Evaluation of the Mineral Composition and Mycoflora of Yellow Monkey Cola (*Cola lepidota* K. Schum) Fruit Pulp

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Abstract

"Cola," the genus name for Cola lepidota, is derived from the Arabic word "kola," meaning "food for the soul." The nuts of this plant are widely utilized as a natural stimulant and energy enhancer, and its cultural and historical significance is reflected in their name. The production of Cola lepidota is currently threatened by pest and disease pressure, despite its ecological and cultural significance. For this reason, research into the nutrient composition and fungal organisms associated with the fruit pulp of Yellow Monkey Cola (Cola lepidota) is necessary. Using established procedures, the chemical profile of the Cola lepidota fruit pulp was examined. The result for proximate composition of Cola lepidota showed the presence of Moisture (42.45%), Ash (2.80%), Crude Fibre (2.10%), Lipid (8.20%), Protein (18.48%) and Carbohydrate (25.65%). The lowest and highest content as analysed were Crude Fibre (2.10%) and Moisture (42.60%) respectively as shown in Table 1. The result for the nutrient analysis showed the presence of Calcium (27.23±0.63 mg/100 g), Iron (4.03±0.05 mg/100 g), Magnesium (23.33±0.57 mg/100 g), Phosphorus (85.67±1.73 mg/100 g) and Potassium (84.00±1.15 mg/100 g). The lowest and highest content as analysed were Iron (4.03±0.05 mg/100 g) and Phosphorus (85.67±1.73 mg/100 g) respectively as shown in Table 2. The result for fungal isolates is presented in Table 3, and revealed the presence of Candida sp. and Mucor sp. This study presents C. lepidota as good for human consumption and can be exploited for animal feed production.

Keywords: *Mineral Composition, Mycoflora, Monkey Cola, Proximate Composition*

Introduction

The World Health Organization (WHO) held a conference in 2003 to talk about the benefits of eating fruits and vegetables for both illness prevention and overall health promotion (Ngoka *et al*., 2021). One of the important findings (Dena *et al*., 2007) was that if people are able to consume adequate fruits and vegetables in their diets, they may be able to save almost 2.7 million lives annually. The World Health Organization (WHO) held a conference in 2003 to talk about the benefits of eating fruits and vegetables for both illness prevention and overall health promotion (Ngoka *et al*., 2021). The possibility of saving almost 2.7 million lives annually if individuals are able to consume enough fruits and vegetables in their diets was one of the important findings (Dena

et al., 2007). Inadequate consumption of fruits and vegetables has been recognized by WHO (2003) as one of the top ten causes contributing to global mortality (Dena *et al*., 2007). Thus, a healthy diet depends on consuming an adequate amount of fruits and vegetables. Numerous illnesses, including certain malignancies and heart problems, can be avoided by them (Craig, 2009).Inadequate consumption of fruits and vegetables has been recognized by WHO (2003) as one of the top ten causes contributing to global mortality (Dena *et al*., 2007). Thus, a healthy diet depends on consuming an adequate amount of fruits and vegetables. Numerous illnesses, including certain malignancies and heart problems, can be avoided by them (Craig, 2009). According to Bloch and Thompson (1995), fruits are one of the food groups that combat cancer the least often recognized.

"Cola," the genus name for *Cola lepidota*, is derived from the Arabic word "kola," meaning "food for the soul." Ngoka *et al*. (2021) reported that Cola lepidota is a kind of tropical plant native to the rainforests of West and Central Africa, encompassing nations like Nigeria, Cameroon, and Gabon, is called *Cola lepidota*. The plant's nuts which are historically and culturally significant are widely employed in many West African societies as a natural stimulant and energy booster (Udechukwu *et al*., 2014). Osabor *et al*. (2015) state that *Cola lepidota* fruit has long been recognized as the main nutritive fruit of the South-South forest region of Nigeria. Fruit trees in Africa are among the finest defenses against diseases brought on by a deficiency or shortage of vitamins in the diet, thus the economic value of *Cola lepidota* fruit to the local population cannot be overstated (Osabor *et al*., 2015). *Cola lepidota* is used in culture, but in recent times, its possible health advantages have also drawn attention. According to Engel *et al*. (2011), *C. lepidota* is used as a febrifuge, for pulmonary issues, and for illnesses associated to cancer in Nigerian traditional medicine. *Cola lepidota* may have antispasmodic, analgesic, antioxidant, and anti-inflammatory qualities, according to studies (Udechukwu *et al*., 2014). *Cola lepidota* is a useful ecological characteristic because it is important for supplying food and habitat to a variety of animals, such as rodents, birds, and primates. For many primate species, including chimpanzees, gorillas, and monkeys, the nuts are a vital source of food that helps with both their nutrition and general survival (Gautier-Hion *et al*., 1999).

Despite its ecological and cultural importance, the pressure from pests and diseases is presently posing a threat to *Cola lepidota* production. Plant yield is severely reduced and in certain cases completely destroyed by pests such as bacteria, fungus, viruses, and insects. According to Nyaligwa *et al*. (2017), pests and illnesses are among the reasons why plant yields are low. Therefore, accessing, isolating, and identifying these organisms that can harm *Cola lepidota* is essential.

Materials and Methods

Sample Collection and Identification

In June, 2023, Healthy and spoilt samples of *Cola lepidota* were bought from Fruit Garden Market, Port Harcourt and brought to the Department of Plant Science and Biotechnology, Rivers State University for identification and further studies.

Proximate Composition Determination

Protein, crude fibre, fat, moisture and ash contents of the samples were determined by Standard Analytical Method AOAC (2005). Carbohydrate content was calculated by difference (Pearson, 1976).

Mineral Composition Determination

Mineral analysis was performed via wet digestion, which involved a mixture of HNO_3 and H_2SO_4 in a 3:1 ratio. Five centimeters of the digestion mixture were added to a conical flask containing two grams of powdered sample, which had been weighed. The mixture was then allowed to cool and digest for two hours at a temperature between 150-200°c in a fume closet. After adding $30cm^3$ of distilled water to the digest, giving it a good shake, and filtering it. The filtrate has a $100cm^3$ marking on it in a volumetric flask. A flame photometer was used in the digest to measure the following: sodium (Na), potassium (K), calcium (Ca), iron (Fe), magnesium (mg), and phosphorus (P), but calcium was determined using EDTA complexometric titration (ASTM, 2004).

Preparation of Mycological Medium

In the lab, all of the equipment required for the experiment, including slides, Petri dishes, and conical flasks, was sterilized. Glassware washed with soap and then sanitized for one hour at 120 degrees Celsius in the oven, while other equipment, while other equipment was surface cleaned with 70% ethanol to avoid microbiological contamination, the glassware was sterilized in an oven at 120°C for an hour following soap washing (Chuku, 2009). After being heated to a red temperature and submerged for 20 seconds in 70% ethanol, inoculating loops and scalpels were sterilized. Sabourand Dextrose Agar, made in a conical flask according to usual procedure, was the mycological medium utilized. The mouth of the flask was plugged with non-absorbent cotton wool and wrapped with aluminum foil. The conical flask containing the mycological medium was autoclaved at 12^0C and pressure of $1.1kgcm^{-3}$ for 15 minutes. The molten agar was allowed to cool to about 40^oC and dispensed into petri dishes at 15mls per plate and allowed to cool and solidify.

Isolation of Fungal Organisms from *Cola lepidota*

A three-fold serial dilution was used in accordance to the method of Mehrotra and Aggarwal (2003). 1g of spoil *Cola lepidota* samples were transferred into the first test tube containing 9mls of normal saline. 1ml of the solution was transferred to the second test tube and finally from the second to the third. 0.1ml aliquots from the second and third dilutions were plated onto Sabourand Dextrose Agar in Petri dishes containing ampicillin to hinder the growth of bacteria and this was done in triplicate. The inoculated plates were incubated for 5days at ambient temperature of 25^oC ± 3^oC (Chuku, 2009). The entire set up was observed for 7 days to ensure full grown organisms. Pure cultures of isolates were obtained after series of isolations.

Identification of Fungal Organisms from *Cola lepidota*

The needle mount approach was used to examine fungal isolates under a microscope (Cheesebrough, 2000). The fungus spores were appropriately separated to guarantee optimal visibility. The widely dispersed spores were investigated under a microscope with a low power and high power objective after being stained with cotton blue in lacto phenol. The keys of (Barnett and Hunter, 1998) were used to identify the fungi based on their spores, colonial morphology, mycelia structure, and other related structures.

Determination of Percentage Incidence

The percentage incidence of fungal occurrence was determined by the formula of Chuku *et al*. (2019) as stated below;

$$\frac{X}{Y} \times \frac{100}{1} = \% \text{ Incidence}$$

Where;
X = total number of each organism in a variety
Y = total number of all identified organism in a variety

Pathogenicity studies

Pathogenicity studies were carried out on *C. lepidota* to check if the fungi isolated from the rotted fruits were capable of causing spoilage on healthy fruit samples. The methods of (Agrios, 2005) were basically followed. The fungal isolates were innoculated into healthy fruits and incubated for seven days. The set up was examined visually daily for growth and signs of spoilage**.**

Results

Table 1: Proximate Composition (%) of *Cola lepidota*

S/N	PARAMETER	COMPOSITION (%)
1.	Moisture	42.45±0.51
2.	Ash	2.80±0.00
3.	Lipid	8.20±0.00
4.	Crude Fibre	2.10±0.00
5.	Carbohydrate	25.65±0.05
6.	Protein	18.51±0.10

Table 2: Mineral Composition (mg/100 g) of *Cola lepidota*

S/N	PARAMETERS	COMPOSITION
1.	Calcium	27.23±0.63
2.	Iron	4.03±0.05
3.	Magnesium	23.33±0.57
4.	Phosphorus	85.67±1.73
5.	Potassium	94.00±1.15

Table 3: Fungal Isolates and Percentage Incidence (%) from *Cola lepidota*

Fungal isolates	% incidence
Candida sp.	80
Mucor sp.	20

Discussion

An examination of the proximate analysis of *C. lepidota* showed that it had 42.45% moisture, 2.80% ash, 2.10 % crude fiber, 8.20 % lipid, 18.48 % protein, and 25.65% carbohydrates. The lowest and highest mineral content as analysed were Crude Fibre (2.10%) and Moisture (42.60%) respectively as shown in Table 1. The values obtained from the study were similar with that of Okwu *et al*. (2020), who reported the presence of Moisture (88.9%), Crude Protein (2.5%), Crude Fat (0.5%), Crude Fibre (0.6%), Ash (1.1%) and Carbohydrate (6.6%) in the fruit pulp of *C. lepidota*. The higher moisture content of the fruit has been established as a contributory factor to the microbial attack (Oranusi *et al*., 2020).

Cola lepidota did, however, have less moisture than some other fruits. Akubor and Egbekum (2007) reported that 84%, 82%, and 82% of the moisture content was found in most fruits, including pawpaw, pineapple, and soursop. According to Okwu *et al*. (2020), there are several reasons for the high moisture content found in the study, including the temperature, humidity, and storage conditions during the species' growing phase, as well as the time of harvesting and maturation.

Table 2 revealed that *Cola lepidota* contain nutrients such as; Calcium (27.23±0.63 mg/100 g), Iron (4.03±0.05 mg/100 g), Magnesium (23.33±0.57 mg/100 g), Phosphorus (85.67±1.73 mg/100 g) and Potassium (84.00±1.15 mg/100 g) in varying concentrations. The highest mineral composition was Phosphorus (85.67±1.73 mg/100 g) and Potassium (84.00±1.15 mg/100 g). Phosphorus is an essential mineral naturally occurring in numerous fruits and dietary supplements, phosphorus is an essential mineral. Foods such as dairy products, meats and poultry, fish, vegetables, nuts, and grains are among the several food kinds that include phosphorus (McClure *et al*., 2017). Essential for the activation of enzymes and maintenance of proper blood pH, it is found in bones, teeth, and cell membranes. Eno-obong *et al*. (2016) have demonstrated that potassium is necessary for the proper operation of the nervous system, muscles, and the preservation of the body's acid-base.

Furthermore, the presence of magnesium is necessary for active transport of calcium and potassium ions across cell membranes, which is a process that is vital to the conduction of nerve impulses, the contraction of muscles, and the maintenance of a regular heartbeat (Rude, 2012). However, the fruit's low iron content (4.03±0.05 mg/100 g) indicates that it isn't suitable for anemia patients as it may make them feel exhausted and short of breath (CEC, 2018).

Table 3 reveals the result for macroscopic and microscopic characteristics of fungal isolates of *C. lepidota* revealed the presence of *Candida sp*. and *Mucor sp*. with a percentage incidence of 80 and 20 respectively. Little is known about the mycoflora of C. *lepidota* but earlier study has shown the presence of spoilage microorganisms in its close relative *C. parchycarpa* juice and jam (Okudu and Ene-Obong, 2015; Chuku and Barber, 2019).

Conclusion

Result from the study has shown that *C. lepidota* fruit is rich in abundant nutrients and provides necessary mineral elements required for a healthy living. Improper handling predisposes this endowed fruit to organisms especially fungi that are capable of causing spoilage. Therefore, proper and hygenic measures should be followed in order to prevent contamination by these organisms with a sole aim of providing healthy fruits that are safe for consumption.

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