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BIBLIOMETRIC ANALYSIS ON USING ARTIFICIAL INTELLIGENCE IN DAIRY SCIENCE

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Abstract: Interest in artificial intelligence, which began in the 1950s, has gradually increased and has caused the same interest to renew and increase day by day and spread many of the scientific fields including dairy science. In this study, making the bibliometric analysis of the usage of the artificial intelligence methods on the dairy sciences between the years of 2001 and 2025 was aimed. For the artificial intelligence methods used on the dairy sciences the annual percentage growth rate which was calculated as 9.05 showed that the artificial intelligence methods used on the dairy sciences will continue to increase. This increasing trend is also depend on the increasing studies on precision in livestock farming.

Keywords: Dairy, Bibliometric study, Precision in livestock farming, Artificial intelligence

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1. Introduction

The act of learning, which has existed since the dawn of humanity, has revealed a tendency to imitate nature, and natural imitation has become a means of acquiring much knowledge. The work done by scientists on this ability to imitate is one of the reasons why the scientific world has advanced in this field. In this sense, the book written by Arf (1959) called "Can a machine think and how can it think" on the production and functional structure, considering the working principles of the human brain, and many studies have been carried out, the foundations of the soldiers made in the field of artificial intelligence today have been formed (Fetzer, 1990; Chatterjee and Laudato, 1995). The main purpose is to solve problems by modeling the intelligence structure of human beings and by using a set of algorithms and artificial intelligence on computers and machines controlled by computers (Baş, 2006).

This interest in artificial intelligence, which began in the 1950s, continues to grow day by day. Thus, it has provided the emergence of a field different from the classical algorithmic calculation methods of today's computers (Çanakçı and Hosoz, 2006). It is possible to list the areas where artificial intelligence technology is widely used as genetic algorithm, expert systems, artificial neural networks and fuzzy logic (Elmas, 2003).

Increasing the production and quality of animal derived foods, which play a critical role in human nutrition, requires improvements in both the environmental conditions and genetic structures of farm animals (Kolenda et al., 2025). Dairy farming is one of the oldest areas of animal production and is widespread throughout the world (Dagtekin et al., 2023). According to the farm's milk or meat production purpose, it is necessary to raise animals of qualified breeds with quality feeds in a modern way under hygienic care feeding conditions. In intensive animal breeding, which is done by providing the environmental conditions needed by animals with good genetic characteristics and feeding them with quality feed sources to obtain higher yields (Ermetin and Erkan Can, 2023; Okuyucu et al., 2023). Important environmental factors that do not have a genetic effect on milk yield are lactation period, calving age, calving season and calving stage (Elahi Torshizi, 2016). In addition, the effects of environmental factors such as calving year, calving interval, calving season, number of births, herd and milking frequency on milk yield should be investigated and therefore, to study these relationships, machine learning methodologies from traditional statistical methods have been increasingly adopted (Çanga Boğa et al., 2024).

To understand the usage of the artificial intelligence methods on the dairy sciences, the bibliometric analysis seems to be a valuable tool, which is used many areas of science (Özlü, 2022; Önder and Tırınk, 2022; Önder, 2025). Bibliometrics, which refers to the application of mathematical and statistical methods to analyze scientific publications on a specific topic, serves to provide quantitative information on bibliographic properties, such as authors, journals, citation scores, and countries of distribution. Many different techniques such as citation analysis, co-citation analysis, and bibliometric matching

analysis, co-asset analysis and bibliometric mapping can be used together in bibliometric analysis methods (Özlü, 2022).

In this study, bibliometric analysis of the usage of the artificial intelligence methods on the dairy sciences was aimed to evaluate the literature related to artificial intelligence methods on the dairy sciences since it started to be worked was examined to understand the evaluation and spreading of it.

2. Materials and Methods

In this study, studies related to artificial intelligence methods used on the dairy sciences between the years 2001-2025 were taken into account. In this context, the "artificial intelligence", "machine learning", and "dairy" expression were used for searching on the Web of Science (WoS) database. The bibliographic information under the heading "artificial intelligence", "machine learning", and "dairy" of 49 studies from 2001 to 2025 was used as material

In this study, the bibliometric analysis for artificial intelligence in dairy science was performed with R software (R Core Team, 2020). For this aim, the bibliometrix package were used (Aria and Cuccurullo, 2017). The bibliographic data were obtained from the WoS system in Plain text format. Further, the data was changed as the data frame by using "convert2pdf" function. The biblioAnalysis function was used for performing the bibliometric analysis.

3. Results and Discussion

The most productive authors were given in Figure 1, where Goli (4 articles) can be recognized as the first productive author over time even if Goli started the publication in the year of 2019.

In the year of 2001 and 2002 only one articles has been published. Until 2018 there was no more publication about artificial intelligence methods on the dairy sciences. From the year of 2018 the number of articles proceed on the use of artificial intelligence methods on the dairy sciences started to increase. In 2024 the number of articles reached to 16 which is eight time more than 2018. Interestingly, the first article in 2001 has been cited 26 times. The maximum number of average total citations per year was observed as 65 in 2019 (Figure 2). From the year of 2018 the growth of number of article has been increased, the main case of this should be recognizing the artificial intelligence as a precision in livestock farming. The annual percentage growth rate was calculated as 9.05, which is a great growth rate. The document average age was observed as 3.08, average citations per document was 14.24, and average citations per year per document was 3.458.

The top manuscripts per citations was recognized to belong to Alireza Goli from University of Tehran with the article "Hybrid artificial intelligence and robust optimization for a multi-objective product portfolio problem Case study: The dairy products industry" which achieved to take 113 citations (Table 1).

The most article producer country was determined as USA and the follower was Spain. These top ten producer countries were produce the 83.33% of the total production. The rate of publications produces by single country was calculated as 87.50%. The rate of publications produces by multiple country was the highest for the USA (Table 2).

As Iran took the first place for the total citations because 33.28% of total production of top 10 countries was belong to Iran. Even the Zimbabwe, Poland, and Hungary not listed in top ten countries, they took place in the most cited publisher countries. The case of this situation could be the publications of Golia' publications (Table 1 and Table 3). The most relevant journal was determined as Journal of Dairy Science and the follower was Applied Sciences-Basel. In the first five ranked journals only one of them were the journals that it' aim of scope is dairy science (Table 4).

When the collaboration matrix (Figure 3) was examined, it was understood that some working groups existed on the studies of the artificial intelligence methods used on the dairy sciences. The co-citations couldn't be centeralized (Figure 4). The conceptual structure map (Figure 5) showed that "body temperature", "ruminal acidosis", and "heat stress" were generally used together.

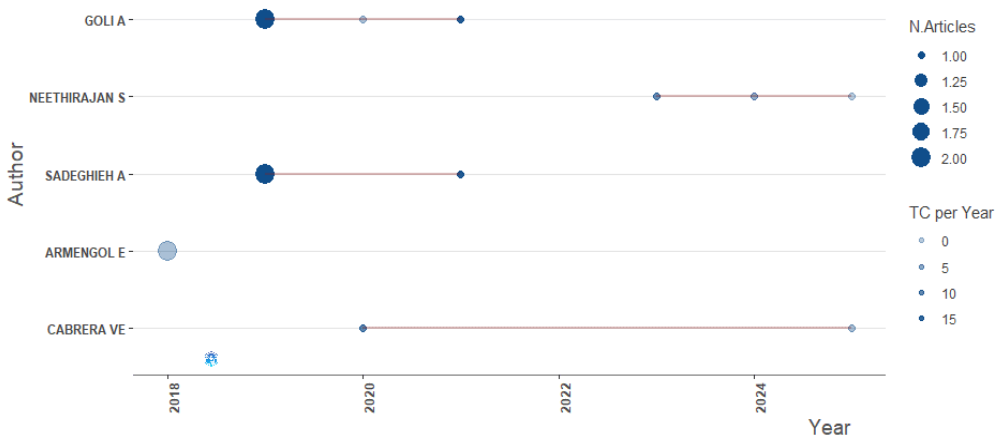

Figure 1. Authors' production over time (the first 20).

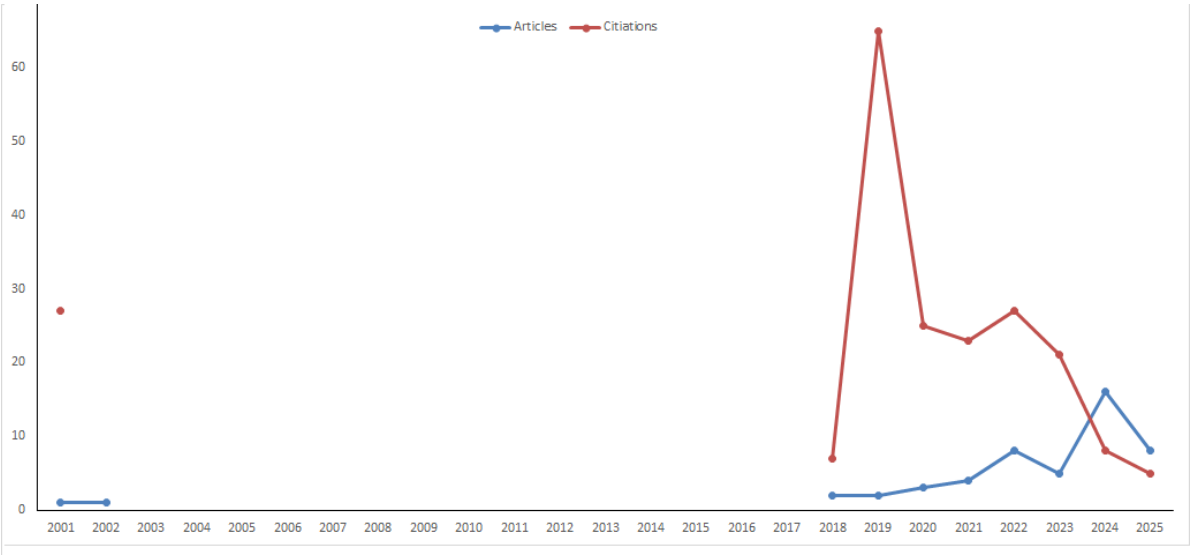

Figure 2. Number of articles and citations published from 2001 to 2025.

Table 1. Top manuscripts per citations

Paper	DOI	TC	TC/Y
GOLI A. 2019	10.1016/j.cie.2019.106090	113	16.14
BAO J. 2022	10.1016/j.jclepro.2021.129956	102	25.50
GOLI A. 2021	10.1080/0954898X.2020.1849841	85	17.00
CABRERA VE. 2020	10.3168/jds.2019-17145	63	10.50
ADDANKI M. 2022	10.1016/j.afres.2022.100126	49	12.25
KUTYAURIPO I. 2023	10.1016/j.jafr.2023.100502	46	15.33
NEETHIRAJAN S. 2023	10.3390/s23167045	28	9.33
GOYACHE F. 2001	10.1017/S1357729800058045	26	1.04
DE VRIES A. 2023	10.15232/aas.2022-02345	21	7.00
GOLI A. 2019	10.9781/ijimai.2019.03.003	20	2.86

Table 2. Corresponding author's countries

	Country	Articles	SCP	MCP	MCP Ratio
1	USA	7	5	2	0.286
2	Spain	6	5	1	0.167
3	Brazil	5	4	1	0.200
4	Canada	5	5	0	0.000
5	China	4	4	0	0.000
6	India	4	3	1	0.250
7	Iran	4	4	0	0.000
8	Japan	2	2	0	0.000
9	UK	2	2	0	0.000
10	Ecuador	1	1	0	0.000

SCP= Single Country Publications, MCP= Multiple Country Publications.

Table 3. Total citations per country

	Country	Total Citations	Average Article Citations
1	Iran	227	56.75
2	China	123	30.75
3	USA	102	14.57
4	India	70	17.50
5	Zimbabwe	46	46.00
6	Spain	41	6.83
7	Canada	37	7.40
8	Poland	18	18.00
9	Hungary	13	13.00
10	Brazil	5	1.00

Table 4. The most relevant sources for the publications about the artificial intelligence methods used on the dairy sciences

Rank	Journal title	Number of articles
1	JOURNAL OF DAIRY SCIENCE	4
2	APPLIED SCIENCES-BASEL	2
3	JOURNAL OF AGRICULTURE AND FOOD RESEARCH	2
4	JOURNAL OF FOOD COMPOSITION AND ANALYSIS	2
5	SENSORS	2

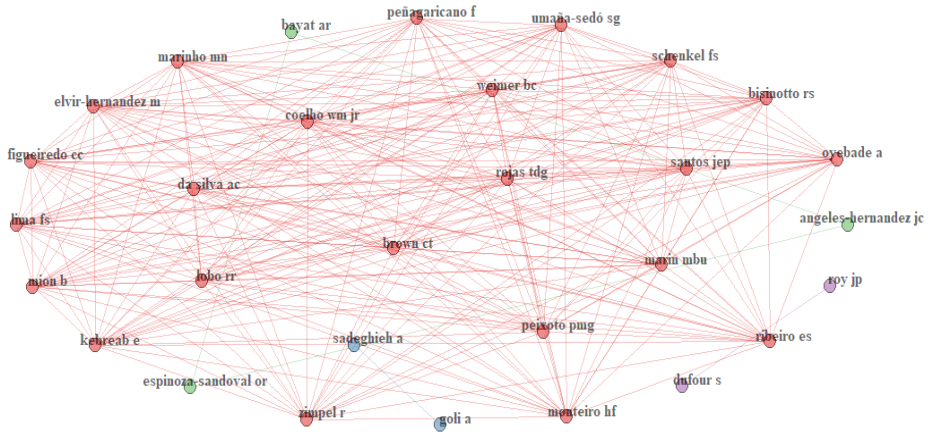

Figure 3. Collaboration matrix.

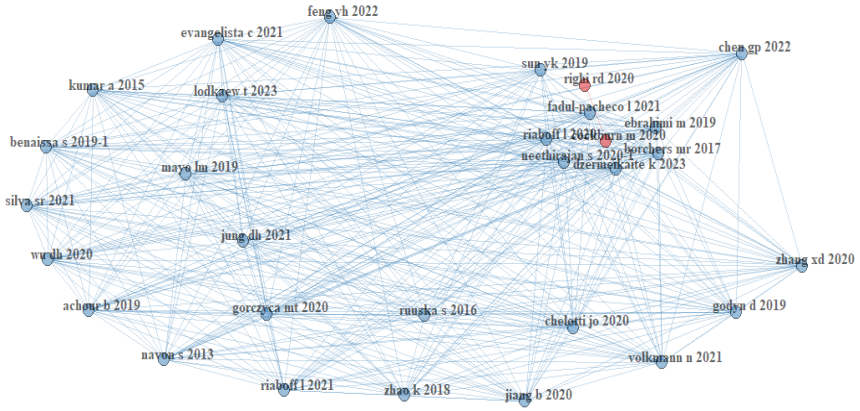

Figure 4. Co-citations.

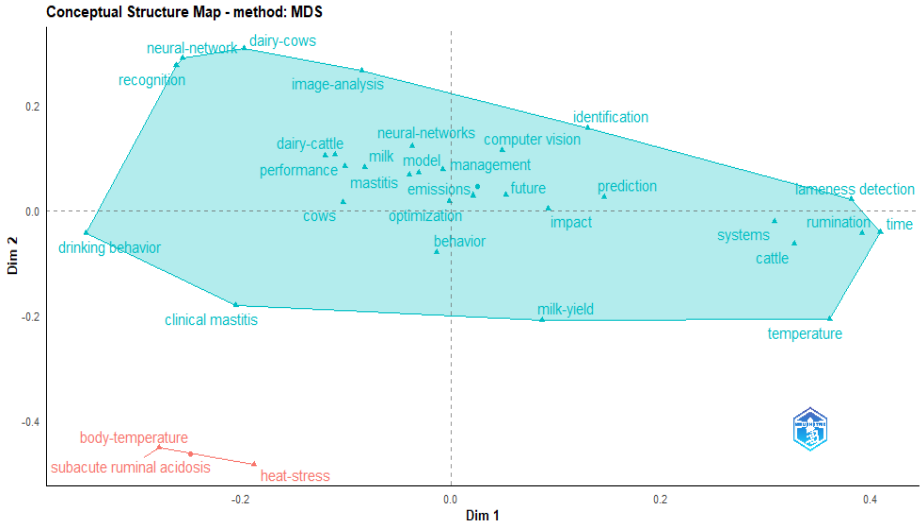

Figure 5. Conceptual structure map.

4. Conclusion

For the artificial intelligence methods used on the dairy sciences the annual percentage growth rate which was calculated as 9.05 showed that the artificial intelligence methods used on the dairy sciences will continue to increase. This increasing trend is also depend on the increasing studies on precision in livestock farming.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	H.Ö.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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