

Research Paper

Proximate and Heavy Metal Composition Studies of *Chrysophyllum Albidum* Seed Cotyledons as a Possible Animal Feed Additive

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The seed cotyledons of *Chrysophyllum albidum* were analyzed for phytochemical, proximate and heavy metal composition. The phytochemical analysis indicated the presence of saponins, tannins, phenols, flavonoids, terpenoids, and steroids. This showed that *C. albidum* is a potential source of bioactive molecule which could be used in the treatment of various diseases. Proximate analysis showed that *C. albidum* seed cotyledon is a relevant source of essential nutrients especially for carbohydrates, proteins, lipids, and fibre. Its low moisture content indicates that it would have a long shelf life. Heavy metal/composition analysis

indicated the presence of Lead (Pb) and Cadmium (Cd) which are poisonous heavy metals. The Lead level in the seed cotyledons is 0.0302 mg/dm³ which is significantly lower than 1.00 mg/dm³ threshold concentration, suggesting that the consumption of the cotyledons may be safe. However, Cadmium concentration level was 0.0079 mg/dm³ which is infinitesimally higher than 0.0075 mg/dm³ threshold concentration, suggesting that *C. albidum* seed cotyledons may be toxic and its ingestion injurious.

Keyword: Seed cotyledons, heavy metals, feed additive

INTRODUCTION

As human population continues to grow, there is a considerable worldwide interest in the utilization of lesser known plants as potential sources of human and animals feeds (Akubor *et al.*, 2013). Fruits are sources of minerals, fibre and vitamins which also provide essential nutrients for human health (Ali and Deokule, 2009).

African Star Apple (*Chrysophyllum albidum*) fruit is a large berry that contains up to five seeds that are flat in shape. The plant belongs to the family *Sapotaceae*. It could be ellipsoid, round or pear shaped. It has a milky sweet pulp that houses the seeds. When cut transversely it appears like an asterisk in the central core or like the pointed stars. Thus the name "STAR APPLE" (CENDARD, 1999). African Star Apple is one fruit of great economic value in tropical Africa due to its diverse industrial, medicinal and food uses. However, the use of *C. albidum* seeds remains traditional and the species not well utilized (Ajala and Adeleke, 2014).

Chrysophyllum albidum fruits present a high nutritional

value, rich in vitamin C, and this turns it into an excellent nutritional choice with a relevant correlation between quality attributes and flavor (Adisa, 2000). The nutritional quality of any feed or ingredient can be judged by its biological, chemical and physical content (Eddy and Udo, 2004). Chemical content has proven to be a very important tool in food chemistry because it tends to examine the nutritional quality based on the proximate composition of the food and feed which includes the protein, carbohydrate, lipid, moisture, ash and dietary fibre contents respectively (Ajayi and Ifedi, 2015). Essential nutrients reported to be present in the seed Viz K, P, S, Ca, Mg, Al, and Zn (Chukwuemeka, 2006). The juice from the seed and root when applied on the fresh wounds, inhibited microbial growth of known wound contaminants and accelerates wound healing process (Okoli and Okere, 2010). It has also been reported that replacement of maize by *Chrysophyllum albidum* seed flour in the diets of *Clarias gariepinus* fish significantly

reduced the growth and nutrient utilization by *Clarias gariepinus* (Jimoh and Olajidi, 2004). Another study reported that the replacement of corn bran by *Chrysophyllum albidum* seed flour in rat diet formulation with other supplements significantly increased the weight of the rats (Ajayi and Ifedi, 2015). The extracts of the seeds and roots of *C. albidum* are good potentials as anti-inflammatory, anti-diarrheal and anti-hemorrhoidal compounds (Okoli and Okere, 2010). Cotyledons from the seeds *C. albidum* are used externally as ointments in the treatment of vaginal and dermatological infections traditionally in Western Nigeria (Okoli and Okere, 2010). The cotyledons have also been reported to possess anti-hyperglycemic and hypoglycemic effects (Olorunnisola *et al.*, 2008), antimicrobial activity (Idowu *et al.*, 2003), anti-nonceptive, anti-inflammatory and antioxidant activities (Idowu *et al.*, 2006), and antiplatelet effect (Adebayo *et al.*, 2010). Other previous studies carried out on the seeds have reported its food value (Amusa *et al.*, 2003), physical properties (Oyelade *et al.*, 2005), potent antimicrobial and additive in agricultural feeds (Akin-Osanaiye *et al.* 2018), use of the seeds kernel for the removal of metal ions (Ugboju and Akukwe, 2009) and the antimicrobial effect of oil from *C. albidum* seeds against some local clinical bacteria isolates (Oboh *et al.*, 2009). Reported toxicological evaluation of *C. albidum* when included in rat diet formulation showed no significant differences in the haematological and biochemical parameters of blood and also histopathological examination of the liver kidney and heart sections showed no visible lesion in the *Albino* rat (Onyeka *et al.*, 2012). The study aimed to determine the proximate and heavy metal composition of *chrysophyllum albidum* seed cotyledons and its possible use as a feed additive.

MATERIALS AND METHODS

Sample preparation and extraction

The fresh sample of *C. albidum* seeds were collected from Oyo state, Nigeria. The seeds were washed and air dried at room temperature three times and subsequently deshelled. The cotyledons obtained were air dried at room temperature and later pulverized using electric blender. 86.96 g of the powdered sample was subjected to cold maceration for 48 h using 99% ethanol. The extract obtained was concentrated using rotary evaporator and subsequently weighed. The 18.26 g crude extract gotten was later partitioned using n-hexane and 99% ethanol. 7.13 g and 2.09 g of ethanol and n-hexane crude extracts were obtained respectively. These samples were subjected to phytochemical, proximate analysis, and heavy metal analysis according to Udo and Oguwele, (1986); James, (1995) and AOAC (1990) respectively.

RESULTS AND DISCUSSION

The results of the phytochemical, proximate and heavy

metal composition studies of *Chrysophyllum albidum* seed cotyledons are shown in (Tables 1, 2, and 3) respectively. The phytochemical analysis showed the presence of Tannins, Phenols, Saponins, and Steroids in ethanol extract. The analysis indicate positive for Saponins, Steroids, and Flavonoids in n-hexane extract. Tannins are noted for astringency and bitter taste, hasten healing of wounds and inflamed mucus membranes (Duke, 1992) Herbs containing tannins as part of their phytochemical content are used in the treatment of intestinal disorders such as diarrhea and dysentery (Duke, 1992), therefore exhibiting antimicrobial activity (Duke, 1992). Tannins have also been observed to possess anticancer activities and cancer prevention abilities. Therefore suggesting that *C. albidum* could be a possible source of important bioactive compounds for the prevention and treatment of cancer. Tannins have also been studied to possess antioxidant potencies (Duke, 1992). Saponins have been reported to possess anti-inflammatory activities, haemolytic activity, and cholesterol binding properties (Sadipo and Akiniyi, 2000). Possible antimicrobial mechanism of Saponins involves reducing glucose utilization efficiency in micro-organism, therefore inhibiting their growth and proliferation thereby minimizing the activities of major enzymes in physiological metabolism and deactivating the synthesis of important proteins and finally eliminating the microbial activity (Yu *et al.*, 2013). Phenols have been observed to reduce DNA damage and oxidative stress (Lim *et al.*, 1998). Phenolic compounds are important electron donors which can permanently stop the free radical chain reaction by converting the free radicals to stable products (Hao *et al.*, 2007). Flavonoids are effective super-antioxidants and free radical scavengers. They inhibit oxidative cell damage, possess potent anticancer activity and prevent mechanisms of carcinogenesis (Salah *et al.*, 1995). Flavonoids in intestinal tracts reduce risk of cardiac disease, inflammation and represent the most abundant groups of plant phenolic compounds (Oranusi *et al.*, 2015). The scavenging activity of phenolic flavonoids such as Quercetin has been reported to appreciably reduce water induced reactive oxygen increment has been observed to deactivate oxidative rearrangement of low density lipoprotein and cytotoxicity of low density lipoprotein (Rao *et al.*, 2003). Flavonoids also deactivate cyclooxygenase, leading to lower platelet aggregation and decreased thrombotic tendencies (Rao *et al.*, 2003).

Proximate analysis

The proximate analysis of *C. albidum* seed cotyledons was carried out to determine the level of essential nutrients present in the cotyledons of *C. albidum* (Table 2).

Moisture content

The percentage moisture content of the seed cotyledons obtained from the analysis was 8.86%. This value is

Table 1. Phytochemical screening of *C. albidum* seed cotyledons.

Phytochemical constituents	Ethanol extract	n-Hexane extract
Tannins	+ve	-ve
Phenols	+ve	-ve
Saponins	+ve	+ve
Steroids	+ve	+ve
Terpenoids	-ve	-ve
Flavonoids	-ve	+ve

Keys: +ve = present, -ve = absent

Table 2. Proximate analysis results of *C. albidum* seed cotyledons.

Parameters	<i>C. albidum</i> seed cotyledons %
% crude proteins	6.97±0.02
% crude fibres	1.84±0.02
% crude lipids	11.08±0.01
% Ash	1.87±0.02
% Moisture	8.86±0.03
% Carbohydrate	69.38

The values are means +SD of triplicate analysis.

Table 3. Heavy metal composition results from elemental analysis.

	Lead (Pb) Conc. (mg/dm ³)	Cadmium (Cd) Conc. (mg/dm ³)
Sample	0.0302	0.0079
Threshold	0.1	0.0075

slightly lower than 9.0% and 9.39% reported by Akubor *et al.* (2013) and Damilola *et al.* (2016) respectively. The value is significantly lower than 24.17% reported by Florence *et al.* (2015). The low moisture content of the seed cotyledons would enhance its storage stability by inhibiting mould growth, decreasing moisture dependent biochemical reactions (Onimawo and Akubor 2012).

Crude fibre content

The percentage crude fibre content of the seed cotyledons discovered after the analysis was 1.84%. The value is higher than 1.36% reported by Florence *et al.* (2015) but slightly lower than 2.80% and 2.96% reported by Akubor *et al.* (2013) and Damilola *et al.* (2016) respectively. Fibre has been reported to prevent heart diseases, diabetes, and colon cancer. Fibre also contributes to treatment of digestive disorder (diverstickulosis) and constipation (Anderson *et al.* 1994).

Crude protein content

The percentage protein observed from the analysis of *C. albidum* seed cotyledons was 6.97%. This value is significantly higher than 4.50% and 2.45% previously reported by Akubor *et al.* (2013) and Florence *et al.* (2015) correspondingly. But significantly lower than 13.14% reported by Damilola *et al.* (2016). Protein is essential nutrient for repair of worn out tissues and provide support for cells.

Crude lipid content

The percentage lipid discovered from the proximate analysis was 11.08%. This is significantly higher than 0.82%, 7.80%, and 9.30% reported by Damilola *et al.* (2016), Florence *et al.* (2015) and Akubor *et al.* (2013) respectively. Fat is an important source of energy, protect internal tissues and play a role in essential cell processes. It also increases transport of fat soluble vitamins.

Ash content

The percentage ash content of *C. albidum* seed cotyledons obtained from the proximate analysis was 1.87%. This is higher than 1.40% reported by Florence *et al.* (2015), but slightly lower than 2.62% and 3.80% reported by Damilola *et al.* (2016) and Akubor *et al.* (2013) correspondingly. Ash content shows the amount of mineral present in the samples.

Carbohydrate content

The percentage carbohydrate observed from the proximate analysis of the seed cotyledons was 69.38%. This value is significantly higher than 60.39% previously reported by Florence *et al.* (2015). But infinitesimally lower than 70.60% and 71.40% respectively reported by Akubor *et al.* (2013) and Damilola *et al.* (2016). Carbohydrate is an excellent source of energy.

Heavy metal composition analysis

The seed cotyledons showed the presence of Lead (Pb) and Cadmium (Cd) which are known to be heavy metals. Lead is known to cause kidney damage. It also causes nephropathy and cause Fanconi syndrome in which the proximal tubular function of the kidney is impaired. Lead also cause high blood pressure. Cadmium causes respiratory tract and kidney problems. Impairment of pulmonary function with obstructive changes, it may also cause renal dysfunction with both tubular and glomerular damages with resultant proteinuria. The concentration of lead was obtained from the elemental analysis was 0.0302 mg/dm³ which is significantly than the maximum consumable concentration (threshold) of 1.0 mg/dm³. This indicates that the seed cotyledons with regards to Lead poisoning are safe for consumption. However, Cadmium concentration observed from the analysis was 0.0079 mg/dm³ is infinitesimally higher than the maximum consumable concentration (threshold) of 0.0075 mg/dm³. Thus accumulation of this concentration over a long time may have adverse effect on some internal organs in human body. Therefore *Chrysophyllum albidum* seed cotyledons are not safe however *C. albidum* seed cotyledons may be used as bio-indicator for heavy metals (Table 3).

Conclusion

The proximate analysis showed that *Chrysophyllum albidum* seed cotyledons are good source of nutrients. However the heavy metal analysis indicates the seed cotyledons is toxic, and its consumption on long term may cause several cases of Cadmium poisoning leading to deterioration and disorder of internal organs in humans.

Recommendation

The *Chrysophyllum albidum* seed cotyledons have shown a plausible nutritional value as evidenced by the result of its proximate analysis. However since these studies also report a high cadmium concentration, a more detailed analysis of the heavy metal constituents of the seeds is recommended as well as a detailed toxicity analysis on animals vital organ

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