

# Assessment of the economics and quality of productive processes for cannabis industrialization

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## Abstract

A documentary review was carried out on the production and publication of research papers related to the study of the variable assessment of the economics and quality of productive processes for cannabis industrialization. The purpose of the bibliometric analysis proposed in this document is to know the main characteristics of the volume of publications registered in the Scopus database during the period 2016-2021, achieving the identification of 119 publications. The information provided by the said platform was organized using tables and figures categorizing the information by Year of Publication, Country of Origin, Area of Knowledge, and Type of Publication. Once these characteristics were described, the position of different authors regarding the proposed topic was referenced through qualitative analysis. Among the main findings of this research, it is found that the United States, with 31 publications, is the country with the highest production. The Area of Knowledge that made the greatest contribution to the construction of bibliographic material referring to the study of the Economic Valuation and Quality in the industrialization processes of Cannabis was Agriculture and Biological Sciences with 48 published documents, and the Type of Publication that was most used during the period indicated above was the Journal Article, which represents 67% of the total scientific production.

**Keywords:** Economic Valuation, Quality, Quality in Productive Processes, Cannabis Industrialization, Cannabis.

## 1. INTRODUCTION

The production of cannabis combines certain activities that go from the preparation of the land to, the sowing, cultivation, and harvesting of the plant. This last step is not the end of the process, because from then on, the extraction of its derivatives begins, which are used for different purposes, including being an input in the production of other more sophisticated products. The cannabis plant turns out to be more versatile than it seems, since the sectors in which it stands out the most are the food, beverage, and cosmetic industries, and of course, the medicinal industry (Ramírez, 2019).

The cannabis industry as an alternative to medical treatments was recently legalized and since then its production has had accelerated growth in recent years. It is estimated that at the global level the production went from 100 tons in 2015 to 406.1 tons in 2017 according to the INCB (INTERNATIONAL NARCOTICS CONTROL BOARD, 2018) in fact, studies confirm that the governments of Argentina, Chile, Peru, Paraguay, Colombia, Mexico, Jamaica, and Puerto Rico, have given free rein to the production of this plant for medicinal treatments during the period 2015 and 2017, two decades after the first law issued in favor of such activity, in 1992 in Israel, being the first to regularize the use of cannabis and its

derivatives for pharmacological treatments (Labiano, 2020). In total, 30 countries worldwide have defined the legality of cannabis production, including some for recreational purposes (Global Markets - EY Knowledge, 2018).

All of the above has been a subject of debate in the design of commercial strategies for the use of this plant, and the quotation of products derived from it, so knowing its economic viability and projection in terms of sustainability and sustainability in the market, is a priority when introducing products that within its elaboration, involves some cannabis derivative either for medical, recreational, cosmetological or even food purposes. This research focuses its efforts on knowing the current status of the published literature on the studies that have been carried out by Latin American institutions on the valuation and/or economic viability in the production of different cannabis-derived products. For this reason, a documentary review was defined to answer the question: How has the production and publication of research papers indexed in Scopus been regarding the Economic Valuation and the Quality of Production Processes in the industrialization of cannabis in Latin America during the period 2016-2021?

## 2. General objective

To analyze from a bibliometric and bibliographic perspective, the production of high-impact research papers on the variable Economic and Quality Valuation in the industrialization processes of Cannabis during the period 2016-2021.

## 3. Methodology

Quantitative analysis of the information provided by Scopus is carried out under a bibliometric approach to the scientific production related to the Economic Valuation and Quality in the industrialization processes of Cannabis. Likewise, it is analyzed from a qualitative perspective, with examples of some research works published in the area of the study mentioned above, from a bibliographic approach to describe the position of different authors on the proposed topic.

The search is carried out through the tool provided by Scopus and the parameters referenced in Table 1 are established.

### 3.1 Methodological design

Table 1. *Methodological design*

	PHASE	DESCRIPCION	CLASIFICACION
PHASE 1	DATA COLLECTION	The data collection is carried out employing the Scopus web page search tool, using which a total of 60 publications are identified.	Published papers whose study variables are related to the importance of the study of Digital Competencies in teachers for the design of didactic material in online education. Research papers were published during the period 2017-2021. Imitated Latin American countries Without distinction of the area of knowledge. Without distinction of the type of publication.
PHASE 2	CONSTRUCTION OF ANALYSIS MATERIAL	The information identified in the previous phase is organized. The	Word Co-occurrence. Year of publication



which allows inferring that effectively the studied researches have contemplated the implementation and start up of projects and production processes that give as a result, cannabis based products for its commercialization in the frame of legality in each country that authorizes it.

#### 4.2 Distribution of scientific production by year of publication

Figure 2 shows how the scientific production is distributed according to the year of publication, taking into account the period from 2017 to 2021.

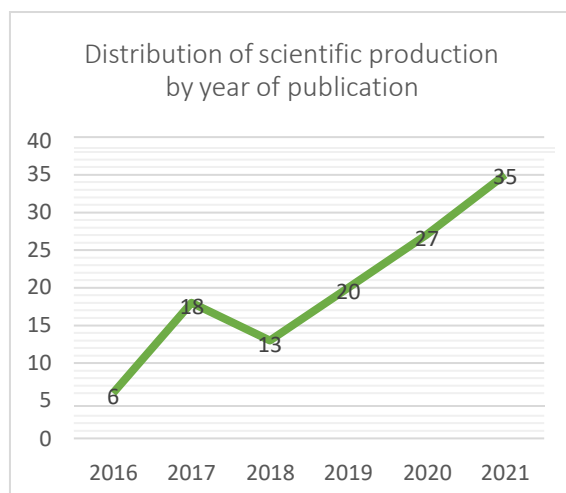


Figure 2. *Distribution of scientific production by year of publication*

Source: Own elaboration (2022); based on data provided by Scopus.

Starting from the bibliometric analysis proposed in the methodology for this document, the review of the volume of scientific production according to its year of publication is carried out, which yields a result that the period 2016-2021 was the latter year in which the largest number of publications were indexed in Scopus database, with a total of 35 documents that contemplate the economic valuation and quality products in the treatment of cannabis, an example of this was the article entitled “Foreign investment in emerging markets of legal medical cannabis: The Jamaican case study” (Rychert et al., 2021) whose objective was to explore the

opportunities and risks of foreign investment in an emerging domestic legal cannabis market in a developing country.

To this end, the researchers used semi-structured face-to-face interviews with 22 key informants from the Jamaican government, the local cannabis industry, academia, and civil society, and field observations of legal and illegal cannabis growers. Thanks to the above, it was possible to establish that foreign investment is undoubtedly one of the mechanisms with the greatest impact on improving the quality of cannabis-derived products through the transfer of technical knowledge and financial capital, which improved the quality of production processes from the selection of healthy seeds to the sale of finished products.

It is important to highlight how the volume of scientific production referring to the topic proposed in this article was increased from its lowest point which was in 2018 when only 13 papers were published, however, thanks to the new laws in different countries allowed the use of cannabis derivatives for medical treatments and in some cases, recreational, research began to increase reaching in 2019 to 20, in 2020 to 27 and finally in 2021 to 35. One of the most relevant publications in 2019 was the review entitled “Cannabis for medicinal purposes and its prescription” (Kiefer et al., 2019) whose purpose was to offer the scientific community, the information necessary to establish the background in terms of causes and effects in the medical prescription in the treatment of different health conditions, based on cannabis.

For them, it was necessary to identify the source of the disease reported by the patients, who can now obtain it as dried flowers or extracts in standardized pharmaceutical quality by medical prescription (prescription of narcotic drugs, except cannabidiol). Likewise, the review article shows the step by step that health professionals must follow to be able to prescribe this type of product to their patients, the first of which consists of deciding what therapeutic effects are to be achieved and which is the most appropriate cannabis product. From then on, periodic evaluations of the

effects caused by the cannabis treatment on these patients should be carried out to make decisions regarding changes or reaffirmation of the treatment.

#### 4.3 Distribution of scientific production by country of origin.

Figure 3 shows the distribution of scientific production according to the country of origin of the publications.

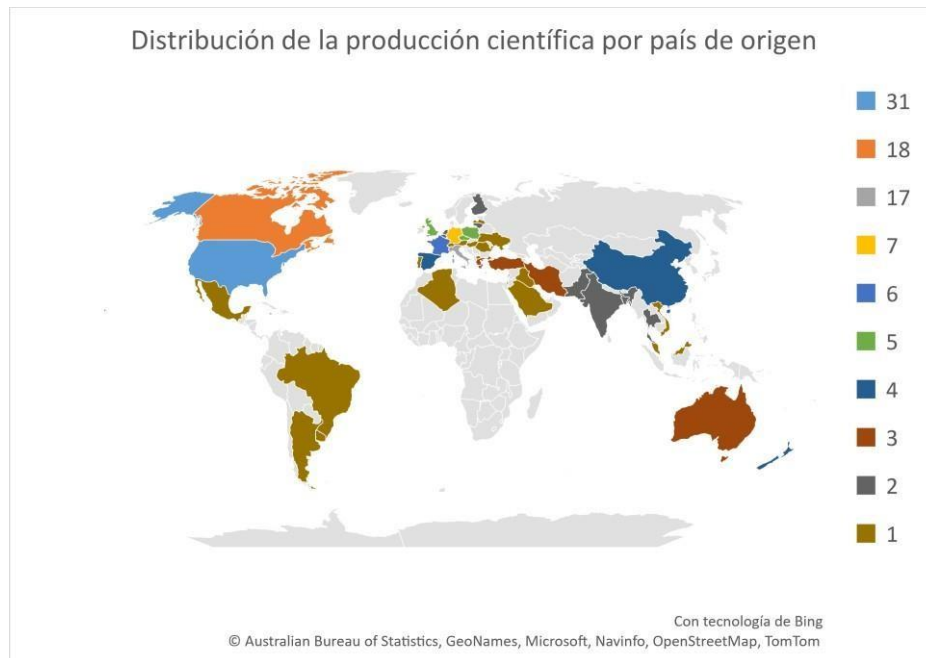


Figure 3. *Distribution of scientific production by country of origin.*

Source: Own elaboration (2022); based on data provided by Scopus

Figure 3 shows the distribution of the publications identified through Phase 1 of the Methodological Design proposed for this article, according to the country of origin of the institution responsible for the publication registered in Scopus. In this case, it can be seen that the United States was the country with the highest number of publications worldwide according to Scopus, with a total of 31 documents, within which the article entitled “Greenhouse gas emissions from indoor cannabis production in the United States” stood out (Summers, Sproul, & Quinn, 2021) whose purpose was to analyze the energy and materials required to grow cannabis indoors and quantify the corresponding greenhouse gas (GHG) emissions using the life cycle assessment methodology for a cradle-to-gate system boundary. This is in response to one of the issues arising from the legalization of cannabis and the increase in its demand and commercial production.

The study was able to establish that life cycle GHG emissions are largely attributed to the production of electricity and natural gas consumption of indoor environmental controls, the high-intensity growth lights, and the supply of carbon dioxide to accelerate plant growth, and proposes the use of planet-friendly technology to reduce this type of environmental impact.

At this point, it should be noted that the production of scientific publications, when classified by country of origin, presents a special characteristic and that is the collaboration between authors with different affiliations to public and private institutions, and these institutions can be from the same country or different nationalities so that the production of an article with co-authorship of different authors from different countries of origin allows each of the countries to add up as a unit in the general publications. This is best

explained in Figure 4, which shows the flow of collaborative work from different countries.

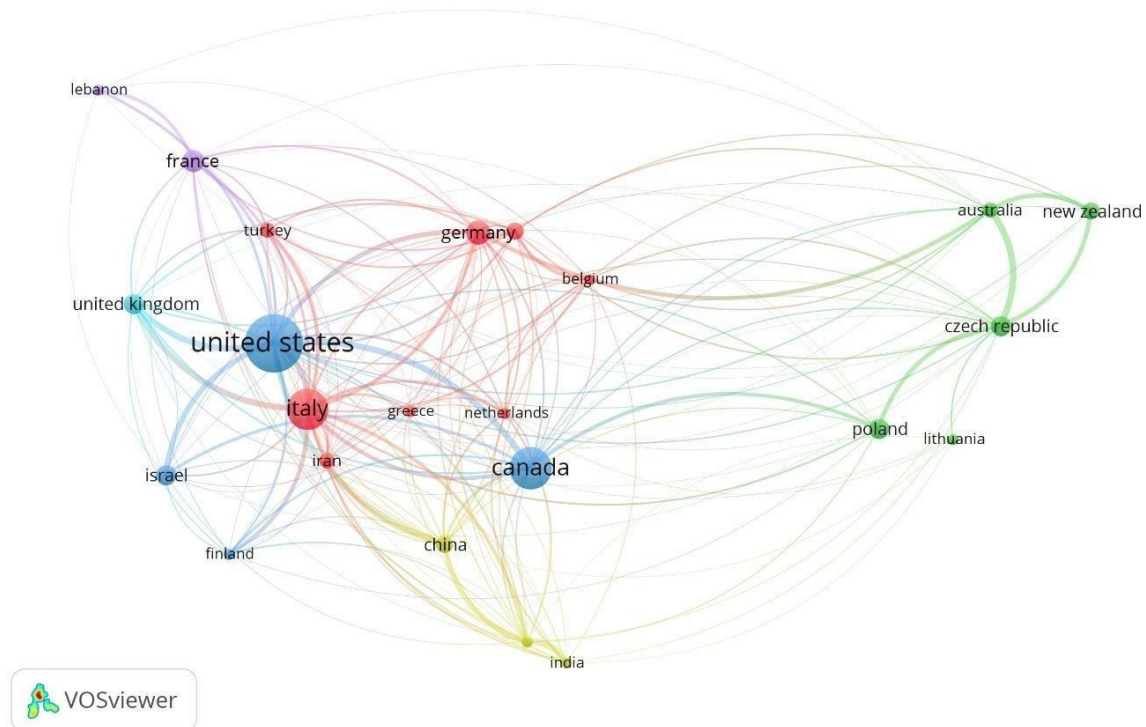


Figure 4. *Co-citations between countries.*

Source: Own elaboration (2022); based on data provided by Scopus

Figure 4 shows how the generation of scientific production is often carried out jointly with authors associated with different institutions that may even be from different countries, which is called International Co-authorship. Thus, the United States, which was the country with the highest number of documents published during the period 2016-2021 according to Scopus, shows important interaction with authors affiliated with institutions mainly from Canada, Israel, and Finland, as well as the United Kingdom. On the other hand, the Czech Republic, Australia, New Zealand, Poland, and Lithuania, make up a group of countries with scientific production in common.

An example of the above in the article entitled “Research on fibrous plant preparation for solid pressed biofuel and determination of pellet indicators” (Streikus et al., 2017) whose aim was to describe the process of biofuel creation starting from fibrous hemp (*Cannabis sativa* L.) and fibrous nettle (*Urtica dioica* L.) - because of their high productivity and undemanding

soil. Three types of fibrous hemp were chosen: Felina 32, USO 31, Finola, and a type of fibrous nettle, thus showing a novel and unusual use of plants associated with cannabis, such as the generation of an effective fuel based on *Cannabis sativa* L, which turned out to be, within this study, the most resistant and therefore of greater benefit when measuring the effectiveness of the biofuel.

#### 4.4 Distribution of scientific production by area of knowledge

Figure 5 shows how the production of scientific publications is distributed according to the area of knowledge through which the different research methodologies are executed.

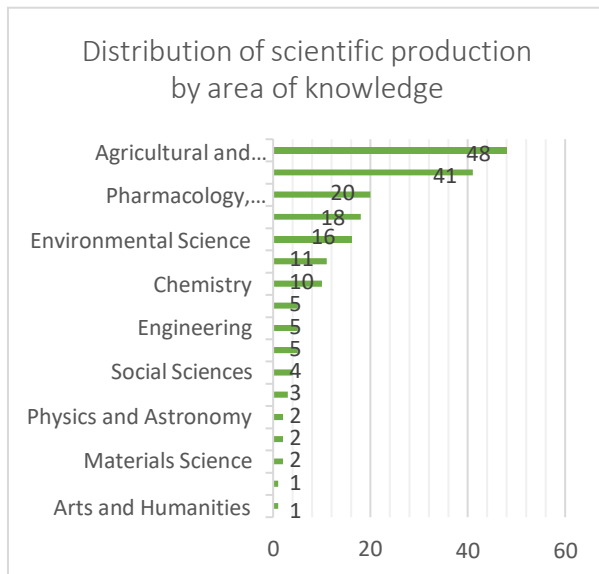


Figure 5. *Distribution of scientific production by area of knowledge.*

Source: Own elaboration (2022); based on data provided by Scopus.

The distribution of the scientific production related to the study of the economic valuation and quality in the productive processes in the industrialization of cannabis according to the area of knowledge allows registering what is the contribution that they generate in the study of the topic proposed in the present research. It is possible to establish that Agriculture and Biological Sciences lead the theoretical contributions in the construction of scientific documents related to the topic, with a total of 48 publications that have based their analysis methodologies on theories derived from this area of knowledge.

Within this group of works registered in Scopus is the article entitled “Cultivation media for the production of medical cannabis in North America” (Nemati et al., 2021) whose purpose was to provide a general description of the most commonly used cultivation media for the production of medical cannabis and to analyze their advantages and disadvantages. To achieve this purpose, the authors decided to classify the production media according to the type of material used in their composition and the stages of plant growth, establishing the categories: coconut fiber-based, peat-based, rock wool, phenolic foam, and living soil. The study concludes by considering the advantages

and disadvantages of each production medium, which does not allow establishing which is the best medium for cannabis production; however, it can be determined that coconut fiber-based products are the intermediate substrates that show the most advantages and the least weaknesses; however, the choice of any of these categories depends greatly on the cultivation technique and the production system.

#### 4.5 Type of publication

Figure 6 shows how the bibliographic production is distributed according to the type of publication chosen by the authors.

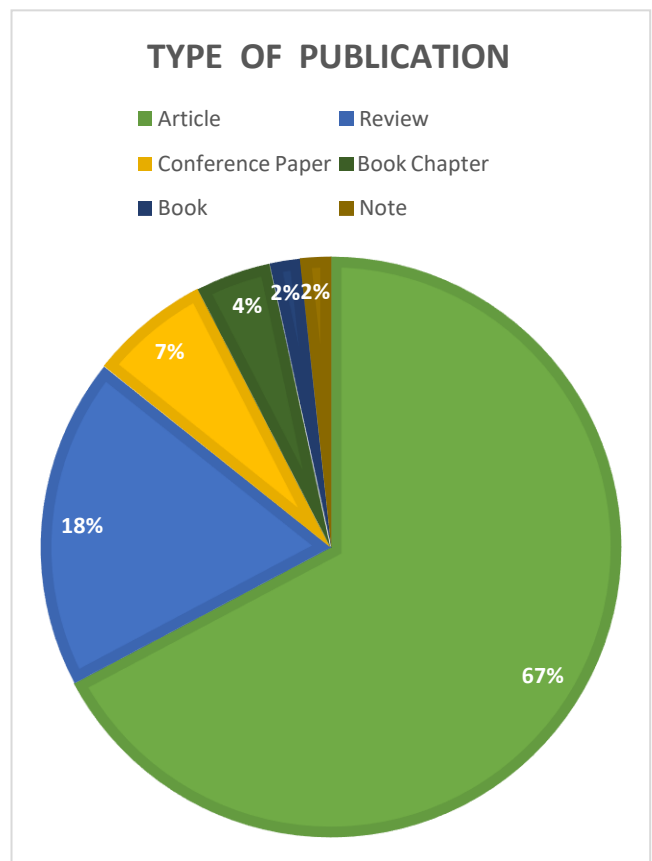


Figure 6. *Type of publication*

Source: Own elaboration (2022); based on data provided by Scopus.

Within the different types of publications that the authors have as alternatives to make known their contributions in the development of new knowledge regarding the topic proposed by this article, it is established that 67% of the total number of publications identified correspond to Journal Articles, 18% to Reviews, 7% to

Conference Articles, within which it is important to highlight the one entitled “Waiting to exhale: Cannabis in Canada - Potential environmental impacts and the regulatory landscape” (Butler et al., 2019) whose purpose was to measure the environmental impact and social perception towards the consumption of cannabis-derived products from its production, which is regulated and seeks to reduce pollution from plantations of said plant.

One of the main problems derived from this type of crop is the odor produced by cannabis during its handling, which is established: The Cannabis Regulation requires cannabis facilities to be equipped with air filtration to “prevent the escape of odors”. However, the odor is more commonly regulated under the Environmental Protection Act (EPA) in Ontario, including considerations of adverse effects and the potential requirement for an Environmental Compliance Approval (ECA). Therefore, this research work hopes to identify the most efficient means for the production of this plant while minimizing the impact on the environment in which the various associated tasks are performed.

## 5. Conclusions

Thanks to the bibliometric analysis carried out in the development of this article, it is possible to determine that within the main characteristics presented by the volume of scientific production regarding the study of the Economic Valuation and Quality of the Productive Processes for the Industrialization of Cannabis during the period 2016-2021 carried out in journals indexed in the Scopus database, the United States was the country with the highest number of publications registered in the said platform during the aforementioned period, so it is possible to infer that within the legislation that governs that country, the scientific analysis of consequences and impacts analysis in the commercialization and consumption of cannabis-derived products, whether for medical or recreational purposes, is contemplated, so the scientific community focuses its efforts on knowing details from the

planting, cultivation, and harvesting to the social impact generated by the consumption of such products.

It is important to highlight that as countries have been legislating in favor of the production and consumption of cannabis for medical or recreational purposes, the scientific production around the subject has been increasing due to the interest of the institutions in measuring all the variables associated with such practice, even more in subjects that involve theories of Agriculture and Biological Sciences, which were the areas of knowledge with the greatest impact in the execution of different research methodologies for the study of the production processes of this plant, which for this document established an important guide in the intention of the different authors cited, which have presented high impact research concerning the entire production line from planting, through the different cultivation techniques, to harvesting, storage, and delivery to the final consumer.

This information represents important material for measuring the quality of cannabis-derived products, which should be measured from the beginning of the production chain, as this determines the purity of each element. Based on this, it was also possible to identify an important number of investigations that evaluate the effects caused on the health of some patients with specific symptomatology to whom cannabis-derived treatments have been assigned, after evaluation by medical personnel specialized in the use of cannabis-derived medicines, thus guaranteeing their success.

This article concludes by reaffirming the importance of knowing the current state of the literature published on the proposed topic, through which it is possible to establish that the interest of the scientific community increases as new theories and evaluation methodologies are generated for the effects of the use of cannabis-derived products in different areas of interest such as recreation or health. Similarly, its impact on the food industry and even in the manufacture of biofuel, so it is possible to confirm the economic viability of cannabis production through legislation that allows this



practice away from the illegality still present in many countries worldwide. It is expected that based on reviews such as the one proposed in this document, the generation of new knowledge will be sought to advance in terms of technology, cultivation and harvesting techniques, health, and food safety, among others associated with the consumption of cannabis-derived products.

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