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AMINO ACIDS, FATTY ACIDS AND MINERAL ELEMENTS COMPOSITION OF *Roystonea regia* and *Ptychosperma macarthurii* PALM KERNELS

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ABSTRACT

Roystonea regia and *Ptychosperma macarthurii* are exotic palm species widely grown in Nigeria as ornamentals. The kernels of *R. regia* and *P. macarthurii* were subjected to amino acids, fatty acids, and mineral elements analyses in this study. Glutamic acid (13. 64 and 14.00 g/100 g), aspartic acid (9.72 and 9.50 g/100 g), arginine (8.68 and 7.49 g/100 g), and leucine (7.23 and 7.98 g/100 g) were the dominant amino acids in *R. regia* and *P. macarthurii* seeds. The percentage yields of kernel oils were 13.9 and 1.7% for *R. regia* and *P. macarthurii*, respectively. Gas chromatograph facilitated the identification of thirteen fatty acids, mainly comprised of oleic acid (25.19 and 35.64%), linoleic acid (57.88 and 45.60%), and palmitic acid (9.6 and 10.03%) in *R. regia* and *P. macarthurii*, respectively. The analysis also revealed the high unsaturated nature of fixed oils of *R. regia* (83.63%) and *P. macarthurii* kernels (81.66%). Calcuim, copper, iron, zinc, magnesium, manganese, sodium, and potassium were also detected in the kernels; majorly, calcium (71.5 mg/L) and magnesium (23.1 mg/L) in *P. macarthurii* kernels, whereas sodium (24.6 ppm) and potassium levels (50.1 ppm) were higher in *R. regia* kernels. These results reveal the high amino acids, fatty acids, and mineral elements content of *R. regia* and *P. macarthurii* kernels. These unexploited palm fruits could be properly utilized as animal feed, edible oil, or for other industrial purposes with the knowledge of its nutritional value and fixed oil content.

INTRODUCTION

Palms represent the third most important plant family for human use (Johnson, 1998). *Roystonea regia* (Kunth) O.F.Cook, also known as the Cuban royal palm and *Ptychosperma macarthurii* (H. Wendl. Ex H. J. Veitch) H. Wendl. Ex Hook. f., otherwise called Macarthur palm, are unexploited and underutilized palms widely cultivated in the tropics and subtropics for their exotic appearance (Janick *et al*., 2014). *Roystonea regia* seeds are used as a source of oil and for livestock feed. Research has shown a potential use of a lipid extract (D-004) obtained from *R. regia* fruits for the treatment of benign prostatic hyperplasia (Arruzazabala *et al*., 2004). Rodrı´guez-Leyes *et al*. (2007) reported that *R. regia* fruits are a potential source of edible oil due to their abundance, high oil yield and low free fatty acids content. A study has also shown the presence of saponins and tannins in the seeds of *P. macarthurii*, in addition to its antimicrobial and antioxidant properties (Antia *et al*., 2017). Literature search has proved the paucity of data on the chemical constituents of *R. regia* and has shown that *P. macarthurii* has not been previously studied for its amino acids, fatty acids and mineral composition. As part of our evaluation of the underutilized palms for their naturally occurring compounds and potential applications, we here report the amino acids, fatty acids and mineral elements composition of *R. regia* and *P. macarthurii* palm kernels.

MATERIALS AND METHODS

Plant Material

Ripe fruits were collected from *R. regia* and *P. macarthurii* palms in the month of May 2020 within Uyo metropolis, Akwa Ibom State, Nigeria. Plant samples were identified by a taxonomist, M. E. Bassey, Department of Botany and Ecological Studies, University of Uyo, where voucher specimens were deposited. The fruits were peeled to expose the seeds. The seeds were sun-dried after which the endocarps were removed to obtain the kernels.

Amino Acids Analysis

The amino acid profile was determined using the method described by Benitez (1989). The ground samples were dried to constant weight, defatted, hydrolyzed and evaporated in a rotary evaporator, and loaded into the Technicon Sequential Multi-sample Amino Acid Analyzer (TSM).

Extraction and Esterification of Fatty Acids from Seeds

The air-dried palm kernels were pulverized and macerated in *n*-hexane for 72 hours; the residue obtain was re-macerated for complete extraction of oil. The kernel oils were obtained using a rotary evaporator at 40 °C. The oils (50 mg) were saponified by refluxing with absolute methanol containing potassium hydroxide (0.5 M) at 90°C. The saponifiable lipids were converted to fatty acid methyl esters (FAMEs) at 90 °C using the standard boron triflouride–methanol catalyzed transesterification, according to the method of Morrisson and Smith (1964) and AOAC (2000).

Gas Chromatography (GC) Analyses

Fatty acid methyl esters (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.

Determination of Mineral Elements

The minerals were determined after the ground samples were subjected to dry ashing. Calcium (Ca), magnesium (Mg), manganese (Mn), iron (Fe), copper (Cu) and zinc (Zn) were analyzed using atomic absorption spectrophotometer (UNICAM 959). Sodium (Na) and potassium (K) were determined using flame atomic emission spectrometer (AOAC, 2000).

RESULTS AND DISCUSSION

The amino acids composition of *R. regia* and *P. macarthurii* seeds are presented in Table 1. Seventeen amino acids were identified; comprising eight essential amino acids (29.59 and 31.95 g/100 g) and nine non-essential amino acids (50.21 and 50.74 g/100), respectively. Glutamic acid (13. 64 and 14.00 g/100 g), aspartic acid (9.72 and 9.50 g/100 g), arginine (8.68 and 7.49 g/100 g), and leucine (7.23 and 7.98 g/100 g) were the abundant amino acids in *R. regia* and *P. macarthurii* seeds. Similarly, some underutilized palm kernels of *Archontophoenix tukeri*, *Adonidia merrilli*, *Livistona chinensis*, and *Areca catechu*, have been reported to contain high levels of glutamic acid and leucine (Antia *et al*., 2017; Essien *et al*., 2021); though, the amount of glutamic acid, aspartic acid, arginine, and leucine were relatively lower compare with *R. regia* and *P. macarthurii* kernels. The percentage yields of kernel oils were 13.9 and 1.7% for *R. regia* and *P. macarthurii*, respectively. The fatty acids profiles for *R. regia* and *P. macarthurii* palm kernel oils are shown in Table 2. Thirteen fatty acids were characterized, which mainly comprised of oleic acid (25.19 and 35.64%), linoleic acid (57.88 and 45.60%), and palmitic acid (9.6 and 10.03%) in *R. regia* and *P. macarthurii*, respectively. The analysis revealed the high unsaturated nature of fixed oils of *R. regia* (83.63%) and *P. macarthurii* kernels (81.66%). Lauric acid was not detected in the oils and low levels of the unsaturated constituents (< 1%) were also observed for palmitoleic acid, linolenic acid, arachidonic acid, and erucic acid in both samples; similarly, for myristic acid, magaric acid, arachidic acid, behenic acid, and lignoceric acid, which comprised the saturated fatty acids. Oils rich in oleic and linoleic acids have potential uses in food applications (Warner *et al*., 1997) and Rodrı´guez-Leyes *et al*. (2007) likewise showed that *R. regia* fruits are a potential source of edible oil due to their high oil yield and low free fatty acids content. Therefore, the high percentage oil yield (13.9%) in *R. regia* kernels compared with oil yield in *P. macarthurii* (1.7%) validates *R. regia* kernels as a rich source of fixed oil which could be utilized in food processing because of its high oleic and linoleic acids content. The kernels of *A. tukeri*, *A. merrilli*, *L. chinensis*, and *A. catechu* have also been shown to contain high amount of palmitic acid, stearic acid, oleic acid, and linoleic acid (Antia *et al*., 2017; Essien *et al*., 2021). However, *A. tukeri* kernels, endowed with high levels of palmitic acid (20.14%) and oleic acid (61.83%) in its oil. has a relative low oil yield compared with *R. regia* kernels, and this may limit its applications.

The composition of mineral elements in *R. regia* and *P. macarthurii* kernels are indicated in Table 3. Comparatively, high amount of calcium (71.5 mg/L) and magnesium (23.1 mg/L) were detected in *P. macarthurii* kernels, whereas sodium (24.6 ppm) and potassium levels (50.1 ppm) were higher in *R. regia* kernels. Calcuim could be implicated in the maintenance of firmness of fruits and seeds (Soetan *et al*., 2010) and its requirements are related to cell wall stability and membrane integrity (Belakbir *et al*., 1998). The values found for sodium, and potassium are significant; these minerals regularize muscular system function and heartbeat when found in association. The low calcium level in *R. regia* kernel may limit its use as feed stock for animals, though the kernel may be blended with other biomass rich in calcium. In addition, the bioavailability of most minerals could be affected by high anti-nutritional compounds (Hazell, 1985); phytate and oxalate are the two main chelating agents in foodstuffs.

Table 1: Amino Acids Profile (g/100 g) of *R. regia* and *P. macarthurii* Kernels

Amino acid	*R. regia*	*P. macarthurii*	Amino acid	*R. regia*	*P. macarthurii*
Lysine	3.74	3.79	Cystine	1.80	1.87
Threonine	3.01	3.29	Aspartic acid	9.72	9.50
Valine	4.32	5.02	Serine	2.82	3.00
Methionine	1.72	1.64	Glutamic acid	13.64	14.00
Histidine	2.35	2.48	Proline	3.02	3.25
Isoleucine	3.52	3.26	Arginine	8.68	7.49
Leucine	7.23	7.98	Tyrosine	2.81	3.14
Phenylalanine	3.70	4.49	Alanine	3.73	3.98
Total EAA	29.59	31.95	Total NEAA	50.21	50.74
Glycine	3.99	4.51			

EAA: Essential amino acids; NEAA: Non-essential amino acids

Table 2: Fatty Acids Composition of *R. regia* and *P. macarthurii* Kernels

Fatty acid	*R. regia* (%)	*P. macarthurii* (%)	Fatty acid	*R. regia* (%)	*P. macarthurii* (%)
Lauric acid, C12:0	0.00	0.00	Arachidic acid, C20:0	0.08	0.05
Myristic acid, C14:0	0.05	0.05	Arachidonic acid, C20:4	0.04	0.05
Palmitic acid, C16:0	9.60	10.03	Behenic acid, C22:0	0.03	0.04
Palmitoleic acid, C16:1	0.03	0.04	Erucic acid, C22:1	0.02	0.02
Margaric acid, C17:0	0.07	0.07	Lignoceric acid, C24:0	0.07	0.09
Stearic acid, C18:0	6.47	8.01	Total SFA	16.37	18.34
Oleic acid, C18:1	25.19	35.64	Total USFA	83.63	81.66
Linoleic acid, C18:2	57.88	45.60	Total PUFA	58.39	45.96
Linolenic acid, C18:3	0.47	0.31	Total FA	100	100

SFA: Saturated fatty acids; USFA: Unsaturated fatty acids; PUFA: Polyunsaturated fatty acids

Table 3: Mineral Elements Composition of *R. regia* and *P. macarthurii* Kernels

Mineral (mg/L)	*R. regia*	*P. macarthurii*	Mineral	*R. regia*	*P. macarthurii*
Ca	2.44±0.014	71.50±0.044	Mg (mg/L)	8.20±0.010	23.10±0.004
Cu	0.22±0.001	0.19±0.003	Mn (mg/L)	0.69±0.018	0.82±0.010
Fe	3.03±0.045	1.52±0.000	Na (ppm)	24.60±0.003	22.40±0.010
Zn	0.99±0.082	0.82±0.097	K (ppm)	50.10±0.001	18.02±0.005

Results presented as mean ± standard deviation of three determinations

CONCLUSION

The kernels of *R. regia* and *P. macarthurii* contain high amount of glutamic acid, aspartic acid, arginine, and leucine. The kernel oils of *R. regia* and *P. macarthurii* are endowed with unsaturated fatty acids (oleic and linoleic acids) and saturated fatty acids (palmitic and stearic acids). Also, the kernels of *R. regia* are a rich source of fixed oil which may be utilized in food processing because of its high oleic and linoleic acids content. In addition, the main mineral elements in *R. regia* kernels were sodium and potassium levels while *P. macarthurii* kernels contained relative higher amount of calcium and magnesium. Therefore, these palms are endowed with vital nutritional components and may be exploited as potential products for animal nutrition, edible oils, and for other applicable industrial purposes.

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