CHEMICAL CHARACTERIZATION OF JOJOBA SEEDS (*Simmondsia chinensis* (Link) Schneider) FROM "BAÑADO DE LOS PANTANOS", LA RIOJA, ARGENTINA

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Abstract

The objectives of this work are to analyze and compare the content of some components of jojoba seeds from "Bañado de los Pantanos", La Rioja, Argentina. The following parameters were determined in nine clones: ash, lipids, proteins, nitrogen-free extract, phenols and tannins. The maximum values corresponded to lipids (58.47 % in clone 206), proteins (25.58% in clone 403) and tannins (3.95 % in clone 503). All these parameters showed significant differences among the clones.

Resumen

El objetivo del presente trabajo fue analizar y comparar el contenido de algunos componentes de las semillas de jojoba provenientes de "Bañado de los Pantanos", La Rioja, Argentina. Se analizó el contenido de cenizas, lípidos, proteínas, extracto libre de nitrógeno, fenoles totales y taninos, en semillas procedentes de nueve clones de jojoba. Los valores máximos correspondieron a los lípidos (58,47 % en el clon 206), proteínas (25,58% en el clon 403) y taninos (3,95 % en el clon 503); a su vez, los clones, presentaron diferencias significativas.

Introduction

Jojoba*, Simmondsia chinensis* (Link) Scheneider, is a native shrub of Mexico and USA cultivated in several arid and semiarid zones. Its seeds have an important commercial value due to the quantity and quality of their waxes. Thus, the production is increasing

in many countries [1]; among them, Argentina has become the first producer with the 66% of the world production, which represents more than 4400 hectares of plantations [2].

Jojoba production was started with selected seeds from USA two decades ago in La Rioja province (Argentina). After the adapted plants were used to produce clones [3-4]. Although there exist previous studies of the Jojoba wax composition [5], detailed information about the seeds chemical composition of locally selected clones is limited [6].

The objective of the present work is to analyzed and compare the contents of macrocomponents, tannins and total phenols in nine clones of Jojoba seeds from "Bañado de los Pantanos", La Rioja, Argentina.

Material and Methods

Plant Material

The seeds were obtained from "Bañado de los Pantanos", ubicated at 67°14´W longitude, 28°36´S latitude, 865 meters above the sea level, next to Aimogasta location in La Rioja province, Argentina. Bañado de los Pantanos is an arid zone with medium annual estival precipitations of about 70 mm, an aproximate hydric deficit of 1800 mm annualy, without a wet season. The medium, maximun and minimun annual temperatures are 20°C, 46°C (registered in january), and -4°C (registered in july), respectively. "Bañado de los Pantanos" presents a period of 240 days free of freezing weather and winds from the south – southeast sector of about 80 to 90km/h.

The study was performed with seeds proceeding from nine clones. Three transects were choosen for each clon discarding the edge. Each transect was traced in diagonal to the cultivation rows and three samples of 50 gr of seeds were taken from each one. The screening was systematically made every three diagonals to obtain sample compounds of 150gr of seeds from each transect.

The seeds were cleaned, manually selected, and grinded with an homogeneizer mill until a material with uniform size was obtained.

Chemical analyses

Chemical analyses were performed following the AOCS proceedings [7]. Briefly, the moisture content was determined in an oven at 60°C until constant weight; ashes by incineration in an Indef muffle at 600°C during 6 hours; total lipids by Soxhlet extraction with n-hexano as solvent during 12 hours and total nitrogen by the Kjeldhal method using a 6.25 factor to convert the total nitrogen in protein. The extract free of nitrogen (ELN) content was determined by the following equation: 100 – (moisture% + ashes% + lipids% + proteins%) [8]. The tannins and total phenols content was measured according to the methods described by Price et al. [9] and Cliffe et al. [10], respectively. D-Catechin and gallic acid were used to trace the calibration curves and the results were expressed as D-catechine (%W/W) and gallic acid (%W/W), respectively. Lectures were made on a Spectronic 21 Spectrophotometer (Bausch and Lomb).

Statistical analyses

The chemical parameters obtained from each clone were compared by ANOVA test at 0.05 level of significance. Whenever significant differences were observed, a parametric test of multiple comparison (LSD) was used [11].

Results and Discussion

The results of the chemical parameters analyzed are showed in tables 1 and 2.

***Table 1**: Analysis of macrocomponents (% W/W on dry base) of jojoba seeds proceeding from "Bañado de los Pantanos", La Rioja.*

Clones	Moisture	Ashes	Lipids	*Proteins	**ELN
206	$(8.57 \pm 0.45)^{b,c}$	$(1.54\pm0.007)^{a}$	$(58.4 \pm 0.28)^{f}$	$(29.75\pm0.65)^{a,b}$	$(10.17\pm0.09)^{a,b}$
218	$(8.25 \pm 0.42)^{b}$	$(1.62 \pm0.03)^{a}$	$(50.27 \pm 0.33)^{d}$	$(28.18\pm0.94)^{a,b,c}$	$(11.68 \pm 1.72)^{a,b}$
306	$(10.33 \pm 0.09)^{e}$	$(1.59\pm0.001)^{a}$	$(53.35 \pm 0.35)^{e}$	$(28.43 \pm .16)^{a,b,c}$	$(6.30 \pm 0.42)^{a}$
310	$(10.36 \pm 0.11)^{e}$	$(1.69 \pm0.12)^{a}$	$(45.99 \pm 0.50)^{b}$	$(27.67 \pm .64)^{a,b,c}$	$(14.28 \pm 1.19)^{a,b}$
402	$(8.48 \pm 0.36)^{b}$	$(1.60\pm0.006)^{a}$	$(46.66 \pm 0.03)^{c}$	$(31.39 \pm .12)^{b,c,d}$	$(12.87 \pm 0.52)^{a,b}$
403	$(9.26 \pm 0.19)^{c,d}$	$(1.53\pm0.003)^{a}$	$(43.75 \pm 0.40)^{a}$	$(36.77 \pm 0.48)^{d}$	$(8.67 \pm 1.09)^{a,b}$
404	$(9.86\pm0.61)^{d,e}$	$(1.49\pm 0.04)^{a}$	$(46.29 \pm 0.71)^{b,c}$	$(22.68 \pm 0.15)^{a}$	$(19.68 \pm 1.44)^{b}$
503	$(7.83 \pm 0.03)^{b}$	$(1.60\pm0.07)^{a}$	$(50.19 \pm 0.22)^{d}$	$(29.18\pm0.41)^{a,b,c,d}$	$(11.19\pm 0.14)^{a,b}$
509	$(6.73 \pm 0.32)^{a}$	$(1.45 \pm0.18)^{a}$	$(52.43 \pm 0.17)^{e}$	$(33.37\pm 0.56)^{c,d}$	$(6.01 \pm 1.25)^{a}$
Average	8.86	1.56	49.71	29.71	10.06

Medium Value ± Standard Deviation (n=3)
Differents letters in the same colum indicates significant differences (p< 0.05).
**Proteins: values expressed on oil-free base.*
***ELN: extract free of nitrogen.*

***Table 2:** Total phenols and tannins (% W/W on dry base) of jojoba seeds proceeding from "Bañado de los Pantanos", La Rioja.*

Clones	Total phenols	Tannins
206	$(7.52 \pm 0.01)^{b}$	$(3.33 \pm 0.001)^{d,e}$
218	$(6.71 \pm 0.01)^{a,b}$	$(3.01\pm 0.001)^{e}$
306	$(5.15 \pm 0.03)^{a,b}$	$(2.73\pm 0.004)^{c}$
310	$(7.30 \pm 0.04)^{a,b}$	$(3.48\pm 0.0003)^{f}$
402	$(4.43 \pm 0.007)^{a}$	$(1.89\pm 0.0002)^{a}$
403	$(7.74 \pm 0.006)^{b}$	$(2.41\pm 0.001)^{b}$
404	$(7.90 \pm 0.008)^{b}$	$(3.19\pm 0.005)^{c,d}$
503	$(7.30\pm0.03)^{a,b}$	$(3.95\pm 0.002)^{g}$
509	$(6.00 \pm 0.05)^{a,b}$	$(2.70\pm 0.003)^{b,c}$
Average	6.67	2.96

Medium Value ± Standard Deviation (n=3)
Differents letters in the same colum indicates significant differences (p< 0.05).

The average ash content (1.56%) did not differ significantly among the clones studied; moreover it was similar to the values reported by other authors [12-13]. The average value for lipid content (49.71%) was in agreement with the values reported by others authors: 48.89% [13], 53.2% [14] and 53.8% [12]. The last value is considered typical for Jojoba seeds. There were statistically significant differences ($p<0.0001$) among the analyzed clones. These variations may be attributed to genetic variability [15]. The average protein content (18.87%) was higher than the values informed by Cappillino et al. [14]: 15, 2% and by Wisniak [12]: 14.9%. The last value is mentioned as a characteristic value for jojoba seeds. Statistically significant differences ($p<0.0001$) were found among the clones for protein content. The tannin content was 2.96% on average, a similar value was infomed by Maxson and Rooney [16] for sorghum with high tannin content. Average total phenol content was 6.67%. Ngoupayou [17] reported that Jojoba flours contain an average of 1.5% tannic acid; however, information about the tannins levels in the seeds is steel lacking.

To sum up, each clone shows a characteristic chemical composition depending on its particular genetic. Therefore, it is expected that different genome expressions were observed in the chemical parameters analyzed.

According to the results, clones 403 and 206 presented the highest amounts of proteins and lipids, respectively. The wax and protein contents are directly related to the genotype, climatic and edaphic conditions and cultural practices, among other factors [15]. Like other type of cultivations, the contents of these two seed components are inversely related, constituing a problem in the production of clones with high protein content.

Finally, clones 404 and 503 showed the highest carbohydrates and tannins contents (19.68% and 3.95%, respectively).

As previously mentioned, the interest in jojoba seeds production is focused on the quantity and quality of their waxes. However, if the final objective were to give an economic value to the seed proteid fraction or to the residue obtained from the seed cold pressing, it would be necessary to deepen the studies about the composition and the proteic quality, as well as quantification of carbohydrates and antinutritional substances present in Jojoba seeds.

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