




# Specialization and Competitiveness in Blueberry (*Vaccinium* spp.) Production in Mexico

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## ABSTRACT

**Objective:** Assess national competitiveness in the global blueberry market from 2011 to 2021.

**Methodology:** Five indicators were estimated to analyze production specialization and the commercial competitiveness of Mexican blueberries in the three leading producing states.

**Results:** Specialization in blueberry production has increased; both planted and harvested areas expanded in recent years due to agricultural and sectoral strategies implemented by the governments of the main producing states. As a result, Michoacán and Baja California emerged as the most specialized states in this production.

**Conclusions:** The commercial competitiveness of blueberries has risen and continues to grow. Mexican blueberries are profitable due to strong demand, with national production meeting both domestic and international consumption. It remains one of the least affected products during the COVID-19 pandemic.

**Keywords:** competitiveness, blueberry, production, specialization, growing.

**Citation:** Pérez-Hernández, N. J., & Hernández-Mendoza, N. (2025). Specialization and Competitiveness in Blueberry (*Vaccinium* spp.) Production in Mexico. *Agro Productividad*. <https://doi.org/10.32854/9087mh98>

**Academic Editor:** Jorge Cadena Iñiguez

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

**Guest Editor:** Daniel Alejandro Cadena Zamudio

**Received:** May 05, 2024.

**Accepted:** February 16, 2025.

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

*Agro Productividad*, 18(4). April. 2025. pp: 35-43.

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## INTRODUCTION

Berries are a category of small, wild, reddish or purplish fruits with a pleasantly tangy-sweet flavor, including blueberries, raspberries (*Rubus idaeus*), strawberries (*Fragaria*), and blackberries (*Rubus ulmifolius*) (Palacio, 2018). These fruits are rich in antioxidants, vitamin C, iron, and tannins plant-based polyphenols used medicinally to promote healing due to their anti-inflammatory and restorative properties (Quiñones *et al.*, 2012). The blueberry (*Vaccinium* spp.), commonly known as “blueberry,” and the cranberry (*Vaccinium macrocarpon*) are deciduous shrubs from the *Vaccinium* genus, part of the Ericaceae family, and are native to the Northern Hemisphere, primarily the United States and Canada (Bustillo, 2018). These berries are spherical, measuring between 1 and 2 cm in diameter, and range in color from deep to light blue hence the name “blueberry” or red in the case of cranberries (SAGARPA, 2017). They are consumed fresh or used in products such as jams, purées, juices, wines, pastries, and cereals. In some areas, they are also sold frozen or dehydrated; however, most of Mexico’s domestic production is exported immediately (Undurraga,



2013). In recent years, blueberry production has increased at an average annual growth rate of 28%, with more than 26% of cultivated land dedicated to the crop, resulting in improved yields and a 4.5% increase compared to 2020 (SIAP, 2022). Blueberries are grown in central, western, and northwestern Mexico; *per capita* annual consumption is 71 grams, and the fruit represents 0.3% of the country's total fruit production (Secretaría de Agricultura y Desarrollo Rural, 2023). In 2021, Jalisco led production, accounting for half of Mexico's blueberry output. However, Michoacán recorded the highest market prices, where producers earned an average of over 82,000 pesos per ton, generating 1.278 billion pesos from 15,490 tons harvested (SIAP, 2022). There are several blueberry varieties, though most consumption still comes from wild sources. The most widely cultivated type in Europe and the Americas is the highbush blueberry (*Vaccinium corymbosum*), representing 80% of cultivated species, due to a breeding program initiated in 1906 (González *et al.*, 2017). This variety produces the highest quality fruit in terms of size and flavor. The rabbiteye blueberry (*Vaccinium ashei*) is less commonly grown, as are cranberries (*Vaccinium macrocarpon*) and sour cranberries (*Vaccinium oxycoccos*) (González *et al.*, 2017). Mexico contributes 5.97% of global blueberry production, harvesting approximately 66,000 tons, placing the country fifth worldwide (FAOSTAT, 2023). From 2011 to 2021, the planted area and production increased by 451% and 650%, respectively the period for which consistent statistical records are available. Therefore, evaluating Mexico's competitiveness in the global blueberry market is essential to offer a clear analysis of its production and to assess competitiveness, which is defined as the agri-food chain's dynamic ability to continuously and sustainably maintain, expand, and enhance its market share (Gómez *et al.*, 2023).

## MATERIALS AND METHODS

Blueberries are identified under tariff code 0810.40.01. This falls under Chapter 08, which covers edible fruits and nuts; peel of citrus fruits, melons, or watermelons. Heading 08.10 includes other fresh fruits; subheading 40 groups cranberries, blueberries, and other fruits of the *Vaccinium* genus (SNICE, 2023). The research was conducted using databases from FAO, SIAVI, and SIAP. Global and national data were collected for the period 2011-2021 to measure five indicators aimed at analyzing production specialization and commercial competitiveness in Mexico.

### Location quotient

It is a static measure that reflects the current state of an activity within a specific sector. This ratio compares the relative size of a sector in a region to the relative size of the same sector at the national level (Boisier, 1980). It can be determined in terms of activities, meaning the agricultural sector and blueberry production will be compared at both the national and state levels using the following formula:

$$Q_{ij} = \frac{V_{ij}}{\sum_i V_{ij}} \div \frac{\sum_j V_{ij}}{\sum_i \sum_j V_{ij}}$$

Where:  $Q_{ij}$ =Value of the location quotient for sector  $i$  in region  $j$ .  $V_{ij}$ =Value of variable  $V$  corresponding to sector  $i$  in region  $j$ .  $\sum_i V_{ij}$  =Value of  $V$  corresponding to the regional total.  $\sum_j V_{ij}$  =Value of  $V$  corresponding to the sectoral total.  $\sum_i \sum_j V_{ij}$  =Value of  $V$  corresponding to the national total.

In this research, the value of “V” refers to the production value, in thousands of Mexican pesos, of an activity “i”, which is blueberry production, for region “j”, which includes the three main blueberry-producing states in Mexico.

The calculation of this quotient yields three results:

- If  $Q_{ij} < 1$ , the relative size of the region is smaller than that of the country; therefore, there is no specialization.
- If  $Q_{ij} = 1$ , the relative size of the sector in the region is identical to the relative size of the same sector nationwide; therefore, there is no specialization in the activity within the region.
- If  $Q_{ij} > 1$ , the relative size of the region is greater than the national size; therefore, there is regional specialization in the activity or sector under study (Boisier, 1980).

### Lafay International Specialization Indicator

This refers to specialization and measures the degree to which a country has a comparative advantage in a particular area, allowing it to be a natural exporter (Durán & Alvarez, 2018). This indicator is obtained as follows:

$$IL^k = \frac{Pd_{ij}}{|Pd_{ij} + M_{ij} - X_{ij}|}$$

Where:  $IL^k$ =Lafay’s International Specialization Index.  $Pd$ =It is the production of a good  $i$  in region  $j$ .  $M$ =Imports of said good in region  $j$ .  $X$ =Exports of good  $i$  in region  $j$ .

The interpretation of the results following the calculation of the Lafay index reveals the following scenarios:

- If  $IL > 1$ , the country is a net exporter of the good; therefore, this situation improves as exports become the main destination of production.
- If  $IL < 1$ , the country is not a net exporter of the good; therefore, its production should focus more on exports (Durán & Alvarez, 2018).

In this study, only the volume of production in tons, as well as the value of imports and exports (in thousands of pesos) of blueberries in Mexico and the main producing states during the 2011-2021 period, are considered.

### Relative trade balance

The Relative Trade Balance (RTB) measures the relationship between the trade balance—defined as exports minus imports of a product—and the total sum of a country's exports and imports (Nazif Astorga, 1977).

$$BCR_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}}$$

Where, according to the period from 2011 to 2021:  $X_{ij}$ =Value of exports in tons of product  $i$  in  $j$  which is Mexico and  $M_{ij}$ =Value of imports in tons of product  $i$  in Mexico.

In general, when this indicator is greater than 1, the country is a net exporter; when it is less than 1, the country is a net importer.

### Commercial Dependency Index

This index calculates the ratio between the value of imports (M) and the value of apparent consumption (AC) over the same period. It reflects the extent of international competition for domestic demand (Ramírez *et al.*, 2016). Commercial dependency can be defined as the economic condition of a country that is largely influenced or determined by a stronger country. The dependency index is obtained by replacing exports with imports in the formula for the export specialization index (Placer, J. L., 2015b). This index is measured using the following formula:

$$IDC_{ij} = \frac{M_{ij}}{P_{ij} + M_{ij} - X_{ij}}$$

Where:  $IDC_{ij}$ =Trade dependency index of product  $i$  in country  $j$ ;  $M_{ij}$ =Imports of product  $i$  from country  $j$ ;  $P_{ij}$ =Domestic production of product  $i$  of country  $j$ ;  $X_{ij}$ =Exports of product  $i$  from country  $j$ .

These values will be analyzed using tons as the unit of measurement. A country or region is considered to have relative dependency in a specific sector when the relative weight of that sector in its imports is lower than its weight in the comparison environment (Placer, J. L., 2015a). This can be interpreted as follows:

- If the coefficient approaches zero, the sector's productivity competitiveness is higher, and
- If it approaches one, the sector's competitiveness is lower.

### Revealed Comparative Advantage Index

According to Vollrath (1991), the Revealed Comparative Advantage (RCA) Index reflects the relative share of a good  $i$  in the trade of a country  $j$  compared to the

share of that same good in global trade (w). It can be calculated using the following formula:

$$IVCR_i^j = VCE_i^j - VCI_i^j$$

Where *VCE* represents the revealed comparative advantage of exports, and *VCI* represents the revealed comparative advantage of imports. They are calculated as follows:

$$VCE_i^j = \ln \left[ \left( \frac{X_i^j}{X_n^j} \right) / \left( \frac{X_i^w}{X_n^w} \right) \right]$$

where:  $X_i^j$  = Exports of product *i* in country *j*;  $X_n^j$  = Total exports less those of product *i* in country *j*;  $X_i^w$  = Exports of product *i* in the world;  $X_n^w$  = Total exports less those of product *i* in the world.

$$VCI_i^k = \ln \left[ \left( \frac{M_i^j}{M_n^j} \right) / \left( \frac{M_i^w}{M_n^w} \right) \right]$$

$M_i^j$  = Value of imports of product *i* in country *j*;  $M_n^j$  = Total value of imports less those of product *i* in country *j*;  $M_i^w$  = Value of imports of product *i* in the world;  $M_n^w$  = Total value of imports less those of product *i* in the world.

The index can take on positive or negative values. A negative index indicates a trade deficit, while a positive index reflects a surplus and expresses a comparative advantage or disadvantage in trade. In other words, a Revealed Comparative Advantage (RCA) index greater than zero indicates the presence of a competitive sector with potential, whereas a negative index suggests a net importing sector lacking competitiveness in the global market.

## RESULTS AND DISCUSSION

According to FAOSTAT, in 2021 the leading blueberry-producing countries were the United States, followed by Peru, Canada, Chile, and Mexico in fifth place. The top blueberry-importing countries in 2021 were the United States which, despite being one of the largest producers, does not meet its domestic demand followed by the Netherlands, Canada, Germany, and the United Kingdom (Trade Map, 2023). The Tariff Information System Online (SIAVI) reports that the primary importer of Mexican blueberries is the United States, which acquired approximately 96% of the total exported volume. The remaining exports were distributed across 31 markets, including Japan, Canada, Hong Kong, Kuwait, the United Arab Emirates, and others (SIAVI, 2023). Mexico has experienced continuous growth in both planted and harvested blueberry area. In 2021, 5,832.66 hectares were harvested, yielding over

66,400 tons of blueberries the highest productivity recorded, with an average yield of 11.4 tons per hectare (SIAP, 2023). Globally, this agricultural activity has gained economic, political, and social relevance and continues to grow and develop (Rebollar, 2013). Since 1996, the United States has been one of the largest global consumers and producers. Due to its proximity and high demand, Mexico has increased its production (Pérez, 2018).

Nationally, the states of Michoacán, Jalisco, and Baja California are the most specialized in blueberry production. In addition to having favorable soil and climate conditions, they also benefit from advanced technology and a skilled labor force for both production and commercialization (SADER, 2018).

### Location quotient

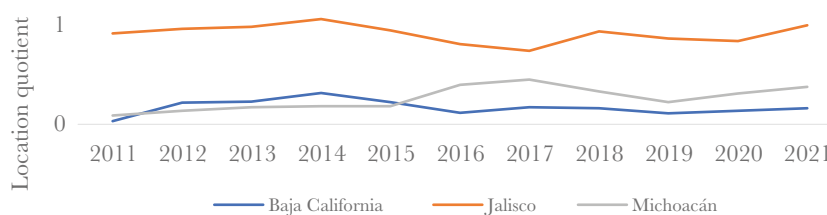
The location quotient allows us to observe and analyze the level of specialization in the three main blueberry-producing states: Jalisco, Michoacán, and Baja California. The calculation of this quotient shows that the higher the concentration of production in a state relative to national production, the greater the degree of specialization. Jalisco demonstrates a high level of specialization in blueberry production, supported by a government initiative coordinated by the Secretariat of Rural Development called the “Berry Agribusiness Development Program in the State of Jalisco” (Government of Jalisco, 2010). This program provided registered producers with blueberry plants to maximize economic returns, along with other measures to boost productivity (Revilla *et al.*, 2023). Baja California reached its highest location quotient in 2014, while Michoacán peaked in 2017 (see Figure 1).

### Lafay International Specialization Indicator

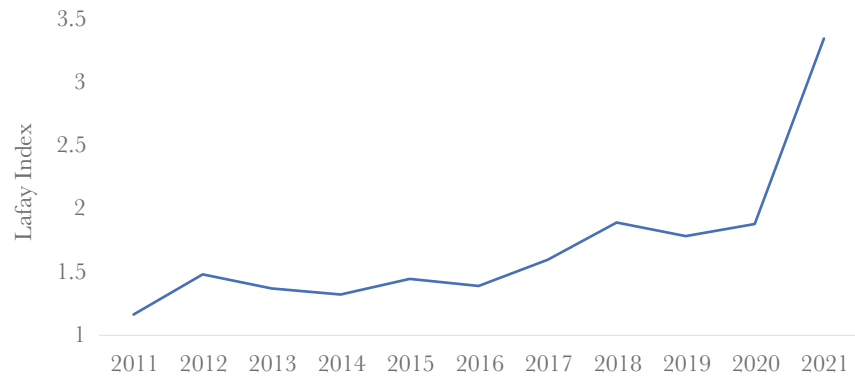
This indicator reveals the degree of a country’s specialization in terms of comparative advantage (Figure 2). It was determined that Mexico is a natural exporter of blueberries, as indicated by a value greater than one, driven by high yields in recent years. This is largely the result of increased planted area and production, particularly since 2017.

### Relative Trade Balance

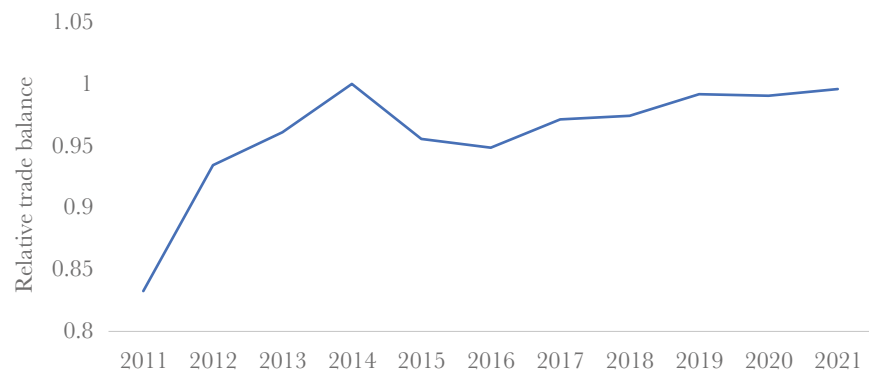
The indicator shows values close to 1 throughout the series, indicating that Mexico did not import or purchase a significant quantity of blueberries from abroad. This confirms that there is no commercial dependency on blueberries in Mexico (see Figure 3).



**Figure 1.** Blueberry Location Quotient by State (2011-2021). Source: Prepared with data from the latest SIACOM update, 2023.



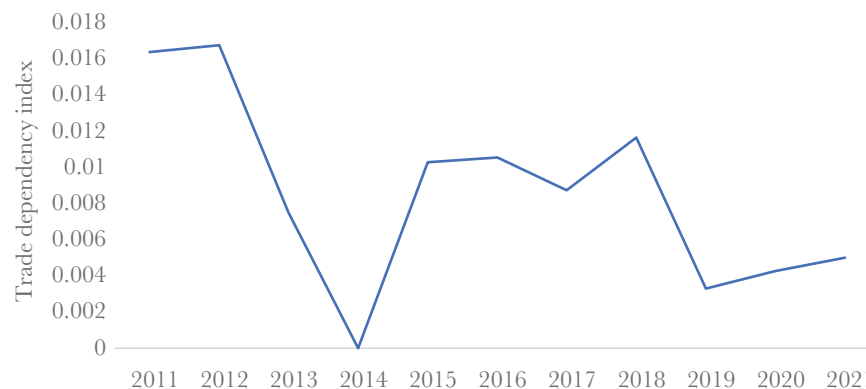
**Figure 2.** Blueberry specialization indicator (2011-2021). Source: Prepared with data from SIAP and SIAVI, 2023.



**Figure 3.** Relative Trade Balance of Blueberries (2011-2021). Source: Prepared with data from SIAVI, 2023.

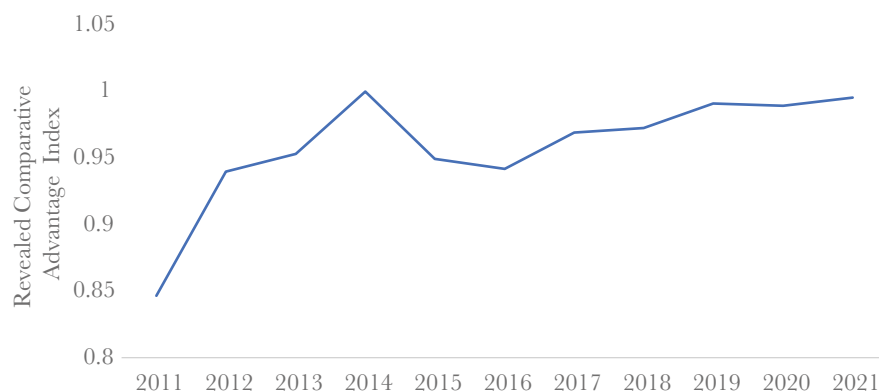
### Commercial Dependency Index

Overall, Mexico’s commercial dependency index for blueberries shows positive results, indicating that the Mexican market is not dependent on the international blueberry market. As shown in Figure 4, the index peaked between 2015 and 2018, meaning that imports exceeded exports during that period. It can be inferred that blueberry competitiveness has increased in recent years.



**Figure 4.** Commercial Dependency Index of Blueberries (2011-2021). Source: Prepared with data from SIAVI and SIAP, 2023.

The Revealed Comparative Advantage (RCA) of Mexican blueberries in the global market has shown positive trends, as illustrated in Figure 5. A positive index indicates a trade surplus and reflects a comparative advantage in trade. An RCA greater than zero demonstrates that the global market presents a favorable sector with potential for blueberry commercialization.



**Figure 5.** Revealed Comparative Advantage Index of Blueberries (2011-2021). Source: Prepared with data from SIAVI and TRADE MAP, 2023.

## CONCLUSIONS

The primary international market for blueberry commercialization is the United States, due to its geographic proximity and the free trade agreement. Nevertheless, Mexico must continue seeking ways to diversify its markets to avoid relying on a single destination. The Mexican blueberry market does not show signs of commercial dependency; as domestic production satisfies internal demand. Competitiveness indices confirm that Mexican blueberries are a strategic export product.

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