# EFFECT OF OIL EXTRACTION ON CHEMICAL COMPOSITION OF BALLNUT KERNEL (*CALOPHYLLUM INOPHYLLUM)* MEAL FOR MONOGASTRICS

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**ABSTRACT**
*Feeding poultry and pigs by farmers in Nigeria is becoming difficult due to high cost of compounded feeds. In the recent time, farmers have been using feed alternatives. Knowledge of utilizing bullnut as feedstuff is scanty Hence, this study was carried out to evaluate the effect of oil extraction on chemical composition of ballnut kernel meal. Mature ballnut fruits were harvested and processed for milling. The milled seeds in the first group were stored in an airtight container and labeled "full fat ballnut cake," while the second group was transferred into a simple screw press to extract the oil. The oil-extracted ballnut cake was further divided into two sub-groups; the first sub-group was stored in another airtight plastic container and tagged "mechanically defatted ballnut kernel cake." The second sub-group was subjected to chemical oil extraction using petroleum ether. Proximate, phytochemical, and fatty acid compositions of the samples were determined. Data were subjected to analysis of variance using General Linear Model (GLM) procedures of GenStat 14th edition. The results of proximate analysis showed that chemical extraction method increased the crude protein of ballnut kernel meal from 19.73% to 28.28%, crude fibre from 2.80% to 4.45%, and ash from 4.17% to 5.47%. Concentration of flavonoids, tannins, and cyanide were increased with the chemical oil extraction method to 13.25%, 26.83% and 20.74%, respectively. It can be concluded that the chemical method improved the chemical composition of ballnut kernel meal relative to other methods.*
**Key words: Ballnut, oil extraction, mechanical, chemical, phytochemical**

## INTRODUCTION

Feeding poultry and pigs by farmers in Nigeria is becoming very difficult due to the high cost of compounded feeds. The prices of maize and soybean, which constitute about 50 to 60 percent and 25 to 35 percent, respectively, in feeds for these animals, have tremendously risen due to drought, poor yields, and massive exports out of the country by farmers. According to Amata (2014), utilization of non-conventional feed resources, which has been one of the approaches used in solving this problem, is also becoming scarce and expensive. It is therefore imperative for animal nutritionists to search for other alternative feed resources to support the livestock industry. In this regard, the ball nut (*Calophyllum inophyllum)* kernel has been considered. Prabakaran and Britto (2012) observed that mature ball nut seed was poisonous when fed to rats and that most of these poisonous substances were concentrated in the oil components of the seed.

There is therefore a need to reduce the anti-nutritional factors and improve the nutritive value of the seed meal for the feeding of animals.

### Location of the study

The chemical analyses were carried out at the Faculty of Agriculture Laboratory, University of Calabar, and the IAR and T Laboratory at Ibadan.

**Sample collection and preparation:** The mature ballnut fruits were harvested from the premises of the Cross River State Library Complex in Calabar, sun-dried under direct sunlight for between 4 and 6 hours per day for three weeks before manually peeled to expose the kernels.

The dried kernels were milled using a locally fabricated milling machine with a 0.20-mm screen and thereafter divided into two groups. The milled kernel in the first group was stored in an airtight container and labeled full-fat ballnut, while the second group was transferred into a simple screw press to mechanically extract the oil. The oil-extracted ballnut kernel was further divided into two sub-groups; the first sub-group was stored in another airtight plastic container and tagged ballnut cake, while the second sub-group was subjected to further oil extraction using petroleum ether. The sample was washed repeatedly until the oil content was significantly reduced, and the residue was oven dried prior to storage in a third airtight plastic container labeled "ball nut kernel meal." All the samples were stored at a temperature below 10ºC prior to the determination of their chemical contents.

**Chemical analyses**

Proximate analysis of the three samples was carried out using methods of AOAC (2005). Composition of crude protein, crude fat, ash, fiber, and nitrogen-free extract was determined. Protein content (N x 6.25) was determined by the micro-Kjeldahl method.

Atomic Absorption Spectrometer (model 703 Perkin Elmes, Norwalk, CT, USA) was employed in determining calcium, manganese, magnesium, sodium, potassium, and iron. Sodium and potassium were determined using a flame photometer (Shewood flame photometer 410, Sherwood Scientific Ltd., Cambridge, UK), while phosphorus concentration was measured using the vanadomolydate method (AOAC, 2005).

The phytochemical analyses (cynogenic glycosides, tannins, oxalates, and alkaloids) were carried out using the methods described by AOAC (2005) and Harborne (1973). The phytate content of the samples was determined by the anion-exchange method as described by AOAC (2000), using phosphate as the standard. Trypsin activity was monitored using the method of Prokopet and Unlewonick (2002), while saponins were determined using the spectrometric method as described by Bruner (1984), and the total flavonoids and alkaloids were determined according to the methods outlined (Harborne, 1973).

## RESULTS AND DISCUSSION

**Proximate composition of *ballnut* processed kernel**

Table 1 summarizes the results of proximate chemical composition of the oil extracted ball nut kernel. The result showed that the dry matter content of 94.96% observed in the full-fat ballnut kernel was statistically (P<0.05) higher than the 92.76% obtained for the mechanically extracted (cake) ballnut kernel and 88.54% for the chemically extracted (meal) ballnut kernel. Oil extraction significantly (P<0.05) increased the crude protein content of the ballnut to 23.53% with the mechanical extraction and further to 28.28% with the chemical extraction. The fat content showed a significant (P<0.05) difference, with the full-fat ballnut kernel meal having a significantly higher value of 26.76%. Crude fibre content (4.25%) was higher (P<0.05) with chemical extraction compared to mechanical (3.14%). Oil extraction increased the ash content from 4.17% in the full-fat kernel to 4.66% by mechanical extraction and further to 5.47% by chemical extraction. A nitrogen-free extract of 41.49% was recorded for the full-fat ballnut kernel and was increased to 54.31% for the mechanically extracted ballnut kernel. Gross energy content of the ball nut kernel was significantly (P<0.05) influenced following oil extraction, with the full-fat ball nut kernel having the highest value of 5.88 kcal/g.

**Table 1: Proximate composition of *C. inophyllum* processed kernel**

| | Oil extraction methods | | | |
|---|---|---|---|---|
| **Parameters (%)** | Full-fat | Mechanical | Chemical | ±SEM |
| Moisture | $5.04^{c}$ | $7.24^{b}$ | $11.46^{a}$ | 1.19 |
| Dry matter | $94.96^{a}$ | $92.76^{b}$ | $88.54^{c}$ | 1.19 |
| Crude protein | $19.73^{c}$ | $23.53^{b}$ | $28.28^{a}$ | 1.56 |
| Crude fat | $26.76^{a}$ | $7.13^{b}$ | $2.66^{c}$ | 4.69 |
| Crude fibre | $2.80^{c}$ | $3.14^{b}$ | $4.25^{a}$ | 0.28 |
| Ash | $4.17^{c}$ | $4.66^{b}$ | $5.47^{a}$ | 0.03 |
| Nitrogen free extract | $41.49^{c}$ | $54.31^{a}$ | $47.89^{b}$ | 2.34 |
| Gross energy (Kcal/g) | $5.88^{a}$ | $5.11^{b}$ | $3.98^{c}$ | 0.35 |

**±SEM**=standard error of mean

**a,b,c**= means with different superscript differ significantly at P<0.05

Higher crude protein content of the chemically extracted ball nut kernel meal compared to the full-fat and mechanically extracted samples establishes a negative relationship between the oil content and the protein level of the oil seed meal, indicating that the lower the oil content, the higher the protein level. Bello *et al*. (2019) observed non-significant differences in the protein content for the three extraction methods employed, implying that the method of extraction did not have a significant effect on the protein content of *Hura crepitans* seed cake.

Oil extracted was responsible for the low content of crude fat in the mechanical and chemically extracted ball nut kernel relative to the full-fat. Increase in the crude fibre following oil extracted from the ballnut kernel meal agrees with the findings of Oladimeji and Kolapo (2008), who observed an increase in the crude fibre contents of cashew, melon, soybean, groundnut, and coconut. The fibre became more concentrated after the oil extraction. The crude fibre range (2.80%-4.25%) obtained in this experiment was lower than the 6.01% reported by Chijioke *et al*. (2015) for the walnut seed and the 4.50-6.00% reported by Effiong and Ofem (2018) for the mature and immature ball nut seed. Ibironke *et al*. (2015) gave 34.25 percent as the crude fibre content of areca nuts, a value quite higher than the results of this study. It has been reported that the presence of fairly high levels of crude fibre in food material decreases dry matter digestibility in animals. Ash content of a food is reflective of its mineral content and is an index for assessing the quality of feeds and feedstuffs. It is recommended that the ash content of nuts, seeds, and tubers be within the range of 1.5–2.5% in order to be suitable as animal feeds. Ash contents of the test samples were higher than this range. Nitrogen-free extract (41.49%–54.31%) from this study was lower than the 79.18% reported by Ibironke *et al*. (2015) for areca nuts. Nitrogen-free extract content is an index of the potential of such feed material to supply energy for animals. The gross energy (3.98–5.88 kcal/g) recorded in this study was higher than the 3.43, 3.30, and 3.00 kcal/g reported for maize, guinea corn, and cassava meal, respectively. The above results indicated that ball nut seed meal has the potential to replace conventional feed resources as an energy source in poultry and livestock feeds.

**Phytochemical composition of oil extracted and *C. inophyllum* processed kernel**

The results of phytochemical composition of full-fat, extracted, and chemically extracted ball nut kernels are shown in Table 2. It was observed that the oxalate level in the ballnut kernel was reduced ($P<0.05$) from 339.95 mg/100 g in full-fat ballnut kernel to 219.75 mg/100 g after oil mechanical extraction and further to 197.75 mg/100 g with chemical oil extraction. Reduction in level of oxalate in defatted ballnut sample suggests that this compound is inherent in oil, hence its reduction after oil extraction. Concentration of flavonoids, tannins, cyanide, alkaloids, and saponins were found to be on the increase ($P<0.05$) as a result of the oil extraction. For instance, flavonoids were increased from 5.25% in the sample to 6.30% with the mechanical extraction and further to 13.25% with the chemical extraction, suggesting that the compound was inherent in the residue and not in the oil, hence the increase in its concentration after oil extraction. The tannin concentration was equally increased from 20.45 mg/100 g in the full-fat ball kernel to 26.83% in the chemically extracted kernel meal. The results suggest that both

**Table 2: Phytochemical composition of *C. inophyllum* processed kernel**

| | Oil extraction method | | | |
|---|---|---|---|---|
| **Parameters** | **Full Fat** | **Mechanical** | **Chemical** | **±SEM** |
| Oxalate (mg/100g) | 339.95$^{a}$ | 219.75$^{b}$ | 197.75$^{c}$ | 27.95 |
| Flavonoids (%) | 5.25$^{b}$ | 6.30$^{b}$ | 13.25$^{a}$ | 1.60 |
| Tannins (mg/100g) | 20.45$^{c}$ | 22.25$^{b}$ | 26.83$^{a}$ | 1.21 |
| Cyanide (mg/100g) | 14.81$^{b}$ | 13.21$^{c}$ | 20.74$^{a}$ | 1.46 |
| Alkaloid (%) | 10.45$^{c}$ | 13.75$^{a}$ | 12.15$^{b}$ | 0.61 |
| Saponin (%) | 0.29$^{c}$ | 0.41$^{a}$ | 0.34$^{b}$ | 0.02 |

**±SEM**= standard error of mean
**a,b,c** = means with different superscript on the same row differ significantly at $P<0.05$

mechanical and chemical methods showed least effect on tannin concentration of the ballnut kernel. Cyanide concentration was reduced from 14.81 mg/100g in full-fat sample to 13.21 mg/100 g by mechanical extraction. Chemical extraction method increased concentration of this compound. Highest concentration of alkaloids and saponins, corresponding to 13.75 and 0.41% in mechanically extracted sample, indicated that the process has a lesser reducing effect on alkaloids and saponin levels in ballnut kernel relative to chemical method.

## CONCLUSION

It was therefore concluded that the chemical method improved the chemical composition of ballnut kernel meal relative to other methods.

Further processing of the chemically extracted ballnut kernel meal is being recommended to reduce the inherent anti- nutritional factors to safe limit

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