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BEHAVIOR OF ECONOMIC VARIABLES AND TRADE INDICATORS FOR THE MEXICAN MANGO

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ABSTRACT

The most predominant mango producers are India, Indonesia, China, Mexico and Pakistan, whereas the most important exporters are Mexico, Thailand, the Netherlands, Brazil and Peru. Mexico is the fourth producer and first worldwide exporter of mangoes; and its main partners in the mango trade are the United States of America, Canada and Japan. This work intended to characterize the behavior of economic variables and the trade indicators of mangoes produced in Mexico. The applied methodology consisted of calculating the growth rates of the variables and trade indicators, in order to assess competitiveness in the Mexican mango trade. The growth rates of production, export, total trade and trade balance variables exceeded zero, reflecting expansion in both production and trade; likewise, the relative trade balance coefficients, tradability index, export openness index and export coefficient had values above zero, revealing export competitiveness; while imports represented around 0.1% of national consumption and the trade dependency index was around zero, indicating little national consumption dependence on imports. The positive growth rates for the variables and positive coefficients of the trade indices reflect that mango production and exports are expanding and are competitive.

Keywords: competitiveness, export, import, production, trade balance.

INTRODUCTION

99% of tropical fruits, are produced in countries that are developing economically, mainly, by small farmers who work land areas no greater than 5 hectares. For this reason, the production of tropical fruits represents not only substantial income for these small farmers but, also export earnings for the countries that produce them, thus highlighting the social and economic importance of this agricultural sector (FAO, 2020).

Worldwide, the main mango producing countries are: India with 25,631,000 tons (45.9%), Indonesia with 3,294,817 tons (5.9%), China with 2,415,000 tons (4.32%), Mexico with 2,396,675 tons (4.3%) and Pakistan with 2,270,229 tons (4.7%). Regarding exports, these are predominantly in Mexico consisting of 18.9%, which is equivalent to 413,443 tons, Thailand 10.5% with 229,768 tons, Holland 10.1% with 221,323 tons, Brazil 9.9% with 216,048 tons, Peru 9.2% with 201,068 tons and Vietnam 8.1% with 176,246 tons (FAOSTAT, 2021).

These data indicate that Mexico has greatest participation in world mango exports; in 2020 it exported 372,240 tons (87.92%) mainly to the United States of America, Canada

with 41,303 tons (9.76%) and Japan with 3,237 tons. (0.76%); representing 98.4% of Mexican mango exports worldwide (Tariff Information System Via Internet [SIAVI], 2021). The main producing states are Guerrero with 395,477 tons (19.6%), Sinaloa with 337,462 tons (16.8%), Nayarit with 304,619 tons (15.1%), Chiapas with 270,644 tons (13.4%), Oaxaca with 207,710 tons (10.3%). Michoacán with 170,580 tons (8.5%) and Jalisco with 110,917 tons (5.5%). Altogether, in 2020 these represented 89.3% of total production (Agricultural, Food and Fisheries Information Service [SIAP], 2021).

In 2020, mangoes were imported from Ecuador 1,188 tons (42.83%) and from Peru 1,180 tons (42.53%); which represented 85.36% of total imports in Mexico. The rest of the imports came from Thailand, the United States of America and India; together they contributed the remaining 14.6% of total imports (SIAVI, 2021). Mexico ranked 49th worldwide in terms of mango imports, and is not considered to participate significantly in the international market, as its imports are limited compared to those of other countries; in the year of 2019, only 1,942 tons were imported, which represented 0.11% of total imports in the world (FAOSTAT, 2021).

Competitiveness refers to the true state of permanence or expansion that a product manifests in an international market, which can be affected both by market failure or government intervention. Likewise, it reflects the level of performance of a product in the economic context where it is marketed, in compliance with the laws of supply and demand, which can be affected by external circumstances, causing variations in the level of profitability (Contreras-Castillo, 1999). The bases of trade competitiveness represent comparative advantages, which refer to differences in the amount of revenue related to regional factors of production, that enables them to specialize in the production and trade of the good at a relatively low price or in terms of exchange factors; these are manifested in units of domestic production in comparison to foreign products (Dornbusch, 1993).

Distortions in the market can cause variations ineen comparative advantage and competitiveness. Comparative advantage and competitiveness are considered as factors at stepped levels, meaning that the competitiveness of a product in a market is initially related to its comparative advantages, associated with existing advantages and the country specializing in a particular product, which can be modified by external factors such as the exchange rate, asymmetric information, monopolies, among others (Cruz-López *et al*., 2020).

However, the competitiveness of agricultural products lies in their capacity to compete in different types of markets and statistical information on trade reveals the advantages that a country may have in terms of its total exports, but also makes it possible to assess their participation compared to the rest of the world (Padilla, 2006; Avendaño-Ruiz, 2008). Competitiveness indices are factors that explain a country's ability to efficiently produce goods and services in compliance with international standards and thus achieve high levels of productivity and income (Pérez-Soto and Bermúdez-Acosta, 2012). Various indicators enable assessing the competitive performance of a country's economy, the most relevant are: apparent national consumption, trade balance, relative trade balance, tradability

index, export openness index and others, which reflect competitiveness of production or dependence on imports (Ramírez-Padrón *et al.*, 2016).

This research intended to characterize the behavior of the economic variables of the mango trade that takes place in Mexican territory, in order to have an overview of its commercialization and to calculate and analyze the behavior of the competitiveness indices related to the mango trade, with the intention of assessing the competitive performance of the Mexican mango on the world market. The working hypothesis indicates that the production and export of mangoes is competitive and expanding; manifested in the growth of the economic variables of trade, which reflect expanding production, increased trade and increased consumption of this product and likewise, in the positive and growing trade competitiveness indices that reflect competitiveness on the world market.

MATERIALS AND METHODS

The statistical information for the period analyzed extends from 1994 to 2020 and was obtained from the databases of the Agricultural, Food and Fisheries Information Service (SIAP), of the Statistics Division of the United Nations Food and Agricultural Organization (FAOSTAT); and the Internet Tariff Information System (SIAVI). The information was ordered based on trade variables: production, export and import. Subsequently, calculations were made of the growth rates of the trade variables (production, exports, imports, trade balance, total trade and apparent national consumption) and of the main competitiveness indices (relative trade balance index, tradability index, coefficient of commercial dependency, index of degree of export openness and export coefficient), in order to assess the behavior of the variables and indicators of competitiveness for the Mexican mango trade.

The conceptualization, interpretation and calculation procedures for growth rates and competitiveness indicators are as follows:

Growth rate (GR): positive or negative change of a variable between two different moments in time; expresses the total change in a variable between two dates, as a percentage. When the growth rate is positive, it signifies growth and when it is negative, it indicates a decline (López, 2019). The calculation procedure is:

$$GR = \left[\frac{Period\ n}{Base\ period} - 1 \right] \times 100 \quad (1)$$

where *GR*: Growth rate from year 1 to year *n*; *n*: Number of years; *Period n*: Value in the last year; *Base period*: Value in year 1.

Apparent national consumption (ANC): is the quantity of a certain product that is consumed or required by a region, country or several countries over a certain period. It

is the result of adding national production to imports and then subtracting exports, if apparent national consumption is less than production, there are exportable surpluses and if it is greater than production there will be dependence on imports (Moreno-Sáenz *et al.*, 2016). The calculation procedure is:

$$CNA = Y + M - X \tag{2}$$

where *CNA*: Apparent national consumption of the country; *Y*: national production of the product; *M*: Product Imports; *X*: Product Exports.

Trade balance (*TB*): is the record of imports and exports carried out by a country during a given period; where, if imports are greater than exports, the situation implies a trade deficit, on the contrary, if exports are greater than imports, the situation implies a trade surplus (Mankiw, 2020). The calculation procedure is:

$$BC = X - M \tag{3}$$

where *BC*: The country's trade balance; *X*: Product Exports; *M*: Product Imports.

Relative trade balance index (RTB): measures the relationship between the trade balance of a product (exports minus imports) and the total trade of that product for a given country on the world market (exports plus imports). It is mainly used to identify which products are intended for export or import. If the RTB index is between –1 and 0, the country is considered a net importer of the product and there is no competitive advantage. On the contrary, if the RTB index is between 0 and 1, the country is considered a net exporter of the product and has competitive advantage (García, 1995). The calculation procedure is:

$$RTB_{ij} = \frac{\left(X_{ij} - M_{ij}\right)}{\left(X_{ij} + M_{ij}\right)} \tag{4}$$

where RTB_{ij}: relative trade balance index of a product i of the country *j*; X_{ij}: Exports of a product *i* of country *j* to the world market; M_{ij}: Imports of a product *i* of country *j* to the world market.

Tradability index: shows the relationship between the value of the trade balance and the value of apparent consumption (domestic production plus imports, minus exports). Meaning, it measures the capacity to generate net exportable surpluses in relation to domestic consumption. If the index is less than zero, the sector is considered an importer, as there is excess demand; therefore, the sector is not competitive within the country.

Contrarily, when the indicator is greater than zero, the sector is considered an exporter, as there is an excess supply; therefore, this represents a competitive sector within the country (Fernández, 2013). The calculation procedure is:

$$T_{ij} = \frac{\left(X_{ij} - M_{ij}\right)}{\left(Q_{ij} + M_{ij} - X_{ij}\right)} \tag{5}$$

where T_{ij}: Tradeability index of a product *i* from country *j*; X_{ij}: Exports of a product *i* from country *j*; M_{ij}: Imports of a product *i* from country *j*; Q_{ij}: Domestic production of a product *i* from country *j*.

Trade dependency ratio: expresses the share of imports of a product over apparent national consumption during a given period. The closer the coefficient is to zero, the greater the capacity to supply national demand through domestic production. Contrarily, the closer the coefficient is to one, the lower the capacity to supply national demand through internal production, so that internal consumption will depend on imports (Velín and Medina, 2011). The calculation procedure is:

$$CDC_{ij} = \frac{M_{ij}}{\left(Q_{ij} + M_{ij} - X_{ij}\right)} \tag{6}$$

where CDC_{ij}: Coefficient of trade dependency of a product *i* from country *j*; M_{ij}: Imports of a product *i* from country *j*; Q_{ij}: Domestic production of a product *i* from country *j*; X_{ij}: Exports of a product *i* from country *j*.

Index for degree of export openness: reflects the share of exports of a product over apparent national consumption. In addition, it makes it possible to assess the capacity for inclusion in a specific market. The higher the index, the greater the competitiveness of the product in the international market and the closer to zero the indicator is, the lower the competitiveness of the product in the world market (Ramírez-Padrón *et al.*, 2016). The calculation procedure is:

$$GAE_{ij} = \frac{X_{ij}}{\left(Q_{ij} + M_{ij} - X_{ij}\right)} \tag{7}$$

where GAE_{ij}: Index for degree of export openness of a product *i* from country *j*; X_{ij}: Exports of a product i from country *j*; Q_{ij}: Domestic production of a product *i* from country *j*; M_{ij}: Imports of a product *i* from country *j*.

Export coefficient: represents the relationship between the value of exports and the value of production during a given period. Meaning, it measures the quantity of total production exported. The indicator range varies between 0 and 1; the closer it is to one, the greater the exported quantity of the product, and the closer it is to zero, the lower the exported quantity (Fernández, 2013). The calculation procedure is:

$$CE = \frac{X}{VP} \tag{8}$$

where *CE*: Export coefficient; *X*: Exports of the product; *VP*: Production volume of the product.

RESULTS AND DISCUSSION

The growth rates of the economic variables for trade (production, export, import, total trade, trade balance and domestic consumption) for the Mexican mango have been positive throughout the period from 1994 to 2020, and reflect the expanding production, increased trade and increased consumption of the product in Mexico (Table 1). The results obtained are similar to those of García-Del Hoyo (2020), where the growth rate of mango exports during the period from 2000 to 2013 had a behavioral increase of 172.2%, and for the same period, imports showed a growth rate of 335%.

Table 1. Principal mango trade variables in Mexico, 1994–2020.

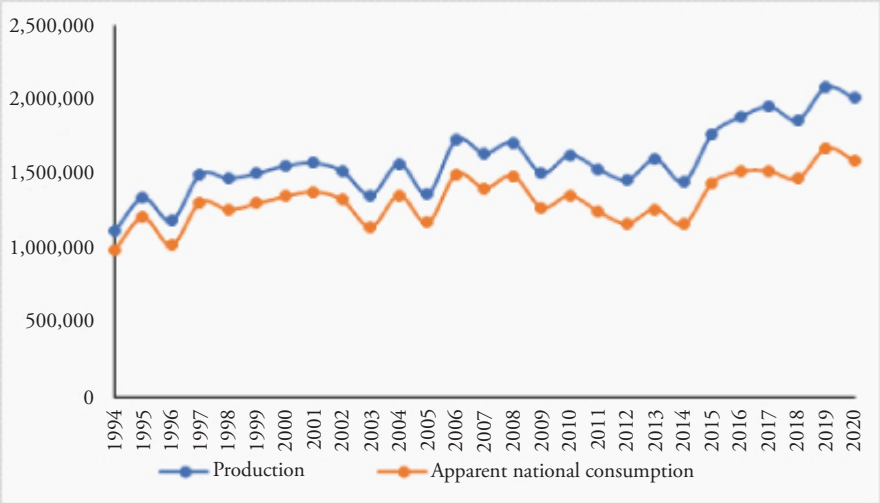
Year	Production	Exportation	Importation	Total trade	Apparent national consumption	Trade balance
1994	1,117,808	125,775	2	125,777	992,035	125,773
1995	1,342,088	131,721	0	131,721	1,210,367	131,721
1996	1,189,989	164,903	20	164,923	1,025,106	164,883
1997	1,501,432	187,127	60	187,187	1,314,365	187,067
1998	1,473,852	209,426	28	209,454	1,264,454	209,398
1999	1,508,468	204,002	167	204,169	1,304,633	203,835
2000	1,559,351	206,782	1,007	207,789	1,353,576	205,775
2001	1,577,447	194,540	2,271	196,811	1,385,178	192,269
2002	1,52,3159	194,591	989	195,580	1,329,557	193,602
2003	1,362,375	216,316	2,244	218,560	1,148,303	214,072
2004	1,573,269	212,505	1,545	214,050	1,362,309	210,960
2005	1,368,091	195,210	1,937	197,147	1,174,818	193,273
2006	1,734,766	232,382	2,004	234,386	1,504,388	230,378
2007	1,643,355	236,004	2,161	238,165	1,409,512	233,843
2008	1,716,537	226,083	2,007	228,090	1,492,461	224,076
2009	1,509,272	232,643	2,982	235,625	1,279,611	229,661

Table 1. Continuation.

Year	Production	Exportation	Importation	Total trade	Apparent national consumption	Trade balance
2010	1,632,649	275,366	2,300	277,666	1,359,583	273,066
2011	1,536,654	287,771	1,976	289,747	1,250,859	285,795
2012	1,465,190	297,295	2,921	300,216	1,170,816	294,374
2013	1,603,810	338,169	3,307	341,476	1,268,948	334,862
2014	1,451,890	289,647	2,041	291,688	1,164,284	287,606
2015	1,77,5507	331,148	1,588	332,736	1,445,947	329,560
2016	1,888,187	369,314	1,768	371,082	1,520,641	367,546
2017	1,958,491	435,815	1,909	437,724	1,524,585	433,906
2018	1,867,298	395,539	2,347	397,886	1,474,106	393,192
2019	2,089,041	413,443	1,942	415,385	1,677,540	411,501
2020	2,013,066	423,390	2,775	426,164	1,592,451	420,615

Source: self elaborated with data from SIAVI and FAOSTAT, 2021.

Total mango production in Mexico increased by 80% in the analyzed period; for the year 1994, 1,117,808 tons were produced, whereas for 2020 production reached 2,013,066 tons. However, there were important ups and downs, as during the period from 1994 to 2001, production showed an increase of 41.1%, but in 2002 a set of fluctuations in production initiated, which did not stabilize until 2014; in the following year the increase in production resumed, reaching its highest level in 2019 with 2,089,041 tons (Table 1 and Figure 1). Moreover, the results are similar to those of Caamal-Cauich *et al.* (2019) who mention that mango production in Mexico increased by 75.2% from 1994 to 2017, and less than



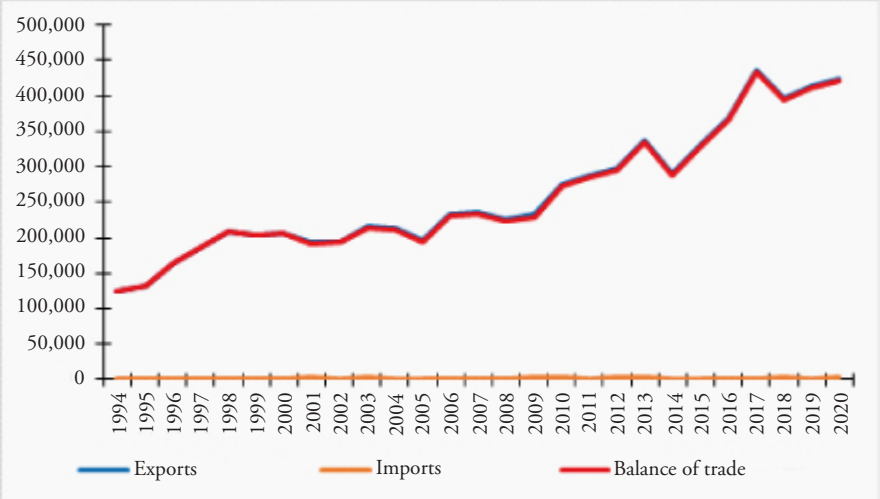
Source: self elaborated with data from FAOSTAT, 2021.
Figure 1. Behavior of apparent national consumption and mango production, in Mexico**.**

80% from 1994 to 2020, reflecting an expansion in production. However, the increase in mango production was mainly due to the increase in the harvested area, which presented a growth rate of 51%, increasing from 127,982 to 193,246 hectares (SIAP, 2021).

Apparent national consumption of mango in Mexico behaved in a similar way to total production; for the year 1994, 992,035 tons were consumed, whereas for the year 2020, consumption reached 1,592,451 tons, showing a growth rate of 61%. However, there were significant ups and downs, having its lowest point in the year 1994 with 992,035 tons and reaching the highest level in the year 2019 with 1,677,540 tons (Table 1 and Figure 1).

During the study period, the existence of exportable production surpluses is evident, because production values exceeded apparent national consumption values (Table 1 and Figure 1). These were also similar to those obtained by Ramón-Canul *et al*. (2016), in which Mexico presented the highest percentage for the amount of mango exports during the analysis period, with the United States being the main destination of these exports.

Regarding the trade balance during the period from 1994 to 2020, mango exports in Mexico increased 236.6%, from 125,775 to 432,390 tons, revealing a growing trend during the study period. However, mango exports in 2014 decreased 14.3% compared to 2013; subsequently exports increased, reaching their highest level in 2017 with 435,815 and in 2018 exports decreased by 9.2%, despite this, the years 2019 and 2020 continued with a trend for growth, which is explained by the variations in production (Table 1 and Figure 2). At the same time, mango imports in Mexico grew 1,386 times from 1994 to 2020; for the year 1994, barely 2 tons were imported, while for the year 2020, 2,775 tons of mango imports were registered. However, there were increases and decreases during the



Source: self elaborated with data from FAOSTAT, 2021.
Figure 2. Trade balance behavior for mango in México.

period from 2002 to 2020, reaching the highest level in 2013 with 3,307 imported tons. The observed tendency manifests growth and fluctuation throughout almost the entire study period, imports being small compared to production levels (Table 1 and Figure 2).

The mango trade balance in Mexico was positive; as a greater amount of mango was exported than imported, known as a trade surplus. This means that the country is capable of supplying itself, while also selling products abroad. Notably, mango imports, although they have increased, still do not represent a large share in the trade balance in Mexico (Table 1 and Figure 2). The results obtained are similar to those of Luquez-Gaitan *et al*. (2022), who conclude that imports are insignificant compared to exports, the trade surplus was almost equal to exports, throughout the study period. On average, imports compared to exports only accounted for 0.8%.

Caamal-Cauich *et al*. (2019) obtained similar results during the study period from 2005 to 2017, showing that exports and total trade had positive growth rates; likewise, the trade balance always manifested a positive surplus. For his part, García-Del Hoyo (2020) showed similar results for the period from 2000 to 2013, where the trade balance showed a surplus, with a growth rate of 170% during that period.

Trade competitiveness indices (relative trade balance, tradability index, export openness index and export coefficient) were positive and growing, which allows us to infer that the Mexican mango is competitive in the world market (Table 2).

During the study period, the relative trade balance index was found to be very close to one, a value which reflects that Mexico has great export capacity; in other words, there is a trade surplus that implies a greater amount of exports than imports, due to the excess supply of the national product that covers the existing demand in the country and also contributes to satisfying some of the demand from international markets; enabling Mexico to be a net exporter. The average relative trade balance index throughout the period was 0.99, close to one (Table 2 and Figure 3).

Table 2. Principal competitiveness indices for mango in Mexico, 1994–2020.

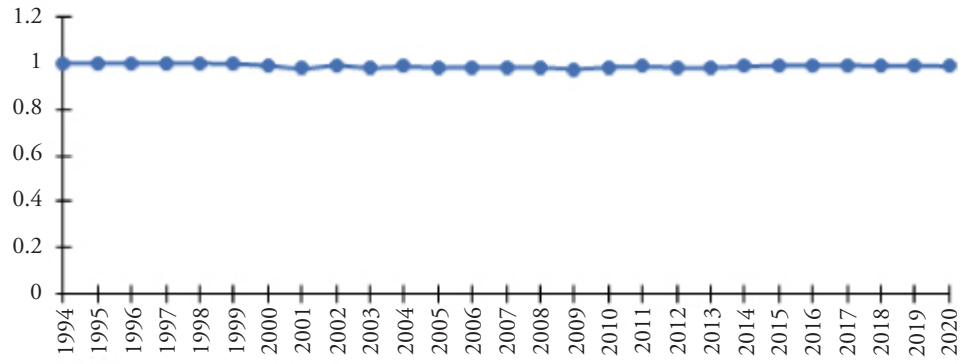
Year	Relative trade balance	Tradability index	Commercial dependency ratio	Export openness index	Export ratio
1994	0.999968198	0.126782825	2.01606E-06	0.126784841	0.112519324
1995	1	0.108827323	0	0.108827323	0.098146321
1996	0.999757463	0.160844811	1.95102E-05	0.160864321	0.138575217
1997	0.99935893	0.142325001	4.56494E-05	0.14237065	0.124632351
1998	0.999732638	0.165603515	2.21439E-05	0.165625659	0.142094337
1999	0.9983641	0.156239294	0.000128005	0.156367299	0.135237836
2000	0.990307475	0.152023185	0.000743955	0.15276714	0.132607696
2001	0.976922022	0.138804577	0.001639501	0.140444077	0.123325881
2002	0.989886491	0.145613917	0.000743857	0.146357774	0.127754885
2003	0.979465593	0.186424598	0.001954187	0.188378786	0.158778557
2004	0.985564121	0.154854761	0.001134104	0.155988865	0.135072279

Table 2. Continuation.

Año	Balanza comercial relativa	Índice de transabilidad	Coeficiente de dependencia comercial	Índice de grado de apertura exportadora	Coeficiente de exportación
2005	0.980349688	0.164513164	0.001648766	0.16616193	0.142687893
2006	0.982900003	0.153137369	0.001332103	0.154469472	0.133955829
2007	0.981852917	0.165903475	0.001533154	0.167436629	0.143611056
2008	0.982401684	0.150138605	0.001344759	0.151483363	0.13170879
2009	0.974688594	0.179477206	0.002330396	0.181807602	0.154142531
2010	0.983433334	0.200845356	0.001691695	0.202537051	0.168662059
2011	0.986360515	0.228478938	0.001579714	0.230058652	0.187271141
2012	0.980540677	0.25142628	0.00249484	0.253921121	0.202905377
2013	0.980631142	0.263889556	0.002606097	0.266495653	0.210853592
2014	0.986005595	0.247023839	0.001753008	0.248776847	0.199496465
2015	0.990454895	0.22791987	0.001098242	0.229018112	0.186509004
2016	0.990471109	0.241704719	0.001162668	0.242867387	0.195591902
2017	0.991277609	0.28460596	0.001252144	0.285858104	0.222525905
2018	0.988202651	0.266732562	0.001592152	0.268324713	0.21182428
2019	0.990649638	0.245300235	0.001157647	0.246457882	0.197910412
2020	0.986979094	0.264130671	0.001742297	0.265872967	0.210320795

Source: self elaborated with data from SIAVI and FAOSTAT, 2021.

The results obtained for the relative trade balance index were similar to those from Pat-Fernández *et al*. (2017), who analyzed the value of the net trade balance and the flow of exports from Mexico during the period 2000-2013, obtaining a resulting average trade balance index of 0.98, concluding that Mexico is a net exporter of mango. For their part, Luquez-Gaitan *et al*. (2022) analyzed the relative trade balance index during the period from 2005 to 2018, where the lowest index was in 2009 with a value of 0.974 and the highest index was in 2017 with 0.991, demonstrating that Mexico has maintained a growing competitive advantage, as the calculated value of the relative trade balance was



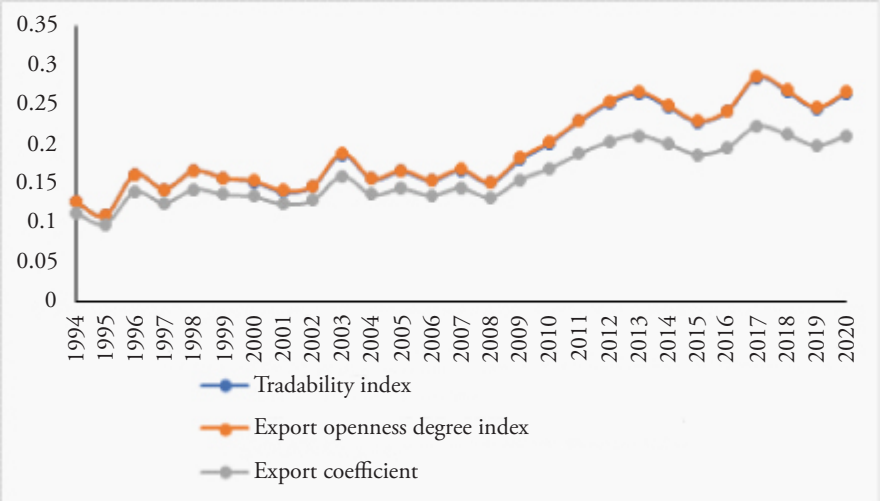
Source: self elaborated with data from FAOSTAT, 2021.
Figure 3. Behavior of the relative trade balance for mango in Mexico.

close to one throughout the study period; concluding that Mexico has a high potential for mango export.

The tradability index was greater than zero (positive) for each of the years of the study period; meaning that mango is a competitive product in Mexico, as there is an excess of national supply that allows it to be exported to international markets. Mango competitiveness shows a tendency for growth throughout the study period; however from 2010 to 2020, it has remained in a range of 0.20 and 0.28, reaching the highest level in 2017 with an index of 0.28 (Table 2 and Figure 4).

These results are similar to those presented by Luquez-Gaitan *et al*. (2022), as an average tradability index of 0.2 during the period from 2005 to 2018 is evident. They indicate that mango production and trade have become increasingly competitive and conclude that mango producers in Mexico have the ability to adapt to new and more efficient forms of production. In addition, these results coincide with those obtained by García-Del Hoyo (2020), where they show that the tradability index obtained values greater than 0.15 during the period from 2005 to 2016 and conclude that mangoes in Mexico are a competitive product in the internal and external market. Thus, the country is considered an exporter of mangos because there is an excess supply.

Mexico ranks fourth in world mango production and is the country with the largest share of exports in the world market. The average index for degree of export openness during the entire study period was 0.19; however, from 2010 to 2020 it had an average index of 0.25, which reflects that the Mexican mango in the international market is very competitive, being capable of supplying national demand and contributing greatly to foreign trade of mangoes (Table 2 and Figure 4).



Source: self elaborated with data from FAOSTAT, 2021.
Figure 4. Behavior of mango trade indicators in Mexico.

The results obtained from this index are similar to those obtained by Pat-Fernández *et al*. (2017), who analyzed the value of the export openness index, identifying an increasing index value from 2006 to 2013, with values similar to the present investigation for the period from 2009 to 2013 which showed an index greater than 0.1, so the increasing trend for the indicator indicates the sector's export vocation.

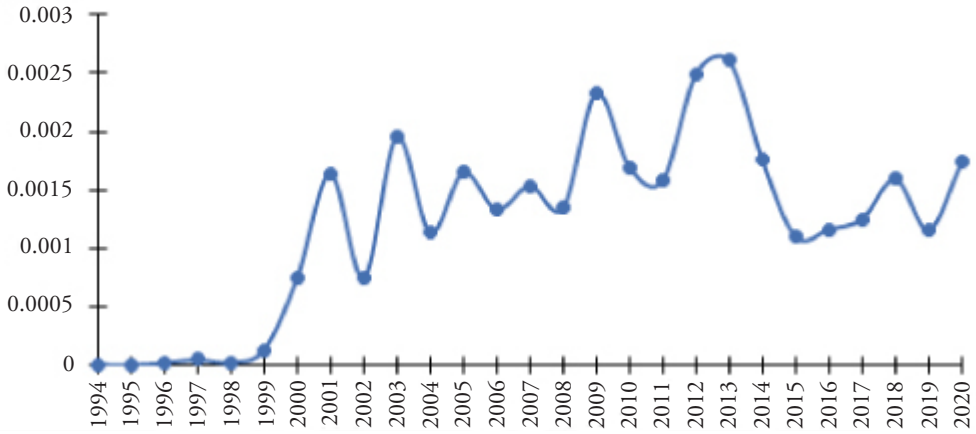
Moreover, Luquez-Gaitan *et al*. (2022), also analyzed the value for the export openness index from 2005 to 2018, obtaining similar results, as in each of the years analyzed, this index is positive, thus affirming that domestic demand in Mexico has been covered throughout the study period and that therefore mangoes should be considered as a strategic product, meaning that their production and export should be promoted.

From 1994 to 2020, Mexico was showing a growing trend for mango export; for the year 1995 the export coefficient represented 9.8% of total production; this being the lowest level throughout the study period. The highest export coefficients were found between 2008 and 2020, with an average of 19.1%, with the year 2017 standing out as having the highest level in export volume, representing 22.2% of total production (Table 2 and Figure 4).

The results obtained for the mango export coefficient are similar to those presented by García-Del Hoyo (2020), where they analyzed the value of its exports during the period 2000 to 2013; obtaining an average export coefficient in Mexico of 0.17, indicating that it exports 17% of national production. Furthermore, Ayyaz *et al*. (2019) show with their results that compared to the principal mango producers in the world, Mexico participates consistently in exportation, meaning that it is competitive because it shows comparative advantage in mango exports.

Mexico is a net exporter of mangoes; the tradability index is greater than zero and shows great capacity to generate net exportable surpluses; in other words, due to its excess national supply, mango is a competitive product to sell in international markets. According to the index for the level of export openness and the export coefficient, in recent decades the Mexican mango has increased its participation in foreign trade, confirming that the product is competitive (Table 2 and Figure 4). The results obtained by Ayala-Garay *et al*. (2009) in the study period from 1990 to 2005, show that Mexico is competitive in exports; likewise, it is apparent that other countries such as Brazil and India have been strengthening their position in the cultivation of mangoes for international markets.

Mango imports in Mexico were small compared to production during the period analyzed from 1994 to 2020, showing a trade dependency coefficient very close to zero; which indicates that Mexico is almost self-sufficient, as it produces enough to cover the country's demand with national production and additionally, this is enough to satisfy part of the international market demand. The average trade dependency coefficient throughout the period was 0.0012 (Table 2 and Figure 5). The results obtained from this coefficient are similar to those presented by Pat-Fernández *et al*. (2017), where the value of the coefficient of commercial dependence on mangoes from 2000 to 2013 was analyzed, identifying that



Source: self elaborated with data from FAOSTAT, 2021.
Figure 5. Trade dependency ratio for mango from Mexico.

the coefficient is close to zero during the study period, indicating mango competitiveness, and that imports are marginal in comparison with production and consumption.

García-Del Hoyo (2020), also obtained similar results when analyzing the coefficient of commercial dependence on mangoes in the period from 2005 to 2016, where the coefficient was close to zero, thus explaining that the dependence of the mango productive sector is low and imports are small compared to production and consumption; therefore, he concludes that mango production in Mexico has a competitive advantage.

CONCLUSIONS

Both production and apparent national consumption of mango behaved in a similar way during the study period; similarly, production exceeded consumption, which reflects the existence of exportable production surpluses. Moreover, the trade balance for mangoes has been positive, which means that enough is produced to supply the domestic market and furthermore, it has the capacity to sell products abroad. Mango imports have been increasing, but they do not play a significant role in terms of the trade balance of mangoes in Mexico.

The relative trade balance index indicates that imports are marginal in relation to exports, so the relative trade balance is close to one, and there is competitive advantage in mango production and exports, reflected in the fact that domestic production is capable to satisfying national demand and contributing to international demand. Likewise, the tradability index, the index for the extent of export openness and the export coefficient reflect that the Mexican mango is competitive in international markets, as there is an excess supply of mangoes in Mexico that has enabled increasing participation of this product in foreign trade.

Regarding the trade dependency index, which is very close to zero; this indicates that imports are small compared to production and consumption; therefore, Mexico produces

enough to satisfy domestic demand, meaning it is almost self-sufficient in mango production and also has the capacity to export.

In general, the mango trade variables in Mexico have shown increases, generating a positive trade balance; meaning more mangoes are exported than imported. This means that the country is capable of supplying domestic demand and, in addition, selling products abroad. The positive growth rates of the trade variables and the positive competitiveness indices reflect that mangoes are a competitive product, which is expanding.

REFERENCES

Avendaño-Ruiz BD. 2008. Globalización y competitividad en el sector hortofrutícola: México, el gran perdedor. El cotidiano. Agricultura y mercado. pp. 91-98.

Ayala-Garay AV, Almaguer-Vargas G, De la Trinidad-Pérez D, Caamal-Cauich I, Rendón R. 2009. Competitividad de la producción de mango (Mangifera indica L.) en Michoacán. Revista Chapingo. Serie horticultura, 15(2), 133-140.

Ayyaz S, Bonney L, Akmal N. 2019. Competitiveness in mango trade: a comparative analysis between pakistan andother mango exporting nations. International Journal of Food and Agricultural Economics (IJFAEC), 7 (1128-2019-4185), 341-349.

Caamal-Cauich I, Pat-Fernández VG, García-Rodríguez JF, Caamal-Pat ZH. 2019. Tasas de crecimiento e índices de competitividad del comercio exterior del mango mexicano. En Algoritmos, estrategias y modelos en las aplicaciones de métodos cuantitativos. Tomo II. Editorial Académica Española. 293-310.

Contreras-Castillo JM. 1999. La competitividad de las exportaciones mexicanas de aguacate: un análisis cuantitativo. Revista Chapingo Serie horticultura. 1(5), 393-400.

Cruz-López DF, Caamal-Cauich I, Pat-Fernández VG, Gómez- Gómez AA, Espinoza-Torres LE. 2020. Posicionamiento internacional del aguacate (Persea americana) producido en México. Revista Mexicana de Agronegocios, 1(47), 561-571.

Dornbusch R. 1993. La macroeconomía de una economía abierta. 2da. Ed. Basic Books Inc. Barcelona, España. 307 p.

FAO (Organización de las Naciones Unidas para la Alimentación y la Agricultura). 2020. Las principales frutas tropicales (Análisis del mercado 2018). Roma. Consultado el 12 de junio 2021, disponible en https://www.fao.org/3/ca5692es/CA5692ES.pdf

FAOSTAT (Food and Agriculture Organization of the United Nations Statistics). 2021. Base de datos estadísticos de la FAOSTAT. Consultado en julio de 2021, disponible en http://www.fao.org/faostat/es/#home

Fernández DG. 2013. Indicadores de Comercio Exterior y Dinamismo Comercial Aplicación para Uruguay en el período 1997 al 2012. Banco Central de Uruguay, Uruguay. Consultado el 18 de julio 2021, disponible en http://fcea.edu.uy/Jornadas_Academicas/2013/file/ECONOMIA/Indicadores%20CE_fernandez_2013.pdf

García R. 1995. Metodología para elaborar perfiles de competitividad del sector agroalimentario. Documento de trabajo, IICA. Proyecto Multinacional. (Apoyo al Comercio y a la Integración en el Área Andina). Caracas, Venezuela.

García-Del Hoyo JJ. 2020. Anales de economía aplicada (2018): economía del transporte y logística portuaria, 215. Servicio de publicaciones de la Universidad de Huelva. PP. 182-184.

López JF. 2019. Tasa de crecimiento. Economipedia. Fecha de publicación: 15 de noviembre de 2019. Consultado el 12 de julio de 2021, disponible en https://economipedia.com/definiciones/tasa-de-crecimiento.html

Luquez-Gaitan CE, Gómez-Gómez AA, Hernández-Mendoza N. 2022. International positioning of Mexican mango, analysis of foreign trade competitiveness indices from 2005 to 2018. Agro Productividad, 15(4). April. 2022, 33-40. Consultado el 23 de septiembre de 2022, disponible en https://pdfs.semanticscholar.org/1736/0183b1a118d84b045cf479e14e001aad0c96.pdf

Mankiw NG. 2020. Los flujos internacionales de capitales y la balanza comercial. G. Mankiw, Macroeconomía. pp: 219-220.

Moreno-Sáenz LI, González-Andrade S, Matus-Gardea JA. 2016. Dependencia de México a las importaciones de maíz en la era del TLCAN. Revista Mexicana de Ciencias Agrícolas, 7(1), 115-126.

Padilla R. 2006. Instrumento de medición de la competitividad. México. Cepal. Consultado el 15 de agosto de 2021, disponible en http://www.competitividad.org.do/wp-content/uploads/2009/01/2.1Indicadores decompetitividad1.pdf

Pat-Fernández VG, Caamal-Cauich I, Caamal-Pat ZH. 2017. Comportamiento y competitividad del mango de México en el mercado mundial. Ciencias Sociales: Economía y Humanidades Handbook T-III. Pérez, F.

Pérez-Soto CA, Bermúdez-Acosta MA. 2012. Índices de competitividad internacional. Observatorio de la Economía Latinoamericana, 170.

Ramírez-Padrón LC, Caamal-Cauich I, Pat-Fernández VG, Martínez-Luis D. 2016. Índices de competitividad de la fresa (Fragaria vesca L.) de México en el mercado mundial. Agroproductividad: 9(5). Fecha de publicación: mayo de 2016. Consultado el 23 de julio de 2021, disponible en https://revista-agroproductividad.org/index.php/agroproductividad/article/view/756/622

Ramón-Canul L, Figueroa-Rodríguez K, Arévalo-Galarza MLC, Ávila-Reséndiz C, Soto-Estrada A. 2016. Competitividad en la comercialización de mango (Mangifera indica L.) de México. AGRO. Fecha de publicación: mayo de 2016. Consultado el 23 de julio de 2021, disponible en https://www.colpos.mx/wb_pdf/Veracruz/2016/2016_%2027.pdf

SIAP (Servicio de Información Agroalimentaria y Pesquera). 2021. Base de datos estadísticos de la SIAP. Consultado en mayo de 2021, disponible en https://nube.siap.gob.mx/cierreagricola/

SIAVI (Sistema de Información Arancelaria Vía Internet). 2021. Base de datos estadísticos de la SIAVI. Consultado en julio de 2021, disponible en http://www.economia-snci.gob.mx/

Velín M, Medina P. 2011. Cálculo y análisis de indicadores sectoriales de comercio exterior para el caso ecuatoriano. En Analítika, 2(1). INEC, Ecuador. Consultado el 25 de julio de 2021 disponible en http://repositorio.cedia.org.ec/bitstream/123456789/632/1/Calculo%20y%20analisis%20de%20indicadores%20sectoriales%20de%20comerio%20exterior.pdf.