



COMPARATIVE FOOD CONTENTS OF RIPE AND UNRIPE FRUITS OF AFRICAN STAR APPLE, *Chrysophyllum albidum* G. Don (Syn. *Gambeya albida*)

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ABSTRACT

This study analyzed the nutritive values of the edible portions of ripe and unripe fruits of Chrysophyllum albidum. Ripe and unripe fruits of C. albidum were harvested fresh from Ijan Ekiti, Ekiti State, Nigeria. The fruits were weighed and then oven-dried at 80°C for 24 h. The seeds were extracted while the skin and the fleshy part of the fruit were then milled into powdery form. These were then analyzed chemically in triplicates. The data obtained was subjected to Student's t-test. Weights of ripe and unripe fruits of C. albidum did not reveal any significant difference however when mean values for the two categories were considered, ripe fruits gave a higher value of fruit weight being 55.8 g while unripe fruits gave a lower weight value of 45.2g. Furthermore, Student's t-test result showed significant differences for all the parameters measured between ripe and unripe fruits of C. albidum. However, considering the mean values for the two fruit categories, those of unripe fruits were higher than those of ripe fruits for all the parameters except for Ash, Moisture content and pH. Unripe fruits had Protein content of 2.30 while ripe fruits had 1.02 with the value of unripe fruits exceeding double that of ripe fruits. Similarly, Fat, Fibre, Carbohydrate (CHO) and Titratable Acidity (TTA) for unripe fruits were higher than those of ripe fruits with values of 1.21, 1.24, 25.20 and 1.39 respectively while ripe fruits had lower values of 0.19, 0.65, 22.00 and 1.06 respectively. However, the % Vitamin C for the two fruit categories were so close with unripe fruits having a value of 0.052 while ripe fruits had a value of 0.049. Nevertheless, % Ash, % Moisture and pH values of 0.63, 70.66 and 2.96 respectively for Unripe fruits were less than those of ripe fruits with values of 0.72, 76.06 and 3.42 respectively. Manufacturing industries can take advantage of these higher nutritional contents of unripe fruits of African star apple instead of the ripe fruits of the same species.

Key words: *Chrysophyllum albidum*, indigenous fruit, chemical analyses, benefits

INTRODUCTION

Non-wood forest products (NWFPs) remain central to the sustenance of Nigerians (Osemeobo and Ujor 1999) because a particular plant species may be used to meet various end uses in different locations and ecological zones. These various products have served as sources of food for both human beings and animals; medicine to guard against several forms of diseases; natural food colours and spices that give appeal and add flavour to food to promote their sales marketability value. The dietary contribution of forest trees especially edible fruits obtained from them in improving the nutritional status of mankind is further

enhanced by the timing of their availability which often falls at strategic periods of general food shortage in most African countries particularly in Nigeria. These fruit species often form part of traditional diet. In addition, a wide range of indigenous fruit trees available in many areas can enable farmers to meet their varied household needs for food, nutrition, medicines (Schreckenbery, *et al.* 2006). Okafor and Lamb (1994) noted that edible forest products constitute important and cheap sources of vitamins, minerals, proteins, carbohydrates and fats and their contribution to the diet of people is often significant. Some of the importance of fruits in

diet as highlighted by Young (2005) include hydrating effect apart from the supply of numerous nutrients; diuretic effect thereby lowering urine density which ultimately speeds up the process of eliminating nitrogenous wastes and chlorides from the body; richness in fibre which aids smooth passage of food in the digestive tract and bowel movement; detoxification of the body because of its alkaline effect and supply of quick source of energy especially to the sick. Most people in the world cannot afford the luxury of selecting a daily diet that contains both dairy and meat products, instead, they rely heavily on plant products as their source of food for their greatly needed calories and proteins. It was estimated that on a global scale, plants directly provide 88 percent of the calories (i.e. carbohydrates and fats) and 80 percent of proteins that human beings consume; the rest comes from animal products (Muhammad and Amusa, 2005).

Considering the benefits that can be derived from fruits either in isolation or in combination with other products, this study on *Chrysophyllum albidum*, an indigenous fruit tree from the family Sapotaceae commonly known as African star apple becomes important. It is called "Osan agbalumo" in Southwestern Nigeria and "Udara" in the Southeastern Nigeria. It has other local names in different countries one of which is "Mululu" or "Nkalate" in Uganda. It is known as "Alasa" or "Adasima" in Ghana depending on the region. It is usually found in the wild and forms an important source of food. It is primarily a forest tree species and its natural occurrence has been reported in diverse ecological zones in Nigeria, Uganda, Niger Republic, Cameroon and Cote d'ivoire (Bada 1997). The plant often grows to a height of 36.5m though it may be smaller (Bada 1997). The African star apple fruit is a large berry containing 4 to 5 flattened seeds or sometimes fewer due to seed abortion (Keay, 1989). The plant has in recent times become a crop of commercial value in Nigeria. The fleshy pulp of the fruit is eaten as snack and relished by both young and old (CENRAD, 1999). The African star apple has been reported as an excellent source of vitamins, irons in diets and raw materials in some manufacturing industries (Okafor and Fernandes 1987, Bada 1997, Umelo 1997, Adisa 2000). African star apple is common in both urban and rural centres especially during the months of December to April and the fruits are not usually harvested from the trees

but left to drop naturally to the forest floor where they are picked. The many benefits derivable from *C. albidum* qualify the species as a multipurpose tree species. Madubuiké and Ogbonnaya (2003) stated that the juice from the fruit is a potential source of soft drink and can be fermented for the production of wine and alcohol. It has also been proposed as a raw material for jam production without additional pectin, as there is indication that its original pectin content is high enough to meet the pectin requirement for jam production. Madubuiké and Ogbonnaya (2003) carried out a study that assessed the potential use of the cheap African star apple seeds (*Chrysophyllum albidum*) and physic nut (*Jatropha curcas*) as feed ingredients for livestock using rats as preliminary test animal which was successful. *C. albidum* fruits have been fermented and distilled for the production of spirits. In addition, its seeds are a source of oil, which is used for diverse purposes.

In spite of the importance of fruits generally, it is popularly believed that when fruits start getting ripe, deterioration sets in implying that unripe fruits should be considered more nutritious than ripe fruits. The aforementioned statement may however be a probability hence the need for this study. Fleshy fruits undergo a natural stage of development known as ripening. This occurs when the fruit has ceased growing and is said to be mature. Ripeness is followed by ageing (often called senescence) and breakdown of the fruit (FAO 1989). *Chrysophyllum albidum* fruits are fleshy therefore, this study analyzed the nutritive values of the edible portions of ripe and unripe fruits of *Chrysophyllum albidum* with special emphasis on its food values to determine differences between them.

MATERIALS AND METHOD

The experiment was carried out in the laboratory of the Institute of Agricultural Research and Training (IAR&T) in Ibadan to determine the percentage crude protein, crude fat, carbohydrate, ash, fibre, moisture content, vitamin C, titratable acidity and pH in the ripe and unripe fruits of *Chrysophyllum albidum*. The method involved carrying out proximate analyses of both the ripe and the unripe fruits of the species as well as determination of the variations in the percentage proportion of the chemical components between the ripe and unripe fruits of *C. albidum*.

Source of Raw Materials and Laboratory Analyses

Ripe and unripe fruits of *Chrysophyllum albidum* were collected fresh from Ijan-Ekiti, in Ekiti State, Nigeria (7°37'0"North, 5°24'0"East). Five fruits per category were selected and weighed. Four fruits were selected under each category for chemical analyses. These were oven-dried at 80°C for 24 hours, the seeds were extracted while the skin and the fleshy part of the fruit were then milled into powdery form. Samples were then analysed chemically according to the official methods of analyses described by the Association of Official Analytical Chemists (A.O.A.C., 2005) with all analyses carried out in four replicates. The crude protein in the sample was determined using the routine semi micro Kjeldahl procedure. The techniques entailed digestion,

distillation and titration. Moisture and ash contents were estimated using weight difference method. Fibre content was determined the loss in weight of the crucible and its content on ignition. Carbohydrate was determined by difference.

RESULTS

Fruit Weight

Weights of ripe and unripe fruits of *Chrysophyllum albidum* were subjected to Student's t-test and the result showed that there was no significant difference between the weights of ripe and unripe fruits. However when mean values for the two categories were considered, ripe fruits gave a higher value of fruit weight being 55.8g while unripe fruits gave a lower value of 45.2g (Table 1).

Table 1: Weights of Ripe and Unripe *Chrysophyllum albidum* fruits

Fruit Sample	Weight of Ripe fruits (g)	Weight of Unripe fruits (g)
1	64.4	57.6
2	61.9	46.5
3	54.7	39.3
4	47.8	43.0
5	50.3	39.8
Mean weight (g)	55.8	45.2

Chemical contents of ripe and unripe fruits of *Chrysophyllum albidum*

Student's t-test result showed significant differences for all the food parameters studied between ripe and unripe fruits of *C. albidum* (Table. 2). However, when the mean values for the two categories of the fruits were considered, the mean values for unripe fruits were higher than those of ripe fruits for all the parameters except for % Ash, % Moisture content and pH (Table 2). Unripe fruits had % Protein content of 2.30 while ripe fruits had 1.02 with the value of unripe fruits exceeding double that of ripe fruits.

Similarly, % Fat, % Fibre, % Carbohydrate (CHO), and % Titratable Acidity (TTA) for unripe fruits were higher than those of ripe fruits with values of 1.21, 1.24, 25.20 and 1.39 respectively while ripe fruits had lower values of 0.19, 0.65, 22.00 and 1.06 respectively. However, the % Vitamin C for the two fruit categories were so close with unripe fruits having a value of 0.052 while ripe fruits had a value of 0.049. Nevertheless, % Ash, % Moisture and pH values of 0.63, 70.66 and 2.96 respectively for Unripe fruits were less than those of ripe fruits with values of 0.72, 76.06 and 3.42 respectively (Table 2).

Table 2: Chemical Analysis of ripe and unripe of *Chrysophyllum albidum* fruits

Food Parameter	Ripe fruits	Unripe fruits	T-cal	T-tab
% Protein	1.02	2.30	11.59	2.45
% Fat	0.19	1.21	26.09	2.45
% Fibre	0.65	1.24	16.90	2.45
% Ash	0.72	0.63	2.83	2.45
% Moisture	76.06	70.66	9.23	2.45
% CHO	22.00	25.20	4.83	2.45
% Vitamin C	0.049	0.052	7.89	2.45
pH	3.42	2.96	6.63	2.45
% TTA	1.06	1.39	11.88	2.45

DISCUSSION

Weight of Ripe and Unripe Fruits of *Chrysophyllum albidum*

The physical property of *C. albidum* in respect to its weight showed that there is variation in the weight of the ripe and unripe fruits with the mean value ranging from 47.8g to 64.4g for ripe fruits of *C. albidum* and 39.3g to 57.6g for unripe fruits. However, the result of statistical analyses revealed that there is no significant difference between the weights of the ripe and unripe fruits of *C. albidum*.

SOME FOOD CONTENTS

Moisture Content

The edible portions of the ripe *C. albidum* fruits showed higher moisture content than unripe fruits. This higher moisture content of ripe fruits than the unripe fruits will then make the former more perishable and susceptible to microbial infections than the latter. Also, the implication is that unripe fruits can be stored for a longer time than the ripe fruits. This agrees with the result of Lidianys Maria *et al.* (2014) on *Morinda citrifolia* fruits whereby its amount of moisture increased with ripening.

Carbohydrate

The unripe fruits of *C. albidum* is richer in carbohydrate content than ripe fruits of the same species, this buttresses what has been generally reported about the characteristics of carbohydrate composition of fruits whereby the more ripe a fruit is, the simpler its carbohydrate composition. This implies that when unripe fruits are eaten, it might take a longer time to be broken-down in the stomach due to the complex structure of the carbohydrate composition in them. In other words, the simpler the carbohydrate structure of a food component, the

easier its digestibility. Contrary to what was observed in *C. albidum* fruits, total carbohydrates in Noni (*Morinda citrifolia*) fruits increased with ripening (Lidianys Maria *et al.*, 2014). Nevertheless, FAO (1995) stated that unripe fruit is frequently high in starch and low in sugars. This finding may be species specific although the same observation was obtained in *C. albidum* fruits.

Titrateable Acidity

Generally, fruits with moderate sourness are preferred. However, the titrateable acidity of unripe fruits of *C. albidum* is higher than that of the ripe fruits. This results agrees with that of Appiah *et al.* (2011) who observed a similar trend in Keitt mango fruits with titrateable acidity declining with ripening. Moreover, substance with high pectin value are always associated with high acidity as stated by Schneeman (1990), this forms a fundamental reason why unripe pulp of *C. albidum* could be considered for jam preparation. The taboo reported by Bown (2012) that star apples should be allowed to fall before collecting could be attributed to the fact that *C. albidum* is non-climacteric and definitely when it falls by itself, it would have ripened leading to reduction of acid content in the fruit. The taboo might have emerged as a means of allowing the fruit to ripen before being eaten by humans due to the very acidic content of the unripe fruit. It has been stated generally by FAO (1995) that acid content of fruits reduces on ripening.

Vitamin C

The vitamin C content of unripe fruits of African star apple is higher than that of the ripe fruit and this is in agreement with what has been reported concerning vitamin C content of many fruits. Similar result was

obtained by Appiah *et al.* (2011) who reported a decline in Vitamin C content of Keitt mango fruits with ripening. Likewise, Muhammad *et al.* (2014) reported that Vitamin C content of fruits such as sour orange, cashew, apple, mango, pineapple, orange and guava is higher when slightly immature but declines as these fruits hit peak ripeness. Nevertheless, Muhammad *et al.* (2014) observed a different result in water melon whereby the ripe fruit had a higher level of ascorbic acid than the green one.

Ash

The ash content in ripe fruits of *C. albidum* is higher than that of unripe fruits. Similar finding by Appiah *et al.* (2011) was recorded for mango slices (chips) whereby they showed increased levels of ash with ripening.

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CONCLUSION

This study has shown that there were significant differences for all the food parameters studied between unripe and ripe fruits of *Chrysophyllum albidum*. Moreover, unripe fruits of *C. albidum* though acidic to taste had higher percentage values than the ripe fruits for all the chemical contents examined except for moisture content, percentage ash and pH. It could therefore be implied that unripe fruits of *Chrysophyllum albidum* are more nutritious than the ripe fruits although they are not usually consumed fresh due to the fact that they are very acidic to taste. Nevertheless, pharmaceutical and juice manufacturing industries can take advantage of these higher nutritional contents of unripe fruits of African star apple instead of the ripe fruits of the same species.

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