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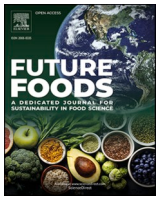

How will artificial intelligence drive marketing in the beverage industry? - A bibliometric literature review

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ABSTRACT

Application of Artificial Intelligence (AI) in the Drinks & Beverages (D&B) industry is becoming increasingly important for the competitiveness of companies in the sector. AI application for Marketing 5.0 in the D&B industry is of growing interest to both researchers and companies. AI-tools allow to create extremely precise market segmentations and satisfy increasingly differentiated consumer preferences or even influence them. However, at present, research on AI for Marketing of companies in the D&B industry is still at an early stage. Furthermore, to the best of our knowledge, there is a lack of systematic and quantitative reviews mapping the scholarly landscape at the intersection of these topics of research. Therefore, in order to help fill this gap, this review is the first study that aims to provide a comprehensive and detailed bibliometric analysis of the scientific literature published to date on the topics of AI for marketing and consumer studies in the D&B sector; in addiction, this study highlights the most discussed connecting themes among the main topics. Scientific co-occurrence maps were provided and Time Series analysis was carried out. Results showed limited number of scientific documents whose primary objective is the study of AI for Beverages' Marketing, despite the likely increase in academic interest in these topics. Machine Learning is the most widely used technology for customer profiling and preference prediction. Findings suggest an interdisciplinary approach for future AI-based marketing research and consumer studies, to provide open tools for personalized marketing tactics and strategies for SMEs.

1. Introduction

As is known, Artificial intelligence (AI) is a branch of computer science concerned with the creation of systems able to perform tasks that would normally require human intelligence. AI can perform highly technical and specialized activities such as robotics, speech and picture recognition, natural language processing, problem-solving, etc.… During the last ten years, AI has applied in multiple fields of research, such as robotics, engineering, medicine, and computer sciences, but also finance, business, decision making, and political sciences, either creative fields, such as the arts (Prasetyo et al., 2024; Huang et al., 2025). From late 2022, with the launch of "OpenAI's ChatGPT" (Kacperski et al. 2025), the practice of AI was increasingly introduced also by entrepreneurs in several business sectors. In fact, in relation to business, researchers have been studying how firms can use AI for economic value creation and appropriation (Climent et al., 2024). Despite several concerns about ethical data usage and potential conflicts in data ownership and quality (Corrales-Garayet al., 2024), algorithmic bias, and costs (Aldoseri, et al., 2023), AI is going to play a major role for the development of mankind (Haefner, et al., 2021).

The beverage sector is one of the most important ones of the agri-food industry and includes production, distribution, and marketing of products in liquid form for human consumption, including alcoholic and non-alcoholic beverages. This sector integrates a wide array of product categories such as bottled water, soft drinks, juices, coffee, dairy-based drinks, energy drinks, beer, wine, and spirits. It plays a central role in the global economy, driven by complex supply chains, technological innovation, and shifting consumer preferences, particularly in relation to health, sustainability, and lifestyle trends (Agnoli et al., 2025; García-Barón et al., 2025).

The alcoholic beverage industry, including wine, beer and spirits, represents the most economically significant and culturally embedded category (WHO, 2023). It accounts for the largest share of global beverage revenues and it is a key driver of value creation, branding strategies, and international trade (Statista, 2025). According to market researches, alcoholic beverages have a consistent market value at global level and high profit margins, especially in developed and emerging economies. Moreover, the beverage industry is characterized by high

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levels of consumer engagement, brand loyalty, and marketing innovation, and is well suited for data-driven strategies, including the use of artificial intelligence in high personalization and predictive modeling (Swaminathan et al., 2024).

The Beverage industry faces increasing competition, and rapidly evolving consumer preferences that compel businesses to adopt innovative technologies to remain competitive (de Oliveira et al., 2021; Niu et al. 2024). For this reason, in the beverage industry the application of AI's algorithms is expanding rapidly and transforming various aspects of beverage supply chain, such as production, distribution and consumption. AI's ability to analyse vast amounts of data in real-time provides critical insights into market trends, consumer behaviour, and supply chain dynamics, enabling beverage companies to create tailored marketing strategies with personalized relationships with customers (i.e. marketing 5.0). For example, AI-powered predictive analytics can anticipate seasonal demand fluctuations, optimize resource allocation, and identify emerging market opportunities (Rajawat et al., 2025; Hossain 2024). In particular, the combination of AI and Marketing 5.0 becomes a strategic tool to respond to the growing demand for authentic and tailored experiences in an increasingly fragmented and competitive market. In fact, in line with the principles of Industry 5.0, which focuses on human-machine cooperation and advanced personalization, Marketing 5.0 represents a new age in which businesses use intelligent technologies not only to optimize processes, but more importantly to create highly personalized and relevant customer experiences (Alhassan et al., 2025; Bakator et al., 2024). According to Alhassan et al. (2025), Marketing Industry 5.0 is characterized by a strong integration between automation and humans, aiming to enhance the centrality of the customer experience through predictive tools, behavioural analytics, and empathic interactions (this is possible through conversational AI models, robotics machine learning algorithms). In parallel, Kumar et al. (2025) highlight how the core of Marketing 5.0 lies in the adoption of technologies that mimic human cognitive and relational capabilities, such as intelligent chatbots, recommender systems, and sentiment analysis technologies, enabling companies to understand and anticipate consumer needs in a sophisticated way. In the specific context of the beverage and wine industry, this approach opens up new perspectives for personalized marketing, enabling companies to intercept emerging trends, accurately profile consumers, and build more effective data-driven strategies. Therefore, nowadays Marketing 5.0 is an emerging paradigm in the context of digital transformations driven by Artificial Intelligence, and it will have an increasingly central role in modelling interaction between businesses and consumers.

Despite its numerous benefits and advancements, and its high potential of development and innovation, at the present time, the application of customized AI for marketing strategies in the beverage sector appears very restricted so far, and these topics have not yet been fully investigated by academics. Existing studies tend to focus on AI in general marketing contexts (Haleem et al., 2022), without adequately addressing the unique characteristics and challenges inherent to the beverage industry. These include factors such as sensory experience, emotional branding, and strong regional identity, which require tailored AI-driven marketing approaches, especially in younger people (Hasim and Mohd Nazri, 2025). Furthermore, to date, there is a lack of systematic and quantitative reviews that map the scholarly landscape at the intersection of AI, marketing, and beverage research. This absence limits understanding of how research efforts are structured and interconnected, as well as which topics are gaining momentum. In addition, empirical evidence examining the impact of AI-enabled marketing tools on consumer behavior in the beverage domain is scarce. Few studies have investigated how consumers perceive, interact with, and respond to AI-driven personalized marketing tactics (Lu et al., 2024) within this sector. Another critical gap is the scarcity of sector-specific theoretical frameworks and conceptual models that could guide businesses in adopting AI technologies aligned with the Marketing 5.0 paradigm. While Marketing 5.0 emphasizes human-AI collaboration, personalization, and empathetic consumer engagement, there is limited research translating these principles into practical models tailored to beverage marketing. Finally, researchers, entrepreneurs and stakeholders would benefit of more multidisciplinary research that bridges computer science with marketing and food sciences, allowing the development of sophisticated, context-aware AI applications to address the complexities of beverage production, distribution, and consumption.

To provide valuable knowledge and contribute to filling these gaps, the existing scientific literature was analyzed. A bibliometric literature review was carried out with the aim to quantitatively assess the impact, structure, and trends of scholarly work on the combined topics of "Artificial Intelligence and Marketing/Consumer for Beverages" and highlight the most discussed subjects of linkage among various research fields. In fact, these emerging topics of investigation will be able to guide future research directions.

Based on these research gaps and aims, the following questions guided this study:

(1) "How does the adoption of AI in the beverage sector may impact the businesses' marketing?"
(2) "What are the actual trends and linked topics related to AI applications for marketing in the beverage sector?"

these guiding questions were sub-divided into specific research questions.

Table 1 shows the research questions and rationales.

As far as we know, this study is the first bibliometric review on these research topics. Results may be useful to researchers and entrepreneurs who are interested in the application of AI for marketing in the beverage industry. In fact, results may contribute to suggesting researchers develop new and pioneering innovative tactics using AI for marketing strategies of companies in the beverage industry and suggest prospective directions for future research on linked and networked topics of interest for companies and stakeholders in the beverage industry.

1.1. Literature review about AI and marketing

Artificial intelligence is redefining the paradigms of marketing (Huang and Rust, 2021), offering transformative tools that enable companies to offer highly personalized and data-driven experiences. When applied to standard commercial processes, these technologies can learn, act, and perform with human-like intelligence. These tasks

Table 1
Research questions and rationales.

	Research questions	Rationales
RQ1	What is the state of the art of scientific literature in terms of annual publications, geographical distribution and most referenced documents in the field of AI for Beverage marketing research?	This will provide an overall picture for literature, including trends and themes, the most influential countries and the most impactful publications in the field of AI in marketing research.
RQ2	What are the most discussed trends and topics by authors in academic literature regarding the application of AI in the beverage industry for marketing and consumer sciences?	Thematic clustering through the co-occurrence analysis will provide insight into the principal AI technologies applied and their influence and specific field of application in relation to marketing/consumer science.
RQ3	What are the gaps and critical points in current literature and what are the progressions of AI in marketing and possible future research directions and linked topics?	AI technologies for beverage marketing are still in their early stages, so there are still significant limitations on their diffusion. At the same time, because they are still less developed, they offer researchers a wide margin of freedom to explore their different dimensions and applications.

include language recognition, problem solving, learning, visual perception and decision making. The AI Machine Learning (ML) sub-domain focuses on designing algorithms capable of learning from data and improving their performance over time without being explicitly programmed (Jordan and Mitchell, 2015). This approach is based on identifying patterns in the data, using techniques such as supervised, unsupervised and reinforcement learning. For example, ML is used to predict user preferences inside the recommendation systems used by platforms such as "Netflix" and "Amazon".

The integration of AI in marketing encompasses a wide range of applications, from the automation of repetitive tasks such as customer segmentation and email campaigns to the possibility of dynamic pricing strategies and real-time customer interactions through AI-based chatbots. These innovations not only improve business performance but also foster deeper connections between brands and their consumers, offering hyper-personalized experiences (Jarek and Mazurek, 2019; Khadka et al., 2024).

Most of the AI applications in marketing nowadays employ Machine Learning to personalize product suggestions, to assist customers in discovering the most successful promotion channels, to estimate customer churn rate or lifetime value and create superior customer groups, to optimize operations, discover hidden information about consumers and create targeted campaigns with extraordinary precision (Khadka et al., 2024). Thanks to these advances, businesses may interact in real time with their customers and thus reshape traditional marketing actions and tactics (Halem et al., 2022).

Some authors studied the impact of AI-based recommendations and interactions at every stage of the online shopping experience (Tairov et al., 2024; Al-Otaibi, 2024). Other authors proposed a new AI system that provides real-time insights into tourist preferences and experiences, enabling targeted interventions and improvements (Alzahrani et al., 2025). Furthermore, the integration of AI into marketing requires substantial investments in infrastructure and training, along with overcoming resistance to change among stakeholders (Gupta et al. 2025). In digital marketing, AI has revolutionized engagement strategies by driving hyper-personalized content, chatbot integration, and automated advertising campaigns (Bathia, 2021). Personalized recommendations and voice-assistant technologies further enhance customer experiences, aligning with individual preferences (Dumitriu and Popescu, 2020). A recent study highlighted the potential high relevance of the use of AI in the strategic marketing and management of wine firms (Festa et al., 2025). Moreover, in digital Marketing, AI influencers, also known as "virtual influencers", are revolutionizing digital communication (Ingrassia et al., 2022a) by leveraging AI technologies (like machine learning and natural language processing) and could soon replace even the most expert and followed Wine Influencers (Ingrassia et al., 2020). However, these innovations will contribute to enforce connections between wine brands and their consumers, although they raise issues related to authenticity, transparency, and ethical considerations (Güzel, 2025). Therefore, despite AI numerous benefits, ethical considerations, such as data privacy, transparency, and potential biases in AI algorithms, need to be addressed to ensure responsible usage (Saura et al., 2024; Davenport et al., 2020).

2. Methodology

For this study a bibliometric methodology was applied to evaluate quantitatively the existing corpus of scientific literature up to and including 2025 (up to the date of completion of the study) and highlight the main fields of research and topics thematically linked to those of Artificial Intelligence and Marketing/Consumer Sciences in the Beverage sector.

2.1. Study design

For this study the PRISMA protocol was applied (Naila et al., 2024; Reitano et al. 2024; Trabelsi et al. 2023; Usman et al., 2024) because it is widely used for bibliometric reviews, since it provides transparency of the methodological steps and replicability of the procedures followed (Bellia, et al. 2022). In fact, this protocol allows extracting relevant documents from scientific database through specific steps that helps researchers to simplify the extraction rules and validate results.

For the scientific literature research, the Elsevier-Scopus and the Clarivate-Web of Science (WoS) databases were used (Bellia, et al. 2022). The Elsevier-Scopus database was chosen because it provides the most thorough global overview of research outputs in multidisciplinary areas and at the same time contains the greatest collection of academic research publications of acceptable quality (Bellia, et al. 2022). In addition, the Clarivate-Web of Science database was used because it contains a high number of indexed journals of medium–high quality (Bellia, et al. 2022). The combination of these two databases helped to increase the probability of identifying all relevant scientific contributions in the chosen topics and the quality of searching and selection procedure. In fact, the choice to combine these two databases allowed greatly reduce any type of bias in the selection of data sources, as it ensured an adequate number and model of document classification according to the purpose of this study. Among other the scientific databases, for example, "Google Scholar" database was excluded because it indexes also non-scientific papers. Additionally, the "PubMed" database is more specific for collecting biomedical literature and therefore it appeared not suitable for this investigation. Moreover, by using internationally accepted and widely used indexing services, we ensure that the methodology is replicable by other researchers. Non-indexed journals may contain valuable insights, but the goal is to capture trends in international and peer-reviewed research in the beverage industry, particularly relevant to the study of topics such as technology adoption, marketing innovation, and applications of artificial intelligence in beverages. The inclusion of non-indexed sources could introduce heterogeneity that is difficult to manage in a rigorous review framework.

Basing on existing literature on the fields of Marketing and Consumer sciences in the beverage sector, the most suitable thematic keywords were identified with the aim to make a search of the existing scientific literature on the combined topics of "Artificial Intelligence and Marketing/Consumer for Beverages" (Potwora et al., 2024; Basrowi and UTAMI, 2023; Vitsentzatou et al., 2022).

Bibliometric literature review requires that a proper set of thematic keywords for the extraction of documents are clearly defined and reported in the methodology section (Soaita, Serin, and Preece, 2020). For the identification of the set of thematic keywords numerous tests were carried out by using different sets of keywords and keywords' combinations in the two scientific databases to highlight number and topic of documents obtained time after time. After several pre-tests, it was identified as optimal the following combination of thematic keywords: "ARTIFICIAL INTELLIGENCE"; "AI"; "BEVERAGE"; "WINE"; "SPIRITS"; "BEER"; "MARKETING"; "CONSUMER".

2.2. Query construction

The query is a string of code that uses the previously identified thematic keywords and sets them up in the best possible way to obtain the finest collection of results related to the research topic. The final set of keywords, identified after tests, was used to build the query and provided the best result for number and topic of documents. According to previous studies (Bellia, et al. 2022), the thematic keywords used in Abstracts, Titles, and Keywords of documents, are essential and very crucial for the identification of topics covered and discussed by authors in the documents.

For this study two specific queries were built for the bibliometric search, the one for searching in the Elsevier-Scopus database and another different one for the search in the Clarivate-Web of Science (WoS) database.

Therefore, the query identified and used to conduct this bibliometric

literature research on the Elsevier-Scopus database was the following:

TITLE-ABS-KEY: ("AI" OR "ARTIFICIAL INTELLIGENCE") **AND** ("WINE" OR "BEER" OR "SPIRITS" OR "BEVERAGE") **AND** ("CONSUMER" OR "MARKETING")

Similarly, in consideration of the different method of search that uses the topic as extraction key, the query identified and used to conduct the literature research on the Clarivate-Web of Science database was the following:

TOPIC ("ARTIFICIAL INTELLIGENCE" OR "AI") **AND TOPIC** ("WINE" OR "BEER" OR "SPIRITS" OR "BEVERAGE") **AND TOPIC** ("CONSUMER" OR "MARKETING").

2.3. Selection of thematic areas of research and exclusion criteria

Due to the scope of this review, the documents' search in the scientific database was refined, limiting it in the fields of Agricultural and Socio-Economic sciences.

These branches of research consisted of different topic categories on the Elsevier-Scopus database and on the Clarivate-Web of Science database.

In particular, with regard to the Elsevier-Scopus database the chosen topic categories were: "Agricultural and Biological Sciences", "Business, Management and Accounting", "Decision Science", "Economics, Econometrics and Finance" and "Social Sciences".

Similarly, the results obtained from the Clarivate-Web of Science database were limited to the following topic categories: "Agriculture Multidisciplinary", "Agronomy", "Automation Control Systems", "Behavioral Sciences", "Business", "Communication", "Economics", "Education Educational Research", "Environmental Sciences", "Food Science Technology", "Green Sustainable Science Technology", "Hospitality Leisure Sport Tourism", "Management", "Multidisciplinary Sciences", "Nutrition Dietetics", "Operations Research Management Science", "Plant Sciences", "Telecommunications".

For this review, the only exclusion criterion applied, apart from duplicates and out of scope, was the language used. The selection was limited to the scientific documents in English language because of their potential wider diffusion (English is the typical language of science) and because English language guarantees greater visibility and citability to publications, given the innovative topic. However, no others geographical or temporal exclusion criteria were applied.

2.4. Co-occurrences analysis

Science mapping is especially suitable for knowing the intellectual structure of a specific research field or topic of interest. This type of mapping is a spatial representation of the links between the scientific papers extracted basing on the "co-occurrence" of specific words, or thematic keywords, in the documents. In this study Science Maps were performed and commented for the extracted documents using "VOS viewer" Software (Chen, 2017) because it is a robust software tool mainly used to construct and visualize bibliometric networks (Kirby, 2023). The VOS viewer software calculates the weight (weighted frequency) of all the keywords selected and displays the greatest number of "thematic networks" (i.e. "nodes"). Each node is a cluster; different clusters of nodes are represented by different colors, among other "new" words (or topics) which are connected to the initially selected keywords. The importance of a node is signified by its position in the network and by the thickness of the bond (Bellia, et al. 2022). The links between nodes indicate that the words appear together, and the thickness of the links means the strength of the link based on the frequencies of the co-occurrence of the connected nodes. This representation helps to visualize the research topics of connections among documents.

2.5. Time series analysis

Time series analysis is a method used to analyze and interpret data points collected at successive time intervals (Hamilton, 2020). It is generally applied in economic analysis to time-ordered data with the goal of learning about underlying patterns, in the form of trends, seasonal variations, cyclical behavior over time, but also the possible existence of irregular long-term fluctuations in the data (often related to economic cycles or business conditions), or random variations or irregular fluctuations in the data that do not follow any predictable pattern. Common time series analysis techniques include decomposition of the time series into trend, seasonality and noise components, prediction of future values based on past values, moving averages and exponential smoothing. In this study, a time series analysis was carried out to help have an insight into the possible and most accurate future trend of the observed phenomenon, based on past values and possible existence of irregularities in the data due to the characteristics of the phenomenon. This analysis allows to explain the significance of the past trend and highlight the underlying structure of the specific time series analyzed. Time series analysis was performed using the SPSS IBM software, v.21 by applying the "Expert Modeler", a SPSS tool that uses specific algorithms to automate the data analysis process (Wendler and Gröttrup, 2016).

This tool analyzes the characteristics of the input time series and selects the most appropriate model from a predefined range of Auto-Regressive Integrated Moving Average (ARIMA), exponential, and seasonal models, estimating the optimal parameters. The use of Expert Modeler is particularly useful in application contexts where the main objective is to obtain robust and interpretable forecasts quickly, while ensuring good statistical quality of the selected model (Wendler and Gröttrup, 2016). Moreover, the Expert Modeler is considered most suitable when there is no a priori idea of what the shape of the trend might look like (McCormick and Salcedo, 2017). For this study, considering the innovative nature of the topic, the Expert Modeler appeared the most suitable and effective tool in the model selection phase.

3. Results of bibliometric analysis of literature

Fig. 1 shows the inclusion-exclusion criteria applied by using the PRISMA protocol for the bibliometric review. Following the stated criteria $N = 109$ documents were extracted, which constitute the final dataset for this review and will be the basis for analysis below.

Fig. 2 shows the number of publications by year, from 1994 up to the end of 2024. 2025 was not considered because it did not end at the time of the extraction (February 2025). The 1994 is the first year of publication of documents on the combined topics of "Artificial Intelligence and Marketing/Consumer for Beverages". Until the first decade of 2000s, the number of publications was slight, about one article per year, instead, from 2018 it is possible to note a progressive growth of scientific documents published until 2023. In 2024 results show a peak in the number of publications (29), more than double compared to the previous year (13). The meaning of this result is that the topic of AI for "Marketing" in the beverage sector began to appear in the early 90 s and, in recent years, it gained the greatest interest (from 2017 to 2024).

In addition, Fig. 2 shows a 5-year forecast for the number of published documents, which is visible as the blue line, by applying the time-series analysis. As can be seen, the forecast model suggests that a continuous growth in the number of documents per year may occur in the future, showing a positive trend until 2033.

Table 2 shows the distribution of extracted documents by document types. Scientific articles are more prevalent; however, the considerable number of conference papers shows that the topics are of interest to the scientific community. Furthermore, as we can see, there are already five books and various sections of books published.

These results highlight that the implementation of AI in the SCs of

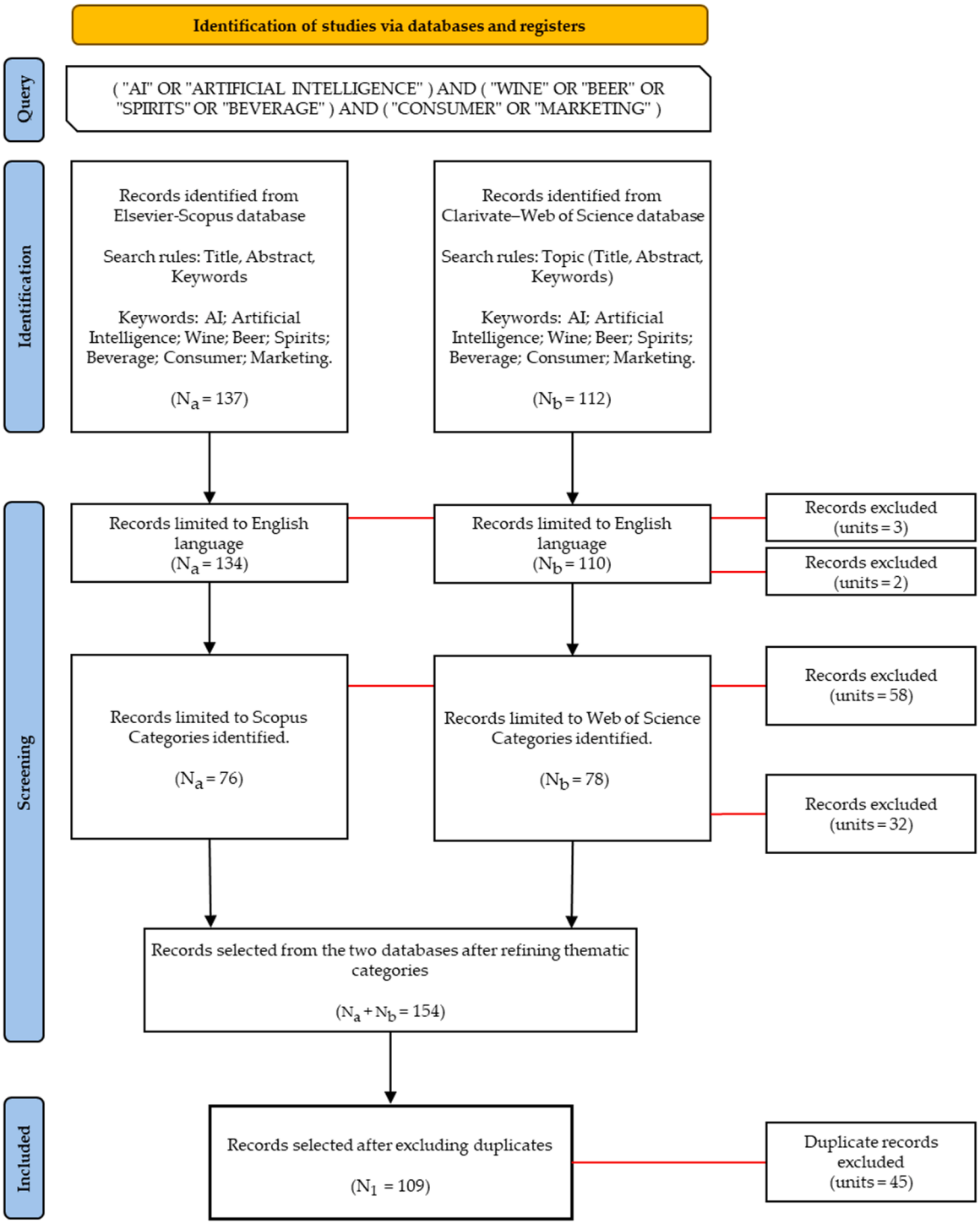

Fig. 1. Inclusion and exclusion criteria using PRISMA protocol.

"Economics and Marketing" is still in its preliminary stages in general, because it is a topic that, so far, has been addressed the most, in terms of AI technological development and not of its application to marketing.

Fig. 3 illustrates the percentage distribution of published scientific documents among specific scientific subject categories (SCs), in fact, the observed documents may refer to more then one scientific category. Despite the refined query, such relevant heterogeneity is observed among the scientific SCs of the documents identified, actually, Artificial Intelligence for marketing/consumer purposes in the sector of beverage is discussed in several different SCs but only in few documents.

The research subject category "Agricultural and Biological Sciences" lead with 20.3 %, it is the scientific field with the major share of published documents; "Business, Management and Accounting" is the second SC with the 15.1 % of documents. However, the 29.7 % of articles are included in the SCs "Computer Science", "Decision Sciences" and "Engineering", although the query was constructed to focus on topics consumer and marketing. It is interesting to note that there is a deep focus on "Agriculture and Biology sciences" and "Business, Management and Accounting", suggesting that these SCs are those where these combined topics are most discussed.

Fig. 4 is a geographical distribution (using a gradient color scale) of the extracted scientific documents by the corresponding author's

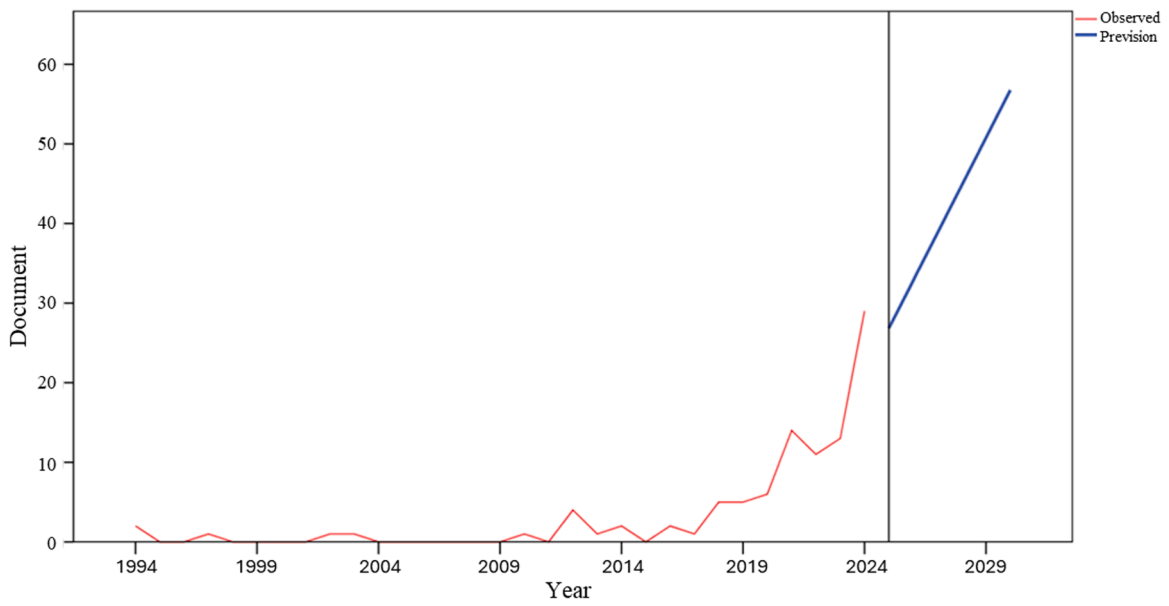

Fig. 2. Time-series analysis of published documents, forecasting model to 2030, processing by expert modeler, SPSS statistical software (v.21).

Table 2
Distribution of documents by typology.

Type of document	Number	Percentage
Scientific Articles	80	73.39 %
Conference's Papers	18	16.51 %
Book's Sections	6	5.50 %
Books	5	4.59 %

research institution of affiliation. This figure shows that the most of scientific documents have authors affiliated to Australian research centers (13 documents), following by United States (11 documents) and India (8 documents). United Kingdom (8 documents), Italy (7 documents) and France (5 documents) are the main countries of the main countries of dissemination of research on these topics in Europe, which is an interesting result, despite the smaller number of universities and research centers compared to the USA, India and Australia.

This result reflects a high interest of academics and researchers in the topics investigated. However, the geographical disparity is evident, and large gaps were observed for Africa and in some parts of the Latin America, maybe because of the economic and technological backwardness of these countries that focus research interests on other topics than these ones.

Table 3 shows a partial list of documents extracted by title, year of publication and number of citations, consisting of 20 articles out of the total dataset. It is interesting to note that the article with the highest number of citations (128) is not recent, but it was published in 2012 and is off-topic with respect to the investigated topics, moreover, several documents are not strictly related to the research topics.

A relatively large number of documents dealing with technology and quality in the beverage industry were found, however, no documents concerned specific marketing studies for beverages products or for companies in the beverage industry. Only two documents focused on tourism (n. 4,5). Additionally, as can be seen in Table 3, the documents about technological topics are the most cited (n. 1,2,3,6,7) and stimulate debates on these subjects. In fact, the most cited documents are related

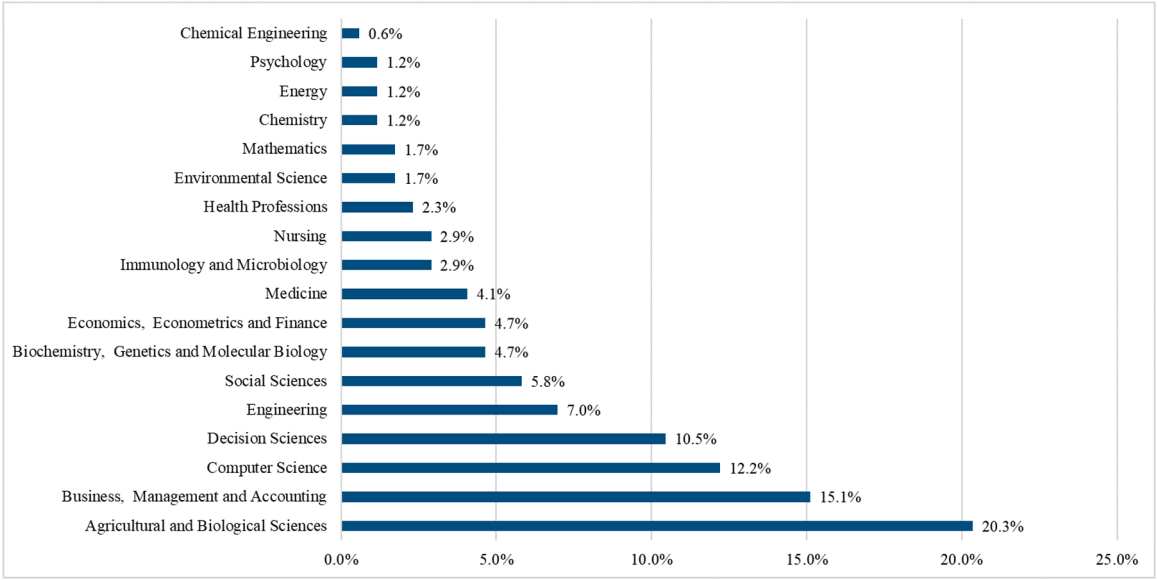

Fig. 3. Percentage of scientific documents matched to the different scientific subject categories, according to the classification of the two scientific databases.

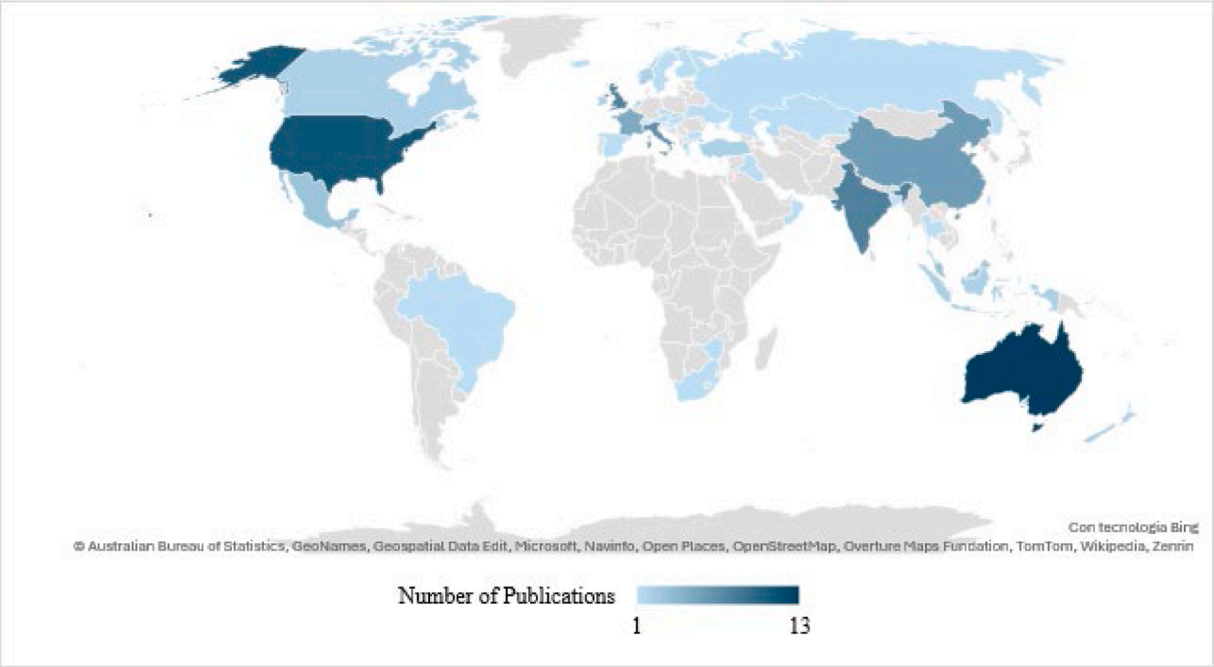

Fig. 4. Geographical distribution of corresponding author's affiliated institutions in selected documents.

to other branches of research rather than marketing. Contrarily, the documents that discuss specific topics like AI and beverage marketing or AI and consumer are more recent and thus more rarely cited and with a limited influence on the scientific debate (n. 4,5,6,18).

These findings highlight that, despite the application of the search query with keywords marketing and/or consumer, the documents extracted are not fully in line with these research topics, confirming the existence of a gap in the scientific literature about studies on AI uses for developing marketing strategies in the beverage sector.

Fig. 5 shows the co-occurrences' map for the analysis of links (i.e. nodes or clusters) among thematic keywords. As described in the Methodology paragraph, the selected thematic keywords were searched from Titles, Abstracts and Keywords of each of the 109 documents extracted. The Science Map (Fig. 5) reveals distinct thematic clusters, each of them corresponding to a group of research topics (nodes). Different colours signify affiliation to clusters. Nodes denote topics linked together and their size indicates the frequency of occurrence of each topic. Thickness of the lines between nodes (links) reflects the strength of co-occurrence links. The nodes linked to each other in Fig. 5 highlight four research branches of interest related to AI and marketing/consumer topic in the beverage industry.

Table 4 shows the four thematic clusters labelled by authors according to the main topics discussed and for each group, the "topics of connection" among the thematic research areas (clusters) where indicated (linkage topics, Table 4).

Cluster 1 (red) is the largest one and it includes keywords such as "Artificial Intelligence", "consumers", "behavior", "trust", "acceptance", "perception", "willingness to pay", and "consumption". The clustering of these keywords based on their co-occurrence highlights a clear focus of the research on the behavioral and psychological aspects of the adoption of AI in the beverage industry. Studies in this cluster frequently explore how AI technologies influence consumer decision-making, willingness to accept technology and perception of quality (Khadka et al., 2024). This finding suggests that consumer's "trust" and "perception" are crucial components (Nazzaro et al., 2024) in the successful implementation of AI-driven marketing strategies and for evaluating market responsiveness.

The green cluster (Cluster 2) is the second one in terms of number of nodes and co-occurrences. It includes the keyword "beverage" and other topics like "nutrition", "risk", "health" and "body mass". This cluster of research reflects health-oriented studies related to beverages, with particular attention to nutritional profiling of products. In this context, this clustering indicates potential use for artificial intelligence to adapt marketing campaigns to specific consumer health segments and profiles. In addition, the connections between terms such as "human," "risk," "health," and "nutritional assessment" highlight a field of research focused on studying the effects on human health of beverage products' consumption, including fermented ones, such as wine and/or beer. Such studies are often carried out besides microbiological analysis and assessments, especially in relation to the presence of probiotics, microbial contaminants, or fermentation residues, which are elements that can influence the nutritional profile and safety of final products.

The main keywords highlighted in Cluster 3 (blue) are "marketing", "wine", "beer", "big data", "data analysis" and "commerce". This thematic group highlights the application of AI technologies in specific beverage categories — especially wine and beer — and focuses on improving marketing strategies using data mining techniques applied to big data regarding markets and consumers. It is interesting to note that the keyword "wine" is a medium sized node, this indicates a high number of co-occurrences (15 co-occurrences) of this topic.

This result suggests that "wine" is one of the most discussed topics within the beverage industry so far, indicating a high level of interest of the scientific community.

Furthermore, the presence of the keyword "blockchain" in Cluster 3 (blue) linked to "wine" and to "marketing" highlights the interest in keeping detailed records of wine production and distribution phases, for traceability purposes, which are perceived as a guarantee of quality, authenticity, safety, and transparency, but also the interest in knowing client interactions, reviews and evaluations, in order to monitor consumer satisfaction (Swaminathan et al., 2024).

In a single separate group, Cluster 4 (yellow), the clustering of the keywords "machine learning", "computer vision", "algorithms", "robotics", "automation" and "deep learning" indicates the relevant presence of different AI technologies used in the beverage sector. This cluster focuses on the development of AI-based systems for processes' automation and quality assessment. This finding suggests well-established

Table 3
List of the most cited articles belonging to the extracted dataset (109 documents).

ID	Title	Year of publication	Number of Citations
1	Antimicrobial impact of the components of essential oil of Litsea cubeba from Taiwan and antimicrobial activity of the oil in food systems	2012	128
2	Mining logistics data to assure the quality in a sustainable food supply chain: A case in the red wine industry	2014	119
3	The Evolution and Future of Retailing and Retailing Education	2018	117
4	Travelling the Metaverse: Potential Benefits and Main Challenges for Tourism Sectors and Research Applications	2023	97
5	The digital skills divide: evidence from the European tourism industry	2023	92
6	Recent advances and applications of artificial intelligence and related technologies in the food industry	2022	76
7	Development of artificial neural network models to assess beer acceptability based on sensory properties using a robotic pourer: A comparative model approach to achieve an artificial intelligence system	2019	74
8	"Alexa, order me a pizza!": The mediating role of psychological power in the con sumer–voice assistant interaction	2021	63
9	Emerging technologies based on artificial intelligence to assess the quality and consumer preference of beverages	2019	63
10	Shifts in consumer behavior towards organic products: Theory-driven data analytics	2021	59
11	A tale of two recommender systems: The moderating role of consumer expertise on artificial intelligence based product recommendations	2021	56
12	Robotics and computer vision techniques combined with non-invasive consumer biometrics to assess quality traits from beer foamability using machine learning: A potential for artificial intelligence app lications	2018	54
13	Bubbles, foam formation, stability and consumer perception of carbonated drinks: A review of current, new and emerging technologies for rapid assessment and control	2019	37
14	Novel digital technologies implemented in sensory science and consumer percep tion	2021	36
15	Smart detection of faults in beers using near-infrared spectroscopy, a low-cost electronic nose and artificial intelligence	2021	30
16	Low-cost methods to assess beer quality using artificial intelligence involving robotics, an electronic nose, and machine learning	2020	29
17	Beer aroma and quality traits assessment using artificial intelligence	2020	28
18	The impact of different types of service robots usage in hotels on guests' intention to stay	2023	25
19	Drinking water intake is associated with higher diet quality among French adults	2016	24
20	Towards Extracting Drug-Effect Relation from Twitter: A Supervised Learning Approach	2016	20

research about the integration of AI tools and technologies into the different production/transformation phases, with the aim of improving efficiency and accuracy in the companies and throughout the beverage supply chain.

Moreover, it is interesting to note the marked interconnection between the blue and the yellow clusters, which highlights the convergence of topics like "machine learning", "computer vision", "quality control", "automation" and "sensors". This is a research branch strongly oriented towards AI-based technologies development for quality control and microbiological monitoring in real-time. In relation to this aspect, AI technologies are often applied to automate and guarantee quality control, to optimize fermentation processes (e.g., for wines or craft beers), and to support contamination control along the supply chain. In addition, non-destructive techniques (e.g., spectroscopy, hyperspectral imaging, machine vision) are applied to identify microbial alterations. Moreover, the use of predictive algorithms enables us to estimate beverage quality, as in a variety of studies conducted on wine in relation to microbial shelf-life, also enabling improved biohazard management, thus contributing to the maintenance of high quality and safety standards of products.

The very interesting finding is that the keyword/node "artificial intelligence" occurs centrally in the Science Map, with the highest value of co-occurrences (42 co-occurrences). In fact, this topic is multiply connected, and it is likely as a bridge between all the thematic clusters.

This finding outlines its central and interdisciplinary importance in relation to the technological and strategic dimensions of the marketing strategies in the beverage industry.

However, the topic, "marketing" (39 link strengths) is one of the least discussed keywords in scientific literature so far, with few connections and relatively few occurrences, demonstrating how this topic is still not very well established. However, "marketing" node is linked with the AI topic and with "wine" and "big data" topics, highlighting the prevalent use of AI for marketing in the wine sector, which appears more plausible for its specific tailored marketing strategies.

A solid implementation of AI technologies can be observed for the qualitative and technological side of production, which is the greatest of those investigated (Table 3). Moreover, yellow clusters (Fig. 5) are closely linked with red and blue clusters, indicating that product technological advancements and quality development are being made for the market and consumer satisfaction. Additionally, the close connection between the red and blue clusters indicates that consumer perception and trust are critical to the effectiveness of AI-driven marketing strategies.

Finally, the intersection between the red and green clusters (Fig. 5) reflects the growing importance of health and nutrition in shaping consumer behavior and preferences for beverages.

To confirm the analysis by the Science Map, a quantitative analysis of keywords was conducted. Fig. 6 shows a bar chart with the most frequently occurring keywords and their co-occurrence's strength with other nodes in the dataset. "Artificial intelligence" appears the most prominent keyword with 42 occurrences and the highest total link strength (132), confirming the interest of researchers in the selected scientific fields with regard to the use of AI for beverage industry. "Beverage" and "human" (99 - 92 total link strength respectively) are two other very used topics, this demonstrates that researches were conducted on the application of AI tools in the beverage industry for aims related to the consumer. Keywords such as "machine learning" (16 occurrences, link strength 72) and "computer vision" (12 occurrences, link strength 61) indicate a significant prominence on specific AI methodologies. These techniques are likely applied to tasks such as quality control and consumer behavior analysis. The "Consumers" keyword (76 link strength) is strongly connected and centrally positioned in the map, among "artificial intelligence" and "beverage" (Fig. 5), this highlights the interest of researchers on consumer engagement. The high link strengths associated among "artificial intelligence", "machine learning", "beverage", "quality" and "consumers" keywords suggest that these fields are frequently discussed and highly interconnected within the literature. This highlights the multidisciplinary feature of the topics investigated. There is an integration of AI technologies for marketing strategies and consumer behavior analysis, but at the same time there is a coexistence of terms related to technology

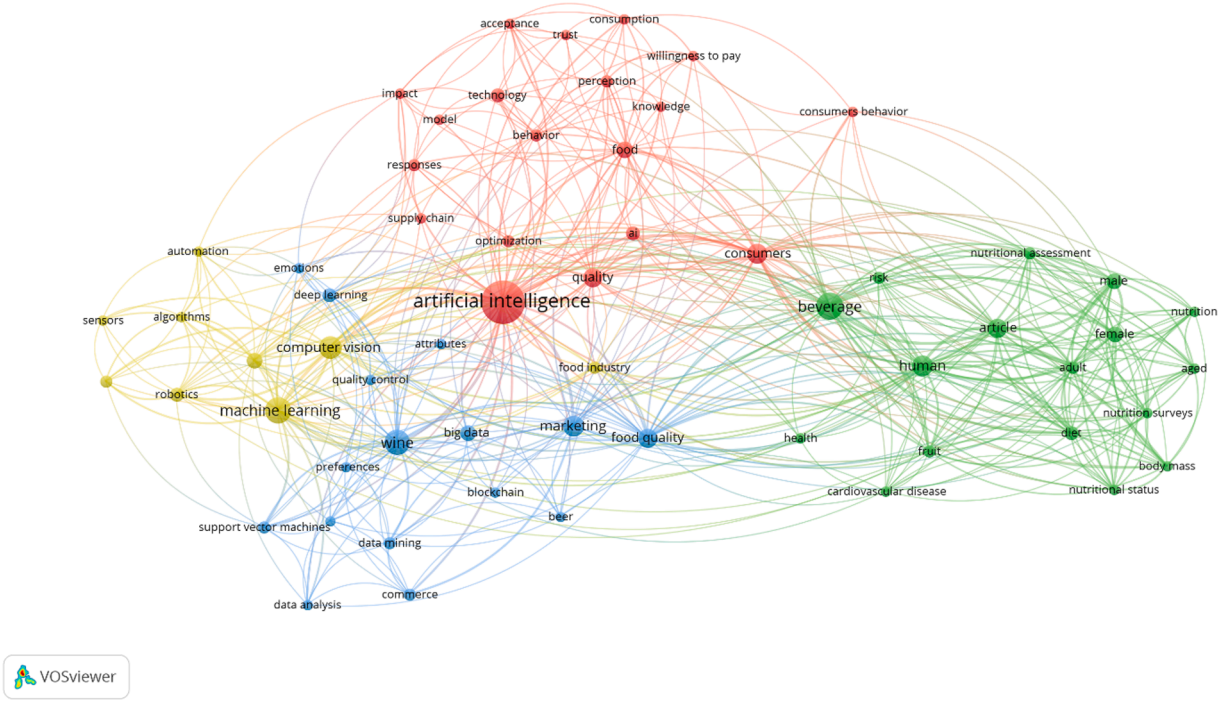

Fig. 5. VOS viewer output of keywords' co-occurrences in the 109 documents extracted from Elsevier and WoS databases.

Table 4
Clusters information for bibliometric analysis.

Cluster	Color	Items	Label	Linkage topics
1	Red	19	Artificial Intelligence and Consumer Behaviors (acceptance, willingness to pay)	"beverage", "wine", "marketing", "machine learning"
2	Green	17	Beverage industry, Health/Risk for consumers	"consumers", "food quality", "machine learning"
3	Blue	16	Wine, Marketing and Food quality	"machine learning", "computer vision", "artificial intelligence", "human", "beverage"
4	Yellow	9	Machine Learning and other AI Technologies	"Artificial Intelligence", "wine", "preferences", "emotions"

("computer vision"), products ("wine", "food") and people ("human", "male", "female", "adult"). This finding emphasizes a holistic research approach, that seeks to optimize marketing strategies by responding to both technological potential and consumer expectations.

4. Discussion

Results of this study led to relevant findings for the scientific community and entrepreneurs in the beverage industry. The bibliographic analysis revealed that research on AI applied in beverage industry for marketing strategies is inherently multidisciplinary. The corpus of existing research integrates perspectives from engineering, consumer psychology, health sciences, and marketing analytics.

One finding that emerges from the results is that AI implementation in the beverage sector has already reached very high levels of technological development and it is discussed mostly in some branches of research such as in computer science or medicine and automation. Moreover, in the beverage industry, the main application of AI is still closely related to the technological aspects of production, quality and management. The documents extracted and analyzed show different types of AI tools which have been supporting entrepreneurs in various stages of production processes such as, quality control, improvement of the intrinsic quality characteristics of products (both objective-intrinsic and subjective-consumer preferences), and, to some extent, also in management, streamlining of business processes, and risk expectation in the decision-making stage. Moreover, the topic of beverages is linked with topics like blockchain technology, supply chain and food industry.

Therefore, to conclude, it is possible to divide the literature into two main thematic fields, one focused on the technical development and deployment of AI systems for the technological side of production, and another smaller one focused on understanding, meeting and influencing consumer behavior and preferences. In fact, an in-depth analysis of the co-occurrences map highlighted a thematic research area related to the technological quality of beverages and the quality control in relation to AI technologies (blue-yellow cluster), these subjects are linked to the risk for human health in the green cluster. All these topics are strongly discussed by researchers working in the field of food microbiology, which plays a fundamental role in the beverage sector, especially in relation to technological and organoleptic quality of products (Zahoor et al., 2025; Zhang et al., 2020). Therefore, these outcomes highlight the strong multidisciplinary characteristic of topics discussed by academics and researchers in relation to the central node of "artificial intelligence". This confirms that AI is not, yet a technology properly applied to marketing in the beverage industry, but instead it is taking on a large scale on the technological side of production.

Findings of this review confirm that there is a deep gap in the scientific research on AI for marketing strategies in the beverage sector. This results in a lack of open, available and shareable knowledge for businesses in this sector that still lack businesses' opportunity to take advantage of the AI technologies for marketing. Instead, the integration of AI technology in beverage industries' processes can improve not only production but also marketing strategies, actions and tactics, offering insights into consumer attitudes to enable more tailored approaches to satisfy different and demanding market segments (Basrowi and UTAMI, 2023). Nevertheless, the results of this review showed that, as far as the marketing stage and the study of market characteristics, consumer profiling and product positioning are concerned, there are still no

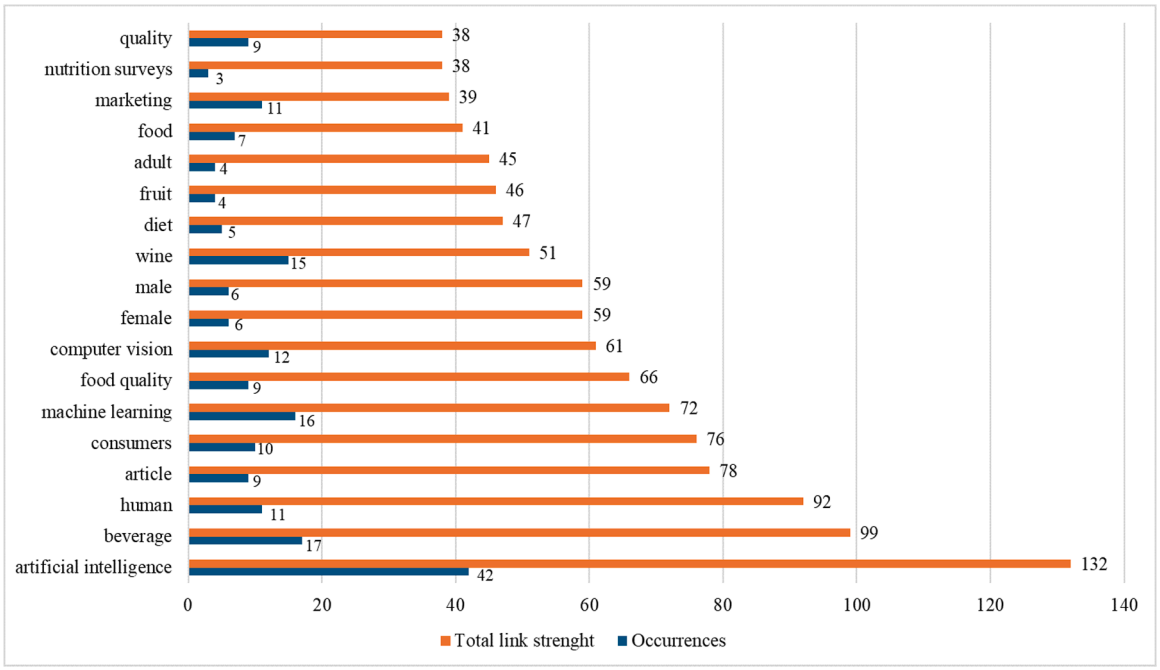

Fig. 6. Total link's strength values and Occurrences by keyword analysis.

scientific documents proposing customized models for the beverage industry, although future research should focus on the ethical implications of applying AI to marketing and consumer profiling studies (Saura et al., 2024).

Certainly, each enterprise also has its own specific peculiarities in terms of the products offered. This implies the real difficulty of developing marketing models that are generalizable, that is, suitable for different types of businesses and products, which are instead very important for the competitiveness of enterprises in this sector (Vitsentzatou et al., 2022). However, results of this study open up a reflection on the importance of open and shareable AI marketing applications and models for Small and Medium-sized Enterprises (SMEs) in the beverage industry. Indeed, SMEs often have few financial resources to invest "in-house" in AI innovation for marketing, unlike some of the world's largest and most successful beverage companies that maintain a dominant position in the global soft drink market (e.g., companies such as Coca Cola, Pepsi, etc.). Instead, open and free AI application models for marketing could be developed by researchers for SMEs and provided to them as effective tools for marketing strategies (Ingrassia et al., 2022b), which are crucial for their competitiveness, nowadays, given the critical issues caused by globalization. Finally, the results suggest an interdisciplinary approach for future marketing research and consumer studies using AI in the beverage industry, which integrates economic studies with other branches of research such as AI-based technologies, food quality and technology, and food traceability. This result is also supported by time series analysis, which shows the likely increase in academic interest in these topics given the estimated upward trend in the number of future publications.

5. Conclusion

This study aimed to examine the progression of scholarly documents on Artificial Intelligence application for marketing strategies in the beverage industry, from 1994 to 2025. In this study, a bibliometric analysis was conducted on a total of 109 research articles extracted from the Elsevier-Scopus and Clarivate-Web of Science databases through the inclusion and exclusion criteria from the PRISMA flow diagram. The analysis of the 109 documents resulted in articles, conference papers, book chapters, and books. The co-occurrence and link-strength analyses outcome shows that Artificial Intelligence is the topic most discussed of all by scholars. After this, beverages, humans, machine learning and consumers are the most frequent.

Artificial intelligence is becoming an integral part of every production activity in the beverage industry. It has already been efficiently integrated at technological production level, particularly in wine production, and it is quite likely that in the future it will become a mainstay of marketing for the D&B sector.

Despite this analysis highlighted that marketing studies regarding the application of artificial intelligence for the beverage industry are not fully investigated, results showed the interest of researchers regarding these topics and highlights many other linked topics to those selected for the search. In particular, this review revealed a clear interconnection between the topics discussed in this scientific landscape in relation to the implementation of AI for marketing in the beverage industry. One of the most important results is that the topic "artificial intelligence" is central in the map of scientific research with the highest value of occurrences (42 co-occurrences) and it is multiply connected, as a bridge between all the thematic fields. Another important finding is the high link strength among the keywords "artificial intelligence", "machine learning", "beverages", "quality", and "consumers". Both findings suggest that these topics are of high interest for the scientific community and highly interconnected to each other, within the literature, and confirm that artificial intelligence is discussed, in the beverage sector, according to a holistic research approach, which seeks to optimize marketing strategies by responding to both technological potential and consumer expectations. In fact, it was found an integration of AI technologies for marketing strategies and consumer behavior analysis, but at the same time, there is a coexistence of terms related to technology, products ("wine," "food", "beer") and people/consumer. Therefore, these findings suggest that, although the topic of AI applied to beverage marketing is concerned with typical marketing positioning issues (Chironi and Ingrassia, 2015), such as price, product, place, and promotion, there is a clear convergence towards other issues of growing importance, including one that is of extraordinary relevance to consumers today, namely food safety and quality, where food microbiology can be one of the key areas of applied research in artificial intelligence to meet consumer demands.

In such a rapidly changing sector consumers are more and more curious and demanding, and production is increasingly consumer-

centric, therefore adopting AI-based tools companies may effectively predict consumer needs and intercept market demand, which is an essential added value for gaining a competitive advantage and remaining economically sustainable.

Australia with the United States and India have engaged the most significant collaborations, and in Europe, United Kingdom, Italy and France are the most interested countries. However, some collaborations appeared also in Africa and some countries of Latin America. Certainly, the time series analysis also shows that these studies could increase progressively over time, partly because the beverage industry will always require very specific and customized marketing strategies for different types of businesses. It is fair to assume that the application of AI in marketing will enable the development of increasingly targeted strategies that can be applied to each of the tactics in the marketing mix. The implementation and adoption of AI tools for marketing will be the foundation for future marketing and for the survival of SMEs in this highly competitive scenario where economic power is concentrated in large companies. In fact, in line with most of literature (Zahoor et al., 2025; Zhang et al., 2020), as research has already made significant progress in the AI implementation for improving product and process quality in the beverage industry, next move could be the its application for Marketing 5.0 in the beverage sector, for developing, hopefully, specific marketing algorithms and techniques for SMEs (Haleem et al., 2022; Alhassan et al. 2025).

In addition, open and free research by scientists will be able to provide valuable support for the competitiveness of small- to medium-sized companies in the beverage sector that, unlike the large multinational companies that drive the market globally, have difficulty in developing "in-house" innovative tools for marketing models. The search for specific solutions for businesses with customized, open, and free innovations can support the development of AI tools to improve companies' efficiency and help them remain competitive in the market. In particular, the development of these algorithms as open innovation for marketing could promote the resilience of small firms in this sector in the global market. In parallel, new open AI marketing technologies for SMEs could favor the development of networks among producers with similar market segments who cooperate and share open innovation, reducing costs but remaining competitive.

The ethical and regulatory implications of AI application for marketing of beverages should also be examined, to ensure user/consumer privacy in the processing of personal data (Saura et al., 2024), for example by promoting collaborative networks between researchers, institutions, and stakeholders to link social and ethical issues (Yang et al., 2025) with marketing aims and strengthen trust in the role of AI in sustainability initiatives (Bhagat et al., 2022). Thus, further research should be conducted on the ethical and regulatory implications of AI to ensure that AI applications comply with rules and guidelines on personal data processing and consumer privacy.

Since it turned out that the wine sector is the most advanced in terms of the application of AI in marketing, future research should be developed to improve wine consumers' experience and provide highly personalized products and services for wine consumers (Nam et al., 2018). Moreover, adoption of AI requires competence to handle the occasionally increased complexity of the new processes, nevertheless, this adoption, sharing, and integration of the technologies will vary per sector and region. Considering the characteristics of the agri-food sector, it appears therefore important to develop research also in the field of training for the development of knowledge and skills suitable for understanding and using AI technologies also for the beverage marketing and particularly wine.

The provided outcomes will be of interest for academics, entrepreneurs and stakeholders and suggest avenues for future research about the development of AI tools for marketing in the beverage sector.

Ethical statement for future foods

Hereby, I - Marzia Ingrassia - consciously assure that for the manuscript How will artificial intelligence drive marketing in the beverage industry? - A bibliometric literature review, fulfills: 1) This material is the authors' own original work, which has not been previously published elsewhere. 2) The paper is not currently being considered for publication elsewhere. 3) The paper reflects the author's own research and analysis in a truthful and complete manner. 4) The paper properly credits the meaningful contributions of coauthors and co-researchers. 5) The results are appropriately placed in the context of prior and existing research. 6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference. 7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content. I agree with the above statements and declare that this submission follows the policies of the journal as outlined in the Guide for Authors and in the Ethical Statement.

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CRediT authorship contribution statement

Pietro Chinnici: Software, Formal analysis, Conceptualization, Data curation, Writing – original draft, Investigation. **Simona Bacarella:** Resources, Conceptualization, Validation, Supervision, Project administration. **Stefania Chironi:** Supervision, Project administration, Validation, Resources, Conceptualization. **Vincenzo Naselli:** Validation, Supervision, Conceptualization, Funding acquisition. **Marzia Ingrassia:** Project administration, Writing – review & editing, Visualization, Supervision, Resources, Methodology, Funding acquisition, Data curation, Validation, Software, Conceptualization, Writing – original draft, Investigation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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