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CHARACTERIZATION OF FAMILY HONEY PRODUCTION UNITS IN LLERA, TAMAULIPAS

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— Abstract—

The central region of Tamaulipas has a potential for beekeeping due to the floristic richness that produces nectar and pollen. This activity strengthens the local economy, and pollination is essential for the survival of ecosystems and their biodiversity. In the municipality of Llera efforts continue to strengthen agricultural production. The objective of this study was to characterize the Family Production Units (UPF) of honey in Llera, Tamaulipas. The information from the UPF was analyzed with 224 producers belonging to the group "Productores de Llera", who live in highly marginalized localities; we carried out surveys on their production systems and visited them for georeferencing and data collection in the field. We analyzed data in Microsoft Excel and Statgraphics. 100% of beekeepers are dedicated to the extraction of honey, with an average age of 45.7 years and 10.2 years of study. The average number of hives per producer is 79.6, in addition, 61% mention the time of abundance of pollen between February and August, and 27% mention September to January. On top of that, 83% offer sugar, 7% high fructose, with frequencies of eight to 15 days, 97% use protein supplements (brewer's yeast, soy flour, and pollen). Production per producer per year was 1,290 kg on average, its sales are mainly to the collector and a lesser extent in retail sales. Beekeeping is one of the main activities of UPF de Llera and its strengthening is very important for economic growth and well-being in the area.

Keywords

Beekeeping, pollination, economy, producers, marginalization, welfare.

The improvement of agricultural production focused on the economic scales of fewer resources is of vital importance to improve primary production in areas of high marginalization, so it is necessary to strengthen the set of rural enterprises at the family and local level, to enable them to profitably assume the economic functions of the production chains in which they participate, based on a gradual process of integration, to reduce production costs, generate added value, improve the prices of their products and income; as well as profitability and sustainability (De Grammont *et al*., 2010; Basurto and Escalante, 2012).

In Mexico, tropical climate zones represent 27.7% of the national territory, which plays an important role in agricultural production, which is very diverse. In these areas, the State of Tamaulipas is one of the most important in the country, with approximately 90 thousand producers in the main production chains such as sorghum, corn, soybeans, citrus, meat, and honey, among others (Martínez-González *et al*., 2008). Of these, beekeeping is very important, which is the raising and care of bees in order to obtain honey and other products from the hive; it is both economically and ecologically relevant since it generates jobs and contributes to plant pollination. Bees have a fundamental role from the ecological point of view, by carrying out pollination that favors production in crops (Magaña *et al*., 2016).

In 2019, 43 thousand beekeepers and 2,172,107 hives were counted in the country, which produced 61 thousand tons of honey, positioning it as 9th place worldwide. Of this production, 33 thousand tons were exported, mainly to Germany and the United Kingdom, also ranking 5th in this area (SIAP, 2020). Beekeeping activity is immersed in the flowering seasons, characterized by variations in the climate and flora of each region, which allows beekeeping to become the third-largest source of foreign exchange in Mexico's agricultural sector. This activity is closely linked to the environment and natural resources of the area that the producer uses to install his apiaries so that temporal and vegetation knowledge is important to plan the management and mobility of the hives (Luna *et al*., 2019).

Pollination is a fundamental process for the survival of ecosystems and their biodiversity; it is essential for the production and reproduction of many crops and wild plants. About 90% of flowering plants, 75% of food crops, and 35% of the world's agricultural land depend on pollination for reproduction (SIAP, 2020). Beekeeping is an activity that has developed alongside the emergence of civilization (Martínez-Puc *et al*., 2018), it has great economic importance nationally and internationally. Mexican honey has excellent quality and is appreciated and consumed in various parts of the world (Magaña *et al*., 2010).

Tamaulipas continues its efforts to position itself as a leader in agricultural production in the country, with the coordination of the three levels of

government and producers. The central and southern regions of the state have great potential to contribute to bee production due to the rich flora that produces nectar and pollen (González-Rodríguez *et al*., 2010). In the state, 690 tons of bee honey are produced, with 32,986 hives and the participation of about a thousand beekeepers, of which 300 are women; the municipalities of Llera, Victoria, Hidalgo, Padilla, and González contribute 74% of the production in the state, whose value amounts to $34 million annually (SIAP, 2020). In this production chain, 40% of the beekeepers are located in the municipality of Llera de Canales, where this activity strengthens the local economy and alternates with corn, beans, citrus, and cattle, pig, and poultry production, among others. In this region, the municipality contributes about 293 tons of honey per year (SIAP, 2020), although honey is the main product, it has ventured into value-added activities such as the production of soaps and sweets, among others (González-Rodríguez *et al*., 2010). Therefore, the objective was to characterize the family honey production units in Llera, Tamaulipas.

MATERIALS AND METHODS

Location and characteristics

The municipality of Llera de Canales is located between parallels 23° 35' and 23° 02' north latitude and meridians 99° 17' and 98° 25' west longitude, with an altitude between 100 and 2,200 meters above sea level (masl). It borders the municipalities of Victoria, Casas, González, Xicoténcatl, and Jaumave, occupying 3.2% of the state's surface, with a temperature of 14 to 26° C and an annual rainfall of 600 to 1,200 mm. The municipality's climate ranges from warm sub-humid to very warm semi-dry with summer rains (INEGI, 2009). The Llera producer group is composed of 18 localities in the municipality of Llera, Tamaulipas (Image 1).

Sampling of family production units (UPF)

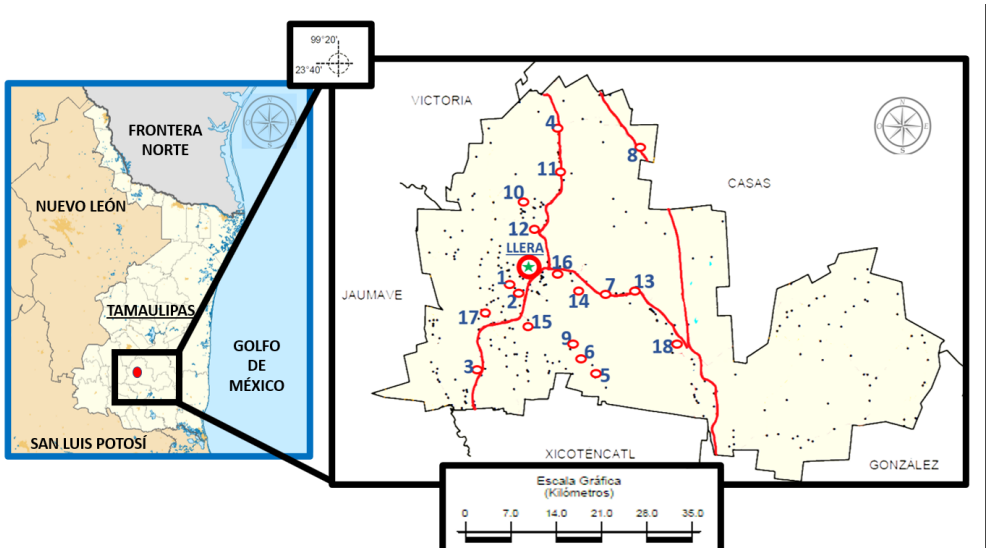
The productive, social, and economic information of the Family Production Units (UPF) was analyzed from January to March 2020. Random sampling was carried out using for the sample size the formula suggested by Rojas (1979) and Garay-Martínez *et al*. (2020); selecting the UPF at random, and taking into account the total of 224 producers of which 48 UPF were calculated as the number of surveys required employing the following equation:

$$n = \frac{\frac{Z^2 p_n q}{d^2}}{1 + \frac{Z^2 p_n q}{Nd^2}}$$

Where: Z= Confidence level (95 %), d= Precision level (10 %), Pn= Proportion of the population belonging to the group of interest (0.8), q= (1-pn) = 0.2, N= Population size and n= Sample size.

Survey for Family Production Units

The cooperating producers were gathered in the municipal capital of Llera, Tamaulipas, to generate the information by conducting surveys with the required data to be able to analyze and collect information on the states in which their production systems are located. The questionnaire was applied randomly to the owner of the UPF. The survey consisted of 57 questions for the beekeepers, which were divided into the following sub-themes: identification of the producer, characterization of the UPF, marketing, relevant data, feeding, management, natural resources, production, and infrastructure. Subsequently, we visited the UPFs of each producer in the different localities for georeferencing and field data collection to corroborate the data collected in the surveys (Image 1). The target population included the UPFs that live in the municipality of Llera, in the rural priority attention zones for the year 2019 that live in highly marginalized localities (CONAPO, 2010).



Ejido	UPF	Ejido	UPF
1. Congregación La Mina	4	10. José Ma. Morelos	11
2. Congregación San Juan	16	11. La Alberca	4
3. Conrado Castillo	4	12. La Angostura	4
4. Dos de Octubre	2	13. Las Compuertas	50
5. El Ébano	5	14. Nuevo San Luis	6
6. El Nuevo Paraíso	4	15. Rancho Nuevo del Sur	25
7. Emiliano Zapata	24	16. San Rafael	4
8. Emilio Portes Gil	4	17. Santa Isabel	16
9. Felipe Carrillo Puerto	30	18. Voz Campesina	11
		TOTAL	224

Figure 1. Location of *ejidos* and number of family production units (UPF) in Llera, Tamaulipas. Source: Own elaboration

Statistical analysis

The database was generated in the Microsoft Excel program, in which the information collected in the surveys was organized and selected, then graphed and analyzed using the Statgraphics statistical program. The information was interpreted and described using descriptive statistics such as means, frequencies, and deviations, as well as graphs.

RESULTS AND DISCUSSION

Characterization of the UPFs of the honey product system

100% of the beekeepers surveyed are engaged in honey extraction and have at least two years in this activity. 73% of the beekeepers, alternate beekeeping with other secondary activities such as livestock, agriculture, commerce, housekeeping, or paid work. The remaining 27% did not mention any other agricultural activity. The average number of apiaries per farmer is 2.6, with a minimum of one and a maximum of four; the average number of hives per farmer is 79.6, with a minimum of 10 and a maximum of 200; the number of days per week dedicated to this activity varies from one to five. Honey production is for sale and self-consumption, some for export. Luna *et al*. (2019) mention similarly to the present study that a high percentage of beekeepers alternate beekeeping with agriculture, livestock, and commerce to obtain other sources of income. Martínez-Puc *et al*. (2018) report in Campeche an average number of apiaries per producer of 2.27 and the number of hives per apiary of 20.2, resulting in an average of 45.8 hives per producer, and Yucatán Magaña *et al*. (2007) indicate an average of 2.6 apiaries per producer with the number of hives per apiary of 20.9 and several hives per producer of 53.7, results that differ from those of the present study, with a lower number of hives per producer, which may be due to the support and organization of the beekeepers as a group. According to the classification of Vélez *et al*. (2016), in the region under study, the producers are located as medium producers because on average they have between 51 and 200 hives.

Level of education and years as a producer

The beekeepers surveyed have an average age of 45.7 years and 10.2 years of study; however, the surveys showed that in this livestock activity there are producers with postgraduate studies (Table 2). Experience as beekeepers varies from two to 54 years, with an average of 13.1 years, some of them dedicated their entire lives to this activity; 38% have more than 10 years of experience (Image 5). In this regard Martínez-Puc *et al*. (2018) mention that beekeepers in the State of Campeche in the municipalities of Hopelchén and Champotón have an average age of 57 years; similar data are reported by Contreras *et al*. (2018) in the state of Yucatán, which are higher than those observed in the present study, this may be due to the incursion of young beekeepers and children that renew the generation of beekeepers in the area of Llera. On the other hand, Contreras *et al*. (2013), reports that in the State of Jalisco the average age of beekeepers is 47 years, with an average experience of 16.46 years, which agrees with what was observed in

this work, while Luna *et al*. (2019) mention that in the northern highlands of Veracruz the average experience is 22 years, the author emphasizes that experience is not an indication of a certain degree of specialization and professionalization in the beekeeping sector, this is possible since in general a large percentage of beekeepers are over 57 years old, and advanced age can be a limitation to adopt new technologies to improve the production system.

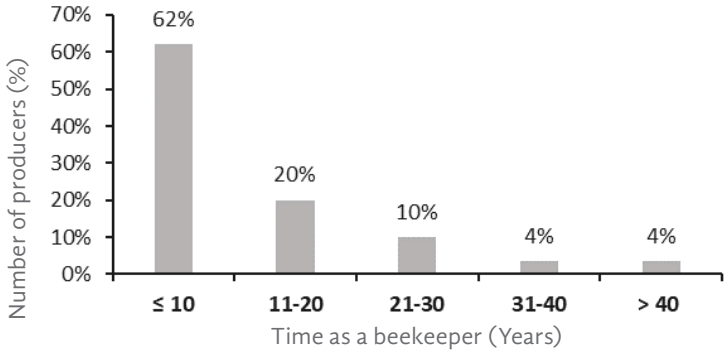


Image 2. Years dedicated to honey production by beekeepers of the Family Production Units of Llera, Tamaulipas. Source: Own elaboration

Land tenure and apiary characteristics

59% of the beekeepers mentioned that their apiaries were located on rented land, 14% on private property, 20% on borrowed land, and 7% on *ejido* land (Image 6). The land varies from a quarter of a ha to 190 ha, with an overall average of 17.4 ha. Magaña *et al*. (2007) found in Yucatan that, in terms of land ownership, apiaries are located 57.8% on private property, 16.5% on *ejido* land, and 17.3% on rented land while Chan *et al*. (2018) mentions that beekeepers in the state of Campeche have their apiaries located on *ejido* land. What was reported by both authors differs from what was observed in the present study, since in different regions of the country there are different types of land tenure and beekeepers have adapted in a versatile way to this type of characteristic in their production systems.

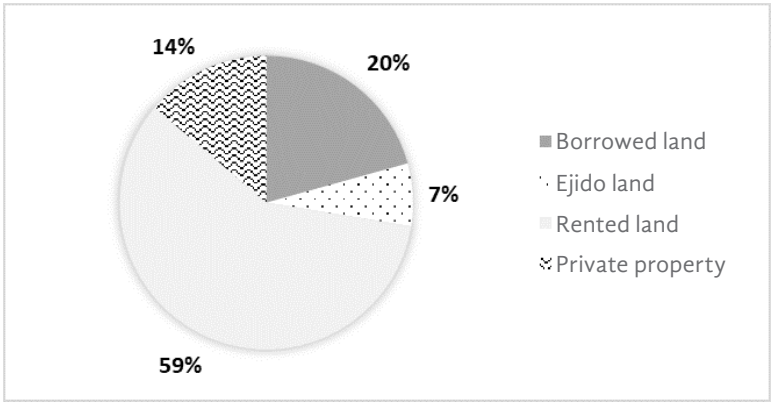


Image 3. Land Tenure by the Beekeepers of the Family Production Units in Llera, Tamaulipas.
Source: Own elaboration

Flowering time and vegetation

61% of the beekeepers report the time of pollen abundance between February and August, 27% mention the months of September to January, and 12% in both periods. This variation is because beekeepers move their apiaries to different areas of the region. Regarding the time of nectar abundance, 37% report that it occurs between March and June, another 37% mention it's between July and November, and 26% say that it occurs in both periods (Image 7). It is worth noting that 100% mention that they have been affected by the lack of rainfall during 2019. The predominant vegetation reported in the area was: citrus such as orange (*Citrus sp.*) and grapefruit, corn (*Zea mays*), sorghum (Sorghum spp), *huizache* (Acacia farnesiana), *mesquite* (*Prosopis glandulosa*), *tasajillo* (Cylindropuntia leptocaulis), ebony (Ebenopsis ebano), mouse ear (*Dichondra argéntea*), *palo de arco* (Handroanthus serratifolius), tenaza (*Havardia pallens*), *crucero* (*Colletia spinosissima*), *retama* (*Retama sphaerocarpa*), and *epazotillo* (*Hyptis verticillata*). Regarding vegetation, depending on the honey-producing zone, Mexico has a great diversity of vegetation and climates in which a great diversity of flora of great importance as a nectar-polliniferous resource develops. In the case of Campeche, the surrounding vegetation of the apiaries is mainly composed of *tzitzilché* (*Gymnopodium floribundum*), which flowers from February to May; *tzalam* (*Lysiloma latisiliquum*), from March to June; *jabín* (*Piscidia piscipula*), from February to May; *tajonal* (*Viguiera dendata*), from December to January; *chukun* (*Abarrida albicans* (Kunth), from April to June; black *chechen* (*Metopium brownei*), from March to April; *sakc atzin* (*Mimosa bahamensis*), from May to July, among others (Pat-Fernández *et al.*, 2012). In Bacalar, Quintana Roo, Aguilar-Hernández *et al.* (2019) recorded in a study a list of nectar-polliniferous species in the harvest season, of which 70% highlight the species *Chacá* (*Bursera Simaruba*), *Tajonal* (*Viguiera*

Dentata) and *Jabín* (*P. piscipula*). In the pampas of Argentina and Ecuador, several species of the Asteraceae, Fabaceae, Mirtaceae, Rosaseae, and Solanaceae families are reported to be in full bloom in September and October, as well as in October and November (Naab *et al*., 2007; Calva *et al*., 2019).

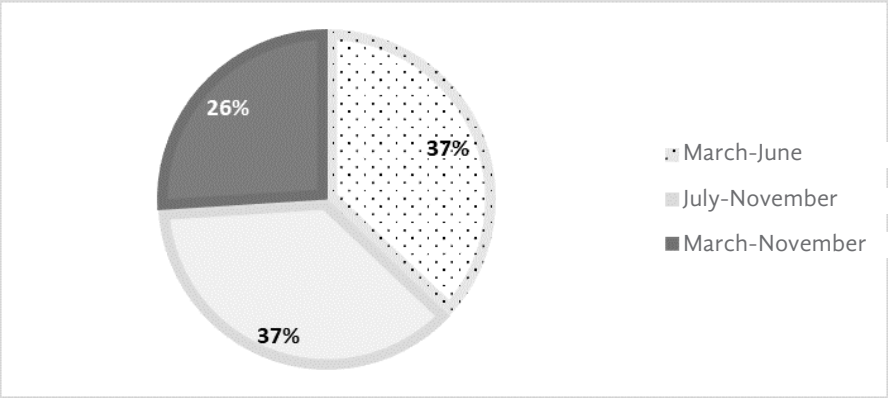


Image 4. Time of nectar abundance in the apiaries of the Family Production Units in Llera, Tamaulipas.
Source: Own elaboration

Supplementation in apiaries

Regarding carbohydrate or energy supplementation by beekeepers, 83% offer sugar, 7% high fructose, and 3% bee honey during the nectar shortage season, with frequencies of eight to 15 days; only 7% do not offer any energy supplement. As for protein supplementation, 97% of the producers mentioned using commercial mixtures of brewer's yeast, soybean meal, and pollen during the pollen shortage season; the indicators used to know when to supplement are low flowering and lack of reserves in the hives. Bee nutrition is based mainly on the consumption of honey and pollen. Lack of food in the hive leads to increased susceptibility to disease, population reduction, and swarming (abandonment of the hive). Aguilar-Hernández *et al*. (2019) mention that in the State of Quintana Roo, in the municipality of Bacalar, 60% of beekeepers provide honey as auxiliary food followed by other supplementary products such as sugar and pollen.

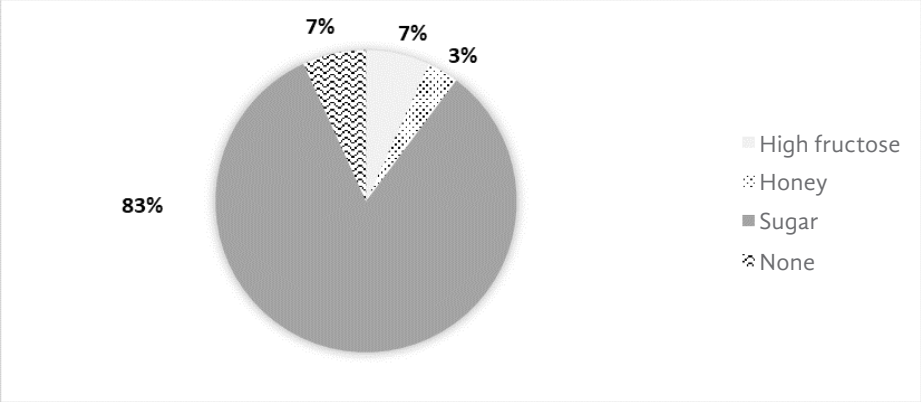


Figure 5. Energy supplements in the apiaries of the Family Production Units in Llera, Tamaulipas. Source: Own elaboration

Harvesting and marketing of honey

Production is carried out in the extraction room by 73% of the beekeepers and at home by 27%; the equipment is owned, borrowed, rented, or worked in partnership and is reported in fair to good conditions. A total of 79.3% of the beekeepers report having taken or are taking courses on good honey production practices. Last year's loss of hives per farmer ranged from zero to 60 hives with an average of 15.6, the reported causes being hive abandonment, ant attack, fire, and no flowering. The 48.2% reported that they keep production records and that their sales are mostly to the collector and in smaller proportion in retail sales; the production per producer per year was 1,290 kg on average, with a minimum of 70 and a maximum of 5,600 kg and the reported prices range from $21 to $100, with an average of $41.60 (Table 2). The harvest or collection of honey depends on the rainy season and flowering. In the municipality of Calkiní, Campeche, honey is harvested from January to June, when rainfall is null or sporadic, the same time when they get more honey, which is consistent with the abundance of flowering. (Pat-Fernández *et al*., 2012). Most of the production of beekeepers in the region under study commercializes honey with local collectors, only a low percentage commercializes their product in the community, which is in agreement with what Fernandez *et al*. (2020) and Mercado and Rimac (2019) reported.

Table 1
Characteristics of the Bee Honey Family Production Units of the Beekeepers of Llera, Tamaulipas

Datos apicultura Llera	$\bar{x}$	*S*	Mínimo	Máximo
Edad de los apicultores (Años)	45.7	17.7	22	81
Años de estudio	10.2	4.3	3	19
Superficie (ha)	17.4	36.6	0.25	190
Años como productor	13.1	12.4	2	54
Apiarios con los que cuentan	2.6	1.2	1	4
Total de colmenas	79.6	51.8	10	200
Días de la semana que acude a su apiario	2.5	1.4	1	5
Colmenas que perdió el año pasado	15.6	15.7	0	60
Cantidad de miel obtenida (kg/año)	1,290.3	1,352.3	70	5,600
Precio de venta ($)	41.6	18.0	21	100

x: average; S: standard deviation

Source: Own elaboration

CONCLUSIONS

Beekeeping is one of the main activities of the Family Production Units in the municipality of Llera, Tamaulipas, so it is very important to strengthen it for economic growth and welfare in the area. Continuity is required in both advisory services and in the attention given to producers. The implementation of records in production systems is important to improve problem detection and control, as well as production. There is little diversification of beehive products, as well as variants in the markets.

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