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Genuine Mexican cheeses: technological processes and manufacturing parameters

Centeno-Rodríguez, Mónica A. C.[1]; Gutiérrez-Cárdenas, Mónica G.[1]; Jaime-Patlán, Mariana[1]; Meza-Plaza, Ezequiel F.[1]; Montecillos-Ramírez, Karen E.[1]; Rojas-Salinas, Wilma B.[1]; Ozuna, César*

Universidad de Guanajuato. Posgrado en Biociencias. División de Ciencias de la Vida. Campus Irapuato-Salamanca. Carretera Irapuato-Silao km 9, Irapuato, Guanajuato, México. C. P. 36500.
***Corresponding author**: cesar.ozuna@ugto.mx

ABSTRACT

Objective: Provide an overview of the current situation of genuine Mexican cheeses (GMCs), their characteristics, and the conditions of their manufacturing processes (origin of the milk, curdling agent, type of aging, and ripening).

Methodology: We compiled, analyzed, and classified the information available for 20 GMCs in scientific articles, databases, and web pages.

Results: GMCs are mainly classified based on their moisture content in soft or fresh, semi-soft or semi-hard, and hard cheeses. Most of the GMCs are not subjected to ripening processes, which limits their shelf life and large-scale commercialization. Ripened GMCs use their own microbiota, developing characteristic textures and flavors.

Limitations: Few studies have evaluated the manufacturing processes of GMCs and their impact on the physical and sensory properties of the final product. Furthermore, no GMC has a designation of origin, which puts them at a disadvantage in the face of a globalized market.

Conclusions: Most GMCs are handmade, and only a few of them are produced on a semi-industrial scale. A standardized production would allow producers to improve and innovate GMCs and increase their shelf life.

Keywords: Mexican dairy products, texture, cheese ripening, curdling agent.

INTRODUCTION

Cheese is a product derived from the coagulation of milk proteins and represents a high-value source of proteins, vitamins, and minerals. Furthermore, the presence of lactic acid bacteria provides a probiotic effect. The coagulated proteins determine the physical, chemical, and organoleptic characteristics of the cheese (González-Córdova *et al*., 2016). After its elaboration, the cheese can be subjected to fermentation, ripening, or both processes, promoting the formation of bioactive peptides with beneficial health properties (Hernández-Galán *et al*., 2016).

Cheese production in Mexico is one of the most important activities in the food industry. In 2019, cheese production amounted to 355 thousand 381 tons, with a market value of more than 18,000 million Mexican pesos (SIAP, 2019). Although most cheese production is concentrated in large national and transnational companies, traditional

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cheesemaking has a remarkable market (Mazorra-Manzano, 2019). However, traditional Mexican cheesemaking is still not very competitive due to the lack of technology and standardization of manufacturing processes and, in some cases, the loss of knowledge of production procedures. Therefore, this review aimed to provide a current overview of the production, classification, and particular characteristics of GMCs, in order to spread knowledge and contribute to its preservation.

Genuine Mexican cheeses and their current situation

GMCs are considered traditional products of origin and agri-food products with significant economic, commercial, and social potential. These cheeses are part of the tradition, culture, and representative heritage of the Mexican town or region where they are made (FAO, 2010). The importance of GMCs lies in the number of existing varieties in the country, the local economic value of their production, and their economic impact in the international market of dairy products (González-Córdova *et al*., 2016).

The elaboration of GMCs can be homemade, artisanal, or industrial. Small-scale production often has little technology and poorly standardized processes. In general, the production of GMCs uses raw milk, producing distrust in the consumer. However, there are high-quality raw milks in Mexico that, because of their microbiota, can provide cheeses with unique sensory characteristics (Villegas-de Gante *et al*., 2016). GMCs are differentiated by the origin of milk, type of rennet, ripening, appearance, and other characteristics (Jiménez *et al*., 2018).

The limited production of certain GMCs is due to the lack of knowledge of this type of product by consumers, the strong competition with industrialized cheeses, and the short shelf life that prevents commercialization (Villegas-de Gante *et al*., 2016). Furthermore, the migration of producers to large cities and the lack of resources have caused the loss of knowledge on the manufacturing of GMCs. Therefore, it is essential to preserve and communicate the knowledge of the manufacturing processes of GMCs, to train producers in the development of standardized processes, the use of technologies to increase the shelf life of their products, and encourage them to obtain quality and safety certifications for the GMCs to maintain the standards that the consumer needs and demands (Vargas, 2016; Cervantes-Escoto *et al*., 2017; Villegas-de Gante *et al*., 2016).

Classification of genuine Mexican cheeses

GMCs can be classified by their texture, based on their moisture content. Soft cheeses make up the majority of Latin American cheeses and possess a percentage of moisture in nonfat substance (MNFS) higher than 67%, semi-soft cheeses have a MNFS ranging from 61-69%, semi-hard from 54-63%, hard from 49-56%, and extra-hard less than 51% (NMX-F-713-COFOCALEC-2014). Based on this classification, Figure 1 shows the general manufacturing process of GMCs and the characteristics of each one of them. Table 1 shows the main conditions of the production process of GMCs (origin of milk, curdling agent, type of aging, and ripening) and some final characteristics of these products.

Description of some genuine Mexican cheeses

Soft or fresh cheeses

Queso de Bola de Ocosingo (Chiapas): It consists of a ripened double-cream cheese, lined with a bright yellow rind of cheese made with skim milk to the point of quesillo. It is hard with a spherical form and a diameter between 8 and 12 cm, from 400 g to 1 kg (López *et al*., 2015; Villegas-de Gante *et al*., 2014; Sepulveda & Esparza-Chavez, 2016). The core of the cheese has an off-white color and a soft, creamy, spreadable, and crumbly texture with acid aromas and flavors (González-Córdova *et al*., 2016; Cobo-Monterroza *et al*., 2019). In 2005, the Instituto Mexicano de la Propiedad Industrial (IMPI) granted the Collective Trademark Registration, thus guaranteeing the consumer the originality of the product (Villegas-de Gante *et al*., 2014; López *et al*., 2015). The Bola de Ocosingo cheese was the first Mexican cheese to obtain a Collective Trademark classification and aims for a Protected Designation of Origin (PDO) (López *et al*., 2015).

Queso Jarocho (Veracruz): This cheese is an artisan creation with a cheesemaking tradition of almost 50 years, native to the tropics, manufactured in the municipalities of Tierra Blanca, Tlalixcoyan, and Ignacio de la Llave in the State of Veracruz (Villegas-de Gante *et al*., 2014). It is a fresh cheese with a soft texture, white color, and slightly acid aroma and flavor. This cheese has a cylindrical shape (26 cm in diameter and 13 cm in height) and its weight varies between 6 and 8 kg (Cervantes-Escoto *et al*., 2006). Its production process is considered innovative since it uses ice to better preserve the curd and increase its

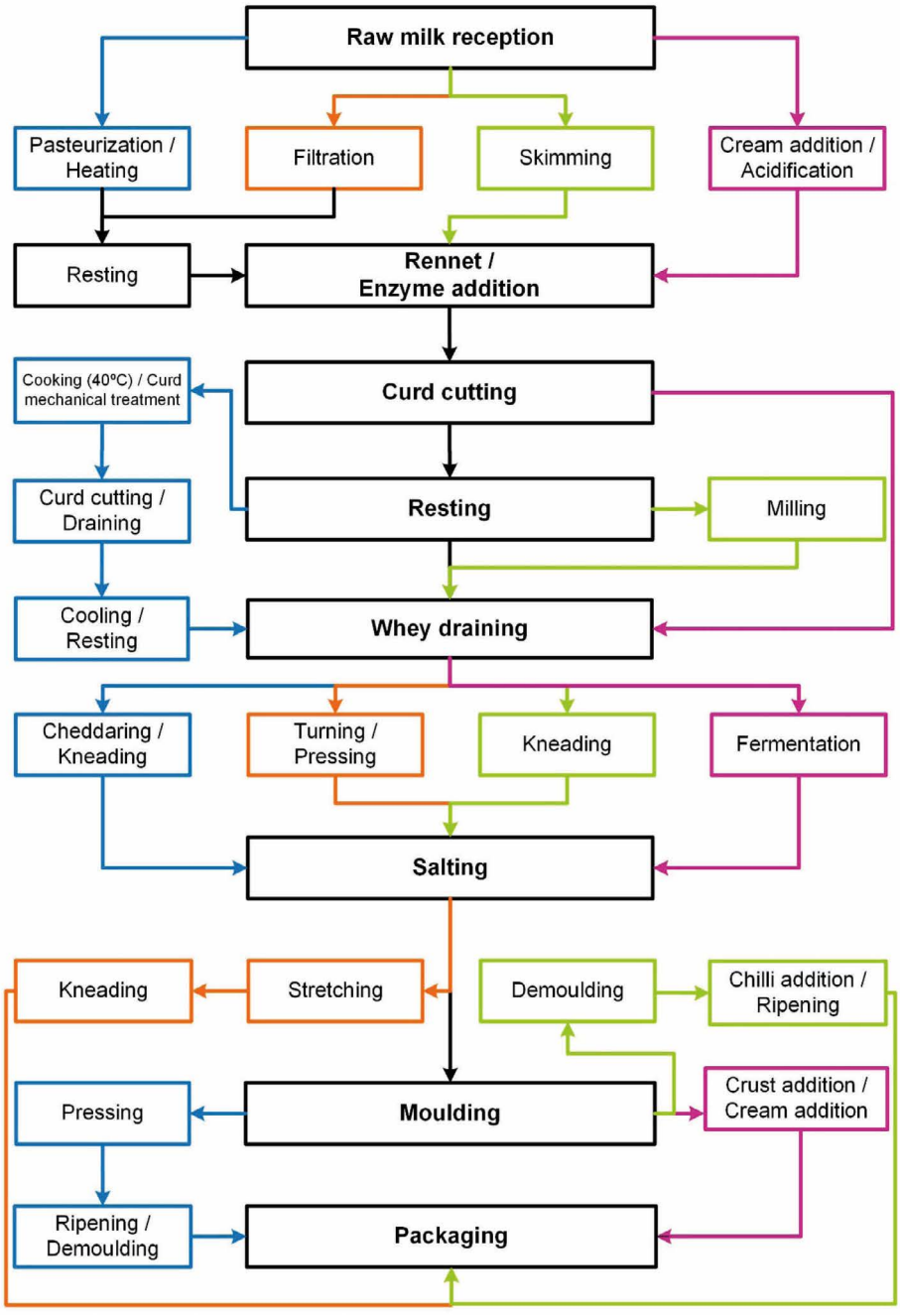

Figure 1. Diagram of the manufacturing process of genuine Mexican cheeses. Overall manufacturing process of cheeses (black) and specific processes for soft (purple), semi-soft (blue), semi-hard (orange), and hard (green) cheeses.

yield (Villegas-de Gante *et al.*, 2014). The Comisión Federal para la Protección contra Riesgos Sanitarios (COFEPRIS) is responsible for communicating information and training for improvements in the production of this type of cheese (Villegas-de Gante *et al.*, 2016).

Queso Tenate de Tlaxco (Tlaxcala): This cheese is characterized by its peculiar mild milk flavor (Cruz, 2015). It is very similar to the Tenate de Hidalgo cheese, with the difference of having the potential to achieve legal-economic protection (Villegas-de Gante *et al.*, 2014). Because of its low commercial demand and the small economic profit margins (Grass-Ramírez *et al.*, 2013), in addition to the oral transmission of the production process across generations, Tenate cheese is in danger of extinction (Cruz, 2015).

Semi-soft/ semi-hard cheeses

Queso crema (Chiapas): This is a traditional product from Chiapas, it is manufactured in the Norte, Frailesca, and Costa regions (Rangel-Ortega *et al.*, 2012; Villegas-de Gante & Cervantes-Escoto, 2011). It is a unique product, specific and impossible to imitate due to the quality of the milk, its manufacturing process, physicochemical characteristics, salt content, and sensory properties (acidity and strong fruity aromas) that result from fermentation. Shaped as a small flat cylindrical and rectangular prism from 250 g to 1 kg (Agudelo-López, 2015; Cervantes-Escoto *et al.*, 2006; Moreno & Villegas-de Gante, 2016). This cheese is protected by the Collective Trademark "Chiapas Centenario" Queso Crema de Chiapas, which grants it national establishment (Pérez, 2014).

Queso de Poro (Tabasco): This is a fresh ripened cheese of semi-hard and pressed paste (Alejo-Martínez *et al.*, 2015; Díaz-Ramírez *et al.*, 2016) and artisan manufacture in the Ríos region of Tabasco, specifically in the municipalities of Balancán and Tenosique. An important characteristic of this cheese is its 7-day ripening. Due to the microbiota present in the whey used for its manufacture, small holes or pores develop, attributed to the production and accumulation of gas. This cheese has a rectangular shape and its weight ranges from 250 g to 1 kg. It has a characteristic intense aroma, an acid-salty flavor, and a humid texture (Cervantes-

Table 1: Conditions of the manufacturing process of genuine Mexican cheeses and their main characteristics.

CHEESE NAME, ORIGIN	MILK ORIGIN	COAGULATION AGENT	RIPENING TIME	FERMENTATION / RIPENING	PASTE PROPERTIES	FAT CONTENT (FDE %)	MOISTURE CONTENT (MNFS %)	REFERENCE
Adobera de la Sierra de Amula, Jalisco	Brown-Swiss, Simmental, Zebu, and their crosses	Rennet	Fresh	Indigenous raw milk microbiota	Sliceable or crumbly (friable)	Full fat (48.27 %)	Semi-hard (63.63 %)	Villegas-de Gante *et al.*, 2014.
Ahumado de la Joya, Veracruz	Holstein, Jersey, Swiss, Zebu, and Holstein-Swiss crosses	Liquid rennet	Fresh	Indigenous raw milk microbiota	Semi-hard, pressed, and sliceable	NR	Semi-hard (54-63 %)	Villegas-de Gante *et al.*, 2016.
Aro de Etla, Oaxaca	Guernsey, Holstein, Jersey, Swiss and their crosses	Rennet	Fresh	Unfermented	Soft, sliceable, and unpressed	NR	Soft (>67 %)	Cervantes-Escoto *et al.*, 2019; Villegas-de Gante *et al.*, 2014; 2016.
Asadero, Aguascalientes	Holstein and Swiss–Dutch and HolsteinJersey crosses	Renin or microbial rennet and acetic or lactic acid	Fresh	Unfermented	Filata and meltable	Medium fat (29.31 %)	Semi-hard (60.32 %)	Villegas-de Gante *et al.*, 2014.
Bola de Ocosingo, Chiapas	Brown Swiss and Zebu, and Brown Swiss crosses	Mixed: calf rennet and natural acidification	21-30 days	Indigenous raw milk microbiota	Center (spreadable and crumbly), surface (filata)	High fat (71.52 %)	Soft (76.4 %)	López *et al.*, 2015; Vázquez-Velázquez *et al.*, 2018.
Chapingo, Estado de México	Holstein and Jersey-New Zealand	Rennet or microbial enzymes with ripened milk	4-6 weeks	Mesophilic starter culture (*Lactococcus lactis* ssp *lactis* y *Lactococcus lactis* ssp. *cremoris*)	Firm or sliceable	High fat (65.6 %)	Semi-hard (67.77 %)	Villegas-de Gante *et al.*, 2014.
Chihuahua menonita de Cuauhtémoc, Chihuahua	Holstein	Enzymatic	1-6 days	Indigenous raw milk microbiota	Semi-hard and sliceable	Medium fat (26.0 %)	Semi-soft (45 % WB)	Villegas-de Gante *et al.*, 2014
Chipilo, Puebla	Holstein	Enzymatic	1-4 weeks	Indigenous raw milk microbiota	Soft, sliceable, and unpressed	NR	Soft (>67 %)	Villegas-de Gante *et al.*, 2014; 2016.
Crema, Chiapas	Zebu-Brown Swiss and their crosses	Mixed: rennet and natural acidification	Fresh	Indigenous raw milk microbiota	Spreadable and crumbly	Full fat (48.25 %)	Semi-hard (61.70 %)	Villegas-de Gante *et al.*, 2014.
Guaje de Tanquián, San Luis Potosi	Swiss and Zebu-Swiss and Zebu-Dutch crosses	Commercial calf rennet and 3-day whey	Fresh	Unfermented	Filata, unpressed, shaped like a pod (guaje), and with cream filling	Medium fat (38.78 %)	Soft (53.10 % WB)	Villegas-de Gante *et al.*, 2014
Hoja de la Costa Chica, Oaxaca	Zebu	Natural rennet / commercial liquid rennet	Fresh	Unfermented	Soft or semi-hard and sliceable	NR	NR	Villegas-de Gante *et al.*, 2014; 2016.

Table 1: Continues....

CHEESE NAME, ORIGIN	MILK ORIGIN	COAGULATION AGENT	RIPENING TIME	FERMENTATION / RIPENING	PASTE PROPERTIES	FAT CONTENT (FDE %)	MOISTURE CONTENT (MNFS %)	REFERENCE
Jarocho, Veracruz	Zebu and European crosses	Microbial rennet and/or calf rennet	Fresh	Unfermented	High moisture, sliceable, and lightly pressed	Medium fat (29.5 %)	Soft (51.52 % WB)	Villegas-de Gante *et al.*, 2014
Poro, Tabasco	Zebu and European crosses	Rennet	7 days	Indigenous raw milk microbiota	Semihard, low moisture, and small pores	Medium fat (27.13 %)	Semi-hard (69 %)	Díaz-Ramírez *et al.*, 2016; Alejo-Martínez *et al.*, 2015
Quesillo de Reyes Etla, Oaxaca	Holstein	Commercial or natural rennet	Fermented (8-15 h)	Indigenous raw milk microbiota	Filata	Medium fat (29.8 %)	Semi-soft (48 % WB)	Villegas-de Gante *et al.*, 2014; 2016.
Cotija región de Origen	Holstein, Zebu-Swiss, and Zebu-Holstein	Rennet	Ripened (3-12 months)	Indigenous raw milk microbiota	Extra-hard, pronounced taste, hard aroma, and crumbly	Low fat (24.8 % WB)	Extra-hard (37.1 % WB)	Villegas-de Gante *et al.*, 2014.
Enreatado de Nuevo Morelos, Veracruz	Zebu and Brown Swiss crosses	Rennet	Soft ripened (2-7 days)	Indigenous raw milk microbiota	Semi-hard, sliceable, and gratable	NR	Semi-hard	Villegas-de Gante *et al.*, 2014, 2016.
Añejo de Zacazonapan, Estado de México	Zebu Swiss, Zebu American, Gyr, Simmental, and Criollo crosses	Cuerito rennet	Drying (24 weeks) Aging (> 1-12 months)	Indigenous raw milk microbiota	Crumbly (friable)	Full fat (44.55 %)	Hard (49.95 %)	Hernandez *et al.* 2009; Villegas de Gante *et al.*, 2011.
Tenate de Tlaxco, Tlaxcala	Holstein (low genetic quality)	Liquid rennet	Fresh or ripened (2 weeks)	Indigenous raw milk microbiota	NR	NR	Soft (>67 %)	Villegas-de Gante *et al.*, 2014.
Tenate, Hidalgo	Holstein (low genetic quality)	Enzymatic	Fresh or ripened (2 weeks)	Unripened	NR	NR	Soft (>67 %)	Villegas-de Gante *et al.*, 2014.
Tetilla, Nayarit	Zebu and crosses between Brown Swiss and Zebu	Natural rennet	Fresh	Indigenous raw milk microbiota	Soft	NR	Soft (>67 %)	Villegas-de Gante *et al.*, 2014.
Seco (añejo) de Chiautla de Tapia, Puebla	Holstein, Zebu-Brown Swiss or Simmental crosses	Cuerito rennet	Ripened (1 week to months)	Indigenous raw milk microbiota	Semi-hard and sliceable	NR	Soft (>67 %)	Villegas-de Gante *et al.*, 2014; 2016.

*Cuerito: dry and salty calf abomasum that is soaked in whey or milk to obtain an aqueous extract for curdling; *WB %: Wet basis percentage; *FDE %: Fat in dry extract; * MNFS %: Moisture in nonfat substance. NR: Not reported.

Escoto *et al*., 2006; Díaz-Ramírez *et al*., 2016). Queso de Poro has the Collective Trademark "Queso de Poro de Balancán, Región de Origen", granted by the IMPI (Cervantes-Escoto *et al*., 2017; Díaz-Ramírez *et al*., 2016).

Queso Chihuahua (Chihuahua): This product is of Mennonite origin and has been produced since 1992 in various regions of Chihuahua, being Cuauhtémoc municipality the one with the greatest market presence (Sánchez-Carlos & Bautista-Flores, 2017; Villegas-de Gante *et al*., 2014). Queso Chihuahua, also known as Mennonite or Chester cheese, has a flat cylindrical shape and is characterized by aromas of milk and melted butter (López-Díaz & Martínez-Ruíz, 2018; Villegas-de Gante *et al*., 2016).

Queso Adobera de la Sierra de Amula (Jalisco): This cheese has been manufactured for more than 100 years in the regions of Los Altos (Arandas, Tepatitlán, Lagos de Moreno, and other municipalities) and Sierra de Amula (Atengo, Tenamaxtlán, Tecolotlán, and other municipalitites) in Jalisco (Flores & Villegas-de Gante, 1990). In Sierra de Amula, the queso adobera of Soyatlán is manufactured in two modalities: "adobera de mesa" and "quesadilla". It can be fresh, aired (semi-ripened), or ripened (Flores & Villegas-de Gante, 1990). It is named for its characteristic rustic clay brick (adobe) shape. Its aroma, acidic-salty flavor, and ivory yellow color provide remarkable characteristics to this artisan product (Flores & Villegas-de Gante, 1990).

Queso Chapingo (Estado de México): This product is characterized by its cylindrical shape and weights from 4 to 5 kg (Villegas-de Gante *et al*., 2014). This cheese has a golden-yellow color, is creamy and has a characteristic hazelnut aroma. It is produced by the Universidad Autónoma de Chapingo (Cervantes-Escoto *et al*., 2006).

Hard cheeses

Queso Cotija (Jalisco-Michoacán): It has been made for more than four centuries in Sierra de Jalmich (Villegas de Gante *et al*., 2014). It is recognized as cultural heritage of the region and is protected under the Collective Trademark "Queso Cotija Región de Origen". Being a ripened product, no heat treatments are used in its production, and the physicochemical changes that intervene during its aging give it unique characteristics, which are favored by the environmental conditions of the manufacturing region (Hernández *et al*., 2009; Escobar-Zepeda *et al*., 2016; González-Córdova *et al*., 2016). Several studies have reported that during ripening, this cheese produces peptides with antioxidant and antihypertensive activities, showing its highest activity at the end of this process (Hernández-Galán *et al*., 2016).

Queso Añejo de Zacazonapan (Estado de México): The artisan production of this cheese has been performed for more than 100 years in the Zacazonapan municipality, southwest of Mexico State (Villegas-de Gante *et al*., 2014). This cheese is mainly manufactured during the rainy season because the environmental humidity allows the cheese to air better, and thus avoid the formation of superficial cracks due to a high loss of humidity (Hernández-Morales *et al*., 2011). Queso Añejo can be fresh or aged; the fresh product is consumed after its manufacture and is slightly less salty, while the aged cheese is consumed after 20 days up to one year of maturation, which provides typical features such as strong smell and flavor, attractive red color, and its characteristic consistency (Hernández-Morales *et al*., 2011).

CONCLUSIONS

Most GMCs are handmade. Only a few of them are produced on a semi-industrial scale, such as the Oaxaca, Chapingo, and some fresh cheeses. The standardization of the manufacturing processes would allow improvements and innovations; it would also increase the shelf life of GMCs. Moreover, obtaining a Protected Designation of Origin by the IMPI would contribute to the differentiation of GMCs from imitations, highlighting their identity, quality, and originality. This added value would also benefit local cheese producers, making their products known at a national and international level.

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REFERENCES

Agudelo-López, M. (2015). Atlas de los quesos mexicanos genuinos. Agricultura, Sociedad y Desarrollo, 12(2), 257-260.

Alejo-Martínez, K., Ortiz-Hernández, M., Recino-Metelín, B.R., González-Cortés, N., & Jiménez-Vera, R. (2015). Tiempo de maduración y perfil microbiológico del queso de poro artesanal. Revista Iberoamericana de Ciencias, 2(5), 15-24.

Cervantes-Escoto, F., Islas-Moreno, A., & Camacho-Vera, J.H. (2019). Innovando la quesería tradicional mexicana sin perder artesanalidad y genuinidad. Estudios Sociales. Revista de Alimentación Contemporánea y Desarrollo Regional, 29(54), 2-18.

Cervantes-Escoto, F., Patiño-Delgado, A.L., Cesín-Vargas, A., & González-Santiago, M. (2017). Innovando los estudios de mercado de los quesos artesanales. El valor simbólico del queso de poro. Estudios Sociales 27(49), 67-91.

Cervantes-Escoto, F., Villegas-de Gante, A., Cesín-Vargas, A., & Espinoza-Ortega, A. (2006). Los quesos mexicanos genuinos: un saber hacer que se debe rescatar y preservar. *In*: Congreso Internacional de la red SIAL "Alimentación y Territorio". Disponible en http://lactodata.info/, Consultado el 01/06/2020.

Cobo-Monterroza, R., Rosas-Quijano, R., Gálvez-López, D., Adriano-Anaya, L., & Vázquez-Ovando, A. (2019). Bacterias ácido lácticas nativas como cultivo iniciador para la elaboración de queso crema mexicano. Agronomía Mesoamericana, 30(3), 855-870.

Cruz, J.L. (2015, diciembre 11). Norma preserva la producción del queso de tenate. La Jornada del Oriente. Disponible en: https://www.lajornadadeoriente.com.mx. Consultado el 25/05/2020.

Díaz-Ramírez, M., García-Garibay, M., Jiménez-Guzmán, J., & Villanueva-Carvajal, A. (2016). Inocuidad en alimentos tradicionales: El queso de Poro de Balancán como un caso de estudio. Estudios Sociales, 25(47), 87-110.

Escobar-Zepeda, A., Sanchez-Flores, A., & Baruch, M.Q. (2016). Metagenomic analysis of a Mexican ripened cheese reveals a unique complex microbiota. Food Microbiology, 57, 116-127.

FAO (Organización de las Naciones Unidas para la Alimentación y la Agricultura). (2010). Uniendo personas, territorios y productos. Editorial FAO. Roma, Italia. Disponible en http://www.fao.org/. Consultado el 25/05/2020.

Flores V.J. & Villegas de Gante, A. (1990). Los quesos de Leche Bronca, condenados a desaparecer. Programa Interdisciplinario Agricultura Agroindustria (PIAI) Universidad Autónoma Chapingo.

González-Córdova, A.F., Yescas, C., Ortiz-Estrada, Á.M., Hernández-Mendoza, A., & Vallejo-Cordoba, B. (2016). Invited review: artisanal Mexican cheeses. Journal of Dairy Science, 99(5), 3250-3262.

Grass-Ramírez, J.F., Cervantes-Escoto, F., & Altamirano Cárdenas, J.R. (2013). Estrategias para el rescate y valorización del queso tenate de Tlaxco: Un análisis desde el enfoque de sistemas agroalimentarios localizados (Sial). Culturales, 1(2), 9-54.

Hernández, B.V., Quirasco, B.M., & Quintero, S.B. (2009). Un acercamiento al mundo del queso Cotija Región de Origen MC: Arte y tradición de México. CULINARIA Revista Virtual Gastronómica, 7(5), 5-19.

Hernández-Galán, L., Cardador-Martínez, A., Picque, D., Spinnler, H.E., López del Castillo, M., & Martín del Campo, S.T. (2016). Angiotensin converting enzyme inhibitors and antioxidant peptides release during ripening of Mexican Cotija hard cheese. Journal Food Research, 5(3), 85-91.

Hernández-Morales, C., Hernández-Montes, A., Aguirre-Mandujano, E., & Villegas de Gante, A. (2011). El proceso socio-técnico de producción de Queso Añejo de Zacazonapan, Estado de México. Revista Mexicana de Ciencia Pecuaria, 2(2), 161-176.

Jiménez, A. M., Robles, M. D., Salcido, M. D., Salcido, L. M., de la Torre, C. M., & Esquivias, F. M. (2018). Aislamiento e identificación de enterobacterias a partir de quesos adobera. XX Congreso Internacional Inocuidad de Alimentos.

López-Díaz, J. A., & Martínez-Ruiz, N. D. (2018). Perfil sensorial y fisicoquímico del queso Chihuahua considerando las preferencias del consumidor. Agrociencia, 52(3), 361-378.

López, R., Hernández-Montes, A., Villegas-de Gante A., & Santos-Moreno, A. (2015). Caracterización socio técnica del Queso Bola de Ocosingo, Chiapas. Revista de Ciencias Naturales y Agropecuarias. 2(2), 345-353.

Mazorra-Manzano, M.Á., & Moreno-Hernández, J.M. (2019). Propiedades y opciones para valorizar el lactosuero de la quesería artesanal. Ciencia UAT, 14(1), 133-144.

Moreno, O.L., & Villegas-de Gante, A. (2016). Valorización simbólica del Queso Crema de Chiapas, un queso mexicano tradicional con calidad de origen. Revista de Turismo y Patrimonio Cultural, 14(2), 459-473.

NMX-F-713-COFOCALEC-2014. Sistema Producto Leche–Alimentos–Lácteos–Queso y queso suero–Denominaciones, especificaciones y métodos de prueba. Diario Oficial de la Federación, 06 de abril de 2015.

Pérez, M. Y. C. (2014). El queso crema Chiapas: una historia que nos identifica. 2a. ed. Tuxtla Gutiérrez, Chiapas: Universidad Autónoma de Chiapas, Unidad de Divulgación Científica,

Rangel-Ortega, S.C., Ercolini, A.F. González-Córdova, & Vallejo-Córdoba,B.. (2012). Identification and characterization of lactic acid bacteria in Crema Tropical Cheese through DGGE. Abstract number 132-02 in 12-IFT Annual Meeting and Expo, New Orleans, LA. Institute of Food Technologists, Chicago, IL.

Sánchez-Carlos, O. A., & Bautista-Flores, E. (2017). La producción quesera en el noroeste de Chihuahua: el queso tradicional menonita. Chihuahua Hoy, 15(1), 289-320.

SIAP, Servicio de Información Agroalimentaria y Pesquera (2019). Estadística de producción pecuaria: leche de bovino. Disponible en: https://www.gob.mx. Consultado el 31/05/2020.

Vargas, A. C. (2016). Valorización de los quesos mexicanos genuinos: Conocimiento, degustación, acompañamiento y gastronomía. Agricultura, Sociedad y Desarrollo, 13(1), 175-178.

Vázquez-Velázquez R., Salvador-Figueroa M., Adriano Anaya L., DeGyves–Córdova G., & Vázquez-Ovando A. (2018). Use of starter culture of native lactic acid bacteria for producing an artisanal Mexican cheese safe and sensory aceptable. CyTA-Journal of Food ¸16(1), 460-468

Villegas de Gante, A., & Cervantes-Escoto, F. (2011). La genuinidad y tipicidad en la revalorización de los quesos artesanales mexicanos. Estudios Sociales, 19(38), 146–164.

Villegas de Gante, A., Cervantes-Escoto, F., Cesín-Vargas, A., Espinoza-Ortega, A., Hernández-Montes, A., Santos-Moreno, A., & Martínez-Campos, A.R. (2014). Atlas de los Quesos Mexicanos Genuinos. Biblioteca Básica de Agricultura. Colegio de Postgraduados. México.

Villegas de Gante, A., Santos-Moreno, A., & Cervantes-Escoto, F. (2016). Los quesos mexicanos tradicionales. México: Universidad Autónoma Chapingo: Juan Pablos Editor.