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Chemical evaluation of *Geoffroea decorticans* seeds as source of oil and protein

By **Alicia L. Lamarque***, **Damián M. Maestri, Julio A. Zygadlo** and **Carlos A. Guzmán**

* Cátedra de Química Orgánica, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, IMBIV, CONICET. Av. Vélez Sarsfield 1600, Córdoba 5016, Argentina.

RESUMEN

Evaluación química de las semillas de *Geoffroea decorticans* como fuente de lípidos y proteínas

Se determinaron los contenidos de humedad, aceite, proteínas, carbohidratos y cenizas de las semillas, y las composiciones en ácidos grasos y esteroles del aceite seminal de *Geoffroea decorticans (Leguminosae)* originaria de la región central de Argentina. Las proteínas representaron el 21.6% (p/p) de la semilla. El aceite seminal se extrajo con n-hexano, dando un rendimiento del 47.2% (p/p). Los índices de saponificación y de yodo resultaron similares a los observados en el aceite de cacahuete. Estas observaciones fueron corroboradas mediante el análisis de la composición acídica por cromatografía gaseosa capilar. La relación ácidos grasos insaturados/saturados fue de 5.94, siendo el ácido oleico el principal ácido graso (53.7%). La composición de esteroles indicó altos porcentajes de β-sitosterol y estigmasterol. Los resultados obtenidos mostraron que *G. decorticans* puede ser considerada como recurso potencialmente oleaginoso para las regiones semiáridas de Argentina.

PALABRAS-CLAVE: Aceite - Geoffroea decorticans - Proteína.

SUMMARY

Chemical evaluation of *Geoffroea decorticans* seeds as source of oil and protein.

Proximate, fatty acid and sterol compositions of the oil were determined to ascertain the general characteristics of the seed and seed oil of *Geoffroea decorticans (Leguminosae)* originating from central area of Argentina. Proteins represented 21.6% (w/w) of the seed. Seed oil was extracted with n-hexane, yielding 47.2% (w/w). The saponification and iodine values indicated that the oil could be classified among the peanut group of oils. These facts were supported by the detailed fatty acid composition determined by capillary gas chromatography. The ratio of total unsaturated to total saturated fatty acids in the oil was 5.94, with oleic acid being the dominant fatty acid (53.7%). The sterol composition showed higher percentages of β-sitosterol and stigmasterol. The results obtained indicated that, with their attractive properties, *G. decorticans* is a good candidate for further studies to evaluate their future commercial prospect.

KEY-WORDS: Geoffroea decorticans - Oil - Protein.

1. INTRODUCTION

Geoffroea decorticans (Hook. et Arn.) Burkart, locally called «chañar», is a member of the *Leguminosae* plant family. It is a valuable tree of Argentinean semiarid regions, and its bark, flowers and leaves have various uses in popular medicine (Burkart, 1952). The fruits provide a valuable food source for man and their animals in rural communities. The seeds, cooked in rural ovens, are a good source of essential nutrients, such as proteins, carbohydrates and lipids, and have been consumed by local people over many generations (Braun & Candia, 1980). However, there is no scientific information about the chemical composition of such seeds; hence the examination of the proximate composition, fatty acids and sterols was of interest.

2. MATERIALS AND METHODS

2.1. Plant material

Geoffroea decorticans fruits were collected at full maturity stage in the western area of Córdoba province (Argentina).

2.2. Seed and seed oil characteristics

Moisture, protein, oil, and ash contents and some physical and chemical characteristics of the oil were determined in triplicate by standard methods according to AOAC (1980). Carbohydrate content was calculated by difference (Wattanapat *et al.*, 1994).

2.3. Fatty acid composition

The oil was subjected to alkaline saponification (1M KOH in methanol). Unsaponifiable matter was extracted with hexane. The fatty acid methyl esters (FAME) of total lipids were obtained using 0.5 M H_2SO_4 in methanol and analysed by gas chromatography (GC) with a fused silica capillary column AT-WAX (30 m x 0.25 mm id), nitrogen as carrier gas (1 ml min^{-1}), and a temperature gradient

of 4°C min^{-1} from 180 to 240°C. Injector and detector temperatures were 250°C. A standard fatty acid methyl ester mixture was used to identify sample peaks. Fatty acid levels were estimated on the basis of peak areas of known concentrations of the standards. The FAME were also analysed using a Hewlett Packard MSD 5970 gas chromatography-mass spectrometer (GC-MS). The identification of the compounds was carried out by a built-in NIST Peak Matching Library Search System (NIST 3.0) and by published data.

2.4. Sterol analysis

Unsaponifiable material was fractionated on preparative TLC (silica gel, 0.5 mm), and developed with chloroform/ethyl ether (90:10, v/v). After developing the plates were sprayed with a solution of rhodamine in ethanol (0.5 g $litre^{-1}$) and observed under ultraviolet light. The sterol fraction was scraped from the plates and analysed by GC according to Maestri and Guzmán (1995).

3. RESULTS AND DISCUSSION

Proximate composition of seeds and some physical and chemical characteristics of *G. decorticans* oil are given in Table I. The oil content is high (47.2%) and compares favourably with those of commercial oilseeds such as peanut (38-50%), rapeseed (40-60%) and sunflower (20-32% old strains, 40% new strains) (Padley *et al.*, 1986). Based on their oil yield, the studied seeds can be classified as high yielding, indicating their potentiality as a new source of vegetable oil. Protein content (21.6%) is similar to those reported earlier for other wild *Leguminosae* species (Balogun and Fetuga, 1986; Banergi *et al.*, 1988; Lamarque *et al.*, 1994; Grosso et al., 1997; Lamarque and Guzmán, 1997). Because of their high protein content, «chañar» seeds could be used as a protein supplement in foodstuffs.

Table II shows the fatty acid composition of the oil. The bulk of the oil is made up of C_{18} fatty acids. The degree of unsaturation (85.6%) is quite similar to many commercial vegetable oils (Maestri *et al.*, 1998; Padley *et al.*, 1986; Grosso *et al.*, 1994). Oleic acid is the most abundant fatty acid (53.7%), followed by linoleic (30.7%), palmitic (7.2%) and stearic (4.3%) acids. Another important feature of *G. decorticans* seed oil is the absence of linolenic acid (18:3). These characteristics are reflected in the iodine value (IV) (104.9) and oleic to linoleic (O/L) ratio (1.75). Accordingly, *G. decorticans* oil has similar IV and higher O/L ratio than peanut oil (Grosso *et al.*, 1994).

Table I

Proximate composition and oil characteristics of *Geoffroea decorticans* seeds and seed oil. Mean values and standard deviations (SD), n=3

Proximate composition	mean ± SD
% Moisture	8.2 ± 0.82
% Oil	47.2 ± 1.51
% Proteins	21.6 ± 0.95
% Carbohydrate	20.1 ± 1.00
% Ash	2.9 ± 0.08
Oil Properties	
Refractive index	1.466 ± 0.02
Saponification value (mg KOH/g)	175 ± 1.5
Unsaponifiable matter % (w/w)	0.15 ± 0.01

Table II

Fatty acid composition (% of total fatty acids), percentage of unsaturated (% US), oleic to linoleic (O/L) ratio and iodine value (IV) of seed oil from Geoffroea decorticans. Mean values and standard deviations (SD), n=3

Fatty acids	mean ± SD
14:0	tr[a]
16:0	7.2 ± 0.51
18:0	4.3 ± 0.23
20:0	1.5 ± 0.06
22:0	1.3 ± 0.12
24:0	tr
16:1	n.d.[b]
18:1	53.7 ± 1.9
18:2	30.7 ± 0.8
18:3	n.d.
20:1	1.2 ± 0.08
% US	85.6 ± 0.25
O/L	1.75 ± 0.23
IV	104.9 ± 0.28

[a] tr, trace: < 0.1; [b] n.d., not detected.

The seed oil of *G. decorticans* contains cholesterol, campesterol, stigmasterol, β-sitosterol Δ^5-avenasterol, Δ^7-stigmastenol and Δ^7-avenasterol (Table III). The β-sitosterol, stigmasterol and campesterol are the principal constituents (75.6%, 14.7% and 5.4%, respectively). Cholesterol, Δ^7-stigmastenol and Δ^7-avenasterol are detected in trace amounts.

Table III
Sterol composition (% of total sterols) of seed oil from *Geoffroea decorticans*. Mean values and standard deviations (SD), n=3

Sterols	mean ± SD
Cholesterol	tr[a]
Campesterol	5.4 ± 0.21
Stigmasterol	14.7 ± 1.50
β-Sitosterol	75.6 ± 2.83
Δ^5-Avenasterol	4.0 ± 0.15
Δ^7-Stigmastenol	tr
Δ^7-Avenasterol	tr

[a] tr, trace: < 0.1.

From the results of the present investigation it appears that *G. decorticans* seeds provide a good source of protein, comparable in quantity to some other oilseeds. They are found to be an excellent source of oil containing unsaturated fatty acids. This oil may be used to nutritional advantage by blending it with saturated oils and fats to provide essential fatty acids. Although long term toxicological studies are necessary to establish its safety before it can be recommended as an edible oil for human consumption, *G. decorticans* could be considered as potentially valuable oilseed plant for semiarid regions of Argentina.

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REFERENCES

AOAC (1980).—«Official Methods of Analysis of the Association of Official Analytical Chemist».— Horwitz, W. (Ed.). Washington DC, USA.

Balogun, A.M. and Fetuga, B.L. (1986).—«Chemical composition of some underexploited Leguminous crop seeds in Nigeria».—*J. Agric. Food. Chem.* **34**, 189-192.

Banerji, R., Chowdhury, A.R., Misra, G. and Nigam, S.K. (1988).—«Chemical composition of *Acacia* seeds».—*J. Am. Oil Chem. Soc.* **65**(12), 1959-1960.

Braun, W. y Candia, R.J. (1980).—«Poder calórico y contenido de nitrógeno y carbono de componentes del algarrobal de Ñacuñan, Mendoza». *Deserta* **6**, 91-99.

Burkart, A. (1952).—«Las Leguminosas Argentinas. Silvestres y Cultivadas».—2nd edn., Ed. Acme Agency S.R.L., Buenos Aires, Argentina.

Grosso, N.R, Lamarque, A.L., Maestri, D.M., Zygadlo, J.A. and Guzmán, C.A. (1994).—«Fatty acid variation of Runner peanut *(Arachis hypogaea* L.) among geographic localities from Córdoba (Argentina)».—*J. Am. Oil Chem. Soc.* **71**(5), 541-542.

Grosso, N.R., Zygadlo, J.A., Lamarque, A.L., Maestri, D.M. and Guzmán, C.A. (1997).—«Proximate, fatty acid and sterol compositions of aboriginal peanut *(Arachis hypogaea* L.) seeds from Bolivia».—*J. Sci. Food Agric.* **73**, 349-356.

Lamarque, A.L., Maestri, D.M., Grosso, N.R., Zygadlo, J.A. and Guzmán, C.A. (1994).—«Proximate composition and seed lipid components of some *Prosopis* (Leguminosae) from Argentina».—*J. Sci. Food Agric.* **66**, 323-326.

Lamarque, A.L. and Guzmán, C.A. (1997).—«Seed chemical variation in *Prosopis chilensis* from Argentina».—Genetic Resources and Crop Evolution **44**(6), 495-498.

Maestri, D.M and Guzmán, C.A. (1995).—«A comparative study of seed lipid components of *Nicotianeae (Solanaceae)*».—*Biochem. Syst. Ecol.* **23**(2), 201-207.

Padley, F.B., Gunstone, F.D. and Harwood, J.L. (1986).—«Occurrence and characteristics of oils and fats» en *The Lipid Handbook.* p. 49. F.D. Gunstone, J. L. Harwood and F. B. Padley (Eds.), London and New York.

Wattanapat, R., Nakyama, T., Beuchat, L.R. and Phillips, R.D. (1994).—«Kinetic of acid hydrolysis of defatted peanut flour».—*J. Food Science* **59**(3), 621-625.

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