

Grasshopper consumption in Mexico

Consumo de chapulín en México

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Abstract

Mexico is the nation with the greatest variety of identified edible insect species, with more than 400 recorded to date. The grasshopper is considered the most popular edible insect in Mexico, with species present in most states of the country. The present narrative review discusses the current status of activities related to the grasshopper value chain, as well as recent academic research related to the nutrients it contains as an unprocessed product, and possible ways to incorporate it as an ingredient into other food products. Opportunity areas were identified: a single manufacturer of grasshopper products is currently in operation; most of the grasshopper production is destined for the domestic market, with a only a small proportion destined for exports; most of the grasshopper production is commercialized as unprocessed product, so the research carried out by the academic sector on grasshopper processing has yet to be employed by the insect-processing industry.

Entomophagy, Edible insects, Mexico

Resumen

México es el país con mayor variedad de especies de insectos comestibles identificadas, con más de 400 registradas hasta la fecha. El chapulín es considerado el insecto comestible más popular en México, existiendo especies en la mayoría de los estados del país. La presente revisión narrativa analiza el estado actual de las actividades relacionadas con la cadena de valor del chapulín, así como investigaciones académicas recientes relacionadas con los nutrientes que contiene como producto no procesado y posibles formas de incorporarlo como ingrediente en otros productos alimenticios. Se identificaron áreas de oportunidad: actualmente está en funcionamiento un único fabricante de productos de chapulín; la mayor parte de la producción de chapulín se destina al mercado interno, y sólo una pequeña proporción se destina a la exportación; la mayor parte de la producción de este insecto se comercializa como producto sin procesar, por lo que la investigación realizada por el sector académico sobre el procesamiento de chapulín aún no ha sido empleada por la industria procesadora de insectos.

Entomofagia, Insectos comestibles, México

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1. Introduction

The consumption of insects as part of the regular diet, called "entomophagy", is documented in the Old and New Testament where the consumption of locusts is described (Evans *et al.*, 2015). In the case of Mexico, this practice dates back to pre-Hispanic times. However, this widespread consumption practice was abandoned due to the influence of the Spanish conquistadors but persisted in regions that preserved the indigenous language and traditions.

Entomophagy is a practice rooted mainly in Asian, African and Latin American countries. Within Latin America, Mexico is one of the main consumers of insects in regions with a high proportion of indigenous population, such as Chiapas, Oaxaca, Mexico State, Hidalgo, Morelos, Michoacán, Puebla, Tlaxcala, and Veracruz, to mention a few.

At present, the indigenous population of the aforementioned states practices the collection and consumption of insects as part of their regular diet. Likewise, in these regions, entomophagy has spread to the general population and to tourists who like exotic foods.

Mexico is the country with the greatest variety of edible insect species, with more than 400 recorded to date (Jongema, 2014). The species consumed vary from state to state, but there are species found in most states of the republic, such as the grasshopper. This edible insect is considered the most popular in Mexico (Cruz-López *et al.*, 2022).

The present narrative review discusses the current status of activities related to the grasshopper value chain, as well as recent research related to the nutrients it contains.

2. Grasshopper production

Although it is possible to cultivate grasshoppers, production in Mexico is limited to harvesting them from crop fields (Figure 1), since to date no breeding sites have been identified for this insect. The collection of grasshoppers is an ancestral practice that has been passed down from generation to generation and is mainly carried out by indigenous people, who seek to ensure the sustainability of the activity.

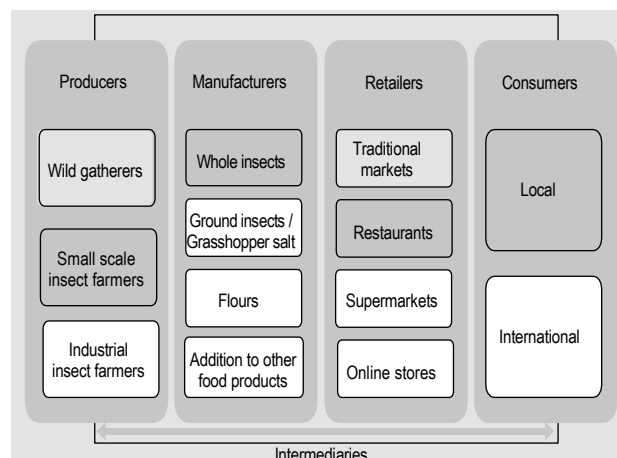


Figure 1 Main participants in the grasshopper value chain

Source: Author's own elaboration

The collection of grasshoppers destined for commercialization is carried out in the consumer states themselves, complemented with product from the state of Puebla, an important producer that supplies other states with high consumption, such as Morelos and Oaxaca (Pino Moreno *et al.*, 2016). For harvesters, this practice represents an additional source of income (Hurd *et al.*, 2019). Once the collection is done, the harvesters or small producers of the insect can sell them to distributors, who supply exotic food restaurants or large collection centers such as central supply centers.

Grasshoppers can be harvested from various crops, such as corn, beans, Jamaica flower, alfalfa, and pastures, where the presence of these insects can be considered a pest. Collection usually takes place early in the early morning because the insects are cold-blooded and are inactive at that time, which facilitates collection (Sosa *et al.*, 2015).

Grasshoppers are mainly collected in the nymph and adult stages. In the state of Oaxaca, grasshoppers of the species *Melanoplus mexicanus* are mainly collected; in the states of Chiapas, Guanajuato, Hidalgo, Mexico State, Michoacán, Morelos, Oaxaca, Puebla, Querétaro, and Tlaxcala, the species *Sphenarium purpurascens* is collected.

Once collected, the grasshoppers are left in bags without food for 1 to 3 days to allow debris to leave their systems, but, since these insects are consumed with their gut microflora, microbial risks persist (Hurd *et al.*, 2019). There is a seasonal component to the collection of grasshoppers.

The months of greatest abundance of this insect are between May and October in the state of Oaxaca (Hurd *et al.*, 2019); and between June and November in the state of Morelos (Pino Moreno and Reyes-Prado, 2020). However, there is availability of the product throughout the year in the markets, since they can be preserved for months by boiling them, to later dry them in the sun or season them with lemon (Pino Moreno *et al.*, 2016).

3. Grasshopper processing

In academia, most research focuses on 1) analyzing the nutritional content of grasshoppers; or 2) identifying different ways to combine grasshoppers, used as an ingredient, with traditional foods, to achieve greater acceptance by the general public.

Some results of research focused on analyzing the nutritional content are:

- Grasshopper flour has a high protein and fat content, which makes it a high-calorie food source that could be used in foods requiring a higher energy value. The color parameters of grasshopper flour were obtained, which could help determine which food products it could be added to without causing any sensory change in food color (Torruco-Uco *et al.*, 2018).
- The diet of grasshoppers could be controlled to change their chemical composition, enabling the design of insect-based foods with higher nutritional value (Ibarra-Herrera *et al.*, 2020).
- Grasshopper hydrolysates have a high antioxidant capacity, suggesting that further research is needed to identify and characterize the compounds responsible for this activity (Marín-Morales *et al.*, 2022).
- The chemical composition of grasshoppers can vary depending on location, environmental conditions and time elapsed since insect hatching, but in general, they are affordable and accessible to all social groups (Melo-Ruiz *et al.*, 2015).

Some results of research focused on identifying different ways to combine grasshoppers with other foods are:

- Grasshopper flour can be used as a binder in meat products with up to 10% substitution. Sausages made with grasshopper flour had higher toughness, elasticity, gumminess and chewiness, and possessed herbal flavor, brown color and grainy texture. However, the overall taste of the sausage was not high, and further research is needed to improve product acceptability (Cruz-López *et al.*, 2022).
- The addition of grasshopper flour to nixtamalized corn flour has nutritional potential because its supplementation increases the protein content and the supply of essential minerals such as K, P, and Mg. Grasshopper flour is also composed of a large amount of chitin that acts as fiber, alkali-soluble proteins and unsaturated fats. However, the addition of grasshopper flour affected some physicochemical properties such as viscosity and hardness in corn dough and produced a reduction of tensile and shear forces in tortillas. Nevertheless, tortillas with between 2 and 6% of grasshopper flour had good acceptance by consumers (Contreras Jiménez *et al.*, 2020).
- The consumption of grasshopper burger patties instead of beef patties could significantly reduce greenhouse gas emissions and would reduce the hectares of corn planting destined for animal feed, freeing corn for human consumption (Wegier *et al.*, 2017).

4. Manufacture of grasshopper products

Since 2009, private universities in Mexico have been conducting business feasibility studies for the production and marketing of insect flours as an ingredient for food products (Arroyo-Marlés, 2023).

However, to date, only one established company has been identified that manufactures grasshopper products (Merci Mercado), located in Oaxaca (Engström, 2023), a state which is one of the main producers and consumers of this insect. Its products, made from dried and packaged grasshoppers, are whole grasshoppers (without legs or wings), ground grasshoppers, and grasshopper salt (www.mercimercado.com). The company retails directly online to domestic and international consumers and also supplies other online stores.

5. Commercialization and consumption of grasshoppers

According to a survey of consumers in the state of Morelos conducted in 2014, 29.3% of respondents purchased grasshoppers every 15 days, while 24.4% purchased them weekly (Pino Moreno *et al.*, 2016). Prices in urban areas of Morelos ranged from 176.68 to 416.67 pesos per kilogram (Pino Moreno and Reyes-Prado, 2020), while, in Oaxaca City, the price per kilogram had a wider dispersion, ranging from 200 to 600 pesos (Hurd *et al.*, 2019) (Graph 2).

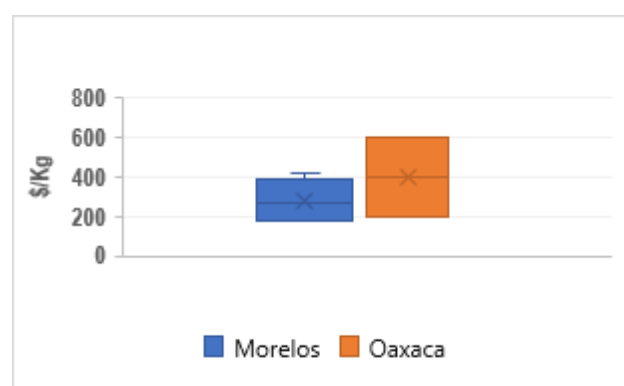


Figure 2 Prices per-Kg of grasshopper recorded in urban areas of Morelos and Oaxaca

Source: Author's own elaboration based on Hurd KJ *et al.*, 2019; Pino Moreno JM and Reyes-Prado H, 2020

When consumed at home, grasshoppers can be eaten whole as a snack or in tacos but are generally incorporated into other dishes. In restaurants, grasshoppers are incorporated into antojitos such as quesadillas, tlayudas, tacos, and other foods, and as a condiment in sauces, salsas, and vinaigrettes; they are also used in desserts (Hurd *et al.*, 2019).

Regarding the main motives of the population to consume grasshoppers, two different surveys, one applied in the state of Morelos in 2014 (Pino Moreno *et al.*, 2016) and another applied in the state of Oaxaca in 2019 (Hernández Ramírez, 2023), reach similar results (Figure 3). In Morelos, 93.4% of respondents mentioned the taste of grasshoppers as one of the reasons for consumption; likewise, 33.1% mentioned that they consider them nutritious. In Oaxaca, 57.4% of the total number of respondents mentioned the taste of grasshoppers as the main reason for consumption; 24.0% of the total number of respondents mentioned that they consume them because they are considered nutritious or rich in vitamins.

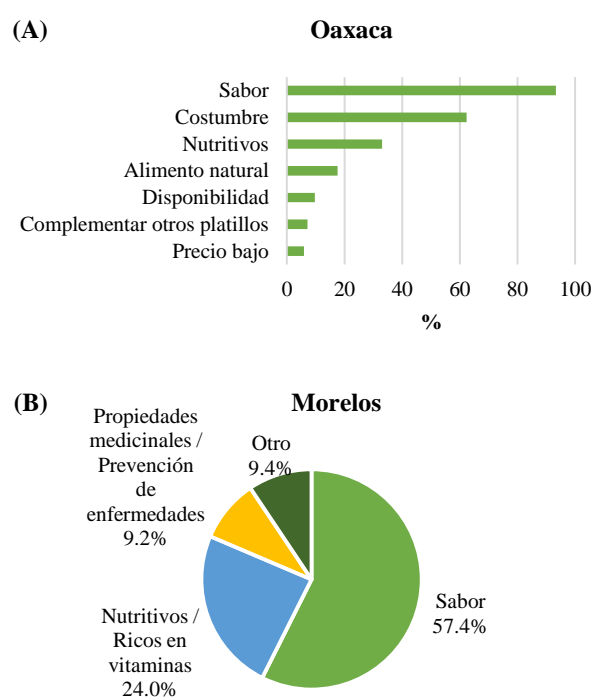


Figure 3 (A) Main reasons for consuming grasshoppers in Oaxaca; (B) Main reasons for consuming grasshoppers in Morelos

Source: Author's own elaboration based on Hernández Ramírez JC, 2023; Pino Moreno JM *et al.*, 2016

6. Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

7. Conclusions

There are opportunity areas in the production of manufactured grasshopper products, as only one company is currently operating.

The fact that most of the grasshoppers are purchased in traditional markets means that most of the production is destined for the domestic market. The small proportion of exports represents another opportunity area.

Most of the grasshopper production is commercialized as unprocessed product, so the research carried out by the academic sector on grasshopper processing has not been assimilated by the industry, which implies a dissociation between academic and industrial activities in this market.

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