Australian Journal of Basic and Applied Sciences

2022 November; 16(11): pages 24-29
https://doi.org/10.22587/ajbas.2022.16.11.4

Research Paper AENSI Publications

Dairy Cattle Breeding Systems

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Received date: 12 July 2022, Accepted date: 22 September 2022

Citation: M. L. S. Evaristo1, V. R. M. da Silva1., F. L. Bim Cavalieri., S.do A. Freire., M. A.Andreazzi., 2022. Dairy Cattle Breeding Systems. Australian Journal of Basic and Applied Sciences, 16(11): 24-29. DOI: 10.22587/ajbas.2022.16.11.4.

ABSTRACT: The dairy activity has a satisfactory perspective on the world scenario and this is due to the improvement of technologies in the activity and the choice of the best breeding system. The objective of this work was to carry out a theoretical approach on the different systems of raising dairy cows. A scientometric study of scientific literature published in journals indexed in the SciELO database was carried out. The search was carried in 2022 and the following descriptors were used, in portuguese and english: dairy cow production systems; facilities for dairy cows; extensive system of/for dairy cows; semi intensive system from/to dairy cows; intensive system from/to dairy cows; collective beds for dairy cows; single beds for dairy cows; loose Housing; free stall and compost barn. The process resulted in 21 articles, from which the information was collected: year of publication, central thematic axis of the research, periodicals with the highest number of publications on the theme and the classification of the periodical. Data were analyzed descriptively. The analysis revealed a low number of publications on the subject, over more than 20 years, mostly in low impact journals. The main themes of the publications addressed the characteristics of the Free-Stall system, studies on the economic and financial viability of intensive production systems and the Compost Barn System. There was a highlight in publications that evaluated the environmental conditions both in the Free Stall system and in the Compost Barn system

Keywords: Dairy cattle; dairy cows; systems of raising dairy cows.

INTRODUCTION

The increase in the implementation of refinements in dairy farming makes the chain more promising worldwide, with constant growth in milk supply (Fernandes; Minhoto, 2019). South America occupies the fourth place in the ranking of world milk production, with Brazil being a prominent producer with more than 50% of the total of the subcontinent, with producers heterogeneously distributed throughout the national territory and employing different managements and production systems (Anuário Leite, 2022). Thus, different production systems are classified as extensive, semi-extensive and intensive. Among the intensive or confined systems, we have the Tie Stall, Loose Housing, Free Stall and the most recent Compost Barn. The extensive system is characterized by animals released in native pasture, in small areas of pasture, without the use of genetic improvement and, sometimes, milk is not the property's main focus. The semi-extensive system occupies more extensive areas and requires vegetation cover, usually with a pasture system rotated in paddocks. This system depends on favorable weather conditions to maintain the quality of food and herd production (Mota et al., 2017).

In relation to the intensive production system or confinement regime, it is verified that it is a common and recurrent practice that is necessary in many countries of the world, both for the exploitation of meat and milk, due to the limitation of areas and the high costs of land (Mota et al., 2017). Thus, the intensive system is the most common system in dairy farming, has low seasonality

influence, and uses advanced technologies that promote less wear and greater herd production. However, it requires a greater investment and, in some cases, cows may have a high incidence of hoof problems and a greater propensity to infectious diseases. As confinement systems for dairy cattle, we have the individual stalls, called Tie Stall, and the free housing systems with the Loose Housing and Free Stall models, which are the best known by producers, and the most recent, Compost Barn (Black et al., 2013; Mota et al., 2017; Meinl; Vieira, 2021). In the Tie Stall system, the cows remain side by side, contained in individual stalls most of the time and are held by a chain around the neck. They receive all their food in the trough and are usually released only at the time of milking. The intensive free-stall system is a well-known modality, characterized by individual stalls with beds for rest and free stables and the animal tends to spend less energy on pastures, producing more, feeding and reproducing more easily. However, facilities require high investment costs (Mota et al., 2017; Meinl; Vieira, 2021). In the Loose Housing system, the confinement takes place in stables with a communal resting area and although confined, the animals have access to free areas, with beds of straw or earth in the shade, coupled with a sunbathing area. However, problems in the feet, inflammation, mastitis and injuries are common in this system (Mota et al., 2017). In the Compost Barn, the animals are loose inside the shed, which improves the comfort and well-being of the animals and, consequently, the productivity rates of the herd (Black et al., 2013). The Compost Barn is characterized by a large resting area where natural composting of waste and bedding material takes place. This system offers high comfort to cows, leading to greater productivity and longevity (Leso et al., 2013; Meinl; Vieira, 2021), but one of the difficulties is finding bedding materials in some areas of the country (Sampaio et al., 2021), in addition, to correctly handling the bed. Due to the importance of choosing the best housing system for dairy cows, there is a need to analyze and know the direction of investigations and understand the scientific behavior of publications related to this topic. Hence, the objective of this work was to carry out a theoretical analysis, through a scientometric study, based on the scientific publications of the last 20 years that evaluated the different systems of raising dairy cows.

MATERIALS AND METHODS

The present work consisted of a scientometric study of scientific literature and the object of analysis was the scientific production published in journals indexed in the Scientific Electronic Library Online (SciELO) databases (http://www.scielo.org), according to methodological recommendations for scientometric studies by Schubert, Glanzel and Braun (1989). The search for scientific articles was carried out in July 2022, and the descriptors were used in Portuguese and English: Milk cow production systems; Extensive System from/to dairy cows; Semi-Intensive System from/to dairy cows; Intensive System cows from/to dairy cows; Collective beds for dairy cows; Single beds for dairy cows; Loose Housing; Free Stall, Compost Barn and Dairy Cow Facilities. The search process allowed the identification of 21 articles that met the adherence criteria. After that, the following information was identified and collected: the year of publication of the scientific article, the central thematic axis of the research, the periodicals with the largest number of publications on the topic and the classification of the journal according to the criterion Qualis/ CAPES/ Brazil, in the area of Veterinary Medicine. Data were tabulated and organized in an electronic spreadsheet (*Microsoft Excel* 2016) and descriptive analysis was used.

RESULTS

The percentage of articles published per year is shown in Figure 1. Regarding the main research subjects, after analyzing the titles and abstracts of the articles, it was possible to define 4 thematic axes (Figure 1), with publications on the Free Stall system standing out. Thus, considering that more than half of the articles dealt with the Free Stall and Compost Barn systems, these articles were classified according to the main objective of the research (Table 1). The main scientific journals that were published on the topic are listed in Table 2. It was observed that the 21 articles found in this survey were published in 12 different journals and these were classified according to the Qualis/ CAPES/ Brazil criteria, 2016, in the area of Veterinary Medicine (Table 3).

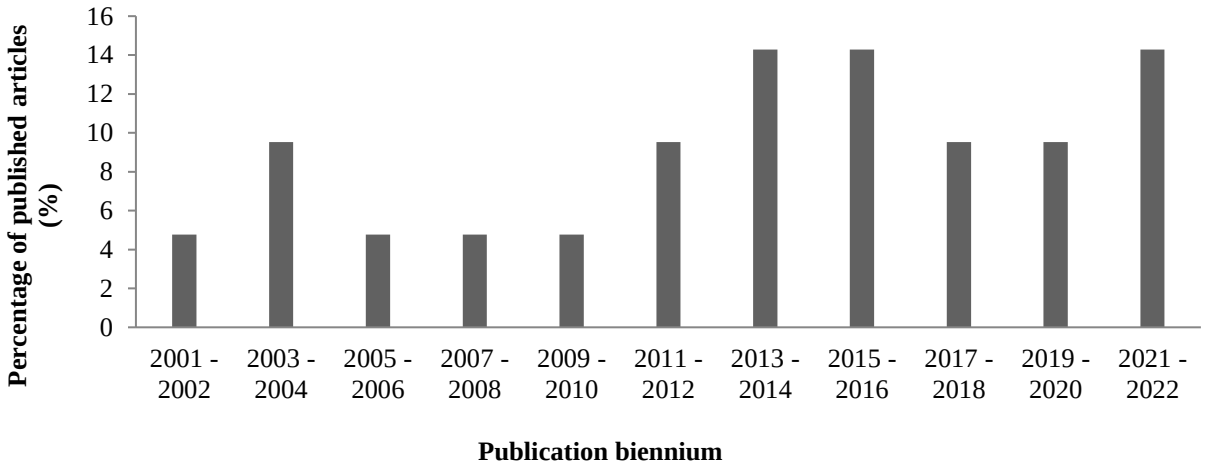

Figure 1. Percentage of scientific articles published on the topic "Dairy cow production systems", every 2 years, between 2001 and 2022 (n:21).

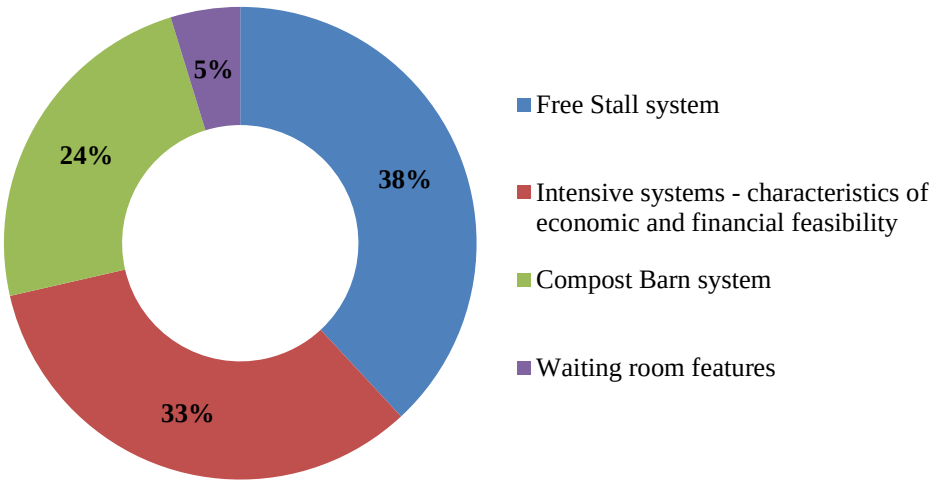

Figure 2. Percentage of scientific articles published on "Dairy cow production systems", analyzed between 2001 and 2022, according to the main research topic (n:21).

Table 1. Percentage of scientific articles published on the topic "Dairy cow production systems", analyzed between 2001 and 2022, according to the main objective of the research on Free-Stall and Compost Barn Systems.

Main research topic	Amount (n)	Percentage (%)
Free Stall system		
Environmental conditions	2	25.0
Productive and reproductive aspects	2	25.0
Occupancy rate	1	12.5
Handling with robotic milking	1	12.5
Economic viability	1	12.5
Foot diseases	1	12.5
Total	**8**	**100**
Compost Barn system		
Environmental conditions	3	60
Bed management	1	20
Productive aspects	1	20
Total	**5**	**100**

Table 2. Main scientific journals with publications on "Dairy cow production systems", analyzed between 2001 and 2022 (n:21).

Main scientific journals	Amount (n)	Percentage (%)
Brazilian Archive of Veterinary Medicine and Zootechnology	4	19.05
Journal of the Brazilian Association of Agricultural Engineering	4	19.05
Brazilian Animal Science	2	9.52
Acta Scientiarum. Animal Sciences	2	9.52
Annals of the Brazilian Academy of Sciences	2	9.52
Other journals with only 1 publication	7	33.34
Total	**21**	**100**

Table 3. Percentage of scientific journals that published on "Dairy cow production systems", analyzed between 2001 and 2022, according to the Qualis/CAPES/ Brazil stratum, in the area of Veterinary Medicine.

Qualis stratum	Amount of scientific journals (n)	Percentage of scientific journals (%)
Upper stratum		
A1	0	0
A2	2	16.67
B1	1	8.33
Lower stratum		
B2	5	41.66
B3	2	16.67
B4	2	16.67
Total	**12**	**100**

DISCUSSION

The historical analysis of publications made it possible to determine the number of articles published, according to the year of publication, between 2001 to 2022, grouped by biennium. The results showed fewer publications with variable behavior over the years. In addition, the survey results showed that several studies discussed the Free Stall System (38.09%). In the free-stall system, the cows are free within a fenced area, part of which is divided into individual stalls, where the animals remain side by side and are lined with bedding. The stalls are intended for the animals to rest and the other part of the facility is designed for food and exercise. The system has become very popular among producers due to its management, as when cows are not being milked, they can roam freely in a large open space (Mota et al., 2017).

The investigations addressed different contents, such as the evaluation of the pregnancy rate in Holstein cows confined in Free Stall, in summer and winter (Pires et al., 2002); analysis of environmental conditions (Souza et al., 2004a) and analysis of investment in air conditioning for dairy cattle in a free-stall housing system (Souza et al., 2004b); the simulation of the profitability and economic viability of a milk production model in a Free-Stall system (Silveira et al., 2011); the forecast of the occupancy rate in the sheds (Campos et al., 2013); studies on reproductive and productive parameters in dairy cows in management (Villadiego et al., 2016) and the impact of production factors and animal welfare on the frequency of robotic milking of confined Holstein cows (Córdova et al., 2018).

Studies comprising the economic aspects and feasibility of intensive systems also stood out, such as the study that aimed to compare intensive systems of milk production in Brazil and the Netherlands through SWOT analysis. The authors analyzed 21 properties and concluded that the production of Brazilian properties is higher in quantity than in the Netherlands. However, they show less intensification compared to Dutch properties (Passetti et al., 2016). Oliveira et al. (2016), seeking to contribute to the sustainability and competitiveness of dairy farming in northeastern Brazil, surveyed and evaluated the technological, zootechnical and socioeconomic profiles and identified and quantified reference indicators to be used in dairy cattle production systems.A prominent system was the Compost Barn (23.82%). The compost barn is an alternative confinement system to the loose housing system, where the animals are free and can walk freely inside the shed, aiming primarily to improve the comfort and well-being of the animals and, consequently, to improve the productivity rates of the herd (Black et al., 2013). The compost barn facilities are sustainable and offer benefits to the cows, who have more freedom of movement and ample space to lie down naturally. This system allows for greater social interaction and better cow welfare (Mota et al., 2017). It is known that the success of confinement for dairy cattle in the Compost Barn model depends mainly on the type of material used in the litter and the management used, including the turning of the litter. Thus, Mota, Andrade and Leite (2019) characterized the spatial variability of bed temperature in the Compost Barn confinement model and its effect on the efficiency of bed turning performed with different agricultural implements. Sampaio et al. (2021) evaluated the thermal attributes of bedding based on carnauba bagana (*Copernicia prunifera*), an alternative bedding material for dairy cows housed in the Compost Barn system. Knowing that the environmental conditions of housing directly affect the productive sector, Souza et al. (2004a) analyzed the ecological requirements of housing with 470 cows, housed in free-stall systems, with and without an acclimatization system. They verified the best results for the group housed in the acclimatized system. Still, about the ambience and conditions of the waiting room, Silva and Passini (2018) evaluated the effect of different air conditioning systems in the waiting room for dairy cattle through environmental variables, milk production and economic indices. As expected, it was found that the main journals that were published on dairy cow production systems were those related to animal production areas, such as zootechnics and veterinary medicine. However, the result regarding the classification of scientific journals in which the articles of this study were identified, based on the Qualis/ CAPES/ Brazil, 2016 criteria, in the area of veterinary medicine, revealed that most of the articles (75%) was published in scientific journals classified in lower Qualis stratum, that is, journals without high quality and scientific rigor.

CONCLUSIONS

The scientometric analysis on the subject of Dairy Cow Production Systems revealed few publications on the subject over more than 20 years, most of them in journals of low scientific impact.

The main themes of the publications addressed the characteristics of the Free-Stall system, studies on the economic and financial viability of intensive production systems and the Compost Barn System. Research that evaluated the environmental conditions in both the Free Stall system and the Compost Barn stood out.

ACKNOWLEDGMENTS

The authors are grateful to Cesumar Institute of Science, Technology and Innovation- ICETI, for the financial contribution.

AUTHOR'S CONTRIBUTIONS:

The authors confirm contribution to the paper as follows: study conception and design: Maria Luiza Simão Evaristo, Vitoria Raissa Moraes da Silva and Márcia Aparecida Andreazzi; data collection: Maria Luiza Simão Evaristo and Vitoria Raissa Moraes da Silva; analysis and interpretation of results: Fábio Luiz Bim Cavalieri, Sidnei do Amaral Freire and Márcia Aparecida Andreazzi; draft manuscript preparation: Maria Luiza Simão Evaristo, Fábio Luiz Bim Cavalieri and Márcia Aparecida Andreazzi. All authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest

SOFTWARE/DATA AVAILABILITY

Electronic spreadsheet (*Microsoft Excel* 2016)

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