Food Chemistry 193 (2016) 154–159

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Analytical Methods

Nutrient and phytochemical composition of two varieties of Monkey kola (*Cola parchycarpa* and *Cola lepidota*): An underutilised fruit

Henrietta N. Ene-Obong [a,*], Helen O. Okudu [b], Ukamaka V. Asumugha [b]

[a] Department of Biochemistry (Nutrition and Dietetics Unit), Faculty of Basic Medical Sciences, University of Calabar, Calabar, Cross River State, Nigeria
[b] Department of Human Nutrition and Dietetics, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

ARTICLE INFO

Article history:
Available online 24 November 2014

Keywords:
Monkey kola
Cola parchycarpa
Cola lepidota
Nutrients
Phytochemicals
Underutilized fruit

ABSTRACT

The nutrient and phytochemical composition of two varieties of Monkey kola: *Cola parchycarpa* and *Cola lepidota* were determined. The pulps were extracted, grated and dried using solar dryer. Dried pulps were milled into flour with attrition milling machine (0.5 mm sieve size). The nutrient compositions were determined using standard AOAC methods. Gravimetric and spectrophotometric methods were used for phytochemical determinations. There were significant ($p < 0.05$) differences in the proximate and some mineral and vitamin composition of the two varieties. Most abundant minerals were calcium (195–199 mg for *C. parchycarpa*), potassium (204–209 mg/100 g for *C. lepidota*) and β-carotene (2755–5028 μg/100 g for *C. parchycarpa*). Calcium:phosphorus and sodium:potassium ratios were adequate (>1.0 and ⩽0.06, respectively). Monkey kola had substantial amounts of iron, zinc, and copper; the B-vitamins and vitamin C. The phytochemical contents were quiet high, the most abundant being flavonoids (415–494 mg/100 g). Monkey kola is a fruit that should be fully exploited for its potential health benefits.

1. Introduction

Fruits, including vegetables are indispensible part of human diet. They provide a diversified flavoured, colourful, tasty, low caloric and protective, micronutrient rich diet (Sachdeva, Sachdeva, & Sachdeva, 2013). The protective effect is mediated probably through the action of antioxidants and micronutrients, such as flavonoids, carotenoids, vitamin C and folic acid, as well as dietary fibre (WHO, 2003), which are abundant in fruits and vegetables. Low fruit and vegetable consumption is ranked as the 6th main risk factor for mortality in the world (WHO, 2009). The worldwide mortality currently attributable to inadequate consumption of fruits and vegetable is estimated to be up to 2.6 million deaths per year (Lock, Pomerleau, Causer, Altman, & McKee, 2005). Low fruit and vegetable intake are among the risk factors contributing about 75% of cardiovascular disease (Waxman, 2003). High intake of fruits and vegetables were associated with reduced incidence of cancer and cardiovascular disease (Pomerleau, Lock, & McKee, 2006; Van't Veer, Jansen, klerk, & Kok, 2000).

Unfortunately, it has been shown that globally, majority of people consistently consume less than the daily recommended fruit and vegetable requirement. Hall, Moore, Harper, & Lynch (2009) found that 77.6% of men and 78.4% of women from 52 mainly low- and middle-income countries consumed less that minimum recommended five daily serving of fruits and vegetables. This may account for the high prevalence of malnutrition, particularly micronutrient deficiencies and the increasing prevalence of diet related non-communicable diseases in low- and middle-income countries. The lack of good database and poor knowledge of the nutrient composition and quality of traditional food crops are some of the reasons for low fruit and vegetable consumption in developing countries (Grivetti & Ogle, 2000).

It is common knowledge that in Nigeria a number of indigenous plant foods have been abandoned and are becoming extinct. According to Joshi & Joshi (2005) the vast store of information on indigenous knowledge, practises and technologies is being eroded as a result of rapid urbanisation, over-exploitation of resources, unscientific land use, change in lifestyle and behaviour. Most have not been identified and evaluated for their nutritional and functional properties and therefore are underexploited. One of such plant food is the Monkey Kola.

Monkey kola belong to the family *Sterculiaceae*; and genus *Cola*. It is made up of three varieties: red (*Cola latertia*), yellow (*Cola parchycarpa*), white (*Cola lepidota*) (Singh, Gupta, Bansal, Singh, & Kumer, 2010; Ogbu, Essien, Essien & Anaele, 2010). The pod of the yellow variety is roundish, while the white variety is more cylindrical (Fig. 1). Monkey kola is identified by various local names in

* Corresponding author.
E-mail addresses: nkeneobong@yahoo.com (H.N. Ene-Obong), helenokdu@yahoo.com (H.O. Okudu), vuasumugha@yahoo.com (U.V. Asumugha).

http://dx.doi.org/10.1016/j.foodchem.2014.11.045
0308-8146/

South-eastern Nigeria ("achicha" or "Ochiricha" in Igbo and "ndiyah" in Efik) (Personal communication). It is commonly found in Southern Nigeria between the months of June to November (Ogbu, Essien & Kadurumba, 2007). The matured pulp is crispy and tastes sweet and is cherished by young children and adults. The pod size varies between 25 g to 150 g (Ogbu, Essien & Kadurumba, 2007). The Monkey kola tree can be found in the forest or wild as well as homesteads. A more detailed description of Monkey kola is given by Keay, Onochie, & Stanfield (1964). Research and information on this highly cherished fruit is very scanty. It is therefore the objective of this study to determine the nutrient and phytochemical compositions of two common varieties of Monkey kola.

2. Materials and methods

2.1. Source of materials and identification

Monkey kola (*C. parchycarpa* and *C. lepidota*) was identified botanically in the Department of Forestry, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The yellow and white varieties were collected from the major markets in Calabar (in the South-south zone) and Umuahia (in the South-east zone). Samples were purchased from at least five randomly selected vendors in the various markets and pooled to obtain the samples for analysis. The two varieties under investigation are shown in Fig. 1.

2.2. Preparation of Monkey kola for chemical analysis

The fruits were inspected and sorted. Fruits that were firm, matured and free from insect damage or mechanical injuries were selected. The outer covering of the fruits were cut open using a kitchen knife and stripped/peeled off manually. The pulps (edible part) were carefully cut longitudinally and then separated from the seed. The membranous layer separating the pulp from the seed was scraped off using a kitchen knife. The arils (pulps) were grated with a kitchen grater. Samples were taken away immediately for moisture analysis, while the rest were dried for three days using solar dryer. Milling the dried pulp into flour was done using attrition milling machine (Thomas Wiley Model ED-5) to 5 mm sieve size. The milled samples were stored in air-tight containers and stored in the refrigerator until needed for chemical analysis.

2.3. Proximate analyses

The proximate composition was determined using standard AOAC (2006) methods. The fruit as consumed and the solar dried fruit were dried in a moisture extraction oven at 100–105 °C in order to determine actual moisture and residual moisture contents, respectively. The drying of the fruit samples for milling into powder was done at 55 °C. The actual moisture content of the fresh fruit and the residual moisture of the samples were used to calculate the moisture conversion factor (WCF) which was used to obtain the nutrient composition of the fruit as consumed. The crude protein content was determined using micro-Kjeldahl method, using 6.25 as the Nitrogen conversion factor. The crude fat content of monkey kola was determined by Soxhlet extraction method using petroleum ether. Ash content was determined by incinerating the samples at 600 °C in a muffle furnace. Carbohydrate was obtained by difference. Energy was calculated using the Atwater Conversion factors in kJ and kcal (17 kJ/4 kcal, 17 kJ/4 kcal, and 37 kJ/9 kcal, for protein, carbohydrate and lipid).

2.4. Mineral analysis

Mineral elements were determined using wet digestion method for multiple nutrients determination. The digest was used for the elemental composition. Calcium (Ca) and magnesium (Mg) were determined by the EDTA versanate complexometric titration method. Ten (10) ml of the aliquot of the digest was pipette into a conical flask then a pinch of potassium cyanide and potassium ferrocyanide was added to the digest to mask the interference of other ions during the determination. NH_4 buffer solution (10 ml) was added to raise the pH of the system to pH 10, with solochrome Black-T indicator; the system was titrated with 0.02 N EDTA to get a greenish end point from original colour. Calcium was determined alone by using 10% NaOH as buffer to raise the pH to 12 of which EDTA forms complex with Ca alone using solochrome dark blue indicator. A blank determination was also carried out and titrated with the 0.02 N EDTA reagent.

Potassium (K) and sodium (Na) was determined by the flame photometry method; five (5) ml of the sample digest was pipette into a 50 ml volumetric flask and diluted to 50 ml with distilled water. A set of potassium (K) and sodium (Na) was prepared containing 0 ppm, 2 ppm, 4 ppm, 6 ppm, 8 ppm and 10 ppm of the elements in solution. The flame photometer was turned on and sealed calibrated with 6 ppm and adjusted to 60. The standard solutions were tested and their values recorded. The appropriate filter (Photocell) was selected for each element. The atomizer of the instrument was dipped into the sample solution and the metre reading taken. The values obtained from the standards were used to plot the calibration curve for each test element and the concentrations of the sample element were determined by extrapolating from the graph as ppm off the curve.

Phosphorus (P) was determined by the vanadomolybdate yellow method using the spectrophotometer. Five (5) ml of the extract

Fig. 1. Pictorial image of the *Cola parchycarpa* (yellow) and *Cola lepidota* (white) varieties.