

Chemical Composition of the Marc of a Wild Tropical Plant *Tacca involucrata* (Schumach and Thonn, 1827)

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Received 29 December 2014; accepted 10 January 2015; published 13 January 2015

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Abstract

Tacca involucrata (Batflower or Polynesian arrowroot) tubers are a stable food in tropics where it occurs. In central Nigeria, it is processed locally after digging it from the ground by peeling with sharp sand, grating and soaking in fresh water after which it is filtered and the filtrate is dried and is cooked with other ingredients. The marc, said to be bitter, is usually discarded by deep burial as it is considered poisonous to livestock and humans. All parts of the plant are used in folk medicine to treat various diseases. The aim of this work was to analyze quantitatively the phytochemical, elemental, vitamin and proximate composition of the marc of the tubers with a view of assessing its pharmacological and nutritional potentials. The marc was obtained from Jandeikyura Village in Wukari LGA of Taraba State, Nigeria, and was extracted with 80% methanol for 72 hr to give a yield of 10.1% w/w and was whitish in colour. Phytochemical analysis showed the presence of reducing sugars, tannins, flavonoids, steroids, glycosides and hydrogen cyanide at 195.65 ± 0.5 , 3.44 ± 0.2 , 1.29 ± 0.5 , 0.83 ± 0.4 , 1.36 ± 1.0 and 0.00985 ± 0.3 (mg/100g), respectively. The elemental analysis showed the presence of potassium, sodium, magnesium, selenium, manganese, vanadium and some heavy metals like lead, aluminium, arsenic and mercury at 36.45 ± 0.1 , 44.04 ± 0.1 , 1.52 ± 0.2 , 0.80 ± 0.9 , 0.52 ± 0.7 , 0.27 ± 0.7 , 0.07 ± 0.6 , 0.008 ± 0.05 , 0.085 ± 0.6 and 0.026 ± 0.6 (mg/100g), respectively. Vitamin analysis showed the presence of vitamins A, B1, B2, B3, C and E in various amount as 2.26 ± 0.8 µg, 0.83 ± 0.8 mg/100g, 0.58 ± 0.4 mg/100g, 0.33 ± 0.6 mg/100g, 9.80 ± 0.4 mg/100g and 6.86 ± 0.9 mg/100g, respectively. The proximate analysis showed the marc to contain moisture, ash, fats, fibre, crude protein and carbohydrate in the range of $10.83\% \pm 0.3\%$, $1.93\% \pm 0.6\%$, $1.06\% \pm 0.5\%$, $4.42\% \pm 0.4\%$, $6.12\% \pm 0.6\%$ and $86.07\% \pm 0.3\%$, respectively. This shows that despite the presence of hydrogen cyanide and some heavy metals in traces amount which are considered poisonous to livestock and humans, the marc contains some elements, vitamins, phytochemical and nutrients which are pharmacologically and nutritionally important.

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Keywords

Elements, Phytochemicals, Proximate, *Tacca involucrata*, Vitamins

1. Introduction

Disease and hunger are major problems of human and animal life that affect them in diverse ways. The two are interrelated such that hunger can lead to disease and *vice versa*. This is evident in the fact that there is an increase in dietary diseases among children and women, especially pregnant and lactating women when there is hunger in the community [1]. The increase in population, especially in the developing world, couple with conflicts, unstable agricultural policies and general lack of commitment to the welfare of the populace by various governments, have further compounded the problem of hunger and disease [2]. There may be no end to this twin problem of hunger and disease if concerted effort by all stakeholders is not made in this direction [3]. A lot of efforts are being made towards solving this twin problem especially that of hunger. According to some workers [4], though measures are being taken to boost food production by conventional agriculture, there exist a need to exploit the vast number of unconventional plants resources that exist in the wild. It has been reported that many of such plants have been identified but lack of data on their chemical composition has limited the prospect of their utilization [5]. Proximate analysis of some of the wild plants indicates that they can fill the gap of nutrition for man and animals [6].

In the tropics, the indigenous people do exploit these wild plants as a measure to avoid hunger and malnutrition. Evidence abound that most rural populations (where these edible wild plants exist) depend on them to meet their hunger and nutritional need [7] [8]. Despite the fact that these plants are consumed by the native population, some of them are known to contain some chemical factors that could be toxic to the body and can be a threat to health hence solving one and creating another problem when taken by humans or animals [9]. It is imperative therefore to have an understanding of the nutritional and chemical composition so as to appreciate their toxicity and ultimately encourage their cultivation and consumption.

Tacca involucrata (Schumacher and Thonn, 1827) is a flowering plant of the family Dioscoreaceae. It was formerly classified under the family Taccaceae until 2003 [7]. It is also called Batflower or Polynesian arrowroot. It is distributed from West Africa through South East Asia to Northern Australia. It was intentionally brought to tropical pacific island by early human migration [10] [11]. It is a perennial herb with a tuberous underground rhizome (bulb) from which arises two stems, a petiole 60 - 90 cm long bearing deeply lobed leaf blades consisting of three main segments, and an inflorescent borne on a long stalk 70 - 100 cm with small green flowers surrounded by six or more bracts and numerous thread-like puplish inner bractes [11] [12]. The fruit is an ovoid berry, smooth, about 3.5 cm long and greenish but turns yellowish when it is ripe and is usually being eaten by children [7]. The tubers are hard, 10 - 12 cm in diameter, brownish and potato-like and whitish inside [11].

Traditionally, the tubers are consumed in areas where the plant is found. In Nigeria, it is locally processed after digging from the ground by peeling with sharp sand, grating and soaking in fresh water. Thereafter, it is filtered and the filtrate is dried, cooked and served as a staple food among the people of this area.

Its infusion is used to treat hepatitis and sores of guinea worm infections. Roots and flower are used to treat snake bite. The fruits are eaten by children when they are ripe. It is also used for rituals and as an aphrodisiac by traditional rulers. The water from the grating is used as a detergent [7]. Recently it has been discovered that the marc of *Tacca* has antidiabetic effects [13].

Despite these numerous uses, the marc from the processed tubers is considered very poisonous to both human and animals such that it is usually discarded by deep burial or thrown far away from human settlement where it is assumed that domestic animals will not come in contact with. In the course of processing it is repeatedly washed as a local way of reducing the poison. Based on these facts above, this study was designed to look at the phytochemical, elemental, vitamins and proximate composition of the marc of the tubers that are considered as staple food and used in treating many disease conditions while its marc is treated with so much fear due to its purported poisoning. This is to give us a better understanding of the composition of the plant to enable us carryout further studies on it.

2. Materials and Methods

The plant material and the marc were obtained from Jandeikyura and Tse-Dzor villages in Wukari Local Government Area of Taraba State Nigeria. Some of the tubers were processed locally to get the marc while the remaining material was identified by Mr. Joshua Waya of the Department of Biological Sciences, Benue State University, Makurdi, Nigeria. The tubers were washed in a pool of water rubbing them on sharp sand to remove the outer cover which is very light, thereafter they were grated and water was added to submerge it. A piece of cloth used in filtering water was used to filter it and the filtrate allowed to sediment over night and decanted. The marc was dried in the sun to a constant weight and extracted with 80% methanol to give a yield of 10.5% w/w. Phytochemical analysis was carried out as described by [14] [15]. The following phytochemicals were analysed reducing sugars, tannins, alkaloids, saponins, flavonoids etc. Elemental analysis was carried out by atomic absorption spectrophotometry (AAS) method and vitamins analysis was carried out as described by Association of Official Analytical Chemists (AOAC) [16]. Vitamin A was estimated by colorimetric method. This involved reacting the extract with antimony trichloride that converts the vitamin into a coloured compound whose absorbance was measured and compared against a standard. Vitamin C was estimated by titrimetric method. The extract was titrated against the dye DPIP (2, 6-dichlorophenolindophenol). Vitamin C reduced this dye from blue to a colourless form. The dye was standardized against a solution of vitamin C of known concentration, then the extract was titrated and assayed. The B group and vitamin E were estimated by fluorimetric method. This is the method used in assaying vitamins that fluoresce. Vitamins that do not possess natural fluorescence are converted to fluorescent derivatives and determined. Proximate analysis was by Kjeldahl method and as described by [15]. The analysis consists of moisture, ash, fibre, fats/oil, protein and carbohydrate. This was done in line with the AOAC guidelines [16].

3. Statistical Analysis

Result was expressed as mean and standard error of mean. One-way analysis of variance (ANOVA) was used to compare means of variables where applicable.

4. Results

The phytochemical analysis of the marc of *Tacca involucreta* revealed the presence of reducing sugars, 195.65 mg/100g, saponins, 15.20 mg/100g, starch, 13.32 mg/100g, tannins, 3.44 mg/100g, alkaloids, 1.43 mg/100g, flavonoids, 1.29 mg/100g and steroids 0.83 mg/100g etc. in that descending order (Table 1).

The elemental analysis of the same marc indicated that it contain some heavy metals like lead 0.07 mg/100g, aluminium, 0.008 mg/100g, arsenic, 0.085 mg/100g, and mercury, 0.026 mg/100g. It also contain some pharmacological important trace elements like selenium, 0.80 mg/100g, manganase, 0.52 mg/100g, zinc, 1.599 mg/100g and chromium, 0.063 mg/100g etc. (Table 2).

The vitamin analysis showed that the marc of *Tacca involucreta* contain vitamin C 9.8 mg/100g, vitamin E, 6.86 mg/100g, vitamin A 2.26 mg/100g etc. (Table 3).

The proximate analysis also revealed the presence of carbohydrate 75.64%, moisture, 10.83, crude protein, 6.12%, fibre, 4.42% and fats 1.06% etc. (Table 4).

Table 1. Phytochemical analysis.

Parameter	Amount (mg/100g)
Reducing sugars	195.65 ± 0.5
Tannins	3.44 ± 0.2
Flavonoids	1.29 ± 0.5
Steroids	0.83 ± 0.4
Glycosides	1.36 ± 1.0
Hydrogen cyanide	0.00985 ± 0.003
Alkaloid	1.4275 ± 0.4
Starch (%)	13.320 ± 0.3
Saponnin	15.20 ± 0.05

Table 2. Elemental analysis.

Parameter	Amount (mg/100g)
Potassium	36.45 ± 0.1
Sodium	44.04 ± 0.1
Magnesium	1.52 ± 0.2
Selenium	0.80 ± 0.09
Manganese	0.52 ± 0.07
Vanadium	0.27 ± 0.07
Lead	0.07 ± 0.06
Aluminium	0.008 ± 0.005
Arsenic	0.085 ± 0.06
Mercury	0.026 ± 0.06
Iron	1.375 ± 0.3
Zinc	1.599 ± 0.5
Chromium	0.0627 ± 0.02
Phosphorous	6.669 ± 0.6
Copper	0.698 ± 0.04

Table 3. Vitamins analysis.

Parameter	Amount (mg/100g)
Vitamin A (µg)	2.26 ± 0.8
Vitamin B1	0.83 ± 0.02
Vitamin B2	0.58 ± 0.04
Vitamin B3	0.33 ± 0.06
Vitamin C	9.80 ± 0.4
Vitamin E	6.86 ± 0.9

Table 4. Proximate analysis.

Parameter	Amount (%)
Moisture	10.83 ± 0.3
Ash	1.93 ± 0.3
Fats	1.06 ± 0.05
Fibre	4.42 ± 0.04
Crude protein	6.12 ± 0.06
Carbohydrates	75.64 ± 0.25

Each value was taken in triplicate.

5. Discussion

From the result of the study as seen above, the marc of *Tacca involucrata* contains some important minerals, vitamins and phytochemicals that make it a good source of food for human and animal consumption.

Most of the phytochemicals present in *Tacca* marc like reducing sugars, flavonoids, tannin, steriods, alkaloid and saponnins have various nutritional, physiological and pharmacological uses in the body of individuals [1]

[14] [17].

Flavonoids and saponins are known to be antioxidant. They prevent the damage caused by free radicals to cells. They can mediate in most cases of chronic diseases such as cancer and diabetes. They also slow or even can stop the proliferation of cancer cells. [1] [14] [17]. Saponins also help in lowering cholesterol levels thereby preventing arteriosclerosis and hypertension. It is antitumor and antimutagenic [1]. Saponins also interfere with the metabolism of vitamin E and causes gastroenteritis manifesting in diarrhoea and dysentery. So with the high level of vitamin E in the marc this can be a potential source of toxicity.

The presence of hydrogen cyanide in the marc here shows that this can be toxic. Though it can be argued that the cyanide content here is low compared to the report of other workers. Ubwa [1] reported between 43 - 45 mg/kg of cyanogenic glycoside in *Tacca* peels. It is believed that processing normally reduces the toxicity of *Tacca* [7]. Therefore the process the *Tacca* marc underwent may be responsible for the low cyanide content in this study.

The elemental analysis showed that the marc contain some elements that have beneficial effect in the body. For example, Iron apart from being needed by blood carrying haemoglobin also help in immune responses [14]. Zinc, vanadium and manganese help in diabetes. While selenium in conjunction with vitamin E are good sources of antioxidant [17]. The host of other elements has a lot of beneficial effects in the body.

It can also be observed here that the marc of *Tacca* contain a reasonable amount of vitamins A, C, E which are all antioxidant vitamins these will have a positive effect on the body of humans and animals that consume it. Antioxidant normally scavenge the free radicals from reactive oxygen species in the body. Free radicals are incriminated in the pathogenesis of many chronic diseases like cancers, diabetes etc. [17]. *Tacca* also contain some traces of the B vitamins.

The proximate analysis also showed that it is a good candidate for nutrition with 76% carbohydrate, 6% protein, 4% fibre, 2% ash and about 1% fats. These figures are comparable with other workers like Ubwa [1] who found these to be 71%, 2%, 4% and 3% respectively, while Zuku [3] found them to be 88%, 2%, 0.2% and 0.1% respectively. High level of fibre in food help in treating constipation by expanding the inside walls of the colon, absorbing large amount of water resulting in softer and bulkier stool. It also lowers cholesterol levels in the blood and reduces the risk of cancers and other bowel diseases [1].

The marc also contain some heavy metals that can be toxic to the body of humans and animals like lead, arsenic, mercury, aluminium, etc. Some of the heavy metals like lead have been associated with poisoning in humans. A recent case of lead poisoning in Zamfara State, North Western Nigeria due to illegal mining. Though most of the heavy metals here do not exceed the recommended daily allowance by the American Chemical Society. The recommended daily allowance for most of these heavy metals is 0.1 mg/day. It can be observed that none of the heavy metal is up to that quantity per 100 g. From my interaction and experience with the plant I know that it is not possible for an individual to consume up to 100 g of the processed flower of *Tacca involu-crata* in one day.

6. Conclusion

It can therefore be seen that the marc of *Tacca involu-crata* has all the potentials of a good source of food for humans and animals, and it also contains some potential harmful phytochemicals and heavy metals that can be harmful to health and need to be processed well before consumption. Efforts are underway for more studies on the toxicological and pharmacological effects of the marc.

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