Article

Labeling, agriculture and consumer: a reflection based on bibliometric tools

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Abstract

The certifications seek to give a guarantee to the consumer, so agrifood producers have had to integrate this tendency to certify production, moving away from generic products towards a trend of differentiation. The objective of the research was to carry out an analysis using bibliometric tools on the subject of labeling, agriculture and consumer. A review of the topic was carried out from 1968 to 2018 (September 28), identifying 285 publications and conserving 204 useful documents, from which were analyzed: journals, countries and institutions that have published on the subject. The data was obtained from Scopus and analyzed with the VOSviewer program to determine the co-occurrence of terms and map the science. The results show that research is concentrated in three areas: the consumer, the agricultural producer and legislation. The issue of labeling is important for producers especially those who seek to be governed by aspects of ethical and ecological production; however, it is necessary to carry out communication campaigns to make the consumer aware of the certifications. In conclusion, the research on labeling, agricultural production and the consumer is in force, several studies are necessary that include the vision of the Mexican consumers or producers in order to be able to contribute to the scientific debate on this topic.

Keywords: certification, ecological, fair trade, legislation, organic agriculture.

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Introduction

Certifications in agriculture seek to inform, standardize and guarantee the quality of a product, they are aimed at farmers, food consumers and society in general. The labels when they are directed to the farmer, try to highlight the information of the toxic contents that can contain the agrochemicals and their form of employment. On the other hand, consumers search the labels for information that helps them achieve a balanced diet, avoid allergens, as well as knowing the origin, environmental, ethical and technological conditions in which the food was produced (Verbeke, 2005).

In particular, the certifications shown on the labels arise from the concern on the part of consumers and civil society after many scandals in the agri-food industry, regarding uncertainty about the origin of food and due to the lack of transparency of information that gives confidence to the consumer (Hall, 2010). Both private institutions, government, consumers and civil society seek to promote certifications of various kinds and their respective presentation on labels that are displayed on food, this to provide useful information to help decision makers who consume these products (Verbeke, 2005).

One of the ways to understand the impact of various certifications is through labels or labeling. This action is what creates the contact with the consumer, so they are the ones that must be evaluated if you want to know their effectiveness in the eyes of the final customer. In comparison with other topics, the availability of scientific articles that address the issues of labeling in agriculture and the consumer is reduced. Therefore, this review aimed to know the state of the art on the labeling of agricultural products in order to better understand the trends of research that address these issues and establish guidelines for future research.

Materials and methods

It is used a comprehensive approach that included different scientific documents under a bibliometric research technique. The bibliometric mapping is data driven and is based on computational algorithms and visualization techniques to create maps that allow a visual representation of the field of study showing the relationship of up to 400 terms (Heersmink *et al.*, 2011). The publications obtained from the meta-database of library services Scopus de Elsevier (www.scopus.com) were used. The words: labeling, agriculture and consumer were used within the title, summary and keywords, which yielded 285 documents.

After a quick review it was observed that several of the articles were not directly related to certifications in agriculture, so it was decided to exclude those from the areas of medicine (71) and nursing (28), which reduced the documents to 204. The period of analysis was from 1968 to 2018 (September 28). The type of documents were: articles (119) with 58.3% of the writings, reviews (24), book chapters (22), conference abstracts (12), notes (8), letters (6), surveys (5), editorials (3), books (2), article in press (2) and a conference review.

Content analysis

An analysis of the co-occurrence of key words and academic terms in the titles and abstracts and key words of the publications was carried out, following a co-occurrence method, showing only the elements connected with others, the normalization-strength of association method (FA), resolution of 1.5, 80% display scale, TLS weight, label variation size of 80% and core width 30%.

The complete counting method was established, with a number of records of each term ≥10 and a minimum cluster size of one. With the terms retained, the map for the visualization of the network was created, the VOSviewer v software was used. 1.6.9. (Center for Science and Technology Studies, 2018). The algorithm was designed so that the terms that co-occurred were positioned closer to each other, with larger frames those with greater frequency.

Results

In this section a bibliometric analysis is provided for publications related to labels, agriculture and the consumer.

Performance analysis

There are 204 documents registered from 1968 to September 28, 2018. The distribution of the publications is presented in Figure 1. As of 1998, the number of publications begins to increase, having years with higher scientific production: 2000, 2004 and 2012. The 80% of publications are concentrated after 2003, although 50% corresponds to the last five years, the average for the entire period analyzed is six publications per year, and for the last ten years is 11.6 publications per year.

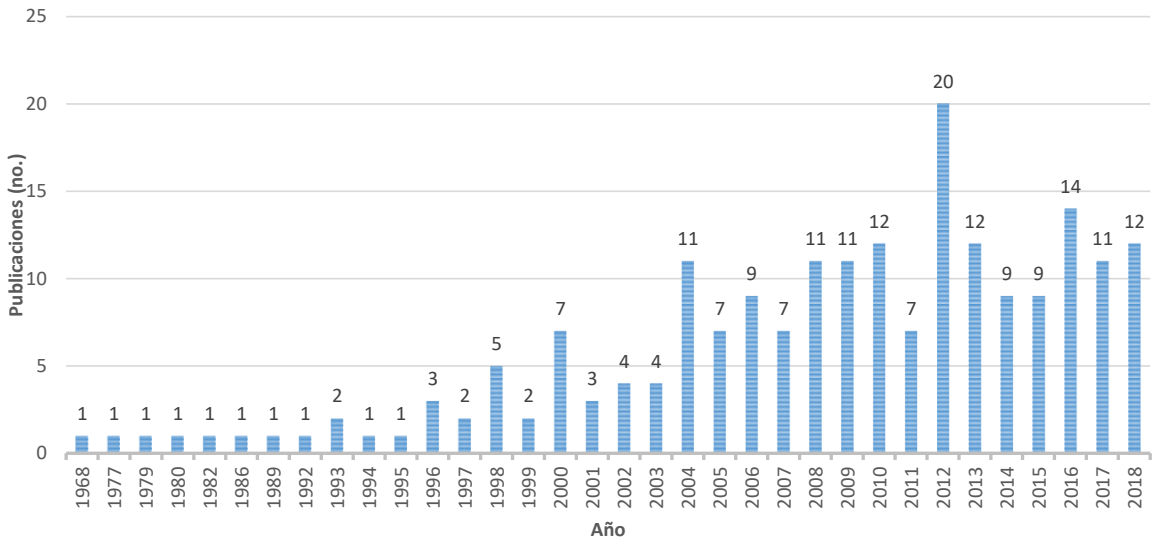

Figure 1. Distribution of publications on labeling, agriculture and consumers from 1968 to 2018 (September 28).

Of the total of documents, 143 have been cited, accumulating a total of 3 365 citations. There are seven documents that have more than 100 appointments, seven have between 50 and 99 appointments, 49 have between 10 and 49 appointments, 58 have between two and nine appointments and 22 documents have an appointment. On average there are 23.5 citations per document for the period analyzed, Table 1 shows the ten most cited articles.

Table 1. The 10 most cited articles on labeling, agriculture and consumer.

Rank	Authors (Year)	Title	Source title	Cited by
1	Roy *et al.* (2009)	A review of life cycle assessment (LCA) on some food products	Journal of Food Engineering	368
2	Lenzen *et al.* (2012)	International trade drives biodiversity threats in developing nations	Nature	345
3	Verbeke (2005)	Agriculture and the food industry in the information age	European Review of Agricultural Economics	260
4	Blokhuis *et al.* (2003)	Measuring and monitoring animal welfare: Transparency in the food product quality chain	Animal Welfare	130
5	Onozaka and McFadden (2011)	Does local labeling complement or compete with other sustainable labels? A conjoint analysis of direct and joint values for fresh produce claim	American Journal of Agricultural Economics	127
6	Pelletier *et al.* (2009)	Not all salmon are created equal: Life cycle assessment (LCA) of global salmon farming systems	Environmental Science and Technology	117
7	Giannakas (2002)	Information asymmetries and consumption decisions in organic food product markets	Canadian Journal of Agricultural Economics	78
8	Jordan Lin *et al.* (2004)	Do dietary intakes affect search for nutrient information on food labels?	Social Science and Medicine	75
9	Brown and Getz (2008)	Privatizing farm worker justice: Regulating labor through voluntary certification and labeling	Geoforum	73
10	Sundkvist *et al.* (2005)	On the importance of tightening feedback loops for sustainable development of food systems	Food Policy	69

Source: SCOPUS to September 27, 2018.

The ten journals, countries and institutes with the highest number of contributions publishing issues related to labeling, agriculture and consumer are presented in Table 2.

Table 2. Performance analysis: magazine, country and institute.

Pos.	Journal	Pub.	Country	Pub.	Institution	Pub.
1	Nature Biotechnology	10	USA	76	INRA Institut National de La Recherche Agronomique	7
2	Journal of Cleaner Production	5	Germany	19	Wageningen University and Research Centre	5
3	Chemical and Engineering News	4	Italy	16	University of Wisconsin Madison	5
4	Food Policy	4	UK	11	University of Florida	4
5	Nature	4	France	9	National Agriculture and Food Research Organization	4
6	Sustainability Switzerland	4	Brazil	8	Universitat Gottingen	4
7	Agriculture and Human Values	3	Canada	8	United States Department of Agriculture	4
8	American Journal of Agricultural Economics	3	Netherlands	8	Kansas State University	3
9	Journal of Agricultural and Food Chemistry	3	Norway	8	Cornell University	3
10	Journal of Food Protection	3	Australia	6	Food and Drug Administration	3

SCOPUS to September 27, 2018.

The five journals with the highest number of publications on the subject are: Nature Biotechnology, Journal of Cleaner Production, Chemical and Engineering News, Food Policy and Nature.

As far as affiliation is concerned, the universities of both the European Union and the United States stand out. The institution with the highest number of publications is the INRA Institut National de La Recherche Agronomique, followed by the Wageningen University and Research Center, the University of Wisconsin Madison, the University of Florida and the National Agriculture and Food Research Organization. With respect to the countries, the United States of America has contributed with 31% of the publications, followed by Germany, Italy, the United Kingdom and France. In Latin America, the leader is Brazil with eight publications, Argentina in second place with two publications, the rest are contributions from Colombia, Mexico and Chile who have a publication each.

Mapping of science

The information of the titles, summary and class words was analyzed with the VOSviewer program, which generates maps of terms, in networks, showing co-occurrence and relative impact of citation. Each map includes terms that occurred at least 60 times under a binary content, considering only the number of publications in which the term is presented regardless of the number of times the term is presented in each article individually (Yeung *et al.*, 2017). VOSviewer selected 49 terms that had the highest values to form a map that allowed a visualization of the thematic network, organizing them in three clusters with 997 links.

In Figure 2, the three clusters are observed: one that refers to producers, the other focused on consumers and a third related to regulations mainly by the Department of Agriculture of the United States of America (USDA).

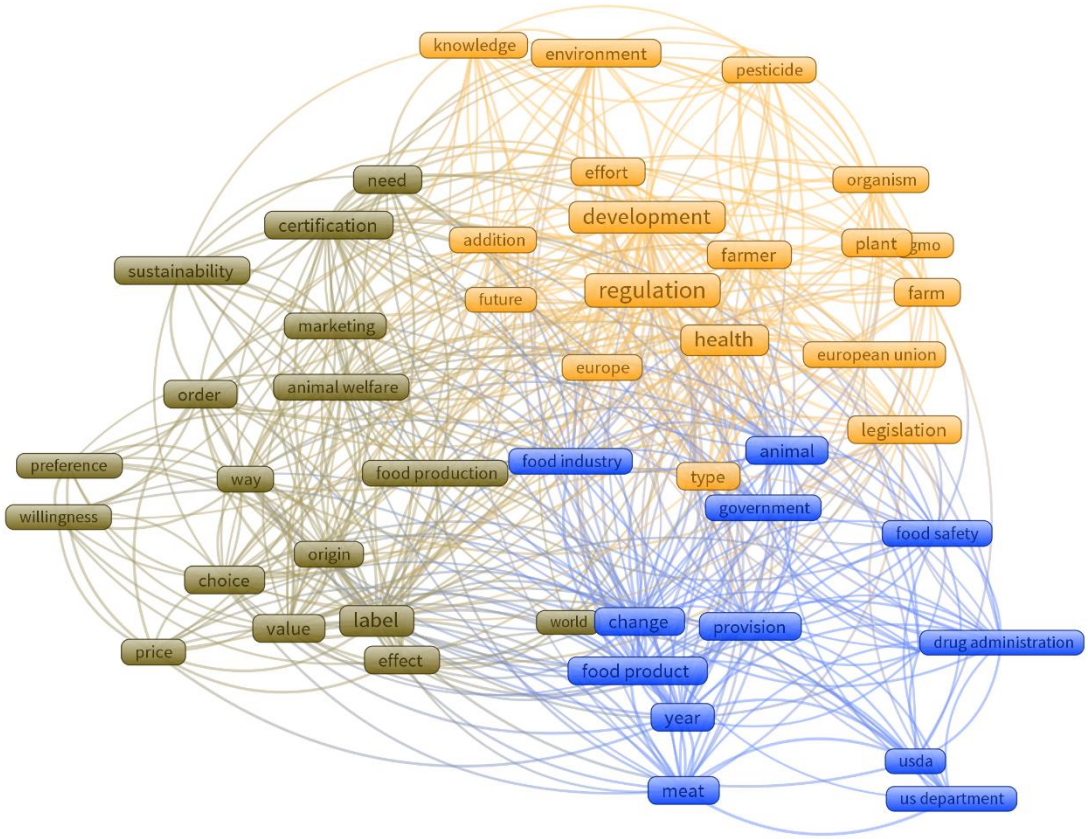

Figure 2. Network visualization using the VOSviewer program. Note: because they are considered generic, the words article, data, person, sample, result, study, survey, time, method, number, application were eliminated.

Discussion

Using data from SCOPUS, the results of this study reveal that research in the area of labeling, agriculture and consumers in terms of publications and contributions by country has been conducted in three main lines of research, one aimed at the perceptions of the consumers, another to the producers and one last to those who dominate the publications: United States of America, in particular its governmental agencies. Next, these trends are discussed.

The consumers

The ultimate objective of agri-food production is to generate products for consumers, derived from this, the safety of food, as well as the conditions in which they were produced, have caused consumers to change their beliefs, attitudes and behavior. Same as reflected in patterns of purchase and consumption (Verbeke, 2005) that impact the agrifood sector. In this same line

of discussion, we find the distinction between compulsory and voluntary labeling. Alfnes *et al.* (2018), in a review on this issue in farmed fish establish that mandatory labeling includes information on species, production systems (breeding or wild) and area of origin, while voluntary labeling includes information on sustainability, production organic, animal welfare, traceability and innocuousness.

The existing publications referring to consumers are about: types of consumers according to their values with respect to meat labeling that evidences animal welfare, environmentally friendly production (Sonoda *et al.*, 2018), willingness to pay (WTP) for wines labeled as produced under water saving systems (Pomarici *et al.*, 2018), appellations of origin or organic production (Troiano *et al.*, 2016), by traditional food production systems, which the consumer perceives as environmentally friendly and whose Food products are of high quality (Wang and Gao, 2017).

An important part of the studies, assess the impact on the attitudes of consumers derived from being informed of various issues, such as: production under organic conditions or extensive livestock (Risius and Hamm, 2017) or the acceptance of products that reduce the impact in terms of the carbon footprint (Lombardi *et al.*, 2017). These studies expose the need to inform consumers more and better.

In general, since labeling is the way information is provided to consumers, it becomes strategic to reach them effectively impacting the food industry, as well as the primary producer. Research warns that not all consumers appreciate the various labeling trends related to sustainability equally and that the success of the initiatives that are reflected in the labels is limited to consumer segments, without neglecting the importance of sensory attributes (Silva *et al.*, 2017) and personal well-being (Bruschi *et al.*, 2015), which largely explain the consumer's behavior and preferences.

The producers

Consumers have played an important role in food labeling processes that directly affect agri-food producers. In general, they use ethical and ecological criteria to select products, which has made it imperative to evaluate the environmental impact and the use of resources in the production and distribution of food by producers, industry or food distributors. One of the tools that have been developed for these purposes and that is present in research related to labeling, agriculture and consumers, is the Life Cycle Assessment Life Cycle Assessment (LCA), which determines the environmental effects of a product, process or activity through its life cycle or lifespan.

The purpose of this tool is to compare between products, processes, and alternative services, in order to compare their life cycles and identify the parts where improvements can be made. Its main application has been in agriculture, industrial processing and agri-food products, with topics related to: emission of greenhouse gases, ecological footprint ecological footprint analysis (EFP), eco-labeling, environmental impact of the use of chemicals for the pest control, waste management, evaluation of production systems of salmon farms and apple production, among others (Canals *et al.*, 2006; Pelletier *et al.*, 2009; Roy *et al.*, 2009; Bessou and Colomb, 2013; Gheewala and Mungkung, 2013).

In general, these studies seek to guide producers on how to improve their processes from the point of view of sustainability. Another important component of the research that relates to producers is the environment. For example, the factors that influence the adoption of good practices to reduce pollution have been studied, concluding the need for certification and labeling schemes (Liu *et al*., 2018); the labeling and training for the use of pesticides in Brazil (Waichman *et al.*, 2007; Pedlowski *et al.*, 2012 and certifications for biodiversity protection biobanks (Edwards and Laurance, 2012).

A third line of research is the impact on producers of labeling and certifications, such is the case of Mook and Overdevest (2018) who found that fair trade acts more as a mechanism of social justice than as a market mechanism. In summary, the subject of interest and the producers can follow several aspects, from regulation, the environment, the effects on the producers, the processes and the products produced under different schemes of certification and labeling.

Legislation

Within the aspect of legislation highlight the key words of the United States, USDA and drug administration, this is explained because 31% of publications are from this country and their public institutions have high representativeness in various studies. Some authors focus on analyzing the efforts made by the government of the United States of America in developing labeling programs for various purposes, such as the program of antibiotic-free meat products (Centner, 2016) or the labeling of allergens in food (Gendel, 2013).

One of the most important issues in terms of legislation is the labeling of foods produced using raw materials based on genetically modified organisms (GMOs) (Bovay and Alston, 2018) or nano foods (Graffagnini, 2010). The use of GMO is the agricultural practice with greater adoption in recent times, which has caused consumers to claim the right to know what is in their food (Privalle *et al.*, 2012), as they are considered misinformed regarding this topic (Boccia, 2015).

One of the reasons is the diversity of terms that are used, such as: genetic engineering, genetic modification or agricultural biotechnology, according to Zahry and Besley (2017), consumers would accept more products labeled with the term genetic engineering. In these debates, the attention that the media has put on the subject has caused supermarkets to recognize the importance of having products on their shelves free of GMOs, where voluntary labeling has allowed their development as a market niche (Bain and Dandachi, 2014). In summary, legislation, especially in developed countries, has been key to protect and inform about the foods available to the consumer.

Conclusions

A bibliometric review on labeling, agriculture and consumer was carried out. The document covers several perspectives: structure of publications, most influential countries, as well as institutes, the analysis of co-occurrence of terms and the scientific mapping on the most important terms within the most cited articles. The results showed that the publications are concentrated in three clusters: consumer, producer and legislation. In the case of the consumer, the importance of adequate communication and information to obtain the desired effect of various certifications and their respective labeling is highlighted.

The research that involves producers extends to issues of regulation, environment, effects on producers, processes and products produced under different certification and labeling schemes. While the legislation focuses on the regulation of foods produced using raw materials based on genetically modified organisms (GMOs) and the role of government agencies in the development of regulations in developed countries, especially the United States of America.

In the analysis conducted no research on Mexico, so this is an area that should be addressed at the national level, mainly due to the amount of agricultural products that are exported and are certified under various initiatives affecting agricultural producers, as well as, better understand the perceptions and behavior of food consumers at the national level.

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