

# Non-Centrifugal Sugar Production in Three Mexican States: A Theoretical Review and *in situ* Observations

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## ABSTRACT

**Objective:** To determine the status of non-centrifugal sugar production in the three main producing states of Mexico through a literature review and direct field observations.

**Design/methodology/approach:** Statistical databases and literary sources were consulted to gather information on non-centrifugal sugar production. Articles were selected based on five criteria to ensure precise information, which was analyzed and complemented with field observations. Additionally, in Veracruz, the locations of the sugar mills were georeferenced.

**Results:** It was found that sugarcane is produced in all three states, primarily for non-centrifugal sugar production. The production process is similar, with some variations in the type of equipment and materials used, as well as in the presentation and packaging of non-centrifugal sugar for marketing. The state of Veracruz is the most technologically advanced in its production units and stands out for its greater diversification of non-centrifugal sugar products, while San Luis Potosí and Hidalgo continue to rely on traditional methods, infrastructure, and marketing practices.

**Limitations on study/implications:** Scarce information is available on the topic.

**Findings/conclusions:** The information presented in this study provides new and relevant data on the current production of non-centrifugal sugar in the three states, particularly from *in situ* observations. Notable findings include the location of sugar mills in Veracruz, variations in sugarcane harvesting methods (burned vs. green), different types of sugar mills, mold options, and the various forms of non-centrifugal sugar.

**Keywords:** sugar mills, production, traditional, burning.

**Citation:** Santiago-Hernández, E., Soto-Estrada, A., Pérez-Hernández, P., & Pérez-Bautista, J. J. (2025). Non-Centrifugal Sugar Production in Three Mexican States: A Theoretical Review and *in situ* Observations. *Agro Productividad*. <https://doi.org/10.32854/nj2sv641>

**Academic Editor:** Jorge Cadena Iñiguez

**Associate Editor:** Dra. Lucero del Mar Ruiz Posadas

**Guest Editor:** Daniel Alejandro Cadena Zamudio

**Received:** July 05, 2024.

**Accepted:** May 12, 2025.

**Published on-line:** July XX, 2025.

*Agro Productividad*, 18(6), June, 2025. pp: 119-128.

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## INTRODUCTION

In Mexico, non-centrifugal sugar (NCS) production is a longstanding tradition with significant economic and social importance. This activity has been carried out since the introduction of sugarcane cultivation in 1493, along with the arrival of mills (trapiches, in Spanish), sugarcane grinding, and its by-products (SIAP, 2018). Since then, non-centrifugal sugar has been considered the primary sweetener for farmers and rural inhabitants.

As a natural sweetener, non-centrifugal sugar maintains the nutritional properties of sugarcane juice, mainly sucrose and other minor sugars such as glucose and fructose (Muñoz, 2018). Additionally, unlike refined sugar, it contains minerals, vitamins, and proteins. However, the establishment of sugar refineries has placed non-centrifugal sugar at a disadvantage in terms of consumption (Jaffé, 2015). Nevertheless, some producers continue the tradition of making non-centrifugal sugar, as it represents a source of livelihood for their families and remains an integral part of Mexico's cultural identity since it is commonly used to sweeten beverages, bread, and traditional sweets such as candied pumpkin and cassava, particularly during Día de Muertos celebrations.

Non-centrifugal sugar is produced in eight states in Mexico, with notable production in San Luis Potosí, Hidalgo, and Veracruz (SIACON, 2024). The production process involves extracting juice from sugarcane using mills (trapiches), removing impurities, evaporating the juice through high temperatures, crystallizing the sucrose, and molding it into various shapes and sizes before it cools completely, with these shapes varying by region (Cabrera & Aguilar, 2018).

Despite the importance of NCS, there is limited current information on the process from sugarcane production to its commercialization. Therefore, the objective of this study was to determine the status of non-centrifugal sugar production in the three main producing states in Mexico through a literature review and direct field observations.

## **MATERIALS AND METHODS**

To obtain statistical data related to non-centrifugal sugar production in the states of San Luis Potosí, Hidalgo, and Veracruz, the database of the Sistema de Información Agroalimentaria de Consulta (SIACON) was consulted.

A literature search was conducted in the databases Google Scholar, Scielo, and Redalyc, as they promote the visibility of scientific production in Latin America, a region where non-centrifugal sugar production, including in Mexico, is prominent. Scientific and review articles, book chapters, scientific bulletins, and theses were consulted. The search terms used were non-centrifugal sugar production (10 results), panela (6 results), non-centrifugal sugar (4 results), jaggery (4 results), and rapadura (2 results). Additionally, the "snowball" methodology was employed, where one reference led to others that contributed to a better understanding of the topic.

As an exclusion criterion, studies published more than 10 years ago were discarded, except for those considered relevant for the development of the sections outlined in this document. The document selection criteria were based on the following factors: raw material (sugarcane), type of mill (trapiche), material of the containers used for processing the sugarcane juice, presentation (shape), and quantity of non-centrifugal sugar production. This information was complemented with 95 incidental observations made directly at the mills during field visits across the three states, from September 2023 to June 2024. Specifically, for the state of Veracruz, the locations of the mills were georeferenced. Based on the obtained data, the topics described below were developed.

### National Production of Non-Centrifugal Sugar

The most recent information on national NCS production and the main producing states corresponds to the year 2019 (SIACON, 2024). The eight producing states and their respective production are presented in Table 1; San Luis Potosí, Hidalgo, and Veracruz stand out, representing 61.78%, 12.90%, and 11.09% of the total national production, respectively.

In San Luis Potosí, the production activity is concentrated in the Huasteca Potosina region, particularly in the municipalities of San Antonio, Aquismón, Huehuetlán, Tancanhuitz, Tanlajás, Tampamolón, Tamazunchale, and Coxcatlán, where 4,834 producers are reported, of which 98% belong to the Teenek ethnic group and 2% to the Nahuatl (Baca *et al.*, 2018). Hidalgo has a non-centrifugal sugar-producing region known as the Huasteca Hidalguense, which includes the municipalities of Huejutla, Atlapexco, San Felipe Orizatlán, Huazalingo, Yahualica, Jaltocán, Xochiatipan, and Huautla (Rivero, 2017). The NCS production in Veracruz is primarily concentrated in the Huatusco non-centrifugal sugar-producing region, consisting of the municipalities of Huatusco, Zentla, Comapa, Totutla, and Sochiapa (García-Barojas *et al.*, 2021).

### Sugarcane Production for Non-Centrifugal Sugar

Table 1 presents the current data on the planted area and sugarcane production for non-centrifugal sugar production. These data have fluctuated over time. For example, during the 2010-2019 period, the total planted area decreased from 14,059 ha in 2010 to 10,821.93 ha in 2019 (SIACON, 2024).

According to the observations made in the three states, non-centrifugal sugar producers grow their own sugarcane to supply their mills; when the supply is insufficient, they purchase sugarcane from other producers. To produce one ton of sweetener, 10 tons of sugarcane are required, which aligns with the data in Table 1, where, for example, 177,849.44 t of sugarcane correspond to 17,784.94 t of NCS. Prior to harvesting, in Hidalgo and San Luis Potosí, the sugarcane is not burned before cutting, which is an environmentally friendly practice; in Veracruz, it can be either burned, unburned, or both. In all three states,

**Table 1.** Non-Centrifugal sugar producing states and their respective sugarcane production in 2019.

State	Non-centrifugal sugar production (t)	Sugarcane surface (ha)	Sugarcane production (t)
San Luis Potosí	17,784.94	7,711.68	177,849.44
Hidalgo	3,714.08	1,196.75	37,140.77
Veracruz	3,193.08	998.00	31,930.78
Nayarit	2,163.80	276.00	21,638.00
Oaxaca	1,728.12	546.50	17,281.29
Chiapas	99.16	21.00	991.62
Puebla	80.30	58.00	803.00
Michoacán	19.80	14.00	198.00
Total	28,783.28	10,821.93	287,832.90

SIACON, 2024.

harvesting is done manually. Harvesting occurs during a single period when the sugarcane is mature. This contrasts with the method used in India, where harvesting is performed using the thinning method, which consists of cutting the mature sugarcane and leaving the immature sugarcane for later harvest (Ordoñez-Díaz and Rue-da-Quiñónez, 2017).

### **Sugarcane transportation**

In the Huasteca Potosina region, sugarcane is transported from the fields to the mills using pack animals (horses and donkeys) where the terrain is difficult to access (Muñiz-Márquez *et al.*, 2017). In Hidalgo, some producers were observed carrying rolls of sugarcane on their shoulders, because their mills were constructed next to their plots of land. In Veracruz, trucks are used due to the larger volumes of harvested sugarcane.

### **Number and Type of Mills**

The number of mills in each state is not fully documented, except in Veracruz. Cabrera and Aguilar (2019) report 650 mills in the state, of which 450 are located in the central region. These data are consistent with field observations, where 88 mills were located, 85 in the Huatusco region and three in the municipality of Atzalan (Zapotitlán locality). Although this number is low compared to the reported figures, the contribution lies in providing their locations (Table 2), which would facilitate their identification.

In San Luis Potosí, it was found that there are two types of mills; the most common is the diesel engine-powered mill, and the electric one is rare. In Hidalgo, most mills are made of wood with animal traction, followed by iron mills with animal traction, and rarely diesel engine-powered mills. Diesel engine and electric mills are more frequent in Veracruz. Morales-Ramos *et al.* (2017) state that in the Huasteca Potosina, the diesel engine mill is common, while in Veracruz, the electric one is more common, which coincides with our findings. Likewise, our data are consistent with those of Rodríguez-Borray *et al.* (2022), who report that in Colombia, mills are powered by animal traction or engines.

A relevant observation in Veracruz was the presence of two electric motor-powered mills in series. Their operation involves crushing the sugarcane in the first mill and then using the resulting bagasse to be crushed in the second mill, with the aim of extracting all the juice. This is an innovative technology similar to the double mill system used in Colombia, which consists of two mills mounted on a single base with two levels, so that the first mill, which receives the cane, is positioned higher than the second one; the second mill then processes the cane again (Hernández-Cely & Torres Zamudio, 2021).

### **Non-Centrifugal Sugar Production Process**

This process begins with the crushing of the sugarcane in the mills. An extraordinary practice in San Luis Potosí is washing the sugarcane prior to crushing (Muñiz-Márquez *et al.*, 2017), which, according to our observations, does not occur in Hidalgo and Veracruz; in the latter state, the sugarcane is even milled with either burned or green leaves. The juice extracted from the cane falls into plastic tubs, mainly in San Luis Potosí and Hidalgo, while in Veracruz, these are made of galvanized sheet metal or stainless steel. The juice is clarified by separating the impurities (Morales-Ramos *et al.*, 2017); these authors report the

**Table 2.** Location of sugar mills in the non-centrifugal sugar region of Veracruz.

Municipality	Locality	Latitude	Longitude	Altitude	Exactitude
Comapa	Boca del Monte	19.15196106°	-96.84443769°	910.0 m	3.7900925 m
Comapa	Boca del Monte	19.15348371°	-96.80960776°	908.0 m	8.434771 m
Comapa	Boca del Monte	19.1398491°	-96.81765721°	988.0 m	3.7900925 m
Comapa	Boca del Monte	19.13873563°	-96.80207401°	778.0 m	5.7422833 m
Comapa	Boca del Monte	19.13299311°	-96.81318269°	816.0 m	5.006217 m
Comapa	El Platanar	19.1248426°	-96.8069486°	768.0 m	4.56 m
Comapa	El Platanar	19.12254654°	-96.80352276°	768.0 m	5.7722464 m
Comapa	El platanar	19.1235202°	-96.79518136°	768.0 m	10.719584 m
Comapa	Pochote Nuevo	19.10408388°	-96.77425093°	660.0 m	9.935046 m
Comapa	Pochote Nuevo	19.10368561°	-96.76707819°	660.0 m	4.8223195 m
Comapa	Comalcuavtl	19.11010754°	-96.76350391°	660.0 m	5.747801 m
Comapa	El Paraíso	19.14491484°	-96.74970803°	662.0 m	3.7900925 m
Comapa	Palo Verde	19.13991975°	-96.7386071°	662.0 m	9.935046 m
Comapa	Paso Pimiento	19.12609221°	-96.69701838°	643.0 m	3.7900925 m
Comapa	Paso Pimiento	19.12545068°	-96.69550698°	643.0 m	3.7900925 m
Comapa	San Felipe	19.1287413°	-96.69991776°	643.0 m	3.7900925 m
Comapa	San Felipe	19.14734847°	-96.69259445°	546.0 m	3.7900925 m
Comapa	San Felipe	19.14425009°	-96.69460251°	546.0 m	3.7900925 m
Comapa	San Felipe	19.12869347°	-96.69975731°	819.0 m	3.7900925 m
Comapa	San Felipe	19.13484162°	-96.69993337°	819.0 m	3.7900925 m
Comapa	San Felipe	19.13472925°	-96.70040562°	819.0 m	3.7900925 m
Comapa	San Felipe	19.13454258°	-96.70073847°	819.0 m	3.7900925 m
Comapa	San Felipe	19.13322192°	-96.70216677°	819.0 m	3.7900925 m
Comapa	San Felipe	19.12696607°	-96.70305324°	819.0 m	3.7900925 m
Comapa	San Felipe	19.12706526°	-96.70282402°	819.0 m	3.7900925 m
Comapa	San Felipe	19.12586272 °	-96.69704892°	819.0 m	3.7900925 m
Comapa	San Felipe	19.12531352°	-96.69554746°	819.0 m	3.7900925 m
Comapa	La Divina Providencia	19.17104387°	-96.86345559°	988.0 m	3.7900925 m
Comapa	El Coyol	19.17598039°	-96.69341114°	546.0 m	3.7900925 m
Zentla	La Flor	19.05480826°	-96.70715954°	501.0 m	5.9501853 m
Zentla	Pueblito de Matlaluca	19.06148242°	-96.78588498°	689.0 m	3.7900925 m
Zentla	Pueblito de Matlaluca	19.06327292°	-96.78934917°	705.0 m	3.7900925 m
Zentla	Pueblito de Matlaluca	19.06881671°	-96.78408779°	686.0 m	3.7900925 m
Zentla	Pueblito de Matlaluca	19.07124945°	-96.79669257°	723.0 m	3.7900925 m
Zentla	Pueblito de Matlaluca	19.09911351°	-96.83905346°	721.0 m	3.7900925 m
Zentla	Tenanzintla	19.0747807°	-96.79681944°	717.0 m	3.7900925 m
Zentla	Tenanzintla	19.07392972°	-96.792479473°	711.0 m	3.7900925 m
Zentla	Col. Manuel González	19.10416048°	-96.86784044°	947.0 m	3.7900925 m
Zentla	Col. Manuel González	19.10419303°	-96.86808488 °	931.0 m	3.7900925 m

Table 2. Continues...

Municipality	Locality	Latitude	Longitude	Altitude	Exactitude
Zentla	Col. Manuel González	19.11285977°	-96.85573589°	929.0 m	4.552489 m
Zentla	Col. Manuel González	19.11548793°	-96.86648455°	975.0 m	4.077302 m
Zentla	Maromilla	19.0414432°	-96.78957062°	654.0 m	5.059679 m
Zentla	Maromilla	19.03926496°	-96.78663428°	646.0 m	5.5583487 m
Zentla	Ejido la Piña	19.02844984°	-96.78256556°	637.0 m	3.7900925 m
Zentla	Ejido la Piña	19.02905767°	-96.78170286°	637.0 m	3.9529984 m
Zentla	Ejido la Piña	19.02798115°	-96.77930254°	631.0 m	3.7900925 m
Zentla	Ejido la Piña	19.02556802°	-96.77845316°	631.0 m	3.7900925 m
Zentla	Ejido la Piña	19.03079953°	-96.78583853°	631.0 m	9.935046 m
Zentla	Ejido la Piña	19.02839495°	-96.79299528°	631.0 m	3.7900925 m
Zentla	Ejido la Piña	19.03331286°	-96.80526003°	631.0 m	3.7900925 m
Huatusco	El Ocote	19.128115183°	-96.90397489°	1064.0 m	3.7900925 m
Huatusco	Sabanas	19.13802801°	-96.93106863°	1149.0 m	3.7900925 m
Huatusco	Capulapa	19.09906139°	-96.88403782°	949.0 m	3.7900925 m
Huatusco	Capulapa	19.09965357°	-96.88143887°	941.0 m	4.1745257 m
Huatusco	Cotecontla	19.0964532°	-96.89247157°	979.0 m	9.935046 m
Huatusco	Carrizal	19.1021776°	-96.9038511°	1020.0 m	3.7900925 m
Huatusco	Cotecontla	19.1184295°	-96.90823108°	1063.0 m	3.7900925 m
Huatusco	Cotecontla	19.12353567°	-96.91500292°	1098.0 m	3.7900925 m
Totutla	Tlapala	19.26329697°	-96.91887461°	31.0 m	4.3579392 m
Totutla	Tlapala	19.27022282°	-96.91213209°	1060.0 m	3.9121404 m
Totutla	Tlapala	19.27076912°	-96.91167141°	1060.0 m	5.527287 m
Totutla	Tlapala	19.27150751°	-96.910445°	1060.0 m	7.307498 m
Totutla	Tlapala	19.27220657°	-96.90969235°	1060.0 m	7.31859 m
Totutla	Tlapala	19.27303559°	-96.90749074°	1043.0 m	3.7900925 m
Totutla	Tlapala	19.275535°	-96.894554912°	976.0 m	3.7900925 m
Totutla	Santuario	19.27660548°	-96.89483617°	976.0 m	4.1985655 m
Totutla	Santuario	19.275535°	-96.894554912°	976.0 m	3.7900925 m
Totutla	Santuario	19.27462936°	-96.89823463°	976.0 m	4.4797688 m
Totutla	Santuario	19.2721348°	-96.90102286°	976.0 m	9.935046 m
Totutla	Santuario	19.270569648°	-96.90280111°	976.0 m	9.935046 m
Totutla	Rincón de Cacahualco	19.23968929°	-96.91641857°	1190.0 m	3.7900925 m
Totutla	Rincón de Cacahualco	19.26143569°	-96.893715°	1007.0 m	8.133801 m
Totutla	Rincón de Cacahualco	19.26145294°	-96.89369947°	1007.0 m	6.274433 m
Totutla	Rincón de Cacahualco	19.2642383°	-96.88977546°	979.0 m	4.542377 m
Totutla	Rincón de Cacahualco	19.2639108°	-96.88862514°	982.0 m	4.3063827 m
Totutla	Rincón de Cacahualco	19.26372804°	-96.8876152°	982.0 m	3.411135 m
Totutla	Rincón de Cacahualco	19.26480562°	-96.88456159°	981.0 m	9.935046 m
Totutla	Rincón de Cacahualco	19.26492345°	-96.88292768°	974.0 m	3.7900925 m

Table 2. Continues...

Municipality	Locality	Latitude	Longitude	Altitude	Exactitude
Totutla	El Capricho	19.20790827°	-96.94552391°	1190.0 m	3.7900925 m
Sochiapa	Tomatlancillo	19.17328623°	-96.92812966°	1226.0 m	3.7900925 m
Sochiapa	Tomatlancillo	19.17329772°	-96.92814135°	1226.0 m	3.7900925 m
Sochiapa	Rancho Nuevo	19.17035785°	-96.92153386°	1190.0 m	3.7900925 m
Sochiapa	2 de Abril	19.04784802°	-96.81106836°	725.0 m	4.084675 m
Sochiapa	2 de Abril	19.04551479°	-96.81396418°	755.0 m	3.7900925 m
Tomatlán	Tomatlán	19.02110701°	-97.01239769°	1327.0 m	3.7900925 m
Atzalan	Zapotitlán	19.81608526°	-97.15944212°	1014.0 m	3.7900925 m
Atzalan	Zapotitlán	19.82216884°	-97.15612775°	866.0 m	3.7900925 m
Atzalan	Zapotitlán	19.83274418°	-97.15910054°	814.0 m	3.7900925 m

Data taken with the Note Cam application.

use of lime slurry ( $\text{Ca}(\text{OH})_2$ ) to control the pH and induce the precipitation of impurities, a practice observed in all three states. For this process, the use of clarifying agents or plants with agglutinating properties is also reported (Quezada-Moreno & Gallardo-Aguilar, 2014; Hernández-Cely & Torres-Zamudio, 2021). Other alternatives to  $\text{Ca}(\text{OH})_2$  could include sodium carbonate, sodium bicarbonate, superphosphate, alum, or sodium hydrosulfate (Kumbhar, 2016).

After clarifying the juice, evaporation is performed to increase the sucrose content (Morales-Ramos *et al.*, 2017). For this, open pans (punteras or pailas, in Spanish), are used, generally made of stainless steel (Muñiz-Márquez *et al.*, 2017); however, it was recorded that these pans are mostly made of sheet metal and stainless steel in Hidalgo and Veracruz, respectively. The pans are placed over a furnace, whose combustion source is the bagasse obtained from the crushing process (Muñiz-Márquez *et al.*, 2017) once it is dry; some producers in Hidalgo also use firewood in smaller quantities.

After evaporation, the process concentration (punteo, in Spanish) is carried out, which involves stirring the syrup to check its viscosity and identify the right moment for cooling and molding (Muñiz-Márquez *et al.*, 2017). This process varies in each state; thus, in SLP and Hidalgo, the same pan used for evaporation is also used for concentration. In contrast, in Veracruz, producers use three to five pans. When three are used, the first one is used to remove remaining impurities, the second undergoes complete evaporation, and the third is for concentration. In the case of five pans, the first two are for impurity removal, the third and fourth are for evaporation (known as consumer 1 and consumer 2), and the last one is for concentration.

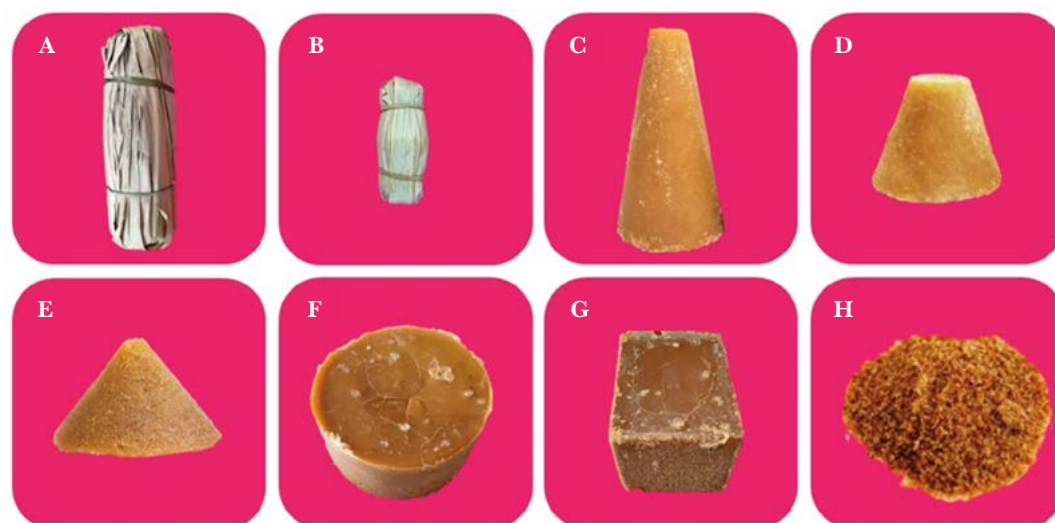
Molding varies in each state. Muñiz-Márquez *et al.* (2017) report the use of wooden molds in SLP for NCS in the shape of a cone. However, communication from some producers in this state indicates the use of clay molds; in Hidalgo, only clay molds are used. The use of mango wood molds was also confirmed in Veracruz, which are rectangular prisms approximately 1 meter long with 12, 28, and 30 cavities for NCS in the shape of a cone, pirinola, and stopper, respectively. Other molds measuring 1.30 meters long by 40

cm wide with 78 cavities are used for the truncated cone shape. The molds are filled prior to a stirring process, which may be manual (SLP and Hidalgo) or mechanical (Veracruz). After filling, the molds are left to cool for the crystallization of the non-centrifugal sugar, followed by the unmolding.

### Presentations or shapes of Non-Centrifugal Sugar

There are various presentations or shapes of non-centrifugal sugar, as well as different colors and sizes (Cabrera and Aguilar, 2019). In SLP, the most common presentations are granulated and cone (Romero *et al.*, 2011; Baca *et al.*, 2018); the latter presentation weighs 250 g (Muñiz-Márquez *et al.*, 2017). In addition to these reports, it was observed in this state that there are also cones that weigh 1 kg. In Hidalgo, the main presentation found is the “mancuerna” (two cones joined at their base and wrapped with sugarcane leaves) weighing 2 kg, and occasionally one weighing 85 g (Figure 1). In Veracruz, a greater variability of presentations was detected: cone, truncated cone, stopper, pirinola, circular (cheese), and bar (soap) with average weights of 250, 180, 45, 39, 466, and 510 g, respectively (Figure 1). The cone is the most common form in the non-centrifugal sugar-producing region of Huatusco, followed by the circular and bar forms. The truncated cone proved to be typical of the municipality of Atzalan. The wooden molds facilitate the unmolding process. Another presentation is granulated non-centrifugal sugar, found in SLP (Muñiz-Márquez *et al.*, 2017; Baca *et al.*, 2018) and in the Huatusco region (Cabrera and Aguilar, 2018). This presentation has not been adopted in the production areas as much as the other forms; it was recorded that only the companies Tzejkom Tzimaxtalab and Endulzantes La Esmeralda S.P.R. de R.L. from SLP and Veracruz, respectively, produce this type of NCS.

Among these presentations, the circular (cheese), bar (soap), and granulated shapes are also produced in Colombia, Brazil, and India (Barbosa *et al.*, 2016; Kumbhar, 2016;



**Figure 1.** Presentations and weights of non-centrifugal sugar in three states of Mexico. A) “mancuerna” (2 kg), B) “mancuerna” (85 g), C) cone (250 g), D) stopper (45 g), E) pirinola (39 g), F) cheese (466 g), G) bar (510 g), and H) granulated (500 and 1000 g).

Gutiérrez-Mosquera *et al.*, 2018); however, in India, the individual weights are larger (1, 5, 10, 19, 20, and 30 kg). Additionally, Ingale *et al.* (2024) report the production of liquid non-centrifugal sugar. This last presentation and the granulated form represent an opportunity area for enhancing the competitiveness of the product in Mexico.

### Marketing

In San Luis Potosí, marketing is done through regional collectors or intermediaries (Baca *et al.*, 2018); however, according to our findings, the representative from the company Tzejkom Tzimaxtalab states that they currently have direct customers, which results in higher profits.

In Hidalgo, marketing is done by selling “mancuernas” in retail markets, through community rounds, or to tourists. Wholesale sales are made to intermediaries and aguardiente producers, and the product is sold in sacks containing approximately 80 “mancuernas”. The production is aimed at the local or municipal market.

In the Huatusco region, during months with excess supply (April to October), production is stored in large distribution centers and marketed from November to March (Cabrera and Aguilar, 2018). Additionally, our findings show that marketing is done wholesale to collectors of the wholesale markets of Veracruz, Mexico City, Monterrey, and Guadalajara, primarily. The product is packed in cardboard boxes. Occasionally, the company La Esmeralda sells retail directly from the factory, via its website, or on Mercado Libre.

Marketing in San Luis Potosí and Veracruz is broader, mainly for the Huatusco region. This is due to the geographic location and existing communication routes, which make it possible for NCS marketing to reach important markets (García-Barojas *et al.*, 2021).

### CONCLUSIONS

The information provided in this work contributes new and relevant insights into the current production of non-centrifugal sugar in the three main producing states: San Luis Potosí, Hidalgo, and Veracruz. A significant contribution is the results from the *in situ* observations, whose data had been either scarcely reported or not reported at all. Among these, the location of the sugar mills in Veracruz, variations in the sugarcane harvesting methods (burning and green cutting), optional types of sugar mills, mold types, and the different shapes of non-centrifugal sugar stand out.

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