



## **Aspects of Fruit Biology of Three Wild Edible Monkey Kola Species Fruits (*Cola spp*: Malvaceae)**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aims:** Monkey kola is a common name given to some edible wild relatives of West African kolanut, viz *Cola lateritia* K. Schum, *C. lepidota* K. Schum and *C. pachycarpa* K. Schum. These are underutilized indigenous tropical fruit species found growing in the humid West and Central African forests. The preliminary study was carried out to examine and characterize the three species of scantily known monkey kola for easy identification and documentation using their fruit morphological features.

**Place and Duration of Study:** Sample collections from matured ripe fruits of the species were assembled from different locations of southeast Nigeria where these species flourish in the wild and protected stands of home gardens, during the 2011 cropping season.

**Methodology:** Fruit characters examined for delineation of the species were: shape, fruit size, skin texture and colour; mesocarp colour, that is the edible waxy pulp around the seed, and average number of seeds per species' fruit. Botanical data of the species were presented after qualitative analysis was made using descriptive statistics.

**Results:** The species produce botanically identifiable follicle, characteristic of the genus *Cola*. Of the three, *C. pachycarpa* showed relatively marked palatable taste as per sweetness of edible fruit part, followed by *C. lepidota* and *C. lateritia* in the order. The various species fruits were characterised based on their respective fruit traits for further plant improvement, conservation and domestication purposes.

**Conclusion:** The present report has attempted presenting basic botanical information

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about the three edible wild fruits of the *Cola* spp which were obviously needed for relevant documentation, development of the species descriptors and stimulation of further advance research interest. The results of this study would be useful for conservation and tree improvement programme of the species; however, additional confirmation research is required for other morphological features of the species of agronomic importance.

**Keywords:** *Characterization; conservation; domestication; monkey kola; indigenous fruit.*

## 1. INTRODUCTION

Tropical African sub-regions are home to many valuable fruit species whose potentials have not been fully realized. A good number of these fruit species are not yet domesticated. However, tangible economic produce are been harvested from their wild and or protected stands in home gardens, farmlands and forest reserves [1,2,3,4]. According to National Academy of Sciences [5], tropical fruits production in Africa today is been dominated by species introduced from Asia and the Americas, such as bananas, pineapples (*Ananas comosus*), mangos (*Mangifera indica*), papayas (*Carica papaya*) among others. These and other adapted exotic crops which were already improved through horticultural selection and breeding, arrived on the continent centuries ago and increasingly displaced the indigenous species that had fed Africans for millennia. These introduced species also received the support of colonial powers who wanted familiar crops that were profitable to grow, and thus, the indigenous fruits continued their downward spiral of dwindling cultivation and knowledge. Ironically, only recently has this bequeathed colonial bias for introduced exotic fruit species witnessed slight reversal as well as positive trend for African native fruits among the National Agricultural Research Systems (NARS) across the continent. Protracted paucity of information and research inputs on these native plants have led to terms such as lost crops, minor, neglected and underutilized species been used to brand them [6,7,8,4].

The Monkey kola fruit species of humid West and Central African forest regions aptly fitted into the description stated above. Monkey kola is a common name given to a number of minor relatives of the *Cola* spp that produce edible tasty fruits. Native people of southern Nigeria and the Cameron relish the fruits, as well as some wild primate animals especially monkeys, baboons and other species. They belonged to the same botanical family Malvaceae and sub-family Sterculioideae with the popular West African plantation kola nuts (*Cola nitida*), grown for their masticatory and stimulating nuts [9,10,11]. Among the species commonly referred to by this name (Monkey kola) are the *Cola pacycarpa*, *C. lepidota* and *C. lateritia* [3,12]. Substantial quantities of produce (mainly the fruits, herbal medicine and lumber) of these species are still been gathered from forest reserves, community woodlands, and home gardens for direct consumption as well as for local markets [1,13]. Anya [14] reported that the southeast Nigeria holds rich species diversity of the *Cola* group, and had been regarded as the primary centre of early domestication for the monkey kola species.

The identification, characterization, evaluation and domestication of various neglected and underutilized species (NUS) have been marked as necessary steps toward the conservation and preventing sustained exploitation as well as extinction of Tropical African rich plant genetic diversity [15]. African native fruits can make much greater contribution to nutrition, health and economic development of the nations within the continent and beyond, given renewed scientific and institutional support [8,5]. The genetic resources of the various edible Monkey kola species have not been characterized and described for selection of superior

progeny in the plants' improvement, propagation and domestication programme due to dearth of research investment [16]. This study was therefore conducted to assess and characterize the fruit biology of these three wild *Cola* fruit trees that are of economic importance in southern Nigeria, using morphological characters of the fruit.

## 2. MATERIAL AND METHODS

Matured ripe fruits of *Cola pacycarpa*, *C. lepidota* and *C. lateritia* were sourced from the some local markets in cities of south east Nigeria, namely: Aba (Long 7° 24'E; Lat 5° 10'N), Enugu (Long 7° 31'E; Lat 6° 24'N), Calabar (Long 8° 16'E; Lat 4° 56'N), Ishiagu (Long 7° 35'E; Lat 5° 52'N) and Okigwe (Long 7° 21'E; Lat 5° 50'N) all located in southeast ecological zone of Nigeria. The zone is characterized by tropical humid forest in the southern axis and derived savanna vegetation northward. The raining season in the zone stretches between 6 to 8 months, depending on location [17]. The idea for many collection centres is to have wide genetic base, in addition to ensuring fair representation of the species and their likely variations. This is in line with the technical recommendation of World Agroforestry Centre (ICRAF) on indigenous fruit tree domestication programme [18]. For each species, collections were screened and characterized on the following parameters: fruit morphological features – skin texture, shape and colour; fruit size (cm) in terms of length by use of table meter ruler and thickness by use of caliper; number of seeds per fruit; mesocarp colour and fruit sweetness taste. The fruit edible part sweetness was determined by group of seven adult person assessors who were randomly and separately (i.e. independent of others) given edible pieces each of the three monkey kola species fruits for palatability assessment. The individuals' qualitative feedbacks were collated and ranked according to level of sweetness. Data collected were analyzed using descriptive statistics of mean and standard deviation, and presented as basic botanical descriptors among monkey kola fruit species.

## 3. RESULTS AND DISCUSSION

Multi-seeded dry fruits known as follicle characterized these species. The caulescent follicles contain one to eight seeds depending on the species and individual fruit length. Usually fruits with longer length as observed in both *Cola pachycarpa* and *C. lateritia* have more number of seeds than the relatively shorter sized fruits of *C. lepidota*. Physical dimensions of fruits of the three species and it ranges are given in Table 1. *C. pacycarpa* follicles were found to be more regularly cylindrical and longer than the other two species, which were rather ovoid or semi-spheroid. Number of seeds per follicle varies with fruit length among the species, with *C. lepidota* containing the least, often one or two seeded (Table 2).

**Table 1. Monkey kola species fruit size**

Species	Length (cm)		Mean±SD	Thickness (cm)		Mean±SD
	Minimum	Maximum		Minimum	Maximum	
<i>C. lateritia</i>	12.50	25.00	18.29± 1.75	5.60	14.20	9.06± 0.45
<i>C. lepidota</i>	3.20	8.20	6.80± 0.28	2.70	4.63	5.78± 0.33
<i>C. pachycarpa</i>	8.70	25.90	15.73± 1.43	3.65	5.53	4.55± 0.29

**Table 2. Monkey kola species fruit size – number of seed(s) per follicle**

Species	Number of locule per unit		
	Minimum	Maximum	Mean±SD
<i>C. pachycarpa</i>	2(dilocular)	7(heptalocular)	4.13±1.44
<i>C. lepidota</i>	1(monolocular)	4(tetralocular)	1.45±1.13
<i>C. lateritia</i>	2(dilocular)	5(pentalocular)	3.31±1.30

Fruit skins (the epicarps) differ widely from one species to another in terms of colour and texture (Fig. 1a-c). The *C. lateritia* is characterized by shiny red glabrous skin with short stalk and pronounced beak; having boat-like shape and may be ribbed. Finely pubescent and scaly rough dark brown epicarp characterized follicle of *C. lepidota*. Follicle of *C. pachycarpa* is beaked and ribbed with rough light brown skin. Seeds of the monkey kola species are obliquely ovoid with two flattered surfaces, rough and reddish brown or green; but not edible unlike the seeds of kola nut (*C. nitida*).

**Fig. 1(a). Monkey kola fruit – red type (*Cola lateritia* K. Schum.)**



**Fig. 1(b). Monkey kola fruit – yellow type (*Cola lepidota* K. Schum.)**



**Fig. 1(c). Caulescent Monkey kola fruit – White type (*C. pachycarpa* K. Schum.) still attached to parent plant in the wild**

The aril, i.e., waxy mesocarp, formed the edible portion of the follicle, and varied in colour, with the *C. lateritia* and *C. pachycarpa* having whitish aril, while *C. lepidota* is characterised by yellowish aril. These various arils also differed in sweetness as revealed by the palatability assessment of the species fruits, with *C. pachycarpa* having relatively the most pronounced fruit sweetness taste, followed by *C. lepidota* and *C. lateritia* in the order.

Proximate analysis of the various species fruits nutritional composition as earlier published by Ogbu et al. [19] correlated with the fruit sweetness taste in the present results. For *C. pachycarpa*, the fruit contained, per 100 g of the waxy aril: moisture content 80.15 g; fibre ash 1.76 g; energy value 58 kcal; fats 0.00 g; carbohydrate 26.7 g; crude protein 1.77 g; vitamin C 13.47 mg; vitamin A 0.27 IU; phosphorus 0.06 mg; potassium 0.14 mg; calcium 0.48 mg; and magnesium 0.05 mg.

For *C. lepidota*, the fruit contained per 100 g of edible part: moisture content 82.60 g; fibre ash 1.58 g; energy value 55 kcal, fats 0.00 g; carbohydrate 25.8 g; crude protein 1.75 g; vitamin C 11.28 mg; vitamin A 0.25 IU; phosphorus 0.09 mg; potassium 0.19 mg; calcium 0.42 mg; magnesium 0.09 mg.

While *C. lateritia* fruit showed that it contained per 100 g edible part: moisture content 87.46 g; fibre ash 1.19 g; energy value 32.0 kcal; fats 0.03 g; carbohydrate 25.3 g; crude protein 1.15 g; vitamin C 6.37 mg; vitamin 0.14 IU; phosphorus 0.14 mg; potassium 0.39 mg; calcium 0.18 mg; magnesium 0.22 mg.

#### 4. CONCLUSION

African's IFT are one of the best tools available for preventing diseases caused by the lack of micronutrients in the diet of most staple foods of the continent. According to World Agroforestry Centre (ICRAF), the continent's IFT are disappearing at a rate faster than nature can replenish them. Often time, the people traditionally harvest fruits from the wild and rarely seek to plant such species. This traditional disposition constituted real cause for concern in terms of conservation, plant improvement, re-introduction and domestication on-farm of the species, if the negative trend must be averted [20,21].

The present report has attempted projecting three underutilised but promising useful indigenous fruit trees of the humid tropical forest of southern Nigeria. Presented were basic botanical information about the three edible wild fruits of the *Cola* spp which were obviously needed for relevant documentation, development of the species descriptors and stimulation of further advance research interest. The results of this study would be useful for conservation and tree improvement programme of the species.

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#### COMPETING INTERESTS

Authors hereby declare that no competing interests exist.

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