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Nutritional Composition and Acute Toxicity Potentials of *Archontophoenix tukeri* and *Adonidia merrilli* Kernels

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Abstract

Archontophoenix tukeri and *Adonidia merrilli* are exotic species widely grown in Nigeria as ornamental palms. In this study, the kernels of *A. tukeri* and *A. merrilli* were subjected to amino acids, fatty acids, proximate, anti-nutrients and mineral element analyses, in addition to acute toxicity evaluation. Glutamic acid (11.30 and 5.33 g/100 g) and leucine (5.9 and 4.2 g/100 g) were the most abundant essential and non-essential amino acids; the fatty acids profile revealed three major fatty acids: palmitic acid (20.14 and 11.27%), oleic acid (61.83 and 25.78%) and linoleic acid (13.05 and 55.26%); low linolenic acid levels were also observed (<1%) with 75.87 and 81.98% total unsaturated fatty acids in *A. tukeri* and *A. merrilli* respectively. Carbohydrate (85.73% and 90.15%) and oxalate contents (1927.2 and 2072.4 mg/100 g) were relatively high, while low levels of cyanide (12.05 and 65.45 mg/100 g), phytates (6.32 and 2.53 mg/100 g) and tannins (35.36 and 20.16 mg/100 g) were observed. *A. tukeri* indicated higher Ca, Cu, Fe, Zn, Mg, Mn and Na contents. The anti-nutrient-mineral ratios were computed and compared with critical values. Acute toxicity of *A. tukeri* and *A. merrilli* was 866.03 mg/Kg. These palms contain vital nutritional components, and with proper processing could serve as potential products for both human and animal nutrition.

1 Introduction

Palms represent the third most important plant family for human use[1]. Several wholesome products are produced from palms, which comprise the popular *Elaeis gunneensis*, *Cocus nucifera*, *Phoenix dactylifera*, and diverse palm lipids. *A. tukeri* and *A. merrilli* are ornamental palms widely cultivated for their exotic appearance[2].

Archontophoenix tuckeri, the Rocky River palm or Cape York palm (Arecaceae) is native to Northern Australia, where it is mostly found in moist tropical areas, particularly in rainforest or along streams. *A. tuckeri* is a large, single-trunked palm reaching 22 meters in height and 26 cm in diameter with an expanded base. The red fruits (17-25 mm long) produced by the mature palm at maturity possess both thin and thick mesocarp fibres in two different layers bound together[3] (Fig. 1). A recent study has shown that *A. tukeri* fruit pericarp contain bioactive compounds which exhibit cytotoxic, antioxidant and antimicrobial properties[4]. Viera *et al*.[5] reported the nutrient and anti-nutrient composition of flours made from *Archontophoenix alexandrae* residue obtained after heart-of-palm production.

Adonidia merrilli, syn. *Normanbya merrilli* (Becc.), or *Veitchia merrilli* (Becc.) H. E. Moore (Arecaceae) is commonly known as *Adonidia* palm, Manila palm or Christmas palm. Manila palm is native to the Philippines and Sabah[3]. *A. merrilli* is an erect, solitary, unarmed, monoecious palm, 5-10 m high. The fruits are ovoid, 3-4 cm long, beaked, pale green becoming bright red at maturity (Fig. 2). *A. merrilli* fruit is used as a masticatory when ripe, but is an inferior substitute for betel-nut[6]. Some biological activities of *A. merrilli* fruits pericarp have been established *in vitro* [4].

A number of researches on the nutritional, fatty acids, tocopherols and carotenoids contents of pulp and kernels of some ornamental palms in Brazil (*Veitchia merrilli*, *Ptychosperma macarthurii*, etc.) have been reported[7,8].

However, there is a lacuna in published data on the potential use of most ornamental palm fruit pulps and seeds as food and for other industrial purposes. Therefore, in continuation of our systematic evaluation of the nutraceutical potentials of the poorly studied ornamental palms[9], we report the nutritional composition and acute toxicity indices of *A. tukeri* and *A. merrilli* seeds for a possible use in human and animal nutrition.

Fig 1: Mature fruits and seeds of *Archontophoenix tuckeri*

Fig 2: Mature fruits and seeds of *Adonidia merrilli*

2 Materials and methods

2.1 Plants materials and extraction

The mature ripe fruits of *A. merrilli and A. tuckeri* were collected in the month of April – July, 2015 within Uyo metropolis, Akwa Ibom State, Nigeria. Plant samples were identified and authenticated by a taxonomist, M. E. Bassey, Department of Botany and Ecological Studies, University of Uyo, where voucher specimens were deposited. The fruits pericarps were peeled to expose the seeds. The seeds were sun-dried, and the endocarps were removed to obtain the kernels. The pulverized kernels, seeds oil extracted in n-hexane, and methanol extracts were utilized for analyses.

2.2 Determination of amino acids

The amino acid profile was determined using the method described by Benitez[10]. The sample was dried to constant weight and defatted using Soxhlet extractor. The defatted sample (2 g) was weighed into a glass ampoule; 7 mL of 6 M HCl was added and oxygen was expelled by passing nitrogen into the glass ampoule sealed with Bunsen burner flame and placed in an oven at 105±5 ºC for 22 hours. The ampoule was allowed to cool before broken at the tip and the content was filtered to remove the organic matters. The filtrate was then evaporated to dryness at 40 ºC in a hot air oven. The residue was dissolved in 5 ml of acetate buffer (pH 2.0) and stored in specimen bottles which were kept in the freezer. The hydrolysate (7.5 µL) was dispensed into the cartridge of the Technicon Sequential Multi-Analyser (TSM) using a syringe. The TSM analyser is designed to separate and analyse neutral, acidic and basic amino acids of hydrolysate. The amount of amino acids was obtained from the chromatogram peaks. The whole analysis lasted for 76 minutes and the gas flow rate was 0.50 mL per minute at 60 ºC with reproducibility consistent within ±3%.

2.3 Fatty acids analysis

The fatty acids composition of the oils was evaluated by Gas Liquid Chromatography of fatty acid methyl esters (FAMEs) prepared by boron trifluoride-catalyzed transesterification, according to the method of Morrisson and Smith[11] and AOAC.[12]. FAMEs were analyzed on a HP 6890 Powered with HP ChemStation Rev. A09.01 [1206] Software and equipped with a hydrogen flame ionization detector (FID). Separation was performed using a fused capillary column (HP INNOWax, 30 m x 0.25 mm x 0.25 µm) as stationary phase. The oven temperature was programmed as follows: initial temperature at 60 ºC, first ramping at 12 ºC/min for 20 min; second ramping at 15 ºC/min for 3 min, maintained for 8 min. The injector and detector temperatures were 250 ºC and 320 ºC respectively. The carrier gas was nitrogen and a split ratio of 20:1 was used. The FAMEs were identified by comparing their retention times to those of a standard mixture of fatty acids and the peak areas were integrated.

2.4 Proximate compositional analysis

Moisture content was obtained from fresh samples; total lipid, protein, ash, crude fibre and carbohydrate were determined from oven-dried powder using standard procedures[13,14]. The moisture content was obtained by drying in a moisture determination apparatus (Precisa HA60) at 110 ºC until circulation was complete; ash, from the incinerated residue was obtained at 550 °C after 3 h; crude protein content was established by the Kjeldahl method with a conversion factor of 6.25; while the crude fat was gravimetrically determined after Soxhlet extraction with petroleum ether. The crude fat was converted into fatty acids by multiplying with conversion factor of 0.8. The total carbohydrate was calculated as 100% - (% moisture+ % ash+ % crude protein+ % fat+ % fibre). The total energy values were calculated by multiplying the amounts of protein and carbohydrate by the factor of 4 Kcal/g and lipid by the factor of 9 kcal/g. Data points represent mean of three determinations and proximate values were reported in percentage.

2.5 Determination of anti-nutritional factors

2.5.1 Phytate determination

Extraction and precipitation of phytate were done through phytic acid determination using the procedure described by Lucas and Markaka[15]. This entails the weighing of sample (2g) into a 250 mL conical flask. 2% conc. HCl (100 mL) was used to soak the samples in the conical flask for 3 h and then filtered through a double layer filter paper. Sample filtrate (50 mL) was placed in a 250 mL beaker and distilled water (107 mL) added to give/ improve proper acidity. 0.3% ammonium thiocyanate solution (10 mL) was added to each sample solution as indicator and titrated with standard iron chloride solution which contained 0.00195 g iron/mL and the end point was signified by brownish-yellow colouration that persisted for 5 min. The percentage phytic acid was calculated.

2.5.2 Tannins determination

Tannin values were obtained by adopting the method of Jaffe[16]. Each sample (1g) was dissolved in distilled water (10 mL) and agitated, left to stand for 30 min. at room temperature. The samples were centrifuged and the extracts recovered; the supernatant (2.5 mL each) were dispersed into 50 mL volumetric flask. Similarly, standard tannic acid solution (2.5 mL) was dispersed into separate 50 mL flasks. Folin-dennis reagent (1.0 mL) was measured into each flask followed by the addition of saturated Na_2CO_3 solution (2.5 mL). The mixture was diluted to 50 mL in the flask and incubated for 90 min at room temperature. The absorbance of each sample was measured at 250 nm with the reagent blank at zero. The % tannin was calculated.

2.5.3 Cyanogenic glycoside determination

The alkaline picrate method[17] was used for cyanogenic glycoside determination. The samples (5 g each) in conical flasks were added distilled water (50 mL) and allowed to stand overnight. Alkaline picrate (4 mL) was added to sample filtrate (1 mL) in a corked test tube and incubated in a water bath for 5 min. A colour change from yellow to reddish brown after incubation for 5 min in a water bath indicated the presence of cyanides. The absorbance of the samples was taken at 490 nm and that of a blank containing distilled water (1 mL) and alkaline picrate solution (4 mL) before the preparation of cyanide standard curve.

2.5.4 Oxalates determination

The oxalates content of the samples was determined using titration method[18]. The samples (2 g each) were placed in a 250 mL volumetric flask suspended in distilled water (190 mL) for soluble oxalate determination; 6 M HCl solution (190 mL) was added to the samples (2 g each). The suspensions were digested at 100 ºC for 1h. The samples were then cooled and made up to 250 mL mark of the flask. The samples were filtered, triplicate portions of the filtrate (50 mL) were measured into beaker and four drops of methyl red indicator was added, followed by the addition of concentrated NH_4OH solution (drop wise) until the solution changed from pink to yellow colour. Each portion was then heated to 90 ºC, cooled and filtered to remove the precipitate containing ferrous ion. The filtrates were again heated to 90 ºC and 5% $CaCl_2$ (10 mL) solution was added to each of the samples with consistent stirring. After cooling, the samples were left overnight. The solutions were then centrifuged at 2500 rpm for 5 min. The supernatant were decanted and the precipitates completely dissolved in 20% H_2SO_4 (10 mL). The total filtrates resulting from digestion of the samples (2 g each) were made up to 200 mL. Aliquots of the filtrate (125 mL) were heated until near boiling and then titrated against 0.05 M standardized $KMnO_4$ solution to a pink colour which persisted for 30 sec. The oxalate contents of each sample were calculated. All determinations were performed in triplicates and presented in mg/100g.

2.6 Determination of mineral elements

The minerals were determined after the ground samples were subjected to dry ashing. Triplicate sample of one gram each were weighed into porcelain crucible and placed in muffle furnace. The temperature was raised gradually to 450 ºC. The sample was ashed at 550 ºC for 5-6 hours. After cooling to room temperature, the ash was dissolved in one millilitre (l ml) 0.5% HNO_3. The sample volume was made up to 100 mL and the level of mineral elements, calcium (Ca), magnesium (Mg), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn), was analyzed by atomic absorption spectrophotometer (UNICAM 959). Sodium (Na) and potassium (K) were determined using flame atomic emission spectrometer[12].

2.7 Experimental Animals

Twenty four (24) wistar albino mice of either sex weighing 20-30 g of 70 days were used for acute toxicity studies. The animals were procured from the Animal House, Department of Pharmacology and Toxicology, Faculty of Pharmacy, University of Uyo, Uyo. The animals were fasted 24 hours prior to drug administration to avoid food-drug interaction but were allowed access to water *ad libitum.* The animals were kept in wooden cages under standard environmental condition (25 ± 2 °C) at a natural day and night cycle. Permission and approval for animal studies were obtained from the College of Health Sciences, Animal Ethics Committee, University of Uyo, Uyo. The investigation conformed to the Guide for the Care and Use of Laboratory Animals published by the U. S. National Institute of Health (NIH Publication No. 85-23, revised 1996) for studies involving experimental animals.

2.8 Determination of Acute Toxicity

The method described by Lorke[19] was used to determine acute toxicity. The study was conducted in two phases. In the first

phase, three groups of three mice each were intraperitoneally administered the crude methanol extract at respective doses of 1000 mg, 3000 mg and 5000 mg per kg body weight. The mice were observed for signs of toxicity and possible deaths for 24 hours, 72 hours and 2 weeks. In the second phase, another group of three mice each were administered a dose of 750 mg per Kg body weight of the extract. They were equally monitored. The volume of extract administered was calculated using the formula:

$$\frac{\text{Weight of mice (Kg)} \times \text{Dose rate (mg/Kg)}}{\text{Extract concentration (mg/mL)}}$$

$LD_{50} = \sqrt{(D_0 \times D_{100})}$

D_0 = Highest dose that gave no mortality; D_{100} = Lowest dose that produced mortality.

3 Results and Discussions

The amino acids composition of *A. tukeri* and *A. merrilli* is presented in table 1.

Table 1: Amino acids profile of *A. tukeri* and *A. merrilli* seeds (g/100 g)

Amino acid	*A.Tukeri*	*A.merrilli*
Lysine	3.05	2.50
Threonine	2.22	2.00
Valine	2.00	2.62
Methionine	3.19	0.48
Histidine	1.29	1.68
Isoleucine	2.71	1.60
Leucine	5.90	4.20
Phenyl alanine	3.17	3.17
Total E. A. A.	23.53	18.25
Glycine	3.17	2.36
Cystine	1.24	0.55
Aspartic acid	7.54	4.20
Serine	2.32	1.85
Glutamic acid	11.30	5.33
Proline	2.20	1.97
Arginine	4.59	3.57
Tyrosine	2.15	1.66
Alanine	2.82	2.98
Total N. E. A. A.	37.33	24.47

E. A. A. = Essential amino acids; N. E. A. A. = Non-essential amino acids

Seventeen amino acids were identified. Eight essential amino acids (EAA) accounted for 23.53 and 18.25 g/100 g of samples; glutamic acid (11.30 and 5.33 g/100 g), aspartic acid (7.54 and 4.20 g/100 g) and leucine (5.90 and 4.20 g/100 g) were the most abundant amino acids in *A. tukeri* and *A. merrilli* respectively. The analysis revealed higher levels of both EAA and non-essential amino acids in *A. tukeri* compared with *A. merrilii* seeds. To the best of our knowledge, no published reports are available on amino acids content of *A. tukeri* and *A. merrilli*. However, available reports from the kernels of the Brazilian grown ornamental palms (*Acrocomia intumescens* and *Syagrus oleracea*) have shown that these palms contain higher levels of amino acids compared to the studied samples, with the exception of methionine and cysteine[20,21]. Sadiq *et al*.[22] reported lower amino acids content for pulp and seeds of the Nigerian grown date palm (*Phoenix dactylifera*) compared to *A. tukeri* and *A. merrilli* in this study. Amino acids possess important functions in a human body; for example, L-aspartic acid is implicated as responsible for improved absorption of minerals, reduction in blood pressure and fatigue, liver protection, and so on[23].

The identified fatty acids in *A. tukeri* and *A. merrilli* kernel oils are presented in Table 2. Palmitic acid (20.14 and 11.27%), oleic acid (61.83 and 25.78%) and linoleic acid (13.05 and 55.26%) were the main fatty acids in *A. tukeri* and *A. merrilli* respectively. Oleic acid was markedly dominant in *A. tukeri* and linoleic acid in *A. merrilli*. The seed oils were distinctly high in unsaturated fatty acids compared with the saturated components; low linolenic acid levels were also observed (<1%). Oils rich in oleic and linoleic acids have potential uses in food applications[24]. Silva *et al*.[8] showed that the Brazilian *A. merrilli* kernel oil is rich in palmitic acid (36.89%) and stearic acid (15.58%); oleic and linoleic acids were not detected while *P. macarthurii* kernel dominated with palmitic acid (92.91%). Areca nut was also reported dominant in myristic acid (46.2%), palmitic acid (12.7%), oleic acid (6.2%) and linoleic acid (5.4%)[25]. These distinct quantitative and qualitative differences in the fatty acids composition of the Nigerian kernel oil of *A. merrilli* and the Brazilian sample[8] are worthy of note.

The proximate composition of *A. tukeri* and *A. merrilli* nuts are presented in Table 3. The result revealed that carbohydrate (85.73 and 90.15%), protein (4.55 and 3.68%) and lipid contents (6.35 and 3.22%) were relatively significant for *A. tukeri* and *A. merrilli* respectively. *A. tukeri* sample also showed higher ash content compared with *A. merrilli*. Ash content is an indication of the presence of some nutritionally important mineral elements. The proximate composition of *A. merrilli* kernel in this study is higher compared to the Brazilian *A. merrilli* sample[8]. Nwosu *et al*.[26] reported high crude fibre content for *Livistona chinensis* palm seeds, though with a relatively low ash, lipid and carbohydrate contents compared to the palm kernels in this study.

Lipid compounds such as free fatty acids, tri-, di- and monoglycerides, phospholipids, tocopherols, sterols and derivatives could be present in these plant tissues as crude fat[27].

Table 2: Fatty acids composition of *A. tukeri* and *A. merrilli* seed oils

Fatty acid	*A.tukeri*	*A.merrilli*
Myristic acid (C14:0)	0.05	0.12
Palmitic acid (C16:0)	20.14	11.27
Palmitoleic acid (C16:1)	0.08	0.08
Margaric acid (C17:0)	-	0.15
Stearic acid (C18:0)	3.82	6.22
Oleic acid (C18:1)	61.83	25.78
Linoleic acid (C18:2)	13.05	55.26
Linolenic acid (C18:3)	0.84	0.71
Arachidonic acid (C20:4)	0.05	0.11
Behenic acid (C22:0)	0.04	0.08
Erucic acid (C22:1)	0.02	0.04
Lignoceric acid (C24:0)	0.08	0.18
Saturated acids	24.13	18.02
Unsaturated acids	75.87	81.98
Mono-unsaturated acids	61.93	25.90
Polyunsaturated	13.94	56.08
Oleic/linoleic	4.74	0.47
Unsaturated/saturated	3.14	4.55

Table 3: Proximate composition of *A. tukeri* and *A. merrilli* seeds

Parameter	*A.tukeri*	*A. merrilli*
Ash (%)	2.04±0.05	1.77±0.01
Fibre (%)	1.34±0.01	1.19±0.03
Protein (%)	4.55±0.49	3.68±0.25
Lipid (%)	6.35±0.04	3.22±0.04
Carbohydrate (%)	85.73±0.72	90.15±0.24
Caloric value (Kcal)	418.23±0.07	404.14±0.21

Values are mean of duplicate determinations ± standard deviation

The anti-nutrients analysis (Table 4) revealed high levels of oxalates (1927.2 and 2072.4 mg/100 g) for *A. tukeri* and *A. merrilli* kernels respectively. Relative low concentrations of cyanide, phytates and tannins were also detected in both samples. Oxalic acid is essentially available in food, as sodium or potassium oxalate (water soluble), or calcium oxalate (insoluble in water), while magnesium oxalate displays partial solubility in water[28]. Lower levels of phytates and tannins were indicated for *A. tukeri* seeds in this study compared with *A. alexandrae* leaf and sifted leaf flour[4]. The cyanide, phytate and tannin contents of *A. tukeri* and *A. merrilli* kernels are below the permissible toxic levels[29] and indicate probable lack of interference with the availability of mineral elements. However, the relatively high oxalate contents of *A. tukeri* and *A. merrilli* kernels can be reduced by proper processing as shown for *L. chinensis* palm kernel[30].

Table 4: Anti-nutrients composition of *A. tukeri* and *A. merrilli* seeds (mg/ 100 g)

Parameter	*A. tukeri*	*A. merrilli*
Hydrogen cyanide	12.05±2.83	65.45±5.75
Oxalate	1927.20±12.44	2072.40±56.01
Phytate	6.32±0.59	2.53±0.00
Tannin	35.36±5.66	20.16±0.00

Results are mean ± standard deviation of three determinations

The mineral elements contents of *A. tukeri* and *A. merrilli* are presented in Table 5. *A. tukeri* indicated higher Ca, Cu, Fe, Zn, Mg, Mn and Na contents, except for K (26.10 ppm) compared to *A. merrilli*, K (29.5 ppm). Calcium was not detected in *A. merilli* kernel; Ca could be implicated in the maintenance of firmness of fruits and seeds[31] and its requirements are related to cell wall stability and membrane integrity[32]. The values found for sodium, and potassium are significant; these minerals regularize muscular system function and heartbeat when found in association. The bioavailability of most minerals could be affected by high anti-nutritional compounds[33]. Phytate and oxalate are the two main chelating agents in foodstuffs. The calculated anti-nutrient to the mineral molar ratio of studied palm samples is indicated in Table 6. The molar ratio of phytate/iron were <1.00 while phytate/zinc were also <15. These ratios predict the bioavailability of Fe and Zn in the palm kernels. However, the phytate/calcium ratio was >0.24 which indicates the likelihood of a poor availability of calcium in *A. tukeri*. Similarly, the oxalate/calcium and oxalate/calcium and magnesium molar ratio were above the critical values[34-37]. According to Davis[38], diminished bioavailability of bi and trivalent minerals only occur after a 1000 mg/100 g concentration of phytate or oxalate.

Table 5: Mineral elements composition of *A. tukeri* and *A. merrilli* seeds

Element	*A.tukeri*	*A.merrilli*
Ca (mg/100 g)	0.52±0.015	-
Cu (mg/100 g)	0.19±0.018	0.14±0.003
Fe (mg/100 g)	1.36±0.068	1.24±0.002
Zn (mg/100 g)	0.84±0.055	0.45±0.068
Mg (mg/100 g)	3.51±0.091	2.50±0.054
Mn (mg/100 g)	1.43±0.032	0.26±0.059
Na (ppm)	27.10	20.60
K (ppm)	26.10	29.50

Results are mean ± standard deviation of three determinations; - = not detected

Table 6: Anti-nutrient to nutrient molar ratio of *A. tukeri* and *A. merrilli* seeds

Molar ratio	*A.tukeri*	*A.merrilli*	Critical value[34-37]
[Phytate]/[Fe]	0.39	0.17	>1
[Phytate]/[Zn]	0.74	0.55	>15
[Phytate]/[Ca]	0.74	-	>0.24
[Oxalate]/[Ca]	1664.9	-	2.5
[Oxalate]/[Ca + Mg]	134.4	205.5	2.5

- = Not detected

The lethal dose of the palm kernel extracts is presented in Table 7. The extract caused dose-dependent mortality where the limit test dose of 5000 mg/Kg body weight was administered. No mortality was observed for 750 mg/Kg body weight; *A. tukeri* and *A. merrilli* showed 100% mortality at 1000 mg/Kg body weight. The median lethal dose (LD_{50}) of the extracts was shown to be 866.03 mg/kg. The LD_{50} results showed that the mice treated intraperitoneally could not tolerate considerably high doses of the crude extracts. Generally, the smaller the LD_{50}, the higher the toxicity and vice versa[39].

According to Lorke[19], 10% and 20% of LD_{50} are adopted as effective doses. As a result, the minimum effective dose (86.6 mg/kg body weight) of *A. tukeri* and *A. merrilli* kernel extracts may be safe. The levels of toxicity observed may be attributed to the intraperitoneal route of administration (higher bio-availability) as the extracts contain varied concentration of bioactive constituents; for instance, saponins when injected into the blood stream are highly toxic because of their ability to lyse erythrocytes *in vivo* consequently reducing the oxygen-carrying capacity of the blood[40], but when administered orally becomes comparatively harmless. Trautmann *et al.*[41] stated that all substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy. The toxicity indices of some ornamental palm seed kernels such as *L. chinensis* and *Areca catechu* have been investigated and shown to be dose dependent[42-44].

Table 7: Acute toxicity (LD_{50}) of the crude extracts of *A.merrillii* and *A. tuckeri* seeds

No. of mice	Doses (mg/kg)	*A. merrilli* seed		*A. tuckeri* seed	
		No. of dead mice	% of dead mice	No. of dead mice	% of dead mice
3	750	0	0	0	0
3	1000	3	100	3	100
3	3000	3	100	3	100
3	5000	3	100	3	100

Palm extract	LD_{50} (mg/Kg)	MED (mg/Kg)
A. tukeri	866.03	86.6
A. merrilli	866.03	86.6

MED = Minimum Effective Dose (10% of LD_{50})

4 Conclusions

A. tukeri kernels contain high levels of amino acids compared with *A. merrilli*. The kernel oils of *A. tukeri* and *A. merrilli* are rich in unsaturated fatty acids; palmitic acid, oleic acid and linoleic acid are the main components. The samples indicate high carbohydrate content compared with other nutrients; while anti-nutrients: cyanide, phytates and tannins contents are low except for the oxalates. Furthermore, the samples contain a significant amount of mineral elements and LD_{50} value of the extracts is 866.03 mg/Kg. The calculated anti-nutrient to mineral molar ratios indicates the bioavailability of Fe and Zn, with the exception of Ca. Processing of the kernels could reduce the oxalate content. Therefore, these palms are endowed with vital nutritional components and could serve as potential products for both human and animal nutrition.

5 Conflicts of Interest

The authors declare no conflict of interest.

6 Author Contributions

EEE and BSA conceived and designed the experiments; EDU performed the experiments; EEE and BSA wrote the manuscript.

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