

Production and commercialization of piloncillo: case of the community of Aldzulup Poytzen, San Luis Potosí

Julio Baca del Moral¹
Venancio Cuevas Reyes^{2§}
César A. Rosales Nieto³
Gerardo Rivera Martínez⁴

¹Autonomous University Chapingo. México-Texcoco Road km 38.5, Chapingo Mexico State, CP. 56230. Tel. 01(595) 9521500. (julio.baca56@gmail.com). ²Valley of Mexico Experimental Field-INIFAP. Los Reyes-Texcoco km 13.5, Coatlinchán, Texcoco, Mexico State. Mexico. AP. 10. Zip CP. 56250. ³San Luis Experimental Field. Ejido Palma de la Cruz, San Luis Potosí, SLP. CP. 7843. (rosales.cesar@inifap.gob.mx). ⁴Research assistant. (g.rivera.lts@live.com.mx).

§Corresponding author: cuevas.venancio@inifap.gob.mx.

Abstract

The objective of the present work was to characterize the production and commercialization of piloncillo in three types of producers in the community of Aldzulup Poytzen, San Luis Potosí. Through non-probabilistic sampling, 36 producers, 17 partners, 10 former members of an organization and 9 producers without organizational experience were interviewed. The study of the scalar variables was carried out by analysis of variance for comparison of means. The three types of producers have similar socioeconomic characteristics, have an age range of 52 to 61 years, an agricultural area of less than 5.3 hectares and an average of 1 to 1.43 planted with sugar cane. The area planted with cane is temporary, the most widely used variety is ZMex 55-32, they do not use fertilizers or pesticides. The 97.3% is linked to the market through the sale of piloncillo, there is no significant difference ($p < 0.05$) between the income obtained from the sale of industrial piloncillo and pellets. The 86.1% of the commercialization of the piloncillo is made through stockists of the same community. It is concluded that new marketing models should be sought and promoted to obtain a greater margin of profit for the piloncillo producers.

Keywords: income, intermediaries, markets, sugarcane.

Reception date: December 2017

Acceptance date: February 2018

Introduction

Agricultural markets in low-income countries are generally underdeveloped and have shortcomings and imperfections in production, for example; production is of variable quality, they have limited access to inputs and financing, they present low levels of investment, limited access to improved technologies and practices, as well as limited knowledge of them (Arias *et al.*, 2013). Despite this, the production of small agricultural producers is multiple and diversified, so that family farming is a provider of a large amount of productive resources that can be marketed immediately (such as grains, vegetables, collection products, milk, egg, etc) and others that by their nature have to be integrated into an integrated commercial chain (such as coffee, cocoa, piloncillo, others).

The insufficiency of productive resources can make participation in agricultural marketing channels of family farming too expensive, or they can limit the amount of surplus production that small producers can or are willing to sell (FAO, 2015). The piloncillo is obtained from the juice of sugar cane (*Saccharum officinarum* L.) in small rural businesses called “trapiches” and it is an agri-food product that requires its insertion in integrated markets. The global production of this type of whole sugars, unrefined, is close to 13 million tons per year (FAO, 2004, 12). In Mexico, the volume of production of piloncillo is fluctuating; however, it is estimated that about 100 000 tons are produced each year, the main producing states are: San Luis Potosi, Veracruz, Nayarit and Colima (Reyes, 2011).

In 2013, the SEDARH (Secretariat of Agricultural Development and Hydraulic Resources) of the state of San Luis Potosi, through a diagnosis in the production system of piloncillo, identified 4 834 producers with 4 487 hectares planted with sugar cane distributed mainly in the municipalities of Tanlajas, San Antonio, Tancanhuitz, Tamazunchale, Huehuetlan, Tampamolón, Aquismon and Coxcatlan of the Huasteca Potosina. The 98% of these piloncillo producers belong to the teenek ethnic group (SEDARH, 2014). The logic of production of this type of producers is based on a family farming approach (diversified, with use of family labor and strong interference by women in the production of brown sugar).

Family farming has multiple meanings. De la O and Garner (2012) identified 36 definitions of family farming. This is defined as “a farm of sufficient size to provide for the sustenance of a family and that in its operation does not require salaried labor, but could be served with the workforce of the family itself” (Maletta cited by Salcedo *et al.*, 2014). Among its most important characteristics: a) family work predominates, b) the administration of the economic-productive unit is assigned to the head of household and c) size of the farm; The most common definitions refer to farms with a small size (Maletta, 2011; De la O and Garner, 2012).

In the indigenous communities of the Huasteca Potosina, the production of piloncillo “is not an isolated family economic activity, it adds to the strategy of self-consumption based on the milpa and the raising of farmyard animals such as pig and chicken, and to this the family garden is added, whose extension rarely exceeds the hectare thus, teenek families live their economic life in agricultural tasks and their annual calendar is scheduled in relation to the cycles of higher and lower pylon production” (Moctezuma, 2006) . In other words, the economic income of this type of

producers are linked to the production and sale of piloncillo in a context of family farming. Given this, it is recognized that “one of the historical issues for peasant organizations has been the problem of commercialization, usually related to intermediaries, but also, increasingly, monocultures that are destroying peasant production” (FAO, 2014).

In such a way that the linkage to the market of small producers usually has disadvantageous conditions, since as FAO (2012) points out: “due to its location, lack of resources and information, prevalence of market failures and lack of organization, small producers face high transaction costs to develop their productive activity, which translates into low prices for their products and low competitiveness. Added to this are reduced volumes, inadequate infrastructure, weak institutions, market asymmetries, as well as marked gender inequality”.

In this way, in order to advance in the understanding of productive aspects and marketing mechanisms that family farming has with products that require an integrated market, such as piloncillo or panela, the following objective was set, to characterize production and commercialization of piloncillo in three types of producers in the community of Aldzulup Poytzen in San Luis Potosí.

Materials and methods

The community of Aldzulup Poytzen belongs to the municipality of Tancanhuitz of Santos, which is located in the southeastern part of the state (98° 58' 24" west longitude and 21° 40' 40" north latitude) with a height of 200 meter above sea level, in the Huasteca zone. In most of the municipality a semi warm humid climate prevails with abundant rains in summer, to the north of the region it has a warm climate, with an average temperature of 23.4 °C (35.3° maximum and 12.8° minimum) and an average rainfall of 2 267.2 mm. The rainy season is from april to november and the dry season from february to april (CEFIM, 2014).

In the community 64 producers are located; however, it was decided to define a convenience sample aimed at 36 producers of piloncillo (56.25% of the population). The selection of the producers was made by non-probabilistic sampling in non-probabilistic sampling methods the researcher is the one who chooses the sample (Abascal, 2005). This strategy was used to include a greater diversity of opinions and characteristics of the producers of piloncillo from the community of Aldzulup Poytzen, for which the following inclusion criteria of producers were used: a) 17 current members of the organization were interviewed “Tzejkom Tzimaxtalab”; b) 10 former members of the same organization; and c) nine producers who have never belonged to any organization.

A survey was applied to the selected producers between January and March 2016. The general objective of the survey was to characterize the production of brown sugar from the piloncillo producers in the community of Aldzulup Poytzen. The survey was structured in five sections, the data in the first section were related to personal data of the producer, the second section referred to the characteristics of agricultural production (in order to capture the difference in the production of cane, the variable cane yield was grouped into five categories: 1) obtained yield from 25 to 35 t ha⁻¹, 2) 36 to 45 t ha⁻¹, 3) from 46 to 55 t ha⁻¹, 4) from 56 to 65 t ha⁻¹ and finally, 5) from 66 to 75 t ha⁻¹).

The third section referred to the aspects related to the production, commercialization and sale of the different types of piloncillo that are elaborated in the community and finally, the fourth and fifth sections on topics related to aspects of social and human capital. The present investigation only uses the information referred to the first three aspects, differentiating the results between those producers that are organized and individual producers. In this way, the characterization of the production and sale system of piloncillo within the family production system was carried out through the comparison of the three types of producers interviewed: 1) partners; 2) former partners of the organization; and 3) producers who have not belonged to a social or productive organization within the community. The analysis of the information was done through descriptive statistics and comparison of means for continuous variables (Pérez, 2001).

Results and discussion

The results focus on the description and analysis of the type of producer, the resources used in the production of sugarcane, as well as the characteristics of the manufacture and sale of piloncillo, differentiated by the belonging or not of the producer in any group organized within of the community.

Socioeconomic characteristics of the piloncillo producers and their family unit

The producers of piloncillo in the community have an age that fluctuates between 52 and 61 years. In the social variables, no significant differences were detected, in such a way that the producers interviewed from the three groups presented similar social characteristics (Table 1). The number of children that the peasant family unit (UFC) has, on average, ranges from four to six children. It was also identified that the number of family members still living in the home ranges from three to four children (Table 1).

Table 1. Personal data of the producer and characteristics of the family unit.

| Variable | Partners | Ex-partners | Producer | F-value |
|---------------------|------------|--------------|--------------|---------|
| Age | 52.4 ±12 a | 53.9 ±16.5 a | 61.9 ±10.8 a | 1.763 |
| Number of children | 5.1 ±3 a | 4.5 ±3.4 a | 6.1 ±3.9 a | 0.552 |
| Members in the home | 4.7 ±2.3 a | 3.9 ±1.1 a | 3.1 ±1.5 a | 2.101 |

According to the characterization of the three types of producers, it was observed that within the group of the partners of the organization 14 of them are engaged in agricultural activities, one producer has the trade of carpenter, one is a merchant of the DICONSA store and one more is dedicated to other activities. In the case of the group of former partners, all are engaged in agricultural activities, this same situation was presented by the group of producers who have never been in an organization. Almost all the producers interviewed speak an indigenous language (teenek), only one producer (ex-partner) does not speak an indigenous language.

The level of studies of the piloncillo producers of Aldzulup Poytzén is distributed as follows: 72% (26/36) have studies at the primary level, 14% (5/36) have studies at secondary level, 5.5% (2/36) have studies at the baccalaureate level, 5.5% have studies at the university level and 3% (1/36) do not have any level of study. The producers who have university studies; one belongs to the organization and one is a former partner of the organization.

Aspects related to the production of piloncillo in family agriculture

No significant difference was found between the total area and the area planted with sugarcane in the rural family unit of the community of Aldzulup Poytzen, the total surface ranges between 3.7 and 5.3 hectares, while the agricultural area available for planting sugarcane and production of piloncillo goes from 1 to 1.4 hectares with producers belonging to the organization (Table 2). According to the data obtained in the surveys, the average area of the family unit of the piloncillo producers in the community of Aldzulup Poytzen is representative of family farming.

Additionally, some authors have indicated that the production of piloncillo is done on small surfaces (Baca, 1995; Jurado and Botero, 2012; Ramírez, 2017). In such a way that Baca (1995) observed in a study carried out on the piloncillera production in the Huasteca Potosina that "... the farmers dedicate a plot of 0.5 to 1 ha to produce corn for self-consumption; then, depending on the conditions of the land, they dedicate another plot of similar size to sugar cane for brown sugar, coffee or orange, or a combination of them".

Table 2. Agricultural area and area planted with cane from the producers of piloncillo from the community of Aldzulup Poytzen.

| Variable | Partners | Ex-partners | Producer | F-value |
|------------------------|------------|-------------|------------|---------|
| Total area (ha) | 3.7 ±2.9 a | 5.3 ±2.6 a | 4.7 ±2.9 a | 1.091 |
| Surface with cane (ha) | 1.4 ±0.8 a | 1.2 ±0.8 a | 1 ±0.8 a | 0.856 |

The variety of cane most used by producers of piloncillo is the Mexican variety ZMex 55-32 (44.4%), secondly, there is a foreign variety of Cane RD 75-11 (36.1%) and in third place, the Cane CP 72-2086 (Table 3). The two varieties most used by producers (ZMez 55-32 and RD 75-11), have an abundant production of foliage (Osorio, 2007; INIFAP 2016), this characteristic represents an alternative potential use for producers of diversified family farming, the abundant foliage can be used by the producers for cattle feed.

Table 3. Varieties of cane used by producers of piloncillo from the community of Aldzulup Poytzen.

| Variable | Partners | Ex-partners | Producer |
|-----------------|------------|-------------|-----------|
| Cane ZMex 55-32 | 16 (44.4%) | 10 (27.7%) | 7 (19.4%) |
| Cane RD 75-11 | 13 (36.1%) | 4 (11.1%) | 1 (2.7%) |
| Cane CP 72-2086 | 3 (8.3%) | | |
| Others | 4 (11.1%) | 2 (5.5%) | 3 (8.3%) |

The average cane yield varies from 25 to 72 t ha⁻¹ among the piloncillo producers of the community of Aldzulup Poytzen. 47.2% (eight partners, six former partners and three non-organized producers) of the producers interviewed mentioned having an average yield of 25 to 35 tons of cane per hectare, 27.8% (four partners, one former partner and five producers) mentioned that the average yield they obtained was between 36 and 45 t ha⁻¹; finally, only one producer pointed out that it obtained yields of 56 to 65 t ha⁻¹. The best yields were obtained by producers of the organization: four partners and two former partners indicated that they obtained a production between 66 and 75 t ha⁻¹.

The latter agrees with that described by Baca and Crispin (2013) who indicate that if a producer of piloncillo has a yield higher than 60 t ha⁻¹, it is a reflection of the fact that the producer included technological innovation in his production through the use of improved varieties. The production of sugarcane in the community of Aldzulup Poytzen is carried out under rainfed conditions, the total of producers interviewed indicated that they do not use external inputs such as fertilizers or pesticides in cane production. So obtaining 60 t ha⁻¹ of cane or more in these conditions may be associated with the appropriate weather conditions and the use of improved varieties.

The cane production obtained is used to produce three types of piloncillo: black or industrial, white or cone, and granulated or crystallized piloncillo (Romero *et al.*, 2011). The production of industrial piloncillo per week and type of producer is the following; the members of the organization produce on average 200.9 kg week⁻¹, the former partners have an average production of 191.5 kg per week, and the producers who do not belong to any organization have an average production of 147.8 kg week⁻¹. The two producers that produce white piloncillo have a production per week of 300 kg (partner of the organization) and 150 kg week⁻¹ (ex-partner). On the other hand, the eleven producers who produce pelleted piloncillo have the following weekly production: 98 kilograms produce the 10 partners of the organization and 250 kilograms produces a former partner of the organization.

The prices per kilogram per type of piloncillo were obtained in the survey applied from January to March 2016. The price of the kilogram of industrial piloncillo was \$3.90 (with a minimum price of 3 and a maximum of 4 pesos per kg), the price of the white piloncillo was of \$6 kg⁻¹, finally the price of the granulated piloncillo was of \$10.64 by kg (with a minimum price of seven and a maximum price of 20). Studies carried out in the Huasteca Potosina region have identified that the income of the family unit comes from the production and sale of piloncillo, which represents between 50 and 70%, the rest is made up of the production of its family garden and its production for self-consumption (Baca and Crispin, 2013).

The producers of the community produce piloncillo during seven months in the year, the income obtained by the production and sale of industrial piloncillo oscillates between \$2 108.00 to \$3 054.10 pesos per month, whereas the obtained average income per month by the sale of piloncillo Granules range from \$700.00 to \$3 011.80 pesos. As noted, a producer who makes industrial piloncillo can even have a higher monthly income (\$3 054.10) compared to a producer that produces pelleted piloncillo (\$3 011.80) (Table 4).

Table 4. Average monthly income per type of piloncillo prepared by producers from the Aldzulup Poytzen community.

| Income (\$ month ⁻¹) | Partners | Ex-partners | Producer | F-value |
|----------------------------------|-------------------|-------------------|-----------------|---------|
| Industrial piloncillo | 3 054.1 ±1643.5 a | 3 052.8 ±1570.6 a | 2 108 ±1558.3 a | 1.371 |
| Granulated piloncillo | 3 011.8 ±5796.7 a | 700 ±2213.6 a | | 1.446 |

According to Baca (1995) the production of piloncillo for the inhabitants of the Huasteca potosina is the main activity, not only in productive but also social and cultural terms, although economically they obtain little income due to the unfavorable marketing situation faced by these producers. These disadvantageous conditions are reflected, mainly in the producers of pelleted piloncillo, since they use a greater number of hours or even days in production (FAO-SAGARPA, 2007), subtracting available time to carry out other activities in the family unit. In this sense, the results obtained show us the effect, it seems that the preparation of granulated piloncillo is more demanding in resources (time, labor, equipment) and does not provide a significant differential in terms of income when compared with production of industrial piloncillo.

Types of piloncillo and relevant actors in marketing

In the community, white, industrial and granulated piloncillo is produced for sale. Although only two producers (a partner and a former partner) produce white piloncillo, one producer sells to a collector in the region and the second sells it to a municipality collector. The piloncillo that has greater production is the industrial piloncillo, 94.6% of the producers elaborate this type of piloncillo and only 11 producers (29.7%) elaborate granulated piloncillo (Table 5). This agrees with other studies, which indicate that “the variations during the production process are those that give rise to one or another type of piloncillo, being the black or industrial the one of greater production for being its less complex and more economic process, its presentation is the traditional cone blocks of one kilogram” (Romero *et al.*, 2011).

Table 5. Number of family units of the Aldzulup Poytzen community that produce different types of piloncillo.

| Variable | Partners | Ex-partners | Producer | Total |
|-----------------------|------------|-------------|-----------|------------|
| Industrial piloncillo | 16 (43.2%) | 10 (27%) | 9 (24.3%) | 35 (94.6%) |
| White piloncillo | 1 (2.7%) | 1 (2.7%) | 0 | 2 (5.4%) |
| Granulated piloncillo | 10 (27%) | 1(2.7%) | 0 | 11 (29.7%) |

The commercialization of the piloncillo produced in the community of Aldzulup Poytzen is carried out through the collectors. The 86.1% of industrial piloncillo produced in the community is sold through collectors of the same community, 5.6% is sold with retailers of the municipality and only 8.38% of this type of piloncillo is marketed through regional collectors (Table 6). Among the producers of piloncillo in the community, there are three producers who are producers and collectors of industrial piloncillo. The work of the collectors is to buy the piloncillo from the producers of the community and sell it to intermediaries of the municipality or the region. The regional intermediaries are responsible for distributing the piloncillo to larger markets in the region or outside it.

Table 6. Commercialization of industrial piloncillo from the producers of Aldzulup Poytzen.

| Acopier | Partners | Ex-partners | Producer | Total |
|--------------|------------|-------------|----------|------------|
| Community | 15 (41.7%) | 7 (19.4%) | 9 (25%) | 31 (86.1%) |
| Municipality | 1 (2.7%) | 1 (2.7%) | 0 | 2 (5.6%) |
| Region | 0 | 2 (5.6%) | 1 (2.8%) | 3 (8.3%) |

The collection in the community consists of each producer taking the production of piloncillo to the house of the collector where the load is weighed and paid according to the current price. The collector of the region visits on average once a week the community to take the collected piloncillo, paying a minimum difference to the collector of the community for having made the collection. It is notorious to point out that, on many occasions, when a producer requires a loan or is in financial difficulty, he borrows from the collector who later discounted it from the production delivered.

On the other hand, the commercialization of granulated piloncillo is carried out through the organization of producers; nine producers sell to the organization, one producer (the leader of the organization) sells directly to national clients and in some organic tianguis. A former partner of the organization produces granulated piloncillo and sells it through a municipality collector. The fact that the vast majority of products market their production with intermediaries in the community may be due to the need to have immediate income, as Muñoz (2015) points out "... commercialization occurs in traditional markets and local, but there are intermediaries that capture production from the family unit, preventing the integration of marketing channels by producers".

International organizations such as the Organization for the United Nations (FAO, 2015) have pointed out that "farmers are currently trying to reinvent the markets for their products, from the defense and value of all their assets. These are not represented only by their availability of capital. The main asset is their family workforce, but there is also intellectual property, knowledge and land. From there they seek to create new markets, reinvent their agricultural practices and find new uses for the resources that are available on their farms".

The production of piloncillo in indigenous communities of the Huasteca Potosina is an activity linked to the social, economic and cultural aspects that have continued for decades, which is why it is necessary to look for strategies that favor a greater commercialization margin for the producer, since as it points out FAO (2015) small producers are likely to increase their market share when specific conditions exist, such as stable prices and availability of credit, efficient infrastructure and extension services, allowing them to sell products that can be placed on the market at a reasonable cost (FAO 2015).

Conclusions

It is concluded that the three types of producers surveyed have similarities in social and productive aspects; however, the linkage to the market differs, being the sale to the local collector the most used. It is important to note that the producer organization has promoted the production of pelleted piloncillo, however, this type of piloncillo is made by a low percentage of producers. This is related

to the fact that the average monthly income for the industrial piloncillo production is higher than the average income obtained from the sale of pelleted piloncillo. In such a way that new commercialization models should be sought and promoted to obtain a greater margin of profit for the piloncillo producers of the Huasteca Potosina, particularly the producers of piloncillo from the community of Aldzulup Poytzen.

Gratefulness

The authors wish to thank CONACYT for the financing granted for the realization of this research work. Which is part of “The strategic project of food security, the crusade against hunger and the synergies to enhance them”. Key: 2015-01-732.

Cited literature

- Abascal, E. y I. G.E. 2005. Análisis de encuestas. España: Edit. ESIC.
- Arias, P.; Hallam, D.; Krivonos, E. and Morrison, J. 2013. Smallholder integration in changing food markets. Roma, FAO. <http://www.fao.org/docrep/018/i3292e/i3292e.pdf>.
- Baca, M. J.; Pacheco, A. A.; Quintero, M. A. P.; Piza, J. L. P. y Fabián, C. 2010. El sistema agroindustrial localizado de piloncillo en la Huasteca Potosina. *Revista Textual*. 50(2):137 -156.
- Baca, M. J. y Crispín, F. L. 2013. La acción colectiva y el capital social de la integradora de piloncillo en la Huasteca Potosina, México. *Spanish J. Rural Development*. 4(3) Copyright© 2013. Ignacio J. Díaz-Maroto Hidalgo. doi: 10.5261/2013.GEN3.01.
- Baca, M. J. 1995. La producción piloncillera en la Huasteca potosina. *Rev. Geog. Agríc.* 21:89-96.
- CEFIM. 2014. Coordinación Estatal para el Fortalecimiento Institucional de los Municipios Tancanhuitz, SLP. Monografías de los municipios de México. <http://www.campopotosino.gob.mx/monografias2014/tancanhuitz.12.pdf>.
- De la O, A. P. and Garner, E. 2012. Defining the “family farm”. Working paper, FAO. 29 p.
- FAO. 2004. Producción de panela como estrategia de diversificación en la generación de ingresos en áreas rurales de América Latina. http://www.fao.org/fileadmin/user_upload/ags/publications/AGSF-WD6s.pdf.
- FAO. 2012. Marco Estratégico de mediano plazo de cooperación de la FAO en agricultura familiar en América Latina y el Caribe: 2012-2015. <http://www.fao.org/docrep/019/as169s/as169s.pdf>.
- FAO. 2014. Agricultura familiar y circuitos cortos. Nuevos esquemas de producción, comercialización y nutrición. <http://www.cepal.org/es/publicaciones/36832-agricultura-familiar-circuitos-cortos-nuevos-esquemas-produccion>.
- FAO. 2015. El estado de los mercados de productos básicos agrícolas. Comercio y seguridad alimentaria: lograr un mayor equilibrio entre las prioridades nacionales y el bien colectivo. <http://www.fao.org/3/a-i5090s.pdf>.
- Graham, B. 2012. Profile of the small-scale farming in the Caribbean. Workshop on small-scale farming in the Caribbean. FAO-Initiative Hunger-Free Latin American and the Caribbean. 60 p.
- Jurado, A. C. y Botero, G. P. 2012. Trapiche, minga y resistencia. Una experiencia de socialización política. *Rev. Eleuthera*. 7:167-192.

- INIFAP. 2016. (Instituto Nacional de Investigaciones, Forestales, Agrícolas y Pecuarias.) Tecnología para el cultivo de la caña de azúcar en temporal en el estado de San Luis Potosí 2016. <http://www.campopotosino.gob.mx/modulos/docs-descargar/cana2-temp2016.pdf>.
- Maletta, H. 2011. Tendencias y perspectivas de la agricultura familiar en América Latina. Documento de Trabajo N° 1. Proyecto conocimiento y cambio en pobreza rural y desarrollo. Rimisp, Santiago, Chile.
- Moctezuma, Y. P. 2006. Los teenek productores de piloncillo de San José Peketén, Tancanhuixt: la construcción de una identidad étnica en la Huasteca Potosina. Estudios de historia y sociedad. XXVII. <http://www.redalyc.org/articulo.oa?id=13710606>. ISSN 0185-3929.
- Muñoz, G. A. 2015. Estudio diagnóstico del modelo productivo tradicional de producción de piloncillo de caña de azúcar en la huasteca, San Luis Potosí. *In: prácticas exitosas en la implementación de políticas de innovación y competitividad local: “redes de conocimiento y cooperación empresa-gobierno-universidades- centros de investigación”*. 139-154 pp.
- Neri, G. J. C.; Ibarra, C. M. E.; Martínez, R. M. A. y De la Rosa, H. M. A. Ed. Plaza y Valdez. Universidad Politécnica de San Luis Potosí. Colección Triple Hélice. No. 2. México.
- Osorio, C. G. 2007. Manual técnico. Buenas prácticas agrícolas -BPA- y buenas prácticas de manufactura -BPM- en la producción de caña y panela. CORPOICA, MANA, FAO. <http://www.fao.org/co/manualpanela.pdf>.
- Pérez, L. C. 2001. Técnicas estadísticas con SPSS. España. Ed. Prentice Hall; 2001. 572 p.
- Ramírez, G. G. J. 2017. Characterization of traditional production systems of sugarcane for panela and some prospects for improving their sustainability. *Rev. Fac. Nac. Agron.* 70(1):8045-8055.
- Reyes, G. M. 2011. El piloncillo endulzante integral. *El economista*, agosto 18 de 2011. <http://eleconomista.com.mx/columnas/agro-negocios/2011/08/18/piloncillo-endulzante-integral>.
- Romero, M. M. A.; Cruz, L. A.; Goytia, M. A. J.; Sámano, R. M. A. y Baca, M. J. 2011. La sustentabilidad de dos sistemas de producción de piloncillo en comunidades indígenas de la región centro de la Huasteca Potosina. *Rev. Geog. Agríc.* 46:73-86.
- Salcedo, S.; De la O, A. P. y Guzmán, L. 2014. El concepto de agricultura familiar en América Latina y el caribe. En Salcedo y Guzmán (Ed.). *Agricultura familiar en América Latina y el Caribe*. FAO. 17-34 pp.
- SEDARH. 2014. (Secretaría de Desarrollo Agropecuario y Recursos Hidráulicos). Caracterización de productores de caña de azúcar de la huasteca potosina dedicados a la producción de piloncillo (2013/2014). Sistema Nacional de Información para el Desarrollo Rural Sustentable (SNIDRUS). Documento de trabajo de la SEDARH.