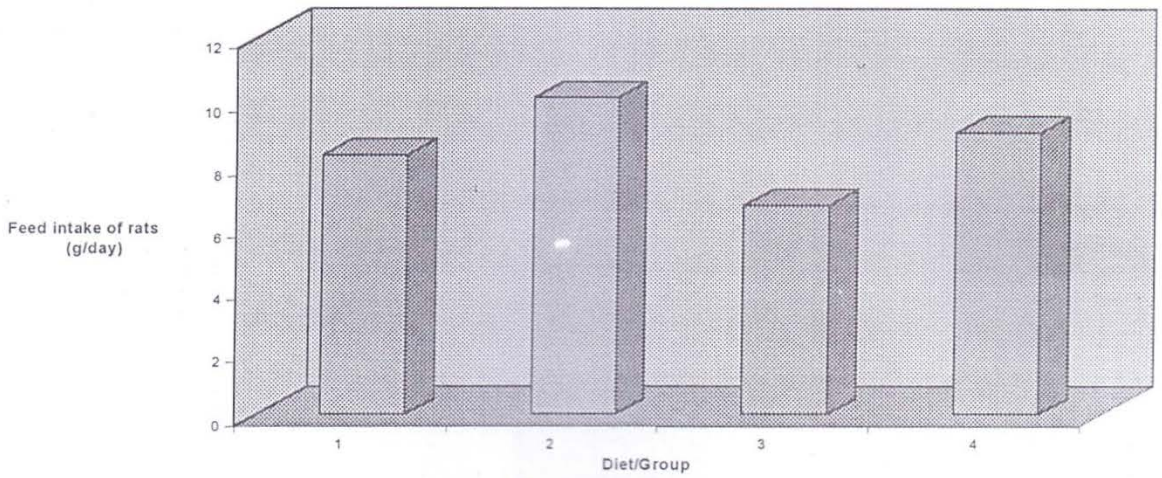

Figure 1: Average daily feed intake of rats (g/day)

This indicates that rats fed on diet 2 (pulp/maize/supplements) consumed the highest amount of feed closely followed by rats fed on control (diet 4). Diet 3 (pulp alone) was least consumed. It can therefore be suggested that the mortality and poor performance of rats fed diet 3 could be responsible for low feed intake. Effect of feeding on the growth rate of rats as shown in Figure 2 suggest that the performance of rats on diet 3 (pulp alone) might have been as a result of continuous deficiency of vital nutrients in the diet as already pointed out in the proximate and elemental compositions. Supplementation of the pulp with protein, fat and mineral/vitamins concentrates seemed to enhance growth rate of rats as indicated in Figure 2. This suggests that the pattern of growth rate of rats was a function of nutrients and their bioavailability.

Feeding rats with the pulp alone (diet 3) had deleterious effect on the physiological and biochemical state of the rats as evidenced by the significant lower Hb, PCV, protein and glucose levels (Tables 3 and 4).

TABLE 3: Haematological Parameters of Rats fed the Different Experimental Diets

DIET/GROUP	Hb (mg/100ml)	PCV (%)
Diet 1	12.61± 0.85[a]	40.80± 3.54[a]
Diet 2	11.23± 0.22[a]	41.02± 1.39[a]
Diet 3	6.95± 0.86[b]	35.77± 5.32[b]
Diet 4	13.34± 0.34[a]	44.30± 3.82[a]

Values are mean ± SD of three determinations
Mean with different letters in the same column are significantly different at the 5% level

TABLE 4: Concentrations of some Biochemical parameters of Rats fed the various Experimental Diets

DIET/GROUP	Total Serum Protein (g/100ml)	Albumin (g/100ml)	Serum Glucose (mg/100ml)
Diet 1	15.06 ± 2.36^{c}	5.13 ± 0.40^{a}	97.91 ± 12.60^{ab}
Diet 2	13.69 ± 2.04^{a}	5.71 ± 0.02^{a}	106.32 ± 7.61^{a}
Diet 3	9.31 ± 1.69^{b}	5.01 ± 0.13^{a}	89.54 ± 13.05^{b}
Diet 4	13.93 ± 0.25^{a}	5.54 ± 0.11^{a}	104.59 ± 10.64^{a}

Values are mean ± SD for 3 determinations
Values with different letters in the same column are significantly different at the 5% level

The pulp-supplemented diets compared well with the control levels. This could also be responsible for the mortality and poor performance of rats on diets 3.

In terms of cost, the Parkia pulp feeds are more cost effective as shown in Tables 5a and 5b.

TABLE 5a: Cost of Foodstuff used in the Diet Formulations

Foodstuff	Quantity	Cost (N:K)
Maize	Local measuring plate*	60.00
Maize offal	"	20.00
Soya bean	"	60.00
G/nut meal	"	70.00
Fish meal	"	150.00
Powdered parkia pulp	"	10.00

- 1 local measuring plate = 1kg

TABLE 5b: Estimated Cost of each Experimental Diet

Feed	Cost (N:K)
Diet 1 (pulp + supplements)	290:00
Diet 2 (pulp, maize & supplements)	325:00
Diet 3 (pulp alone)	20.00
Diet 4 (control)	360:00

This can be attributed to the fact that pulp is cheaper and less consumed by humans when compared to maize and maize offal.

In conclusion, one can speculate that ***Parkia biologosa*** pulp when supplemented can be a good material for the formulation and production of feed for laboratory animals. Its high carbohydrate content can be used to replace the more costly maize, sorghum or wheat thereby ensuring availability, affordability and still meet the desired nutrient requirements of animals.

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