International Scholars Journals

International Journal of Food Safety and Public Health Vol. 7 (1), pp. 001-004, January, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Preliminary Studies on *Piliostigma thonningii* seeds: Proximate analysis, mineral composition and phytochemical screening

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Accepted 17 October, 2019

Qualitative determination of chemical and nutritional composition of *Piliostigma thonningii*, *an* underexploited crop seed in Nigeria, was carried out. Seeds of *P. thonningii* were found to be rich in crude protein, carbohydrate, and mineral elements. Mineral analysis of *P. thonningii* showed the seed as good source of antioxidant micronutrients such as iron, calcium, selenium, zinc and manganese. The phytochemical screening of the seed showed the presence of saponins, flavonoids, phenolics, glycosides, anthraquinones as well as cardiac glycosides while tannins, steroids, phylobatannins and triterpenes were absent. Although the oil has a very low peroxide value and high iodine value, it cannot be recommended for consumption because of the low yield as well as its repulsive odour. The seed, however, can serve as a cheap source of protein, energy, as well as antioxidant micronutrients supplements in both man and animal.

Key words: *Piliostigma thonningii*, proximate composition, phytochemical screening, antioxidant micronutrients.

INTRODUCTION

Piliostigma thonningii is a leguminous plant belonging to the family *Caesalpiniacea*, a family that comprises of trees, shrubs or very rarely scramblers. The tree is perennial in nature and its petals are white to pinkish colour produced between November and April. While the fruits, which is a hairy, hard, flattish pod turns rusty brown, woody and twisted which splits at ripening and usually persistent on the tree are produced between June and September (Lock and Simpson, 1999) .

Locally, the seed is called Abefe in the Yoruba land (Nigeria). Other names include Monkey bread, Camel's foot, Kalgo (Hausa) and Okpoatu (Ibo). *P. thonningii* grows in open woodland and savannah regions that are moist and wooded grassland in low to medium altitudes. It is widely distributed in Africa and Asia. It is found growing abundantly as a wild uncultivated tree in many parts of Nigeria such as Zaria, Bauchi, Ilorin, Plateau, Lagos and Abeokuta (Schultes and Hofmann, 1973; Djuma, 2003).

The seeds of *P. thonningii* fruits have been reported to be eaten by African antelope and elephant while farmers in the lower Savanna region grind up the seed as fodder for cattle during winter months (Djuma, 2003). Although considerable information now exists on the nutrient composition of most well known and easily cultivated legumes in Nigeria, no information could however be obtained concerning the nutritional properties of this seed which is not cultivated but not well known. Moreover, different parts of *P. thoningii* have also been described as useful medicinally (Djuma, 2003). Its root and twig have been used for the treatment of dysentery, fever, infections, respiratory ailments, snake bites, hookworm and skin diseases. Despite this medicinal usefulness, no information could be obtained as regards the phytochemical chemical screening of this plant. The purpose of this work therefore was to chemically evaluate the nutrient composition of *P. thonningii* seeds as well as its phytochemical composition.

MATERIALS AND METHODS

P. Thonningii plant and seeds were identified at the Botany Department of the University of Ilorin, Nigeria. All samples were harvested as one batch on the Campus of the University of Ilorin, Nigeria during the harmattan season of 2002. The seeds were

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collected by hand after disrupting the pods. Dried seeds were subsequently milled into powder and stored in air-tight stopped glassware before analysis was carried out on it.

A portion of the milled sample soaked in petroleum ether (b. p. 40 - 60°C) at room temperature (25°C), and shaken for 36 h with several changes of solvent (4 times). Evaporation of the petroleum ether was performed using a rotary evaporator on a water bath for 1 h. The oil produced was stored in a refrigerator at 4°C in dark tightly stoppered glass until analysis.

The defatted flour was air-dried at room temperature (~25°C) and shaken for 36 h. It was further shaken in a vacuum oven at 50°C for 2 h followed by further grinding to powder to obtain fine flour. The flour was placed in airtight-stoppered glassware before analysis.

Chemical analysis

Chemical composition of *P. thonningii* seed was determined using the AOAC methods (1990). Moisture (method 14:004), total ash (method 14:006), crude fibre (method 14.020), total fat (method 7.056) and protein (method 2.057) were assayed and CHO was obtained by difference (FAO, 1985). The energy content of the seed was calculated using the Bradbury's equation.

Mineral contents of defatted flour

Samples of defatted flour were digested by concentrated nitric acid and perchloric acid (1:1v/v). Na, Ca and K were estimated using emission flame photometer, while Mg, Fe, Zn, Mn and Cu were determined using atomic absorption spectrophotometer using standard methods.

Phytochemical screening

The presence of tannins, phenolics, glycosides, saponins, flavonoids, steroids, phlobatannins and triterpenes were detected by the method described by Odebiyi and Sofowora (1978).

Physicochemical characteristics of the oil

The free fatty acids, acid value, peroxide value and iodine value of the oil sample were determined according to AOCS (1973).

RESULTS AND DISCUSSION

The proximate compositions of *P. thonningii* are presented in Table 1. The lipid content recorded the lowest (1.42 ± 0.03%) amongst the nutrient composition while the crude fibre was found to be the highest (35.03 ± 0.11%). Legumes, except the oil legumes, have been reported to be low in fat content ranging from 1-5%. However oilseeds have a range of lipid contents from about 18% in soyabean to as high as 43% in groundnut (Apata and Ologhobo, 1994; Ene-Obong and Carnovale, 1992; Swaminathan and Jain, 1973). This implies that *P. thonningi* is not an oil seed.

The level of dietary fibre is quite high when compared with that of most legumes and seeds (Elegbede, 1998). Although crude fibre enhances digestibility, the presence of high fibre levels in diet can cause intestinal irritation, lower digestibility and overall decreased nutrient utilization (Oyenuga and Fetuga, 1975; Johns, 1987).

Table 1. Proximate composition of *Piliostigma thonningii* seeds.

Component	Value (% composition)
Moisture content	6.71 ± 0.04
Ash	3.50 ± 0.04
Crude protein	30.33 ± 0.31
Crude fibre	35.03 ±0.11
Lipid	1.42 ± 0.03
CHO	23.00 ± 0.24

Table 2. Mineral composition of *Piliostigma thonningii* seeds.

Minerals	Concentration (ppm)
Fe	781.70±232.90
Se	3.3 ± 0.40
Ca	43.11 ± 0.34
Zn	0.016 ±0.06
Mn	1.00 ± 0.02
P	0.02 ± 0.01

Of all legumes, soyabeans are the richest in terms of protein content (43%), while others have protein content ranging from 20 - 25% (Apata and Ologhobo, 1994; Ene-Obong and Carnovale, 1992; Swaminathan and Jain, 1973) The high crude protein content of *P. thonningii* seed (30.33± 0.31%) coupled with the fact that it is abundant in this part of the world may encourage its use as high protein sources in some food formulations.

The moisture content of *P. thonningii* (6.71 ± 0.40%) is lower than that of most legume seeds (Giani, 1993; Temple et al., 1991). This implies that the shelf life for this seed will likely be longer than that of most legumes.

The ash content of 3.50 ± 0.04% for this seed is comparable with that of other legumes which has been reported to range between 3.0 and 4.8% (Elegbede, 1998). While the carbohydrate content (23.00 ± 0.24%) is at the lower side when compared with that of other legumes ranging from 23% in groundnut to 66% in Bambara groundnut (Apata and Ologhobo, 1994; Ene-Obong and Carnovale, 1993).

The level of iron amongst all minerals analyzed was found to be the highest (Table 2). This might be of nutritional importance especially in the part of the world where anaemia and iron deficiency is relatively rampant. *P. thonningii* seed are also good sources and of calcium (43.11 ppm) while zinc (0.016 ppm), manganese (1.00 ppm) and phosphorus (0.02 ppm) levels were quite low then compared with iron and calcium but comparable with values reported for some legumes (Elegbede, 1998). Iron, selenium, zinc and manganese are

Table 3. Phytochemical screening of *Piliostigma thonningii* seeds.

Phytochemical component	Result
Saponins	Present
Tannins	Absent
Steroids	Absent
Flavonoids	Present
Phylobatannins	Absent
Phenolics	Present
Glycosides	Present
Anthraquinone	Present
Triterpenes	Absent
Cardiac glycosides	Present

Table 4. Physicochemical characteristics of the oil obtained from *Piliostigma thonningii* seeds.

Properties	Values
Acid value	13.73±1.40
Iodine value	50.76 ± 1.80
Peroxide value	1.08 ± 0.08
Colour	Green
Odour	Repulsive

antioxidant micronutrients (Talwar et al., 1989) and their presence could therefore boost the immune system.

The phytochemical screening of the seed (Table 3) showed the presence of saponins, flavonoids, phenolics, glycosides, anthraquinones as well as cardiac glycosides; while tannins, steroids, phylobatannins and triterpenes were absent. Some of these chemical compounds have been reported to have inhibitory effects on some gram-negative bacteria such as *Escherichia coli* and *Bacillus subtilis* amongst others (Kamony, 1995). They also have prominent effects on animal systems and microbial cells (Liu et al., 1990; Topcu et al., 1993; Oyagade et al., 1999). The presence of these chemical compounds therefore suggests the pharmacological activities of *P. thonninggi*. Saponins are glycoside components often referred to as "natural detergent" because of their foamy nature (Seigler, 1998). Saponins in seeds have been known to posses both beneficial and deleterious properties depending on its concentration in the sample (Seigler, 1998; Oakenful and Sidhu, 1989). Seigler (1998) reported that saponins have anticarcinogenic properties, immune modulation activites and regulation of cell proliferation as well as health benefits such as inhibition of the growth of cancer cells and cholesterol lowering activity. The concentration of saponins in *P. thonningii* need therefore be ascertained. Flavonoids have been reported to exert multiple biological effects including antibacterial, antiviral, antitoxic and anti-inflammatory activities (Cook and Samman, 1996). Many of these alleged effects of flavonoids have been linked to their known functions as strong antioxidants, free radical scavenger and metal chelators (Torel et al., 1986; Nakayama et al., 1993). The positive effects of glycosides and cardiac glycosides are not common but their toxic effects include decreased heart rate, decreased sympathetic activity and decreased systemic vascular resistance (Seigler, 1998). The presence of some of these antinutrients could however be reduced by various processing techniques (Elegbede, 1998)

Some of the physiochemical properties of the crude oil extracted from P. thonningii seed are shown is Table 4. The oil of *P. thonningii* had a lower iodine value compared with that of watermelon, pumpkin and paprika seed oil (El- Adawy and Taha, 2001), thus reflecting a lower degree of unsaturation. Although this implies better stability or shelf life due to the fact that it will be more resistant to oxidation, it also implies that it may not contain a high percentage of essential fatty acids (Gurr and James, 1975) . The peroxide value was found to be low. The codex Alimentations commission (1982) stipulated a permitted maximum peroxide level of not more than 10 mequivalent of peroxide oxygen/kg of oil. The colour and odour of the oil were green and repulsive, respectively. This, in addition to the low oil yield, will not enhance the use of the oil for domestic purposes. It is worthwhile to indicate that there are no data in the literature of the chemical and physical properties of *P. thonningii* seed oil for comparison.

In view of the present study, it would appear that if the levels of antinutrients components are ascertained and appropriate methods applied for their reduction/removal, *P. thonningii* could be utilized as a cheap source of protein, energy, minerals and antioxidant supplement for both man and/or livestock.

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