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CHEMICAL COMPONENTS OF THE BRANCHES OF SIX HARDWOOD SPECIES

Miguel Ángel Cárdenas-Gutiérrez, Fabiola Eugenia Pedraza-Bucio
Pablo López-Albarrán, José G. Rutiaga-Quiñones
Universidad Michoacana De San Nicolás De Hidalgo, Facultad
De Ingenieria En Tecnología De La Madera
Morelia, Michoacán, México

Fermin Correa-Méndez
Universidad Intercultural Indigena De Michoacán Desarrollo Sustentable,
Tecnologías Alternativas
Patzcuaro, Michoacán, México

Artemio Carrillo-Parra
Universidad Juárez Del Estado De Durango, Instituto De Silvicultura
e Industria De La Madera
Durango, Durango, México.

Rafael Herrera-Bucio
Universidad Michoacana De San Nicolás De Hidalgo, Instituto De Ciencias
Químico Biológicas
Morelia, Michoacán, México

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This article is dedicated to Felipe Ramírez Cano on the occasion of his retirement as professor at the University of Guadalajara (México)

ABSTRACT

The biomass generated from tree pruning or derived from the forest exploitations could be susceptible to chemical use and studies on chemical composition in tree branches are scarce. Therefore, in this investigation the biomass of the branches of six hardwood species (*Alnus acuminata, A. jorullensis, Quercus candicans, Q. laurina, Q. rugosa* and *Symplocos citrea*), derived from the forest use by the indigenous community of Nuevo San Juan Parangaricutiro from Michoacan State, Mexico, were used. The chemical composition in wood and bark was determined and the tannin content was evaluated by two methods of extraction: aqueous extraction and ethanolic extraction. In general, the results obtained varied as follows: pH (4.25-5.19), ash (0.08-10.23%),

total extractives (6.9-49.5%), solubility to soda (25.36-70.9%), Runkel lignin (17.64-47.33 %), holocellulose (32.74-86.51%), alpha-cellulose (30.58-61.20%), tannins (0.26-10.67% by aqueous extraction, 0.23-12.21% by ethanolic extraction). No heavy metals were detected in the ash. The bark of *Quercus candicans* and *Q. laurina*, could be used for the extraction of tannins.

KEYWORDS: Wood chemistry, tannin content, inorganic material, *Quercus* spp., *Alnus* spp., *Symplocos* spp.

INTRODUCTION

Due to the growing global demand for energy and the decline in fossil fuel reserves, an interest has been generated in developing alternative sources of energy that offer sustainable environmental benefits (Ghosh and Prelas 2011). The use of biological waste from various sources can be an important source of energy (Martínez 2009). The biomass, as material of biological origin, from agricultural and forestry systems can be used to produce energy. A part of this biomass is used in industrial processes, but another biomass remains as waste and it is not used to generate bioenergy (Borja 2006).

The waste generated during pruning and/or clearing in forests and the remains generated by primary timber processing is currently not effectively used due to technical and economic difficulties during its extraction, as well as the lack of technical information on these materials (Marcos and Núñez 2006). Studies on chemical properties in branches of various trees are scarce, and these lignocellulosic materials could represent a potential for chemical use. Therefore, it is important to carry out this study on the chemical properties of branches of six hardwood species (*Alnus acuminata, A. jorullensis, Quercus candicans, Q. laurina, Q. rugosa*, and *Symplocos citrea*), biomass derived from the forest use of the Indigenous Community of Nuevo San Juan Parangaricutiro from State of Michoacan, Mexico. On the other hand, this study is part of an integral work to generate data that can give guidelines for its use as energy, so, it complements other studies that have been carried out in this Indigenous Community (Correa 2013, Herrera 2013, Lima 2013, Lazcano 2014, Pintor 2014, Herrera et al. 2017). The objective of this paper was to determine the chemical composition of the branches of six hardwood species with the aim of providing a basis for future applications.

MATERIALS AND METHODS

Lignocellulosic material

For this study, branches of *Alnus acuminata* H.B.K., *A. jorullensis* H.B.K., *Quercus candicans* Née, *Q. laurina* Humb. & Bonpl, *Q. rugosa* Née, and *Symplocos citrea* Lex., were collected in the forest of the Indigenous Community of Nuevo San Juan Parangaricutiro, Michoacan, Mexico. This forest comprises a commercial wooded area of 10,870.621 ha, with commercial timber stocks of 257,320.446 m^3 tvt (total volume tree), which are currently under forest management, with a total cutting volume of 74,647 m^3 tvt (CINSJP 2009, CINSJP 2011). From each species, branches were gathered by logging (Fig. 1), from which wood and bark were separated. The branches biomass (wood and bark) were dried outdoors, then milled. The resulting woodmeal was sieved to obtain 40 mesh material (420 microns). This lignocellulosic material was stored in sealed plastic bag, until its use.

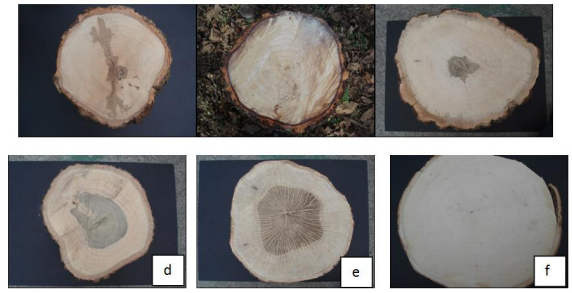

Fig. 1: Discs of branches of wooden species: a) Alnus acuminata, b) A. jorullensis, c) Quercus candicans, d) Q. laurina, e) Q. rugosa, f) Symplocos citrea.

Chemical analysis

The determination of pH (Moisture pH; M pH) was based on a method described by Sandermann and Rothkamm (1959). Mineral content was calculated gravimetrically in accordance with the standard UNE-EN 14775 (2010). Ash microanalysis was carried out with an X-ray spectrometer, coupled to a scanning electron microscope (Jeol JSM-6400) using 20 kV acceleration voltage and 8.5 seconds sampling time (Téllez et al. 2010).

To determine the total extractives content, sequential extractions were applied with a Soxhlet equipment in solvents of increasing polarity (cyclohexane, acetone, methanol) and finally, hot water under reflux (6 h in each case). The solvents were recovered in rotary evaporator while the aqueous extracts were recovered using a lyophilization equipment. After sequential extractions, wood meal named extractive-free wood, and this was used to determine Runkel lignin (Runkel and Wilke 1951), holocellulose (Wise et al. 1946) and cellulose (ASTM 1981).

Tannin content

For this analysis, wood meal and bark meal were used and the total extract, Stiasny number and tannins (Yasaky and Hillis 1977, Waterman and Mole 1994) were determined, for which the extracts were obtained in 50% aqueous ethanol and in hot water.

RESULTS AND DISCUSSION

pH values

The pH results are shown in Tab. 1, and these ranged from 4.25 for bark of *Quercus candicans* to 5.19 for bark of *Q. rugosa*. In general, it can be observed that the pH in bark is slightly more acidic than in wood, which is similar to the literature (Fengel and Wegener 1984). The values found in the present study are within the range reported by Kollmann (1936) and they are classified as "slightly acidic".

In the same Tab. 1, the pH data that were obtained in wood and bark of the same hardwood species were included, but in this case the samples were taken from the stem (Herrera et al. 2017) and it is observed that the results of pH are higher in the samples obtained from the stem, that is, the pH in wood and bark is more acidic in the branches, for the same forest species.

Tab. 1: pH in the branches of the species studied.

Species	pH in branches		pH in stem	
	Wood	Bark	Wood	Bark
Alnus acuminata	4.46 ± 0.04	4.29 ± 0.02	6.57*	5.82*
A. jorullensis	4.47 ± 0.02	4.58 ± 0.09	5.76*	5.44*
Q. candicans	4.36 ± 0.02	4.25 ± 0.03	5.06**	5.42**
Quercus laurina	4.50 ± 0.04	4.45 ± 0.02	5.10**	4.92**
Q. candicans	4.36 ± 0.02	4.25 ± 0.03	5.06**	5.42**
Q. rugosa	4.49 ± 0.02	5.19 ± 0.00	4.74**	4.91**
Symplocos citrea	4.50 ± 0.04	4.43 ± 0.00	4.82*	5.14*

*Experimental data taken from Herrera (2013), ** Experimental data taken from Herrera et al. (2017).

Ash and its microanalysis

The percentage of ash is presented in Tab. 2, showing that the lower value is for wood of *Symplocos citrea* (0.74%), the maximum value is for *Q. candicans* (1.13%); and for the bark, the lower value is for *Q. laurina* (4.57%), and the highest for *Q. rugos*a (10.23%). It is clearly seen that the bark is richer in inorganic substances than wood, which agrees with the literature (Fengel and Wegener 1984).

When comparing the data obtained here, with the results obtained in samples of the same hardwood species taken from the stem (Tab. 2), it is observed that in the branches (in wood and in bark), there is a greater concentration of mineral substances.

Tab. 2: Ash content in wood and bark of different species (%).

Species	Ash in branches		Ash in stem*	
	Wood	Bark	Wood	Bark
Alnus acuminata	0.92 ± 0.01	4.96 ± 0.01	0.67*	5.91*
A. jorullensis	0.96 ± 0.01	6.68 ± 0.04	0.53*	3.34*
Q.candicans	1.13 ± 0.00	5.55 ± 0.01	0.74**	2.35**
Quercus laurina	0.78 ± 0.01	4.57 ± 0.02	0.62**	3.25**
Q.candicans	1.13 ± 0.00	5.55 ± 0.01	0.74**	2.35**
Q. rugosa	0.08 ± 0.00	10.23 ± 0.00	0.70**	9.26**
Symplocos citrea	0.74 ± 0.01	6.26 ± 0.00	0.82*	4.15*

* Experimental data taken from Herrera (2013), ** Experimental data taken from Herrera et al. (2017).

The results of the microanalysis of the ashes are shown in Tab. 3. Variation in the number of chemical elements detected in the analyzed samples was observed: in the wood of *Alnus acuminata* 6 elements were detected and in the bark of *Quercus candicans* and in the wood *Symplocos citrea* were detected 9 chemical elements. In all samples, the chemical elements present in higher concentrations were potassium, calcium and magnesium. It is important to note that no heavy metals were detected. Most of the chemical elements found here are common in wood and bark of these same tree species (Herrera 2013, Herrera et al. 2017) and also in other woods and barks (Cutter et al. 1980, Fengel and Wegener 1984, Martinez et al. 2012, Bernabé et al. 2013, Correa et al. 2013, Correa et al. 2014).

Tab. 3: Results of ash microanalysis (atomic %).

		Chemical elements										
		F	Na	Mg	Al	Si	P	S	K	Ca	Mn	Fe
Aa	W	ND	ND	6.18 ±0.69	ND	0.21 ±0.11	4.57 ±0.88	1.16 ±1.10	48.69 ±3.18	39.23 ±3.40	ND	ND
	B	ND	ND	4.75 ±0.62	0.40 ±0.20	1.11 ±0.42	2.02 ±0.40	0.78 ±0.26	17.38 ±2.15	73.08 ±4.11	ND	0.30 ±0.06
Aj	W	ND	ND	6.05 ±1.21	6.89 ±2.53	0.35 ±0.36	6.63 ±1.90	0.95 ±0.27	45.99 ±8.81	31.26 ±14.40	1.87 ±1.07	ND
	B	7.49 ±1.75	ND	13.72 ±1.99	0.19 ±0.06	0.64 ±0.30	2.77 ±0.48	1.53 ±0.54	13.07 ±2.26	60.44 ±12.24	ND	ND
Qc	W	7.94 ±1.74	ND	18.91 ±3.49	0.10 ±0.02	0.34 ±0.12	8.27 ±1.72	1.28 ±0.29	38.33 ±7.51	24.83 ±5.04	ND	ND
	B	ND	0.21 ±0.06	9.75 ±1.29	0.13 ±0.04	0.53 ±0.12	1.63 ±0.32	0.59 ±0.11	14.12 ±1.02	72.76 ±2.76	ND	0.29 ±0.06
Ql	W	6.77 ±1.14	ND	5.41 ±1.06	0.06 ±0.04	0.27 ±0.06	1.22 ±0.26	0.22 ±0.08	8.93 ±1.44	77.11 ±12.71	ND	ND
	B	7.10 ±1.88	ND	13.62 ±2.21	0.07 ±0.04	0.41 ±0.13	12.85 ±2.32	1.03 ±0.27	38.09 ±6.41	26.83 ±4.85	ND	ND
Qr	W	ND	0.33 ±0.04	27.71 ±0.52	ND	0.28 ±0.19	10.34 ±0.53	0.97 ±0.09	27.07 ±0.69	33.28 ±0.83	ND	ND
	B	ND	0.09 ±0.02	7.18 ±0.78	ND	0.19 ±0.09	1.31 ±0.16	0.23 ±0.05	9.26 ±0.69	81.74 ±1.40	ND	ND
Sc	W	ND	0.01 ±0.03	7.50 ±0.66	2.47 ±0.50	0.76 ±0.16	2.29 ±0.39	1.14 ±0.24	30.10 ±0.89	54.39 ±3.06	ND	0.65 ±0.05
	B	ND	0.64 ±0.01	16.81 ±1.32	0.11 ±0.01	0.34 ±0.15	5.95 ±0.66	2.66 ±0.57	31.41 ±2.18	42.10 ±3.43	ND	ND

Aa = *Alnus acuminata*, Aj = *A. jorullensis*, Qc = *Quercus candicans*, Ql = *Q. laurina*, Qr = *Q. rugosa*, Sc = *Symplocos citrea*, W = Wood, B = Bark, ND = not detected

Extractives content

In Tabs. 4 and 5, the average results of the successive extraction with the different solvents of ascending polarity are presented, as well as the total sum for wood and bark, respectively. It is observed that in wood the extraction yield with acetone was higher, followed by extraction in hot water at reflux for all species. Regarding bark, the percentage of extracts was higher in hot water at reflux, followed by extraction with acetone. In both cases, the concentration of polar substances and medium polarity is higher and to a lesser extent non-polar substances (Tab. 4 and 5), which coincides with other studies (Rutiaga 2001, Bautista and Honorato 2005). The average total of extractives in the wood is higher for *Q. laurina* (15.3%) and the lowest for *Q. candicans* (6.9%), for the bark the highest average of extractables is for *S. citrea* (49.5%) and the lowest *A. jorullensis* (18.4%). As can be seen the values obtained in the bark are much higher than those of the wood which is in agreement with the literature (Fengel and Wegener 1984).

Tab. 4: Extracts content in wood of the branches (%).

Species	Cyclohexane	Acetone	Methanol	Hot water	Total extractives	Total extractives (stem)
A. acuminata	0.69 ± 0.00	3.43 ± 0.06	1.03 ± 0.04	3.8 ± 0.23	8.9 ± 0.3	5.9*
A. jorullensis	0.36 ± 0.02	1.70 ± 0.05	1.15 ± 0.03	3.81 ± 0.20	7.0 ± 0.6	6.6*
Q. candicans	0.24 ± 0.03	2.68 ± 0.00	1.8 ± 0.04	2.19 ± 0.02	6.9 ± 0.2	9.8**
Q. laurina	0.49 ± 0.02	9.33 ± 0.12	3.05 ± 0.09	2.46 ± 0.03	15.3 ± 0.5	9.5**
Q. rugosa	0.26 ± 0.02	4.89 ± 0.09	2.55 ± 0.09	4.1 ± 0.17	11.8 ± 0.3	14.9**
S. citrea	0.61 ± 0.04	6.43 ± 0.10	3.65 ± 0.23	2.46 ± 0.29	13.1 ± 0.5	8.5*

* Experimental data taken from Herrera (2013), ** Experimental data taken from Herrera et al. (2017).

Tab. 5: Extracts content in bark of the branches (%).

Species	Cyclohexane	Acetone	Methanol	Hot water	Total extractives	Total extractives (stem)*
A. acuminata	2.10 ± 0.02	10.18 ± 0.19	5.16 ± 0.00	11.52 ± 0.02	28.9 ± 0.4	19.0*
A. jorullensis	5.77 ± 0.11	3.84 ± 0.22	2.43 ± 0.00	6.42 ± 0.01	18.4 ± 0.2	20.6*
Q. candicans	0.87 ± 0.04	10.11 ± 0.25	3.61 ± 0.02	8.6 ± 0.18	23.2 ± 0.3	11.9**
Q. laurina	2.36 ± 0.05	13.05 ± 0.37	6.16 ± 0.13	14.23 ± 0.27	35.8 ± 1.2	13.1**
Q. rugosa	1.18 ± 0.03	11.95 ± 0.11	6.71 ± 0.16	24.25 ± 0.09	44.1 ± 0.2	17.6**
S. citrea	2.06 ± 0.05	18.47 ± 0.14	15.65 ± 0.31	13.28 ± 0.45	49.5 ± 1.2	31.7*

* Experimental data taken from Herrera (2013), ** Experimental data taken from Herrera et al. (2017).

Honorato and Hernández (1998) report extractives contents for the genus *Quercus* from 2.79% to 7.21% with organic solvents, observing that the values obtained in this work are higher, which could be due to the method and solvent used in the extraction, in addition may be due, as is already known, to environmental and genetic factors, tree age, climate, amount of water supplied, available nutrients, as well as the cutting season, among others (Hillis 1971).

There are reports for the same oak species studied here (Herrera et al. 2017) and for *Alnus acuminada* and *A. jorullensis* (Herrera 2013) but in samples of wood (Tab. 4) and bark (Tab. 5) taken from the stem at 1.30 m of the stump. The values of total solubility in the branches of the species studied here are in general, higher than the solubility obtained in samples taken from the trunk (Herrera et al. 2017), which coincides with Sandoval (1979) who found that the extractable content is higher in the bark than in the wood and sometimes slightly higher in the branches than in the wood taken from the stem at 1.30 m from the ground.

Soda Solubility

The results obtained for this analysis are reported in Tab. 6. In the case of wood, *Q. laurina* presents higher soda solubility (33.48%) and *Q. rugosa* the lowest value (25.36%). In relation to the bark, *A. acuminata* presented higher solubility (70.9%) and *A. jorullensis* had the lowest solubility (46.49%). Clearly, the bark of the species studied has a higher soda solubility than the wood and the results are within the range reported for hardwoods (Rowell 1984). The soda solubility is higher in wood and bark of branches than in wood and bark of samples taken from the stem (Tab. 6), for the same tree species (Herrera 2013, Herrera et al. 2017).

Tab. 6: Soda solubility for wood and bark of the species studied (%).

Species	Solubility to soda in branches		Solubility to soda in stem	
	Wood	Bark	Wood	Bark
Alnus acuminata	30.38 ± 0.26	70.9 ± 0.43	21.15*	35.58*
A. jorullensis	26.31 ± 0.27	46.49 ± 0.19	21.74*	37.48*
Quercus candicans	26.55 ± 0.23	47.98 ± 0.31	21.30**	26.02**
Q. laurina	33.48 ± 0.01	47.06 ± 0.32	21.01**	22.42**
Q. rugosa	25.36 ± 0.25	51.12 ± 0.07	23.67**	27.77**
Symplocos citrea	29.46 ± 0.27	66.12 ± 0.10	23.05*	51.08*

*Experimental data taken from Herrera (2013); ** Experimental data taken from Herrera et al. (2017).

Runkel lignin content

The average values for Runkel lignin in wood and bark are presented in Tab. 7, where the highest value in wood is for *Q. candicans* (28.87%), while the lowest for *Q. rugosa* (17.64%). For the case of the bark, the maximum value is *A. jorullensis* (47.33%), the lowest was for *Q. rugosa* (17.69%). There is a higher concentration of lignin in the bark compared to the wood of the branches. The amount of lignin in oak woods coincides in general with the results of previous studies with wood of this genus (Rutiaga et al. 2000, Rutiaga 2001, Bautista and Honorato 2005).

Tab. 7: Percentage results of lignin for wood and bark of the species studied (%).

Species	Lignin in branches		Lignin in stem	
	Wood	Bark	Wood	Bark
Alnus acuminata	25.95 ± 0.15	46.05 ± 0.02	25.66*	56.51*
A. jorullensis	23.40 ± 0.06	47.33 ± 0.07	21.43*	50.63*
Quercus candicans	28.87 ± 0.02	34.23 ± 0.02	17.68**	29.00**
Q. laurina	20.99 ± 0.14	32.20 ± 0.12	17.01**	34.68**
Q. rugosa	17.64 ± 0.12	17.69 ± 0.12	17.50**	22.83**
Symplocos citrea	20.50 ± 0.25	26.29 ± 0.19	19.88*	23.46*

* Experimental data taken from Herrera (2013); ** Experimental data taken from Herrera et al. (2017).

When comparing the lignin content of the wood of the branches with the amount found in wood taken from the stem (Tab. 7), it is observed that in general there is a higher concentration of lignin in the branches, whereas in the case of the bark, it is not clear that there is a tendency to find more lignin in the branches (Herrera 2013, Herrera et al. 2017)

Holocellulose content

The amount of holocellulose present in the wood samples ranged from 86.51% in *Q. rugosa* to 74.99% in *A. acuminata*. For the case of the bark, the highest value was presented in *Q. rugosa* (69.47%) and the lowest *A. jorullensis* (32.74%). In these results show a higher concentration of polysaccharides in the wood compared to bark (Tab. 8), which agrees with the literature (Fengel and Wegener 1984). The concentration of polysaccharides in oak wood coincides in general with previous data reported for wood of this genus (Honorato 2002).

Tab. 8: Holocellulose in wood and bark of the species studied (%).

Species	Holocellulose in branches		Holocellulose in stem	
	Wood	Bark	Wood	Bark
Alnus acuminata	74.99 ± 0.06	46.63 ± 0.48	78.14*	56.34*
A. jorullensis	75.32 ± 0.42	32.74 ± 0.21	76.91*	56.74*
Quercus candicans	86.20 ± 0.04	68.06 ± 0.18	85.34**	83.91**
Q. laurina	78.51 ± 0.15	51.49 ± 0.14	86.87**	81.92**
Q. rugosa	86.51 ± 0.15	69.47 ± 0.04	86.17**	83.97**
Symplocos citrea	79.05 ± 0.30	63.86 ± 0.27	82.00*	74.04*

* Experimental data taken from Herrera (2013); ** Experimental data taken from Herrera et al. (2017).

When comparing these results of the proportion of polysaccharides in the wood of the branches with the amount reported for wood obtained from the stem of these same tree species (Herrera 2013, Herrera et al. 2017), a similarity is observed in the values found, while for the case of the bark larger amounts are obtained in the samples obtained from the stem (Tab. 8).

α- cellulose content

The proportion of alpha-cellulose in wood is higher in *Q. laurina* (56.56%) and lower in *A. acuminata* (51.85%). For the bark the values found ranged from 30.58% in *A. jorullensis* to 61.20% in *S. citrea* (Tab. 9).

Tab. 9: α-Cellulose content in the studied species (%).

Species	α- celulose in branches		α- celulose in stem	
	Wood	Bark	Wood	Bark
Alnus acuminata	51.85 ± 0.10	40.47 ± 0.29	54.86*	52.99*
A. jorullensis	52.95 ± 0.27	30.58 ± 0.32	53.79*	53.65*
Quercus candicans	51.99 ± 0.20	46.06 ± 0.18	60.44**	62.14**
Q. laurina	56.56 ± 0.00	48.49 ± 0.14	58.48**	59.21**
Q. rugosa	55.60 ± 0.28	57.40 ± 0.33	64.34**	42.32**
Symplocos citrea	55.19 ± 0.05	61.20 ± 0.13	53.47*	67.07*

* Experimental data taken from Herrera (2013); ** Experimental data taken from Herrera et al. (2017).

According to the results obtained, more alpha-cellulose is observed in the wood compared to the bark. In the case of oaks, the results obtained here are within the range (37% to 56%) reported for some Mexican oaks (Honorato 2002). On the other hand, according to the results presented in Tab. 9, the values of alpha-cellulose in wood are similar to those reported for wood obtained from the stem of the same tree species (Herrera 2013, Herrera et al. 2017) And in general, more alpha-cellulose can be observed in the bark samples obtained from the stem compared to the values obtained for the bark of the branches.

Tannins content

The extraction of tannins was carried out using water and ethanol, the results are summarized in Tab. 10. For the aqueous extraction, the values varied from 0.26% in *A. jorullensis* wood to 10.67% in *Q. laurina* bark, while that for the ethanolic extraction the results were 0.23% in wood from *Q. rugosa* to 12.21% in bark of *Q. candicans*.

In general, the tannin content detected for oak species coincides with data reported for wood (1.52-3.46%) and bark (7.40-10.42%) from different Mexican oaks (Honorato and Hernández 1998). The literature indicates that a minimum value of 8% of tannins can be considered as marketing potential (Rowe and Conner 1979) or at least 10% to be considered as exploitable (Happich et al. 1954, Kirk 1962, Mule and Gonzales 1973), so that taking into account these references, the barks of *Q. candicans* and *Q. laurina* could be potential biomass for the extraction of tannins, however, aspects such as the purity of their tannins and their possible applications should be evaluated.

Tab. 10: Tannin content by two extraction methods (%).

Species	Aqueous extraction		Ethanolic extraction	
	Wood	Bark	Wood	Bark
A. acuminata	1.14 ± 0.12	5.38 ± 0.21	1.23 ± 0.09	5.29 ± 0.27
A. jorullensis	0.26 ± 0.04	1.65 ± 0.22	1.04 ± 0.04	2.47 ± 0.12
Q. candicans	0.41 ± 0.02	9.45 ± 0.25	1.94 ± 0.01	12.21 ± 0.35
Q. laurina	1.15 ± 0.04	10.67 ± 0.36	3.14 ± 0.12	11.36 ± 0.13
Q. rugosa	0.91 ± 0.06	3.09 ± 0.06	0.23 ± 0.10	5.00 ± 0.01
S. citrea	2.39 ± 0.21	5.54 ± 0.2	1.65 ± 0.10	5.63 ± 0.19

For both extraction methods the bark proved to be richer in tannins than the wood, which agrees with the literature (Fengel and Wegener 1984) and in general through of the ethanolic extraction it was obtained a greater yield of tannins.

CONCLUSIONS

The evaluation of the chemical composition of the branches of the six species of forest trees of the Nuevo San Juan Parangaricutiro Indigenous Community of Michoacán state, Mexico, reveals the variation between wood and bark and between species. The pH of the materials is slightly acidic. Ash content is higher in bark than in wood. No heavy chemical elements were detected in the ash of the biomass samples. According to the applied extraction sequence it was found that for the wood the behavior of higher to lower yield was as follows: acetone > hot water > methanol > cyclohexane, while for the bark the behavior was hot water > acetone > methanol > cyclohexane; the bark contains more extractives than wood. It was found higher solubility in soda and higher concentration of lignin in the bark than in wood. In relation to the content of polysaccharides their concentration was higher in wood. The bark of *Quercus candicans* and *Q. laurina*, could be used for the extraction of tannins.

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Miguel Ángel Cárdenas-Gutiérrez, Fabiola Eugenia Pedraza-Bucio
Rafael Herrera-Bucio, Pablo López-Albarrán, José G. Rutiaga-Quiñones*
Universidad Michoacana De San Nicolás De Hidalgo
Facultad De Ingeniería En Tecnología De La Madera
Francisco J. Múgica S/N. Cuidad Universitaria, Edificio "D"
Col. Felicitas Del Rio, C. P. 58040
Morelia
Michoacán, México
*Correspondimg author: rutiaga@umich.mx

Fermín Correa-Méndez
Universidad Intercultural Indígena De Michoacán
Desarrollo Sustentable. Tecnologías Alternativas
Carretera San Juan Tumbio – Cherán, Km 16.2, C.P. 60291
Patzcuaro,
Michoacán, México

Universidad Juárez Del Estado De Durango
Instituto De Silvicultura e Industria De La Madera
Boulevard Del Guadiana 501, Ciudad Universitaria
Torre De Investigación, C. P. 34120
Durango
Durango, México

Rafael Herrera-Bucio
Universidad Michoacana De San Nicolás De Hidalgo
Instituto De Ciencias Químico Biológicas
Morelia
Michoacán, México