Volume 2, Issue 3 – July – December-2015

E C O R F A N

Journal-Bolivia

ISSN-On line: 2410-4191

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ECORFAN Journal-Bolivia, Volume 2, Issue 3, July-December 2015, is a journal edited four- monthly by ECORFAN-Bolivia. Loa 1179, Cd. Sucre. Chuquisaca, Bolivia. WEB: www.ecorfan.org, revista@ecorfan.org. Editora en Jefe: RAMOS-ESCAMILLA, María. PhD, Co-Editor: IGLESIAS-SUAREZ, Fernando. BsC. ISSN-On line: 2410-4191. Responsible for the latest update of this number ECORFAN Computer Unit.ESCAMILLA-BOUCHÁN, Imelda. PhD, LUNA SOTO-Vladimir. PhD. Loa 1179, Cd. Sucre. Chuquisaca, Bolivia., last updated December 31, 2015.

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Estimation of Pure-Component Physical Properties of Biodiesel: Fatty Acids and Methyl Esters

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Received August 12, 2015; Accepted November 5, 2015

Resumen

La mayoría de los ácidos grasos y esteres metílicos, especialmente aquellos con cadenas de carbono largas, no cuenta con todas las propiedades físicas del componente puro en la literatura, relevante para el diseño de procesos. Una forma para determinar estas propiedades es usar métodos predictivos como los métodos de contribución de grupos (CG), los cuales necesitan solamente la estructura molecular del compuesto. En este trabajo, nueve propiedades físicas de componente puro (temperatura de ebullición, temperatura crítica, presión crítica, volumen crítico, factor de comprensibilidad crítico, entalpía de formación, energía de Gibbs de formación, temperatura de fusión, calor latente de vaporización, factor acéntrico) de tres ácidos grasos y sus correspondientes esteres metílicos fueron estimados empleando el paquete computacional ICAS. Tres métodos de CG diferentes son comparados con respecto a las doce propiedades físicas de componente puro. La comparación entre los métodos de CG se realiza con datos experimentales disponibles, indicando que los métodos de CG son de mayor confianza para la estimación de propiedades físicas de componente puro encontradas en el biodiesel.

Contribución de grupos; Biodiesel; Ácidos grasos; Esteres metílicos

Abstract

Most fatty acids and methyl esters, especially those with long carbon chains, do not have all pure-component physical properties found in the literature, relevant for process design. One way to determine these properties is to use predictive methods such as group contribution (GC) methods which need only the molecular structure of compound. In this work, nine pure-component physical properties (boiling temperature, critical temperature, critical pressure, critical volume, enthalpy of formation, Gibbs energy of formation, melting temperature, latent heat of vaporization, acentric factor) of three fatty acids and their corresponding methyl esters were estimated by using ICAS computer software. Three different of GC methods are compared with respect to the twelve pure-component physical properties. Comparison among the GC methods is made within available experimental data, indicating that the GC methods are more reliable for estimating pure-component physical properties found in biodiesel.

Group contribution; Biodiesel; Fatty acids; Methyl esters

Citation: CÁRDENAS, J. Carlos, MARMOLEJO, Danahéb, MENDOZA, M. de los Ángeles, VÁZQUEZ, Edgar. Estimation of Pure-Component Physical Properties of Biodiesel: Fatty Acids and Methyl Esters. ECORFAN Journal-Bolivia 2015, 2-3:143-151

† Researcher contributing as first author.

Article ECORFAN-Bolivia Journal
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Introduction

In process simulation, reliable and accurate property estimation methods play an important role in the solution of various simulation problems where convergence is often traced to failures in the reliable predictions of physical properties. In the literature there are a several papers with this subject (Constantinou and Gani, 1994; Constantinou et al., 1995; Klincewicz and Reid, 1984: Joback and Reid, 1987; Gani and Constantinou, 1996; Gani et al., 1991) and they proposed, for the estimation of physical properties of pure-component, the group contribution (GC) methods as the most accurate one. According to these methods, the property of a compound could be estimated as a summation of the contributions of first- and second-order groups which are defined by specific molecular structure. They provide the important advantage of quick estimates without requiring substantial computational resources. This method is very important for calculating the boiling temperature (for many organic compounds are not available in literature) which is essential in separation processes and for the estimation of the critical temperature. Also, the molecular structure is often oversimplified, making isomers indistinguishable.

On the other hand, biodiesel is an oxygenated fuel composed by monoalkyl esters of long chain fatty acids derived from vegetable oils or animal fats, and is designated by ASTM B100 (2005). Esterification reaction (e.g., vegetable oils) and methanol are the most common reactants for biodiesel production, and therefore it is often said that biodiesel is composed by a mixture of methyl esters. This esters distribution in a biodiesel depends directly of fatty acid profiles present in the source used for it respective synthesis.

Fatty acids contained in edible oils are those of myristic, palmitic, stearic, oleic, linoleic and linolenic acids. This holds for biodiesel feedstocks, such as cotton, soybean, sunflower, coconut, canola, palm, corn and peanut oils (Knothe, 2010). Non-edible oils are emerging as biofuel feedstocks and oils such as jatropha (*Jatropha Curcas L.*), castor (*Ricinus Communis L.)* and karanja (*Pongamia Pinnata*) are being implemented as possible solution to overcome the short-comings of using edible oils (Gui et al., 2008).

In addition, growing interest in non-fossil fuel components has led to an increased need for physical property data of biodiesel related components such as fatty acid methyl esters related fatty acids. For production, purification, and application as fuel components in a mixture with fossil components, pure-component properties of these substances are the basis for engineering calculations. Although, the important physical properties like boiling temperature, density, viscosity, etc. and the combustion related properties like heat of combustion, cetane number, flash point and pour point of a biodiesel fuel derived from different vegetable oils are reported in literature, there is a lack of data on some other useful properties like vapor pressure, surface tension, thermal conductivity and latent heat of vaporization (Anand et al., 2011; Su et al., 2011). These properties are needed for accurate spray and combustion modeling. The 3D CFD codes like KIVA require these properties of biodiesel fuel at a wider temperature ranges up to their critical temperature. The experimental determination of all these properties at various temperature ranges is cumbersome and time consuming and hence it is important to establish proper methodology to estimate these properties. The task of determining the physical properties of biodiesel fuels still remains a challenge for engine researchers.

ISSN:2410-4191

Therefore, mainly specialized approaches have been developed for the estimation of pure-component properties of biodiesel related substances, and little has been published on model comparisons.

Materials and Methods

Primary properties of pure components can be estimated based on the structure of their molecules. There are many methods that use the GC concept to estimate pure-component primary properties (Poling et al., 2001). There are also methods like Cedeño et al. (2000) and Rowlinson-Bondi equation reported by Poling et al. (2001) that are based on primary properties for estimating other properties. As an example of the use of these methods, Díaz-Tovar et al. (2011) had calculated melting temperature, enthalpies de formation and critical properties using Ceriani et al. (2007) and Marrero and Gani (2001) methods and their respective extensions (Ceriani and Meirelles, 2004; Ceriani et al., 2009; Gani et al., 2005) for 29 fatty acids and 29 methyl esters. Ceriani et al. (2013) presented a GC model for the estimation of the vapor pressures and heats of vaporization of fatty compounds. This approach was used by Yuan et al. (2005) for the calculation of Antoine parameters for methyl esters. Halvorsen et al. (1993) reported experimentally regressed parameters for a modified Rackett equation for the estimation of densities of fatty acids. Krisnangkura et al. (2006) used an empirical approach for predicting dynamic viscosities of methyl esters. Cunico et al. (2013) reviewed the application of the Marrero and Gani (2001) model to lipids, using model parameters from Hukkerikar et al. (2012) as well as lipid-specific parameters.

Perdomo et al. (2014) applied SAFT-γ (Statistical Associating Fluid Theory by GC) for the prediction of properties in biodiesel fuels by adequately representing the physical behavior and stereochemistry of biodiesel molecules. These authors obtained a realistic representation of the molecular structure of long chain methyl esters and esters that contains hydroxyl groups, which are the typical biodiesel fuel constituents. Finally, Perdomo et al. (2014) implemented a simplex simulated annealing algorithm as global optimization method to determine the SAFT-γ parameters for the groups that fully represent the biodiesel compounds, which were fitting to experimental data available for analogous chemical families like secondary alkanols and short chain esters.

In this work, we selected a variety of methods for testing their predictive capacity based on experimental data for primary properties of fatty compounds, namely boiling temperature (T_b), critical temperature (T_c), critical pressure (P_c), critical volume (V_c), enthalpy of formation (ΔH_f^0), Gibbs energy of formation (ΔH_G^0), melting temperature (T_m), latent heat of vaporization [$\Delta H_V(Tb)$] and Pitzer´s acentric factor (ω), that we found in the open literature: Joback and Reid (1987), Constantinou and Gani (1994) and Marrero and Gani (2001) for T_b, T_c, P_c, V_c, ΔH_f^0, ΔH_G^0, T_m and $\Delta H_V(Tb)$, Constantinou and Gani (1994), Constantinou et al. (1995) for ω.

The base equations for estimating the physical properties of fatty acids and methyl esters can be described as a simple function of the property X, depending of GC method:

a) Klincewicz and Reid (1984)

$$f(X) = a + \sum_{j=1}^{M} n_{ij}\Delta_j + c\left[\sum_{j=1}^{M} n_{ij}\Delta_j\right]^2 \quad (1)$$

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b) Joback and Reid (1987)

$$f(X) = a + b\sum_{j=1}^{M} n_{ij}\Delta_j + c\left[\sum_{j=1}^{M} n_{ij}\Delta_j\right]^2 \quad (2)$$

c) Constantinou and Gani (1994)

$$f(X) = \sum_i N_i C_i + w\sum_j M_j D_j \quad (3)$$

d) Marrero and Gani (2001)

$$f(X) = \sum_i N_i C_i + w\sum_j M_j D_j + z\sum_k O_k E_k \quad (4)$$

Where in equations (1) and (2), Δ_j is the contribution for group j, n_{ij} is the number of such groups and M is the total number of different types of groups; a, b and c are constants. In equations (3) and (4), C_i is the contribution of the first-order group i that occurs N_i times, D_j is the contribution of the second-order group j that occurs M_j times and E_k is the contribution of the third-order group k that has O_k occurrences in a compound. In the first level of estimation, the constants w and z are assigned zero values because only first-order groups are employed. In the second level, the constants w and z are assigned unity and zero values, respectively because only first- and second-order groups are involved while in the third level, both w and z are set to unity values.

Results and discussion

In this research, three methods were studied [Joback and Reid (**JR**), 1987; Constantinou and Gani (**CG**), 1994; Marrero and Gani (**MG**), 2001)]. These predictive methods were selected based on the fact that they are:

(i) among the most commonly used in the literature to predict the critical properties of pure components involved during the esterification of fatty acids, (ii) easy to use, (iii) accurate and (iv) are not restricted to a certain types of substances. Moreover, these methods use GC techniques to determine contribution factors for specific groups of atoms constituting the molecule of interest. Values of these contribution factors for each critical property are tabulated for every method and their sum represents the final correction applied to the calculation of the critical property. Application of these methods requires knowledge of the GC models based on the molecular structure and molecular weight (Mw) of the compound.

Using the GC method (i.e., first-, second- and third-order groups) and ICAS computer software (2008), some pure-component properties for two fatty acids (palmitic and oleic acids) and two methyl esters (methyl palmitate and oleate) were estimated and shown in Tables 1, 2, 5 and 6. These tables present the comparison of the three predictive methods proposed. The deviations $x_{i,calc} - x_{i,exp}$, average absolute mean deviations (AMDs) and average relative mean deviations (RMDs) are summarized in the Tables 3, 4, 7 and 8. Note that AMDs and RMDS were calculated according to the equations:

$$AMD = \frac{1}{n}\left(\sum_{i=1}^{n}\left|x_{i,calc} - x_{i,\exp}\right|\right) \quad (5)$$

and

$$RMD\,(\%) = \frac{1}{n}\left(\sum_{i=1}^{n}\left|\frac{x_{i,calc} - x_{i,\exp}}{x_{i,\exp}}\right| x100\right) \quad (6)$$

For fatty acids, a lower average RMD was found in the prediction of T_b for the

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method of Marrero and Gani (2001). Besides, there is a clear tendency of increase of average relative mean deviations with carbon chain length for the method of Joback and Reid (1987); such tendency is found for methyl esters. The methods of **CG** and **MG** give comparable values of AMD. Based on the results of Tables 3 and 7, it is not possible to affirm which method is more suitable in the prediction of T_b. The knowledge of T_b is the key property since it indicates the rate of vaporization/condensation of analyzed acids and esters. This thermodynamic information is very important for the adequate (reaction-)separation process which represent on step in production/purification of biodiesel.

For T_c and P_c, three methods were evaluated according to Tables 1, 2, 5 and 6. For fatty acids, the methods of Constantinou and Gani (1994) and Marrero and Gani (2001) provided very good predicted values in comparison with the experimental values reported in Tables 3 and 4. There is a clear tendency between the methods of Marrero and Gani (2001) and Joback and Reid (1987) of decrease of relative deviations with carbon chain length, in particular for P_c. For the critical properties of methyl esters, i.e., T_c and P_c, the method of Marrero and Gani (2001) gave the lowest AMD. For *Tc*, there is again a clear tendency of the methods of Marrero and Gani (2001) and Joback and Reid (1987) of increase of relative deviations with carbon chain length.

For the other physical properties considered in this work, V_c, ΔH_f^0, ΔH_G^0, T_m and $\Delta H_V(Tb)$, the literature provides no experimental value; however, the GC method of Marrero and Gani (2001) determined good predictions.

Furthermore, it is only possible to perform an analysis of pure-component properties among selected methods related to the tendencies of their predicted values. For fatty acids and methyl esters, the estimated values of acentric factor show the tendency with chain length, i.e., to decrease as CH_2 groups are added in the molecule. A lower contribution is assigned for the unsaturation.

Conclusions

Very few experimental data are available in the literature for fatty acids and methyl esters for primary properties as T_b, T_c, P_c, V_c, ΔH_f^0, ΔH_G^0, T_m, $\Delta H_V(Tb)$ and ω. Based on experimental data found in the open literature, we concluded that for fatty compounds, the method of Marrero and Gani (2001) is more suitable for predicting T_b and P_c, and has comparable predictive capacity in comparison with the method of Joback and Reid (1987) for ΔH_f^0 and ΔH_G^0. The predictive method of Constantinou and Gani (1994) is indicated in the estimation of T_c.

Component	Fatty acid			Formula	
Palmitic acid	$C_{16:0}$			$CH_3(CH_2)_{14}COOH$ CAS No. 57-10-3 *Mw* = 256.4 g/mol	
Parameter	**JR**	**CG**	**MG**	**Experimental**	**Units**
T_b	710.99	608.47	614.90	622.30[a]	K
T_c	887.34	780.38	822.22	785.22[b]	K
P_c	14.08	14.18	15.33	14.68[b]	bar
V_c	955.50	953.21	960.81	-	cm^3/mol
ΔH_f^0	-723.84	-722.04	-718.90	-	kJ/mol
ΔH_G^0	-260.07	-257.06	-241.29	-	kJ/mol
T_m	430.18	329.58	358.25	-	K
$\Delta H_V(Tb)$	68.37	56.48	67.18	-	kJ/mol
ω	1.044	1.093	0.516	0.92970[c]	-

[a] Ashour and Wennersten (1989); [b] D´Souza and Teja (1987); [c] Wallek et al. (2013)

Table 1 Estimated physical properties of $C_{16}H_{32}O_2$ in this work

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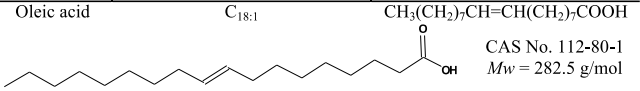
Component	Fatty acid	Formula
Oleic acid	$C_{18:1}$	$CH_3(CH_2)_7CH{=}CH(CH_2)_7COOH$



CAS No. 112-80-1
Mw = 282.5 g/mol

Parameter	JR	CG	MG	Experimental	Units
T_b	760.91	624.11	634.29	625.30[a]	K
T_c	942.86	795.17	841.99	814.50[a]	K
P_c	12.71	12.16	14.06	12.964[a]	bar
V_c	1047.50	1054.24	1062.61	-	cm^3/mol
ΔH_f^0	-647.90	-649.15	-644.50	-	kJ/mol
ΔH_G^0	-163.01	-162.77	-145.85	-	kJ/mol
T_m	447.64	331.44	368.30	-	K
$\Delta H_V(Tb)$	72.78	54.46	71.96	-	kJ/mol
ω	1.040	1.151	0.513	1.10703[a]	-

[a] Wallek et al. (2013)

Table 2 Estimated physical properties of $C_{18}H_{34}O_2$ in this work

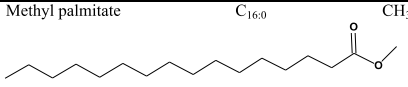
Component	$T_{b,calc} - T_{b,exp}$ (K)			$T_{c,calc} - T_{c,exp}$ (K)		
	JR	CG	MG	JR	CG	MG
Palmitic acid	88.69	-13.83	-7.40	102.12	-4.84	37
Oleic acid	135.61	-1.19	8.99	128.36	-19.33	27.49
AMD	112.15	7.51	1.59	115.24	12.085	32.245
RMD (%)	17.965	1.206	0.125	57.5	0.8768	4.04

Table 3 Deviations, AMDs and RMDs for boiling and critical temperature of fatty acids

Component	$P_{c,calc} - P_{c,exp}$ (bar)			$\omega_{calc} - \omega_{exp}$		
	JR	CG	MG	JR	CG	MG
Palmitic acid	-0.60	-0.50	0.65	0.1143	0.1633	-0.4137
Oleic acid	-0.254	-0.804	1.096	-0.0670	0.0439	-0.5940
AMD	0.427	0.652	0.873	0.0236	0.1036	0.5038
RMD (%)	3.015	4.800	6.435	3.120	10.760	49.090

Table 4 Deviations, AMDs and RMDs for critical pressure and acentric factor of fatty acids

Component	Methyl ester	Formula
Methyl palmitate	$C_{16:0}$	$CH_3(CH_2)_{12}CH_2COOCH_3$



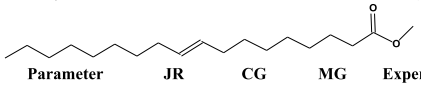
CAS No. 112-39-0
Mw = 270.5 g/mol
[a]ρ = 0.858 g/mL

Parameter	JR	CG	MG	Experimental	Units
T_b	646.58	580.99	585.44	595.20[b]	K
T_c	811.52	717.63	760.30	765[b]	K
P_c	12.35	12.55	14.18	12.767[b]	bar
V_c	1013.50	1007.10	1013.81	-	cm^3/mol
ΔH_f^0	-711.49	-710.24	-712.50	-	kJ/mol
ΔH_G^0	-218.11	-215.07	-209.15	-	kJ/mol
T_m	323.18	287.17	269.08	-	K
$\Delta H_V(Tb)$	60.84	58.53	62.67	-	kJ/mol
ω	0.879	0.892	0.676	0.8037[b]	-

[a] Wallek et al. (2013)

Table 5 Estimated physical properties of $C_{17}H_{34}O_2$ in this work

Component	Methyl ester	Formula
Methyl oleate	$C_{18:1}$	$CH_3(CH_2)_{15}CH_2COOCH_3$



CAS No. 112-62-9
Mw = 296.5 g/mol
ρ = 0.87 g/mL

Parameter	JR	CG	MG	Experimental	Units
T_b	696.50	598.78	607.44	617[a]	K
T_c	866.94	738.21	785.83	774.10[a]	K
P_c	11.22	10.89	13.13	12.783[a]	bar
V_c	1105.50	1108.13	1115.61	-	cm^3/mol
ΔH_f^0	-635.55	-637.35	-638.10	-	kJ/mol
ΔH_G^0	-121.05	-120.77	-113.71	-	kJ/mol
T_m	340.64	289.97	286.97	-	K
$\Delta H_V(Tb)$	65.25	55.84	67.44	-	kJ/mol
ω	0.886	0.953	0.655	0.9388[a]	-

[a] Wallek et al. (2013)

Table 6 Estimated physical properties of $C_{19}H_{36}O_2$ in this work

Component	$T_{b,calc} - T_{b,exp}$ (K)			$T_{c,calc} - T_{c,exp}$ (K)		
	JR	CG	MG	JR	CG	MG
Methyl palmitate	51.38	-14.21	-9.76	46.52	-47.37	-4.70
Methyl oleate	79.50	-18.22	-9.56	92.84	-35.89	11.73
AMD	65.440	16.215	-9.660	69.680	41.630	3.515
RMD (%)	10.755	2.665	1.585	9.035	5.410	0.4478

Table 7 Deviations, AMDs and RMDs for boiling and critical temperature of methyl esters

Component	$P_{c,calc} - P_{c,exp}$ (bar)			$\omega_{calc} - \omega_{exp}$		
	JR	CG	MG	JR	CG	MG
Methyl palmitate	-0.417	-0.217	1.413	0.0753	0.0883	-0.1277
Methyl oleate	-1.563	-1.893	0.347	-0.0528	0.0142	-0.2838
AMD	0.990	1.055	0.880	0.0112	0.0512	0.2057
RMD (%)	7.740	8.245	6.885	1.870	6.245	23

Table 8 Deviations, AMDs and RMDs for critical pressure and acentric factor of methyl esters

Boiling temperatures of esters are mostly represented significantly better than those of acids. The best results were obtained from the GC approach of Marrero and Gani (2001). The estimation of acentric factor generally shows limited representation of the available data by the selected models. Compared to Constantinou and Gani (1994) and Marrero and Gani (2001) models, the GC of Joback and Reid (1987) approach is clearly superior, with an average RMD of 3.12% for fatty acids and 1.87% in the methyl esters. For the estimation of T_c, the **CG** approach can be recommended, reproducing measured data within an RMD of 0.87% for acids and 0.44% for esters using the **MG** method.

ISSN-On line: 2410-4191

For the estimation of P_c, the **JR** model is best for acids, with an RMD of 3%; in the case of esters, the **MG** method is the best, with an RMD of 6.8%.

In the literature there are GC methods other than those used in this work (e.g., the methods of Wilson and Jasperson, 1996; Marrero-Morejón and Pardillo-Fontdevila, 1999; Tu, 1995; Jalowka and Daubert, 1986; Han and Peng, 1993). However, for substances larger than 3 carbons, which is the case of the present study, the Constantinou and Gani (1994) approach generally gives better results than those of Wilson and Jasperson (1996) and Marrero-Morejón and Pardillo-Fontdevila (1999). In addition, the estimation of critical molar volume is not considered in the Wilson and Jasperson (1996) method. The approaches of Tu (1995) and Jalowka and Daubert (1986) generally lead to almost the same average errors as those given by the above indicated GC methods, but they are more difficult to implement.

GC methods are very suitable for fatty compounds, considering that few function groups are able to describe acids, esters and acylglycerols, which correspond to the main fraction of vegetable oils and fats, and also biodiesels.

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ISSN-On line: 2410-4191

Article ECORFAN-Bolivia Journal
Chemestry December 2015 Vol.2 No. 3 152-155

Identification and evaluation of microorganisms isolated degraders of soil organochlorine pesticides agricultural in the State of Guerrero

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Received July 7, 2015; Accepted November 3, 2015

Abstract

Organochlorine pesticides (POC's) are highly hazardous to human health organic chemicals, animals and the environment. Because the POC's are chemically stable and lipophilic have a slow degradation rate and therefore tend to bioaccumulate. **General objectiv**e. Identify and evaluate microorganisms capable of degrading organochlorine pesticides isolated from agricultural soils from AjuchitlánandTixtla on the Guerrero State. **Methodology.**The fungal strains isolated were identified by microculture and Coomassie blue cotton , bacterial isolates were identified using techniques Gram stain, biochemical characterization was performed with VITEK 2 compact and bacterial growth and degradation POC's was performed cultured in M9 medium supplemented with Endosulfan I or Heptachlor (30 ng / ul). **Results.** The Identified strains of fungi were *Aspergillusniger* , *Penicilliumexpansum* , *Aspergillusfumigatus* and *Aspergillussp*, the bacterial strains were identified *Pantoeasp, Kocuriakristinae, Sphingomonaspaucimobilis, Pseudomonas alcaligenes* and *Staphylococcus lentus*, The bacterial growth kinetics shows that grows in *Sphingomonaspaucimobilis* shorter incubation in respect of *Pseudomonas* and *Staphylococcus lentusalcaligenes* time, the fastest growing strain Heptachlor was *Pantoeasp* compared to *Kocuriakristinae*. **Conclusion.** The strains of *Sphingomonaspaucimobilis* strains, *Staphylococcus,Pseudomonas* and *Alcaligeneslentus* degrade endosulfan. *Pantoeasp*and *Kocuriakristinae* degrade heptachlor. The strains are capable of growth on minimal medium and aerobically at 30 ° C.

Pesticides, soil, bacteria, identification, degradation

Citation: RAMÍREZ-CASARRUBIAS, Grecia Elizabeth, RUIZ-HERRERA, Raymundo, SIMÓN-CASTRO, Juana Iris, MORENO-GODINEZ, Ma. Elena, HUERTA-BERISTAIN, Gerardo. Identification and evaluation of microorganisms isolated degraders of soil organochlorine pesticides agricultural in the State of Guerrero. ECORFAN Journal-Bolivia 2015, 2-3:152-155

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Introduction

Organochlorine pesticides are most commonly used generally contain several chlorines in the molecule and have a high toxicity. Its chemical structure corresponds to that of chlorinated hydrocarbons which gives them high physical and chemical stability, water insoluble, nonvolatile, highly soluble in organic solvents. Depending on the number and position of chlorine substituents determine the ease of compound degradation. For this reason, these compounds are considered in the group of persistent organic pollutants (POPs) (Padilla, 2008).

Some public health problems in Mexico, caused by environmental pollution, due to the presence of chemicals. The presence of agrochemical residues began with the introduction in the country massively pesticides for use in agriculture.

Organochlorine pesticides are have aroused greater concern because of its undesirable effects on living beings and the environment. Today one of the major problems of contamination are due to the use of pesticides among which are organochlorine, although the use of such pesticides is prohibited, remaining residues of them into the environment because these used in agriculture and home to control various pests. In studies previously conducted by some researchers, they have discovered some Gram-negative and Gram-positive bacteria which have the ability to metabolize DDT, including *Alcaligeneseutrophus, Hydrogenomonassp and Pseudomonasputida*.

In a study 41 morphologically different bacterial colonies by biochemical tests were classified as *Staphylococcussp., Micrococcussp., Bacillussp., and Pseudomonassp* were isolated..

And other studies have linked them with processes of microbial degradation of DDT in soil under aerobic conditions (Son et al., 2008). Some researchers have shown great capacity Cupriavidussp., In the degradation of aromatic compounds such as soil contaminants (Perez et al., 2008). *Bacillusthuringiensis* can produce insecticidal toxins with potential, with the ability to degrade pesticides such as glyphosate. P*henylobacteriumspuede* pesticides degrade Family carbamates in agricultural soils (Perez et al., 2008). In 2001 an experiment where 53 species of fungi in soils contaminated with pesticides, able to degrade the herbicide metribuzin were isolated in liquid medium was performed. The most common species were *Aspergillus fumigatus, A. niger, A. terreus, Absidiacorymberifera, and Rhizopusmicrosporusvar. Microsporis*.

It was demonstrated that the herbicide turn promoted the growth of Fusarium genera Absidia and, which managed to eliminate 50% of the compound after 5 days (Ouahibaet al., 2001).

Based on the above, this paper aims to identify microorganisms present in soils of agricultural communities capable of degrading organochlorine pesticides and microorganisms have been reported using such pesticides as sole carbon sources.

Methodology to develop

Biological material

The used microorganisms were recovered from vials kept in a bank Biotechnology Laboratory strains of UACQB. Recovery of microorganisms was performed in minimal medium supplemented with organochlorine pesticides and incubated at 30 ° C.

ISSN: 2410-4191

Standards pesticides

Pesticides used in this work were DDE, endosulfan, heptachlor in analytical grade brand Restek, Bellefonte, PA. 16823-8812. USES. Identification of bacteria and fungi For identification of bacteria Gram stain (Appendix I) was first performed, as well as biochemical tests were carried out: Kliger, Simons citrate, RM-VP, Urea, MIO, LIA, malonate (Annex II). Confirmation of the bacterial strains was performed using the VITEK 2 compact equipment. (Annex III). For identification of fungi were stained with blue cotton (Annex III) and microcultures was also performed for macroscopic and microscopic reading (Annex IV). Kinetics of bacterial growth 100 mL of minimal medium broth was prepared in flasks for growing four strains endosulfan and 2 heptachlor, were placed 10.08 colonies and this was supplemented with 74.4 .mu.l of pesticide at a concentration of 30 ng / mL, they were incubated at 30 ° C for 6 days in a shaking incubator. 2 ml of sample was taken at time 0, at 24, 48,72, 96 and 120 hrs, the absorbance at 600 nm in nanodrop these were centrifuged at 10,000 rpm for 5 minutes was measured, it was removed the supernatant and this it was frozen for later purification pesticide is performed.

Results

Características	ENDC 1D4A	ENDC 3D4T	HPC1 D5A	HPC5 D4A	DDEC 1D5T	HPC1 D4A	DDEC 4D5T
Nombre	*Penicillium expansum*	*Aspergillus fumigatus*	*Penicillium sp*	*Aspergillus níger*	*Penicilium expansum*	*Penicillium sp*	*Penicillium sp*
Imagen							
Medio de cultivo	Sabouraud + plaguicidas	Sabouraud + plaguicidas	Sabouraud + plaguicidas	Sabouraud + plaguicidas	Sabouraud + plaguicidas	Sabouraud + plaguicidas	Sabouraud + plaguicidas
Tamaño (mm)	5mm	4cm	1cm	3cm	1cm	3cm	3cm
Aspecto	Algodonoso	Polvoso	Polvoso	Algodonoso	Granuloso	Algodonoso	Algodonoso
-Color Anverso	Blanco	Verde	Verde-Blanqusino	Negro	Blanco	Verde-Blanquesino	Verde-Blanquesino
Reverso	Blanco	Amarillo	Amarillo	Negro	Blanco	Amarillo	Amarillo
Forma	Filamentoso	Filamentoso	Filamentoso	Filamentoso	Circular	Filamentoso	Filamentoso
Superficie	Plana	Plana	Plana	Plana	Granular	Plana	Plana
Elevación	Plana	Plana	Plana	Elevada	Plana	Elevada	Elevada
Consistencia	Blando	Blando	Blando	Blando	Dura	Blando	Blando

Figure 1 Macroscopic characteristics of the strains of the fungal strains, identified as (A) Peniciliumexpansum, (B) Aspergillus sp, (C) Aspegillusníger, (D) Aspergillus fumigatus.

Características	ENDC2D5T	HPC4D4A	HPC1D5A	ENDC4D4T	ENDC1D4T	ENDC1D5A
Nombre	*Staphylococcus lentus*	*Pantoea sp*	*Kokuria kristinae*	*Pseudomona alcaligenes*	*Sphingomonas paucimobilis*	*Sphingomonas paucimobilis*
						
Tinción	Cocos (+)		Cocos (+)			
		Bacilos (-)		Bacilos (-)	Bacilos (-)	Bacilos (-)
Medio de cultivo	Medio mínimo + plaguicidas	Medio mínimo + plaguicidas	Medio mínimo + plaguicidas	Medio mínimo + plaguicidas	Medio mínimo + plaguicidas	Medio mínimo + plaguicidas
Tamaño (mm)	1mm	1mm	1mm	1mm	2 mm	2mm
Forma	Puntiforme	Puntiforme	Puntiforme	Puntiforme	Puntiforme	Circular
Elevación	Plana	Plana	Convexa	Plana	Plana	Elevada
Margen o borde	Entero	Entero	Entero	Entero	Entero	Entero
Color	Blanco	Blanca	Beige	Amarillo	Beige	Blanco
Superficie	Lisa	Lisa	Lisa	Lisa	Lisa	Lisa
Aspecto	Húmedo	Húmedo	Húmedo	Húmedo	Húmedo	Húmedo
Luz reflejada	Mate	Mate	Mate	Mate	Mate	Brillante
Luz transmitida	Opaca	Opaca	Opaca	Opaca	Opaca	Translucida
Consistencia	Suave	Suave	Suave	Suave	Suave	Suave

Table 1 Macroscopic and microscopic features fungi isolated from soil of crops.

ISSN: 2410-4191

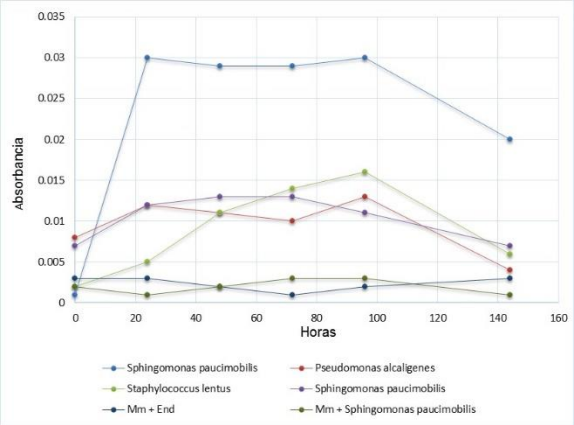
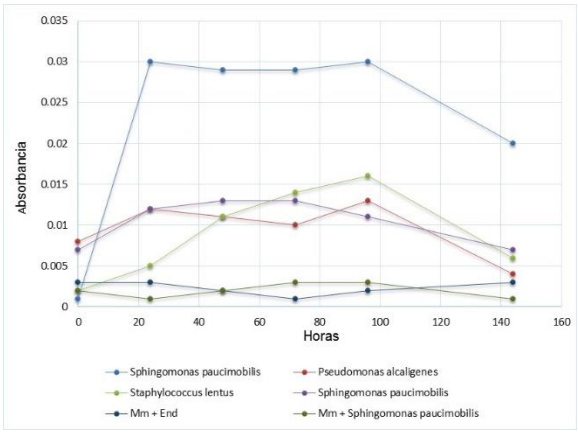
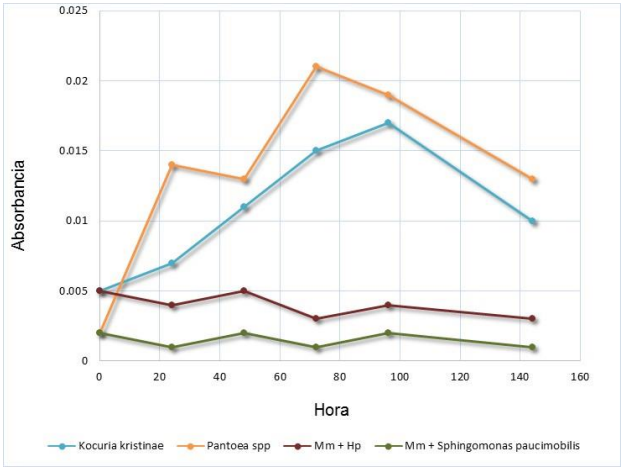


Table 2 microscopic and macroscopic of agricultural soils bacteriasaisladas Features.



Graphic 1 Kinetics of growth of Staphylococcuslentus strains isolated from soil PseudomonaalcaligenesSphingomonaspaucimo bilis Tixtla and of Ajuchitlán of Progress. At least a half Endosulfán.Mm Minimum Medium.



Graphic 2 Kinetics of growth of Pantoeaspp, Kokuriakristinaey Sphingomonaspaucimobilisaisladas Tixtla soil and Progress of Ajuchitlán strains. At least a half Heptacloro.Mm Minimum Medium.

According to the microscopic and macroscopic characteristics, strains of fungi grown in the presence of heptachlor, endosulfan DDE were *Penicillumexpansum, Aspergillus niger, Aspergillus sp and Aspergillus fumigatus*, these Penicillium had higher growth in Heptachlor as carbon source in compared with the strains exposed to DDE and Endosulfan. In a study by Rainer Martens in 1976, he showed that the genera *Aspergillus sp and Penicillumsp* has the ability to degrade the pesticide Endosulfan 65%. Likewise, a study by ouahiba and colleagues in 2001 identified strains of related fungi (*Aspergillus fumigatus, A. niger, A. terreus, Absidiacorymberiferay Rhizopus*) however show that these strains have the ability to degrade the pesticide metribuzin.

The bacterial strains identified agricultural soils were *Staphylococcuslentus, PseudomonaalcaligenesySphingomonaspaucim* obilis which are capable of degrading the pesticide endosulfan, *Pantoeaspy Kocuriakristinae* strains are capable of degrading the pesticide heptachlor.

ISSN: 2410-4191

In a study conducted by Son et al in 2008, they found *Pseudomonasp, Micrococcusspy Bacillussp* with the ability to degrade the pesticide DDT some of these bacteria are similar to those identified in this paper. It vijaiyan in 2013 showed that P*seudomonasspes* bacteria capable of degrading the pesticide Endosulfan up to 70% after 36 hours of culture.

The growth of the bacterial strains in cultures in minimal medium with 30 ng / mL of Endosulfan I as sole carbon source, showed that bacteria S*phingomonaspaucimobilis* has further growth unlike Staphylococcuslentus, Pseudomonaalcaligenes strains. On the other hand, the strain grew in minimal medium with 30 ng / mL of heptachlor as a carbon source was *Pantoeaspp* to 24 hours of exposure compared to the Kocuriakristinae strain. These differences between the growth of a strain and another may be due to their biochemical characteristics. Regarding the degradation of pesticides is expected that the concentration diminishes with respect to elapsed culture time, for it has been collected culture supernatants, to which they determine the concentration of pesticides by gas chromatography capture detector electron.

Conclusions

The Sphingomonas paucimobilis, Staphylococcus lentus and Pseudomonas Alcaligenes strains degrade endosulfan in cultures in minimal medium. Pantoeasp and KocuriaKristinaedegradan Heptachlor in minimal medium. Strains are capable of growth using Heptachlor Endosulfan or as sole carbon source and aerobic conditions at 30 ° C.

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ISSN: 2410-4191

Article
ECORFAN-Bolivia Journal
Optical
December 2015 Vol.2 No. 3 156-159

Characterization of pectin ataulfo handle (*Manguifera indica L.)* by infrared absorption spectroscopy in Fourier transform

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Received June 3, 2015; Accepted November 26, 2015

Resumen

El objetivo del presente estudio fue desarrollar una correlación que permita calcular el porcentaje de metoxilación de pectinas de cáscara de mango ataulfo a partir del espectro de absorción en infrarrojo con transformada de Fourier (FT-IR), para lo cual se hidrolizó químicamente un extracto de pectina de mango hasta diferentes grados de metoxilación, se uso un dispositivo de reflactancia total atenuada (ATR) que permitió analizar el polvo de pectina directamente sin el uso de KBr. Se tomó en cuenta el área de los picos de absorción a 1630 y 1740 cm^{-1} como indicadores de los ácidos galacturónicos no esterificados y esterificados con metanol respectivamente.

Como contribución se obtuvo una ecuación que permite calcular el grado de metoxilación de la pectina de cáscara de mango específicamente y que tiene una correlacion superior a 0.98.

FT-IR, pectina, metoxilación, mango ataulfo.

Abstract

The objective of this study was to develop a correlation to calculate the percentage of methoxylation of ataulfo mango peel pectin from the absorption spectrum of infrared Fourier transform (FT-IR), for which pectin extract of mango was chemically hydrolyzed to different degrees of methoxylation, an attenuated total reflactance device was used (ATR), which allowed analyzing the pectin powder directly without the use of KBr . The area of absorption peaks at 1630 and 1740 cm^{-1} was used as indicator of the galacturonic acids unesterified and esterified with methanol respectively.

The contribution is an equation that allows to calculate the degree of methoxylation of pectin from mango peel specifically and a correlation above 0.98 was obtained.

Keywords: FT-IR, pectin, methoxilation, mango ataulfo.

Citation: LINARES-GARCÍA, José Antonio, PALENCIA-SARMIENTO, Carlos Alberto, PASCUAL-RAMÍREZ, Juan, ESPINOSA-ENRÍQUEZ, José Luis. Characterization of pectin ataulfo handle (Manguifera indica L.) by infrared absorption spectroscopy in Fourier transform. ECORFAN Journal-Bolivia 2015, 2-3:156-159

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Article
ECORFAN-Bolivia Journal
Optical
December 2015 Vol.2 No. 3 156-159

Introduction

Determining the degree of methoxylation is very important for pectins because it defines the functionality of the biopolymer, the options for this determination are the acid-base titration or alkaline release of methanol and subsequent measurement by chromatography or nuclear magnetic resonance, both methods have as disadvantages complexity of procedures and be destructive to the sample (Fissore et al, 2013; Zhang and Mu 2011). Absorption spectroscopy in Fourier transform infrared (FT-IR) is a nondestructive technique instrumental analysis that enables accurate analyzes of compounds a quick way. Infrared radiation generates different vibrational and rotational states in certain molecular species macroscopically denote small changes in energy measuring equipment, instrument development, using an accessory for full transfer attenuated (ATR), it is possible to determine directly on the pectin powder, avoiding the use of KBr that is usually necessary for solid samples. Routine use of FT-IR could reduce the cost and time in the analysis of pectins.

Problem to solve:

Determining degree of methoxylation in pectins is by methods that destroy the sample, complex and time-consuming are. central hypothesis:

If the technique FT-IR analyzes functional groups in a relatively short time without destroying the sample, it is possible to find a correlation to quantify the degree of methoxylation in shell pectin ataulfo handle preserve the specimen and quick.

Methodology to develop

Obtaining the extract

The high methoxyl pectin from mango peel (MMAP) was obtained by hydrolysis with citric acid peel mango dried (1% w / v, boiling, 30 min) and subsequent precipitation with ethanol (1: 2, 96 ºGL) dried under air flow at room temperature, it was ground and stored in closed until analysis (Chen et al., 2014) package. chemical demethoxylation

A solution of MMAP 1.25% at room temperature prepararo, is added NaOH 0.25 N (2 ° C ± 1 ° C, pH 11.5) with constant to obtain different values of methoxylation agitation, the reaction stops with HCl, subsequently added ethanol 96 ºGL (1: 2) to precipitate, dried under air flow at room temperature, then ground and sieved and stored in a stoppered flask.

Chemical analysis

Galacturonic by the spectrophotometric method of quantitative determination of uronic acids (Blumenkrantz and Asboe-Hansen, 1973), which is based on the hydrolysis with sulfuric acid and subsequent chromogenic reaction with m-hydroxydiphenyl to give a colorless compound having an absorbance maximum acid the wavelength of 520 nm. 37.1.10 humidity by the method of the AOAC (1997) The degree of methoxylation was determined by the method of Schultz acid base titration, (1965).

FT-IR analysis

For analysis was used a spectrometer FT-IR mark Bruker Tensor 27 model and an accessory Platinum ATR crystal diamond simple and reflectance.

ISSN: 2410-4191

Each spectrum obtained was the average of 16 scans with a resolution of 4 cm-1 in a range of 400 to 4000 cm-1 with a background spectrum before each analysis The bands that relate to determining the degree of methoxylation are listed 1630 cm -1 (stretching vibration of the galacturonic acids methoxylated) and 1740 cm -1 (stretching vibration of methoxylated galacturonic acids), the degree methoxylation was obtained by dividing the sum of intensities of absorbance at 1740 cm-1 between the sum of intensities of absorbance at 1630 cm-1 + 1740 cm-1 (A1740 / (A1740 / A1630). for analysis of intensities use Opus 7.2 software.

Results

Obtaining the extract and chemical analysis

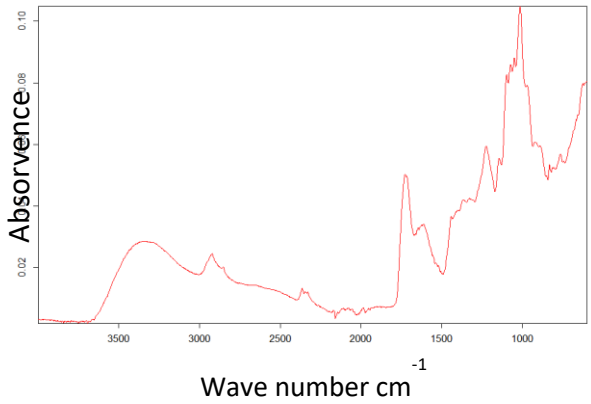
PAMM obtained had a purity of 67.7% galacturonic acid, a degree of methoxylation of 76.7% and 7.3% moisture.

Chemical demethoxylation

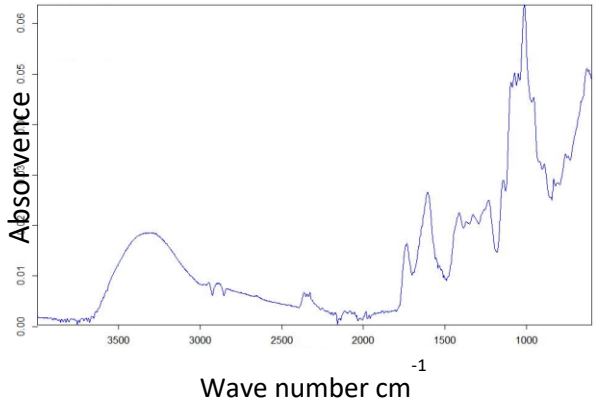
They starting chemical reaction with NaOH samples were obtained with 62, 53, 40 and 28% degree of methoxylation.

FT-IR analysis

Charts 1 and 2 show the FT-IR spectra are shown pectin before and after hydrolysis with NaOH.



Graphic 1 FT-IR spectrum of high methoxyl pectin mango (MMAP)



Graphic 2 FT-IR spectrum pectin bajometoxilo mango (PBMM)

As shown in the graphs, the intensity of the peaks at 1740 and 1630 cm-1 is reversed after reaction with NaOH, as corresponds to demethoxylation process. The relationship of the degree of methoxylation of pectins with the area ratio (A1740 / (A1740 / A1630) can be seen in Figure 3 which presents a good fit to the linear model with a coefficient greater than 0.98 correlation.

ISSN: 2410-4191

LINARES-GARCÍA, José Antonio, PALENCIA-SARMIENTO, Carlos Alberto, PASCUAL-RAMÍREZ, Juan, ESPINOSA-ENRÍQUEZ, José Luis. Characterization of pectin ataulfo handle (Manguifera indica L.) by infrared absorption spectroscopy in Fourier transform. ECORFAN Journal-Bolivia 2015, 2-3:156-159

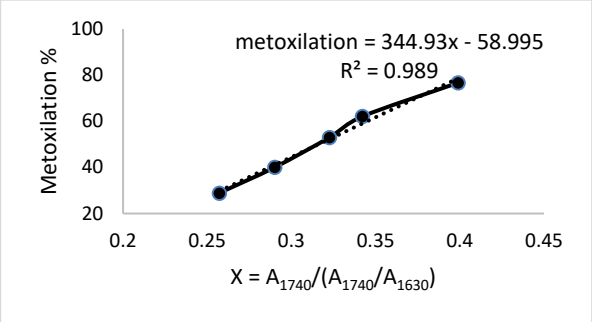


Figure 3 Correlation between A1740 linear / (A1740 / A1630) and the degree of methoxylation for ataulfo shell pectin handle.

Manrique and Lajolo (2002) also earned a linear model with MED = 124.7 X +2.2013 equation, using standard polygalacturonic acid and pectin, and it is possible that part of the difference filed with the equation obtained in this work, as the pectinic extracts may be highly variable depending on origin and sensitive it can ganerar variations.

Conclusions

In this paper we could obtain an equation for calculating the degree of methoxylation of pectins ataulfo handle shell from infrared absorption spectrum Fourier Transform. This can be very useful in routine analysis of this raw material and reagents allow saving time and effort in measuring paramentro said.

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ISSN: 2410-4191

Article **ECORFAN-Bolivia Journal**

Resources December 2015 Vol.2 No. 3 160-164

Statistical analysis of climatological variables Case: Puente Campuzano, Taxco - Guerrero

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Received June 1, 2015; Accepted October 28, 2015

Abstract

It is presented an analysis of weather variables of Puente Campuzano's community, located at Taxco - Guerrero. The weather station is located in the Polytechnic University of Guerrero State, specifically at geographical coordinates: 18.44°, -99.58°. A descriptive statistics analysis is realized of the main variables utilized for design of greenhouse, photovoltaic systems, to implement bioclimatic architecture approaches, and other real applications. The analyzed variables are: environmental temperature, surface temperature, solar irradiance and wind velocity. Location and dispersion values were obtained of each physical parameter. Is presented the histograms of data distribution of temperature, irradiance and wind velocity, and also a summary of the main statistical characteristics of the different data distribution. All the data distribution have a left asymmetry, and only the surface temperature has a mode of 45.50 °C. Monthly irradiance mean is 634.02 W/m^2, the mean wind velocity is 2.75 m/s, and the mean of environmental and surface temperature are: 26.67 °C y 31.30 °C, respectively.

Weather station, descriptive statistics.

Citation: ALANÍS-NAVARRO-J. Andrés, RIVERA-ROMÁN, Ó. Misael, BAHENA-LANDA, M. Yuridia. Statistical analysis of climatological variables Case: Puente Campuzano, Taxco - Guerrero. ECORFAN Journal-Bolivia 2015, 2-3: 160-164

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Introduction

Currently, in the state of Guerrero you have access to the use of reliable climatological variables that allow for design and / or sizing of environmental and solar systems: solar dryers, greenhouses, home design room considering aspects of bioclimatic architecture, etc. However, weather stations are located in specific areas, and it is not feasible to use information from a remote area of the site of interest. In the state of Guerrero, the civil protection system has 34 automatic weather stations (EMAs) [SMA, 2015], of which only one is located in the municipality of Taxco Guerrero, specifically in the coordinates: 18 ° 32'53 "99 ° 36'10", at an altitude of 1654 masl (meters above sea level). In this paper the information of some climatic variables in the southern area of Taxco, which is presented by geographical location (18.44 °, -99.58 °) are similar to the conditions of Iguala de la Independencia, among other communities as Naranjo, and Taxco.

Goals

Form a database of climatological variables that serve as reference for the design of environmental and solar systems, in the southern part of the municipality of Taxco - Guerrero.

Understand, from a statistical standpoint, the variation of some physical parameters used in climatology.

Methodology

automated measurements were conducted during 2014 and 2015 of the variables: irradiance, wind speed, ambient temperature, and temperature of a surface selective absorption with an absorption coefficient of ~ 87%.

The measurements were systematically performed every 10 minutes from 6:00 to 23:50 h. Due to the large amount of data, this study only the information of March this year presented.

The system used for the acquisition of climatological variables is "SMA Sunny sensor box", which includes an anemometer cups and a calibrated cell to measure solar irradiance, expressed as a solar power per unit area (W / m2) or energy transfer per unit area and unit time (J / (m2s)). In Figure 1 a photograph of the data acquisition system is shown.

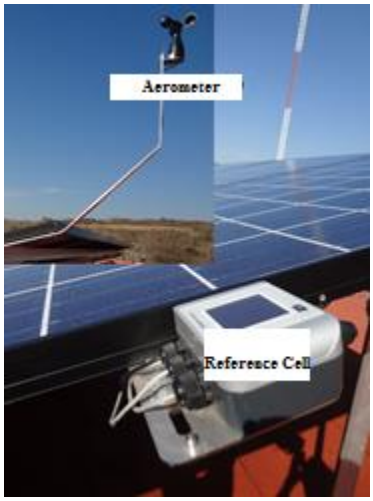

Figure 1 Reference cell and anemometer used to measure wind speed and irradiance respectively.

The next step was to perform a statistical analysis of physical variables. An analysis was performed to determine the measures of central tendency and measures of location and dispersion measurements using the computer program OriginPro 8. The measures of central tendency calculated are: i) the average, ii) medium, and iii) fashion; while dispersion measures analyzed are: iv) range, v) standard deviation (s), vi) bias or obliquity (sk: skewness) and vii) the coefficient of variation (CV) [Levin, 2004; Devore, 2008].

ISSN:2410-4191

Results

The solar irradiance data, the surface temperature and ambient temperature is shown in Figure 1. It is possible to observe that reaches near the irradiance 1150 W / m2 values, while the surface temperature exceeds 45 ° C, with a temperature of 14 ° C, on the other hand, ambient temperature is between 21 ° C and 32 ° C.

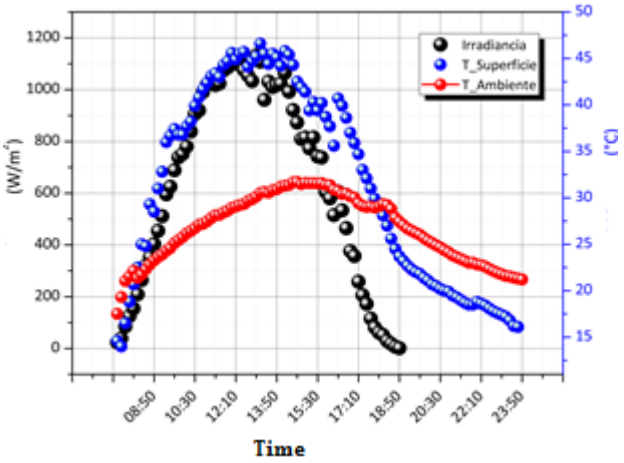

Figure 1 Irradiance, surface ambient temperature and a function of time.

The variation of velocity versus time is shown in Figure 2, which is compared with the temperature variation of the selective absorption surface. One can see that both physical variables follow a trend.

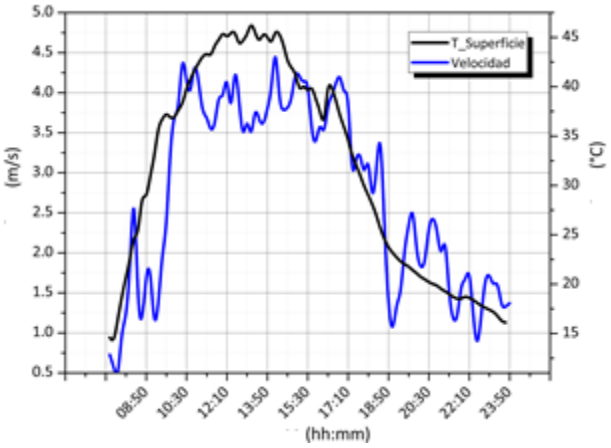

Figure 2 Wind speed and surface temperature versus time.

Data analysis using descriptive statistics

Due to the large amount of information of the variables analyzed, we chose to conduct an analysis of descriptive statistics, which includes the calculation of measures of central tendency: mean, median and mode, as well as measures of dispersion: range, deviation standard, bias, and coefficient of variation. In Figure 3, the histogram data solar irradiance occurs. Irradiance data do not present fashion, have an average of 634.02 W / m2, a medium is 737.92 W / m2, the range is 1131.98 W / m2 and a coefficient of variation of 0.6. Graph 4 the histogram data presented wind speed. The wind speed data is an average of 2.75 m / s, a median of 3.04 m / s and no fashion; It has a range of 4.33 m / s and a coefficient of variation of 0.44. Regarding the room temperature in Figure 5 shows the histogram. The average data is 26.67 ° C, a median of 27.07 ° C and no fashion; It has a range of 14.19 ° C and a coefficient of variation of 0.14. Finally, Figure 6 shows the results of analysis of surface temperature data shown are as follows: an average of 31.30 ° C, a median of 32.10 ° C, and a mode of 45.50 ° C; It presents a range of 32.6 ° C and a coefficient of variation of 0.34.

ISSN:2410-4191

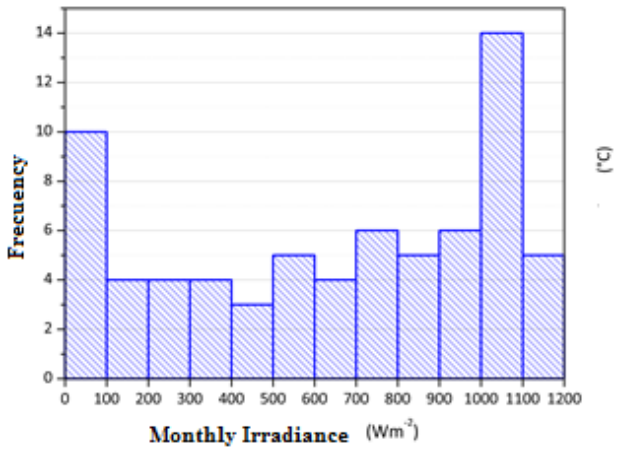

Figure 3 Histogram irradiance data.

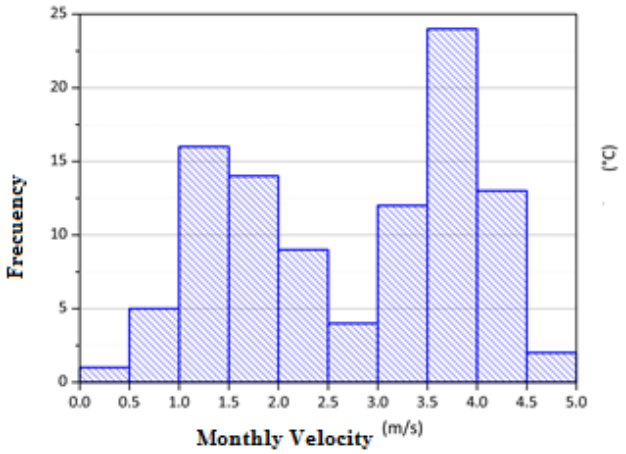

Figure 4 Histogram of the wind speed.

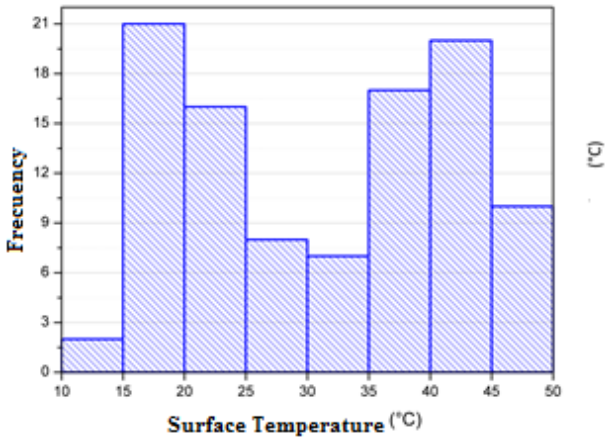

Figure 6 Histogram of surface temperature.

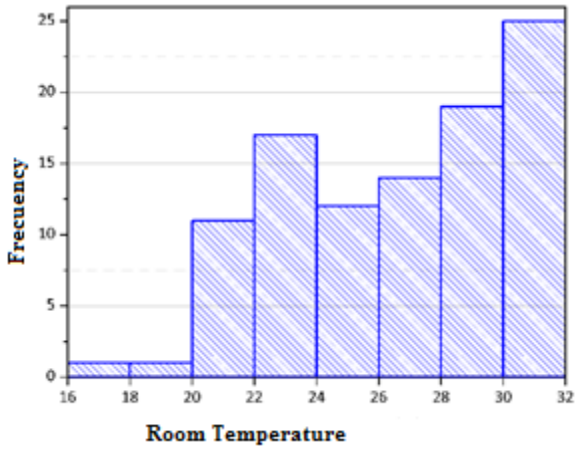

Figure 5 Histogram room temperature.

Table 1 summarizes the main measures of central tendency and dispersion measurements of physical variables studied in this work is presented.

	Media	Mediana	Moda	Rango	S	Sk	CV
Irradiancia	634.02 W/m²	707.02 W/m²	--	1101.98 W/m²	280.37 W/m²	-0.33	0.80
Velocidad	2.75 m/s	3.04 m/s	--	4.38 m/s	1.20 m/s	-0.21	0.44
T_Ambiente	26.67 °C	27.07 °C	--	14.16 °C	3.80 °C	-0.07	0.14
T_Superficie	31.30 °C	30.10 °C	45.50 °C	30.80 °C	10.88 °C	-0.07	0.34

Table 1 Summary of measures of central tendency and dispersion of the variables analyzed.

Conclusions

Wind energy, greenhouse design, natural heating, heaters and solar dryers, power generation from energy: a statistical analysis of some useful climatological variables for the design and development of projects related to renewable energy and the environment is presented solar, among other applications. This information is useful to the south of the city of Taxco, Guerrero. The distribution of the data of the four physical variables have a left asymmetry, and only the surface temperature presents a fashion, which is 45.5 ° C. The average irradiance variables, wind speed, ambient temperature and surface are: 634.02 W / m2, 2.75 m / s, 26.67 and 31.30 ° C ° C, respectively.

ISSN:2410-4191

Solar irradiance data having a higher heterogeneity (60%) compared with the other variables. The ambient temperature is the parameter of greater homogeneity, introducing a coefficient of variation of 14%.

In this paper partial information of a larger study shows, however, information is available for consultation.

Thanks

A Polytechnic State University Guerrero and Engineering Department in Energy and Environmental Technology for providing climatological data.

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ISSN:2410-4191

Article **ECORFAN-Bolivia Journal**
Food Technology December 2015 Vol.2 No. 3 165-170

Potential uses of *Tagetes lucida* medicinal Cav. through detection phytochemicals groups in different extracts

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Received July 10, 2015; Accepted November 4, 2015

Abstract

The pericón is a highly branched grass and smells of anise. The most common medicinal use of this plant is in digestive disorders. This research was conducted to be an alternative for primary health care. In this study pericón its types of secondary metabolites using proper techniques for identification they were determined. In the phytochemical analysis of EE (ether extract), EA (alcoholic extract) and EAC (aqueous extract) of *T. lucida* oil were detected in the US stem-leaves and flowers; alkaloids in EE and EA-leaf stems and flowers; EE and EA coumarin in roots, stems-leaves and flowers; triterpenos mostly in the US and EA leaf-stalks and flowers; EA catechins in the roots; EA resins flowers; reducing sugars in EA and EAC all parts of the plant; EA saponins in the roots; phenols and tannins in the EA and EAC stem-leaves and flowers; quinones in the EA-leaf stems and flowers; EAC flavonoids in the three parts of the plant, and the EAC bitter stem-leaf and flower early.

***Tageteslucida,*phytochemicals groups medicinal uses.**

Citation: PARRA-M., José L., ESCALANTE-E. Yolanda I., CAMPOS-L., Hugo y CARBAJAL-L., Yolanda. Potential uses of Tagetes lucida medicinal Cav. through detection phytochemicals groups in different extracts. ECORFAN Journal-Bolivia 2015, 2-3: 165-170

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The rainy season, mainly in late October. The people of the communities formerly used in traditional medicine for its emetic, purgative and antimicrobial properties, but gradually this knowledge has been lost. In Mexico the leaves as a seasoning, the whole plant for diarrhea, as a remedy for malaria and for sufferers of "spitting blood" were used. Even today, the plants are collected, dried and stored for later use. In the form of tea, anise flavor, is used to treat scorpion bites, fever and fever, even as an aphrodisiac. Pericón also burnt as incense in religious ceremonies and homes against mosquitoes.

Essential oils (AE), isolated from the aerial parts, flowers and leaves with stems of T. lucida grown in Costa Rica, were analyzed by gas chromatography-mass spectroscopy (GC / MS) and 30 compounds were identified, of which the major constituent was the methylchavicol (95-97%) (Ciccio, 2004). Cespedes et al (2006) reported that the aerial parts of T. lucida found seven coumarins: 7,8-dihidroxicumarina, umbelliferone (7-hydroxycoumarin), scoparone (6,7-dimethoxycoumarin), esculetin (6,7-dihidroxicumarina), 6-hydroxy-7-methoxycoumarin, herniarin (7-methoxycoumarin), and scopoletin (6-methoxy-7-hydroxycoumarin). Flavonoids are also three: patuletin, quercetin, and quercetagetina.

T. lucida is used in traditional Mexican medicine for the treatment of various central nervous system disease. Guadarrama-Cruz et al (2008) worked on the antidepressant effect of *T. lucida* extract in rats as well as the potential adverse effects on sexual behavior in males. A tool for integrated pest management is the use of AE and plant extracts. Caballero-Garcia, et al. (2011) analyzed by GC / MS AE *T. lucida* and other species growing in Colombia.

These AE as several of its components were tested against Triboliumcastaneum, resulting repelents. In *T. lucida* all the principal component was methylchavicol. The aim of this work is to perform the phytochemical study of pericón (*Tagetes lucida*Cav.) To determine the type of secondary metabolites in plant organs. The specific objectives raised were performed the phytochemical study from ethereal, alcoholic and aqueous extracts of *T. lucida* bodies to contribute to knowledge about its components and test whether there are secondary metabolites such as alkaloids, coumarins, saponins, flavonoids, reducing sugars, triterpenes, steroids, anthocyanidins and quinones, to support its use in the treatment of diseases of humans and plants.

Materials and methods.

Biological material

Pericón plants were collected in Tixtla, Guerrero in the area known as Alta Stone coordinates Latitude 17 ° 33'56 "N, Longitude 99 ° 24'08" W and at 1374 meters. In the collection 30 whole plants were taken. Tratamientodel plant material: Plants were washed with water to remove traces of dust and soil, then immersed in sodium hypochlorite at 1 mL / L of water for 10 minutes. They allowed to drain exposed to sunlight for about an hour. roots, stems, leaves and flowers-separated. Each part was cut into small pieces of 1-3 cm. They were dried at room temperature for ten days. They were ground separately in a blender until an approximate particle size of 2 mm. The dry powder and stored in amber bottles with frosted cap to protect from light and moisture parties.

ISSN: 2410-4191

Obtaining extracts

50 g of plant material were weighed, extracted with 150 mL of diethyl ether by maceration for 72 hours. It was filtered to obtain the ether extract (EE) and the solid residue (RS1) was dried and weighed. The RS1 extracted with 150 mL of ethanol, by maceration for 72 hours. It was filtered to obtain the alcohol extract (EA) and the solid residue (RS2) was dried and weighed. The RS2 was extracted with 150 mL of distilled water, by maceration for 72 hours. It was filtered to obtain the aqueous extract (EAC) and the solid residue (RS3) was dried, weighed and discarded. Each part of the dried plant was subjected to three successive extractions at room temperature. Subsequently separately in each extract he was subjected to reactions characterization.

Qualitative phytochemical analysis

For the phytochemical analysis methodology Miranda (2002) was followed.

1. Ether extract (EE): Each ether extract was divided into six fractions of 5 mL for testing of oils and fats (test Sudan), alkaloids (Dragendorff tests, Mayer, Wagner), lactonasy coumarins (test Baljet) and triterpenes and steroids (Lieberman-Buchard test).
2. Alcoholic extract (EA): Each alcoholic extract was divided into 15 fractions of 2 mL for testing catechins (test sodium carbonate) resins, reducing sugars (test Fehling), lactones (test Baljet), triterpenes and steroids (test Lieberman-Buchard), saponins (foam test), phenols and tannins (ferric chloride test), amino acids (ninhydrin test), quinones (test Borntrager), flavonoids (test Shinoda), cardenólidos (test Kedde), anthocyanins (amyl alcohol test) and alkaloids (Dragendorff tests, Mayer, Wagner).

3 Aqueous extract (EAc): Each aqueous extract was divided into six fractions of 2 mL for testing alkaloids (tests Dragendorff, Mayer, Wagner), tannins (ferric chloride test), flavonoids (test Shinoda), reducing sugars (Fehling test) and saponins (foam test); plus a fraction of 10 mL for mucilage (cooling test) and a few drops for test bitter principles (Taste test).

The interpretation of the test results was performed according to the following qualitative scale, which was based on the intensity change in the color of the chemical reaction: (-) Negative (+) Low evidence, (2 +) Median evidence (3+) High evidence.

Results and discussion.

Reactions coloring or appearance of precipitates, applied according phytochemical analysis techniques, are specific to the chemical group that was investigated. Table 1 shows the chemical composition of the extracts of pericón. oils with high evidence (3+) were detected in the US stem-leaves and flowers; alkaloids in EE and EA-stem leaves and flowers with high intensity were extracted using alcohol as solvent, in the method of detecting the Mayer showed lower sensitivity; coumarins were detected in the US and EA root, stem-leaves and flowers, with less intensity in the roots and stem-leaves, the ether extracts of stems and leaves had low concentration compared with the median intensity was obtained with alcohol extracts , extracts of flowers were obtained alcohol had high intensity than in other parts of the plant that were tested; triterpenosse found in the highest concentration in the flowers, at the root had low intensity and medium-stems sheets.

ISSN: 2410-4191

Catechins were detected with high intensity in the EA roots; resins were detected with high intensity in the EA flowers; reducing sugars in EA and EAC all plant parts, more extraction with water as solvent; EA saponins in the roots with high intensity, low intensity obtained with EAC in roots and flowers and the stems and leaves EA also at low intensity; phenols and tannins in the EA and EAC stem-leaves and flowers are at higher concentration than in the roots where they are to medium intensity; Quinones in the EA stem-leaves and flowers in greater intensity than in the root was found in medium intensity; flavonoids were detected with medium intensity in the EAC of the three parts of the plant, cardenólidos were detected with medium intensity in the EA of flowers, with low-intensity stem-leaves and bitter principles with high intensity in the EAC stems -aluminum flowers. No anthocyanins, or mucilages.

Almost all secondary metabolites were determined in this plant are found in flowers, with variation of low, medium to high intensity reaction to the tests, have oils, alkaloids, lactones-coumarins, triterpenes, resins, reduced sugars, saponins, phenol-tannins, amino acids, quinones, flavonoids, cardenólidos and bitter principles, not only had catechins. It constituted 93% of certain compounds.

Determination	*Root*			*type of extract stem - leaves /*			*flowers type extract / type of extract*		
Group fitochemical	*EE*	*EA*	*EAC*	*EE*	*EA*	*EAC*	*EE*	*EA*	*EAC*
Sudán/aceites grasas	–			3+			3+		
Dragendorf /alcaloides	–	–	–	2+	3+	2+	2+	3+	2+
Mayer /alcaloides	–	–	–	2+	3+	–	2+	2+	–
Wagner /alcaloides	–	–	–	2+	3+	–	2+	3+	–
Baljet/Lactona, cumarina	2+	2+		+	2+		2+	3+	
Liebermann /triterpenos	+	+		2+	2+		3+	3+	
Catequinas		3+			–			–	
Resinas		–			–			3+	
Fehling/azúcares reduc		2+	3+		2+	3+		3+	3+
Espuma /saponinas		3+	+		+	–		–	+
$FeCl_3$/fenoles, taninos		2+	2+		3+	3+		3+	3+
Ninhidrina /aminoácidos		+			+			–	
Borntrager /quinonas		2+			3+			3+	
Shinoda /flavonoides		–	2+		–	2+		–	2+
Kedde /cardenólidos		–			+			2+	
Antocianinas		–			–			–	
Mucílagos			–			–			–
Principios amargos			–			3+			3+

Table 1 Groups phytochemicals found in different organ extracts of *Tagetes lucidaCav*.

The intensity of reaction tests is associated with the amount of the particular compound in the plant organs. The stems and leaves pericón also had almost all metabolites were studied in variation from low to high intensity, lack of catechins and resins. Are present 86% of secondary metabolites were determined. tannins, quinones, flavonoids, except oils, fats, alkaloids, resins, amino acids, bitter principles cardenolides and - less in roots than in other metabolites organs had coumarin, triterpenes, reduced sugars, saponins, phenols found. They had 50% of chemical compounds analyzed. It is noteworthy that only the root had catechins and resins flowers. In any organ of the plant anthocyanins and mucilages found.

On the catechins were detected only in the extracts from the roots of pericón it could be able to do studies to give a medical use because it reportedly has an action hepatoprotective which would be related to its antioxidant properties (Harborne, etal. , 1975).

ISSN: 2410-4191

It is reported by Caceres, A. (1996) leaves and flowers Pericón in Guatemala aceiteesencial contain (limonene, β-ocimene, β-caryophyllene, myrcene, acetol, alilanisole, estragole (methylchavicol), methyl ether of eugenol, tagetone, dihydrotagetone, tetrahidrotagetona and linalool), quaternary alkaloids, flavonoids (quercetagetina, patuletin), saponins, leucoanthocyanins, gallic acid, polyacetylene, glicósidoscianogénicos, coumarins (7-hydroxycoumarin dimetilalileter of 7-methoxycoumarin and 6,7,8-trimetoxicumarina), derivatives thiophene, α-terthienyl, polyacetylenes (5- (3-buten - ynyl) - 2,2`-bitienol), gum, dextrin, fats, pectin, three resinasacídicas, tannins and minerals. These results agree with phytochemicals groups detected in this study, the difference was the specification of them and in this case the plant and intensity of the reaction by the presence of groups.

The same author attributes to the biological and pharmacological α-terthienyl and herniarin that are present in the leaves and flowers activity. The α-terthienyl is a yellow crystal, molecular weight 248, melting point 93-94 ° C, soluble in ether, acetone and ethanol, insoluble in water; It has antimicrobial activity. The herniarin (7-methoxycoumarin) is a white-yellow crystal, molecular weight 176, with antibacterial, antispasmodic, diuretic and anti-inflammatory activity. The presence of flavonoids, specifically flavones, which is the group they belong to the flavonoids in Pericón: quercetagetina and patuletin. The antibacterial activity found in a flavonol 7-O-glycosylated first, make quercetagetina 7-O-glu promising antimicrobial agent to consider with good bioavailability in humans (Jensen et al., 1998) .The quercetagetina and patuletin they are active against Lewis carcinoma (language).

Pericón plants that were collected in Tixtla, Guerrero bear resemblance to the chemical groups that were reported by Cáceres in Guatemala.

By this evidence of congruence Pericón plants have the potential to be used in the pharmaceutical industry and in traditional medicine, can already grown formally and not just wild as at present.

Conclusions

Flowers pericón (Tageteslucida) are oils, alkaloids, lactones-coumarins, triterpenes, resins, reduced sugars, saponins, tannins phenol-amino acids, quinones, flavonoids, bitter principles cardenólidos and lack of catechins. The stems and leaves were all metabolites were detected in the flowers except catechins and resins. tannins, quinones, flavonoids, except oils, fats, alkaloids, resins, amino acids, bitter principles cardenolides and - in the roots coumarins, triterpenes, reduced sugars, saponins, phenols found. It is noteworthy that only resins tienencatequinas roots and flowers. In any organ of the plant anthocyanins and mucilages found. Some substances of this type have biological activity, which is of biological interest to identify and separate the major components of the extracts. By this evidence Pericón plants have the potential to be used in the pharmaceutical industry and in traditional medicine, can be grown and formally and not just wild as at present. It is also proposed to continue the study of alkaloids and essential oils pericón and testing its cytotoxic, antispasmodic, insecticide and against mosquitoes that transmit dengue activity.

ISSN: 2410-4191

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ISSN: 2410-4191

Article **ECORFAN-Bolivia Journal**

Anatomy December 2015 Vol.2 No. 3 171-176

Phylogenetic variability analysis of *Helicobacter pylori* strains isolated from patients with gastric pathologies in the state of Guerrero

FERMAN Alan M., TORRES Rogelio G., ROMAN Adolfo, TORIBIO Jeiry

Received August 14, 2015; Accepted November 1 2015

Abstract

Objectives: Amplify the *glmM* gene in the *H. pylori* strains isolated from patients with gastric diseases in the state of Guerrero. Analyze if there is genetic variability based on phylogenetic analysis of the *glmM* gene. Study the correlation of the molecular epidemiology of clonal distribution of H. pylori strains between Guerrero with other human populations.

Methodology: 12 DNAs of *H. pylori* were analyzed during the study period realized between November 2014 and March 2015, in which the *glmM* gene was amplified and sequenced then a phylogenetic tree was carried out to study the sequence homology between state level and other geographical groups.

Contribution: This study is among the first of its kind in the state of Guerrero and is the basis for the development of others because the methodology can be applied to other genes and bacterial species.

***Helicobacter pylori*,*glmM*, Phyologeny**

Citation: FERMAN Alan M., TORRES Rogelio G., ROMAN Adolfo, TORIBIO Jeiry. Phylogenetic variability analysis of Helicobacter pylori strains isolated from patients with gastric pathologies in the state of Guerrero. ECORFAN Journal-Ecuardor 2015, 2-3: 171-176

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Introduction

H. pylori is a gram-negative bacillus, microaerophilic, of different morphology, measuring 2.5-5.0 microns long and 0.5-1.0 microns wide (Acute S., et al., 2010). The main reservoir of H. pylori is the human stomach, this species has affinity for the gastric mucosa (Salama N., et al., 2013). The presence of H. pylori in the stomach has been linked to the development of various diseases such as gastritis, gastric and duodenal ulcers, gastric cancer and MALT lymphoma (Zamora, O.R, et al., 2010).

H. pylori has a genome of 1700 genes that have been functionally characterized, 5% -10% of these genes are considered as species specific (Yamaoka, Y., 2012). Furthermore, there are auxiliary genes in a hypervariable region called "plasticity zone" and represent 6-7% of the total genome of H. pylori (Boneca I., et al., 2003). The genetic diversity of H. pylori is high among strains of the same geographical origin and is even more globally. Differences in genetic diversity, are associated with the ancient and modern migrations. Subsequent recombination between strains have homogenised the ancestral population structure, but between related strains have tended to retain as a result of selective genomic mechanisms (Delport, W., et al., 2006).

In the H. pylori genome, the GLMM (NC_000921.1) gene encoding the protein fosfoglucosaminamutasa, this is located in a region between 76.299 and 77.636 bp bp, having a size of 1,338 (Genomiccontext, NCBI, 2014).

The fosfoglucosaminamutasa is the main component of the cell wall of all eubacteria. This is a heteropolymer comprising glycan chains bound to small peptides.

In eubacteria it is essential for peptidoglycan synthesis, lipopolysaccharides and teichoic acids. (Barreteau, H., et al., 2008). The GLMM gene is preserved and used to identify H. pylori in gastric biopsies for its high degree of sensitivity and specificity (Tamer, E., et al., 2013).

H. pylori is found in half the world's population. Its prevalence shows high variability by geographic region, ethnicity, race, age and socioeconomic factors (Hunt, R.H, et al. 2010).

In Mexico, in 2008, the Directorate General of Epidemiology reported that the estimated children one year old infection was 20%, with a rate of increase of 5% annually for the first ten years of life, reaching 80% in young adults between 18 and 20 years old (Sanchez, M., et al., 2010).

The prevalence of H. pylori in the state of Guerrero, by (Roman, A., et al., 2013), detectaronH. pylori in saliva and gastric biopsy in 196 patients, and determined the correlation between the vacA genotypes found in saliva and stomach from the same patients, of which 24% of patients had H. pylori DNA in saliva and biopsies, 52.5% only 6.6% biopsies and saliva.

In Mexico and particularly in Guerrero there are few studies on the phylogenetic and genealogical analysis of H. pylori, in this paper we point out the clinical and evolutionary significance of this bacterium, to promote research of genetic and molecular type, in order to meet with major criterion new diagnostic methods for the development of new treatments that may promote a decrease in the prevalence of H. pylorienelestado of Guerrero and likewise reduce the incidence of gastric cancer in the population Guerrerense.

ISSN: 2410-4191

Methodology to develop

The samples used in the study were obtained from the sample bank Clinical Research Laboratory of the Academic Unit of Chemical and Biological Sciences, UAGro. Chromosomal DNA extraction DNA from H. pylori strains was obtained by the method of phenol-chloroform isoamyl alcohol (Ortiz M., et al., 2004). genetic variability of the population. GlmMfue gene amplification by PCR with the oligos and conditions used by Aquino and Mozo (2013), employing them oligonucleotides: glmMF (3'-5'-CGCGAGCCACAACCCTTTTGAAG), and glmMR (5'-GCTTATCCCCATGCACGATATTC-3 ') . MJ Research thermocycler (Watertonwn, MA, USA) was used, using the following amplification pattern: A starting temperature to 94 ° C for 5 minutes, 30 cycles 94 ° C for 1 minute, 54 ° C for 1:30 minutes, 72 ° C for 1:30 minutes and final extension of 10 minutes at 72 ° C. the PCR products were electrophoresed on agarose gel 1.0%, then were stained with ethidium bromide and visualized on a transilluminator with (UV) light UVP brand, modeloDigiDoc-it observed a product of approximately 796 bp. Purification products for sequencing was performed with PCR kit UltraClean. The products were sequenced in the area of synthesis of the Institute of Biotechnology of the UNAM.

Analysis of data

The sequences obtained from glmMfueron Chromas analyzed with the program for the clarification and editing sequences, BLAST was performed later in the GenBank to obtain GLMM other sequences in order to make a multi alignment with the program ClustalW 2.

Subsequently, build a phylogenetic tree of the sequences with a method neighborjoining boobstrap 1000 with MEGA 6.1 program.

Results

12 gastric biopsy samples come from different parts of the state of Guerrero, sehizo sampling EN6 men (30%) and 6 women (70%) of different ages, with an average of 44 years, the database is shown in Table 1)

Code	Sample	Sex	Age	Location	Region
4191	HG 150	Male	57	Chilpancingo	Centro
4192	UEGE 748	Male	57	Tlapehuala	Tierra Caliente
4193	HG 66	Female	27	Chilpancingo	Centro
4194	HG 199	Female	44	Chilpancingo	Centro
4195	HG 182	Male	25	Chilpancingo	Centro
4196	HG 79	Male	38	Chilpancingo	Centro
4197	HG 165	Female	39	Chilpancingo	Centro
4198	HG 171	Female	37	Chilapa	Centro
4199	HG 200	Female	42	Chilpancingo	Centro
4200	HG 203	Male	37	Zumpango	Centro
4201	HG 162	Male	19	Apango	Centro
4202	HG 189	Female	30	Chilpancingo	Centro

Table 1 Distribucion of cepasen basis of sex, age, town and region, in the state of Guerrero.

Phylogenetic analysis

With a phylogenetic tree sequences which homology ezquematiza the clones and using this information is shown to exist in Guerrero certain degree of homology between strains from different regions, as in the case of 748 strains UEGE (Hp.4192) was performed and HG 199 (Hp.4194), these strains come from Tlapehuala and Chilpancingo respectively and in 58% in the analysis of homology in their sequence GLMM, designated by bootstrap analysis of 1000

ISSN: 2410-4191

Compared to the other strains, the program Mega6 allows you to place the clones in clades to monitor developments regarding homology with other clones, which allowed us to observe that the clones of the state of Guerrero have similarities with clones belonging to other geographical groups in the world, so we can suggest that Clonas Guerrero state are not native to the same, tienendocomo origin countries around the world, these clones probably came through population migration and once reached the state of Guerrero, by selective pressure using their areas of plasticity modified their survival genes, one of these the GLMM gene, making these unique clones in the world.

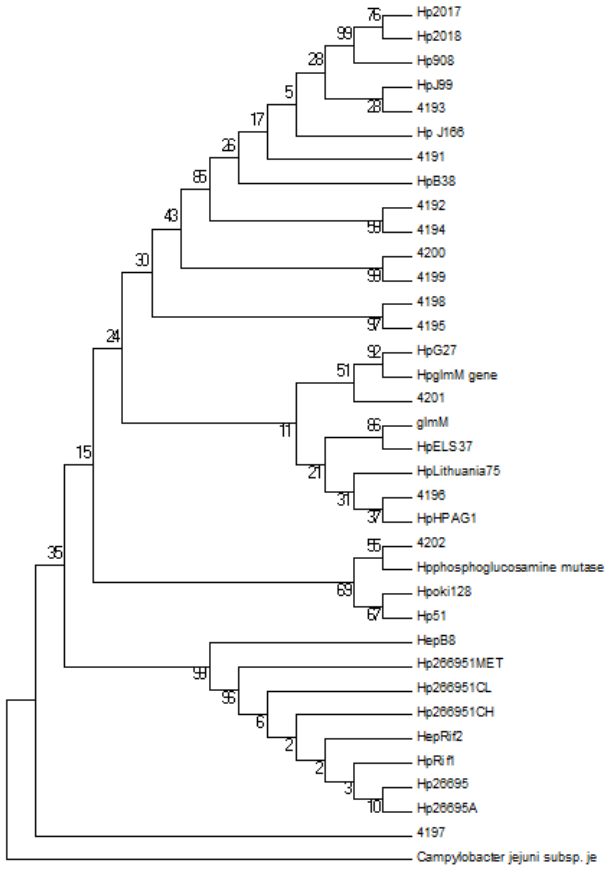

Figure 1 Phylogenetic GLMM with the neighbor-joining method with 1000 bootstrap tree.

Annexes

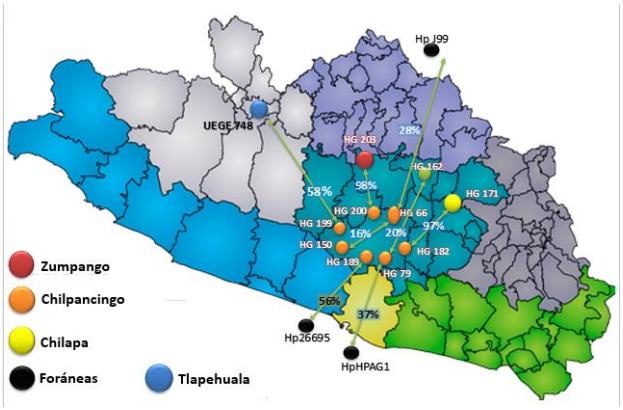

Figure 2 Guerrero with the distribution of clones.

Gratitude

We thank CONACYT Sector Fund to support us with funding of this project, also Dr. Jesus Silva and Alejandro Sanchez Q. CISEI the National Institute of Public Health for collaboration and guidance in this research project.

Besides Cerritos thank Dr. René Flores, professor and researcher T. C. at the Faculty of Medicine, UNAM, by the advice in the areas of genomics and bioinformatics.

Conclusions

We analyze the genetic variability in strains of H pylori isolated from patients with gastric pathologies of the state of Guerrero, during the period ranging study from November 2014 to March 2015, by amplifying the GLMM gene, gene highly conserved and used as white H. pylori study. This variability define it as the existence of new clones, identical and similar in Guerrero state with respect to the other groups of H. pylori clones reported in the world.

ISSN: 2410-4191

This is mainly due to the high genomics recombiancion thus we can say that the high genetic variability among strains of H. pylori due to the microdiversity a gene level and the macrodiversity to genome level.

The bootstrap presenting our strains were low in the majority, referring variability between these relative to GLMM gene is significant at the genetic level, the percentages obtained observed in the map, were as low 2% and as high 98%, indicating that strains of H. pylori in guerrero state are highly variable at the genetic level by selective pressure, mainly due to environmental changes, the different culture and customs in feeding the people of guerrero, the immune system of each host and population migration.

With these data, the development of other studies to deepen the search for new therapeutic targets as well as the natural history and evolution of H. pylori in the state of Guerrero and the Mexican republic is possible.

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ISSN: 2410-4191

Article **ECORFAN-Bolivia Journal**

Nutrition December 2015 Vol.2 No. 3 177-183

Yield and nutritional value of forage maize varieties in the state of Guerrero

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`INIFAP. Centro Nacional de Recursos Genéticos, hasta enero del 2014. Boulevard de la biodiversidad Núm. 400. C.P. 47600, Tepatitlán, Jalisco. ``INIFAP-Campo Experimental Valle de México. ```INIFAP-Campo Experimental Iguala. ````INIFAP-Campo Experimental La Posta.

Received August 5, 2015; Accepted November 24, 2015

Abstract

In the State of Guerrero there is high demand for forage maize in different livestock systems and information on production and forage quality of existing varieties is limited. Therefore, the objective of this study was to evaluate the productivity and nutritional value of forage maize varieties. The experiment was established in the municipality of Iguala, Guerrero, in 2008 under rainfed conditions and ten varieties of maize were evaluated. The results indicated that forage yields ranged from 50.5 to 56.1 t ha^{-1} for GFY, 18.2 to 20.4 t ha^{-1} for DMY, PC ranged from 6.9 to 8.5% and IVDMD had values between 60.7 to 67.4%. In order to identify relevant variables in this research, canonical discriminant analysis and according to the multivariate analysis of variance the first two canonical variables accounted for 96% of the total variance we were used. Depending on the results obtained it is concluded that the silking, plant height and *in vitro* digestibility parameters are most heavily weighted in this study. The varietie with the best response in productivity was: V-526.

Productivity, protein, *in vitro* digestibility.

Citation: PÉREZ-MENDOZA, Claudia, TOVAR-GÓMEZ, Ma. del Rosario, GÓMEZ-MONTIEL, Noel Orlando, MONTERO-LAGUNES, Maribel. Yield and nutritional value of forage maize varieties in the state of Guerrero. ECORFAN Journal-Bolivia 2015, 2-3: 177-183

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Introduction

In Mexico, corn preserved as silage, is very important for feeding ruminant animals, mainly dairy cattle energy food. Nationally forage maize production declined slightly, both in 2014 alone, about 440,000 hectares were planted under temporary irrigated and 137,000 were harvested 13.8 million tons of green fodder (SIAP, 2015). The largest area for the production of forage maize concentrated in the states of Jalisco (32.5%), Zacatecas (20.6%), Aguascalientes (10.6%), Chihuahua (9.2%), Durango (8.6%), Mexico (4.5%) and a lesser proportion of the area planted to this crop was located in Baja California (0.13%) and Guerrero (0.07%) (SIAP, 2015).

In Mexico, corn genotypes used for forage production have been developed for the production of grain. Cultivars of forage maize planted in Mexico have low energy value compared to the US this because it has only been given emphasis to improving grain yield, regardless of forage quality (Nunez et al ., 2003; Nunez et al, 2005). In the tropical region of Guerrero there is high demand for forage maize in different livestock systems and information on production and forage quality of existing varieties is limited, as well as, its use as forage in its various forms (silage, stover and grain) and the use of the cob with totomoxtle ground or in association with legumes. In this state, an extensive and backyard livestock that requires attention to improve livestock feed and corn is one of the most important crops that are used in these systems is presented. However, the cultivation of corn for forage in the state of Guerrero is not widespread due mainly to ignorance of varieties and hybrids of corn INIFAP has generated in recent years, which could be used as silage, to have available forage during the lean season and thus increase milk production in this period.

Some studies have been conducted to demonstrate the effect of the variety in agricultural, productive and nutritional characteristics of corn for forage. Perez et al., (2015), in a study conducted in the state of Guerrero, reported significant differences for plant height, forage yield and nutritional value. These authors mention in court for silage dry matter yields ranging from 15.6 to 23 t ha-1 and a grain production of 4.1 to 9.7 t ha-1 and digestibility percentages ranging between 53.9 and 61.3%. Therefore, the objective of this study was to evaluate the agronomic characteristics and productive potential of the varieties of corn for forage.

Methodology to develop

The experiment was established in the city of Iguala, Guerrero, in the spring-summer 2008 cycle under rainfed conditions. ten varieties of open-pollinated corn generated by INIFAP with adaptability to the Tropical Region were evaluated. The experimental design was randomized blocks with three replications. The population density used was 70,000 plants ha-1 and dose of fertilizer (NPK) was 120-60-00 for which 130 kilograms of urea and 130 kg of calcium triple superphosphate were used and subsequently supplemented in the second weeding using the formula 60-00-00 equivalent to 130 kg of urea. When the plants reached a height of 30 cm, thinned with the purpose of adjusting the density of 70,000 plants per hectare was made. Also, the application of pre-emergent herbicides Gesaprim C90 and Primagram was performed, applying them with a knapsack sprayer.

The harvest took place in the cutting step for silage (30-38% dry matter of the plant). The variables recorded were: days to male and female flowering (FF and FM).

ISSN:2410-4191

When 50% of plants in each plot had silking or pollen; root lodging (AR) as the percentage of plants that showed inclination from the base of the plant; plant height (AP) was determined by selecting ten random plants per treatment with complete competition, in which the height in centimeters was measured from the stem base to the knot of the first ear insert.

The yield of green forage (GFR) was estimated in the two central rows of each experimental unit; for this purpose the total plant was cut. In addition, a random sample of five complete plants was taken, they were picked and dried in a forced air oven at a temperature of 60 ° C until constant weight. With these data the yield of total dry matter (RMS) was determined. Dried samples of the five plants were ground in a Willey mill with a sieve of a mm; once ground, they determined the in vitro dry matter digestibility (IVDMD) by Van Soest technique and modified by Sosa (1979); crude protein (CP) Microkjendahl method described by AOAC (1975).

Finally, the yields of protein (RPC) and dry matter digestibility (RMSD) were calculated by multiplying the dry matter yield for the protein content and digestibility.

The data were recorded as percentages were transformed by arcsine, to get an approximation to the normal distribution. Also it added as covariate the dry matter of the plant to adjust the data of protein digestibility, protein yield and digestible dry matter. All data were processed and analyzed using the statistical package SAS version 9.2 for Windows. the procedure for generalized models (GLM) and multiple comparison of Tukey at α = 0.05 was used. Also, the variables were subjected to multivariate statistical analysis as canonical discriminant (SAS, 2000).

Results

The results showed significant differences (P <0.001) for the variables, female and male flowering, dry matter yield and digestible dry matter yield (P <0.01). The days to silking (FF) for the varieties were 52-60 days and 51-58 days to male flowering (FM) (Table 1). In that context, Sierra et al., (2008) mention that in southeastern Mexico in the spring-summer cycle is shortened vegetative hybrid plant and an example of this is that the hybrid H-520 reaches to 54 days 53 male flowering and silking so these results are consistent with those of this work were conducted under rainfed conditions, in times where soil moisture was not limiting.

As plant height (AP) showed values ranging from 241.7 to 293.3 cm being V-526 variety with greater height (293.3 cm) and V-559 the lower height (241.7 cm) (Table 1). These values AP found in the present study agree conHegviet al., (2009) who performed in 2007 and 2008 a study of forage maize in Hungary under rainfed conditions and registered AP averaged 238.0 cm in 2007 and 274.2 cm 2008.

	†Variables			
Variety	FF (d)	FM (d)	AP (cm)	AR (%)
VS-535	56	55	266.7	12.9
VS-558	54	53	260.0	8.8
V-559	52	51	241.7	14.3
V-526	60	58	293.3	20.3
V-454	55	53	273.3	12.9
VS-536	54	53	276.7	9.5
V-537C	58	56	271.7	10.6
Sintético 3	59	57	270.0	9.7
V-556	53	52	275.0	27.4
V-521	53	52	253.3	7.1
Media	55	54	268.2	12.6
DMSH	1.60	1.68	50.9	18.1

† FF = Days to Bloom Women; FM = Days to Bloom Male; AP = Height of plant; AR = root lodging. DMSH = Minimum difference honest significant (Tukey, α = 0.05).

Table 1 Comparison of means for agronomic variables evaluated in forage maize varieties.

The percentage of root lodging (AR) ranged from 7.1 to 27.4% being the variety V-556 the most susceptible to lodging (Table 2). In this regard, Jugenheimer (1981) points out that the lack of lodging resistance among corn cultivars is caused by differences in maturity, resistance to diseases and insects, stem structure, root system, plant height and stem fertility soil and population density.

Moreover, yields of green forage and dry matter, which were determined during the step of cutting the corn for silage ranged from 50.5 to 56.1 t ha-1 for RFV, from 18.1 to 20.5 t ha-1 for RMS, varieties being V-537C, V-454 and VS-558 the most productive in both parameters (Table 2). The results obtained in this study are slightly lower than those reported by Fuentes et al., (2001) who conducted an evaluation of varieties and hybrids of corn silage in the state of Coahuila where reported yields of green forage from 69 to 114 t ha-1 and between 14.9 to 29 t ha-1 of dry matter.

	†Variables			
Variety	FF (d)	FM (d)	AP (cm)	AR (%)
VS-535	56	55	266.7	12.9
VS-558	54	53	260.0	8.8
V-559	52	51	241.7	14.3
V-526	60	58	293.3	20.3
V-454	55	53	273.3	12.9
VS-536	54	53	276.7	9.5
V-537C	58	56	271.7	10.6
Sintético 3	59	57	270.0	9.7
V-556	53	52	275.0	27.4
V-521	53	52	253.3	7.1
Media	55	54	268.2	12.6
DMSH	1.60	1.68	50.9	18.1

† RFV = Green Forage Performance; RMS = Performance Dry Matter; RPC = Performance Protein; RMSD = Performance Dry Matter Digestible. Least Significant Difference DMSH = Honesta (Tukey, α = 0.05).

Table 2 Comparison of average productivity for the variables evaluated in the cutting step for silage maize varieties for forage.

Regarding yields protein (RPC) and dry matter digestibility (RMSD) varied from 1.28 to 1.61 t ha-1 with a mean of 1.42 t ha-1 for RPC and RMSD ranged from 10.9 to 13.5 t ha-1 with averages 12.3 t ha-1; V-557 C varieties, V-556 and VS-535 presented the RPC and RMSD (Table 3) higher. However, RMSD values obtained in this work, similar to those reported by Vera and Vazquez (2001) which showed a mean of 14.8 t ha-1 ranging from 8.7 to 21.8 t ha-1.

As for the nutritional value of silage, PC content ranged from 6.9 to 8.5% and IVDMD had values between 60.7 to 67.4% being cultivars VS-535 (67.4%), V-559 (66.0%) and VS-558 (65.0%) the most outstanding for its DIVMS while the variety V-454 (8.5%) had the highest concentration of PC (Figure 1).

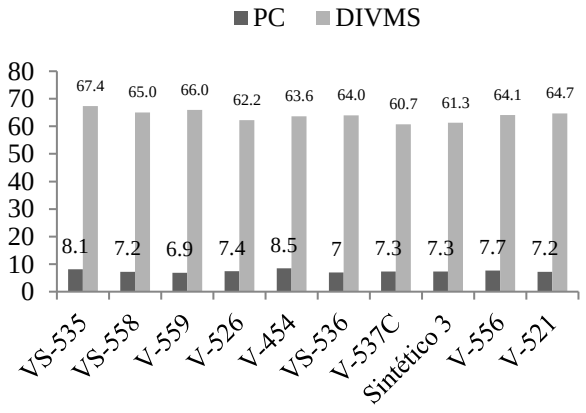

Figure 1 Percentage of protein (CP) and in vitro digestibility of dry matter (IVDMD) of vraiedades corn for fodder.

The results of this study show a similar hybrids for production and nutritional quality of forage to maturity stage at harvest silage response and are consistent with those reported by Nunez et al., (2005) that recorded for PC values 8.5 to 9.2% and 66.4 to 68.1% in DIVMS.

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Moreover and in order to identify the relevant variables in this research, the canonical discriminant analysis (CANDISC) was used, eliminating FM, RFV, RPC and RMSD for collinearity present. According to multivariate analysis of variance (MANOVA), the first two canonical variables (VC1 and VC2) accounted for 96% of the total variance (P <0.0001).

Given the variety, standardized canonical coefficients show that based on its absolute value the original variables most important in the estudiofueron FF, AR and DIVMS in VC1 and VC2 AR, AP, FF and IVDMD (Table 3) .

Variable	standardized canonical coefficients					
	FF	AP	AR	RMS	PC	DIVMS
VC1	4.99	0.10	0.43	-0.15	0.25	-0.40
VC2	-0.69	0.78	1.07	0.13	-0.02	0.52

Table 3 Contribution of the variables to the axes of analysis in forage maize cultivars using multivariate canonical discriminant analysis technique.

In this context, a study by Vera and Vasquez (2001) who through the technique of principal components characterized 30 materials corn silage and reported variables silking (FF), plant height (AP) digestible dry matter yield (RMSD) and crude protein (CP) were the parameters most weight in the two axes of the main components. This leaves the possibility of considering these parameters in the genetic improvement of maize for silage.

Moreover, taking into account the distribution of cultivars in the two canonical variables four distinct groups (Figure 2) is shown.

Group I. It is formed by the variety V-526 that showed values of FF 54 days, 18.1 t ha-1 RMS and 62.2% IVDMD.

Group II. It consisted of the V-556 materials, V-454 and VS-536. The genotypes of this group had AP 275 and 276.7 cm, an RMS of 18.1 and 18.4 t ha-1 and IVDMD of 64 and 64.1%.

Group III. It is composed of varieties VS-535, V-537C and Synthetic 3. variedadesregistraron AP 266.7 to 271.7 cm, 17.8 to 22.0 t ha-1 RMS and 60.7 to 67.4% of IVDMD.

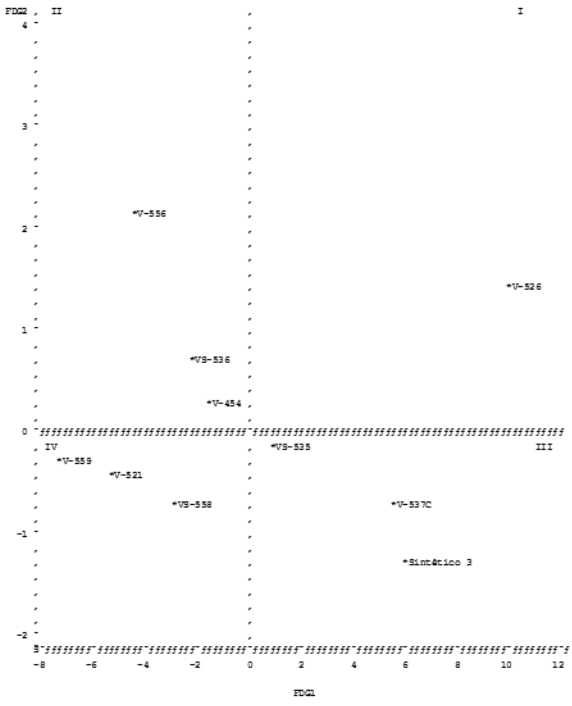

Figure 2 Dispersion of maize varieties in terms of productivity and nutritional value of forage and weighted by the first two canonical variables.

Group IV. It is composed of the varieties V-559, V-521 and VS-558. AP varieties recorded 241.7 to 260 cm, 19 to 20.5 t ha-1 RMS and 65.0% of IVDMD.

Conclusions

In this study we conclude that the variety V-526, which is an alternative for animal feed in the Tropical Region of Guerrero, this because of its good productivity and nutritional quality. Depending on the results it is concluded that the silking, plant height and in vitro digestibility is higher weighting parameters in this study.

Thanks

The authors wish to express their gratitude to the National Institute of Forestry, Agriculture and Livestock (INIFAP), for financial support I provided through the project entitled (No. SINASO Project. 135 260 688): "Genetic Improvement of Maize for forage High Productivity Nutritional value".

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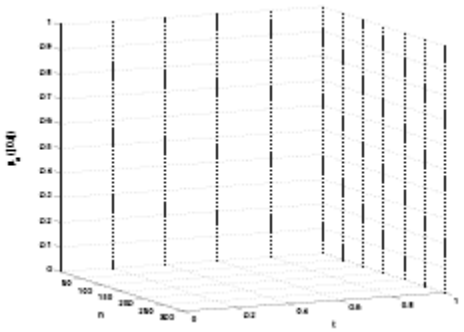

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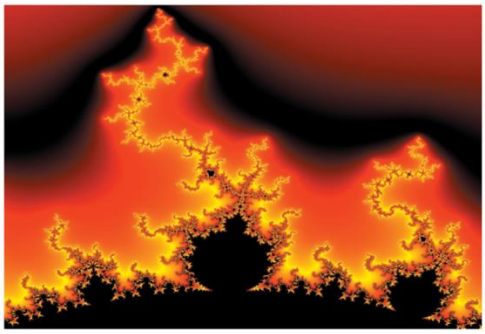

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