








Beef cattle finishing systems used in scientific research in Brazil: an integrative review

[Sistemas de terminação de bovinos de corte utilizados em pesquisas científicas no Brasil:
uma revisão integrativa]

J.G.F. Alves¹, A.L.C. Gurgel^{1*} , M.J. Araújo¹, T.P. Dias-Silva¹, G.S. Difante² ,
L.C.V. Ítavo² , I.B.R. Campelo¹, M.A.S. Marinho¹, I.O.M. Aguiar¹,
J.V. Emerenciano Neto³ , D.M. Almeida⁴ 

¹Universidade Federal do Piauí, *Campus* Professora Cinobelina Elvas, Bom Jesus, PI, Brasil

²Faculdade de Medicina Veterinária e Zootecnia, Universidade Federal de Mato Grosso do Sul,
Campo Grande, MS, Brasil

³Unidade Acadêmica Especializada em Ciências Agrárias, Universidade Federal do Rio Grande do Norte,
Macaíba, RN, Brasil

⁴Universidade Federal Rural de Pernambuco, Recife, PE, Brasil

ABSTRACT

The objective of this review was to identify, synthesize, and characterize, through an integrative approach, the main beef cattle finishing systems used in Brazilian scientific research. A review protocol was developed, and the search terms were based on the PVO strategy to formulate the study's guiding question: study population (P) consists of beef cattle, the variables of interest (V) were the finishing systems adopted in the studies with cattle in Brazil, and the outcomes (O) were the characteristics of the finishing systems. The following guiding question was formulated: What are the major beef cattle finishing systems used in scientific research in Brazil? The databases used were SCOPUS, Web of Science, and Science Direct. 1,388 studies were found, 1,163 of which were scientific articles. However, 33 publications were selected for data extraction. The studies covered different regions of Brazil: Southeast (14), South (10), Midwest (8) and Northeast (1). The confinement finishing system was the strategy used in 63.4% of the experiments and 24.2% of pasture systems with supplementation. In 81.1% of the studies, the pure Nellore breed or crossed with other breeds was used. Scientific research on cattle finishing in Brazil focuses on confinement systems.

Keywords: beef cattle farming, feedlot, finishing, pastures, production systems.

RESUMO

O objetivo desta revisão foi identificar, sintetizar e caracterizar, por meio de uma abordagem integrativa, os principais sistemas de terminação de bovinos de corte utilizados na pesquisa científica brasileira. Foi elaborado um protocolo de revisão, e os termos de busca foram baseados na estratégia PVO para formulação da questão norteadora do estudo: a população do estudo (P) é constituída por bovinos de corte, as variáveis de interesse (V) foram os sistemas de terminação adotados nos estudos com bovinos no Brasil, e os resultados (O) foram as características dos sistemas de terminação. Formulou-se a seguinte questão norteadora: Quais os principais sistemas de terminação de bovinos de corte utilizados em pesquisas científicas no Brasil? As bases de dados utilizadas foram SCOPUS, Web of Science e Science Direct. Foram encontrados 1.388 estudos, sendo 1.163 artigos científicos. Contudo, foram selecionadas 33 publicações para extração de dados. Os estudos abrangeram diferentes regiões do Brasil: Sudeste (14), Sul (10), Centro-Oeste (8) e Nordeste (1). O sistema de terminação em confinamento foi a estratégia utilizada em 63,4% dos experimentos e em 24,2% dos sistemas de pastagem com suplementação. Em 81,1% dos estudos, foi utilizada a raça Nelore pura ou cruzada com outras raças. A pesquisa científica sobre terminação de bovinos no Brasil concentra-se em sistemas de confinamento.

Palavras-chave: confinamento, criação de bovinos de corte, pastagens, sistemas de produção, terminação

*Corresponding author: antonio.gurgel@ufpi.edu.br

Submitted: March 29, 2024. Accepted: April 29, 2024.

INTRODUCTION

Beef cattle farming in Brazil has recently experienced significant transformations, driven by the implementation of technologies such as strategic supplementation in different degrees and the genetic improvement of breeds, which resulted in a reduction in the production cycle (Paula *et al.*, 2011; Laureano *et al.*, 2011). Nevertheless, the almost exclusive production in pastures continues to be the primary factor that maintains the competitiveness of Brazilian beef cattle farming on a global scale. Considering that approximately 85% of animals slaughtered in Brazil originate from systems that use pastures (Beef..., 2022), it is relevant to highlight the territorial extension allocated to these areas, which corresponds to approximately 153.78 million hectares in the country (Beef..., 2022).

Despite technological advances and the significant size of the Brazilian cattle herd, productivity rates remain below those of the major global competitors. This situation is mainly the result of the limited adoption of adequate pasture and grazing management practices, together with the scarce application of fertilization techniques to maintain pastures (Gurgel *et al.*, 2021). As a result, between 60 and 70% of Brazilian pastures are in some stage of degradation, emerging as one of the principal environmental challenges in production systems (Pereira *et al.*, 2018; Gurgel *et al.*, 2022).

Brazilian scientific research aimed at improving animal production systems and mitigating environmental impact has demonstrated significant advances in recent decades. However, the predominance of studies related to beef cattle in confinement environments does not adequately reflect the diversity of national production systems. Additionally, it is notable that most studies on pasture management focus on animals in the rearing phase (Euclides *et al.*, 2019; Costa *et al.*, 2021, 2022).

According to Malafaia and Canella Filho (2019), because of this practice, there is a vast amount of research on the nutrition of finishing cattle that subjects them to a moderate, or even high, intake of concentrated feed daily, regardless of whether be confined or not. The divergence between scientific discoveries and animal production systems can be identified as one of the reasons

underlying the low productivity rates in beef cattle farming in Brazil.

Therefore, it is extremely important to conduct bibliographical research to identify gaps in the literature and stimulate new research that can improve beef cattle production systems. This study consists of an integrative review that aims to provide a broad view of beef cattle finishing systems used in scientific research in Brazil. This approach currently represents the most comprehensive method for reviewing and synthesizing existing knowledge on a specific topic. The integrative review proposes to identify, analyze, and synthesize the results of independent studies related to the same topic (Souza *et al.*, 2010; Costa *et al.*, 2022; Paes *et al.*, 2023). Thus, our objective with this review is to identify, synthesize, and characterize the major beef cattle finishing systems used in Brazilian scientific research through an integrative approach based on the analysis of primary studies published in relevant databases.

MATERIAL AND METHODS

The protocol for this review was previously developed to ensure correct procedures in research, extraction, analysis, and transfer of data for the production of high-level scientific evidence. To this end, a highly sensitive search strategy was used to meet the proposed objectives. To ensure the appropriate and non-random selection of sensitive terms in the search for studies relevant to the review, a peer-reviewed analysis of scientific articles published on the topic under study was carried out. This measure is justified by the lack of standardization of specific controlled terms for the area, as indicated by Costa *et al.* (2021, 2022).

To elaborate on the guiding question of this review, the PVO mnemonic strategy was adopted. The study population (P) consists of beef cattle, the variables of interest (V) were the finishing systems adopted in studies with cattle in Brazil, and the outcomes (O) were the characteristics of the finishing systems. Therefore, the following guiding question was formulated: What are the main beef cattle finishing systems used in scientific research in Brazil?

Beef cattle finishing...

The search was conducted by two researchers simultaneously in three databases that contained studies relevant to the central research question: SCOPUS (Elsevier), Web of Science (main collection), and Science Direct, until April 15, 2022. To access these databases, the CAPES

Periodicals Portal was used, through the proxy of the Federal University of Piau  (UFPI, Brazil). The database filter was also applied to restrict the search to studies developed exclusively in Brazil. Table 1 presents the terms used in cross-search, along with their corresponding synonyms.

Table 1. Terms used in high sensitivity cross-search for studies with beef cattle finishing systems in Brazil

Acronym	Terms
Population (P)	“Beef cattle” OR “Bovinos de corte” OR “Ganado” OR “Vacuno” OR “Beef cow” OR “Beef herd” OR “Beef production” OR “Bos indicus” OR “Bos taurus” OR “Zebu” OR “Livestock” OR “Ox” OR “Oxen” OR “Calves” OR “Herd” OR “Nelore” OR “Angus” OR “Brahman” OR “Brangus” OR “Senepol” OR “Hereford”
Variables (V)	“Production systems” OR “Sistemas produtivos” OR “Sistemas productivos”
Outcomes (O)	“Feedlot” OR “Terminac�o” OR “Terminaci�n” OR “Finishing” OR “Finished” OR “Termination” OR “Confinement” OR “Feedyard” OR “Finishing systems” OR “Finishing cattle” OR “Pasture finishing” OR “Grazing cattle” OR “Grass finished”

Complete research articles available in the databases, developed in Brazil, under any research design and that answered the guiding question, were included in this review. Studies were considered relevant when: (1) they consisted of primary research published in the format of a scientific article, (2) they addressed the finishing of beef cattle in Brazil, and (3) they presented information on the characterization of finishing systems and the animal component used. Duplicate articles, both within and between databases, were counted only once.

Articles presented in editorials, letters to the editor, abstracts, expert opinions, other reviews, correspondence, book chapters, theses and dissertations, lecture summaries, books, or book chapters were excluded. Articles involving fistulated animals, matrices, and animals in the breeding and rearing phases were not included in this review to avoid the introduction of variables that could generate confusion in the overall data analysis. Furthermore, articles derived from theses or dissertations that resulted in two or three articles from the same experiment were considered only once.

In the first stage of screening the database, two reviewers individually evaluated the research results by reading the titles and abstracts of the articles. Any discrepancies between the reviewers were resolved through a consensus meeting, in which the inclusion and exclusion criteria were considered, as well as the objective of the research. In the second stage, the full texts of the selected articles were fully examined and

evaluated against the established eligibility criteria. Microsoft Excel  software was used in all phases of the screening process.

A data extraction form developed specifically for this study was used, covering relevant information such as publication identification (article title, indexed databases, authors, country, language, and year of publication), name of the scientific journal, and details of methodological aspects of the study.

Studies were initially classified according to the level of evidence produced (using the JBI - Instituto Joanna Briggs level of evidence), and those classified as level 2 or higher were included, thus ensuring the incorporation of studies with greater robustness of evidence. To evaluate the methodological quality of the studies, the CASP instruments were used, which were adapted according to the type of methodology of each research (available at: <https://casp-uk.net/casptools-checklists/>), considering only those that met the essential requirements and compliance criteria with the research methods outlined in each study.

RESULTS

Initially, 1,388 studies were identified, of which 1,163 were scientific papers. Among these, 50 studies were highlighted as potential sources of relevant data for the research. Subsequently, after reading in full, 33 publications were selected for presenting methodological robustness and for answering the study's guiding question (Figure

1). Furthermore, all selected studies presented a high level of evidence, as they were individual studies with an experimental design (level 1).

Studies published between 2007 and 2023 were analyzed, where approximately half (48.5%) were published in the last 5 years. These studies covered several regions of Brazil: Southeast (n=14), South (n=10), Midwest (n=8), and Northeast (n=1), published in English or Portuguese. It is noteworthy that most studies were carried out in the state of São Paulo (n=7), followed by Rio Grande do Sul and Minas

Gerais, both with 6 studies (Figure 2). Also, studies were included from the states of Paraná (n=4), Goiás (n=3), Mato Grosso do Sul (n=3), Mato Grosso (n=2), Rio de Janeiro (n=1) and Bahia (n=1).

The confinement finishing system was used in 63.4% of the experiments carried out. In contrast, 24.2% of studies were conducted in pasture finishing systems. Additionally, 12.1% of the experiments adopted both finishing systems, pasture, and confinement, simultaneously (Table 2).

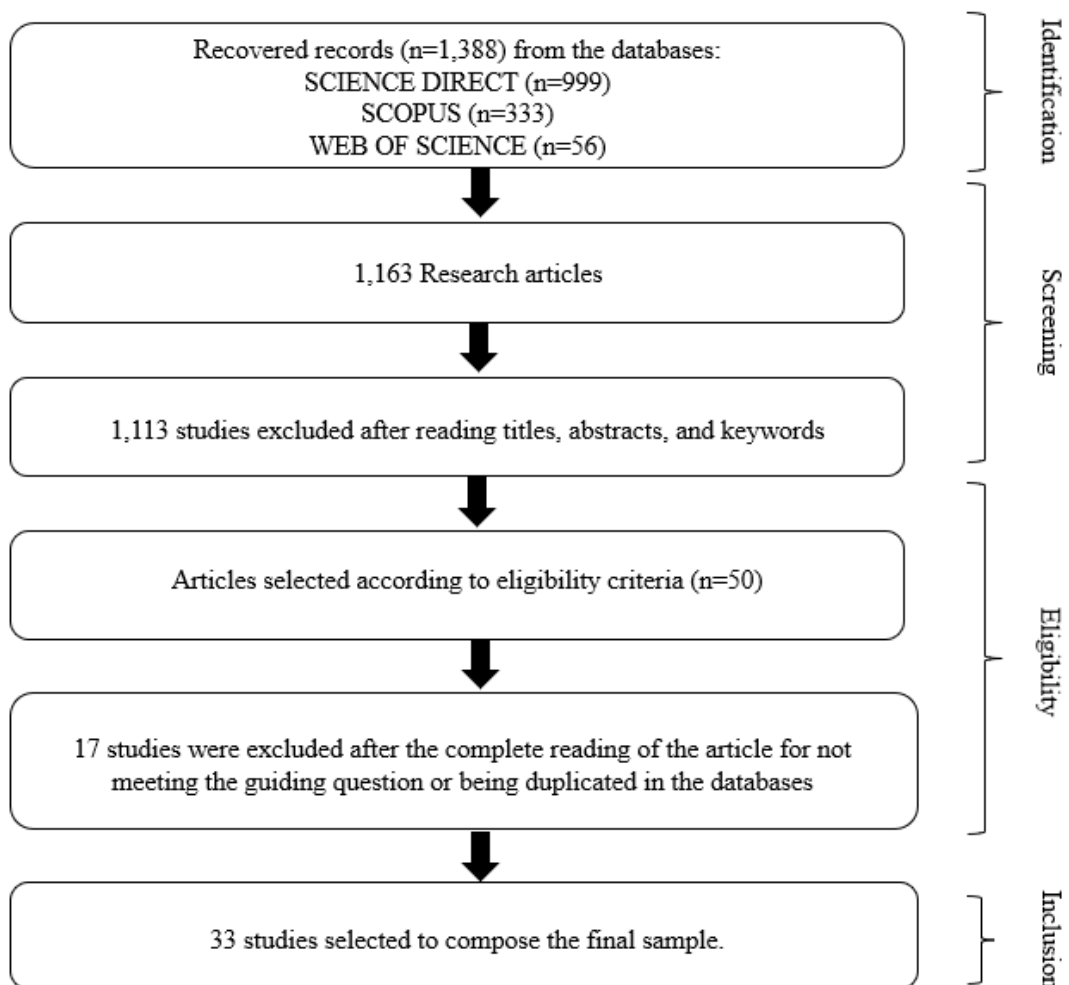


Figure 1. Flowchart of the final sample selection process for the integrative review.

Beef cattle finishing...

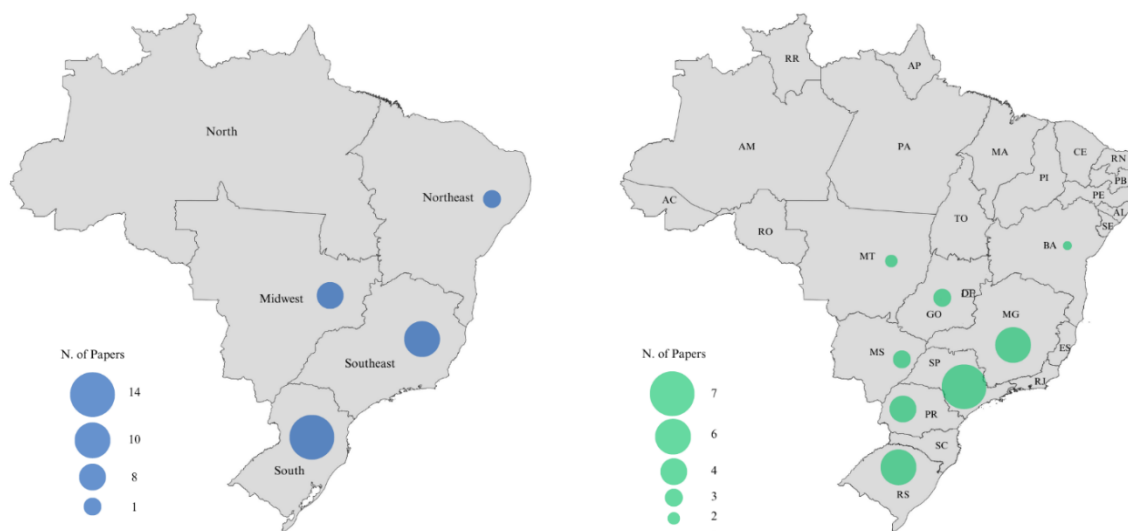


Figure 2. Distribution of papers by region and state on beef cattle finishing in Brazil.

Table 2. Beef cattle finishing systems in Brazil

Author/year	State/region	finishing system	Roughage/cultivate	Supplementation	Roughage/concentrate ratio	Level of evidence
Padre <i>et al.</i> , 2007	Paraná/South	Pasture	<i>Brachiaria brizantha</i> cv. Marandu	Mineral	-	1
Menezes <i>et al.</i> , 2008	Minas Gerais / Southeast	Confinement	Corn silage	-	52/48	1
Moreira <i>et al.</i> , 2009	Goiás/Midwest	Confinement	Corn silage	-	60/40	1
Silva <i>et al.</i> , 2010	Bahia/Northeast	Pasture	<i>Brachiaria brizantha</i> cv. Marandu	Mineral e protein/energy	-	1
Lopes <i>et al.</i> , 2011	Minas Gerais/ Southeast	Confinement	Corn silage	-	50/50	1
Castro <i>et al.</i> , 2013	Paraná/South	Pasture	<i>Brachiaria brizantha</i> cv. Xaraés	Mineral	-	1
Freitas <i>et al.</i> , 2014	Rio Grande do Sul/South	Pasture and Confinement	<i>Paspalum notatum</i> and <i>Paspalum dilatatum</i> Corn silage	-	37/63	1
Pacheco <i>et al.</i> , 2014a	Rio Grande do Sul/South	Confinement	Corn silage	-	60/40	1
Pacheco <i>et al.</i> , 2014b	Rio Grande do Sul/South	Confinement	Corn silage	-	60/40	1
Eiras <i>et al.</i> , 2014	Paraná/ South	Confinement	Corn silage	-	48/52	1
Nichele <i>et al.</i> , 2015	Mato Grosso/Midwest	Confinement	-	-	-	1
Possamai <i>et al.</i> , 2015	Mato Grosso/Midwest	Pasture	<i>Brachiaria brizantha</i> cv. Marandu	protein/energy	-	1
Moreira <i>et al.</i> , 2015	Minas Gerais/Sudeste	Confinement	Sorghum silage	-	50/50	1
Leal <i>et al.</i> , 2017	Rio Grande do Sul/South	Confinement	Corn silage	-	-	1
Dirceu-Pazdiora <i>et al.</i> , 2017	São Paulo/Southeast	Confinement	Sugarcane bagasse	-	-	1
Roth <i>et al.</i> , 2017	São Paulo/Southeast	Confinement	Sugarcane silage	-	25/75	1

Author/year	State/region	finishing system	Roughage/cultivate	Supplementation	Roughage/concentrate ratio	Level of evidence
Zanetti et al., 2017	Minas Gerais/Southeast	Confinement	Sugarcane	-	40/60	1
Oliveira et al., 2018	São Paulo/Southeast	Pasture	<i>Panicum maximum</i> ; <i>Brachiaria brizantha</i> ; <i>Avena byzantina</i> ; <i>Lolium multiflorum</i>	Mineral	-	1
Souza et al., 2019	Paraná/South	Confinement	Corn silage	-	25/75	1
Augusto et al., 2019	Goiás/Midwest	Confinement	Corn silage	-	40/60	1
Araújo Filho et al., 2019	Rio de Janeiro/Southeast	Pasture and Confinement	<i>Brachiaria decumbens</i> <i>Brachiaria humidicola</i>	Mineral and protein/energy	25/75	1
Perdigão et al., 2020	São Paulo/Southeast	Pasture and Confinement	<i>Brachiaria brizantha</i> cv. Marandu Sugarcane silage; Corn silage and Sugarcane bagasse;	-	48/52 e 57,5/42,5	1
Francisco et al., 2020	São Paulo/Southeast	Pasture	<i>Brachiaria brizantha</i> cv. Xaraés	protein/energy	-	1
Baldassini et al. 2021	São Paulo/Southeast	Confinement	Sugarcane bagasse	-	13.2/86.8	1
Santín Junior et al., 2021	Rio Grande do Sul/South	Pasture	<i>Avena strigona</i> ; <i>Lolium multiflorum</i>	protein/energy	-	1
Fornazari Neto et al., 2021	Rio Grande do Sul/ South	Confinement	Tifton hay	-	20/80	1
Ferreira et al., 2021	Minas Gerais/Southeast	Confinement	Corn silage	-	42/58	1
Godói et al., 2021	Minas Gerais/Southeast	Confinement	Corn silage	-	25/75	1
Leal et al., 2021	Mato Grosso do Sul/Midwest	Pasture	<i>Brachiaria brizantha</i> cv. marandu	protein/energy	-	1
Malafaia et al., 2022	Goiás/Midwest	Confinement	Corn silage	-	20/80	1
Araújo et al., 2022	Mato Grosso do Sul/Midwest	Confinement	Sorghum silage	-	50/50	1
Ferrari et al., 2022	São Paulo/Southeast	Pasture and Confinement	<i>Brachiaria brizantha</i> cv. Marandu; Corn silage	Mineral and protein/energy	30/70	1
Medina et al., 2023	Mato Grosso do Sul/Midwest	Confinement	Millet silage	-	30/70	1

In studies conducted in the feedlot finishing system, a roughage:concentrate ratio ranging from 13.2:86.8 to 50:50 was adopted. The major source of roughage used was corn silage (71.4%). Furthermore, other sources such as sorghum silage, Tifton hay, sugarcane bagasse, and millet silage were used in some studies (Table 2).

Among the studies carried out in pasture finishing systems, half (50%) used the species *Brachiaria brizantha* cv. Marandu was the main forage, while 25% used *Brachiaria brizantha* cv. Xaraés. On the other hand, a quarter of the

studies (25%) used mixed grass and legume pastures (Table 2). All studies conducted on pasture finishing systems incorporated some type of supplementation. In 37.5% of the experiments, only mineral supplementation was adopted; 50% used protein and energy supplementation, while 12.5% used both forms of supplementation (Table 2).

Concerning the animal component, it was found that 84.5% of the studies used male animals; 6.1% used females, and 9.1% used both sexes (males and females) to evaluate the finishing of cattle. The Nellore breed, pure or crossed with

Beef cattle finishing...

other breeds, was used in 81.1% of the studies (Table 3). Furthermore, other breeds such as Simmental, Santa Gertrudes, Charolais, Red Norte, Hereford, Braford, Purunã, Angus, and Aberdeen Angus were also used in the selected

studies. The animals were introduced in the finishing phase with ages ranging between 7 and 24 months, presenting a wide range of start weight, from 185 to 386 kg BW (Table 3).

Table 3. Characteristics of the animal component in studies of beef cattle finishing systems in Brazil

Author/year	Gender	Breed	Age (months)	Initial body weight (kg)
Padre <i>et al.</i> , 2007	Male	Nellore, Simmental and Santa Gertrudis	22	-
Menezes <i>et al.</i> 2008	Male	Charolais and Nellore	20	340
Moreira <i>et al.</i> , 2009	Male and Female	Nellore and crossbred Gir rossbred, Girolando	30 – 42 (males) 18 – 30 (heifers) +30 (cull cows)	268
Silva <i>et al.</i> , 2010	Male	Nellore	26	371±1
Lopes <i>et al.</i> , 2011	Male	Nellore e Red Norte	20	321±3
Castro <i>et al.</i> , 2013	Male	Nellore	-	340
Freitas <i>et al.</i> , 2014	Male	Herefords and Braford	22	-
Pacheco <i>et al.</i> , 2014a	Male	½ Charolais-Nellore	20 - 24	-
Pacheco <i>et al.</i> , 2014b	Male	½ Charolais-Nellore	30	361±38
Eiras <i>et al.</i> , 2014	Male	Purunã	7 – 9	209±33
Nichele <i>et al.</i> , 2015	Male	Nellore	-	350
Possamai <i>et al.</i> , 2015	Male	½ Nellore-Frisean Nellore	20	381±26
Moreira <i>et al.</i> , 2015	Male	Frisean ½ Guzerá-Nellore	9-11	241±3
Leal <i>et al.</i> , 2017	Male	½ Charolais-Nellore	8	348
Dirceu-Pazdiora <i>et al.</i> , 2017	-	Nellore	22	-
Roth <i>et al.</i> , 2017	Male	Nellore Frisean-Zebu	8	205±4
Zanetti <i>et al.</i> , 2017	Male	Nellore	-	377±49
Oliveira <i>et al.</i> , 2018	Male	Nellore	15	271±2
Souza <i>et al.</i> , 2019	Female	Nellore	-	297±31
Augusto <i>et al.</i> , 2019	Male e Female	Angus and Nellore	18	354±43
Araújo Filho <i>et al.</i> , 2019	Male	Angus and Nellore	18	-
Perdigão <i>et al.</i> , 2020	Male	-	-	-
Francisco <i>et al.</i> , 2020	Male	Nellore	-	220±33
Baldassini <i>et al.</i> , 2021	Male	Nellore	22 - 24	361±14
Santin Junior <i>et al.</i> , 2021	Male	Aberdeen Angus	7-8	185±25
Fornazari Neto <i>et al.</i> , 2021	Male	Nellore	12	-
Ferreira <i>et al.</i> , 2021	Male	Nellore Frisean-Zebu	24	29 4±19
Godoi <i>et al.</i> , 2021	Male	Nellore	8	265±18
Leal <i>et al.</i> , 2021	Female	Nellore	18	299±22
Malafaia <i>et al.</i> , 2022	Male	Nellore	-	-
Araújo <i>et al.</i> , 2022	Male and Female	Nellore Aberdeen Angus	7-9	-
Ferrari <i>et al.</i> , 2022	Male	Nellore	17	386±25
Medina <i>et al.</i> , 2023	Male	Nellore	-	356±18

DISCUSSION

The studies analyzed in this review demonstrated a high level of reliability due to the quality of their design. Additionally, as recommended by Costa *et al.* (2022), all screening steps were carried out with independent verification by two

reviewers, aiming to certify relevant studies and ensure the inclusion of those that did not compromise the integrity of the review.

Most studies excluded during the eligibility phase, after the evaluators had read the document in full, were due to the use of fistulated animals.

Furthermore, a significant number of studies were observed that evaluated matrices and animals in the rearing phase. Finally, to avoid multiple counting, articles derived from theses or dissertations that generated two or three articles from the same experiment were considered only once.

The first studies evaluated date back to the first decade of the 21st century, when the first attempts were made to establish nutritional requirement tables for beef cattle in Brazil (Valadares Filho and Lopes, 2019), thus driving an increase in the number of research aimed at the finishing of cattle. It is important to highlight that around 50% of publications occurred in the last five years, reflecting a trend observed in several areas of knowledge, which is the increase in the number of publications over the years. According to Hanson *et al.* (2023), the total number of articles indexed in the Scopus and Web of Science databases has grown exponentially in recent years. In 2022, the total number of articles was 47% higher than that recorded in 2016 (Hanson *et al.*, 2023).

The studies were predominantly conducted in the Southeast, South and Midwest regions, this fact being explained by two main reasons: 1) These regions are important hubs for beef production, especially in the states of São Paulo, Mato Grosso do Sul, Mato Grosso, Goiás, Minas Gerais, Rio Grande do Sul and Paraná (Beef..., 2022); 2) These locations are home to the most traditional Animal Science schools in Brazil, in addition to concentrating highly regarded Postgraduate courses with grades 6 and 7 in the area of Animal Science and Fisheries Resources. This relevance occurs because research in the area of animal production, at a national level, is predominantly carried out by universities. Institutions with greater academic recognition receive more resources, which results in a more suitable infrastructure for carrying out research related to the bovine species.

Therefore, the concentration of studies on beef cattle finishing in the central-southern region of Brazil (Figure 2) reveals a significant gap in research on beef cattle finishing in regions with productive potential, especially in the northern part of the country, where a substantial increase in the number of cattle herds has been observed (Beef..., 2022). Additionally, it is important to

highlight that several studies were excluded because they focused on the breeding or rearing phase of beef cattle farming. Hence, it is crucial to intensify research on beef cattle finishing in the northern and northeastern regions, aiming to promote the sustainable development of this activity.

It was found that 63.4% of publications resulted from experiments involving confined cattle, while only 24.2% of studies opted for finishing the animals on pasture. These data corroborate with Malafaia and Canella Filho (2019), who analyzed articles published in the *Revista Brasileira de Zootecnia* on cattle and buffalo nutrition between 1999 and 2018 and found that around 44.1% of the studies were carried out in confinement. On the other hand, less than 20% of publications provided information on cattle raised or finished exclusively on pasture. According to ABIEC (Beef..., 2022) estimates, Brazil slaughtered 39.1 million heads of cattle, of which only 15.4% were animals finished in confinement. In this sense, a divergence between the studies on cattle finishing and the national production system can be seen.

As pointed out by Malafaia and Canella Filho (2019), the main reasons that contribute to the divergence between scientific research on cattle finishing and the reality of the beef production system at the national level include: 1) speed in carrying out the experiment and local control; 2) generation of multiple articles from the same experiment; 3) demand for less area/facilities; 4) more viable partnerships with industries; 5) rapid analysis of new nutrients or additives, facilitating publication in journals with greater academic impact; 6) researchers' tendency to intensify animal production, even if wrongly associated with the use of confinements; 7) possible imitation of trends, driven by encouragement to read international scientific journals and lack of solid foundation in research methodology. Additionally, experiments conducted in pastures require extensive areas (Gurgel *et al.*, 2021) and extend over long periods (Euclides *et al.*, 2019; Almeida *et al.*, 2023), which ends up restricting the training of masters and doctors due to the deadlines established for completing the courses, coupled with the low investment scenario in research in Brazil.

Beef cattle finishing...

The main source of roughage used in studies carried out in confinement was corn silage, present in 71.4% of the studies. However, other sources such as sorghum silage, Tifton hay, sugarcane bagasse, and millet silage were used in some studies. According to Silvestre and Millen (2021), who analyzed nutritional recommendations and management practices adopted by feedlot nutritionists in Brazil, corn silage was also identified as the main source of roughage in finishing diets, used by 69.4% of respondents. Next, sugarcane bagasse was mentioned by 11.1%, followed by grass silage (8.3%), hay (5.6%), cotton pods (2.8%), and silage of sugar cane (2.8%).

In studies conducted in pastures, the predominance of the use of *Brachiaria brizantha* was observed in 75% of the experiments, with the Marandu cultivar highlighted in 50% of these studies. Launched in 1984 (Nunes *et al.*, 1984), the Marandu cultivar gradually replaced *Brachiaria decumbens*, due to its resistance to pasture leafhoppers and high phenotypic plasticity, establishing itself as a monoculture that persisted until the second decade of the 21st century (Valle *et al.*, 2010).

It was observed that 100% of the studies carried out in pastures employed some supplementation strategy, with emphasis on mineral and protein/energy supplementation. Supplementation constitutes a strategy to address nutritional deficiencies in forage plants (Leal *et al.*, 2021). This approach becomes even more crucial during the finishing phase, in the search for superior gains, since forage plants, often used as the only source in the ruminant diet, are unable to meet the nutritional requirements of the animals, which ends up compromising performance (Ferrari *et al.*, 2022).

When characterizing the animal component of the finishing systems, the predominance of finishing by males of the Nellore breed stands out. This is partly due to the climatic conditions of Brazil, marked by high temperatures and intense sun exposure (Nonato *et al.*, 2023), where zebu animals, especially the Nellore breed, demonstrate excellent adaptation to these conditions (Hansen, 2004; Pires *et al.*, 2019). It is necessary to highlight that the use of the Nellore breed in cattle finishing studies reflects practical production conditions since this breed is

widely spread in Brazil, representing around 80% of the beef cattle herd (Pires *et al.*, 2019).

An important detail to note is that among the studies analyzed, few used females (6 to 9%). In a survey conducted by Malafaia and Canella Filho (2019), a smaller number of studies involving females were also identified (approximately 20%). These authors highlight the need to carry out more research involving females in the finishing phase, as these animals represent a significant source of income for livestock farmers, especially cull cows.

The review identified that confinement is the main beef cattle finishing system used in Brazilian scientific research, which differs from current beef production systems in the country. Researchers have strived to use biological elements (plants and animals) corresponding to practical production conditions in their research. This represents a significant advance towards improving production rates. Nevertheless, it is crucial to deepen studies involving animals finished on pastures, to understand the interactions between soil-plant-animal-atmosphere components. This will allow the establishment of production systems that have low environmental impact and, at the same time, generate high financial returns.

It is essential to highlight that most research on cattle finishing has been conducted in beef-producing regions. In this sense, it is interesting to observe a gap in research in the Northern region of Brazil, which has experienced a notable increase in the cattle herd. Likewise, due to the inevitable replacement of extensive livestock farming by agricultural activities in the Midwest and Southeast regions of Brazil, livestock farming tends to migrate to peripheral areas, such as the Brazilian Northeast, where research on cattle finishing has been less significant compared to other regions.

Therefore, it would be necessary to encourage research with cattle in the North and Northeast regions, Caatinga, and the Amazon biomes, which are sensitive areas to changes caused by human action. The insertion of livestock farming in these regions using appropriate sustainable production techniques, can slow down the processes of deforestation and unsustainable use of natural resources.

Finally, Brazilian livestock farming is undergoing significant transformations, with the adoption of quasi-extractive practices and a low return on invested capital, which has accelerated the replacement of livestock farming by agriculture in several regions of the country. In this context, a solution to maintain livestock in areas dedicated to farming is integrated agricultural production systems. This alternative promotes economic, agronomic, social, and environmental benefits to production systems, and, therefore, it is essential to study and improve them according to regional potential, to increase both quantitative and qualitative food production, without expanding into new areas.

CONCLUSION

Scientific research related to the finishing of cattle in Brazil focuses on confinement systems conducted mainly in the Southeast, South, and Midwest regions, which are characterized by the predominant use of the Nellore breed, the use of conventional roughage, such as whole plant corn silage, and the implementation of confined systems. On the other hand, the use of *Brachiaria brizantha* in association with supplementation strategies has been widely adopted in pasture finishing.

ACKNOWLEDGMENTS

The authors express their gratitude to the Federal University of Piauí – Campus Professor Cinobelina Elvas (CPCE/UFPI) and to the Forage Studies and Research Group (GEPFOR – CPCE/UFPI) for their support in this project.

REFERENCES

- ALMEIDA, E.M.; ARAÚJO, A.R.; DIFANTE, G.S. *et al.* Do different soil use and management systems change root weight? *N. Z. J. Agric. Res.*, v.66, p.1-19, 2023.
- ARAÚJO FILHO, H.J.; MALAFAIA, P.; CARVALHO, C.A.B. *et al.* Economic evaluation of finishing beef cattle at pasture or in feedlot with high grain diet. *Custo e Agronegócio*, v.15, p.375-401, 2019.
- ARAÚJO, T.L.C.; FEIJÓ, G.L.D.; NEVES, A.P. *et al.* Effect of genetic merit for backfat thickness and paternal breed on performance, carcass traits, and gene expression in subcutaneous adipose tissue of feedlot-finished steers. *Livest. Sci.*, v.263, p.104998, 2022.
- AUGUSTO, W.F.; BILEGO, U.O.; MISSIO, R.L. *et al.* Animal performance, carcass traits and meat quality of F1 Angus-Nellore steers and heifers slaughtered in feedlot with a similar carcass finishing. *Semin. Ciênc. Agrár.*, v.40, p.1681-1694, 2019.
- BALDASSINI, W.A.; FERREIRA, M.S.; SANTIAGO, B.M. *et al.* Intake, performance, meat quality and fatty acid profile of Nellore bulls finished in feedlot with diets containing dry corn gluten feed. *Livest. Sci.*, v.253, p.104715, 2021.
- BARBOSA, M.A.A.F.; CASTRO, L.M.; BARBERO, R.P. *et al.* Performance of beef cattle on pasture of *Brachiaria brizantha* cv. Xaraés maintained at different sward Heights. *Semin. Ciênc. Agrár.*, v.34, p.4133-4144, 2013.
- BEEF report: perfil da pecuária no Brasil. Brasília: ABIEC, 2022.
- COSTA, C.M.; DIFANTE, G.S.; COSTA, A.B.G. *et al.* Technologies used in ruminant grazing management: an integrative review. *Trop. Anim. Health Prod.*, v.54, p.357, 2022.
- COSTA, C.M.; DIFANTE, G.S.; MIYAKE, A.W.A. *et al.* Grazing intensity as a management strategy in tropical grasses for beef cattle production: a meta-analysis. *Animal*, v.15, p.100192, 2021.
- DIRCEU-PAZDIORA, R.; RESENDE, F.D.; FARIA, M.H. *et al.* Boneless yield of carcass of feedlot-finished young *Bos indicus* L. bulls. *Acta Agron.*, v.67, p.339-346, 2018.
- EIRAS, C.E.; MARQUES, J.A.; PRADO, R.M. *et al.* Glycerine levels in the diets of crossbred bulls finished in feedlot: Carcass characteristics and meat quality. *Meat Sci.*, v.96, p.930-936, 2014.
- EUCLIDES, V.P.B.; MONTAGNER, D.B.; MACEDO, M.C.M. *et al.* Grazing intensity affects forage accumulation and persistence of Marandu palisadegrass in the Brazilian savannah. *Grass Forage Sci.*, v.74, p.450-462, 2019.
- FERRARI, A.C.; BERÇA, A.S.; SILVA, M.L.C. *et al.* Effects of supplement type during the pre-finishing growth phase on subsequent performance of Nellore bulls finished in confinement or on tropical pasture. *Appl. Anim. Sci.*, v.38, p.474-486, 2022.
- FERREIRA, H.C.; CARVALHO, C.C.S.; MONÇÃO, F.P. *et al.* Effect of shading strategies on intake, digestibility, respiratory rate, feeding behaviour, and performance of feedlot-finished Nellore bulls in the semi-arid region of Brazil. *Ital. J. Anim. Sci.*, v.20, p.1759-1769, 2021.

Beef cattle finishing...

- FORNAZARI NETO, A.; MARTINS, C.E.N.; SCHWEGLER, E. *et al.* Blood metabolites and fecal starch as indicators of feed efficiency of beef cattle in the feedlot. *Arq. Bras. Med. Vet. Zootec.*, v.73, p.1260-1268, 2021.
- FRANCISCO, C.L.; CASTILHOS, A.M.; SILVA, D.C.M. *et al.* Temperament of Nelore growing-steers receiving supplementation in grazing system: performance, ultrasound measures, feeding behavior, and serum parameters. *Livest. Sci.*, v.241, p.104203, 2020.
- FREITAS, A.K.; LOBATO, J.F.P.; CARDOSO, L.L. *et al.* Nutritional composition of the meat of Hereford and Braford steers finished on pastures or in a feedlot in southern Brazil. *Meat Sci.*, v.96, p.353-360, 2014.
- GODOI, L.A.; SILVA, B.C.; SILVA, F.A.S. *et al.* Effect of flint corn processing methods on intake, digestion sites, rumen pH, and ruminal kinetics in finishing Nellore bulls. *Anim. Feed Sci. Technol.*, v.27, p.114775, 2021.
- GURGEL, A.L.C.; DIFANTE, G.S.; COSTA, C.M. *et al.* Establishment of tropical forage grasses in the Cerrado biome. *Rev. Mex. Cienc. Pecu.*, v.13, p.674-689, 2022.
- GURGEL, A.L.C.; DIFANTE, G.S.; MONTAGNER, D.B. *et al.* The effect of residual nitrogen fertilization on the yield components, forage quality, and performance of beef cattle fed on Mombaça grass. *Rev. Fac. Cienc. Agrar.*, v.53, p.296-308, 2021.
- HANSEN, P.J. Physiological and cellular adaptations of zebu cattle to thermal stress. *Anim. Reprod. Sci.*, v.82, p.349-360, 2004.
- HANSON, M.A.; BARREIRO, P.G.; CROSETTO, P.; BROCKINGTON, D. The strain on scientific publishing. *ArXiv*, v.2309, p.15884, 2023.
- LAUREANO, M.M.M.; BOLIGON, A.A.; COSTA, R.B. *et al.* Estimativas de herdabilidade e tendências genéticas para características de crescimento e reprodutivas em bovinos da raça Nelore. *Arq. Bras. Med. Vet. Zootec.*, v.63, p.143-152, 2011.
- LEAL, E.S.; ÍTAVO, L.C.V.; ÍTAVO, C.C.B.F. *et al.* Combinations of by-products from biodiesel production included in the supplement for finishing heifers on deferred pastures. *Trop. Anim. Health Prod.*, v.53, p.262-271, 2021.
- LEAL, W.S.; PACHECO, P.S.; PASCOAL, L.L. *et al.* Beef cattle feedlot deterministic financial indicators and production costs in Rio Grande Do Sul-Brazil. *Custo Agronegócio*, v.13, p.201-217, 2017.
- LOPES, L.S.; LADEIRA, M.M.; MACHADO NETO, O.R. *et al.* Viabilidade econômica da terminação de novilhos Nelore e Red Norte em confinamento na região de Lavras-MG. *Ciênc. Agrotec.*, v.35, p.774-780, 2011.
- MALAFAIA, P.; CANELLA FILHO, C.F.C. Visão crítica dos artigos publicados no Brasil sobre a nutrição de bovinos e bubalinos terminados em confinamento ou a pasto, recebendo ou não suplementos proteico-energéticos. *Rev. Univ. Vale Rio Verde*, v.17, p.1-16, 2019.
- MALAFAIA, P.; SOUZA, V.C.; COSTA, D.F.A. Physicochemical evaluations of diets, rumen fluid, blood and faeces of beef cattle under two different feedlot systems. *Animals*, v.12, p.3114, 2022.
- MEDINA, L.C.M.; ÍTAVO, L.C.V.; ÍTAVO, C.C.B.F. *et al.* Sequential use of nutritional additives in diets for finishing Nellore steers in confinement. *Trop. Anim. Health Prod.*, v.55, p.151, 2023.
- MENEZES, L.F.G.; RESTLE, J.; KUSS, J. *et al.* Body measurements of feedlot finished steers from advanced generations of rotational crossbreeding between Charolais and Nellore breeds. *Cienc. Rural*, v.38, p.771-777, 2008.
- MOREIRA, F.S.; OLIVEIRA, M.M.N.F.; VILLELA, S.D.J. *et al.* Productive and economical performance of three genetic groups of animals raised on pasture with supplementation and feedlot. *Arq. Bras. Med. Vet. Zootec.*, v.67, p.140-148, 2015.
- MOREIRA, S.A.; THOMÉ, K.M.; FERREIRA, P.S.; BOTELHO FILHO, F.B. Economic analysis of termination beef feedlot cattle in the dynamic of an agricultural property. Economic analysis of termination beef feedlot cattle in the dynamic of an agricultural property. *Custo Agronegócio*, v.5, p.132-152, 2009.
- NICHELE, E.M.; MORAES, E.H.B.K.; ARAÚJO, C.V. *et al.* Eficiência bioeconômica de bovinos de corte em confinamento. *Rev. Bras. Saúde Prod. Anim.*, v.16, p.699-711, 2015.
- NONATO, L.M.; ITAVO, L.C.V.; ITAVO, C.C.B.F. *et al.* Changes in the skin characteristics of Nellore steers during the rearing phase in hot climate pasture supplemented with protein sources. *Sci. Rep.*, v.13, p.19073, 2023.
- NUNES, S.G.; BOOCK, A.; PENTEADO, M.I.O. GOMES, D.T. *Brachiaria brizantha* cv. Marandu. Campo Grande: Embrapa/CNPQC, 1984. 32p. (Documentos n.21).
- OLIVEIRA, P.P.A.; CORTE, R.R.S.; SILVA, S.L. *et al.* The effect of grazing system intensification on the growth and meat quality of beef cattle in the Brazilian Atlantic Forest biome. *Meat Sci.*, v.139, p.157-161, 2018.

- PACHECO, P.S.; PASCOAL, L.L.; RESTLE, J. *et al.* Risk assessment of finishing beef cattle in feedlot: slaughter weight and correlation amongst input variables. *Rev. Bras. Zootec.*, v.43, p.92-99, 2014a.
- PACHECO, P.S.; RESTLE, J.; PASCOAL, L.L. *et al.* Use of the correlation between input variables in estimating the risk of feedlot finishing of steers and young steers. *An. Acad. Bras. Ciênc.*, v.86, p.945-954, 2014b.
- PADRE, R.G.; ARICETTI, J.A.; GOMES, S.T.M. *et al.* Analysis of fatty acids in Longissimus muscle of steers of different genetic breeds finished in pasture systems. *Livest. Sci.*, v.110, p.57-63, 2007.
- PAES, A.T.F.; BARBIERI, A.R.; CARDOSO, A.I.Q. *et al.* Chronic kidney disease intervention in primary health care: integrative review. *Biosci. J.*, v.39, p.e39007, 2023.
- PAULA, N.F.; ZERVOUDAKIS, J.T.; CABRAL, L.S. *et al.* Suplementação infrequente e fontes proteicas para recria de bovinos em pastejo no período seco: parâmetros nutricionais. *Rev. Bras. Zootec.*, v.40, p.882-891, 2011.
- PERDIGÃO, A.; MARTINS, C.L.; VIEIRA JUNIOR, L.C. *et al.* Identification of the production system of beef cattle by the stable isotope analysis. *Pesqui. Agropecu. Bras.*, v.55, p.e01501, 2020.
- PEREIRA, O.J.R.; FERREIRA, L.G.; PINTO, F.; BAUMGARTEN, L. Assessing pasture degradation in the Brazilian Cerrado based on the analysis of MODIS NDVI time-series. *Remote Sens.*, v.10, p.1761, 2018.
- PIRES, B.V.; STAFUZZA, N.B.; LIMA, S.B.G.P.N.P. *et al.* Differential expression of heat shock protein genes associated with heat stress in Nelore and Caracu beef cattle. *Livest. Sci.*, v.230, p.103839, 2019.
- POSSAMAI, A.; ZERVOUDAKIS, J.; CABRAL, L. *et al.* Glicerina bruta e caroço de algodão em suplementos múltiplos para terminação de bovinos à pasto na época das águas. Análise econômica. *Arch. Zootec.*, v.64, p.246, 2015.
- ROTH, M.T.P.; RESENDE, F.D.; OLIVEIRA, I.M. *et al.* Does supplementation during previous phase influence performance during the growing and finishing phase in Nelore cattle? *Livest. Sci.*, v.204, p.122-128, 2017.
- SANTIN JUNIOR, I.A.; LIMA, H.L.; MATEUS, K.A. *et al.* Carcass and meat quality of young Angus steers with different growth potential finished exclusively grass-fed or corn supplemented. *Trop. Anim. Health Prod.*, v.53, p.521, 2019.
- SILVA, R.R.; PRADO, I.N.; CARVALHO, G.G.P. *et al.* Níveis de suplementação na terminação de novilhos Nelore em pastagens: aspectos econômicos. *Rev. Bras. Zootec.*, v.39, p.2091-2097, 2010.
- SILVESTRE, A.M.; MILLEN, D.D. The 2019 Brazilian survey on nutritional practices provided by feedlot cattle consulting nutritionists. *Rev. Bras. Zootec.*, v.50, p.e20200189, 2021.
- SOUZA, K.A.; MONTESCHIO, J.O.; MOTTIN, C. *et al.* Effects of diet supplementation with clove and rosemary essential oils and protected oils (eugenol, thymol and vanillin) on animal performance, carcass characteristics, digestibility, and ingestive behavior activities for Nelore heifers finished in feedlot. *Livest. Sci.*, v.220, p.190-195, 2019.
- SOUZA, M.T.D.; SILVA, M.D.D.; CARVALHO, R.D. Integrative review: what is it? How to do it? *Einstein*, v.8, p.102-106, 2010.
- VALADARES FILHO, S.C.; LOPES, S.A. Sistema BR-CORTE. *Rev. Cient. Prod. Anim.*, v.21, p.77-87, 2019.
- VALLE, C.B.; MACEDO, M.C.M.; EUCLIDES, V.P.B. *et al.* *Gênero Brachiaria*. In: FONSECA, D.M.; MARTUSCELLO, J.A. *Plantas forrageiras*. Viçosa, MG: UFV, 2010.
- ZANETTI, D.; VALADARES FILHO, S.C.; PRADOS, L.F. *et al.* Impacts of reduction of phosphorus in finishing diets for Holstein×Zebu steers. *Livest. Sci.*, v.198, p.45-51, 2017.