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Araştırma Makalesi

Bibliometric Analysis of Lactation Curves in Livestock

Malik ERGİN[1]*, Rabia ALBAYRAK DELİALİOĞLU[2], Yasin ALTAY[3], Özgür KOŞKAN[1]

[1]Isparta Uygulamalı Bilimler Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, Isparta
[2]Ankara Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, Ankara
[3]Eskişehir Osmangazi Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, Eskişehir

*Sorumlu Yazar: malikergin@isparta.edu.tr

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ABSTRACT

This study presents a bibliometric analysis of lactation curve modeling in livestock based on 1455 articles from the WOS database spanning 1980 to 2023. It highlights the prominent researcher Macicotta NPP with 26 publications and identifies the University of Cornell as the leading institution in terms of publication count. The Journal of Dairy Science emerges as the most relevant journal in the field, with 393 papers. Among the countries represented, Türkiye ranks 13th with 44 studies, primarily conducted in collaboration with other local authors. These findings offer valuable insights for future research endeavors in the domain of lactation curves and provide guidance on coauthor selection, journal selection, and relevant keywords. Therefore, it is suggested in this study that the lactation curve studies should be supported with different mathematical models in livestock.

Keywords: bibliometric analysis, lactation curve, models of lactation curve, milk yield

Çiftlik Hayvanlarında Laktasyon Eğrilerinin Bibliyometrik Analizi

ÖZ

Bu çalışma, 1980 ile 2023 yılları arasında WOS veri tabanındaki 1455 çalışmadan elde edilen verilere dayanarak, çiftlik hayvanlarında laktasyon eğrisi modellemesinin bibliyometrik analizini sunmaktadır. Elde edilen sonuçlarda, 26 çalışmayla öne çıkan yazar Macicotta NPP ve çalışma sayısı açısından Cornell Üniversitesi önde gelen kurum olarak görülmüştür. Bu alanda en önemli dergi olarak Journal of Dairy Science, 393 makaleyle öne çıkmaktadır. Temsil edilen ülkeler arasında Türkiye, 44 çalışma ile 13. sırada yer almakta ve bu çalışmaların çoğunluğu yerel yazarlarla iş birliği içinde yürütülmektedir. Bu bulgular, laktasyon eğrileri alanında gelecekteki araştırma çalışmaları için değerli bir perspektif sunmakta ve ortak yazar seçimi, dergi seçimi ve ilgili anahtar kelimeler konusunda rehberlik sağlamaktadır. Çalışmanın sonucunda, çiftlik hayvanlarında laktasyon eğrilerinin kullanımı için farklı matematik modellerin kullanılması ve yaygınlaşması gerektiği düşünülmektedir.

Anahtar kelimeler: bibliyometrik analiz, laktasyon eğrisi, laktasyon eğrisi modelleri, süt verimi

INTRODUCTION

The lactation curves, which vary depending on factors such as breed, genetic structure, season, calving age, and environmental factors, enable the graphical representation of milk yield within a specific time interval in species with milk yield traits (Borghese et al., 2013). Mathematical models such as Wood, Dhanoa, Wilmink, Inverse Polynomial, Exponential, Parabolic Exponential, Quadratic, Logarithmic Quadratic, and Logarithmic Linear have been widely used to mathematically describe lactation curves, including recent years (Şahin et al., 2014). These mathematical models provide valuable information about breeding programs, nutrition, and health programs in livestock animals. When a literature search is conducted with just a few keywords, many

studies focus on lactation curves. Morant and Gnanasakthy (1989) compared Wood curve and five other different curve models in terms of milk yield during lactation. In the following years, Groenewald et al. (1995) identified the mathematical model that best fits the lactation curve in Merino sheep. Pollot (2000) emphasized the need to include multiple factors affecting milk yield to fully model milk production in animals. Therefore, a comparative study was conducted with commonly used models. Marisela et al. (2005), in a preferred journal such as Small Ruminant Research, investigated total milk yield, lactation curve, and the environmental factors influencing them. In recent years, Ali et al. (2023) characterized the lactation curve using different nonlinear models and utilized daily milk yield records from 1991 to 2018 in 750 crossbred cattle. In addition, Marshall et al. (2023) utilized the lactation curve to provide information on the yield of milk, fat, protein, and lactose during lactation in a dairy sheep breed flock in New Zealand. Therefore, lactation curves still maintain their relevance in studies related to dairy characteristics in animal husbandry. The aim of this study is to examine the general status of the subject by utilizing data from 1455 lactation curve studies conducted between 1980 and 2023 in the Web of Science (WOS) database under various subheadings. This will provide guidance for researchers in future studies by informing them about the correct journal selection, keywords, and the most cited authors related to the subject.

MATERIAL AND METHOD

In the present study, we used bibliometric analysis technique to evaluate studies reviewed. Han et al. (2020) states that bibliometric analysis is a computer-based method used to examine the existing literature in a particular field and establish networks among these studies. The steps of process can be described as follows; (i) Exporting data from Web of Science (WOS) database by searching with “lactation curve” keyword, (ii) Combining the whole dataset, (iii) Constituting the networks among the studies published between 1980 and 2023 and demonstrating these networks through graphs using various methods, (iv) Interpretation of the results and graphics obtained from step (iii). The data from 1455 papers found in the WOS database between 1980 and 2023 were used as the material for this study. After conducting a literature review, the types of studies were classified as research articles, full-text conference papers, abstracts, and reviews. Among these, the majority consisted of 1364 research articles. Bibliometric analyses were conducted using the Bibliometrix package in the R programming language (Aria and Cuccurullo, 2017).

RESULTS AND DISCUSSION

According to the data from the WOS database, the numbers of lactation curve modeling studies conducted between 1980 and 2023 are presented in Figure 1. It can be observed that the rising trend after 2010 experienced a sharp decline around 4 years later in 2014. The year with the highest number of research conducted is 2021, with 76 studies. Considering the increase in the number of articles published in 2010, some studies and their objectives can be summarized. Buttchereit et al. (2010) reported in their study published in the Journal of Dairy Science that the Ali-Schaffer curve model was the most suitable model for predicting the fat-to-protein ratio in dairy cattle milk. Torshizi et al. (2011) emphasized that the Wood model provided the best results in predicting daily milk yield based on 106,581 lactation records obtained from 12,677 cows. Cankaya et al. (2011) compared the Wood, Cobby and Le Du, Wilmink, Exponential, and Parabolic Exponential lactation curve models and reported that the Wood model provided more useful information for genetic improvement in Jersey cattle.

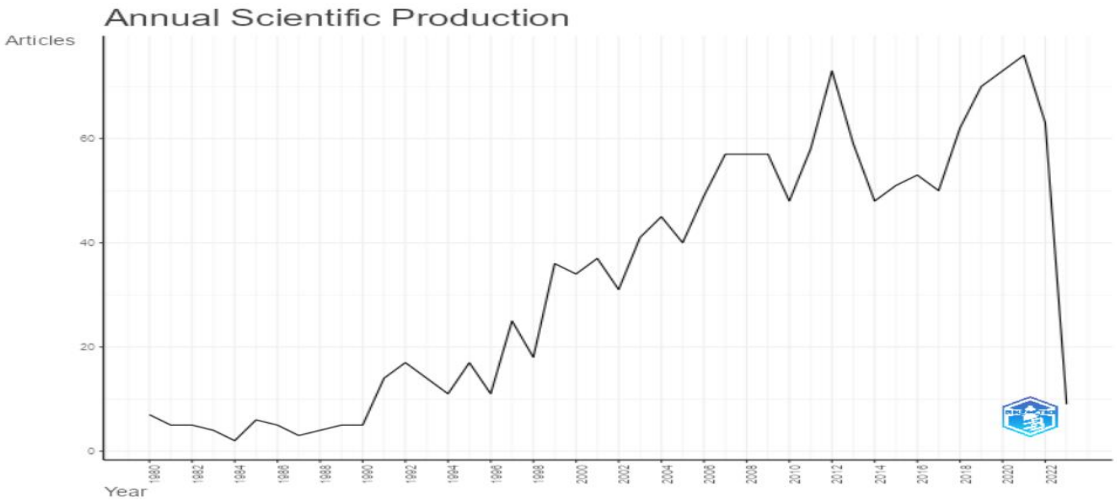

Figure 1. Annual scientific production

The journals with the highest number of publications on lactation curves or models in livestock are shown in Figure 2. From this perspective, the journal with the most articles are the Journal of Dairy Science (N = 393), followed by Livestock Science (N = 48) and Revista Brasileira De Zootecnia (N = 42). The H-index values for these journals are shown in Figure 3. When ranked by H-index, the top three journals are the Journal of Dairy Science (H = 67), Livestock Production Science (H = 26), and Journal of Animal Science (H = 18).

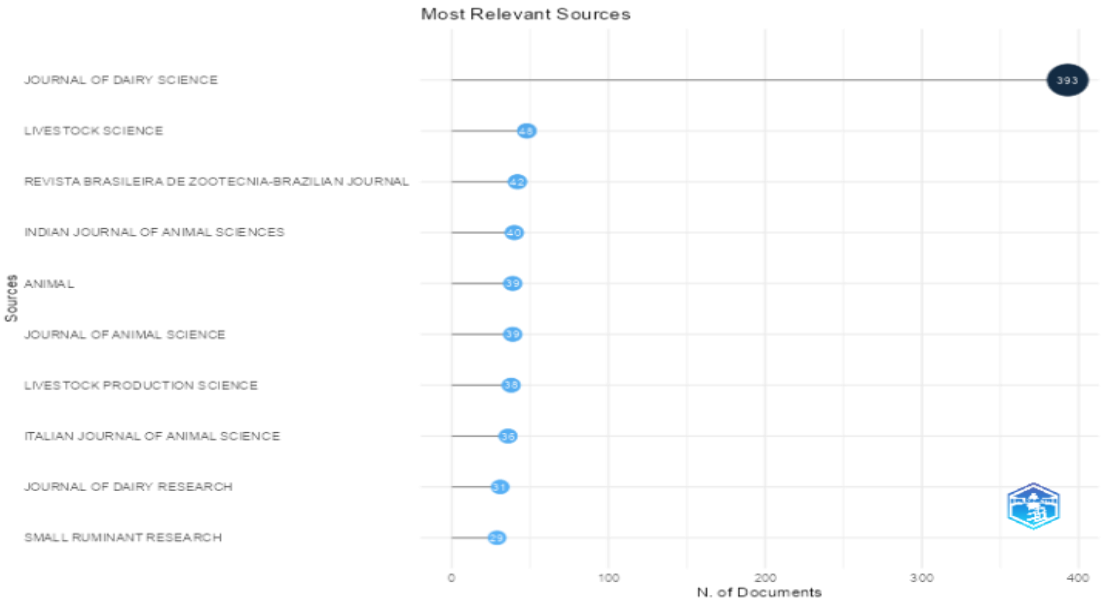

Figure 2. Most relevant journals

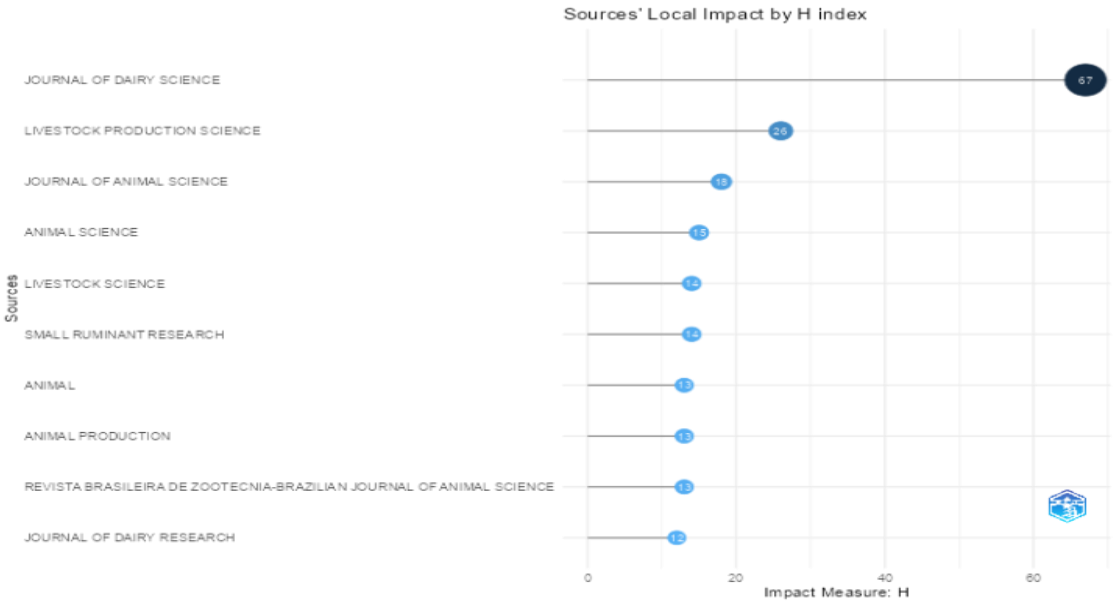

Figure 3. The H index of most relevant journals

The ranking of the most relevant authors in lactation curves and modeling is presented in Figure 4. The top three relevant authors are of Macicotta NPP (N = 26), Jamrozik J (N = 24), and Bruckmaier RM (N = 18). The most common universities where lactation curve models are studied are listed in Figure 5. In terms of the number of completed articles, the University of Cornell from the USA (N = 74), the University of Guelph from Canada, and the Federal University of Viçosa from Brazil (N = 47) are at the top. Kahramanmaraş Sütçü İmam University, one of the universities in Türkiye, ranks 59th with 9 articles and stands out compared to other universities in Türkiye.

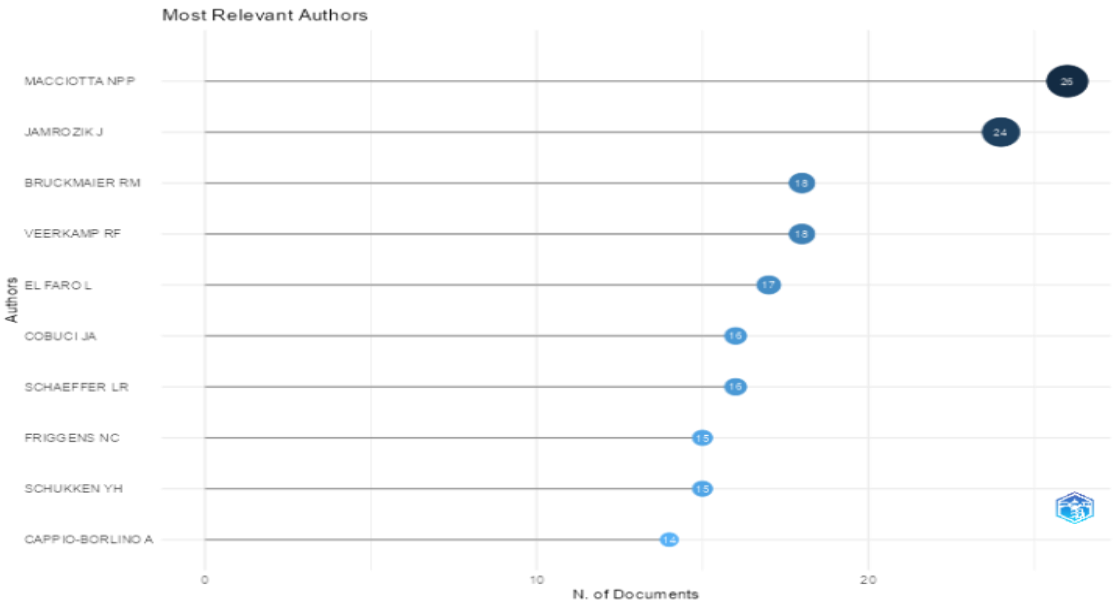

Figure 4. Most relevant authors for lactation curves and modeling studies

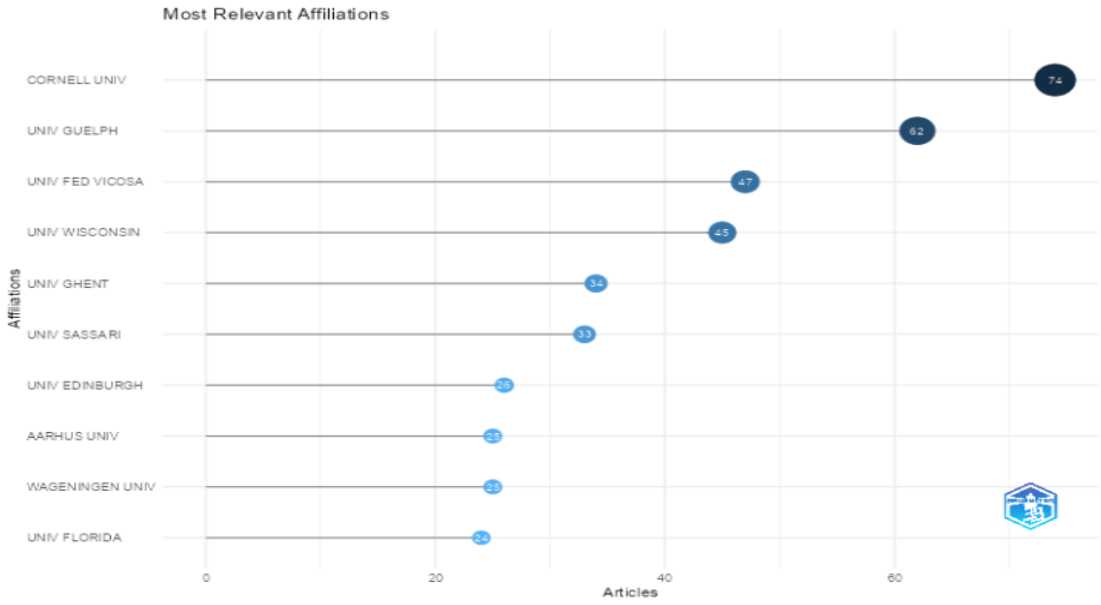

Figure 5. Most relevant affiliations

Table 1 provides the number of publications by the corresponding authors according to the country, the number of publications by researchers in the same country (SCP), the number of publications conducted by researchers from multiple countries (MCP), and their frequencies. When examining the values of the top 13 countries, the USA (N = 167, f = 0.115), Brazil (N = 124, f = 0.085), and Italy (N = 79, f = 0.054) are in the top three. Türkiye ranks 13th with 44 publications. Out of these 44 studies, 42 are publications conducted by researchers in the same country.

Table 1. The number of publications and frequencies by the corresponding authors according to the country

Country	Article	SCP	MCP	Frequency
USA	167	139	28	0.115
BRAZIL	124	98	26	0.085
ITALY	79	65	14	0.054
GERMANY	65	59	6	0.045
CANADA	57	34	23	0.039
INDIA	57	57	0	0.039
IRAN	53	41	12	0.036
NETHERLANDS	51	34	17	0.035
UNITED KINGDOM	51	38	13	0.035
FRANCE	49	37	12	0.034
SPAIN	46	31	15	0.032
TÜRKİYE	44	42	2	0.030

Figure 6 displays the most relevant words. The top three most relevant words are "Cattle" (f = 288), "yield" (f = 253), and "cows" (f = 219).

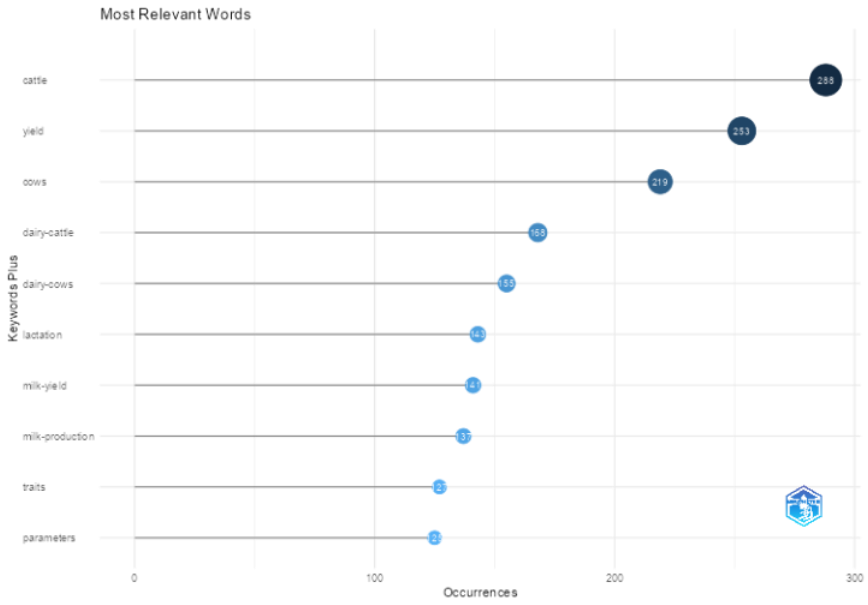

Figure 6. Most relevant words

When the Figure 7 was examined, it can be argued that concepts such as cattle (N=288, %7), yield (N=253, %6), cows (N=219, %5), dairy cattle (N=168, %4), dairy cows (N=155, %4), and lactation (N=143, %3) stand out more in the articles considered.

Figure 7. Tree map obtained from keywords plus

Based on the keywords used by the authors, a keyword theme map was presented in Figure 8. According to the results, the map has three main clusters: metabolism, cattle, and dairy cattle. Niche themes and basic themes were metabolism and cattle respectively.

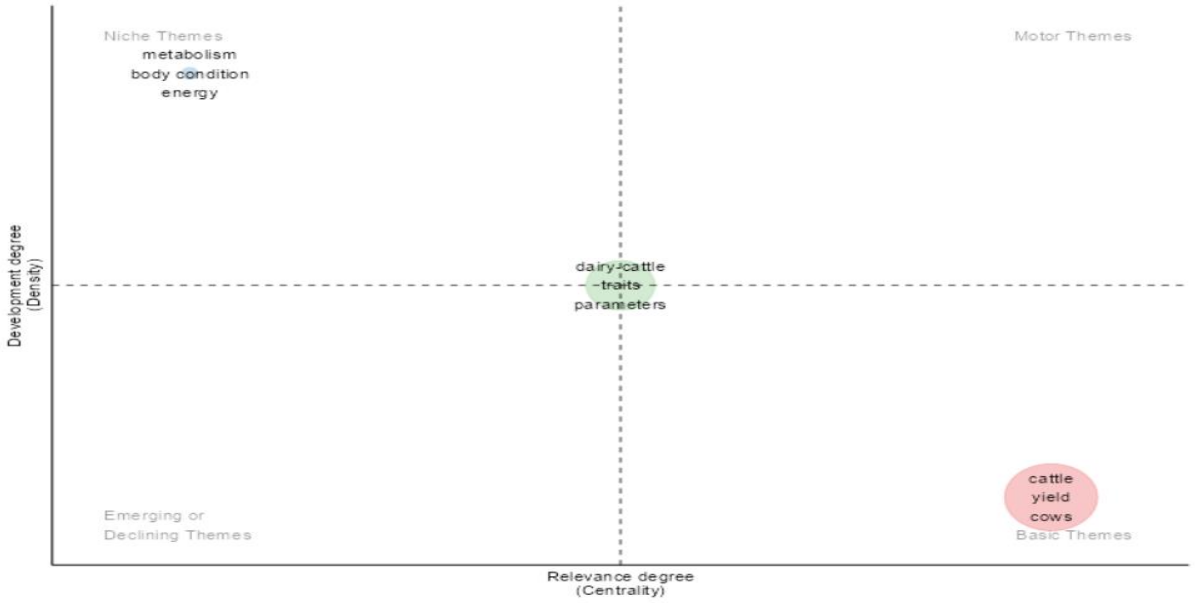

Figure 8. Thematic map

CONCLUSION

According to the bibliometric analysis conducted, it is evident that modeling milk yield during lactation with various curve models remains a topic of ongoing research even in recent years. Particularly in countries like the United States of America, where dairy cattle sector is highly developed, researchers tend to publish more articles in top-ranked journals in the field. Additionally, modified curve models in various mathematical forms have emerged as alternatives to traditional lactation curve models. Many researchers have shown interest in these models. Therefore, it is suggested in this study that the lactation curve studies should be supported with different models in livestock.

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Conflict of Interest Statement: Authors declare that there is no conflict of interest.

Contribution Rate Statement Summary of Researchers: M.E. investigation, writing, review, and editing; R.A.D. investigation, writing, and review; Y.A. investigation, writing, and review; Ö.K. investigation, writing, and review

ORCID of the Authors

Malik ERGİN http://orcid.org/0000-0003-1810-6754

Rabia ALBAYRAK DELİALİOĞLU http://orcid.org/0000-0002-1969-4319

Yasin ALTAY http://orcid.org/0000-0003-4049-8301

Özgür KOŞKAN http://orcid.org/0000-0002-5089-6250

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