



## Comparative Anatomical Studies on the Roots of *Cola acuminata* of and *Cola nitida*

Mbagwu, F.N and Unamba C.I.N.

Department of Plant Science and Biotechnology, Imo State University Owerri Nigeria.

Email: [mbagwu101@yahoo.co.uk](mailto:mbagwu101@yahoo.co.uk)

### ABSTRACT

Comparative anatomical studies on the roots of the two *Cola* species are reported in this study. An analysis of the features of the internal arrangement of the roots showed that these taxa possess vital taxonomic characters that could be used to establish inter-specific relationships among these taxa. The number of vascular bundles, nature of vessels, the crystals and endodermis are some of the characters assessed and discussed in these two *Cola* species investigated. The presence of Calcium oxalate crystals in the root of *Cola acuminata* distinguished the taxon from *Cola nitida*. In these two taxa, their vessels varied in size and number, they are big and numerous in *Cola acuminata* but small and numerous in *Cola nitida*. The size and numbers of vascular bundles is big and numerous in *Cola acuminata* and small and numerous in *Cola nitida*. In this study, there is concentration of vascular bundles at the central part of the root cortex hence the endodermis is not clearly differentiated in both species. These distinctive features are reasons of the two being as different species whereas the similarities in anatomical structure showed inter-specie relationship and why both are in the same family.

**Key words:** Anatomy, Comparative, *Cola acuminata*, *Cola nitida*, Root, Taxonomy.

### INTRODUCTION

The genus *Cola* belongs to the family, Sterculiaceae. They are distributed widely as large forest trees in West Africa and Tropical North Africa. The *Cola* tree is cultivated today in many Tropical climates, including Central and South America, the West Indies, Sri Lanka, and Malaysia. *Cola* nuts are actually seeds removed from the seed coats. Although *Cola acuminata* and *Cola nitida* are plants of hot tropical lowland forest with a rainfall extending over a period of 8 months or more, and a temperature between 23°C and 28°C, they are of great economic importance. They are evergreen plants and grow to a height of about 4.5m to 18m or more, developing either a robust or slender stem with either sparse or bushy foliage. Their flowers are regular bisexual or unisexual; sepals valvate, often united; but calyx rarely splitting down one side; petals are five or totally absent and free; stamens are free or united; ovary is superior, composed of one or more carpels [1].

*Cola nitida* is cultivated more widely than *Cola acuminata* and is known as 'Gbanja cola' [2]. Ibu et al, [3] reported, 'that both species of *Cola* induced significant increase in gastric acid secretion. He advised people suffering from peptic ulcer to avoid eating *Cola* nuts. Atawodi et al, [4] analyzed both *C. nitida* and *C. acuminata* for primary and secondary amines content, and assessed their relative methylating potential. He found out that the seeds of both species contained high level of both primary and secondary amines. Moloney [5] compared the nutritive constituent of *Cola* nuts to other species used as 'Stimulants' such as Cocoa (Sterculiaceae) and Coffee (Rubiaceae). He stated that *Cola* contains more caffeine than coffee and has an appreciable quantity of theobromine, and glucose. Both *Cola* are chewed raw or taken in pulverized or liquid extract form. The *Cola* nut seeds are considered a symbol of hospitality and used in many social ceremonies such as birth, marriage, and funerals. The seeds are used to make a reddish dye, particularly the seeds of *C. nitida*. Seeds of *C. nitida* which contains caffeine are eaten as a stimulant that counteract fatigue, suppresses thirst and hunger, and are believed to enhance intellectual activity [6]. Due to their unique bitter taste, *Cola* nuts are good for mouth refreshing and the twigs are used as 'chewing sticks' to clean the teeth and gums [7].

Additionally, to pregnant or nursing mothers, *Cola* nut is important but must speak with their health care professional before using it. This research work is aimed at describing the anatomical characters of the

roots of *Cola acuminata* and *Cola nitida* with the objective of comparing these anatomical characters so as to deduce their interspecific relationships of the two taxa for their taxonomic characterization.

### MATERIALS AND METHODS

The studies were made on fresh root materials of *Cola acuminata* and *Cola nitida* collected from different parts of Eastern Nigeria. The materials were then fixed in F.A.A (1:1:18) glacial acetic acid; 40% formaldehyde, 70% ethanol (V/V) for 48- 72 hrs. The fixed materials were thereafter used for anatomical studies of the roots. These were then rinsed in several changes of distilled water. The study was carried out in Plant Science and Biotechnology Department Laboratory, University of Nigeria Nsukka in June, 2008.

For sectioning, a Reichert rotary sliding microtome was used and 5-10µm thick sections were made. The moving knife sliding microtome was used for the sectioning using 50% alcohol for lubrication (applied to the knife blade with a Carmel- hair brush). The ribbons were transferred into a staining jar and stained with safranin for 5 minutes. The safranin was drained off and sections washed 3 times with distilled water and later with 97% alcohol and absolute alcohol 2 times. The sections were counter stained in 1% fast green for 5 minutes and washed with absolute alcohol for about 3-4 times. The sections were then transferred into a staining jar containing 50/50 alcohol/ xylene and washed until they became clear. Pure xylene was finally used to clear the sections. The sections were finally mounted in Canada balsam. The slides were dried on hot plate at 30°C. Photomicrographs of the specimens were taken from the permanent slides using a LEITZ WETZLEP ORTHOLUX microscope fitted with RICOHX-3000 automatic camera.

### RESULTS

Table 1: Anatomical features of the roots in the two *Cola* species investigated.

Characters	<i>Cola acuminata</i>	<i>Cola nitida</i>
Size and numbers of Vascular bundles	Big and numerous	Small and numerous
Size and numbers of Vessels	Big and numerous	Small and numerous
Endodermis	Poorly differentiated	Poorly differentiated
Crystals Calcium oxalate	Present	Absent

The anatomical characteristics of the roots of the two species of *Cola* investigated are summarized in Table 1. The number of vascular bundles in the roots of the two taxa varied markedly. In *Cola acuminata*, the vascular bundles are big and numerous. While the vascular bundles are small and numerous in *Cola nitida*. The size and number of vessels is big and numerous in *Cola acuminata* and small and numerous in *Cola nitida*. The endodermis is poorly differentiated in both species. There are presence of calcium oxalate crystals in *C. acuminata* but absent in *C. nitida*.

### DISCUSSION

The presence of dark stained contents which are stains of calcium oxalate crystals at the central cell of *Cola acuminata* is a new observation in this plant. This is because crystals had earlier been described as being found in the mesophyl of leaves and not the pith regions. This localization of crystals covering the pith region is a good taxonomic character that can distinguish this taxon from *C. nitida*. More so, the presence of big and numerous vascular bundles with big and many vessels evenly scattered within the root cortex of *Cola acuminata* distinguished this taxon from *Cola nitida* with small and many vessels at the pith regions. The presence of vascular bundles in these taxa could be an ecological adaptation especially in manufacturing and storage of food and water for the survival of the plants.

The poorly differentiated endodermis in both species showed interspecific relationships.

The observations in this comparative study showed some resemblance and differences in the root anatomical studies of the two taxa. Similarities in structure show reasons for the two taxa being in the same genus *Cola* while the difference show reasons for the two to exist as distinct species.

**REFERENCES**

1. Keay, R.W.J., Onochie, C.F.A., and Stanfield, D.P. (1960). *Nigeria Trees*, Federal Department of Forest Research, Ibadan, Nigeria.
2. Russel, T.A. (1955). *The Cola of Nigeria and Cameroun*. Trinidad: Tropical Agriculture, 32, 210- 240.
3. Ibu, J.O., Iyama, A.C., Ijije, C.T., Ishmael, D., Ibeshim, M., and Nwokedi, S. (1986). The effect of *Cola acuminata* and *Cola nitida* on gastric acid secretion. *Scandinavian Journal of Gastroenterology supplement*, 21, 39-45.
4. Atawodi, S.E., Mende, P., Pfundstein, B., Preussmann, R., and Spiegelhalder, B. (1995). Nitrosatable amines and nitosamide formation in natural stimulants: *Cola Acuminata*, *C. nitida* and *Garcinia cola*. *Food and chemical toxicology*, 33, 625-630.
5. Maloney, A. (1887). *Sketch of the Forestry of West Africa*. London: Sampson low
6. Nickalls, R.W.D. (1986). The discovery that *Cola* nuts contain caffeine. *Pharmaceutical Journal*, 236, 401-402.
7. Lewis, W.H., and Elevelin-Lewis, P.F. (1985). *Medical Botany*. New York: Wiley and Sons,