Short communication

Chemical composition of faveleira (*Cnidoscolus phyllacanthus*) seeds collected in different seasons[1]

*Jovilma Maria Soares de Medeiros[2], Penha Patrícia Cabral Ribeiro[3], Erika Paula Silva Freitas[3], Jéssica Anarellis Barbosa dos Santos[3], Karla Suzanne Florentino da Silva Chaves Damasceno[3]**

10.1590/0034-737X201865030009

ABSTRACT

Cnidoscolus phyllacanthus, popularly known as favela or faveleira, is a species of the caatinga vegetation highly resistant to drought, with high nutritional content, and having several uses. The objective of this work was to evaluate the influence of different seasons on the chemical composition of faveleira seeds in the region of Seridó/RN. The seeds collected in different seasons were separated into 3 lots (lot 1 - rainy season; lot 2 - initial dry season; lot 3 - prolonged dry season), ground, and analyzed for moisture, ash, lipids, protein, and carbohydrates. The chemical analysis the seeds showed predominance of lipids and proteins. The results showed that moisture was significant different ($p < 0.05$) between all the lots; the ash content in lot 1 was significantly ($p < 0.05$) lower (4.67 ± 0.18) than lot 3 (4.96 ± 0.08); and protein content was highest in lot 3 (30.42 ± 1.63) and significantly ($p < 0.05$) different from the others. There was a significant difference ($p < 0.05$) for lipids between the lots, with lot 2 showing the lowest content (21.57 ± 0.37). Significant difference ($p < 0.05$) was also found for carbohydrates between the lots, with lot 1 (14.37 ± 1.83) having the lowest content and lot 2 (39.17 ± 0.52) the highest content. The differences observed between the lots are attributed to the harvest of the seeds in different seasonal periods. The results show that the seasonal period influences the nutritional value of faveleira seeds, and that better forms of use need to be identified according to the period of harvesting.

Keywords: nutritional value; favela; faveleira; faveleira seed; caatinga; seasons.

RESUMO

Composição química da semente da faveleira (*Cnidoscolus phyllacanthus*) em diferentes períodos sazonais

Na vegetação da caatinga a *Cnidoscolus phyllacanthus***,** popularmente conhecida como favela ou faveleira, destaca-se por ser uma planta altamente resistente a seca e de alto teor nutricional, apresentando diversas aplicações. O objetivo deste trabalho foi avaliar a influência de diferentes períodos sazonais na composição química da semente da faveleira da região Seridó/RN. As sementes, separadas em 3 lotes por períodos sazonais diferentes (lote 1 - época chuvosa; lote 2 - estiagem inicial; lote 3 - estiagem prolongada), foram trituradas e analisadas quanto aos teores de umidade, cinzas, lipídios, proteínas e carboidratos. Verificou-se que as sementes da faveleira apresentaram predominância de lipídios e de proteínas. Na análise de umidade observou-se diferença significativa ($p < 0,05$) entre todos os lotes, o teor de cinzas foi significativamente ($p < 0,05$) menor no lote 1 ($4,67 \pm 0,18$) quando comparado ao lote 3 ($4,96 \pm 0,08$), na análise de proteínas o lote 3 ($30,42 \pm 1,63$) apresentou o maior teor e diferiu significativamente ($p < 0,05$) dos demais. Quanto aos lipídios houve diferença significativa ($p < 0,05$) entre os lotes, sendo o lote 2 ($21,57 \pm 0,37$) o que

Submitted on May 27th, 2015 and accepted on May 09th, 2018.

[1]This work is part of the first author's undergraduate monograph.

[2] Universidade Federal Rural do Semi-Árido, Departamento de Ciências Animais, Mossoró, Rio Grande do Norte, Brazil. jovilmasoares@outlook.com

[3] Universidade Federal do Rio Grande do Norte, Departamento de Nutrição, Natal, Rio Grande do Norte, Brazil. penhapatriciar@hotmail.com; erikapsf@hotmail.com; janarellis@gmail.com; karlasuzanne@yahoo.com.br

* Corresponding author: karlasuzanne@yahoo.com.br

apresentou o menor teor. Em relação aos carboidratos também houve diferença significativa ($p < 0,05$) entre os lotes, sendo o lote 1 (14,37 ± 1,83) o de menor teor e o lote 2 (39,17 ± 0,52) o de maior. As diferenças observadas entre os lotes ocorreram, em virtude de as sementes terem sido colhidas em períodos sazonais diferentes. A partir dos dados encontrados é possível afirmar que o período sazonal influência no valor nutritivo da semente da faveleira, devendo-se verificar as melhores formas de utilização de acordo com o período de colheita.

Palavras-chave: valor nutritivo; favela; semente de faveleira; caatinga; períodos sazonais.

INTRODUCTION

The caatinga is the predominant vegetation of the semi-arid region in the Brazilian Northeast. It is influenced by the climatic conditions, especially the distribution of rainfall, which is quite irregular during the year (Alves, 2007; Damasceno, 2007, Santana & Souto, 2011). *Cnidoscolus phyllacanthus*, popularly known as favela or faveleira, stands out in this vegetation (Oliveira *et al*., 2008).

Faveleira is a tree of the Euphorbiaceae family (Lacerda *et al*., 2005) resistant to drought because its roots reach the deepest layers of the soil and take advantage of water and nutrients present there (Arriel *et al*., 2004; Damasceno, 2007; Pordeus Neto *et al*., 2009), being thus classified as a xerophilic plant (Oliveira *et al*., 2008).

This plant species commonly grows around cities, bordering roads and abandoned fields. It grows in all states of the Northeast to the north of Minas Gerais, especially in the regions of the Sertão and Caatinga. In the state of Rio Grande do Norte, it is found in the municipalities of Acari, Serra Negra do Norte, and Caicó (Oliveira *et al*., 2008), as well as in other municipalities such as São José do Seridó.

Faveleira has several uses, including recovery of degraded areas, human and animal (goats, cattle, and sheep) feed, medicinal, wood, and fuel (Arriel *et al*., 2004; França *et al*., 2008; Pordeus Neto *et al*., 2009).

Considering its multiple uses and complete adaptation to the adverse conditions of the semi-arid region, the studies carried out and published to date show that the species is very important for the development of the region, a predominant tree component in degraded areas (Candeia, 2005).

It is a nutrient rich species with a significant amount of lipids and proteins also classified as an oilseed. Because oilseeds are rich in nutrients, they are widely used in manufactured food systems or directly in human and animal feeding (Cavalcanti *et al*., 2009; Souza *et al*., 2012). Faveleira seed and its oil have antioxidant activities. The by-product of the oil production is a source of phenolic compounds, mainly flavonoids, thus, it has physicochemical properties that may indicate its use as edible oil (Ribeiro *et al*., 2017).

Because of the high nutritional and industrial value of the species, it is important to study the factors that may influence its chemical composition, such as rainfall and locality. Therefore, it is of interest to study the chemical composition of the faveleira in the regions where it has good local consumption (availability) during all year, as is the case of the municipality of São José do Seridó/RN.

From the foregoing, therefore, the objective of this study was to evaluate the influence of different seasons on the chemical composition of seeds of faveleira (*Cnidoscolus phyllacanthus*) produced in the municipality of São José do Seridó/RN.

MATERIAL AND METHODS

Thorny fruits of *Cnidoscolus phyllacanthus* were both picked from the plant and collected from the ground, in the rural area of São José do Seridó/RN, in three different seasons. The first lot was acquired in the rainy season, June 2011 (lot 1), the second in the initial dry season, November 2012 (lot 2), and the third in the prolonged dry season, February 2013 (lot 3). The seeds were manually removed from fruits using handmade extractors, placed in plastic bags and stored in the refrigerator until sent for analysis in the Laboratory of Food Analysis of the Department of Nutrition - UFRN, Natal / RN.

The seeds were ground and analyzed for moisture content through oven drying at 105 °C to constant mass. Then, parts of the ground seeds were dried to carry out the other analyses on the dry basis, in triplicate. The lipid analysis was performed by the Soxhlet method, which consists of a continuous extraction process, using hexane as solvent. Ash content was determined by muffle incineration at 550 °C to constant mass. Protein content was determined by the Kjeldahl method. All analyses were performed using the methods standardized by the Adolfo Lutz Institute (Brazil, 2005). After the analyses, all results were converted to wet basis. Carbohydrates were determined by difference (100 g of material - total sum of values found for moisture, lipids, ash, and protein).

The data were analyzed by analysis of variance (ANOVA) and Tukey HSD test. The error probability level $p < 0.05$ was used to determine the significance of the tests, using the IBM SPSS Statistics 20.

RESULTS AND DISCUSSION

Table 1 presents the results of the analysis of the faveleira seeds. The predominant components in the seeds are proteins and lipids. The content of lipids was greater than the other components in lots 1 and 3. According to Carvalho & Nakagawa (2000), seeds can be classified regarding the chemical composition considering the main compound stored, thus the faveleira seeds can be characterized as oilseed, which was confirmed by Cavalcanti & Bora (2010).

Significant difference ($p < 0.05$) was found for moisture between the lots: lot 1 (seeds from the rainy season) showed the highest moisture content (18.38%), differing significantly ($p < 0.05$) from the two other lots; and lot 3 (prolonged dry season) showed the lowest moisture content (6.65%), which was also significantly different ($p < 0.05$) from the others. This result is explained by the different conditions of the seed collection period of each lot, as it is expected that during the dry season seeds will have less water because of the low water availability for the plant in this period (Oliveira *et al*., 1998).

The ash content was not significantly different ($p > 0.05$) between lots 1 (4.67%) and 2 (4.53%), however lot 3 had significantly higher ($p < 0.05$) ash content (4.96%) than the others. It was expected that the ash content would increase gradually from one lot to another, however, comparing the periods of greatest changes in temperature and rainfall, i.e., rainy season and prolonged dry season, lot 1 and lot 3, respectively, a significant ($p < 0.05$) increase was observed between them. During the dry season, sediment deposition in soil is not affected by leaching due to rain, favoring greater permanence of minerals in the soil and consequently in the parts of the plants (Amarante *et al*., 2011), which explains the highest ash content in the seeds from the prolonged dry season.

In relation to protein content, lot 1 (27.12%) and lot 2 (26.99%) were not significantly different ($p > 0.05$). Lot 3 (prolonged dry season) had the highest protein content (30.42%) and was significantly different ($p < 0.05$) from the two others. Amarante *et al*. (2011) found similar results for the nutrient composition of aninga fruit (*Montrichardia linifera*) between rainy and dry seasons and argued that the incident solar radiation in the dry season leads to greater evaporation and thus contributes to increase the concentration of some components. Antoniassi *et al*. (2013) also observed that sesame seeds cultivated in a rainfed environment had higher protein content (23.16%) than those grown in irrigated environment (18.95%).

Lipid content was found significantly different ($p < 0.05$) between the lots. The results show that lot 1 (seeds from the rainy season) had the highest lipid content (35.46%) and was different ($p < 0.05$) from the other lots. Lot 2 (initial dry season) had the lowest lipid content (21.57%) and was also significantly different ($p < 0.05$) from the others (Lot 3: 30.97%). Amarante *et al*. (2011) found an increase in lipid content in aninga fruits from the dry season (2.40%) in relation to fruits from the rainy season (0.88%). The authors attributed this difference to the concentration of nutrients after dehydration fruits undergo during the dry season. The faveleira seeds analyzed in this study had this behavior only between lots 2 and 3, which, similarly to the results of Amarante *et al*. (2011), were collected in different seasons. However, we found that the seeds from dry seasons showed significantly lower lipid content ($p < 0.05$) than seeds from the rainy season, corroborating with the results reported by Antoniassi *et al*. (2013), who found higher lipid content (55.98%) for sesame seeds grown under irrigation.

There was increase in carbohydrate content from lot 1 (14.37%) to 3 (27.00%). Thus, this difference between the rainy season and prolonged dry season indicates that the season of sample collection interfered in the carbohydrate content. Some authors have observed correlations between sugar accumulation of water stress in plants, demonstrating that in plants such as soybean the low availability of water can cause an osmotic adjustment that leads to the accumulation of some solutes, including sugars (Chaves Filho & Stacciarini-Seraphin, 2001)

Table 1: Centesimal composition on wet basis of three lots of faveleira seeds - São José do Seridó/RN, 2011-2013

Lot[(1)]	Moisture (%)	Ash (%)	Protein (%)	Lipids (%)	Carbohyydrate[(2)] (%)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Lot 1	$18.38^{a} \pm 0.28$	$4.67^{b} \pm 0.18$	$27.12^{b} \pm 0.83$	$35.46^{a} \pm 1.76$	$14.37^{c} \pm 1.83$
Lot 2	$7.74^{b} \pm 0.07$	$4.53^{b} \pm 0.03$	$26.99^{b} \pm 0.45$	$21.57^{c} \pm 0.37$	$39.17^{a} \pm 0.52$
Lot 3	$6.65^{c} \pm 0.04$	$4.96^{a} \pm 0.08$	$30.42^{a} \pm 1.63$	$30.97^{b} \pm 0.79$	$27.00^{b} \pm 1.42$

[abc]. Means followed by different letters in the column are significantly different ($p < 0.05$) by the Tukey's test (0.05). [(1)] Lot 1 (rainy season); lot 2 (initial dry season); and lot 3 (prolonged dry season). [(2)] Calculated by difference.

Arriel *et al*. (2004) analyzed seeds collected in the State of Paraíba during the rainy season and found contents of protein (21.2%), ash (3.5%), and lipids (32.6%) lower than the results found for seeds of lot 1 (27.12%, 4.67%, 35.46% for protein, ash, and lipids, respectively) collected in a similar season.

In relation to the centesimal composition, Cavalcanti *et al*. (2012) reported seeds of faveleira with 7.60% moisture, 26.30% protein, 21.80% lipids, 4.40% ash, and 39.90% carbohydrates, which are values similar to those found for seeds of lot 2 in the present study.

Cavalcanti *et al*. (2009) analyzed the composition of raw seeds (without the shell) of faveleira in species with and without thorn from the State of Paraíba. The protein (33.00%), lipids (40.56%), and ash (5.45%) of thorny faveleira seeds were higher than the seeds of all lots analyzed in the present study, but moisture (4.27%) was lower than the seeds of all lots. Carbohydrate content (16.72%) was higher than lot 1 (14.37%) and lower than the other lots (39.17% and 27.00% for lots 2 and 3, respectively) from São José do Seridó, RN.

The chemical composition of faveleira seeds described in this study is different between the three lots, and different between these lots and those found in other studies analyzed. These differences can be explained by several environmental factors such as rainfall, soil type, and time of sowing and harvesting these plants, which interact with plant genetics and, consequently, interfere in the composition of the plant (Soares *et al*., 2013). As an example of this environmental interference, we can mention the reduced protein content in soybean crops of the northern region of the United States due to low temperatures and high rainfall, when compared to other regions of the country (Vollmann *et al*., 2000).

This interference stems from the ability of seeds to mobilize components to develop a plant. When we observe a characteristic, we observe the phenotype, since this is the result of summing genotypic and environment effects and the interaction between both. There are some genes that undergo little interference from the environment, however, there are many characteristics whose phenotype depends on the expression of many genes and on the interaction between them and the environment, as in the case of grain yield (Simões *et al*., 2010).

Considering the variation in chemical composition observed among plant species from different localities, the analysis of food composition is important to provide, among other things, information on the nutritional adequacy of the diet of populations from different localities (Torres *et al*., 2000), since the centesimal composition allows the characterization of chemical components of the food, showing its nutritional value, which allows a better use by the population.

CONCLUSIONS

The seeds of the thorny faveleira from the rural area of São José do Seridó have proteins and lipids as main components, characterizing them as an oilseed plant. The period of harvest was found to interfere in the nutritional composition of the seeds. During the dry season there is reduction in moisture and consequent concentration of other nutrients, except lipids. Therefore, we suggest furthering the studies on the chemical composition of faveleira seeds and analyzing better forms of use, so that the population makes appropriate use of this regional nutrient-rich food.

ACKNOWLEDGEMENTS

The authors thank PROPESQ / UFRN for the Scientific Initiation fellowships.

REFERENCES

Alves JJA (2007) Geoecologia da caatinga no semiárido do nordeste brasileiro. Climatologia e Estudos da Paisagem, 2:58-71.

Antoniassi R, Arriel NHC, Gonçalves EB, Freitas SC, Zanotto DL & Bizzo HR (2013) Influência das condições de cultivo na composição da semente e do óleo de gergelim. Revista Ceres, 60:301-310.

Amarante CB, Solano FAR, Lins ALFA, Müller AH & Müller RCS (2011) Caracterização física, química e nutricional dos frutos da aninga. Planta Daninha, 29:295-303.

Arriel EF, Paula RC, Bakke AO & Arriel NHC (2004) Divergência Genética em *Cnidoscolus phyllacanthus* (Mart.) Pax. et K. Hoffm. Revista Brasileira de Oleaginosas e Fibrosas, 8:813-822.

Brasil (2005) Ministério da Saúde. Agência Nacional de Vigilância Sanitária. Métodos Físico-Químicos para Análise de Alimentos. 4ª ed. Brasília, Ministério da Saúde. 640p.

Carvalho NM & Nakagawa J (2000) Sementes – Ciência, tecnologia e produção. 4ª ed. São Paulo, Funep. 580p.

Candeia BL (2005) Faveleira (*Cnidoscolus phyllacanthus* (Mart.) Pax et k. Hoffm.) inerme: obtenção de mudas e crescimento comparado ao fenótipo com espinhos. Dissertação de Mestrado. Universidade Federal de Campina Grande, Patos. 62p.

Cavalcanti MT & Bora OS (2010) Análise das proteínas e estudo reológico dos isolados protéicos das amêndoas da faveleira (*Cnidosculus phyllacanthus* (Mart.) Pax. et K. Hoffm.) com e sem espinhos. Revista Instituto Adolfo Lutz, 69:243-251.

Cavalcanti MT, Bora PS & Carvajal JCL (2009) Propriedades funcionais das proteínas de amêndoas da faveleira (*Cnidosculus phyllacanthus* (Mart.) Pax. et K. Hoffm.) com e sem espinhos. Ciência e Tecnologia de Alimentos, 29:597-602.

Cavalcanti MT, Bora PS, Carvajal JCL, Florentino ER & Silva FLH (2012) Análise térmica e perfil de ácidos graxos do óleo das amêndoas de faveleira (*Cnidosculus phyllacanthus* Pax. & K. Hoffm) com e sem espinho. Revista Verde de Agroecologia e Desenvolvimento Sustentável, 7:154-162.

Chaves Filho JT & Stacciarini-Seraphin E (2001) Alteração no potencial osmótico e teor de carboidratos solúveis em plantas jovens de lobeira (*Solanum lycocarpum* St.-Hil.) em resposta ao estresse hídrico. Revista Brasileira de Botânica, 24:199-204.

Damasceno MM (2007) Composição bromatológica de forragem de espécies arbóreas da caatinga paraibana em diferentes altitudes. Dissertação de Mestrado. Universidade Federal de Campina Grande, Patos. 61p.

França ISX, Souza JA, Baptista RS & Britto VRS (2008) Medicina popular: benefícios e malefícios das plantas medicinais. Revista Brasileira de Enfermagem, 61:201-208.

Lacerda AV, Nordi N, Barbosa FM & Watanabe T (2005) Levantamento florístico do componente arbustivo-arbóreo da vegetação ciliar na bacia do rio Taperoá, PB, Brasil. Acta Botânica Brasilica, 19:647-656.

Oliveira F, Akisue G & Akisue MK. (1998) Farmacognosia. São Paulo, Atheneu. 412p.

Oliveira DM, Pimentel LA, Araújo JAS, Medeiros RMT, Dantas AFM & Riet-Correa F (2008) Intoxicação por *Cnidoscolus phyllacanthus* (Euphorbiaceae) em caprinos. Pesquisa Veterinária Brasileira, 28:36-42.

Pordeus Neto J, Rodrigues OG, Lima EQ, Marinho MGV & Dantas JP (2009) Avaliação da ação clastogênica do óleo de C*nidoscolus phyllacanthus (Mart.) Pax. et K. Hoffm* em células medulares. Revista de Biologia e Farmácia, 3:06-22.

Ribeiro PPC, Silva DML, Assis CF, Correia RTP & Damasceno KSFSC (2017) Bioactive properties of *faveleira* (*Cnidoscolus quercifolius*) seeds, oil and press cake obtained during oilseed processing. PLoS One, 12:01-12.

Santana JAS & Souto JS (2011) Produção de serapilheira na Caatinga da região semi-árida do Rio Grande do Norte, Brasil. Idesia, 29:87-94.

Simões CMO, Schenkel EP, Gosmann G, Mello JCP, Mentz LA & Petrovick PR (2010) Farmacognosia: da planta ao medicamento. 3ª ed. Porto Alegre, Editora da UFRGS. 1104p.

Soares AB, Pin EA & Possenti JC (2013) Valor nutritivo de plantas forrageiras anuais de inverno em quatro épocas de semeadura. Ciência Rural, 43:120-125.

Souza BB, Batista NL & Oliveira GJC (2012) Utilização da faveleira *(Cnidoscolus phyllacanthus)* como fonte de suplementação alimentar para caprinos e ovinos no semiárido brasileiro. Agropecuária Científica no Semi-Árido, 8:23-27.

Torres EAFS, Campos NC, Duarte M, Garbelotti ML, Philippi ST & Rodrigues RSM (2000) Composição centesimal e valor calórico de alimentos de origem animal. Ciência e Tecnologia de Alimentos, 20:145-150.

Vollmann J, Fritz CN, Wagentristl & Ruckenbauer P (2000) Environmental and genetic variation of soybean seed protein content under Central European growing conditions. Journal of the Science of Food and Agriculture, 80:1300-1306.