Alfalfa Silage Utilisation and Alfalfa Fermentation in Cattle: A Bibliometric Analysis

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Article Info	ABSTRACT
	Alfalfa silage is widely used in the ration of animals. The aim of this study was to determine the publication trends and trending topics of studies on alfalfa silage utilisation and alfalfa fermentation (CAU) in cattle based on the data obtained from the Web of Science (WoS) Core Collection database. The Biblioshiny package, VOSviewer viewing programme and Excel 2022 were used for analysis. A total of 399 documents related to the researched topic were retrieved from WoS from 1980 to 2024. 1203 authors were included in the study. The average citation rate per article is 38.36. The number of articles with a single author is 16. Most of the publications on CAU were found in English language. It was found that the journal that published the most articles was Journal of Dairy Science (198), the most prolific author was GA. Broderick (27), the most cited author was GA. Broderick (2254), the most cited document author was MS. Allen (1073), the most frequently used keyword was "dairy cow", and the most cited country was USA (459). When the results of the trend topic analysis are analysed, it can be said that the topics on increasing silage quality and nutrient content have come to the forefront in recent researches. This study can provide detailed information about the situation in the current literature in the field of CAU.

Sığırlarda Yonca Silajı Kullanımı ve Yonca Fermantasyonu: Bir Bibliyometrik Analiz

Makale Bilgisi	ÖZET
	Yonca silajı hayvanların rasyonunda yaygın olarak kullanılmaktadır. Bu çalışmada, Web of Science (WoS) Çekirdek Koleksiyonu veri tabanından elde edilen verilere dayanarak sığırlarda yonca silajı kullanımı ve yonca fermantasyonu (CAU) ile ilgili çalışmaların yayın eğilimlerini ve trend konularını belirlemek amaçlanmıştır. Analiz için Biblioshiny paketi, VOSviewer görüntüleme programı ve Excel 2022'den yararlanılmıştır. WoS'dan 1980'den 2024'e kadar araştırılan konu ile ilgili toplam 399 doküman alınmıştır. Çalışmaya 1203 yazar dahil edilmiştir. Makale başına düşen ortalama atıf oranı 38,36'dır. Tek yazarlı makale sayısı 16'dır. CAU konusunda en fazla İngilizce dilinde yayına ulaşılmıştır. En fazla makale yayınlayan derginin Journal of Dairy Science (198), en üretken yazarın GA. Broderick (27), en çok atıf alan yazarın GA. Broderick (2254), en çok atıf alan belge yazarının MS. Allen (1073), en sık kullanılan anahtar kelimenin "dairy cow" ve en fazla atıf alan ülkenin ABD (459) olduğu sonuçlarına ulaşılmıştır. Trend konu analizi sonuçları incelendiğinde ise son dönemdeki araştırmalarda silaj kalitesinin ve besin içeriğinin artırılmasına yönelik konuların ön plana çıktığı söylenebilir. Bu çalışma CAU alanında mevcut literatürdeki durum hakkında ayrıntılı bilgi sağlayabilir.

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INTRODUCTION

Forages represent the main source of components in dairy cow diets (Hassanat *et al.*, 2013). In animal nutrition, especially in ruminant nutrition, the use of quality roughage is very important to reduce feeding costs (Harmanşah, 2018). Alfalfa has become a popular forage for silage due to its high crude protein (CP) content and dry matter (DM) yield (Beauchemin *et al.*, 2003). In recent years, scientific studies have been carried out on plants with high tolerance to drought and desertification, which can be potential animal feed and can be used in the improvement of pastures (Armağan and Işık, 2022). Alfalfa is highly important for livestock, given its rapid canopy recovery after each harvest, its capacity to withstand extreme temperatures (e.g. cold nights and hot days), its relative tolerance to salinity, its palatability for livestock and its nutritional value (Ferreira *et al.*, 2015). Alfalfa is frequently used in animal husbandry as roughage due to its high nutrient content (Grev *et al.*, 2017). Alfalfa adapts well to different environmental conditions due to its rich and variable genetic basis and has a wide cultivation area (Radović *et al.*, 2009). Physical changes of feeds (such as particle size) can affect rumen digestion, transit rate and microbial protein synthesis and therefore postruminal or total digestion (Yang *et al.*, 2002). Most alfalfa hay fed to dairy cattle has a CP content of 20% or more (on a DM basis) and about 80% is ruminally degradable (Kleinschmit *et al.*, 2007). Silage is the product obtained as a result of anaerobic fermentation of water-soluble carbohydrates to organic acids in forage plants (Zhang *et al.*, 2018). The purpose of ensiling feeds is to preserve the nutritional composition of the starting material (Garcia *et al.*, 1989). Compared to cereal silages, alfalfa silage contains less neutral detergent fibre (NDF) and more CP (Mustafa *et al.*, 2000). Alfalfa silage is widely used in the ration of animals (Bai *et al.*, 2020). Silaging of alfalfa is difficult due to its relatively low content of epiphytic lactic bacteria (LAB) and water-soluble carbohydrate (WSC) (Li *et al.*, 2024). The use of traditional homolactic bacterial inoculants as starters for alfalfa silage is a recommended practice to minimise the loss of nutrients and DM in the early stages of the ensiling process and to ensure rapid fermentation (Schmidt *et al.*, 2009). LAB are considered the most important microorganisms in determining the final performance of silage (Li *et al.*, 2020).

Bibliometric methods are used to provide quantitative analysis of written publications (Ellegaard and Wallin, 2015). Bibliometrics is simply the study and measurement of all forms of written communication and the publication patterns of its authors (Potter, 1981). The obvious advantages of bibliometrics are that it allows scientists to study a specific area of research and draw very useful conclusions by analysing citations, co-citations, word frequency and geographical distribution (Liao *et al.*, 2018). In this study, it is aimed to determine the publication trends and trending topics of CAU-related studies based on the data obtained from WoS.

MATERIALS AND METHODS

WoS (Science Citation Index, Social Sciences Citation Index and Arts and Humanities Citation Index), which encompasses three ISI (Institute for Scientific Information) citation databases, is the standard tool for a significant portion of citation studies worldwide (Meho and Yang, 2007). In this study, WoS was used as the data source.

The documents constituting the dataset of the study were retrieved from the WoS Core Collection database on 14 September 2024. Search strategy: Articles were searched using the keywords TS=(("alfalfa silage" OR "alfalfa fermentation") AND ("cow" OR "cattle")). No restriction was applied in the data category. As a result of the searches, 399 documents were found and these documents were downloaded from the WoS database in BibTeX format. Bibliometric analysis of 399 documents was performed with R programming language.

VOSviewer is a software tool for creating and visualising bibliometric networks (Van Eck and Waltman, 2017). VOSviewer can be used to analyse all kinds of bibliometric network data, such as co-occurrence relationships between scientific terms, citation relationships between publications or journals, and collaboration relationships between researchers (Van Eck and Waltman, 2011). Bibliometrix and Biblioshiny were developed by Italian academic Massimo Aria in R language environment (Xie *et al.*, 2020).

Biblioshiny is an in-package tool designed for non-coders to provide tools for a complete scientometric and bibliometric analysis, offering numerous options categorised by source, author, document, social structure, conceptual structure and intellectual structure (Nasir *et al.*, 2020). In this study, Biblioshiny package, VOSviewer viewing programme and Excel 2022 were used for analysis.

FINDINGS

General information and annual publication output

Table 1 shows general information about the data and document types obtained from WoS. A total of 399 documents related to the researched topic were retrieved from WoS from 1980 to 2024. Of these, 367 are articles, 7 are article: proceedings paper, 1 is a correction, 3 are meeting abstracts, 11 are proceedings paper, and 10 are reviews. These documents were taken from 78 different sources. 873 authors included keywords. 1203 authors were included in the study. The average citation rate per article is 38.36. The number of articles with a single author is 16.

Table 1

Main data information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1980:2024
Sources (Journals, Books, etc)	78
Documents	399
Annual Growth Rate %	5,12
Document Average Age	16,4
Average citations per doc	38,36
References	9527
DOCUMENT CONTENTS	
Keywords Plus (ID)	994
Author's Keywords (DE)	873
AUTHORS	
Authors	1203
Authors of single-authored docs	14
AUTHORS COLLABORATION	
Single-authored docs	16
Co-Authors per Doc	4,4
International co-authorships %	21,3
DOCUMENT TYPES	
article	367
article; proceedings paper	7
correction	1
meeting abstract	3
proceedings paper	11
review	10

Figure 1

*Language of publication of documents*
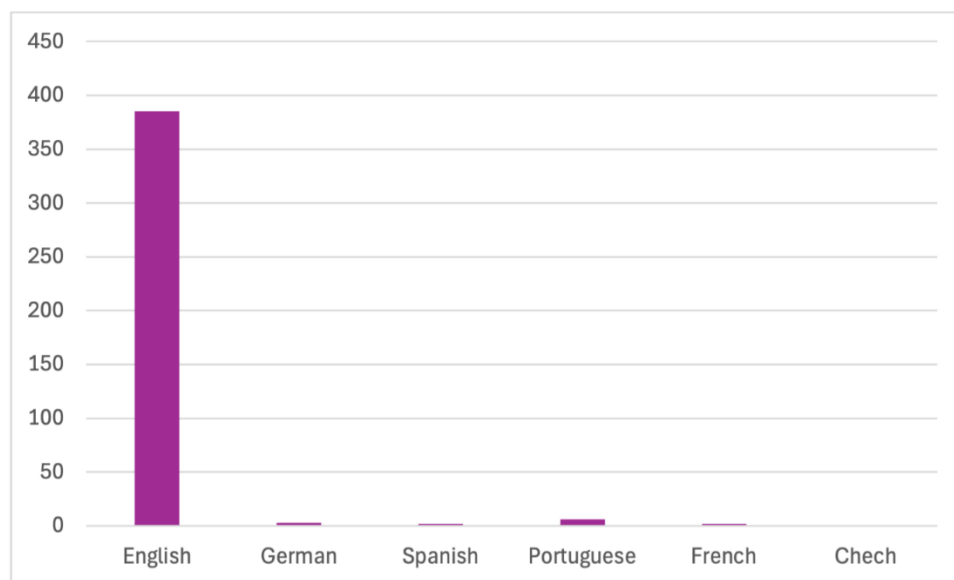
Various languages were used in the results of the outputs. It is noteworthy that most of the results are in English (385). Six are in Portuguese, three in German, two in French, two in Spanish and one in Chech. These results are given in Figure 1.

Figure 2 shows the distribution of citations and articles by year. The general trend increased from 1 article in 1980 to 9 articles in 2024. With 22 articles, the highest number of articles was reached in 2016. Fluctuations in the number of articles and citations are noteworthy. However, the annual growth rate reached 5.12%.

Figure 2

Distribution of annual CAU-related articles and citations from 1980 to 2024
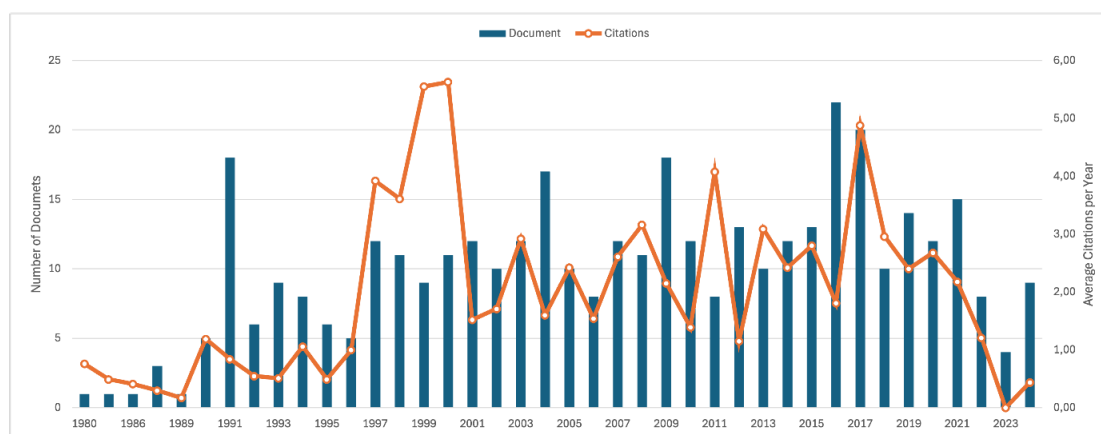
Active Journals

A total of 399 articles were published in 78 journals, and four journals published more than twenty articles on CAU research.

Table 2

Number of publications in journals and some indexes

Source	H-index	G-index	M-index	TC	NP	PYS
JOURNAL OF DAIRY SCIENCE	56	101	1,436	11723	198	1986
CANADIAN JOURNAL OF ANIMAL SCIENCE	16	22	0,356	564	35	1980
ANIMAL FEED SCIENCE AND TECHNOLOGY	15	25	0,441	653	26	1991
JOURNAL OF ANIMAL SCIENCE	15	21	0,429	933	21	1990
ASIAN-AUSTRALASIAN JOURNAL OF ANIMAL SCIENCES	5	8	0,2	77	8	2000
ANIMAL	3	4	0,2	117	4	2010
JOURNAL OF CLEANER PRODUCTION	3	3	0,5	64	3	2019
JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE	3	3	0,15	63	3	2005
LIVESTOCK SCIENCE	3	4	0,176	78	4	2008
AGRICULTURE ECOSYSTEMS \& ENVIRONMENT	2	2	0,222	36	2	2016

TC: Total Citation, NP: Number of Paper, PYS: Publication Year Start

When Table 2 is analysed, Journal of Dairy Science is the journal that publishes the most articles. The number of articles is 198. This journal was followed by "Canadian Journal of Animal Science" (35) and "Animal Feed Science and Technology" (26).

Journal of Dairy Science (JDS), the world's leading general dairy research journal, is the official journal of the American Dairy Science Association. JDS readers represent government, educational and industry organisations in more than 70 countries with interests in biochemistry, genetics, reproduction, food science, microbiology, economics, environment, engineering and nutrition, food safety, processing, physiology, pathology, public health, sanitation and quality assurance.

The Canadian Journal of Animal Science is a quarterly journal that publishes new work in all areas of animal products and animal agriculture, including reproduction and genetics; growth and development; cellular and molecular biology; animal systems modeling; meat science; physiology and endocrinology; non-ruminant nutrition; ruminant nutrition; ruminant behavior, management, and welfare.

Animal Feed Science and Technology is a unique journal of international interest, publishing scientific papers focussing on animal nutrition and feeds.

According to the source local impact total citation index, Journal of Dairy Science was the journal with the highest number of citations in the CAU survey with 11723 total citations. This journal was followed by Journal of Animal Science and Animal Feed Science and Technology with 933 and 653 citations respectively.

Analysis of highly cited documents

Table 3 shows the top ten citation analysis of documents related to CAU research from 1980 to 2024. MS. Allen's paper "Effect of diet on short-term regulation of feed intake by lactating dairy cattle" is the most cited paper with 1073 citations. MS. Allen's article titled "Relationship between fermentation acid production in the rumen and the requirement for physically effective fibre" ranks second with 611 citations. RFD. Valadares's "Effect of replacing alfalfa silage with high moisture corn on ruminal protein

synthesis estimated from excretion of total purine derivatives" is in the third place with 515 citations.

Table 3

Top ten citation analysis of documents related to CAU research.

Paper	DOI	TC	TC per Year
ALLEN MS, 2000, J DAIRY SCI	10.3168/jds.S0022-0302(00)75030-2	1073	42,92
ALLEN MS, 1997, J DAIRY SCI	10.3168/jds.S0022-0302(97)76074-0	611	21,82
VALADARES RFD, 1999, J DAIRY SCI	10.3168/jds.S0022-0302(99)75525-6	515	19,81
BRODERICK GA, 1997, J DAIRY SCI	10.3168/jds.S0022-0302(97)76262-3	416	14,86
DHIMAN TR, 1999, J DAIRY SCI	10.3168/jds.S0022-0302(99)75458-5	334	12,85
JONKER JS, 1998, J DAIRY SCI	10.3168/jds.S0022-0302(98)75825-4	331	12,26
LEONARDI C, 2003, J DAIRY SCI	10.3168/jds.S0022-0302(03)73634-0	293	13,32
CASTILLO AR, 2000, J ANIM FEED SCI	NA	252	10,08
OLIVEIRA AS, 2017, J DAIRY SCI	10.3168/jds.2016-11815	243	30,38
WHITE SL, 2001, J DAIRY SCI	10.3168/jds.S0022-0302(01)74676-0	236	9,83

TC: Total Citation

Analysis of Keywords and Co-occurrence Network

Figure 3 shows the keyword network analysis in the CAU research area. In the analysis of keywords used in articles, a keyword should be used at least five times (Şahiner-Tufan and Midilli-Sarı, 2024a). Out of a total of 837 keywords, 39 keywords with at least 5 occurrences were analysed. According to the criteria determined in the analysis, 7 separate clusters were formed with 39 keywords, 167 links and a total of 275 link strength.

The size of the circles indicates the most frequently used keywords in the keyword network analysis. Words clustered under the same colour indicate the strength of the relationship (Şahiner-Tufan and Midilli-Sarı, 2024a; Ye *et al.*, 2024). The most frequently used keyword was "dairy cow". This was followed by "alfalfa silage" and "silage".

Words in clusters;

Cluster 1: cellulase, digestibility, essential oil, intake, lactating cow, protein, silage and starch

Cluster 2: dairy cow, feed efficiency, manure, milk yield, nitrogen balance, nitrogen efficiency, nitrogen utilisation and rumen fermentation

Cluster 3: alfalfa silage, corn silage, digestion kinetics, enteric methane, fibre and particle size

Cluster 4: cow, forage, greenhouse gas, methane, milk and rumen

Cluster 5: alfalfa, beef cattle, fatty acids and ruminal fermentation

Cluster 6: amino acid, cattle, nitrogen and steers

Cluster 7: dairy cattle, milk composition and milk production keywords.

The keyword "dairy cow" in Cluster 2 is the most frequently used word with 83 total link strength and 26 links. The keyword "silage" in Cluster 1 has 42 total link strength and 24 links. The keyword "alfalfa" in Cluster 5 has 27 total link strength and 15 links.

Figure 3

Network map of co-occurrence between keywords
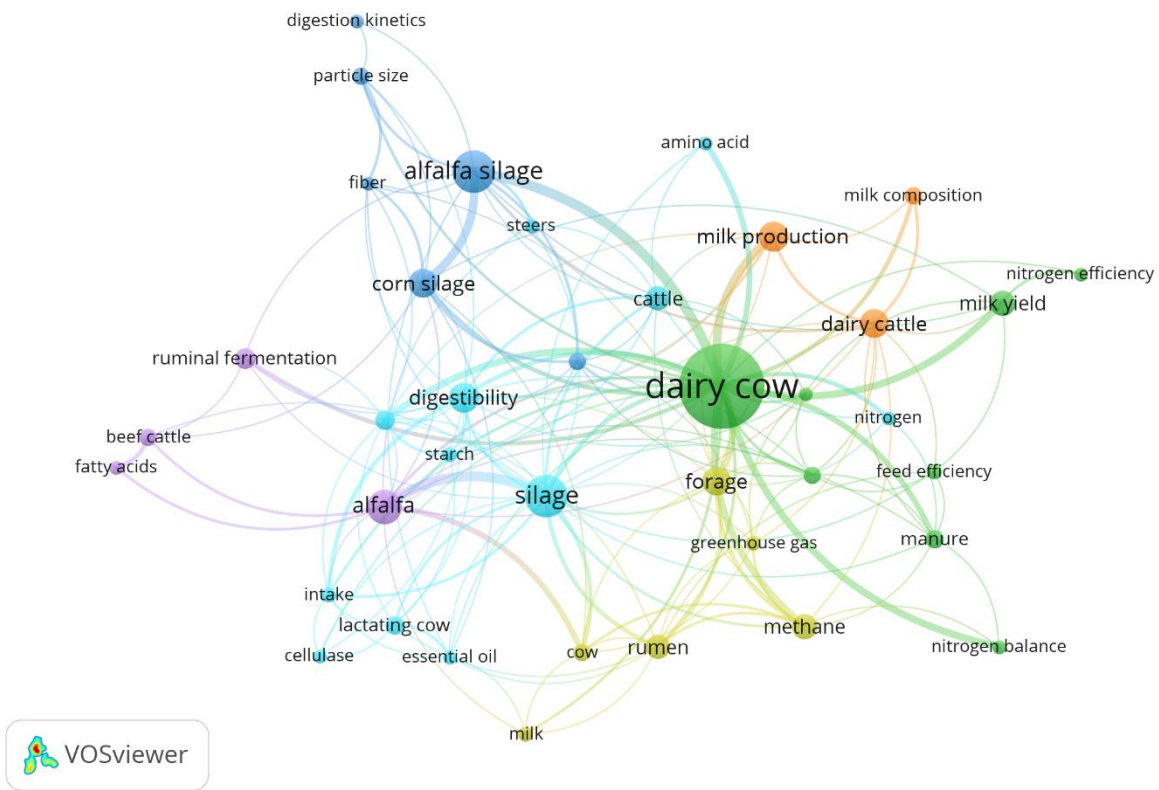
Analysis Authors

A total of 1203 authors contributed to 399 articles related to CAU research. The number of articles by the most active authors and some indexes are shown in Table 4. GA. Broderick was the most prolific author with 27 articles, followed by KA. Beauchemin (19), MA. Wattiaux (18) and MS. Allen (14). GA. Broderick has the highest H-index (18) and the highest number of citations (2254).

Table 4

*Number of publications of authors and some indexes*

Author	H-index	G-index	M-index	TC	NP	PYS
BRODERICK GA	18	27	0,643	2254	27	1997
BEAUCHEMIN KA	16	19	0,457	976	19	1990
WATTIAUX MA	13	18	0,382	646	18	1991
ALLEN MS	11	14	0,379	2027	14	1996
BENCHAAR C	10	12	0,556	649	12	2007
KENNELLY JJ	10	13	0,294	500	13	1991
KHORASANI GR	10	10	0,294	458	10	1991
ARMENTANO LE	9	10	0,243	653	10	1988
HASSANAT F	9	10	0,75	424	10	2013
MCALLISTER TA	9	9	0,333	523	9	1998

TC: Total Citation, NP: Number of Paper, PYS: Publication Year Start

Trending Topics

Figure 4 shows 45 keywords plus, which are trend topics in 2005-2024. While creating the trend topic graphs, the "word minimum frequency" parameter was taken as five and the "number of words per year" parameter was taken as three. It was determined that the first five keywords that are trend topics in the CAU topic are plant-extracts, carbon-dioxide, methane production, greenhouse-gas emissions and enteric methane. The most frequently used keywords were alfalfa silage, milk production, fermentation, performance and neutral detergent fibre.
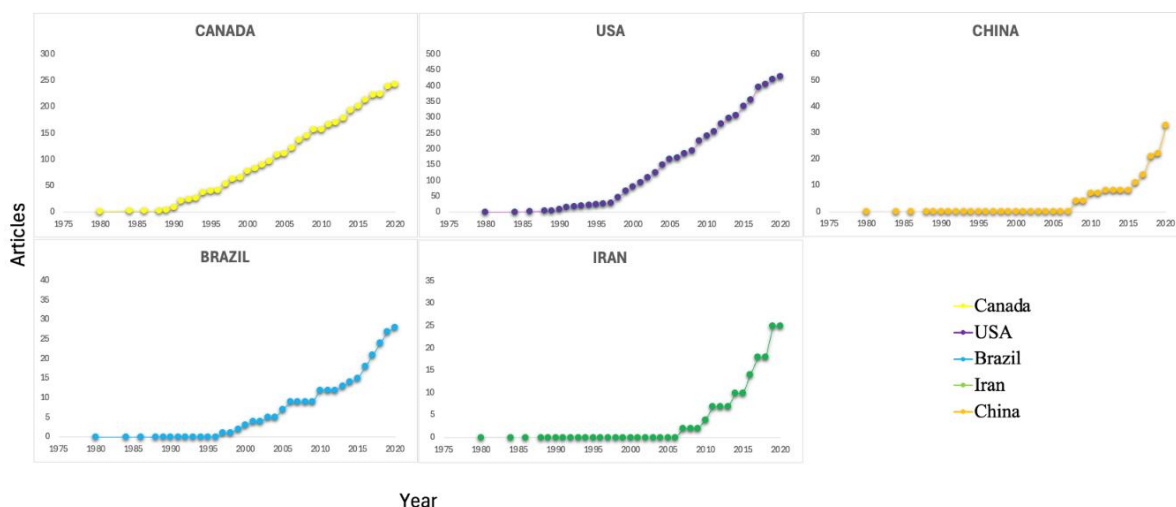
Figure 4

Trending topics between 2005-2024
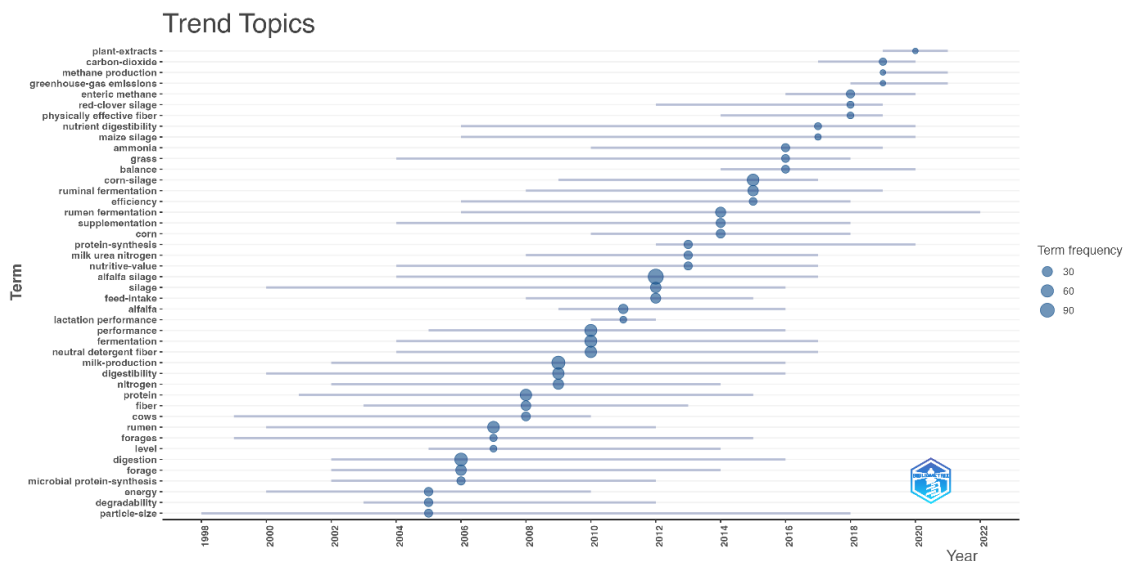
Distribution of Countries

The production of countries in CAU research over time is shown in Figure 5. The USA produced the most articles (459), followed by Canada (255), China (56), Brazil (35) and Iran (32).

Figure 5

Production of countries over time

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Three Field Graphics

In the three area graph in Figure 6, 10 frequently used keywords plus are given in the right part of the graph. The most frequently used keywords are alfalfa silage, milk production, rumen, cattle, neutral detergent fibre, corn-silage, digestion, dairy cows, fermentation and performance. The word "alfalfa silage" was preferred by most authors. It was mostly used by GA. Broderick. Journal of Dairy Science was the most preferred journal. GA. Broderick and KA. Beauchemin were the authors who preferred "Journal of Dairy Science" most frequently.

Figure 6

Illustration of the relationship between authors, references and keywords with three area graphs
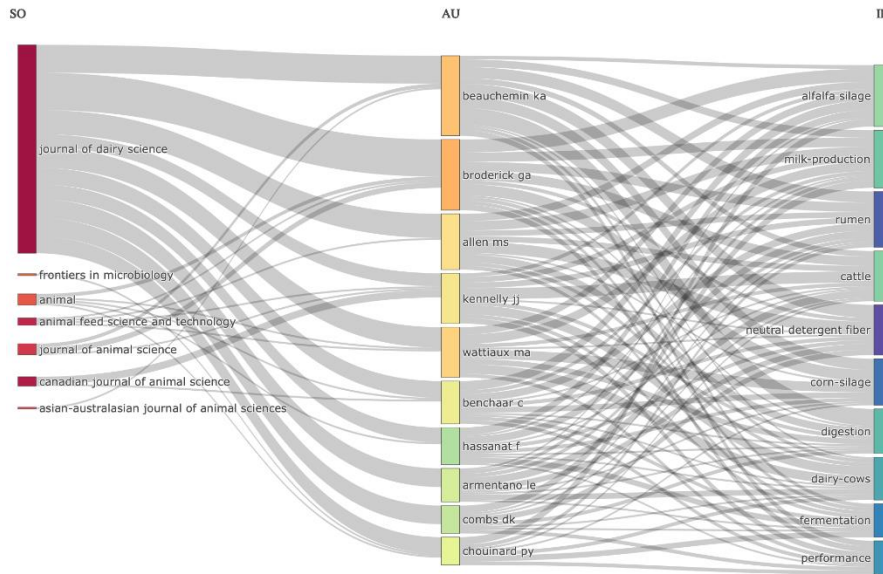
DISCUSSION

Test methods used in veterinary science are not limited and are supported by new methods every day (Selvi, 2024). In this study, the progress of research on alfalfa silage utilisation and alfalfa fermentation in cattle was analysed for more than 40 years from 1980 to 2024. When the distribution of the number of articles according to years and the results of the annual growth rate are analysed, it is thought that the number of studies in this field will increase in a fluctuating manner in the coming years. Out of 399 articles, 16 were single-authored and 383 were multi-authored. According to this result, it can be said that there are many collaborative studies in the field of CAU. When the results of the analysis of journals and countries are analysed, it is seen that the number of citations to Journal of Dairy Science, an American journal, is clearly ahead of other journals. It is also noteworthy that the total number of publications in the USA (459) is higher than other countries. It is thought that this situation is due to the fact that the state is very large, provides serious support to academic studies, hosts many universities and supports the work of talented scientists trained in the field of science and technology in US universities (Şahiner-Tufan and Midilli-Sarı, 2024b). Although MS. Allen and GA. Broderick started their publications on this subject in similar years, the most prolific author is GA. Broderick with 27 papers. However, MS. Allen's article "Effects of diet on short-term regulation of feed intake by lactating dairy cattle" is the leader in this field with 1073 citations.

This article discusses some of the characteristics of dietary components that should be considered when formulating diets for lactating dairy cows and when allocating feed to different animal groups on the farm (Allen, 2000). It serves as a good reference for researchers working in this field. Keywords play a very important role in scientific research as they reflect the main content of the related articles.

Analysing the co-occurrence of keywords allows to determine the closeness and universality of research topics in a scientific field (Ye *et al.*, 2024).

According to the keyword analysis, it is seen that digestibility and milk production are important areas of research on this subject, which include comparative studies with corn silage, which is an important roughage used in animal nutrition as green grass and silage (Erdurmuş, 2023). When the results of the trend topic analysis are analysed, it can be said that the topics on increasing silage quality and nutrient content have come to the forefront in recent researches. There are some limitations in this study. WoS database was used for the research. Only a limited number of studies can be accessed from one database. Research limits can be expanded by using other databases. In addition, although a research directly related to CAU is attempted, the content and quality of publications may not be interpreted by bibliometric analysis. This may mean that some publications are included in the analyses even though they address a different topic than CAU.

CONCLUSION

The number of studies using bibliometric analysis as a tool in science research has been increasing in recent years. Because it facilitates the understanding of many complex researches in a field. This study was conducted using bibliometric analysis in order to create a resource that researchers can read while conducting research in the field of CAU. This study can provide detailed information about the situation in the current literature in the field of CAU. Analyses on authors, sources, keywords and countries that should be researched while reading about the field are included. It is thought that reading and analysing this study carefully in academic research will facilitate researchers to obtain information in the field of CAU.

Author Contributions

Research Design (CRediT 1) Author 1 (%50) - Author 2 (%30) – Author 3 (%20)

Data Collection (CRediT 2) Author 1 (%50) - Author 2 (%10) - Author 3 (%30) - Author 4 (%10)

Research - Data Analysis - Validation (CRediT 3-4-6-11) Author 1 (%50) - Author 2 (%30) - Author 3 (%15) - Author 4 (%5)

Writing the Article (CRediT 12-13) Author 1 (%50) - Author 2 (%30) - Author 3 (%15) - Author 4 (%5)

Revision and Improvement of the Text (CRediT 14) Author 1 (%50) - Author 2 (%30) - Author 3 (%15) - Author 4 (%5)

Finance

The study did not receive any financial support.

Conflict of Interest

There is no conflict of interest.

Sustainable Development Goals (SDG)

Does not support

REFERENCES

Allen, M. S. (2000). Effects of diet on short-term regulation of feed intake by lactating dairy cattle. *Journal of Dairy Science*, *83*(7), 1598-1624.

Armağan, M., & Işık, M. İ. (2022). Karapınar (Konya) Tuzcul Alanlarındaki Kuraklığa Dayanıklı, Mera Islahında Kullanılabilecek Bitkiler. *Ereğli Tarım Bilimleri Dergisi, 2 (2), 67*, 74.

Bai, J., Xu, D., Xie, D., Wang, M., Li, Z., & Guo, X. (2020). Effects of antibacterial peptide-producing Bacillus subtilis and Lactobacillus buchneri on fermentation, aerobic stability, and microbial community of alfalfa silage. *Bioresource technology*, *315*, 123881.

Beauchemin, K., Yang, W., & Rode, L. (2003). Effects of particle size of alfalfa-based dairy cow diets on chewing activity, ruminal fermentation, and milk production. *Journal of Dairy Science*, *86*(2), 630-643.

Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*, *105*, 1809-1831.

Erdurmuş, D. (2023). Afyon Ekolojik Koşullarında Silajlık Mısır Çeşitlerinin Önemli Tarımsal ve Kalite Özelliklerinin Belirlenmesi.

Ferreira, J. F., Cornacchione, M. V., Liu, X., & Suarez, D. L. (2015). Nutrient composition, forage parameters, and antioxidant capacity of alfalfa (Medicago sativa, L.) in response to saline irrigation water. *Agriculture*, *5*(3), 577-597.

Garcia, A., Olson, W., Otterby, D., Linn, J., & Hansen, W. (1989). Effects of temperature, moisture, and aeration on fermentation of alfalfa silage. *Journal of Dairy Science*, *72*(1), 93-103.

Grev, A. M., Wells, M. S., Samac, D. A., Martinson, K. L., & Sheaffer, C. C. (2017). Forage accumulation and nutritive value of reduced lignin and reference alfalfa cultivars. *Agronomy Journal*, *109*(6), 2749-2761.

Harmanşah, F. (2018). Türkiye'de kaliteli kaba yem üretimi sorunlar ve öneriler. *Türktob Dergisi*, *25*, 9-13.

Hassanat, F., Gervais, R., Julien, C., Massé, D., Lettat, A., Chouinard, P., Petit, H., & Benchaar, C. (2013). Replacing alfalfa silage with corn silage in dairy cow diets: Effects on enteric methane production, ruminal fermentation, digestion, N balance, and milk production. *Journal of Dairy Science*, *96*(7), 4553-4567.

Kleinschmit, D., Schingoethe, D., Hippen, A., & Kalscheur, K. (2007). Dried distillers grains plus solubles with corn silage or alfalfa hay as the primary forage source in dairy cow diets. *Journal of Dairy Science*, *90*(12), 5587-5599.

Li, R., Jiang, D., Zheng, M., Tian, P., Zheng, M., & Xu, C. (2020). Microbial community dynamics during alfalfa silage with or without clostridial fermentation. *Scientific reports*, *10*(1), 17782.

Li, W., Li, F., Zhang, C., Gao, J., & Tao, Y. (2024). Genotypic and Phenotypic Characteristics of Lactic Acid Bacteria Associated with Forage Plants in the Native Grassland of Western Inner Mongolia and Their Application for Alfalfa Silage Fermentation. *Animals*, *14*(10), 1394.

Liao, H., Tang, M., Luo, L., Li, C., Chiclana, F., & Zeng, X.-J. (2018). A bibliometric analysis and visualization of medical big data research. *Sustainability*, *10*(1), 166.

Meho, L. I., & Yang, K. (2007). Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus and Google Scholar. *Journal of the american society for*

information science and technology, *58*(13), 2105-2125.

Mustafa, A., Christensen, D., & McKinnon, J. (2000). Effects of pea, barley, and alfalfa silage on ruminal nutrient degradability and performance of dairy cows. *Journal of Dairy Science*, *83*(12), 2859-2865.

Nasir, A., Shaukat, K., Hameed, I. A., Luo, S., Alam, T. M., & Iqbal, F. (2020). A bibliometric analysis of corona pandemic in social sciences: a review of influential aspects and conceptual structure. *Ieee Access*, *8*, 133377-133402.

Potter, W. G. (1981). Introduction to library trends 30 (1) summer 1981: Bibliometrics.

Radović, J., Sokolović, D., & Marković, J. (2009). ALFALFA-MOST IMPORTANT PERENNIAL FORAGE LEGUME IN ANIMAL HUSBANDRY. *Biotechnology in Animal Husbandry*, *25*(5-6), 465-475.

Schmidt, R., Hu, W., Mills, J., & Kung, Jr, L. (2009). The development of lactic acid bacteria and Lactobacillus buchneri and their effects on the fermentation of alfalfa silage. *Journal of Dairy Science*, *92*(10), 5005-5010.

Selvi, M. (2024). The use of statistics in veterinary sciences and the test methods used. *Research and Practice in Veterinary and Animal Science (REPVAS)*, *1*(1), 43-50.

Şahiner-Tufan, A., & Midilli-Sarı, R. (2024a). Bibliometric Analysis of the Relationship between Stress and the Built Environment (1993-2023). *Revista de Arquitectura (Bogotá)*, *26*(2), 167-188.

Şahiner-Tufan, A., & Midilli-Sarı, R. (2024b). Bibliometric Analysis of the Relationship between Stress and the Built Environment (1993-2023). *Revista de arquitectura*, *26*(2), 167-188.

Van Eck, N. J., & Waltman, L. (2011). Text mining and visualization using VOSviewer. *arXiv preprint arXiv:1109.2058*.

Van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*, *111*, 1053-1070.

Xie, H., Zhang, Y., Zeng, X., & He, Y. (2020). Sustainable land use and management research: A scientometric review. *Landscape Ecology*, *35*, 2381-2411.

Yang, W., Beauchemin, K., & Rode, L. (2002). Effects of particle size of alfalfa-based dairy cow diets on site and extent of digestion. *Journal of Dairy Science*, *85*(8), 1958-1968.

Ye, L., Yang, Z., Wang, F., Dan, H., Chen, Q., Wang, J., & Zeng, X. (2024). Progress and trends in photodynamic therapy research in oral science: A bibliometric analysis. *Photodiagnosis and Photodynamic Therapy*, *48*, 104261.

Zhang, Q., Yu, Z., Wang, X., & Tian, J. (2018). Effects of inoculants and environmental temperature on fermentation quality and bacterial diversity of alfalfa silage. *Animal Science Journal*, *89*(8), 1085-1092.