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Proximate analysis and mineral composition of *Pimentaracemosa*var. *racemosa*fruits collected from Táchira state, Venezuela

Abstract

*Pimentaracemosa*var.*racemosa*(Myrtaceae) is a Caribbean arboreal plant known as Bay rum, with a special interest for the cosmetics industry, due to its essential oil. In present study, proximate composition and mineral content of Bay rum fruits was analyzed and results compared to the USDA (2012),[1] through the nutrient database for *Pimentadioica*fruits. The results of bromatologic test of Bay rum revealed a high content of crude fiber (39.46%) and ashes (18.58%). Furthermore, minerals such as potassium (K) and zinc (Zn), found in ashes by using ICP-AES, revealed a higher content of these (6.6 and 1.1 times, respectively), comparing to *P. dioica*. Bay rum fruits might be considered as possible source of Zn and K for human and animal consumption. Additionally, the high crude fiber content might contribute to blood sugar levels regulation and also to reduce developing gastrointestinal diseases such as colon cancer.

Keywords: *Pimentaracemosa*, fruits, proximate analysis, minerals, potassium, zinc

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Introduction

*Pimentaracemosa*var.*racemosa*(Mill.) J.W. Moore, belongs to *Pimenta*genus (Myrtaceae family), commonly known as Bay-Rum Tree, Malagueta, Pepita species and pepper, which is native to the West Indies, being widely grown in the tropical America.[2–10] It is popular in the local cuisine of Dominican Republic.[11] *Pimenta*genus is composed by 19 accepted species, however, in Venezuela, is only represented by *P. racemosa*(Mill.) and it is distributed through eight states, including Táchira state, out of the total around the country.[5-10] To date, studies on this species have been focused on the leaves due to the content and quality of volatile essences that, once distilled, are used in the manufacture of cosmetics, especially in formulations such as after shave lotions, soaps, perfumes and hair treatments.[4,12] Among the biological properties studied on the essential oil of this species include antioxidant,[8,13,14] antibacterial,[7,15] antifungal[7,16] and insecticide[17] activities; while on leaf extracts of this species only schistosomicidal,[18] parasiticidal[19] and antibacterial[20] activities have been reported. It is important to state that natural products search with potential use for human being either in food, cosmetic as pharmaceutical industry has always been a topic of great interest for researchers. To investigate biological properties of secondary metabolites has encouraged scientists all over the world, in order to find new therapeutic alternatives in medicinal plants, such as antibiotic agents, insecticide, antiviral, antioxidant, antitumoral, among others. Present investigation aims to determine the proximal composition and mineral content of *P. racemosa*var.*racemosa*fruits and to compare this to those reported for *P. dioica* fruits by the United States Department of Agriculture (USDA) in 2012. According to literature consulted, there are not previous reports on this matter related to the species under investigation.

Experimental

Materials

Collection of plant material*Pimentaracemosa*var. *racemosa*fruits, were collected in April 2012, near to "Los Corredores de la Palmita" Junín Municipality, Rubio town, located at southwestern Táchira state, Venezuela, altitude 859 m.s.n.m. Botanical identification was carried out by Dr. Leslie R. Landrum, Herbarium Curator, School of Life Sciences at Arizona State University (ASU), USA. Specimens collected in field are sheltered in Venezuela at Herbarium of the Faculty of Pharmacy and Biomedical Sciences (MERF), University of Los Andes (BC-01 code) and also at Arizona Herbarium of Arizona State University (ASU0075448 code), USA (Figure 1).

Figure 1 *P. racemosa* var. *racemosa.*

Plant material processing to assess proximate analysis and mineral composition

A sample of 250g of unripe fruit were dried in an oven with recirculating air at 40°C until constant weight (three days), and then crushed, yielding 100g of dried and ground fruits. This material was maintained in storage until assays performance.

Methods

Proximate composition determination

Proximal chemical composition analysis was performed according to the AOAC standard methods (1998). Moisture content (method 930.15), lipids (method 920.39), ashes (method 942.05), protein (method 988.05), crude fiber (method 962.09) were determined and total carbohydrates were calculated by difference between the value of 100 and the complete amount of moisture, protein, fat, and ash percentages[21] for *Pimentaracemosa*var.*racemosa*grounds fruits. All assays were accomplished by triplicate. The energy calculation was carried out according to the standards of the Ministry of Health and Social Development of the National Institute of Nutrition of Venezuela[22] compiled in a series of blue books according to the Food Composition Table for Practical Use.[23] Results are expressed in Kcal per 100g of grounds fruits.

Determination of minerals

Determination of minerals was performed in homogenized ashes, using Inductively Coupled Plasma of Atomic Emission Spectroscopy technique (ICP-AES), by a sequential brand VARIAN equipment, and Liberty AX model. This assay was performed at the Regional Laboratory of Analytical Services (LaRSA), Chemistry Department, Faculty of Science, University of Los Andes, Venezuela. Wavelengths used are dependent on each element, as follows: Al (308.215nm), As (193.696nm), Ca (317.933nm), Cu (324.752nm), P (213.618nm), Fe (259.940nm), Li (670.784nm), Mg (285.213nm), Mn (260.569nm), K (766.490nm), Pb (220.353nm), Se (196.026nm), Na (589.592nm) and Zn (206.200nm), with detection limits between 0.15ppb (Mn) to 14.6ppb (As).

GC/MS analysis

Chemical composition of fat was analyzed by gas chromatography equipped with mass spectrometer [6] **(Contreras-Moreno *et al.*, 2014a)**, with a modification in terms of fat analysis. In this matter, fat was treated with a carbon active filter to eliminate pigments. This assay was performed during 60 minutes.

Results and discussion

The proximate composition of *P. racemosa*var.*racemosa*fruits showed 18.58% ash, 7.08% protein, 6.97% fat, 67.38% carbohydrates (39.46% crude fiber), expressed on a dry basis and 12.78% moisture (Table 1), while, for the species *P. dioica* 5.08% ash, 6.65% protein, 9.49% fat, 78.79% carbohydrates (23.60% crude fiber) on a dry basis, and 8.46% moisture. Data for *P. dioica* has been previously reported (USDA, 2012) and is used to compare results of present investigation. According to results, fat content (6.97%) and carbohydrates content (67.38%) present in *P. racemosa*var. *racemosa*is lower than *P. dioica* (9.49% and 78.79%, respectively), protein content is similar in both species, while moisture content (12.78%), ash (18.58%) and crude fiber (39.46%) content are higher comparing to *P. dioica* (8.46%, 5.08% and 23.6%, respectively). Ashes, crude fiber, and moisture of *P. racemosa*var.*racemosa*showed to be 3.7; 1.7 and 1.5 times higher than values reported by the USDA for *P. dioica*. This species is used for comparison since is the only sample with official data reported. According to results, high crude fiber content showed by *P. racemosa*var.*racemosa*in present investigation might be considered as beneficial consumption for human and animal health, since it might improve the gastrointestinal system, aid in regulating bloodsugar levels and may be used as cancer prevention.[24,25] Furthermore, branches, leaves and fruits of *P. racemosa*var.*racemosa*has been used as a food ingredient in Taiwan.[26] Moreover, the caloric intake (Table 2) determined for the fruits of *P. racemosa*var. *racemosa*(314.46Kcal/100g) was calculated according to the criteria of the National Institute of Nutrition of Venezuela (INN-Venezuela), Ministry of Health and Social Development; while the caloric content of *P. dioica* fruits (263 Kcal / 100g) was taken from data reported by the USDA (2012). Therefore, the results obtained for *P. racemosa*var. *racemosa*in this investigation were developed following the standards published by the USDA (Table 2), in order to use the same calculation basis for the comparison.Regarding energy (Table 2), fruits of *P. racemosa*var.*racemosa*(209.71Kcal/100g) has a lower energy value than *P. dioica* (263 Kcal/100g), both species have shown a similar energy value and are generally used in Táchira state (Venezuela) as a natural flavoring, specifically in homemade desserts such as milky rice, papaya sweet dessert, among others; as substitute of cloves and cinnamon.On the other hand, minerals present in ashes of *P. racemosa*var.*racemosa*obtained from proximal analysis using ICP-AES technique showed the presence of Ca, P, Fe, Mg, Mn, Zn and K; however, no presence of Al, As, Cu, Li, Pb, Se and Na was detected (Table 3). A considerable amount of Zn (6.6 mg) was observed in *P. racemosa*var.*racemosa*, being 6.6 times higher than *P. dioica*, while the non-detection of As and Pb might indicate a lack of toxicity of the species under investigation by these heavy metals. Results obtained in present investigation are in accordance to data published in USDA (2012) that reports the presence of Al, Pb or Li in *P. dioica*fruits.It is important to state that high values of Zn showed by *P. racemosa*var. *racemosa*in present investigation, might be considered as beneficial to hair health since it might help DNA and RNA production, which, in turn, leads to normal follicle-cell division, also for helping to stabilize cell-membrane structures and assists in the breakdown and removal of superoxide radicals,[27] in addition, GC-MS analysis carry out to determine fat composition revealed the presence of seven components being ethylbenzene (13.12%), 1,3-dimethylbenzene (54.94%) and 1,4- dimethylbenzene (24.30%) in major proportions. The chemical constituents of fat are listed in Table 4 in order of elution from an HP5-MS capillary column.Whereas, values of K (1142.92mg) and absence of Na in *P. racemose*var.*racemose*, might be seen as beneficial to hypertensive patients, since a low potassium diet, decreases blood pressure.[21,23]

Table 1 Proximate composition (%) average in wet basis and dry basis of *P. racemosa*var. *racemosa* and *P. dioica*

Analysis	*P. racemosa*var.*racemosa*		*P. dioica*by USDA (2012)	
	Wetbasis	Drybasis	Wetbasis	Drybasis
Moisture (%)	12.78 ± 0.026		8.46 ± 0.273	
Protein (%)	6.17 ± 0.625	7.08 ± 0.716	6.09 ± 0.336	6.65
Fat (%)	6.08 ± 0.031	6.97 ± 0.037	8.69 ± 0.120	9.49
Ashes (%)	16.20 ± 0.903	18.58 ± 1.031	4.65 ± 0.041	5.08
CrudeFiber (%)	34.42 ± 1.649	39.46 ± 1.898	21.60	23.60
Carbohydrates (%)	58.77	67.37	72.12	78.78

Data represented as mean ± SD of three independent readings

Table 2 Calculation of energy intake (Kcal/100g) of the fruits of *P. racemosa*var. *racemosa*and *P. dioica*

Species	*P. racemosavar.racemosa*		*P. dioica*
Standards	INN-Venezuela	USDA	USDA
Energy (Kcal/100g)	314.46	209.71	263

USDA Factors: Carbohydrate: 2.35, Fat: 8.37, Protein: 3.36, Nitrogen to Protein Conversion: 6.25

INN-Venezuela Factors: Carbohydrate: 4.00, Fat: 9.00, Protein: 4.00, Nitrogen to Protein Conversion: 6.25

Table 3 Mineral content of *P. racemosa*var. *racemosa* fruits, measured by ICP--AES technique and *P. dioica*according to USDA, calculated per 100g of fruits

Mineral	*P. racemosavar. racemosa* (mg)	*P. dioica* (mg)
Aluminum (Al)	ND	NR
Arsenic (As)	ND	NR
Calcium (Ca)	520.96 ± 53.16	661.00 ± 76.56
Copper (Cu)	ND	0.55 ± 0.00
Phosphorus (P)	86.38 ± 2.66	113.00 ± 6.24
Iron (Fe)	4.78 ± 0.68	7.06 ± 0.48
Lithium (Li)	ND	NR
Magnesium (Mg)	67.78 ± 0.08	135.00 ± 12.11
Manganese (Mn)	0.54 ± 0.04	2.94 ± 0.00
Potassium (K)	1142.92 ± 37.21	1044.00 ± 67.81
Lead (Pb)	ND	NR
Selenium (Se)	ND	$2.70*10^{-3} \pm 4.62*10^{-4}$
Sodium (Na)	ND	77.00 ± 7.24
Zinc (Zn)	6.64 ± 0.23	1.01 ± 0.17

ND = not detected by ICP-AES; NR = Not reported by USDA (2012).Data represented as mean ± SD of three independent readings

Table 4 Compounds (% total peak area) of fat obtained from proximate analysis of *Pimentaracemosa*var. *racemosa*collected in Táchira,Venezuela

Compound	Essentialoil (%)	RI
Ethylbenzene	13.12	850
1,3-dimethylbenzene	54.94	861
1,4-dimethylbenzene	24.30	894
Undecane	1.85	1094
Dodecane	2.12	1194
Tridecane	1.89	1302
n-tetradecane	1.78	1394

RI, retention indices relative to C6–C24 n-alkanes on the HP-5 MS column; MS, mass spectrum

Conclusion

Results of present investigation revealed an important contribution of Zn and K in *P. racemosa*var.*racemosa.* High values of Zn are considered as valuable to prevent hair loss whereas presence of K and absence of Na might be useful to hypertensive patients. As and Pb were not detected in this specie, this could indicate no toxicity by these metals. Furthermore, *P. racemosa*var. *racemosa*fruits showed a correlation of higher crude fiber content; regarded as beneficial for human health, especially to improve the gastrointestinal system, regulate blood sugar levels and prevent colon cancer.[27–37]

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None.

Conflicts of interest

Authors declared that there is no conflict of interest.

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