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Analysis of the Normalized Revealed Comparative Advantage Index for Mezcal, Tequila, and Rum in Mexico.

Análisis del índice de la ventaja comparativa revelada normalizada para el mezcal, tequila y ron en México.

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ABSTRACT

Este estudio analizó la dinámica del patrón de ventajas comparativas de exportación para un grupo de tres bebidas alcohólicas -mezcal, tequila y ron-, durante el periodo de 1994 hasta el 2020. Se desarrolló un Índice de Ventaja Comparativa Revelada Normaliza a través de diferentes bases de datos, donde se publicaron las exportaciones que tiene México a nivel mundial en estos productos. Los resultados mostraron una fuerte correlación de competitividad en mezcal y tequila, con un valor del índice de ventaja comparativa mayor a cero. Además, se observó una tendencia alcista de largo plazo. En cambio, el ron mostró un valor negativo (no competitivo) en el índice. Se concluye que el método utilizado permitió hacer un diagnóstico sobre las bebidas alcohólicas según las tendencias de consumo, se identificaron los productos que tienen mayor relevancia en el mercado internacional y cuales se encuentran en vulnerabilidad.

KEY WORDS: Ventajas comparativas, exportación, mercado internacional.

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RESUMEN

Este estudio analizó la dinámica del patrón de ventajas comparativas de exportación para un grupo de tres bebidas alcohólicas -mezcal, tequila y ron-, durante el periodo de 1994 hasta el 2020. Se desarrolló un Índice de Ventaja Comparativa Revelada Normaliza a través de diferentes bases de datos, donde se publicaron las exportaciones que tiene México a nivel mundial en estos productos. Los resultados mostraron una fuerte correlación de competitividad en mezcal y tequila, con un valor del índice de ventaja comparativa mayor a cero. Además, se observó una tendencia alcista de largo plazo. En cambio, el ron mostró un valor negativo (no competitivo) en el índice. Se concluye que el método utilizado permitió hacer un diagnóstico sobre las bebidas alcohólicas según las tendencias de consumo, se identificaron los productos que tienen mayor relevancia en el mercado internacional y cuales se encuentran en vulnerabilidad.

PALABRAS CLAVE: Ventajas comparativas, exportación, mercado internacional.

Introduction

The origin of alcoholic beverages is embedded in the development of human beings, it has been present since ancient times and currently, a progressive increase in consumption is observed for various reasons (Amezcua & Palacios, 2014; Ferrat *et al.,* 2019). In the case of Mexico, in 2020 it became the sixth largest producer worldwide, which represented economic opportunities reflected in employment and a contribution to the Gross Domestic Product (GDP) of 5 %. During 2022, the alcoholic beverages with the highest production were: beer (76 %), agave distillates (21 %), grape and rum-based beverages (2 %), and sugarcane distillates (1 %) (ProMéxico, 2022).

Tequila and mezcal are Mexican products protected by the Designations of Origin (DO), which indicates that a product has a distinctive sign of a region, so its quality depends on the geographical environment and the human factor that produces it. The DO indicates that the product has its own characteristics and specific qualities that distinguish it (Instituto Mexicano de la Propiedad Industrial [IMPI], 2016). In the case of tequila, it had the appellation in 1974 (Diario Oficial de la Federación [DOF], 2000) and mezcal in 1994 (IMPI &DOF, 2012).

Rum, on the other hand, has substantially improved its sales value; in January 2022 it reported an increase of 179.9 % compared to the same month of the previous year (Saldívar, 2022).

Mezcal is an alcoholic beverage produced from one or several agaves, except for the one used to make tequila. There are mainly 14 outstanding species for its production: *Agave angustifolia Haw, Agave americana, and Agave cupreata*, among others. The production process

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starts with the boiling of the agave, followed by the maceration and crushing of the cooked pineapple, fermentation, and distillation. The production process in tequila is segmented into the same principles (Hernández, 2018). Unlike the first two, rum is based on the fermentation and distillation of sugarcane juice (Vingtier, 2018).

Hence, the sugar agricultural industry in Mexico is one of the most important productive sectors, as it contributes to the generation of jobs, especially in rural areas (Aguilar-Rivera *et al.,* 2014). For this reason, some specialists have remarked on the importance of diversifying sugarcane for different uses to perfect its utilization. Currently, surpluses are exported to the world market with prices that represent losses in the sector (Secretaria de Agricultura y Desarrollo Rural [SADER] & Comité Nacional para el Desarrollo Sustentable de la Caña de Azúcar [CONADESUCA], 2021), under these assumptions, rum production represents an activity that may improve and get diversification since it is exported to different countries (Fernández-Peña, 2020), so it is expected to achieve a market niche that currently has not been fully exploited.

On the other hand, the economic importance that mezcal and tequila represent for the country is demonstrated by the argument that these goods are a fundamental part of the products with a positive balance and that contribute to the surplus of the agri-food balance. They are among the exports that contribute the most value to the surplus (US$380 million) (SADER & Servicio de Información Agroalimentaria y Pesquera [SIAP], 2021). In the case of rum, 12.6 million dollars were exported in 2019 and for 2020 it obtained an amount of 8.8 million dollars (Sistema de Información Arancelaria Vía Internet [SIAVI], 2021).

The data presented, highlight the need for studies that explore the analysis of competitiveness. Also, it has been found that Mexico has market opportunities in the alcoholic beverage industry (CRM, 2018).

A problem that has been identified in this industry and directly related to competitiveness, are the marketing difficulties mainly observed in small producers and originated by complications of isolation, lack of knowledge of certification processes, brand registrations, economic and social problems, among others (Rodríguez-Peralta *et al.,* 2019).

The concept of comparative advantage becomes relevant, functioning to provide an explanation of the specialization pattern of a country in the international trade scenario. In turn, if there are distortions due to market failures or government intervention, it also analyzes the structures and costs of marketing transport (Contreras, 1999). Thus, analyzing trade dynamics becomes essential for the development of comparative advantages which will allow for achieving greater economic growth (Arredondo *et al.,* 2016).

Therefore, this study aimed to analyze the competitiveness of Mexican mezcal, tequila, and rum in the international market using a Normalized Revealed Comparative Advantage (NRCA) index. The analysis contributes to the increase of scientific research on the subject of alcoholic beverages since references are scarce.

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Material y Methods

This study analyzes the evolution of comparative advantage in Mexico over a 26-year period (1994 to 2020) for three alcoholic beverages: mezcal, tequila, and rum. These three distillates have been produced and exported since the implementation of the North American Free Trade Agreement (NAFTA).

Exports of these products were obtained from various databases. In the case of mezcal and tequila, data were obtained from the official website of the Banco de México (2021), as well as from the Statistical Yearbook of Foreign Trade of Mexico (Instituto Nacional de Estadística y Geografía [INEGI], 2021) of the Tariff Information System Via Internet (Sistema de Información Arancelaria Vía Internet [SIAVI], 2021).

For rum, data were obtained from the Statistical Yearbook of Foreign Trade of Mexico (INEGI, 2021). Total export figures for the products analyzed were obtained from the Banco de México Database (2021), while exports registered in all countries can be found on the official page of the International Trade Statistics Database (UN Comtrade, 2022).

Once all these references were available, a database was created and subsequently analyzed, then, estimations were generated in R statistical software version 4.2.2.

Revealed Comparative Advantage Index

The empirical measure of comparative advantage was proposed by Balassa (1965), a pioneer in this kind of study. Since comparative advantage is not directly observable, Balassa (1965) suggested that it could be revealed from trade data. The Balassa index, for a type of product and taking the world market as a reference, has the following expression:

$$RCA_{ji} = \frac{\left[\frac{E_{ji}}{E_j}\right]}{\left[\frac{E_i}{E}\right]} = \frac{\left[\frac{E_{ji}}{E_i}\right]}{\left[\frac{E_j}{E}\right]} \quad \ldots\ldots\ldots\ldots\ldots [1]$$

Where:

RCA_{ji}	Revealed Comparative Advantage index for product $_j$ of country
E_{ji}	Exports of product j from country $_i$
E_j	Exports of product $_j$ from all countries
E_i	Total exports of commodity $_j$ of country itos básicos del país $_i$
E	World exports of all commodities.

E: World exports of all commodities.

The RCA index compares the country i's market share in the export market of product j (E_{ji} / E_j) and its market share in the world export market (E_i/E).

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An RCA_{ji} value above 1 will indicate that the market share of country i in the export market of product j is greater than its share in the world export market and, therefore, country i has a comparative advantage in this product.

An RCA_{ji} value below 1 indicates that country i has a comparative disadvantage in product j.

An RCA_{ji} value equal to 1 indicates that country i has a "neutral" comparative advantage in commodity j (Balassa, 1965).

Normalized Revealed Comparative Advantage Index (NRCA)

Once the RCA was obtained, the method proposed by Yu *et al.* (2009) was used as an alternative method.

Thus, the Normalized Revealed Comparative Advantage (NRCA) Index was used, since this index allows to perform comparisons between products, countries, and over time.

To obtain the NCRV index is necessary to take Balassa's index (1965), specifically, $RCA_{ji} = 1$.

$$RCA_{ji} = \frac{\left[\frac{E_{ji}}{E_j}\right]}{\left[\frac{E_i}{E}\right]} = 1$$

$$\left[\frac{E_{ji}}{E_j}\right] = 1\left[\frac{E_i}{E}\right]$$

$$E_{ji} = \frac{E_i E_j}{E} = \hat{E}_{ji}$$

In the situation of neutral comparative advantage, the export of commodity j(E_{ji}), from country i, would be equal to $\hat{E}_{ji} = \frac{E_i E_j}{E}$.

The real export of product j from country i in the real world, E_{ji}, would normally differ from $\hat{E}_{ji}$; and the difference can be shown as:

$$\Delta E_{ji} = E_{ji} - \hat{E}_{ji} = E_{ji} - \frac{[E_i][E_j]}{E} \qquad [2]$$

Normalizing expression (2) by the size of the world export market (E), the NRCA index is obtained:

$$\Delta E_{ji} = \frac{\Delta E_{ji}}{E} = \frac{E_{ji}}{E} - \frac{[E_i][E_j]}{EE} = \frac{E_{ji}}{E} - \left[\frac{E_i}{E}\right]\left[\frac{E_j}{E}\right] \qquad [3]$$

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The NRCA index measures the degree of deviation (or difference) currently observed exports of product j of country i, with respect to the exports that it would have at the neutral point of its comparative advantage given the size of the world export market.

According to equation 3, the economic interpretation of the NRCA index would be as follows: If $E_{ji} > \hat{E}_{ji}$, then: $NRCA_{ji} > 0$ which indicates that exporting country i has a better comparative advantage in product j.

On the other hand, if $E_{ji} < \hat{E}_{ji}$, implies that $NRCA_{ji} < 0$, which shows that exporting country i has a poor performance in terms of the "average" level for product j, i.e., that it has a comparative disadvantage for that product.

Finally, if $E_{ji} = \hat{E}_{ji}$ this means that $NRCA_{ji} = 0$, in this case, there is no advantage or disadvantage, it simply behaves like the average exporter.

The higher or lower the value of the NRCA index, the greater the comparative disadvantage or disadvantage.

Since comparative advantage is a relative concept, the interpretation of the magnitude of the NRCA index is more meaningful in comparative terms. In this way, if in one product the index is 0.1 and in another, it is 0.5 it means that the comparative advantage of the country in the second product is five times greater than its comparative advantage in the first product (Contreras *et al.,* 2019).

It is found that total world exports (E) in terms of alcoholic beverages are large values compared to Mexican exports of mezcal, tequila, and rum, then, the calculated value of NRCA generally corresponds to a small number. Therefore, to facilitate the presentation of results without changing the economic interpretation, the initial values of each NRCA index were multiplied by a constant of 10 000.

The trend of Comparative Advantage over time.

In brief, to find the time trend of the revealed comparative advantage index for Mexico concerning the world market in the three products, it can be estimated through the following regression model, by ordinary least squares (OLS):

$$VCRNt = \beta 0 + \beta 1t + \beta 2t2 + \varepsilon t \quad \text{.....[4]}$$

Where VCRNt is the normalized revealed comparative advantage index of the mezcal product in period t; β0 is the ordinate to the origin or intercept, β1 and β2 are the coefficients that measure the slope and indicate the trend of the revealed comparative advantage for mezcal, t is time and ε is a random error term.

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If β is not statistically different from zero, it implies that the Mexican revealed comparative advantage (or disadvantage) in product j is stable. Thus, it indicates that in this product the country does not sample statistically significant changes for the period under study.

On the contrary, if β is statistically different from zero, the Mexican revealed comparative advantage (or disadvantage) in product j is unstable.

In particular, if $\beta > 0$ it suggests that Mexico is gaining a revealed comparative advantage in product j, and if $\beta < 0$ it points to Mexico losing the revealed comparative advantage in product j.

Results and discussion

Generally, the main destination of Mexican mezcal and tequila exports was the United States of America (USA). In 2020, mezcal exports amounted to 4 million liters. However, in the period 2012-2020, the total export value of the product in question increased by 603 %.

In line with this, 276 million liters of tequila were exported in 2020, the growth rate registered a 10.5 % between 2003 and 2020.

In the specific case for rum, between 2018 and 2020 exports to the United States decreased by -33 %, going from 3.3 million liters in 2019 to 1.5 million in 2020. Although there were also exports to Puerto Rico between 2011 and 2017, the growth rate was -8.4 %.

Normalized Revealed Comparative Advantage index

Mexico has shown international competitiveness in the mezcal sector, as the value of the NRCA index has been greater than zero during the period analyzed (1994-2020), and appears to have a long-term upward trend (Figure 1).

The NRCA index for the international mezcal market fluctuated between 1994 and 2012, however, it has shown an exponential increase in subsequent years. The growth may correspond to three important factors such as the Denomination of Origin, the Mexican Official Standard 070, and the Consejo Regulador del Mezcal (CRM) (CRM, 2018).

According to the Index, the comparative advantage of mezcal grew slowly. In this regard, the CRM confirmed that there was a slow increase in the commercialization of mezcal after the creation of the DO, and only in 2012 a different policy was planned.

Currently, the promotion of mezcal is based on the fact that it is not only an alcoholic beverage, but it is a liquid culture of Mexico that registers all the cultural and traditional values to give it a higher value (CRM, 2018). Additionally, the export of mezcal may be increased for the product identity that provides the Designations of Origin. In this sense, Moses *et al.* (2018) emphasized that brand value has a significant effect on competitive advantage.

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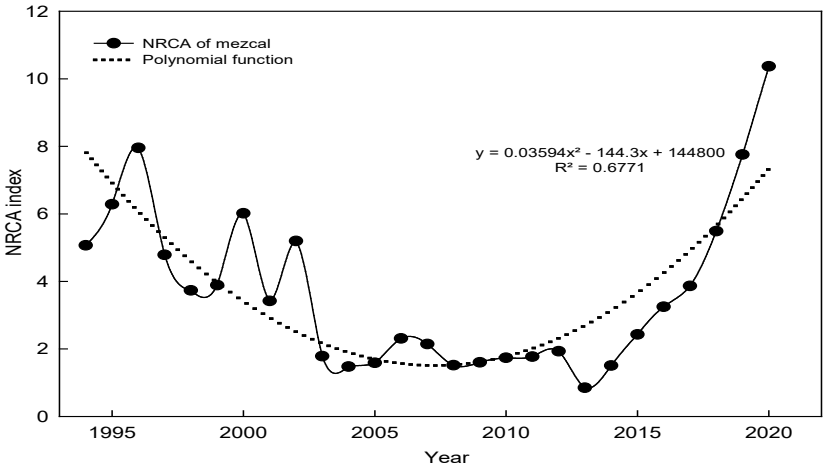

Figure 1. Normalized Revealed Comparative Advantage index of Mexican Mezcal in the international market from 1994 to 2020.

Source: Own elaboration.

Tequila also showed an upward trend, as all its indexes reflected a positive trend in the period studied (NRCA > 0). Besides, it showed higher NRCA values compared to mezcal due to higher volume of exportation (Figure 2).

The NRCA of tequila demonstrated the degree of specialization that the beverage has had over time. In contrast to the situation of mezcal, the comparative advantage indexes of tequila showed a significant increase between 1994 and 2020. Mainly with the entry into force of NAFTA (1994) and the creation of the Tequila Regulatory Council in 1993.

Villa-Flores (2009) describes that the growth and consolidation in the tequila industry occurred mainly in the second half of the 20th century, motivated by the international recognition of the DO by NAFTA. In recent years, its production and distribution in the domestic and international market has grown significantly.

Mexico was not competitive in the rum industry between 2005 and 2020 since the NRCA value was always below zero. Although positive NRCA indices were obtained from 1994 to 1996, and also from 2001 to 2004, the comparative advantage disappeared since 2005 (Figure 3).

Rum, in 2001 and 2002, obtained its highest indexes, but gradually lost competitiveness, increasing its comparative disadvantage. This is perceptible since the value of exports decreased by 30% for the period of 2019 to 2020.

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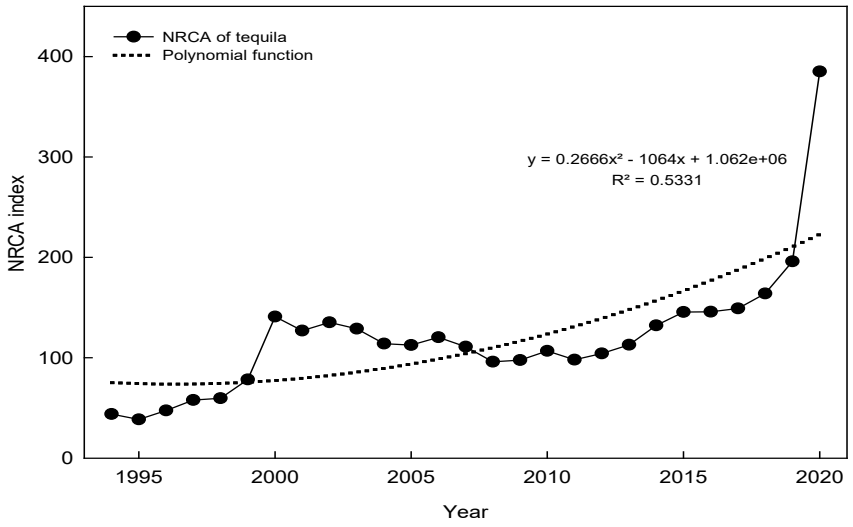

Figure 2. Normalized Revealed Comparative Advantage index of Mexican tequila in the international market from 1994 to 2020.

Source: Own elaboration.

The results of this study on comparative advantage in rum were similar to those of Beňuš *et al.* (2021) who identified it as the second-highest negative value of revealed comparative advantage in 2018. In contrast, countries with DO such as Cuba, Guatemala, Venezuela, and Martinique had the highest comparative advantages. Thus, one of the disadvantages of Mexican rum is a lack of DO leading to disadvantages in the international market.

Fernández-Peña (2020) highlighted that Mexico stood out internationally for being one of the most important producers of sugar cane. However, it is not among the top ten rum producers.

In general, alcohol production from sugarcane declined (SADER & CONADESUCA, 2014). Also, this decrease is associated with the importation of alcohol with a price below the cost of domestic production.

In this scenario, sugarcane derivatives should be economically profitable and competitive to balance the differences in the value of sugarcane destined for food and as raw material for industrial fermentation, in addition, have a higher added value to justify the cost of production (Aguilar *et al.,* 2012).

Another reason why the index is in decline is found in the assumption of low investment within the sector.

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Vingtier (2018) described a vicious circle that has been generated where brands do not want to invest because the market does not grow as in the case of Spain: the market does not invest, it stops, and sales fall. Unlike France and Germany, where the sector is in a virtuous circle because brands invest knowing that sales will increase leading to a larger budget to continue investing and growing.

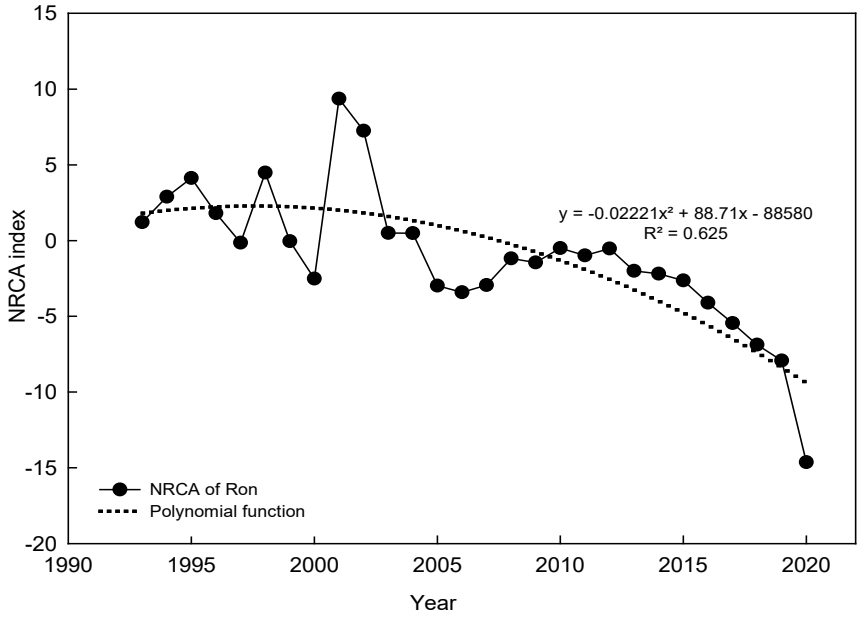

Figure 3. Normalized Revealed Comparative Advantage indices of Mexican rum in the international market from 1994 to 2020.

Source: Own elaboration.

Since comparative advantage is a relative concept, the interpretation of the size of the NRCA index has greater significance in comparative terms. Therefore, the issue of competitiveness and its forms of measurement become a relevant argument for analysis and discussion within the agri-food sector (Contreras & Leos, 2021).

Of the three products studied, tequila presented the greatest comparative advantage. For example, in 2020, mezcal registered a NRCA of 10.37 and tequila 385.18, which indicates that comparative advantage in tequila in Mexico is 37.14 higher compared to mezcal. If these two products are contrasted with rum, the latter remains the least competitive.

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Under these assumptions, some authors suggest that a country should offer a wide variety of products and take advantage of economies of scale, but give more attention to the products with the best comparative advantages (García, 2010). Then, competitiveness studies that focus on strategic sectors are required (Galván & Santos, 2019).

Table 1 presents the guidelines in the comparative advantage of mezcal, tequila, and rum within the world market.

Table 1. Trends in the normalized revealed comparative advantage of Mexican mezcal, tequila, and rum exports in the world market, 1994-2020.

Product	R2	β1	β2	t-student	*p-value*
Mezcal	0,6771	-1,443e+02	3,594e-02	7,078	1,284e-06
Tequila	0,5331	-1,064e+03	2,666e-01	1,602	0,0001073
Rum	0,625	88,71	-0,02221	-2,056	7,74e-06

Source: Own elaboration.

According to parameters β2, the overall trend of the NRCA index was positive and is on the rise in mezcal and tequila. This showed that Mexico has a comparative advantage over exports from other countries. For rum, parameter β2 was negative, indicating a downward trend.

With the support of the R2, the goodness of fit in the regression of data was estimated. In this case, the fit was 68 % for mezcal, 53 % for tequila, and 63 % for rum. With the *p*-value data, the null hypothesis was rejected (β = 0).

These types of results can determine which types of products it is convenient to continue producing (Flores & Ponce de León, 2019). Therefore, it was confirmed that, in the country, at least in the period studied, tequila and mezcal are beverages that generate significant economic income.

The data presented show the importance of the products for export. According to Soto *et al.* (2022), strategies are currently being sought to improve exports in the mezcal sector. In this sense, within the tequila industry, protected production zones are observed, with the aim to establish themselves as export leaders (Salomón, 2003). It is recorded that exports of the product are present in at least 120 countries, in which its production stands out due to the use of 100% agave (Zea, 2018). For rum, it is found that many domestic producers have been seeking certifications for export, mainly to the USA as potential customers (Flores, 2020).

It has been established that tequila is a globally recognized product that gives Mexico identity abroad (Gómez-Cuevas *et al.,* 2020). In the case of mezcal, despite having received the

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distinction of DO just two decades ago, it samples an exponential growth trend since 2012. In this sense, there are export processes where a country finds it profitable to sell its production abroad (Galindo & Ríos, 2015), which have impacts in Mexico on economic growth, productivity, and labor opportunities.

Conclusions

Mezcal and tequila are competitive products in the international market, whose comparative advantage index has shown an upward trend, so attention should be paid to improving the strategies established in export scenarios worldwide.

Although rum has lost competitiveness, it is suggested that the way in which the product's positioning has been worked on should be evaluated and, in turn, initiatives should be sought to make the beverage more relevant in the domestic and international markets.

The Competitiveness Index of tequila was several times higher than that of the other two products, indicating that it is a more consolidated industry and more successful in the international market.

The NRCA allowed comparisons to be generated between the products studied, which enables a diagnosis to be made and identifies information about the markets according to consumer trends.

This information can serve as a guide for other research work by replicating the methodology in different products. It also contributes to the calculation of indicators and clear knowledge of strong and vulnerable products within this sector.

Authors contribution

Conceptualization, author 1; Methodology development, author 1, author 2; Software management, author 1; Experimental validation, author 3; Data analysis, author 1, author 3; Data curation, author 1, author 3; Manuscript writing & preparation, author 1, author 3, author 6; Writing, revising & editing, author 4, author 5, author 6; Project management, author 4, author 5.

Conflict of interest.

"The authors declare that they have no conflict of interest."

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