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Article

Indicators of competitiveness of Mexican mango exports in the world market

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Abstract

Mango is one of the most widely accepted fruits worldwide; in 2020, Mexico ranked as the fourth largest producer, with around 3.91% of world production, and as the largest exporter, supplying 18.95% of the international market and 95.37% of the USA. market, where mango exports are one of the most competitive activities, which generates an important source of income and foreign exchange. The aim of this work was to analyze the behavior and competitiveness of the Mexican mango trade in the world market in order to identify its competitive position and generate alternatives that have a positive impact on exports. It was carried out by calculating growth rates and trade competitiveness indicators for the period from 1994 to 2020, with data on production and trade. The indicators obtained were positive, the relative trade balance averaged 0.9873, indicating that Mexico is a net exporter and has competitive advantages; the tradability indicator was 0.1701, being greater than zero, it shows that there is an excess of exportable supply, so it is a competitive product in the domestic and foreign markets; the trade dependence coefficient was 0.001, reflecting little trade dependence and food self-sufficiency; and the degree of export openness was 0.1711, which indicated exportable surpluses. The indicators obtained showed that mango production was expanding, has an export specialization, and is competitive in the world market.

Keywords:

competitiveness, exports, market and production, trade.

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Introduction

The agricultural sector represents a fundamental pillar for Mexico's economy and development (Jaramillo *et al*., 2018). It has sufficient and necessary conditions to become one of the leading countries in fruit exports (Morales, 2020). Mexican fruit growing is one of the activities within the agricultural sector that presented a surplus in its trade balance; in recent years, the export volume was 4.5 times higher than that imported from 1961 to 2018 (FAO, 2020). Fruit production contributed 8.83% of Mexico's agricultural GDP, mango contributes about 0.87% because more than 20% of its production is destined for export (SADER, 2020).

In 2020, world mango production was 60.65 million tons, Mexico ranked as the fourth largest producer with 2.37 million tons, contributing around 3.91% of world production (FAOSTAT, 2022). Likewise, it was the largest exporter with 421 637 t, supplying around 18.95% of the world market and 95.37% of the USA market (SIAVI, 2022); this country was the main importer with 378 778 t, which represented 90% of total trade (COMTRADE, 2022).

On the other hand, in Mexico, the main producing states were Sinaloa, Guerrero, Nayarit, Chiapas, and Oaxaca, which together contributed around 76.16% of the total volume of mangoes produced in Mexico (SIACON, 2022). The above data place Mexico as a leading country in the international mango trade; however, it has a high percentage of concentration in the United States of America market, so it is necessary to know the degree of competitiveness of exports in the world market.

Since its origins, competitiveness has been linked to international trade, understood as the ability of a given country to successfully insert itself into the world market (Quintero *et al*., 2020). Competitiveness is defined as the actual situation of a product in an international market, which can be distorted both by market failures and by the intervention of governments, and it refers to the level of private profitability of that product and its ability to participate successfully in that market (Contreras, 2000).

Mexico has particular characteristics that have generated favorable conditions for the production and export of fruit and vegetable products, such as climate, natural resources, availability of labor, geographical proximity to the USA market (considered the largest in the world), and the use of technological innovations (Montaño *et al*., 2021).

Competitiveness can be analyzed in two ways: 1) through the measurement of *ex-ante* indicators based on productivity, factor endowment, transportation costs, trade, and exchange rate data and 2) through the measurement of *ex-post* indicators that consider information from the past (Avendaño *et al*., 2023). The second is the one that was used to carry out statistical calculations of competitiveness indicators, such as trade balance, apparent national consumption, relative trade balance, tradability indicator, trade dependence coefficient, and degree of export openness.

This research aimed to analyze the competitive level of mango exports in the world market through the calculation of competitiveness indicators by considering data from 1994 to 2020 to identify their competitive position and thus generate alternatives that have a positive impact on exports. The hypothesis stated that the growth rates of the variables and indicators of trade competitiveness are positive, which reflects expansion and competitiveness of the mango trade.

Materials and methods

Information and variables

A database with variables of production and trade from 1994 to 2020 in terms of volume was organized using Microsoft Excel spreadsheets; the information used was obtained from the statistics of the Food and Agriculture Organization of the United Nations (FAOSTAT), the United Nations Commodity Trade Statistics Database (COMTRADE), and the Agrifood Information Consultation System (SIACON), for its acronym in Spanish.

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The behavior of the indicators is measured with the growth rate, which reflected the proportion in which a variable increased or decreased from one period to another, the decrease or expansion of a product was shown; when the growth rates are positive, it means that the product is expanding and when the growth rates are negative, it means that the product decreases (Caamal *et al*., 2016). The competitiveness indicators were estimated with information on production, imports, and exports from 1994 to 2020.

Calculation procedures

For the research, the growth rates of the production and trade variables were calculated to later calculate the indicators of competitiveness in the world market, which are indirect indicators since they do not identify the determining factors of it; these indicators demonstrate the capacity of a certain product to penetrate or maintain itself in international markets in a space of time, through the use of production, export, and import values (Chica *et al*., 2016). In order to determine the behavior of the variables of production, trade, and competitiveness of mango, the following concepts and formulas were used.

Growth rate by period

It refers to the percentage increase that a given value has in a period of any variable (Caamal *et al*., 2016). It was calculated as follows:

$$GR=\left(\left(\frac{FV}{IV}\right)-1\right)*100$$

Where: GR= growth rate (in percentage); FV= final value (in the last year) and VI= initial value (in year 1).

Average annual growth rate

It links the average annual percentage increase that a value has over a period of time, considering a base year of any variable (Caamal *et al*., 2016). It is calculated as follows:

$$AAGR=\left(\left(\frac{FV}{IV}\right)^{1/n}-1\right)*100$$

Where: AAGR= average annual growth rate (in percentage); FV= final value (in the last year); IV= initial value (in year 1) and n= number of years.

Trade balance

This valuation indicates the balance of trade in a given period and is the expression of the net trade flow in a country's trade. It can be a surplus when exports exceed imports and a deficit when exports are lower than imports and do not cover the total consumption of goods (Pat and Caamal, 2021). It is important for analysis as it can be determined in which products and with which partners there is a competitive disadvantage (Gómez and Valencia, 2023). It was calculated as follows:

$$TB=X-M$$

Where: TB= trade balance; X= exports and M= imports.

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Apparent national consumption

This concept expresses the availability of the product consumed by a region, country, or countries in a given period of time, estimated based on domestic production plus the trade balance (Ramírez *et al*., 2016). An apparent domestic consumption with an increasing trend in a given period indicates that the country has greater availability of the product while a decreasing trend indicates that there is less production and imports or greater exports, resulting in a decrease in consumption (Cruz *et al*., 2022). It was calculated as follows:

$$ANC=Y+M-X$$

Where: ANC= apparent national consumption; Y= national production; M= imports and X= exports.

Relative trade balance

The relative trade balance measures the relationship between the balance of trade and the total sum of a country's exports and imports (Ramírez *et al*., 2016). This indicator allows us to know the degree of existing comparative advantages or disadvantage and compare its evolution over time; it can be interpreted as an index of competitive advantage, which takes positive values when a country exports more than it imports. In addition, it made it possible to identify net exporting countries for the supply of products or to discard them as possible markets or to identify net importing countries, which represent possible potential markets (Pat and Caamal, 2021). It is calculated as follows:

$$RTB_{ij}=\frac{(X_{ij}-M_{ij})}{(X_{ij}+M_{ij})}$$

Where: RTB_{ij}= relative trade balance of product i of country j; X_{ij}= exports of product i by country j to the world market; M_{ij}= imports of product i by country j from the world market.

Tradability indicator

This consideration reflects the relationship between the value of the net trade balance and apparent national consumption; that is, the share of exports or imports in a country's consumption. It was used to monitor the gain or loss of the export capacity of the country that produces the good; it is also important since it allows measuring the capacity to generate net exportable surpluses in relation to domestic consumption; if the indicator is positive, there is an excess supply and therefore, there is the capacity to generate net exportable balances (Pat *et al*., 2014).

It was calculated as follows:

$$T_{ij}=\frac{(X_{ij}-M_{ij})}{(Y_{ij}+M_{ij}-X_{ij})}$$

Where: T_{ij}= tradability indicator of product i of country j; X_{ij}= exports of product i by country j to the world market; M_{ij}= imports of product i by country j from the world market and Y_{ij}= domestic production of product i by country j.

Trade dependence coefficient

This criterion indicates the measure of international competition for domestic demand. The higher the coefficient, the greater the dependence of domestic consumption on imports; on the other hand, if it is lower, it will indicate that the country has a greater capacity to supply its domestic demand with national production. If the indicator ranges between 0 and 1, it means that as the indicator approaches zero, the competitiveness of the sector or production chain is greater, and that imports may become zero, which leads to allocating part of the national production to exports (Pat et al., 2017).

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It was calculated as follows:

$$TDC_{ij}=\frac{M_{ij}}{\left(Y_{ij}+M_{ij}-X_{ij}\right)}.$$

Where: TDC_{ij}= degree of trade dependence of product i in country j; M_{ij}= imports of product i by country j; X_{ij}= exports of product i by country j and Y_{ij}= domestic production of product i by country j.

Degree of export openness

This concept refers to the share of exports of a product in apparent consumption and thus refers to the degree of insertion in a specific market, the higher the value of the index, the greater the competitiveness (Cruz *et al*., 2020). This indicator can range from zero to greater than one, the higher the value, the greater the competitiveness. An index close to zero indicates that the sector is less competitive since a large part of production is oriented to the domestic market while an index of one or greater than one means that enough is produced to cover domestic demand and that it can compete in foreign trade through strong participation in exports (Pat *et al*., 2023). It is calculated as follows:

$$DEO_{ij}=\frac{X_{ij}}{\left(Y_{ij}+M_{ij}-X_{ij}\right)}$$

Where: DEO_{ij}= degree of export openness of product i of country j; X_{ij}= exports of product i by country j; M_{ij}= imports of product i by country j and Y_{ij}= domestic production of product i by country j.

Results and discussion

Production, export, and trade balance

In 2020, world mango production was 60.65 million tons. The main producing countries were India with 24.67 million tons, China with 7.76, Indonesia with 3.61, Mexico with 2.37, and Pakistan with 2.34, together they concentrated about 67.23% of the total production. Mexico ranked as the fourth largest producer, contributing 3.91% of the total volume. The total production of mangoes in the world increased by around 58.19%, from 23.49 million tons in 1994 to 60.65 million tons produced in 2020, with an average annual growth rate of 3.64% (FAOSTAT, 2022).

Mango production in Mexico increased by 52.89%, from 1 117 853 t in 1994 to 2 373 111 t in 2020 (Table 1), which represented an average annual growth rate of 3.35% (SIACON, 2022). The growth rates of mango production in Mexico are positive, indicating that the product is expanding and competitive.

Table 1. Production and trade variables of mangoes produced in Mexico.

Period	Production (t)	Exports (t)	Imports (t)	Trade balance	Apparent consumption
1994-2000	1 384 406.43	206 390.86	180.43	206 210.43	1 178 196
2001-2005	1 543 016.4	205 586.76	1 797.2	203 789.56	1 339 226.84
2006-2010	1 763 082.4	240 492.84	2 290.6	246 134.17	1 527 653.5
2011-2015	1 862 868.26	274 254.18	2 366.82	271 887.36	1 590 980.9
2016-2020	2 285 843.61	348 238	1 873.9	346 364.1	1 939 479.5

(FAOSTAT-COMTRADE-SIACON, 2022).

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In 2020, mango exports worldwide were 2.28 million tons; the main exporting countries in terms of volume are Mexico with 421 637 t, Thailand with 391 279, Brazil with 243 462, the Netherlands with 238 737, and Peru with 237 367, which contributed 68.86% of total exports. Mexico consolidates its position as the main exporter, supplying 18.95% of the world market. World mango exports increased by 88.31%, from 267 538 tons exported in 1994 to 2 286 872 tons exported in 2020 (Table 2), with an average annual growth rate of 10.03% (COMTRADE, 2022).

Table 2. Behavior of Mexican and world mango exports.

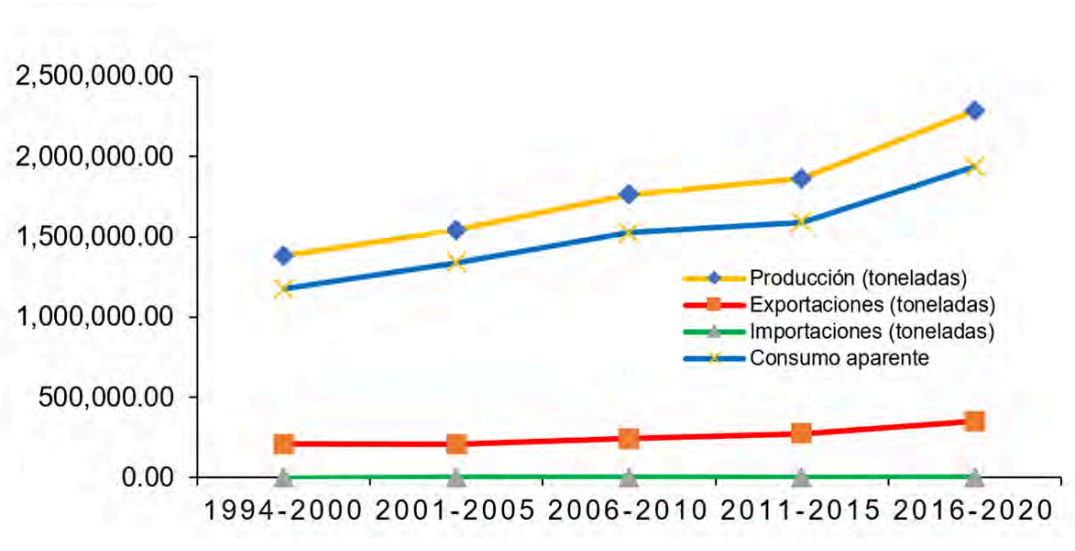
Period	Mexico's exports (t)	Thailand's exports (t)	Brazil's exports (t)	Netherlands' exports (t)	Peru's exports (t)	World exports (t)
1994-2000	174 763	7 614	33 385	23 597	11 618	428 224
2001-2005	202 518	12 454	112 228	50 438	43 844	798 449
2006-2010	240 496	84 533	119 929	86 595	82 775	1 147 934
2011-2015	308 806	213 400	133 130	111 509	120 308	1 498 374
2016-2020	406 952	314 015	192 853	200 729	192 237	2 066 344
Total	1 333 536	632 015	591 524	472 868	450 782	5 939 326

(FAOSTAT-COMTRADE, 2022).

In the national context, Mexico increased its export levels by around 67.51%, going from 136 994 t exported in 1994 to 421 637 t exported in 2020, which represented an average annual growth rate of 8.83% (COMTRADE, 2022). The growth rates of Mexican mango exports are positive, indicating that the product is competitive in the world market.

The trade balance is in surplus, apparent consumption has evolved positively and is below production since there is a significant gap between the two variables (Figure 1), which indicates the existence of exportable surpluses and therefore, there is greater availability of the product.

Figure 1. Behavior of production and apparent consumption of mangoes in Mexico. with data from Table 1.



From 1994 to 2020, Mexico has imported an average of 1 589 t of mangoes, which represents 0.63% of the amount exported in that same period, import levels have had an average annual growth rate of -1.27%, which reflected that mango imports are not relevant and the production is enough to supply the domestic and foreign markets (COMTRADE, 2022).

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Apparent national consumption (ANC) shows the total amount of product available to be consumed over a certain period of time. During the analysis period, the ANC increased by 49.78%, from 980 860 t in 1994 to 1 952 877 t in 2020. This represented an average annual growth of 3.35%, indicating that Mexico has greater availability of the product to meet domestic demand and allocate a high proportion to the foreign market.

Competitiveness indicators

In the period of analysis, the relative trade balance presents values close to one, with an average of 0.9873, which reflects the importance of exports in total trade, indicating that Mexico is a competitive country in the world market as its high export capacity stands out. The tradability index averaged 0.1701, which indicates that Mexican exports represented 17.01% of domestic consumption (Table 3), so it was considered a net exporter of mango and that there is an excess supply of the product, thus managing to satisfy the national and international markets because its production is sufficient and imports are small (Quintero *et al*., 2020).

Table 3. Trade competitiveness indicators of mangoes produced in Mexico, 1994-2020.

Period	RTB (X-M) /(X+M)	T (X-M) /(Y+M-X)	TDC (M)/(Y+M-X)	DEO (X)/(Y+M-X)
1994-2000	0.9983	0.1763	0.0001	0.1765
2001-2005	0.9826	0.1537	0.0014	0.1551
2006-2010	0.9819	0.1637	0.0015	0.1652
2011-2015	0.9827	0.1755	0.0015	0.1771
2016-2020	0.9875	0.183	0.001	0.1839
Total average	0.9873	0.1701	0.001	0.1711

RTB= relative trade balance; T= tradability index; TDC= trade dependence coefficient; DEO= degree of export openness; X= exports; M= imports; Y= production. With data from FAOSTAT, COMTRADE, SIACON (2022).

The degree of export openness (DEO) measures only the share of exports in apparent consumption, an index close to zero indicates that the sector is less competitive since a large part of production is oriented to the domestic market (Pat *et al*., 2014). Likewise, Espinal *et al*. (2005) point out that, if over a period of several years the DEO approaches zero, it indicates that the competitiveness of a country is decreasing compared to other countries.

Despite the fact that Mexico is the fourth largest producer and the main exporter of mangoes, during the period under analysis, it has an average DEO index of 0.1711 (Table 3). Although it is true that the indicator obtained is not so high, the trend in recent years has been growing (Figure 2) and it can be argued that the product is competitive in the world market, where the country is positioned as a net exporter and that the sector may have an export vocation.

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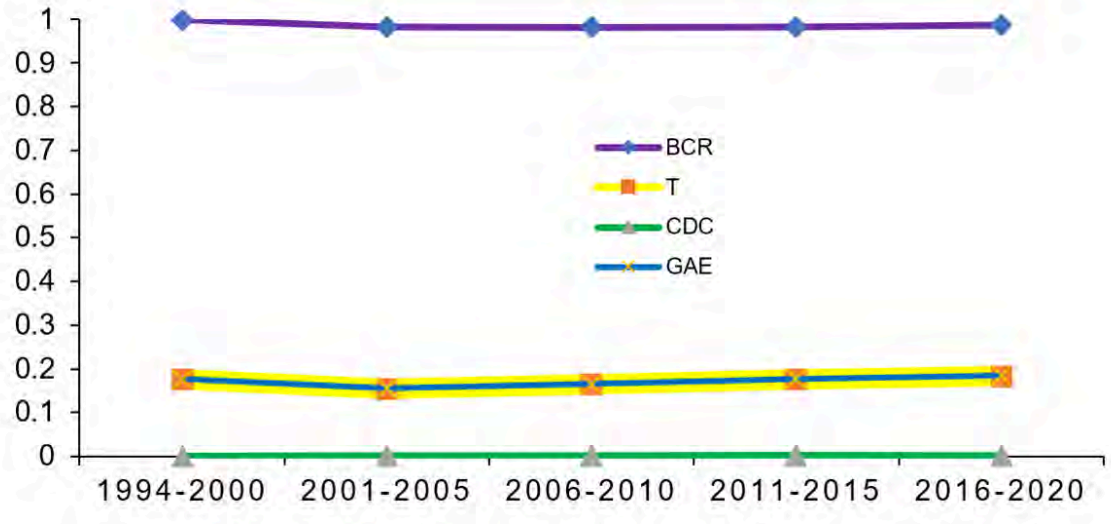
Figure 2. Behavior of trade competitiveness indicators from 1994-2020. With data from Table 3.



The trade dependence coefficient (TDC) is one of the most important indicators as it allows us to measure international competition for domestic demand. The higher the coefficient, the greater the dependence of domestic consumption on imports, and the lower the coefficient, the greater the capacity of the country to supply its domestic demand with domestic production (Pat *et al*., 2014). The calculated indicator has an average value of 0.001 (Table 3), which meant that Mexico has competitive advantages in mango exports, indicating that as TDC values approach zero (Figure 2), competitiveness is greater and imports made by the country may become zero (Ramírez *et al*., 2016).

In recent years, the behavior of mango exports in the world market has had a positive trend (Figure 1), which indicates the presence of competitive and comparative advantages in this activity; this is directly related to the results obtained in the calculation of the indicators, reflecting a highly competitive level because a large part of the production is destined for exports. In general terms, Mexican mango exports have increased; nonetheless, Yosa and Regalado (2021) mention that the growth in competitiveness also depends on technological, climatic, labor, and even political aspects.

For their part, Sánchez *et al*. (2019) mention that, although Mexico is one of the main suppliers of fruit to the U.S. market, the participation of other competing countries causes its participation to decrease. Bustamante *et al*. (2020) pointed out that, in addition to taking advantage of competitive advantages, the appropriate techniques must be provided to improve exports, and this would develop the possibility of increasing market participation, which would generate growth in competitiveness, which in turn will maintain a positive balance in the trade balance.

Conclusions

Competitiveness in the world market depends to a large extent on the level of imports and exports that allow it to appear in the international scenario; Mexico is a leading country in terms of mango production and export. The competitiveness indicators calculated demonstrate Mexico's high potential in mango production and trade because the indices are positive; the relative trade balance shows the importance of exports compared to imports, so Mexico is considered to be a net exporter and has a competitive advantage; the tradability indicator reflected the surplus in consumption, so the country has the capacity to satisfy the domestic and foreign markets; the trade dependence coefficient indicates that the competitiveness of exports is very high because imports are relatively small; and the degree of export openness denotes that there are exportable surpluses.

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Enough is produced to cover domestic demand and compete in the foreign market, so it was concluded that Mexico is a competitive country in the world mango market. In order to maintain a competitive position in the world market, it is advisable to diversify export destinations by taking advantage of comparative and competitive advantages and trade agreements with other countries and to generate alternatives that allow increasing the added value of the product.

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