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Proximate Analysis of Some Caffeine Containing Plants Consumed in Kano, Nigeria

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***Abstract**: This research work studied the proximate compositions of five different caffeinated plants which include coffee beans, kola nuts, bitter kola nuts, black tea and green tea leaves. The analysis was made in triplicates and the results were subjected to statistical analysis which have shown there is significant difference (p<0.05) among the mean values. The results of the caffeinated plants analyzed ranged as follows: moisture content (8.24±0.96-12.51±0.53%), Ash content (0.88±0.10-8.01±0.3%), protein content (1.78±0.63-3.74±0.61%), fiber content (3.80±0.75-21.35±0.69%), fat content (2.32±0.42-14.39±0.55%) and carbohydrate content (47.45-82.65%). The findings of this work provided nutritional compositions of the analysed samples.*

Keywords: *Proximate analysis, caffeine, coffee beans, kola nuts, tea leaves, bitter kola nuts.*

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INTRODUCTION:

There are more than 60 plants that have caffeine in them. The most common sources of caffeine are coffee beans, tea leaves, kola nuts, and cacao pods. These are parts or fruits of the coffee plant, kola tree, and cacao plant. Tea is made from leaves of many different types of plants, especially herbs, some of which have caffeine and some which do not. The only plant that contains caffeine which is native to North America is the yaupon. It is considered a poisonous plant that causes vomiting, nausea and diarrhea. (https://homework.study.com/explanation/what-plants-have-caffeine.html, n.d.).

Kola nuts are widely cultivated in West Africa because they contain two alkaloids, caffeine and theobromine, which are powerful stimulants that counteract fatigue, suppress thirst and hunger, and are believed to enhance intellectual activity (Nickalls, 1986). Due to their unique bitter taste, kola nuts are effective for refreshing the mouth, and the twigs are used as " chewing sticks" to clean the teeth and gums (Lewis and Elvin-Lewis,1985). Kola nuts are also used as a source of alkaloids in pharmaceutical preparations (Opeke, 1992). Traditionally, the leaves, twigs, flowers, fruits follicles, and the bark of both C. nitida and C. acuminata were used to prepare a tonic as a remedy for dysentery, coughs, diarrhœa, vomiting (Ayensu, 1978) and chest complaints (Irvine, 1961).

Coffee comprises more than 90 different numbers of species. However, only Coffea arabica, robusta, and liberica are of commercial importance. Coffea arabica accounts for approximately 75% while robusta accounts for about 25% and liberica (< 1%) of the world's production, other species are of not much commercial value (Pohl *et al*., 2013).

Scientists have identified approximately 1,000 antioxidants in unprocessed coffee beans, and hundreds more develop during the roasting process. Numerous studies have cited coffee as a major — and in some cases, the primary — dietary source of antioxidants for its subjects (Jong, 2017). Coffee containing caffeine can cause insomnia, nervousness and restlessness, stomach upset, nausea and vomiting, increased heart and breathing rate, and other side effects. Consuming large amounts of coffee might also cause headache, anxiety, agitation, ringing in the ears, and irregular heartbeats. (Rxlist, 2021).

Tea is the second most consumed beverages in the world after water and is grown in 30 countries worldwide. It was primarily originated in South Eastern China but recently it is cultivated in many countries across tropical and subtropical regions all over the world and has more than 82 different species (Krafczyk and Glomb 2008; Sultana *et al.*, 2008; Akhlas *et al*., 2003). Tea is the extract of leaves, leaf nodes and internodes of plant (Camellia sinensis) which is consumed as extract in hot water rather than being eaten as such. It is also referred to as an aromatic liquid product which has been made by curing the leaves by applying water in hot form (Xiao et al., 2008).

The high consumption of tea is attributed to richness in important substances having cool, a little bitter flavor, antioxidant properties and health benefits (Dimitrios, 2006). The chemical components in tea include alkaloids (Theo bromine, caffeine, and theophylline), polyphenols (catechism, flavonoids), amino acids, polysaccharides, volatile acids, vitamins, lipids as well as inorganic elements (Monobe *et al.,* 2008; Wei *et al.,* 2010; Xiong *et al.,* 2012). Consumpton of tea is associated to a lower risk of diseases that cause functional disabilities, such as stroke, cognitive impairment, and osteoporosis in the elderly (Tomata *et al*., 2012).

Black tea contains tannins. One 2017 reviewTrusted Source found that tannin-rich foods, such as tea, may be a good source of antioxidants, but that they can also reduce the body's ability to absorb iron.For this reason, people with a history of iron deficiency should avoid consuming tea when taking iron supplements or eating an iron-rich meal.They should also leave an hour between eating and drinking black tea (Medical news today, 2020).

MATERIALS AND METHODS

Sample collection

Five samples of caffeinated plants comprising of coffee beans, bitter kola nuts, kolanuts bought from Rimi market Kano, dried black and green tea leaves bought from Kurmi market Kano were obtained for the analysis.

Table 1: Samples names and codes used

Name of samples	**Codes**
Black tea leaves	BT
Green tea leaves	GT
Coffee beans	CA
Kolanuts	KN
Bitter Colanuts	BC

Preparation of reagents

Methyle red indicator, 0.1N HCl, 4% boric acid and 40% NaOH were prepared and distilled water was used throughout the analysis

Sample preparation

The kola nuts samples (Cola nitida and Garcinia cola) were cleaned, grated using grater and dried (pre dried) under shade for 4 days. All the five samples obtained were ground into powder using wooden motor and pestil, sieved using finely holed plastic sieve (2mm) and stored in labelled airtight containers for use.

Proximate analysis

Proximate analysis of the caffeinated samples which constitutes moisture content, ash, crude protein, fat, crude fibre and the carbohydrate determination by difference was done using AOAC (1990) methods. All analyses were done in triplicates.

1. Moisture content determination

3g of each of the samples were accurately weighed into dried weighed ceramic crucible. The samples were placed in an oven at 105°C and heated for 6 hours. The dried samples were placed into desiccators, allowed to cool and then reweighed. The process was repeated until constant weight was obtained. The difference in weight was calculated as a percentage of the original sample and moisture content was determined.

$$\% \text{ Moisture} = \frac{W1-W2}{W1-W} \times 100$$

Where: W1= weight (g) of crucible with sample before drying

W2= weight (g) of crucible with sample after drying

W= weight (g) of empty crucible

2. Ash content determination

The dried samples from 3.4.1 above were transferred into a murffle furnace at 550°C for 2hrs in order to obtain ash result. The samples from the furnace were placed in a desiccator, allowed to cool and reweighed. The weight of the residual ash was then calculated as:

$$\% \text{ Ash} = \frac{\text{weight of crucible with ashed sample- weight of empty crucible}}{\text{weight of sample}} \times 100$$

3. Crude fat determination

Samples were weghed and fat content was determined using soxhlet extraction The difference in weight was obtained as mass of fat and is expressed in percentage as:

$$\% \text{ Crude Fat} = \frac{\text{weight of sample before defatting - weight of sample after defatting}}{\text{weight of sample}} \times 100$$

4. Protein determination

The protein content was determined using Kjedahl method as described by AOAC (1990). The Nitrogen content was calculated and multiplied with 6.25 to obtain the crude protein content.

$$\%\text{Nitrogen} = \frac{N1 \times V1 \times F1 \times MWN}{Ws \times 10} \times 100$$

Where: V1= volume of 0.10 mol/dm3 HCl

N1= normality of HCl

F1=Acid factor

10 = volume of distillate

Ws= weight of sample

MWN = molecular weight of Nitrogen

%Crude protein= 6.25 x %N

5. Crude fiber determination

Two gram (2.0g) of each of the samples was treated with 200cm^3 of 0.128mol/dm^3 H_2SO_4 and the mixture was booked for 30mins. After filtration and washing with hot water, the residue was treated and boiled with 200cm^3 of 0.313mol/dm^3 NaOH solution for 30mins. After another filtration and washing with hot water. The residue was placed in a crucible and allowed to dry. The fiber was then dried in hot air oven for 2hrs at 105^{o}C and finally weighed after cooling. It was ignited in a muffle furnace at 550^{o}C for 2hrs and the ash was weighed after cooling in a dessicator. Lost in weight produced the crude fiber.

$$\%\text{Crude fiber} = \frac{\text{weight of crucible with fiber - weight of crucible with Ash}}{\text{weight of sample}} \times 100$$

6. Carbohydrates determination

The carbohydrate contents of the samples was obtained by percentage weight difference method. The percentage of proximate parameters (Ash, moisture, crude fat, crude protein and fiber content) values calculated were sum up all together and subtracted from 100%.

%Carbohydrate= 100-(percentage sum of nutrients).

RESULTS AND DISCUSSION

Results

Table 2: Proximate compositions of analysed samples

SID	Moisture content	Ash content	Crude fiber	Crude fat	Protein	Carbohydrate
BT	8.24±0.95	5.16±0.15	11.72±0.29	9.34±0.80	2.78±0.71	62.76±0.00
GT	8.25±2.04	4.86±0.19	13.63±0.53	8.09±0.50	3.74±0.61	61.42±0.00
C	9.38±0.09	8.01±0.34	21.35±0.69	11.37±1.25	2.44±0.57	47.45±0.57
K	12.51±0.53	3.47±0.70	4.19±0.81	14.39±0.55	3.48±0.69	61.96±0.00
B	8.57±0.10	0.88±0.20	3.8±0.75	2.32±0.42	1.78±0.63	82.65±0.00

Discussion

Table 2 showed the Proximate compositions of the caffeinated plants analysed. From the table, kola nuts (KN) has the highest moisture content of 12.51±0.53% followed by coffee 9.38±0.09%, black tea has the lowest moisture content of 8.24±0.96%. The result of this findings is in line with the finding ealier made by Dawudo et al., (2013) and below the findings of Odebunmi et al., (2009) and Jelili (2022) who reported about 60% of moisture content in kola nuts specie.

It was found that coffee has the highest ash content of 8.01±0.3% then black tea with 5.16±0.15% and bitter kola nut was observed to have lowest ash content of 0.88±0.10%. The result of this research work for ash content was compared with that of Odebunmi et al., (2009). It was found that the ash content of bitter kolanuts 0.79%±0.05 is within the range of this finding and that of kolanut 1.50±0.01% is below this research finding which is 3.47±0.70%. The ash content of Black and Green tea leaves of this finding is within the range of finding earlier reported by Adnan et al., (2013) which was found to be 4.94±0.70% in black tea and 4.57±0.82% in green tea. The ash value of these five samples varied relatively. The variation is indicating that the mineral element content relatively differ from one another which may be attributed to the difference in sample specie and class, environmental factor and age of harvesting.

The results of protein content of the samples analysed indicated that Green tea has the highest protein content of 3.74±0.61% followed by kola nuts 3.48±0.70% and bitter kola nut was observed to have the least protein content of 1.78±0.63%. The result of this work deviate from most researches reported earlier like that of Dawudo et al., (2013) who obtained protein content as 19.71±1.38% in green tea and 17.78±0.71% in black tea. It was observed that the protein value obtained in this work fall within the range of result obtained in Odebunmi et al., (2009) who found bitter kola nut protein content as 2.48±0 10% and kola nut as 2.63±0.18%. The highest amount of protein contents in green tea may be due to no fermentation of green tea during processing.

The results of fiber content of the samples analysed indicated that coffee has the highest fiber content of 21.35±0.69% followed by green tea 13.63±0.53% and bitter kola nut has the lowest 3.80±0.75%. The fiber content of tea leaves of this work fall within the range of the findings reported by Mohammrd and Sulaiman, (2009) which was found to be between the range of 11.23-17.41% and 14.00-18.82% respectively. The fiber content of two kola nut species analysed in this work deviate relatively from that of kola nut (7.13±0.09%) and bitter kola nuts 3.80±0.75% reported by Odebunmi et al., (2009) findings.

The results of fat content of the samples analysed showed that kola nuts have the highest value of 14.39±0.55% followed by coffee 11.37±1.25% and bitter kola nut has the lowest value of 2.32±0.42%. The kola nut fat content of this work is higher than the one observed by Odebunmi et al., (2009) which was found to be 5.71±0.74% and bitter kola nut 4.51±0.86% is above this research finding. Bitter kola nuts has the highest carbohydrate content of 82.65% and coffee has the lowest carbohydrate content of 47.45%. The result of this research is compared favourably with that reported by Ajai et al., (2012) who found carbohydrates content of three kola nuts species in the range of 83.10-86.25%. The statistical analysis carried out indicated that there is significant difference between the mean values ($p<0.05$)

CONCLUSION

This research work provides valuable information on proximate analysis of five caffeine containing plants which includes Black tea leaves, Green tea leaves, bitter kolanuts, kolanuts and coffee beans.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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