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ORIGINAL ARTICLE

Lipid profile and Proximate Analysis of the Seeds of *Anisophyllea boehmii*

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ABSTRACT
A. boehmii fruit appear mainly in the rainy season and are eaten raw. The fruit is also processed into jam, or added to porridge. A. boehmii is also widely exploited for its medicinal properties. However, as is the case with most other indigenous fruit-bearing trees, the seeds which may have nutritional, pharmaceutical and or industrial value are largely discarded after consumption of the fruit pulp. The fruits were collected from around trees in Bwana Mkubwa area in Ndola district, Zambia. The seeds were extracted and sent to an accredited laboratory at the Agricultural Research Council's Irene Analytical Services Laboratories, South Africa. All the analytes were assayed as outlined by official Methods of Analysis of Analytical Chemists (AOAC). All analytes were assayed in duplicate of composite samples from five (5) trees and data was presented as means ± sd. The dry matter, ether extract and crude protein of A.boehmii constituted 90.05%, 19.5 %, and 14.68 % of the seed mass respectively. Arginine accounted for about 25.7 % of the crude protein. Palmitic acid was the highest concentrated saturated fatty acid accounting for 35.28 % of the ether extract while cis-oleic and cis-linoleic acid accounted for 32.36 % and 9.53 % of the seeds respectively. The cis fatty acids together accounted for 41.88 % while the omega 9 was 32.43 % of the ether extract. Communities in resource poor areas should be encouraged to exploit A.boehmii seed for its potential nutritional and pharmaceutical uses.
KEY WORDS: *Anisophyllea boehemii, seed, lipid profile, proximate composition*

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INTRODUCTION

Indigenous fruit trees (IFTs) are a source of livelihood in many parts of the world [1]. In southern Africa, these trees contribute about 42 % of the natural food basket that rural households rely on and the trees play an important role especially during famine [2, 1]. *Anisophyllea boehmii* occurs in the higher rainfall parts of Zambia, Tanzania and the Democratic Republic of Congo. It is an ever green scrub or small tree up to 10 m in height. It has hairy leaves which have an unusual venation originating from the base of the leaf [3]. A survey of the populace in the Copperbelt (Zambia) on the uses of the plant revealed that it is widely exploited for its medicinal properties wherein an infusion of the roots is used to cure dysentery and diarhoea whilst decoctions of the bark are used to treat syphilis, stomach ache and as a mouth wash to treat tooth ache and bleeding gums [4]. The survey also revealed that 71 % of the households collected *A. boehmmi* fruit. The delicious plum-like fruits appear during the rainy season and are eaten raw. The fruit is also processed into jam, or added to porridge [3]. As is the case with most other indigenous fruit-bearing trees (IFBTs), the seeds are largely discarded after consumption of their fruit pulp. Previous studies have shown that many of the seeds from IFBTs which are currently not exploited have potential pharmaceutical and, or nutritional potential for humans and / or livestock [5, 6]. Apart from the traditional uses of IFBTs which include provision of firewood, fruit, fodder, shade, construction timber and medicinal exploitation of their roots and aerial parts, there is a need to explore other empowering uses of these local sustainable resources for poverty alleviation in rural areas. Some of the oils from fruit trees fetch a higher price than crude oil. Thus the added value from the seeds of the trees needs to be tapped into. As there is no information on the potential nutritional/pharmaceutical value of the seeds of *A. boehemii,* the aim of this study was to fill this knowledge gap.

MATERIALS AND METHODS

Seed source: The fruits were collected from around five (5) different trees in rural Bwana Mkubwa, a peri-urban area of Ndola district, in Zambia. They were identified by Professor Phiri, a botanist in the School of Mathematics and Natural Resources, Copperbelt University and then dried in the shade until time of assay. Prior to assaying, the seeds were hand shelled and crushed in a blender (Waring; Lasec Pty Ltd. Johannesburg, South Africa) to produce a blended powder. The composite powder was stored in tightly sealed, dark sample bottles at 4ºC until time of assay. Figures 1a and 1b show photographs of dry unshelled and, shelled seeds of *A. boehmii.*

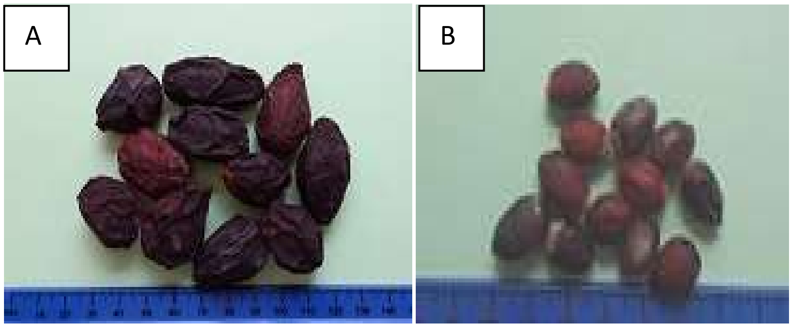

Figure 1 a and b. Photographs of dried unshelled (A) and shelled (B) *Anisophyllea boehmii* Seeds.

Assays: All of the assays were done at the Agricultural Research Council's Irene Analytical services Laboratories, South Africa which is SANAS (South African National Accreditation System) accredited. Dry matter was determined as outlined by the Official Methods of Analysis of Analytical Chemists [7]. Dry matter, ash, crude protein and ether extract were determined as outlined by Official Methods of Analysis of Analytical Chemists [8] method numbers 934.01, 942.05, 954.01 and 920.39 and are for DM, ash, CP and EE, respectively. An MC-1000 Modular Calorimeter equipped with a PC and MC1000 software (Energy Instrumentation, Centurion, South Africa) was used to determine the gross energy value of the seeds.

Amino acid and fatty acid assay: The concentration of each of the assayed amino acids was determined as described by [9]. Fat was extracted by soxhlet method. Methyl esters for capillary gas chromatography were prepared according to the method of Christopherson and Glass [10]. We have previously provided a summary of the equipment and the steps in protocols which have been employed in our assays of seeds [11, 12, 13].

RESULTS

Table 1 shows the proximate composition, Table 2 shows the amino acid profile and Table 3 shows the fatty acid profile of *A. boehmii* seed. The *Anisophyllea boehmii* seeds had a gross energy yield of 20.30 MJ/Kg and ash content of 2.40 %. The dry matter, ether extract and crude protein constituted 90.05 %, 19.5 % and 14.68 % of the seed mass respectively. Arginine, the highest concentrated amino acid accounted for about 25.7 % of the crude protein. Palmitic acid was the highest concentrated saturated fatty acid accounting for 35.28 % of the ether extract while cis-oleic acid and cis-linoleic acid accounted for 32.36 % and 9.53 % of the product respectively. The cis fatty acids together accounted for 41.88 % while the omega 9 fatty acids were 32.43 %.

Table 1. Proximate Composition of *Anysophyllea boehmii* seeds.

Proximate % of product	Mean ±SD
Dry matter	90.05 ± 0.05
Ash	2.40 ± 0.00
Crude Protein	14.68 ± 0.10
Fat yield (ether extraction)	19.47 ± 0.30

Data are presented as mean ± standard deviation, after analysis (in duplicate) of composite samples from five trees.

Table 2. Amino acid profile of *Anisophyllea boehmii* seeds.

Amino acids (g per 100g)	Mean±SD
Arginine	3.78 ± 0.12
Serine	0.54 ± 0.01
Aspartic acid	0.68 ± 0.02
Glutamic acid	1.90 ± 0.03
Glycine	0.56 ± 0.01
Threonine	0.31 ± 0.02
Alanine	0.50 ± 0.08
Tyrosine	0.38 ± 0.02
Proline	0.33 ± 0.01
Hydroproline	0.06 ± 0.01
Methionine	0.84 ± 0.00
Valine	0.40 ± 0.05
Phenylalanine	0.48 ± 0.05
Isoleucine	0.41 ± 0.02
Leucine	0.53 ± 0.02
Histidine	0.51 ± 0.02
Lysine	0.68 ± 0.02
Total	14.68 g per 100 g

Data are presented as mean ± standard deviation, n = 2 composite samples of seeds from the fruit of five trees.

Table 3. Fatty acid profile (ether extract) of *Anisophyllea boehmii* seed oil.

Fatty acid	%
Saturated	
C14:0 (myristic acid)	0.11 ± 0.01
C16:0 (palmitic acid)	35.28 ± 0.83
C17:0 (heptadecanoic acid)	0.17 ± 0.00
C18:0 (Stearic acid)	1.12 ± 0.00
C20:0 (arachidic acid)	0.13 ± 0.00
C22:0 (behenic acid)	0.10 ± 0.07
C24:0 (lignoceric acid)	0.02 ± 0.02
Total	36.98 ± 0.74
Monounsaturated	
C16:1 (palmitoleic acid)	20.50 ± 0.61
C18:1n9c (oleic acid)	32.36 ± 0.08
C20:1 (11-eicosenoic acid)	0.05 ± 0.00
Total	52.99 ± 0.65
Polyunsaturated	
C18:2n6t (linoleic acid)	0.06 ± 0.01
C18:2n6c (linoleic acid)	9.53 ± 0.04
C18:3n3 (alpha-linolenic acid)	0.23 ± 0.01
C18:3n6 (gamma-linolenic acid)	0.01 ± 0.02
C20:5n3 (Eicosapentoic acid)	0.06 ± 0.09
C22:2 (Clupanodonic acid)	0.08 ± 0.06
Total	9.97 ± 0.01
Cis Fats	41.88 ± 0.12
Trans Fats	0.13 ± 0.01
Omega 3	0.29 ± 0.10
Omega 6	9.60 ± 0.02
Omega 9	32.43 ± 0.09

Data are presented as mean ± standard deviation; n = 2 composite samples of seed from the fruit of *Anisophyllea boehmii.*

DISCUSSION

The gross energy of *A. boehmii* seed (20.3 MJ/Kg) is higher than that reported for maize grains (17 MJ/Kg) [14], and therefore opens up the potential for its use as a source of energy in livestock feeds. Legumes are rich sources of protein, energy, and micronutrients consequently playing a vital role in human nutrition

[15]. The crude protein content of *A. boehmii* seed (14.68 %) is lower than that of leguminous seeds such as chickpea (24.0 %), cowpea (24.7 %), green pea (24.9 %) and lentils (26.1 %) [16]. It is however higher than that of ordinary maize varieties which range from 8-11 % [17] and to another fruit bearing indigenous tree, *Mimusops zeyheri* [11]. The low crude protein content of *A.boehmii* makes it unsuitable for use as a sole dietary source of protein in humans and animals. It could however be used as a partial substitute of protein in meals with a high protein content of the amino acids assayed, arginine an essential amino acid was the most abundant in *A. boehmii* seed (3.78 %). The administration of exogenous L-arginine, has been found to have beneficial effects on the cardiovascular system [18]. *A. boehmii* seed could therefore when used as a food ingredient or supplement, potentially contribute to the body's physiological requirements of L-arginine and offer some cardiovascular benefits. The crude oil yield of *A. boehmii* (19.5 %) although lower than that of *Kigelia Africana* (49.2 % of seed mass) [12] was comparable to that of Soyabean (*Glycine max*) (22.9 %) and as such could be exploited for its potential oil yield. *A. boehmii* seed oil contained a high amount of the monounsaturated fatty acid oleic acid (32.6 % of product). About 61.2 % of the monounsaturated fatty acids found in the seed oil were Omega 9 types including oleic acid. The intake of diets rich in oleic acid has been shown to have beneficial effects on cardiovascular health [19]. Palmitic acid, a saturated fatty acid, constituted 35.28 % of *A.boehmii* seed oil. It has long been established that the primary cholesterol-elevating fatty acids are the Saturated fatty acids with 12 (lauric), 14 (myristic) and 16 (palmitic) carbon atoms, they have been associated with hypercholesterolaemia and an increase risk of coronary heart disease [20]. Whilst it is evident that palmitic oil consumption contributes to an increased risk of developing cardiovascular disease [21], when consumed in moderation, SFAs such as palmitic acid, may have anti-atherosclerotic and mild anti-oxidant properties [22].

The essential fatty acid linoleic acid constituted about 9.53 % of the seed oil. It is a component of cell membranes and its dietary deficiency can result in dermatologic problems, alopecia [23] and impaired wound healing [24]. Linoleic acid is commonly added to dermatologic preparations and cosmetics for its beneficial effects on the skin. The seed oil of *A. boehmii* had a much higher content of the cis-fatty acids (41.88 %) as compared to trans-fatty acids (0.13 %). Trans-fats have been shown to increase the level of serum total and low density lipoprotein (LDL) cholesterol and raise the risk of developing coronary heart disease [25].

Communities in resource poor areas should be encouraged to exploit *A. boehmii* seed for its potential nutritional, pharmacologic and pharmaceutical uses. To fully unlock the potential of the seeds and seed oil, there is need to determine its anti-nutritional factor content which may have adverse effects of health if consumed, in addition other physicochemical properties of the seed oil such as iodine value and saponification value need to be investigated to unlock other areas in which the seed oil could be exploited.

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