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Polyphenol Contents and Polyphenol Oxidase Activities of Some Nigerian Kolanuts

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Abstract: The levels of polyphenol and activities of polyphenol oxidases in some Nigerian kolanuts were investigated. *Garcina cola* had the least polyphenol content of 15.60±1.70 (mg/g), while *Cola nitida* (red) recorded the highest value of 33.50±2.51mg/g. Polyphenol oxidase from *Garcina cola* had its optimum pH of activity in the acidic region (pH 3), but the white and red species of *Cola nitida* had a neutral (pH 7) optimum pH. With catechol as substrate, polyphenol oxidase activity was highest in *Cola nitida* (white) (55.70±2.60) and lowest in *Garcina cola* (2.22 ± 0.04). Whilst the values of polyphenol obtained may explain the high incidence of enzymatic browning in some Nigeria kolanuts, the white cultivar of *Cola nitida* could be further explored as a good source of polyphenol oxidase.

Key words: Polyphenol, polyphenol oxidase, Nigeria kolanuts

INTRODUCTION

Kolanuts are of particular importance in the social life and religious customs of people in the tropics of West Africa. In all types of traditional gatherings in these parts, kolanuts are highly esteemed channels of blessings. Kola belongs to the family *sterculaceae*. The four species under this family are *Cola nitida*, *Cola acuminata*, *Cola anomata* and *Cola vercillata*. The main types common in Nigeria are *Cola nitida* (Gbanja) with two phenotypic varieties; the white and red cultivars, *Cola acuminata* (Abata) and *Garcina cola* (Orogbo) (Eka, 1977).

Cola nitida (white and red) are known as the kolanuts of commerce as large quantities of them are usually transported to the Northern parts of Nigeria, where they are widely consumed. The nuts of *Cola nitida* are also widely consumed in the Sudan Savanna area of West Africa in large quantities, owing to their stimulating and sustaining properties. *Cola acuminata* has high social and ceremonial values among the Yoruba's and some other tribal groups in Nigeria amongst whom it is recognized as native kolanut.

Kolanuts generally contain 2-3% caffeine and smaller amounts of theobromine and kolanin which tends to dispel sleep, thirst and hunger. The nut also contains 10% protein, 1.35% fats and 4% starch (Eka, 1977).

In kolanuts and other edible plant products including white yam (*Dioscorea rotundata*), there is a prevalent formation of several shades of colours during processing that involves cutting and peeling. This phenomenon is termed browning (Mathew and Parpia, 1971).

Nutritionally, the effects of polyphenols are detrimental as they make amino acids unavailable by binding strongly to them (Elias and Bressani, 1979).

The aim of this work is to determine the levels of polyphenol and polyphenol oxidase activities of some Nigerian Kolanuts; *Garcina kola* and *Cola nitida* (white and red cultivar). This is with the view of determining the nutritionally advantageous variety and a potential source of polyphenol oxidase for commerce.

MATERIALS AND METHODS

Samples: The two varieties of kolanut, *Cola nitida* (white and red cultivar) and *Garcina cola* (bitter kola) were purchased from Esan West Local Government Area, Edo State, Nigeria.

Reagents/Chemicals: The reagents used were of analytical grade and were products of the British Drug House Chemical Limited, Poole, England.

Preparation of kolanut extract: Kolanuts were washed thoroughly with distilled water and cut into smaller pieces. These were then ground to powder in a mortar with the aid of a pestle. The kolanut extract was prepared according to the procedure of Udayasekhara and Deosthale (1987).

Polyphenol contents: Polyphenol contents were estimated using AOAC, 1984 method.

Polyphenol oxidase assay: Polyphenol oxidase assay was as described by Udayasekhara and Deosthale, 1987.

Table 1: Polyphenol contents and activities of Polyphenol oxidases in some Nigeria Kolanuts

Parameters	Cola nitida (white)	Cola nitida (red)	Garcina cola
Polyphenol content (mg/ml)	29.50±2.67	33.50±2.51	15.60±1.70
Relative activity of polyphenol oxidase (Abs/ min/mg) 10^{-6}	55.70±2.60	32.20±2.60	2.22±0.04
Optimum pH of activity of polyphenol oxidase	7.00	7.00	3.00

Results represent mean ± S.E.M of three estimations.

Table 2: Kinetic constants (Vmax and Km) of Polyphenol oxidases in some Nigeria Kolanuts

Kolanut samples	Vmax (Abs/min)	Km (mM)
Cola nitida (white)	2.63±0.02	0.677±0.00
Cola nitida (red)	2.22±0.00	0.83±0.00
Garcina cola	0.50±0.00	2.50±0.08

Results represent mean±S.E.M of three estimations.

Statistics: Statistical analysis was carried out using computer SPSS software.

RESULTS

Tables 1 and 2 present the results of this study. Polyphenol oxidase activity in *Garcina cola* was the lowest (2.22±0.04) while *Cola nitida* (white) recorded the highest value of 55.70±2.60 abs/min/mg x 10^{-6}. Polyphenol content was however highest in the red variety of Cola nitida. The optimum pH of polyphenol oxidase activity in *Garcina cola* was in the acidic range (pH 3.00), while that of *Cola nitida* (white and red species) were in the neutral pH range (7.00).

DISCUSSION

Kolanut occupies a unique place amongst West Africans where it is widely consumed by them. An interesting occurrence takes place when kolanuts are half eaten or handled in a manner that exposes their tissues; brown patches begin to appear with time, which stain the white teeth of notable consumers. This principle is referred to as browning. Browning is attributed to the oxidation of phenolic compounds present in the plant product. This is catalyzed by polyphenol oxidase. This enzyme utilizes molecular oxygen in producing quinones and melanin, which on interaction with other constituents yield brown pigments (Mayer and Havel, 1979).

Polyphenols make amino acids unavailable by binding strongly to them (Elias and Bressani, 1979). Proteins exposed to enzymatically oxidized polyphenols have lower biological values, protein digestibility and fluorodinitrobenzene (FDBN) reactive lysine values than the original protein (Horrigoine and Kaidatsu, 1968).

This present study examined the polyphenol contents and polyphenol oxidase activities of some Nigerian kolanuts. Purseglove (1991), reported values of polyphenol in the range of 0.8% to 1.3% for *Garcina cola* and 2.5% to 3.0% for the varieties of *Cola nitida*. Work carried out by Ducksworth and Coleman (1970) showed that white cultivars of most crop products such as bitter kola and kolanut lack carotene, a polyphenol, which is responsible for the pigmentation noticed in *Cola nitida*, especially the red cultivar.

The relatively high values of polyphenols obtained in this study may therefore explain the high incidence of enzymatic browning in Nigeria kolanuts. The levels of polyphenols also vary from variety to variety with the highest value occurring in the red cultivar of *Cola nitida* (35.5mg/ml) whilst *Garcina cola* had the lowest (15.6mg/ml). In Garcina cola, polyphenol oxidase recorded the highest K_M for catechol and that could be due to its optimum pH (pH 3.0) of activity, being in the acidic region.

In areas where teeth colouration arising from kolanut consumption is desirable the red variety of Cola *nitida* may be the kolanut of choice as this is positively correlated with the level of polyphenol. However, the white variety of Cola *nitida* may be a good source of polyphenol oxidase as the polyphenol oxidase activity was highest.

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