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Comparative Phytochemical Screening and Nutritional Potentials of the Stems, Leaves and Flowers of *Allamanda Cathartica* (Apocynaceae)

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ABSTRACT

Phytochemical screening and nutritional potentials of the stems, leaves and flower of *Allamanda cathartica* were investigated. The phytochemical screening revealed the presence of tannins, flavonoids, saponins, terpenes, anthraquinones, cardiac glycosides and the absence of alkaloids in all three parts. Quantitative evaluation of the stems, leaves and flowers of *Allamanda cathartica* revealed moisture content (%) 1.50, 3.0, 1.0; Ash content (%) 2.0, 4, 0.5; protein (%) 1.50, 6.80, 2.50; Fats (%) 2.0, 3.0, 5; crude fibre (%) 24.0, 23.20, 22.0; carbohydrate (%) 72.0, 60.0, 69.0 respectively. The result of this study proves that *Allamanda cathartica* contains bioactive compounds that may be useful in nutrition and in the synthesis of various therapeutic drugs, and also suggests the popular use of *Allamanda cathartica* in herbal medicine.

Keywords: *Allamanda cathartica***,** phytochemical, proximate, stems, leaves and flowers.

1. INTRODUCTION

Medicinal plants are groups of plant which in one or more of its parts contain substances that can be used for the synthesis of useful drugs. Plants have been used as medicines since the beginning of human civilizations and have been a source of treatment of the common day ailments [1]. Stuffness and Dovros [2] reported that 50% of all modern chemical drugs are of natural product origin. The usage of plants as medicine still presents a very important phenomenon in the traditional medicine which is imbedded in the culture of people of developing countries [3, 4]. It is on this basis that researchers keep on working on medicinal plants in order to produce and develop the medicines for physiological uses. *Allamanda cathartica* is the most beautiful ornamental plant to have, yet what lies beneath its beauty is the amazing fact that it has both medicinal value and if not properly prepared can be toxic at the same time [5]. *Allamanda cathartica* also known as golden trumpet may reach a free-standing height of 2m and an extension of 5m or more. The species also climbs a few meters into the crowns of fall bush and low trees. Older plant of *Allamanda cathartica* often has multiple stem from the root crown and long stems with relatively few branches. The bark of the lower stems is brown and porrowed. The stems and twigs exude a milky sap when cut. The leathery, yellow-green to dark green leaves grow in whorls of three or four, or are sometimes opposite.

The leaves are 6 to 16cm long, pointed at both ends and have entire margins and short petioles. The bright yellow flowers are 5 to 7.5cm across. Flowers of cultivated varieties are often layer and may be coloured white, cream, pink, purple or orange. Capsules which rarely occur in cultivated varieties are 4 to 6cm in diameter and densely prickled. There are 2n = 18 chromosomes [6]. *Allamanda cathartica* is a native of tropical South America, from Peru and Columbia eastwards to French, Guiana and Brazil. It has been recorded in Central America as far North as Honduras. It is widely cultivated as ornamental plant in gardens throughout the country. *Allamanda cathartica* is a perennial shrub used in traditional medicine for treating malaria and jaundice. The extension and incision models are used to evaluate the wound-healing activity of *Allamanda* and *Laurus nobilis* [7].

According to Tsuchiya *et al.* [8], traditional society in Africa such as Suriname uses this plant to relieve coughs. The leaves are boiled and the vapour is inhaled to clear the nasal passage. The extract of *Allamanda cathartica* leaves, stems and flower have been shown to have in-vivo anti-tumor activities against leukemia in mice and against human carcinomamia of the nasopharynx in culture [9]. Leaf and root decoction of *Allamanda cathartica* are used as a laxative and emetic in traditional medicine in a number of tropical countries but large doses are toxic [7]. All parts of the plant contain allamandin, a toxic iridoid lactone. The leaves, root, flowers maybe used in the preparation of a powerful cathartic (hence the name); the milky sap is also known to possess antibacteria and possibly anticancer properties. Decoction of leaves in small doses used as antidote for poisoning. Infusion of leaves in moderate doses is an excellent cathartic; in considerable doses, it is purgative and a violent emetic [10].

Moreover all parts *Allamanda cathartica* are reported poisonous and hence the plant has not been extensively used in medicine. Processing this plant as an herbal remedy is not recommended to any one by people who have little or no experience in alternative medicine. *Allamanda cathartica* can also be used in the treatment of liver tumors [11]. Golden trumpet vine is widely cultivated as an ornamental. In some areas of the tropics, it has escaped from cultivation and becomes as weed, most notably in the rain forests of northern Queensland. *Allamanda cathartica* as spectacular flowering shrubs for hedges and screens in gardens, parks and public places. They are suitable too for landscaping along

roadside and highway medicine. Ideal to be as a vine with support at porches on treallis, arbors, fences and trees, as well as espaliered on a wall or cascade down a garden wall. It can be grown as a container plant especially for greenhouses or to overwinter indoors in freezing climate [12]. The seed of these yellow bells contain oil which can be used as fuel which can also be a substitute to kerosene. Its lighting efficiency gives a brighter effect when used as fuel for lamp. It emits less soot as compared to kerosene. The oil can be produced with the minimum of efforts and is considered cheap [13].

Rapini and Fabiana [14] conducted an investigation on roots and reported to be diuretic, tonic, anti-syphilitic and vermifuge. They also reported that the decoction of flowers and bark can be used for stomach pains. Moreover, the leaves of *Allamanda cathartica* have been reported to be efficacious in the treatment of malaria, snake bites, jaundice, and coughs [7]. Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. Plants produce these chemicals to protect itself but research work demonstrates that many phytochemicals can protect humans against disease [15, 16]. Knowledge of chemical constituents of plants is desirable because such information will be of value for the synthesis of complex chemical substances.

Several workers have discussed the use of phytochemical screening. Dahanukar *et al*. [17], Essiett and Akpabio [18] and Sofowora [19] reported that phytochemical are the study of organic substances that accumulate plants due to their chemical structure, natural and biological functions. According to Sofowora [20] the phytochemical analysis is non nutritive plant chemicals that have protective properties. Fluoroperin, another iridoid present in plants of the genus *Allamada*, demonstrated antifungal, antileukemic, antimicrobological and anti-HIV properties [21, 22]. The present study was undertaken to establish the chemical constituents of the stem, flowers and leaves of *Allamanda cathartica* which would eventually be useful in preparing a monograph of the plant for identification and determine the different bioactive agent in the stem, flowers and leaves of *Allamanda cathartica* and dietary awareness of its nutritional status. The significance of the study is to prove that *Allamanda cathartica* has therapeutic uses for the synthesis of drugs and medicinal plants in developing countries.

2. MATERIALS AND METHODS

2.1 Collection and Identification of Plant

The plant *Allamanda cathartica* was collected on August 2012 from the State Secretariat in Uyo Local Government Area in Akwa Ibom State. The plant was identified by Dr. (Mrs) U. A. Essiett, a plant taxonomist in the Department of Botany and Ecological Studies, University of Uyo.

2.2 Extraction of Plant Materials

The leaves, stems and flowers of *Allamanda cathartica* were air dried under room temperature and powdered using pestle and mortar. The powdered leaves, stems and flowers were accurately weighed and then macerated cold in 50% ethanol and distilled water for 72 hours at room temperature following the method suggested by Sofowora [20]. The liquid extracts were recovered by filtration using cotton wool and glass funnel. The filtrate obtained was concentrated in a vacuo at 40°C to yield a semi-solid mass. The extract obtained was accurately weighed and then used for phytochemical screening [20, 23].

2.3 Quantitative Microscopy/Proximate Analysis

The moisture content of the powdered leaves was determined loss on drying method [24]. The ash value, acid insoluble ash, water-soluble ash and sulphated ash were determined as described by British Pharmacopeia [25], African Pharmacopeia [24]. The water and alcohol extractive values were obtained using the method outlined by Brain and Tuner [26], British Pharmacopeia [25]. The fat (lipids), crude protein, crude fibre and carbohydrate were obtained using the method outlined by Pearson [27], Okon [28] and AOAC [29].

3. RESULTS

The results of the phytochemical screening of the stems, leaves and flower of *Allamanda cathartica* are summarized in Table I. The stems, leaves and flowers of *Allamanda cathartica* reveals the absence of alkaloids in all the three parts of *Allamanda cathartica*. Flavonoids was moderately present in the leaves and flowers but traces were present in the stem. However, saponins were moderately present in the stem of *Allamanda cathartica* but traces were found in the leaves and flowers. Tannins were moderately present in the three parts of *Allamanda cathartica*. Terpenes were abundantly present in the stem, leaves and moderately present in the flowers. Also Anthraquinones were present abundantly in all three parts. Cardiac glycoside (Salkowski test) was abundantly present in stems, leaves and flowers. Killer Killian test was found in traces in stem and flower but was moderately present in leaves. Lieberman's test was moderately found in the stem and flower but traces were present in leaves.

The quantitative evaluation of the stems, leaves and flowers of *Allamanda cathartica* are as follows:- Moisture content (%) 1.0, 1.50, 3.0, ash content (%) 0.5, 2.0, 4, sulphated ash (%) 0.009, 0.008, 0.0001 and acid insoluble (%) 0.0007, 0.0008, 0.0005 respectively (Table 2). The nutritional analysis of the stem, leaves and flowers of *Allamanda cathartica* were: protein (%) 2.50, 1.50, 6.80; fats (%) 5, 2.0, 3.0, crude fibre (%) 22.0, 24.0, 23.20; carbohydrate (%) 69.0, 72.0, 60.0 respectively (Table 3). The anti-nutritional analysis of the stem, leaves and flowers of *Allamanda cathartica* were: Tannin acid (%) 0.017, 0.215, 0.012; oxalate (%) 0.004, 0.001, 0.002; phytate (%) 0.003, 0.0009, 0.001 respectively (Table 4).

Table 1: Results of Phytochemical Screening Metabolites of Stems, Leaves and Flowers of *Allamanda cathartica*

Metabolites	Inferences		
	Stems	Leaves	Flowers
Alkaloids	-	-	-
Flavonoids	+	++	++
Saponins	++	+	+
Tannins	++	++	++
Terpenes	+++	+++	++
Anthraquinones	+++	+++	+++
Cardiac glycosides			
a) Salkowski test	+++	+++	+++
b) Keller killiani test	+	++	+
c) Lieberman's test	++	+	++

Legend: - = Absent, + = Trace, ++ = Moderate, +++ = Abundance

Table 2: Result of Quantitative Evaluation of the Stems, Leaves and Flowers of *Allamanda cathartica*

Evaluation parameters	Values (% W/W)		
	Stems	Leaves	Flowers
Moisture content	1.50	3.0	1.0
Ash content	2.0	4	0.5
Sulphated ash	0.009	0.008	0.0001
Acid insoluble	0.0007	0.0008	0.0005

Table 3: Result of Proximate Analysis of Nutritional Evaluation of Stems, Leaves and Flowers of *Allamanda cathartica*

Evaluation parameters	Values (% W/W)		
	Stems (%)	Leaves (%)	Flowers (%)
Protein	1.50	6.80	2.50
Fats (lipids)	2.0	3.0	5
Crude fibre	24.0	23.0	22.0
Carbohydrate	72.0	60.0	69.0

Table 4: Result of Anti-nutritional Analysis of the Stems, Leaves and Flowers of *Allamanda cathartica*

Evaluation parameters	Values (% W/W)		
	Stems	Leaves	Flowers
Tannin acid	0.017	0.215	0.012
Oxalate	0.004	0.001	0.002

Phytate	0.003	0.0009	0.001

4. DISCUSSION

The phytochemical screening of the stems, leaves and flowers of *Allamanda cathartica* shows the presence of Tannins, Saponins, Flavonoids, Terpenes, Anthraquinones, Cardiac glycosides. They were known to show medicinal activity as well as exhibiting physiological activity [20]. The presence of tannins which was moderate in the three parts of *Allamanda cathartica* shows that this plant is capable of controlling the ferocity of diarrhea and can also reduce irritations. Saponins are responsible for its antimicrobial, antifungal, anti-inflammatory, anti-yeast and antidote activities. The role of Saponins in the plants serves an anti-feedant and to protect the plant against microbes and fungi [30]. The presence of flavonoids suggests that the plant might induce mechanisms that affect cancer cells and inhibit tumor invasion [31]. Essiett *et al*. [32] reported that many plants containing flavonoids are diuretic and are antioxidant, the leaves and stems of these plants can be equally applied in each case. Terpenes which were also present shows that the plant is a rich source of essential oil. Essential oil can be used as natural flavor additives for food, as fragrance in perfumery and in traditional and alternative medicine such as aeromatherapy [33]. The presence of anthraquinones which was abundant in the three parts are reported to have antioxidants, antimicrobial, antiviral, hypotensive, analgesic, laxative, antimalaria and anti-tumor activities [34]. Cardiac glycosides were detected in the extracts of *Allamanda cathartica* and are reported to be useful in the treatment of asthma [15].

Quantitative evaluation is an important parameter in setting standard for crude drugs [15]. The result of the moisture content in the stems, leaves and flowers of *Allamanda cathartica* that was not too high indicate less chances of microbial degradation of drugs during storage because excess moisture can result in the breakdown of important constituents by enzymatic activity and as a result may encourage the growth of yeast and fungi during storage [24], as such the moisture content of 1.50, 3.0 and 1.0% in the stems, leaves and flowers of *Allamanda cathartica* respectively. However, the general requirement for the moisture content in crude drugs was that it should not be more than 14%. Hence, with the values obtained it implies that the plant can be stored for a longer period with lower chances of microbial attack and growth. The total ash content was 2.0, 4.0 and 0.5% in the stems, leaves and flowers of *Allamanda cathartica* respectively. However, ash content is an indication of mineral content.

Acid insoluble ash value was 0.007, 0.0008 and 0.0005% in the stems, leaves and flowers of *Allamanda cathartica* respectively. This implies that a large portion of the ash content is acid insoluble and hence may be physiologically important as salts in the body when consumed. It is also indicative of high digestibility of the plant when eaten [35]. Sulphated ash value was 0.009, 0.008 and 0.0001% in the stems, leaves and flowers respectively shows that the three parts extracts is moderately pure, thus, sulphated ash is a good criterium used to judge the identity and purity of crude drugs.

Proximate analysis of food is the nutritional composition of that food. It is the estimate of the nutritive value of human food in its chemical form. The proximate analysis as shown shows that the protein content is relatively low in stem (1.5%) than in the leaves (6.8%) and flowers (2.5%) of *Allamanda cathartica* but it can contribute to the formation of hormones which controls the variety of body functions such as growth repairs and maintenance of body protein. The fat content of the flower (5%) was higher than that of the leaves (3%) and stems (2%) of *Allamanda cathartica* and the beneficial of high fat content that can be used for storage and transport forms of metabolic fuels. According to Omede *et al.* [36], high fat content can be exploited for nutritional advantage in health. Also, dietary fats functions in the increase of palatability of food by absorbing and retaining flavours. A diet providing 1-2% of its caloric of energy as fat is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular disorders such as atherosclerosis, cancer and ageing. The crude fibre content of the stem (24%) was higher than that of the leaves (23%) and flower (22%) of *Allamanda cathartica*. The carbohydrate content of the stems (72%) was higher than that of the flower (69%) and leaves (60%) of *Allamanda cathartica*. The relatively high carbohydrate content can be used as energy sources and also it is necessary in the digestion and assimilation of other food.

The result of this study revealed that there were anti-nutrients present in this plant parts of *Allamanda cathartica* and that there was slight variability in the quantity of this anti-nutrients. Tannin acid in the stems and flowers were 0.017 and 0.012% respectively. These values are lower to that of leaves, where the tannin content was recorded as 0.215%. Tannin is known to be bitter and form high polyphenol complex with protein thereby making it unavailable in the diet. Tannins may decrease protein quality by decreasing digestibility and palatability. Tannins are known to inhibit the activities of digestive enzymes and nutritional effects of tannins are mainly related to their interaction with protein [37, 38]. The result of total oxalate in the stems, leaves and flowers which were 0.004, 0.001 and 0.002% respectively were shown to have low values. Oxalates are regarded as undesirable constituents of the diet, reducing assimilation of calcium, favouring the formation of renal calculi [39]. The phylate contents of stems and flowers of *Allamanda cathartica* were 0.001 and 0.003% these values are lower than the leaves which were 0.0009%. The presence of phytic acid in food leads too inhibition of some minerals such as calcium [40]. Phytate can also affect digestibility by binding with substrates or proteolytic enzymes [41].

5. CONCLUSION

The present study demonstrated that the three parts of *Allamanda cathartica* have many beneficial effects with respect to the presence of the above secondary metabolites which are likely to combat many diseases. The phytochemical screening, nutritional analysis and quantitative evaluation which revealed the presence of saponins, tannins, flavonoids, terpenes, anthraquinones, cardiac glycosides, moisture content, ash content, Sulphated ash, Acid insoluble, protein, fat, fibre, carbohydrate Tannin acid, Oxalate, Phytate were not only used to search for bioactive agents but also serves as

starting product for the partial synthesis of some useful drugs. Therefore more research should be carried out on the stems, leaves and flowers of *Allamanda cathartica*.

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