Revealed comparative advantage and competitiveness of Mexican mango exports

Martínez-Hernández, Amador[1] [ID]**; Caamal-Cauich, Ignacio[1*]; Pat-Fernández, Verna G.[1]** [ID]**;
Reza-Salgado, Juventino[2]** [ID]

[1] Universidad Autónoma Chapingo. Chapingo, Texcoco, Estado de México, México. C.P. 56230.
[2] Universidad Tecnológica de Tecamachalco. Barrio la Villita, Tecamachalco, Puebla, México. C.P. 75483.
* Correspondence: icaamal82@yahoo.com.mx

ABSTRACT
Objective: The analysis of competitiveness of Mexican mango in the global market from 1994 to 2020 was conducted.
Design/methodology/approach: The revealed comparative advantage index (RCAI) and the normalized revealed comparative advantage index (NRCAI) were calculated, with the aim of understanding the exporting specialization of Mexico and thus determine the presence of comparative advantages in exports.
Results: The average values obtained for the USA market were 1.09 (RCAI) and 0.04 (NRCAI), and for the Canadian market 6.33 (RCAI) and 0.69 (NRCAI).
Conclusion: The export sector of Mexican mango is competitive and has comparative advantages because the indices are positive.

Keywords: Comparative advantage, competitiveness indices, production, market.

INTRODUCTION

Developing countries produce 90% of tropical fruits and they come mainly from producers with small surfaces that destine part of their production to the global market (FAO, 2022). Therefore, they are beneficial for the agricultural sector because of the income and currencies generated through exports, highlighting their social and economic importance.

The main exporting countries of mango are Mexico, Thailand, Brazil, the Netherlands and Peru, which together contribute 67.01% of the global exports. India is the main producer and sixth exporter. Peru is the eighteenth producer and fifth exporter. China and Indonesia are the second and third producers, but they do not stand out among the main exporters, in contrast with the Netherlands, which is not a producer yet is positioned as the fourth exporter because it is a re-exporting country (FAOSTAT, 2022).

The previous data reflect that the global trade patterns are changing, which is why commercial interaction is definitive to obtain more advantages (Valencia et al., 2017). This implies that the countries diversify their efforts to obtain a broad margin of participation in the markets where competition between countries and economic sectors is the constant (Gómez, 2006).

Presently, international trade is progressively more intense, particularly in foods of high economic and social impact (Maya *et al.*, 2011), which is why the study of competitiveness is fundamental to determine the presence of comparative advantages that allow the sustainability of the population linked to the agro-exporting activity (De Pablo and Giacinti, 2012).

The concept of competitiveness is expressed as the ability of a country to conquer, maintain or increase its participation in international markets (Hilasaca, 2014). This can be described as a specific characteristic of the products that give them advantages in the global market, and their capacity to participate will depend to a great extent on their level of competitiveness in international trade (Contreras, 2000).

The comparative advantage is an important concept to explain commercial patterns; it establishes that each country should be specialized in the products whose relative costs are lower than in the rest of the countries (Pat *et al.*, 2009). However, in a model based on the differences of available resources, it is not possible to observe the relative costs, which is why Balassa (1965) establishes that it is not necessary to include all the factors that impact the comparative advantage, since it can be revealed through the observed commercial patterns (Hassan and Ahmad, 2018). The comparative advantage of observed data is called revealed comparative advantage and its calculation allows measuring the level of competitiveness of a country or a product in specific markets, during specific periods (Caamal *et al.*, 2017). The objective was to analyze the competitiveness of Mexican mango in the global market from 1994 to 2020, through the calculation of the revealed comparative advantage index (RCAI) and the normalized revealed comparative advantage index (NRCAI) to determine the presence of comparative advantages in exports. The working hypothesis suggests that the export sector of Mexican mango is competitive and has comparative advantages because the indices are positive.

MATERIALS AND METHODS

The database from the Statistical Division of the Food and Agriculture of the United Nations (FAO-FAOSTAT) was consulted to analyze and generate information.

Measuring competitiveness

The competitiveness of a product can be measured in the global market through a revealed comparative advantage index, with the convenience that it can be estimated using international trade statistics (Avendaño and Acosta, 2009). These indices allow obtaining a good approach to the exporting performance of countries in a specific product (Torres, 2009).

Balassa's revealed comparative advantage index

The revealed comparative advantage index (RCAI) allows understanding the exporting specialization of a country, calculated as a quotient between the participation of a product in the exports of a country and the participation of this same product in global exports (Caamal *et al.*, 2017). The procedure for the calculation is the following:

$$RCAI_{kij} = \frac{X_{kij} / XT_{ij}}{X_{kiw} / XT_{iw}}$$

Where: $RCAI_{kij}$=Is the revealed comparative advantage index for product k of country i toward country j; X_{kij}=Exports of product k of country i toward country j; XT_{ij}=Total exports from country i to country j; X_{kiw}=Exports of product k carried out by country i toward the world (w); XT_{iw}=Total exports of country i toward the world (w).

The RCAI reflects greater competitiveness as there is higher value obtained and vice versa; the following values can be obtained: 1) RCAI>0, there is comparative advantage for the country or product reflecting that it is competitive in international markets, and 2) RCAI<0, there is comparative disadvantage for the country or product reflecting that it is not competitive in the international market (Contreras *et al.*, 2019).

Normalized revealed comparative advantage index (NRCAI)

The Normalized Revealed Comparative Advantage Index (NRCAI) measures the degree of deviation of the real exports of a country based on its level of comparative advantage in terms of its relative scale regarding the global export market, since it takes into consideration the size of the countries and emerges as an alternative measurement capable of revealing the reach of the comparative advantage that a country has in a basic product more accurately and consistently than other indices. This allows making the results obtained in its calculation symmetrical, taking only values between -1 and 1 (Yu *et al.*, 2009); the following formula is suggested for its calculation:

$$NRCAI = \frac{RCAI - 1}{RCAI + 1}$$

Where: $RCAI$=Revealed comparative advantage index; the values of $NRCAI$ are located in 3 ranges: between $+0.33$ and $+1$, there is comparative advantage for the country in the product's exports; between -1 and -0.33, there is disadvantage for the country in the product's exports; and between -0.33 and $+0.33$, there is a trend toward intra-product trade (Durán and Álvarez, 2011).

With the use of indicators of revealed comparative advantage (RCAI and NRCAI), the magnitude of the comparative advantage that a country has in a specific product can be explained; in addition, they allow performing comparisons of comparative advantages between goods based on their value obtained throughout the years and their markets (Yildiz and Mete, 2019).

Export coefficient

The export coefficient (EC) reflects the relationship that is established between the exports value and the production value during a period of time. It measures the

percentage of production that is exported; a higher export coefficient means that a higher proportion of the production is exported, and a lower export coefficient means that a lower proportion of the production is exported (Caamal *et al.*, 2017). The procedure for calculation is:

$$EC_{ij} = \left(\frac{X_{ij}}{Q_{ij}} \right) * 100$$

Where: EC_{ij}=Export coefficient of product i from country j; X_{ij}=Exports of product i from country j; Q_{ij}=Total production of product i from country j.

Export specialization coefficient

The export specialization coefficient (ESC) allows measuring the degree to which a country has a comparative advantage, classifying it as an exporter of the product, and relating the exports with the apparent national consumption (ANC); if the ESC is higher than zero, it is considered a net exporting country and competitive at the national level in the product (Caamal *et al.*, 2018). For its calculation, the following formula is used:

$$ESC_{ij} = \left(\frac{X_{ij}}{Q_{ij} + M_{ij} + X_{ij}} \right) * 100$$
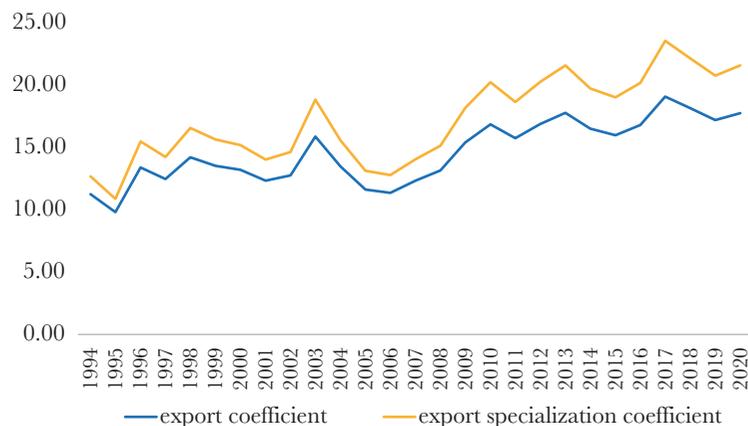
Where: ESC_{ij}=Export specialization coefficient; X_{ij}=Exports of product i from country j; M_{ij}=Imports of product i from country j; Q_{ij}=Domestic production of product i from country j.

RESULTS AND DISCUSSION
Variables and indicators of competitiveness

The export coefficient (EC) indicates the percentage of the total production of a country that is destined to exports; for the case of Mexico, during the period of analysis (1994-2020), it presents an average of 14.63%; this result does not differ much from that obtained by Caamal *et al.* (2018), since in their analysis they obtained an export coefficient of 17% for the 2005-2016 period. This explains that although it is not such a high proportion of the production, it indicates the importance of the increase in exports because its behavior presents a positive trend, reflecting that mango is a viable product for the global market (FAOSTAT, 2022).

The export specialization coefficient (ESC) indicates the degree of market penetration of a country according to its exports and apparent consumption. Figure 1 shows that during the period of analysis the index shows a growing trend, averaging around 17.22% and indicating that Mexico has the capacity to be a competitive country in mango exports (FAOSTAT, 2022).

Figure 1. Behavior of the export coefficient and the export specialization coefficient.
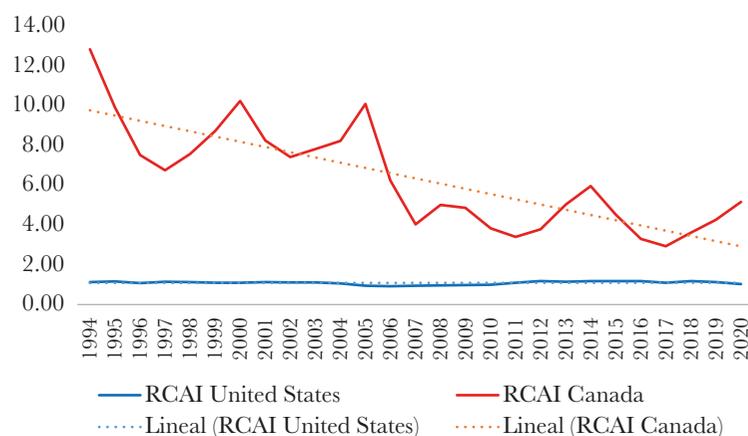Source: Prepared by the authors with data from FAOSTAT, 2022.

Distribution and behavior of exports

The main destinations of exports are the United States of America (USA) and Canada (CAN), with an average market participation percentage of 87.01% and 9.76%, respectively (Table 1). The data indicate that a large part of the exports are concentrated in the United States market, because of the comparative and competitive advantages that Mexico has compared to other countries (FAOSTAT, 2022).

The volume of Mexican mango exports toward the main export destinations has been increasing. Exports to the United States averaged an annual growth rate of 5.05% and a total annual growth rate of 4.83%. Canada presented an annual growth rate of 5.30% and a total annual growth rate of 4.85% (FAOSTAT, 2022).

Balassa's revealed comparative advantage index

The United States of America is the main mango consumer in the world, so it represents an excellent export destination for the Mexican product; the values of RCAI obtained

Figure 2. Behavior of the RCAI in the United States and Canada.
Source: Prepared by the authors with data of FAOSTAT, 2022.

Table 1. Mango exports from Mexico (tons).

Year	World Exports	Exports to United States	%	Exports to Canada	%
1994	125,777	109,237	86.85	11,988	9.53
1995	131,720	114,648	87.04	10,478	7.95
1996	159,416	140,059	87.86	11,552	7.25
1997	187,112	165,470	88.43	12,626	6.75
1998	209,393	180,133	86.03	18,434	8.80
1999	203,985	178,042	87.28	18,975	9.30
2000	205,940	180,644	87.72	20,107	9.76
2001	194,541	172,135	88.48	18,617	9.57
2002	194,590	166,728	85.68	18,494	9.50
2003	216,315	190,397	88.02	21,356	9.87
2004	211,936	186,163	87.84	22,369	10.55
2005	195,210	169,984	87.08	21,113	10.82
2006	232,383	201,450	86.69	24,817	10.68
2007	236,005	202,498	85.80	25,488	10.80
2008	226,084	194,914	86.21	24,051	10.64
2009	232,643	199,122	85.59	26,798	11.52
2010	275,367	238,753	86.70	27,907	10.13
2011	287,772	245,608	85.35	33,166	11.53
2012	297,295	257,469	86.60	30,771	10.35
2013	338,169	295,135	87.27	36,256	10.72
2014	289,646	251,433	86.81	32,858	11.34
2015	331,149	290,812	87.82	33,512	10.12
2016	369,316	329,016	89.09	32,962	8.93
2017	435,816	353,973	81.22	38,732	8.89
2018	395,537	349,076	88.25	37,959	9.60
2019	412,453	368,120	89.25	36,827	8.93
2020	421,637	372,240	88.28	41,118	9.75
Growth rate (%)	5.01	5.05		5.30	
Average annual growth rate (%)	4.76	4.83		4.85	

Source: Prepared by the authors with data from FAOSTAT, 2022.

show a constant behavior with low variation, an average index of 1.09 was obtained. Canada is the second export destination of Mexican mango; the Canadian market shows a clear comparative advantage because it presents higher RCAI values than the unit with an average of 6.33; the variation in this market is very noticeable with a decreasing trend (FAOSTAT, 2022). This reflects that Mexican mango is a product that presents revealed comparative advantage (RCA) in the main export markets, indicating that it is a competitive product in the global market.

Normalized revealed comparative advantage index

During the period of analysis, average values of 0.04 and 0.69 were obtained for the United States of America and Canada, respectively, showing a positive trend for the USA market and a slightly negative trend for the Canadian market (Figure 3). This reflects that Mexico presents comparative advantages in mango and therefore it is increasing its competitiveness, thus maintaining its position in international markets, since during the period analyzed it has remained as the main exporter and as the fourth producer of mango globally (FAOSTAT, 2022).
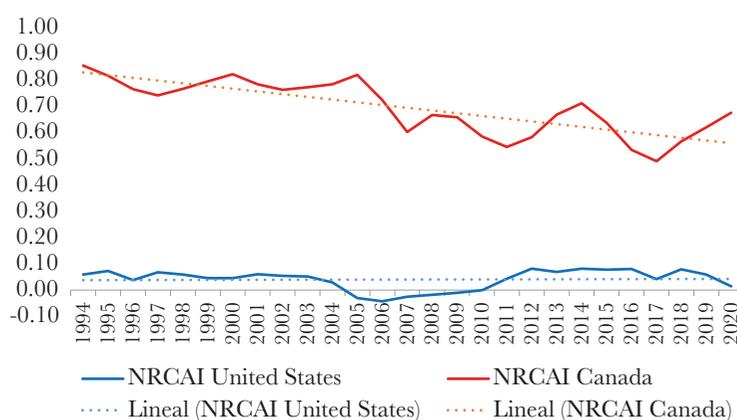
Figure 3. Behavior of the NRCAI of the United States and Canada.
Source: Prepared by the authors with data from FAOSTAT, 2022.

CONCLUSIONS

Mexico has been consolidated as a leading country at the global level, positioned as fourth producer and as the main exporter of mango; its main commercial partners are the United States of America and Canada, which together hoard 96.77% of total exports. In addition, an export coefficient of 14.63% and an export specialization coefficient of 17.22% are seen, reflecting that mango is an exportable product and that Mexico is a competitive country in the global market. The RCAI obtained are higher than zero, reflecting that Mexican mango is competitive in global markets, mainly in the United States market because it presents higher stability and a positive trend in contrast with the Canadian market which, despite presenting very high values of RCAI, is a market that presents very noticeable variations and a negative trend.

The average NRCAI of the United States market is found between -0.33 and $+0.33$ indicating a trend toward intra-product trade; however, the trend is positive so there are comparative advantages compared to the Canadian market which, despite being within the range of $+0$-33 and $+1$, presents a slight negative trend. However, since Mexico presents a NRCAI of $+0$ in the entire period analyzed in both markets, the exporting specialization of Mexico in mango toward these export destinations can be identified.

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