Contribution of Mexican scholars to viticultural and oenological research: where do we stand?

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Wine consumption in Mexico has increased continuously over the last decade. However, domestic wine production is not sufficient to satisfy domestic demand, and foreign wine producers have been the main beneficiaries of the growth of the Mexican market. This highlights the need of Mexican winemakers for scientific evidence and technological innovations that can help to make better management choices both in the field and in the winery. This paper presents the results of a bibliometric study that aimed to investigate the contribution of the Mexican academic community to scientific literature in viticulture and oenology (1987-2017). Results indicate that Mexican academia has failed to keep pace with the constant growth of the wine industry in Mexico. The growth of scholarly scientific output in Mexico has been slower than that of other Latin American countries. In addition, Mexican scientific output relied to a large extent (36%) on collaborations with research groups from developed countries, while collaborative papers with Latin American countries were comparatively rare (7.9%). Domestic collaboration among Mexican institutions is still limited, as indicated by the low number of such publications (23.2%) and by the considerable number of institutions producing papers independently (49%). Agrosciences, biological sciences, chemistry, microbiology and health sciences were the main areas of research of Mexican academics.

Keywords: bibliometric analysis, Mexico, viticulture, oenology, research

Abstract

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Introduction

The increase of international competition is one of the most significant changes that the wine industry and wine market have undergone in the last 30 years. This growth has been triggered to a large extent by the process of “wine globalization”, in which new wine-producing and -exporting countries have entered the wine business (Medina-Albaladejo et al., 2014). During the last decade, wine consumption in traditional producing and consuming countries (e.g., Spain or France) has declined, whereas the production and consumption of wine has increased in countries such as Argentina, Chile, Australia, and Mexico. This shift in the market has triggered competition at an international level. An example of the discrepancy between production and consumption occurred in 2001, when Spain, France, and Italy together were responsible for more than half of the world’s annual wine production, while their own per capita consumption dropped by around 40-50 %, generating a surplus in “Old World” wine production (Anderson and Nelgen, 2015; Bisson et al., 2002). According to OIV (International Organisation of Vine and Wine) data, the level of competition in the wine sector will be further intensified in the coming years as a result of the effects of climate change on grape production (Jones, 2015; van Leeuwen and Darriet, 2016) and the consumer demand for socially and environmentally responsible viticulture and winemaking methods (Mariani and Vastola, 2015).

Mexico has also been part of the process of wine globalization. This is reflected in an annual growth of 8 % in domestic consumption during the period 2000-2010 and of 12 % during the period 2010-2015 (Euromonitor International, 2016; López and Sotelo, 2014). Ironically, domestic grape production in Mexico today is around half what it was in 1987 (Figure a) and wine grape yield has dropped in the years 2015 and 2016 (Figure 1b), probably as a result of the severe drought experienced from 2012-2015 in the main winegrowing areas (Robeson, 2015). As a consequence, foreign production (e.g., Chile, Argentina, Spain, and France) “has been the greatest beneficiary of the growth of the Mexican market” (López and Sotelo, 2014). This situation constitutes a complex scenario for Mexican wine producers, who will face challenges in the coming years due to water scarcity and other effects of climate change in the main wine grape producing areas (Acosta-Zamorano et al., 2013; Muñoz and Sánchez, 2016). The expectation of imminent challenges intensifies the need of the wine sector worldwide for research, scientifically based evidence, and technological innovations that will enable better management choices in both vineyards and wineries (Aleixandre et al., 2016).

A way to explore the intensity of research activity using qualitative and quantitative methods is to analyze the number and the authorship of scientific papers published in peer-reviewed journals. Recently, Aleixandre et al. (2013) found significant growth in the number of research papers concerning viticulture and oenology published by Latin American researchers, particularly those from Brazil, Argentina, and Chile. However, the development and characteristics of the contribution of Mexican academics to these areas remain under-studied. Thus, it is useful to develop an updated diagnostic of the contribution of Mexican scholars to scientific literature related to viticulture and oenology, and to study the evolution of this literature compared to that of other Latin American countries. To accomplish this, we conducted a bibliometric analysis of research and review articles published in peer-reviewed journals during the last 30 years, focusing on publications by authors affiliated with universities and research centers based in Mexico.

Figure 1. Chronological evolution of a) grape production for the period 1987-2016 (FaoStat, 2013) and b) wine grape yield for the period 2004-2016 (OEIDRUS-BC, 2018) in Mexico. Lines represent third order trend-lines.

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Method

1. Bibliometric database

We conducted an extensive survey of the peer-reviewed scientific literature through Internet searches in Elsevier’s Scopus database. In a fashion similar to that employed by Cassi et al. (2012), searches included the following terms: “grapevine”, “grapevines”, “wines”, “wine grape”, “wine grapes”, “wine production”, “red wine”, “red wines”, “white wine”, “white wines”, “winemaking”, “enology”, “enologists”, “viticulture”, “oenology”, “wine yeasts”, “wine yeasts”, “winery”, and “wineries”. These searches led to a large number of papers that were analyzed for inclusion and filtered according to the authors’ countries of affiliation so that at least one author was from the following countries: Argentina, Brazil, Colombia, Chile, Cuba, Ecuador, Mexico, Peru, Uruguay, or Venezuela. We only included articles classified as original research articles and reviews for the period 1987-2017 a suitable period to evaluate the growth of viticulture and oenology research in Latin America (Cassi et al., 2012). From the resulting database we extracted the annual and total production of articles by country.

2. Collaboration network analysis

We then restricted our database to articles written by at least one author affiliated with an institution based in Mexico and extracted the name of the Mexican affiliation entity, the affiliation country of the co-authors, the affiliation country of the corresponding author, and the thematic area for each publication. We performed a network analysis to explore the collaboration network between Mexican and foreign scholars and the collaboration network among Mexican institutions. Finally, we extracted the main thematic area for each of the published papers.

Results

Our initial, worldwide search found 49,388 publications. After restricting the search to papers published by authors with Mexican affiliations, we obtained 3,232 publications (3,106 research articles and 126 reviews). For the 1987-2017 period, Brazil was the country with the most published articles (1,529), followed by Chile (710), Argentina (557), Mexico (164), Uruguay (120), Colombia (50), Venezuela (36), Peru (27), Cuba (26), and Ecuador (13). Figure 2 shows the growth in the number of articles published per year in the five countries with the highest productivity in Latin America during the last 30 years. Brazil showed the highest annual publication growth, followed by Chile, Argentina, Mexico, and Uruguay.

When we restricted the database to papers written by authors with Mexican affiliations, we found 51 institutions that together produced 164 papers (152 research articles and 12 reviews). Results showed that 105 of these papers (63.53 % of total paper productivity) were written by a corresponding author affiliated with a Mexican institution. In addition, 86 papers (52.4 %) were the result of an international collaboration. Network analysis revealed that Mexican academics collaborated with co-authors from 27 countries. Co-authors from Spain, the United States, France, and Italy accounted for 67.9 % of total paper productivity, whereas co-authorships with researchers from other countries in Latin America represented only 7.9 %. Argentina and Brazil were the Latin American countries that collaborated the most with Mexican academics (Figure 3a).

Results also indicated that 38 papers (23.2 %) were the result of a national collaboration (i.e., involving at least two Mexican institutions). Interestingly, 50.2 % of the scientific productivity of the Mexican academia was generated by only 10 institutions. Universidad de Nacional Autónoma de México (UNAM) was shown to be the most productive institution with 15 publications, accounting for 9.41 % of the country’s productivity, followed by Tecnológico Nacional de México (TMN) and Universidad Autónoma de Baja California (UABC), which contributed 14 (8.51 %) and 13 (7.91 %) papers, respectively. Network analysis also showed that 33 (51 %) academic institutions published papers in collaboration with other Mexican institutions.

Figure 2. Annual growth of scientific productivity (number of publications) in Brazil, Chile, Argentina, Mexico and Uruguay for the 1987-2017 period. Dashed lines represent second order trend-lines.
Regarding viticulture and oenology, and to compare over the last 30 years. This is in line with previous aspects of winemaking throughout Latin America its evolution with that of other Latin American Mexican academic community to scientific literature the study of scholarly scientific production is a good bibliometric study to describe the contribution of the Mexican academics were grouped into 12 thematic areas, with agricultural sciences (18.9 %), chemistry (15.9 %), biological sciences (11.6 %), microbiology (11 %) and health sciences being the most studied topics (Figure 4).

Discussion

Since scientific papers are the primary means of communicating and preserving scientific advances, the study of scholarly scientific production is a good proxy for knowledge generation and research progress (Basualdo et al., 2016). We conducted a bibliometric study to describe the contribution of the Mexican academic community to scientific literature regarding viticulture and oenology, and to compare its evolution with that of other Latin American countries.

Our results indicate a significant growth in the number of scholarly publications related to scientific aspects of winemaking throughout Latin America over the last 30 years. This is in line with previous studies by Aleixandre et al. (2013), who found a growing interest in viticultural and oenological research for the period 2006-2010. However, the growth in paper production by Mexican scholars has been relatively slow compared to that of Brazil, Chile, and Argentina, even though in this region Mexico is only second to Brazil in terms of researchers (CEPAL, 2016). If we consider the constant growth of domestic wine consumption in the last 10 years (8-12 % per year), and the current need to increase grape production (López and Sotelo, 2014), it is fair to say that the Mexican academia is failing to keep pace with the continuous growth of the wine sector.

Most of the published papers were written by a corresponding author belonging to a Mexican institution. However, it is worth noting that a considerable part of the total production was developed under the leadership of foreign institutions. Foreign participation in scholarly scientific productivity in Latin America is 30.6 % (Aleixandre et al., 2013); we found that 59 papers, or 35.97 % of the total production, were the product of an international collaboration. This is also reflected in the network analysis, which showed a high level of collaboration with developed countries (Spain, the United States, France, or Italy) but few collaborations with other Latin American countries. We assert that in order for the Mexican academic community to benefit from the scientific knowledge of others, institutional efforts must aim to encourage international collaborations, especially with other countries in Latin America.

Figure 3. a) International and b) domestic collaboration network of Mexican academia in viticultural and oenological research. Node size correlates positively with the number of papers, while node color intensity correlates positively with the number of collaborations. Line color intensity correlates positively with the number of collaborations between a pair of nodes.
Research activity concerning viticulture and oenology in Mexico occurs in an isolated manner and is conducted by relatively few institutions. This is indicated by the low number of publications generated through national collaborations (38, or 23.2 %) and by the considerable number of institutions (49 %) that have produced papers independently. These results highlight the need to encourage domestic collaborative research; doing so will have a positive effect on both the quantity and quality of scientific production (Ding, 2011). Collaborative productivity has become essential in multidisciplinary fields like viticulture and oenology, where successful research depends on the joint efforts of scientists with diverse skill sets ranging from theoretical knowledge to solid experience in the field and the laboratory (Bu et al., 2018). Half of the domestic scholarly scientific production is conducted by 10 institutions that work as collaborative hubs (Figure3a). We call upon these institutions to facilitate collaborative research projects through the creation of an inter-institutional specialized research center such as the Institut des Sciences de la Vigne et du Vin in Bordeaux (France), or the Instituto de Ciencias de la Vid y del Vino in Logroño (Spain).

Finally, we found that scholarly scientific production was grouped into 12 distinct research topics. This reflects the multidisciplinary nature of the field, as noted by Glänzel and Veugelers (2006). However, the results indicated that more than half (57 %) of the publications were concentrated in only five thematic areas (agrosciences, biological sciences, chemistry, microbiology, and health sciences). This presents a challenge to Mexican academics, who will soon have to tackle pressing research topics in viticulture and oenology, such as sustainable wine production under climate change (Aurand, 2015), while continuing to conduct basic research.

Conclusion

Increased competition within the wine market is a trend that will continue at a global scale. Mexico, like other countries in Latin America, has been experiencing an increased demand for wine. However, wine production in Mexico is currently insufficient to satisfy national needs. This highlights the necessity for greater innovation and competitiveness among domestic wine makers. Scientific research plays a fundamental role in meeting these goals. We have found that Mexican scholars are failing to keep pace with the continuous growth of the Mexican wine sector. Inter-institutional academic efforts must be made to achieve a higher degree of scientific autonomy while increasing international collaboration dynamics, particularly with other countries in Latin America. Because of Mexico’s current research capacities in viticulture and oenology, the creation of a specialized national research center dedicated to these areas seems feasible. Creating such a center will strengthen the research on priority topics such as sustainable production, adaptation to climate change, and water use efficiency. Public policy should also promote collaborative workspaces that bring together scientists, viticulturists, oenologists, and stakeholders in the design and implementation of national...
strategies aimed at achieving the sustainability of the Mexican wine sector.

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References


