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Evaluation of the nutrient composition and hepatotoxic potential of *Thaumatococcus danielli*

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Abstract

The aim of this work was to evaluate the nutritional and hepatotoxic potential of leaf of *T. danielli*. Freshly harvested leaves of *T. danielli* was dried at room temperature, ground to fine powder. 500 g of powdered plant sample was soaked in 2 litres of 70% methanol for 72 hrs. The resulting extract was filtered and filtrate concentrated. Twenty adult male albino rats were divided into 4 groups of 5 rats per group.

- Group I: Normal control was fed with only normal rat diet and water ad libitum.
- Group II: Rats were administered with 200 mg/kg b.w of extract of *T.danielli* leaf orally.
- Group III: Rats were administered with 400 mg/kg b.w of methanol extract of *T.danielli* leaf orally.
- Group IV: Rats were administered with 600 mg/kg b.w of methanol extract of *T.danielli* leaf orally.

Nutrient composition of the leaf of *T. danielli* was determined using standard procedures. The proximate analysis on the leaf of the said plant revealed the presence of moisture, ash, fat, protein, fibre and carbohydrate with fat being more abundant (17.30±1.28%) than every other components and carbohydrate the least abundant (8.29±0.20%). However, analysis on the mineral composition, revealed the presence of calcium, phosphorus, potassium, zinc, sodium and iron. While calcium (7.20±0.23 g/ 100 g) was reportedly the most abundant of all elements, sodium was the least (0.40±0.03 g/ 100g). Evaluation of the vitamin composition of the leaf of *T. danielli* revealed the presence of vitamins A, B1, B3, B5, B6 and B12. B12 was the most abundant (8.32±0.42 g/ 100g) of the vitamins. The activity of serum hepatomarkers evaluated was not significantly (P>0.05) different from that reported on the control following oral administration of aqueous extract of *T. danielli*. In conclusion, the leaf of *T. danielli* contains vital nutrients and has no hepatotoxic effect.

Keywords: Nutrient; Proximate; Vitamins; Hepatomarkers; *Thaumatococcus danielli*

1. Introduction

The monocotyledonous herb *Thaumatococcus danielli* (Benn) Benth is predominantly found in the rain forests and coastal areas of West and Central Africa [1]. The plant, a large rhizomatous flowering herb which grows to 3-4 m in height is characterized by large papery leaves [2]. It bears pale purple flowers and a crimson coloured fruits containing a few shiny black seeds [2]. In Nigeria, it is popularly referred to as soft cane [3] and one of the neglected and underutilized plant species. It is known to grow widely in cocoa growing areas of Southwest Nigeria [4]. The plant is used as fetish plants in Gabon [5] and the aril a source of taumatin, a non-toxic and heat stable protein which is used as sweetener or taste modifier in beverages, desserts, chewing gums and pet foods [6].

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The leaves are mainly used for wrapping foods such as agidi, moimoi, ogiri etc in Nigeria and Ghana [7] and has been regarded as an alternative to packaging materials such as nylon and aluminum foil which are mainly used as packaging materials for the aforementioned food stuffs owing to it affordability and biodegradability. Safe packaging is critical to food safety, but this has not undermined by pitfalls that characterise the use of synthetic materials such as leaching and diffusion of substances like Bisphenol A and DEHA (diethylhexyl adipate) from plastics into food and consequently ill health results. Therefore, it is imperative to evaluate the potential contribution of the use of the leaf of *T. danielli* as a packaging material to food safety.

2. Material and methods

2.1. Collection and Preparation of Plant Materials

Mature leaves of *Thaumatococcus danielli* were obtained from a farm. The leaves which were authenticated at the herbarium unit of the Department of Forestry, MichealOkpara University of Agriculture Umudike (MOUAU) Abia State and South East Nigeria were transported to the laboratory in a clean polythene bag after which the leaves were thoroughly washed using clean tap water. The thoroughly washed leaves were spread on a clean flat surface for 6 days to shade dry. They were ground into fine powder

2.2. Determination of Proximate, Mineral and Vitamin composition of plant sample

Proximate composition was determined by the methods described by AOAC [8]. Mineral composition of leaves of *T. danielli* was determined using Atomic Absorption spectrophotometer according to the methods of AOAC [9]. Laboratory procedures for the preparation and determination of mineral contents of leaf sample were used as outlined by Shah et al*.* [10]. Vitamin composition was determined according to the method of AOAC [9].

2.3. Extraction of Plant Material

Leaves of *T. danielli* dried at room temperature after which they were milled to powder with the. The powder obtained was sieved to obtain fine powder. 500 g of the powdered plant sample was soaked in 2 litres of 70% methanol for about 72 hours and stirred intermittently. The extract was filtered and the filtrates concentrated at 40^{oC} [11].

2.4. Animal

Adult male albino rats (150-200 g) were obtained from the Animal House of the Department of Science Laboratory Technology, AkanuIbiam Federal Polytechnic Afikpo. The animals were housed in well-ventilated cages and fed with commercial laboratory diet and water *ad libitum.*

2.5. Acute Toxicity Study

This was performed in accordance with the method of Lorke [12]. The initial phase constituted of 3 groups of 3 rats each and was administered with 10 mg, 100 mg and 1000 mg of the extract per kg body weight orally. They were observed for 24 hours to deduce possible signs of toxicity, including death. In the absence of observable signs of toxicity, the second phase was initiated and constituted of 4 rats which were divided into 4 groups of 1 rat each. The LD_{50} was calculated from the results of the final phase as the square root of the product of the lowest lethal dose and the highest non-lethal dose.

2.6. Experimental Design

Twenty adult male albino rats were divided into 4 groups of 5 rats per group

2.6.1. Group I

Normal control was fed with only normal rat diet and water *ad libitum.*

2.6.2. Group II

Rats administered with 200 mg/kg b. w of methanol extract of *T.danielli* leaf orally.

2.6.3. Group III

Rats administered with 400 mg/kg b. w of methanol extract of *T.danielli* leaf orally.

2.6.4. Group IV

Rats administered with 600 mg/kg b. w of methanol extract of *T. danielli* leaf orally.

Administration of extract lasted for 28 days after which rats were anaesthetized using chloroform and sacrificed 24 hrs after the last treatment. Blood samples were collected in specimen bottles, allowed to clot, centrifuged and serum was collected.

2.7. Liver Function Test

2.7.1. Assessment of Aspartate Aminotransferase (AST)

Exactly 1 mL of reagent was added to test tubes. 500 µL of the sample was added to the test tube and 50µL of the standard reagent was added to the standard test tube and none to the blank. It was incubated at room temperature for 20 minutes, mixed immediately and first absorbance of test was read exactly at 1minute and thereafter at 30, 60, 90 and 120 seconds at 340 nm. The mean change in absorbance per minute was determined and the test results were calculated.

$$\text{Serum AST activity (IU/L)} = \text{Change in A/min} \times F$$

Where, F= 3376

2.7.2. Assessment of Alanine Aminotransferase (ALT)

To 1 mL of reagent added to all required test tubes, 500 µL of the sample was added and 50 µL of the standard reagent was added to the standard test tube and none to the blank. It was incubated at room temperature for 20 minutes, mixed immediately and first absorbance of test was read at exactly 1 minute and thereafter at 30, 60, 90 and 120 seconds at 340 nm. The mean change in absorbance per minute was determined and test results calculated.

2.7.3. Assessment of Alkaline Phosphatase (ALP) activities

Exactly 3 mL of substrate solution was incubated at 37^{0C} for 15 minute and then 0.5 mL of the samples was added. The mixture was mixed thoroughly and immediately 0.05 mL of the mixture was removed and mixed with 9.5 mL of 0.085 N NaOH. This corresponded to zero time assay (blank). The remaining solution (substrate+enzyme) was incubated for 15 minutes at 37^{0C} and then 0.5 mL was drawn and mixed with 9.5 mL of 0.085N NaOH. Absorbance was measured at 405 nm against the reference blank.

2.7.4. Statistically analysis

Data generated were expressed as Mean ± Standard Deviation using SPSS (Ver. 23). Data were analysed using one way Analysis of Variance (ANOVA) and differences in mean compared with Turkey Test. *p-values* less than 0.05 was considered statistically significant.

3. Results and discussion

Table 1 Serum Hepatomarkers of Albino rats administered with *Thaumatococcus danielli*

Group	Treatment	ALT (IU/L)	AST (IU/L)	ALP (IU/L)
Group I	Distilled H20	4.54±0.1	$18.23±0.37^{a}$	$153.62±0.95^{ab}$
Group II	200 mg/kg T. d	4.32±0.23	$20.20±0.43^{b}$	$151.23±0.09^{a}$
Group III	400 mg/kg T. d	4.53±0.60	$19.33±0.57^{b}$	$150.70±1.04^{a}$
Group IV	600 mg/kg T. d	4.16±0.93	$21.02±0.48^{ab}$	$154.02±0.09^{b}$

Results are expressed as mean ± standard deviation of three determinations. Values with different Superscripts in a column are significantly different at P<0.05

Table 2 Nutrient Composition of Leaf of *Thaumatococcus danielli*

Proximate	Composition	Minerals	Composition	Vitamins	Composition
Moisture	10.52±1.25^{ab}	Ca	7.20±0.23^{de}	A	4.02±1.28^{c}
Ash	8.40±2.20^{a}	P	6.82±0.28^{d}	B1	0.9±1.13^{ab}
Fat	17.30±1.28^{c}	K	6.40±0.16^{d}	B3	0.8±1.24^{a}
Protein	12.63±3.20^{b}	Zn	0.9±0.12^{c}	B5	2.11±0.03^{b}
Fibre	14.20±3.20^{bc}	Na	0.4±0.03^{a}	B6	0.94±0.04^{ab}
Carbohydrate	38.29±0.20^{d}	Fe	0.8±2.00^{b}	B12	8.32±0.42^{d}

Results are expressed as mean ± standard deviation from three determinations. Values with the same Superscript in a column are significantly different at P<0.05

4. Discussion

Owing to the importance of the leaf of *T. danielli* in the packaging of locally prepared foods such as moimoi, agidi and others, especially when scientific efforts have revealed the pitfall that characterize the use of polyethene materials in the packaging of locally prepared food stuffs. It is imperative to gradually probe its constituents as well as effect to consumption. Table 1 shows the activity of serum hepatomarkers following oral administration of methanol extract of *T. danielli*. There was no significant (P<0.05) difference in the activity of serum hepatomarkers between the control group and the group administered with 600 mg/kg hence the value for Group 1 (4.54±0.10 IU/L), (18.23±0.37 IU/L) (153.62±0.95 IU/L) and Group IV (4.16±0.93 IU/L), (21.02±0.48 IU/L) and (154.02±0.001 IU/L) for ALT, AST and ALP respectively. This may be attributed to the presence antioxidants in the leaf of *T. danielli*. The outcome of this is consistent with findings of Oke et al. [13] which showed that the aqueous fraction of *T. daniellii* leaf exhibited a significantly (P<0.05) higher DPPH radical scavenging activity than the hexane fraction at 100-500 mg/mL. Table 2 shows the nutrient composition of leaf of *T. danielli*. The proximate analysis on the leaf of the said plant revealed the presence of moisture, ash, fat, protein, fibre and carbohydrate with fat being more (17.30±1.28%) than every other components and carbohydrate the least (8.29±0.20%). However, analysis on the mineral composition revealed the presence of calcium, phosphorus, potassium, zinc, sodium and iron. While calcium (7.20±0.23 g/100 g) was reportedly the most abundant of all elements, sodium was the least (0.40±0.03 g/100 g). Evaluation of the vitamin composition of the leaf of the said plant revealed the presence of vitamins A, B1, B3, B5, B6 and B12 which was the most abundant (8.32±0.42 g/100 g). This work is consistent with the work of Shalom et al [14] who reported that the fruit of *T. danielli* is a rich source of magnesium and phosphorus.

Conclusion

Through this research, it has been revealed that the leaf of *T. danielli* contains vital nutrients and also may likely not harbour hepatotoxic compound(s).

Compliance with ethical standards

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Disclosure of conflict of interest

Authors hereby declare that no conflict of interest exists.

Statement of Ethical Approval

Ethical approval was granted by the University's Ethical Committee on the Care and Handling of Laboratory Animals.

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