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Assessment of biological value of tiger nut (*Cyperus Esculentus) tuber* oil meal-based diet in rats

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ABSTRACT

The effects of Cyperus esculentus tuber oil based meal on the growth performance and its absorption in some selected organs (hearts, kidney, brain and liver) of rats were investigated. Twenty five weaning albino rats (Rattus norvegicus) with an average weight of 24.0 ± 3.4g were maintained on diets composed of Cyperus esculentus tuber oil meal (Tg meal) and soybean oil based meal (control) for six weeks. The weights of the rats were monitored on weekly basis, at the same period of the day and before being served the (weighing) day's feed. The organs and carcasses of the rats were weighed after they were sacrificed and disemboweled, and the chemical compositions of the carcasses were also determined. Their was a significant increase ($p<0.05$)in the body weights of rats fed on Tiger nut oil while the organ to body weight ratio of the rats maintained on of Cyperus esculentus tuber oil meal compared significantly with the weights of the control animal ($p>0.05$). The organs showed the presence of Lauric, Myristic, Palmitic, Stearic, Oleic and linoleic acid using HPLC. It can be deduced that the oil of Cyperus esculentus tuber oil meal could competitively compare with that of soybean oil by increasing the growth rate of rats and in reducing accumulation of lipids in vital organs that can cause inflammation or constriction of the cell.

Key words: tigernut, soybean, oil, diets, organs

INTRODUCTION

The nutritional value of lipids depends in part on the presence of essential fatty acids (EFA) such as linolenic and linoleic acid of which plant is the major source. Lipids occur in considerable amounts in the seeds and fruits of various plants and provide such plants with a storage form of

energy to use during germination. EFA deficiency may lead to pathological conditions such as retarded growth, infertility, increased water uptake and scaly dermatitis [1]. Nevertheless, over consumption of certain lipid components can be detrimental to our health, e.g. cholesterol and saturated fats. Dietary fat provides an average energy intake which is approximately twice that of carbohydrate or protein. A minimum amount of dietary fat is necessary to provide insulation that prevents heat loss, protects vital organs from shock due to ordinary activities, facilitate absorption of fat-soluble vitamins (A, D, E and K) and carotenoids [2].

Due to the benefits of oil from plant sources, there has been rising demand over the years and the food value of oil seeds is becoming appreciated. Presently majority of the seeds is been processed for vegetable oil, which is an household ingredients in kitchen as well as industries [2]

Chufa (*Cyperus esculentus*) a grass like plant of the family Cyperaceae (sedge family) and is widely distributed in many north temperature locations within South Europe as its probable origin [3].Tiger nut is not really a nut but a small tuber, first discovered some 4000 years ago in ancient Egypt and is cultivated today in China, Spain and West Africa [4]. It has many other names like Zulu nut, yellow nutgrass, ground almond, edible rush and rush nut, earth chestnut, and edible galingale. In Nigeria, the Hausas call it Aya, Yorubas imumu, the igbos ofio, aki Hausa in southern Nigeria [5]. Tiger nuts tuber have been cultivated both as a livestock food and for human consumption of the tubers, eaten raw or baked. It is believed that they help to prevent heart attacks, thrombosis and cancer especially of the colon [6,7], relieve indigestion especially when accompanied by halitosis, beneficial to diabetics and those seeking to reduce cholesterol or lose weight, hasten the inception of menstruation and in China the tuber is considered stimulant, stomachic, sedative and tonic [5]. Along with a high-energy content (starch, fats, sugars and proteins), they are rich in minerals such as phosphorous and potassium and in vitamins E, C, soluble glucose and oleic acid. Typically, 100g Tiger nuts contain 386 kcal (1635 kj) as 7% proteins, 26% fats (oils), 31% starch, 21% glucose. They contain 26% fibre of which 14% is non-soluble and 12% soluble [4,8]. Information on the biological value of *C. esculentus* oil consumption is still very scanty in literature.

Furthermore, the lack of adequate information on the chemical and biological values of many plant materials of potential value as human and animal food has limited utilization of such materials, particularly protein and oil rich seeds, in view of the various need of oil, there is need to go into research to study the lesser known sources of oil, of which Tiger nut is an example. This study therefore aimed at investigating its effect on the growth performance and carcass of rats.

MATERIALS AND METHODS

Materials

The dried matured nuts of *C. esculentus* were bought from Hausa hawkers in the open market of Ilorin, Kwara State in March, 2009 and authenticated at the Department of Plant Biology of the University. The albino rats were inbred in the Department of Biochemistry, University of Ilorin, Ilorin, Nigeria. The dried matured nuts were oven-dried at 60^{o}C and were then milled using a manual grinding machine and the oil was extracted.

The Soya bean oil is a product of Algene Ouchadel Utrecht, Holland and was purchased from Matrite Supermarket in Ilorin, Kwara State.

Cellulose was obtained from rice bran locally. Mineral mix used was obtained from the Faculty of Agriculture, University of Ilorin, Nigeria

Oil Extraction

Lipid was extracted from the grounded Tiger nut using the soxhlet extractor as described by Folch *et al.* [9]. Chloroform: methanol (2:1 v/v) mixtures was employed for the extraction in order to extract an appreciable quantity of both the polar and non polar in the sample, this implies that all lipids are extracted with impurities and needs to be purified.

Purification of the extracted oil

The purification was done by employing the method of Folch *et al.* [9].

Feed Formulation: The purified tiger nut oil was used as a source of fat in the formulation of animal feed as shown in Table 1. The Soya bean oil is a product of Algene Ouchadel Utrecht, Holland and was purchased from Matrite Supermarket in Ilorin.

Table 1: Composition of diets g/kg

	Soybean oil	Tiger nut oil
Corn starch	476	476
Soybean	250	250
Rice bran	40	40
D-L methionine	4	4
Sucrose	100	100
Vitamin mix	50	50
Tiger nut oil	-	80
Soybean oil	80	-

Vitamin mix(per kg of diet): thiamin hydrochloride, 6mg; pyridoxine hydrochloride 7mg; nicotinic acid 30mg; calcium pantothenate 16mg; folic acid 2mg; biotin 0.02mg; cyanocobalamin 0.01mg, retinol palmitate 4,000u, cholecalciferol 1000u; tocopherol acetate 50u, menadione 0.05mg; choline chloride 2g.

Proximate Analysis of the Diet

The proximate analysis of the composed diet was carried out using the method described by AOAC [10].

Animals and Diets

Thirty, 3-weeks old weaning albino rats of average weight 51.67±5.29g were divided into three groups of ten (10) animals each. The rats were maintained on normal rat chow, allowed to acclimatize for a week, fasted for 24 hours, and then placed on the different diets. The first group

of rats (the control) was placed on the soybean oil meal-based diet while the second group of rats was placed on *C.esculentus* tuber oil meal-based diet.The rats were housed in 33cm x 20.5cm x 19cm plastic metabolic cages and were fed with their respective diets and water *ad libitum* for six weeks at 25^{o}C ± 1^{o}C, 50% ± 5% humidity and, 12 hours light and 12 hours dark conditions. They were weighed weekly and at the end of the experimental feeding period, were sacrificed by anaesthetizing with (cotton wool soaked in) chloroform. They were then quickly dissected to excise the brain, liver, kidney, and heart. The kidney was decapsulated. All were iced below 4^{0}C and kept for analysis. The formulated diets are shown in Table 1.

Statistical Analysis

Statistical analysis was carried out using the students' t-test [11]

RESULTS

Table 2 shows the proximate analysis of the formulated diets (test and control) on which the rats were maintained. There was no significant difference (p>0.05) in the various components of the diets.

Table 2: Proximate composition of compounded feed

	Soybean	Tiger nut
Moisture content	6.75±0.03^{a}	6.38±0.22^{a}
Total ash	5.21±0.12^{a}	4.75±0.14^{a}
Crude fat	9.32±0.18^{a}	10.33±0.18^{a}
Crude protein	15.73±0.29^{a}	15.22±0.15^{a}
Crude fiber	5.70±0.12^{a}	5.54±0.18^{a}
Dry matter	93.23±0.02^{a}	93.67±0.17^{a}

Each value is a mean of three determinations ±SEM

The percentage organ to body weight ratio of rats fed on soybean oil-based and tiger nut tuber oil based diets had no significant difference (P>0.05) when compared as shown in Table 3.

Table 3: Percentage Organs to body weight ratio of rats fed on soybean oil-based and Tiger nut tuber oil-based diets

Organ	Soybean oil	Tiger nut oil
Liver	6.44± 1.33^{a}	6.34.00± 2.78^{a}
Brain	5.21±0.12^{a}	5.45±0.17^{a}
Heart	1.34±0.22^{a}	1.56± 0.42^{a}
Kidney	1.89±0.76^{a}	2.01±0.93^{a}

Each value is a mean of three determinations ±SEM
Values with the same superscripts across the same row are not significantly different (P>0.05).

Table 4 showed an increase in the final weight of rats fed with tiger nut tuber oil based diet 120.11±10.63 while the soybean oil based diet recorded a lower weight of 106.25±7.63 with almost an the same initial weight of 51.67g after a period of six weeks. The weights of rats fed with *C.esculentus* meal were significantly increased ($p<0.05$) to about two-third (2/3) of the control.

Table 4: Growth performance of the control and tiger nut oil based meal diet rats

Parameter	Soybean oil	Tiger nut oil
Initial weight (g)	51.62±5.49[a]	51.67±5.29[a]
Final weight (g)	106.25±7.63[a]	120.11±10.63[b]

Each value is a mean of three determinations ±SEM
Values carrying the same superscripts across the same row for each parameter are not significantly different. (P>0.05).

The presence of various fatty acid like lauric acid, myristic, stearic, oleic and linoleic acid in varying percentages as indicated in Table 5 showed a non significant difference in the percentage lipid content of liver, brain, heart and kidney maintained on Tiger nut oil based diet and soybean oil based diet.

Table 5: Percentage fatty acid composition of selected organs of rats fed with Soybean (sy) oil-based and Tiger nut (Tg) oil-based diets (%)

	Lauric	Myristic	Palmitic	Stearic	Oleic	linoleic
Sy liver	3.258	-	-	0.096	13.317	-
Tg liver	0.261	-	-	-	17.421	20.115
Sy kidney	-	4.018	2.801	-	-	-
Tg kidney	0.808	10.467	-	3.154	-	-
Sy brain	0.234	3.809	5.665	8.232	7.065	-
Tg brain	2.061	1.478	3.662	0.474	16.510	18.521

DISCUSSION

The first worthy statement about the study is that none of the animals specimen died either naturally or due to feed ingestion. The values obtained from proximate analysis of the formulated diets (Table 2) compared favourably with each other, indicating that the rats in all groups were placed on the same amount of nutrients quantitatively and therefore whatever differences that are noticed might be due to the differences in the quality of the nutrients in these diets or their bioavailability when consumed. The growth pattern in Table 3 showed that the Tiger nut oil diet fed rat weighed more than those fed with soybean oil, this may be due to the presence of high amount of oleic acid which is a precursor of the essential fatty acid that supports growth in the oil as compared to soybean oil based diets fed rats and a high level of Vitamin E which makes the rats look hairy and healthy [8, 12]. Also, this supports Awoyinka and Umoren [13], that poor

availability of essential nutrients necessary for growth and development is also a major factor that affects growth, thus, this shows that tiger nut oil based meal diet supports growth. The fact that there is no significant difference in the organ body ratio of rats shown in Table 4 maintained with Tiger nut oil based diets and soy bean oil based diets is an indication that the oil is not capable of causing inflammation or constriction of the cells . Organ weight changes have been accepted as a sensitive indicator of chemically induced changes to organs, this is used to predict toxic effect on test animals [14]. It also indicates that the secretory capacities of those organs were not affected [15]. The presence of different types of fatty acids in the brain, kidney, liver and heart indicates the moderate assimilation of the oil as shown in Table 5. The non significant difference in the percentage lipid content of liver, brain, heart and kidney maintained on Tiger nut showed that the oil does not encourage the build of lipids that may be detrimental to health and as such can be consumed without side effects. Saturated fat sticks to the arteries and causes high blood pressure. Lipids serve as store energy in some organs and excess accumulation of lipids might be detrimental to some organs [16].

CONCLUSION

The present study indicates that Tiger nut tuber oil meal based diet is a good supplement for other types of oil since it supports the growth of the experimental animal, improve the organ body weight ratio and prevents accumulation of fats in some selected organs and could be due probably to the excellent nutritional quality of the nut.

REFERENCES

[1] J Stamler, D Wentworth, J Neaton. *J m Med Assoc*. **1986**, 256: 2823-2828.
[2] A A Odutuga. Effects of low zinc status and EFA deficiency on growth and lipid composition of rat brain. *Clin. Exptal. Pharmacol. And physiol*. 9, 213-221
[3] Mason D Tiger Nuts **In:** http://www.nvsuk.org.uk/growing show_vegetables_1/tiger-_nut.php **2005**.
[4] N.F. Childers. Fruit farming. **In** the new, Encyclopedia Britannica, Macropaedia, vol. 19 (15thedn) 1982, p. 135- 142. Encyclopedia Britannica, Chicago.
[5] A Maton, J Hopkins, C W McLaughlin, H Susan, M Q Warner, D LaHart, D Jill. Human Biology and Health. Englewood Cliffs, **1993**, New Jersey, USA: Prentice Hall. ISBN 0-13-981176-1.
[6] A.U. Osagie, O.U. Eka. Nutritional quality of plant foods. Post harvest research unit; **1998**; 22: 246-249
[7] J.A Adejuyitan, *Am. J. Food Technol*., **2010** 6: 197-201.
[8] Tiger nut Traders. Tigernut and health In http://www.tigernut.com **2005**.
[9] V.J. Temple, T.O. Ojobe, M.M. Kapu. *J.Sci Agric* **1990**, 50, 261, 263
[10] J Folch, M. Lee, G. Sloane-Stanley. *J. Biochemistry*; **1957**; 226: 497-509.
[11] A.O.A.C. Official methods of analysis, 17th Edition **2000**, Association of Official Analytical Chemistry, Washington D.C
[12] S.O Adamu, Johnson, T.L. Statistics for beginners, Book 1. SAAL a Publication, Ibadan, Nigeria. **1997** Pp. 184 – 199.
[13] P.D.J Rogerio. *Journal of Allergy and clinical Immunology* **2004**, 26: 197-202
[14] O.A Awoyinka, E.A. Umoren. *Acta SATECH* **2004**, 1:30-36

[15] T.J. Bucci. The practice of toxicologic pathology: basic principles. In: Handbook of toxicology (Haschek, W.M., Rousseaux, C.G., Wallig, M.A., eds.), Vol 1, pp 681-784, Academic press, San Diego, CA
[16] M.T Yakubu, S.B. Lawal, M.A Akanji. *BIOCHEM*, **2003**, 15: 50-56.
[17] M.C Nelson, D.L. Lehninger Principles of Biochemistry. 3rd Edition.Worth Publishers, NY **2000**.