RESSALVA

Atendendo solicitação do(a) autor(a), o texto completo desta dissertação será disponibilizado somente a partir de 23/02/2028

SÃO PAULO STATE UNIVERSITY
SCHOOL OF AGRICULTURAL AND VETERINARY SCIENCE
JABOTICABAL CAMPUS

PERFORMANCE OF NELLORE CATTLE SUBJECTED TO VARIOUS ADAPTATION PROTOCOLS TO INTENSIVE PASTURE FINISHING DIETS (IPF)

Fernanda Franco Alves
Animal Scientist

2026

SÃO PAULO STATE UNIVERSITY
SCHOOL OF AGRICULTURAL AND VETERINARY SCIENCE
JABOTICABAL CAMPUS

PERFORMANCE OF NELLORE CATTLE SUBJECTED TO VARIOUS ADAPTATION PROTOCOLS TO INTENSIVE PASTURE FINISHING DIETS (IPF)

Student: Fernanda Franco Alves

Advisor: Prof. Dr° Danilo Domingues Millen

Master's thesis presented to the Graduate program in Animal Science at the School of Agricultural and Veterinary Science – UNESP, Jaboticabal campus, as part of the requirements for obtaining the title of master's in animal science.

A474p

Alves, Fernanda Franco
Performance of Nellore cattle subjected to various adaptation protocols to Intensive Pasture Finishing diets (IPF) / Fernanda Franco Alves. -- Jaboticabal, 2026
53 p. : il., tabs., fotos

Dissertação (mestrado) - Universidade Estadual Paulista (UNESP), Faculdade de Ciências Agrárias e Veterinárias, Jaboticabal
Orientador: Danilo Domingues Millen

1. Cecum health. 2. High-energy diets. 3. Pasture-based system. 4. Rumen development. I. Título.

Sistema de geração automática de fichas catalográficas da Unesp.
Dados fornecidos pelo autor(a).

POTENTIAL IMPACT OF THIS RESEARCH

This research contributes to the advancement of more efficient and sustainable beef cattle production systems, particularly intensive pasture-based finishing (IPF), which is widely adopted in Brazil. By evaluating different adaptation protocols to high-concentrate diets, the study provides relevant information to improve animal performance without compromising ruminal and cecal health.

From a scientific perspective, the findings generate novel knowledge on feeding adaptation strategies in grazing systems, supporting the development of safer and more efficient nutritional protocols. This information may serve as a foundation for future research and improvements in nutritional recommendations for cattle raised under tropical conditions.

Regarding economic impact, the adoption of more efficient adaptation protocols may increase weight gain and improve feed efficiency, reducing production costs and enhancing profitability for producers. Additionally, optimizing concentrate use may increase the competitiveness of IPF systems compared to conventional feedlots.

From a social and environmental standpoint, this research contributes to more sustainable beef production, aligning with the Sustainable Development Goals (SDGs), particularly:

SDG 2 (Zero Hunger and Sustainable Agriculture), by promoting more efficient production systems;

SDG 12 (Responsible Consumption and Production), by optimizing feed resource use;

SDG 13 (Climate Action), by potentially reducing environmental impacts through improved efficiency.

Furthermore, by addressing gastrointestinal health, the study also contributes to animal welfare, an increasingly important concern for society.

Therefore, this research has the potential to generate positive scientific, economic, and social impacts, contributing to the development of a more productive, sustainable, and socially aligned livestock sector.

IMPACTO POTENCIAL DESTA PESQUISA

Esta pesquisa contribui para o avanço de sistemas de produção de bovinos de corte mais eficientes e sustentáveis, especialmente em sistemas de terminação intensiva a pasto (TIP), amplamente utilizados no Brasil. Ao avaliar diferentes protocolos de adaptação a dietas com alto teor de concentrado, o estudo fornece informações relevantes para melhorar o desempenho animal sem comprometer a saúde ruminal e cecal.

Do ponto de vista científico, os resultados geram conhecimento inédito sobre estratégias de adaptação alimentar em sistemas de terminação intensiva em pasto, contribuindo para o desenvolvimento de protocolos mais seguros e eficientes. Esse conhecimento pode servir de base para futuras pesquisas e para a evolução das recomendações nutricionais para bovinos em sistemas tropicais.

Em relação ao impacto econômico, a adoção de protocolos de adaptação mais eficientes pode aumentar o ganho de peso dos animais e melhorar a conversão alimentar, reduzindo custos de produção e aumentando a rentabilidade dos produtores. Além disso, a otimização do uso de concentrado pode tornar os sistemas TIP mais competitivos em relação ao confinamento tradicional.

No âmbito social e ambiental, a pesquisa contribui para a produção de carne bovina de forma mais sustentável, alinhando-se aos Objetivos do Desenvolvimento Sustentável (ODS), especialmente:

ODS 2 (Fome Zero e Agricultura Sustentável), ao promover sistemas produtivos mais eficientes;

ODS 12 (Consumo e Produção Responsáveis), ao otimizar o uso de recursos alimentares;

ODS 13 (Ação Contra a Mudança Global do Clima), ao potencialmente reduzir impactos ambientais por meio de maior eficiência produtiva.

Além disso, ao considerar a saúde gastrointestinal dos animais, o estudo também contribui para o bem-estar animal, um aspecto cada vez mais valorizado pela sociedade. Portanto, esta pesquisa apresenta potencial para gerar impactos positivos científicos, econômicos e sociais, contribuindo para o desenvolvimento de uma pecuária mais produtiva, sustentável e alinhada às demandas atuais da sociedade.

UNIVERSIDADE ESTADUAL PAULISTA

Câmpus de Jaboticabal

CERTIFICADO DE APROVAÇÃO

TÍTULO DA DISSERTAÇÃO: PERFORMANCE OF NELLORE CATTLE SUBJECTED TO VARIOUS ADAPTATION PROTOCOLS TO INTENSIVE PASTURE FINISHING DIETS (IPF)

AUTORA: FERNANDA FRANCO ALVES
ORIENTADOR: DANILO DOMINGUES MILLEN

Aprovada como parte das exigências para obtenção do Título de Mestra em Ciência Animal, área: Nutrição Animal pela Comissão Examinadora:

Documento assinado digitalmente
gov.br
DANILO DOMINGUES MILLEN
Data: 23/02/2026 19:43:57-0300
Verifique em https://validar.iti.gov.br

Prof. Associado DANILO DOMINGUES MILLEN (Participação Presencial)
Departamento de Zootecnia / FCAV UNESP Jaboticabal

Documento assinado digitalmente
gov.br
RODRIGO SILVA GOULART
Data: 24/02/2026 08:47:57-0300
Verifique em https://validar.iti.gov.br

Prof.Dr. RODRIGO SILVA GOULART (Participação Virtual)
Departamento de Zootecnia / USP FZEA Pirassununga/SP

Documento assinado digitalmente
gov.br
FLAVIO DUTRA DE RESENDE
Data: 24/02/2026 15:31:33-0300
Verifique em https://validar.iti.gov.br

Pesquisador Dr. FLÁVIO DUTRA DE RESENDE (Participação Virtual)
Departamento de Descentralização do Desenvolvimento / APTA - Colina/SP

Jaboticabal, 23 de fevereiro de 2026.

AUTHOR DETAILS

Fernanda Franco Alves, daughter of Clêudina Franco Vieira Alves and Euripedes de Castro Alves, was born on October 7, 1999, in Xinguara, Pará, Brazil. In August 2018, she began her degree in Animal Science at the Federal University of South and Southeast of Pará, which she completed in January 2024. During this period, she worked across research, teaching, and extension, and achieved national academic distinctions. In March 2024, she began the Master's degree in the Animal Science program at the São Paulo State University (UNESP) Jaboticabal campus, with a research scholarship granted by the São Paulo Research Foundation (FAPESP).

EPIGRAPH

“*that they may see and know, may consider and understand together, that the hand of the Lord has done this, the Holy One of Israel has created it***.”**

Isaiah 41:20
Holy Bible - English Standard Version

DEDICATION

To the only one who is worthy of all honor, glory and praise - Jesus Christ.

ACKNOWLEDMGENTS

I am eternally grateful to God; without Him, absolutely nothing would be possible. His presence empowered me, and His love has loved me and continues to love me every day.

To my parents, Clêudina and Euripedes, who always did far more than anyone could imagine so that my sisters and I could study and fulfill our dreams. To my grandparents, Jandira, Maria Divina, Antônio, and Élber, for their prayers and affection. To my sisters and brother-in-law, Andria, Angla, and Matheus, for their encouragement and prayers on my behalf. To Mrs Rosenda, who, even after I left Xinguara, continued to pray and ask God for my help.

A special thank you to my advisor, Professor Danilo Domingues Millen, for all the trust, patience, and transparency throughout these years. Being his advisee has elevated my life as a professional and as a person. It is a pleasure to work with you.

I also want to thank the entire Rumenology lab team, especially my friends and undergraduate research students on this project, Maria Eduarda (Duda) and Letícia (Lele), who went far beyond being partners. They helped me inside and outside the department and supported me through my struggles. My sincere gratitude and affection will always be yours. Thank you for being synonymous with peace, joy, and loyalty.

I want to thank Kalista (Kali), who was by my side in the department and was my support, my ride, my tractor driver, and much more; and to Ana Laura for helping me implement the study and for passing on all the methodological knowledge I needed.

I couldn't fail to mention my postdoc and friend Ariany, who was essential for conducting the analyses in the laboratory. Thank you so much, Ari! And to Servidone, who always helped me with the department's operations and was often my only partner in the activities.

Outside of academia, I was also very well supported during this period. My sincere thanks to all the members of the Assembly of God ministry of Belém – Vila Industrial, who are a true family to me. Thank you for your love, prayers, and constant care. Especially to my pastors and friends, Ellen, Hebert, and little Oliver, and to Sarah and Luana, you were God's embrace when I needed it, thank you very much.

I thank my friends who kept in touch and always encouraged me even from afar, Janaina, Maria Tereza, Lilian, and Erica, and my former professors who always encouraged my dream of pursuing postgraduate studies, especially professors Anaiane, Ana Carolina, Caroline Nebo, and Luana Rufino.

To the São Paulo State Research Support Foundation – FAPESP for the financial assistance for the development of this research – Process Number: FAPESP: 2023/16411-1.

SUMMARY

CEUA – COMISSÃO DE ÉTICA NO USO DE ANIMAIS

C E R T I F I C A D O

A COMISSÃO DE ÉTICA NO USO DE ANIMAIS (CEUA), em reunião ordinária no dia 25 de fevereiro de 2026, referendou o Protocolo nº 10691663539/2026, do projeto intitulado: **"Adaptação a dietas de alta energia em sistemas de produção alternativos de bovinos de corte",** sob a responsabilidade do Prof. Dr. DANILO DOMINGUES MILLEN, manifestando-se favoravelmente, de acordo com os Princípios Éticos na Experimentação Animal adotado pelo Conselho Nacional de Controle de Experimentação Animal (CONCEA).

Jaboticabal, 25 de fevereiro de 2026.

unesp
Assinado de forma digital por HELENA CRISTINA DELGADO BRITO:10199881774
Dados: 2026.03.02 16:42:15 -03'00'

Coordenadora – CEUA

Abstract
This study aimed to assess various adaptation protocols for Nellore cattle on intensive pasture-finished diets (IPF), focusing on performance, ruminal and cecal integrity, carcass traits, and the ruminal microbial community. We hypothesized that Nellore cattle in IPF systems require 21 days of adaptation to enhance performance without adversely affecting rumen and cecal health. Twenty-eight 22-month-old Nellore bulls with an initial BW of 337 ± 3.98 kg were used and distributed into four paddocks established with *Urochloa brizantha* cv. Marandu. Animals were blocked by body weight (BW). Experimental treatments consisted of: 1) a 21-d adaptation period starting with a concentrate supply of 0.5% of BW, increased daily in equal increments until reaching 2.0% of BW (AD2105; n = 10; 0.0715% BW per day); 2) a 14-d adaptation starting with 0.5% of BW (AD1405; n = 9; 0.1071% BW per day); and 3) a 14-d adaptation starting with 1.0% of BW (AD1410; n = 9; 0.0715% BW per day), both also increased daily to 2.0% of BW. Bulls were fed for 111 days using individual Calan Gate–type feeding bunks. A higher initial concentrate supply (1.0% BW) combined with a shorter adaptation period (14 d) improved dry matter intake, nutrient digestibility, performance, and ruminal development. However, these strategies also increased the incidence of ruminal and cecal lesions and reduced counts of cellulolytic protozoa. In contrast, no differences were observed in ruminal bacterial community structure among treatments, as indicated by similar alpha diversity indices (Shannon and Chao richness), beta diversity (Bray–Curtis dissimilarity), and relative abundance of dominant phyla, suggesting microbial stability across adaptation strategies. The hypothesis of this study was partially confirmed. A shorter adaptation period of 14 days, combined with a higher initial concentrate supply (1.0% of BW), improves performance and carcass traits of Nellore bulls in IPF systems. However, a 21-day adaptation period is necessary to minimize ruminal and cecal lesions and promote gastrointestinal health during the finishing phase.
Keywords: Adaptation, cecum, intensive beef production, pasture, rumen.

Resumo
Objetivou-se avaliar diferentes protocolos de adaptação para bovinos Nelore em sistemas de terminação intensiva em pasto (TIP), com ênfase no desempenho produtivo, saúde ruminal e cecal, características de carcaça e comunidade microbiana ruminal. A hipótese proposta foi de que um período de adaptação de 21 dias seria necessário para maximizar o desempenho sem comprometer a saúde gastrointestinal dos animais. Foram utilizados 28 touros Nelore, com 22 meses de idade e peso corporal inicial de 337 ± 3,98 kg, distribuídos em quatro piquetes de *Urochloa brizantha* cv. Marandu e previamente blocados por peso corporal (PC). Os tratamentos consistiram em: (1) adaptação de 21 dias, iniciando com fornecimento de concentrado equivalente a 0,5% do peso corporal (PC), com incrementos diários iguais até atingir 2,0% do PC (AD2105; n = 10; 0,0715% PC/dia); (2) adaptação de 14 dias iniciando com 0,5% do PC (AD1405; n = 9; 0,1071% PC/dia); e (3) adaptação de 14 dias iniciando com 1,0% do PC (AD1410; n = 9; 0,0715% PC/dia), ambos também com aumento diário até 2,0% do PC. Os animais foram alimentados por 111 dias, utilizando cochos individuais do tipo *Calan Gate*. A maior oferta inicial de concentrado (1,0% do PC), associada ao menor período de adaptação (14 dias), promoveu aumento no consumo de matéria seca, na digestibilidade dos nutrientes, no desempenho e no desenvolvimento ruminal. Entretanto, essas estratégias também resultaram em maior incidência de lesões ruminais e cecais, além de redução na população de protozoários celulolíticos. Não foram observadas diferenças significativas na estrutura da comunidade bacteriana ruminal entre os tratamentos, uma vez que os índices de diversidade alfa (*Shannon e Chao*), diversidade beta (dissimilaridade de *Bray-Curtis*) e a abundância relativa dos principais filos bacterianos permaneceram semelhantes, sugerindo estabilidade microbiana independentemente da estratégia de adaptação adotada. A hipótese do estudo foi parcialmente confirmada. Protocolos mais curtos de adaptação (14 dias), especialmente quando combinados com maior nível inicial de concentrado, (1,0 %) melhoram o desempenho e as características de carcaça de touros Nelore em TIP. Contudo, um período de adaptação de 21 dias é requerido para amenizar lesões no trato gastrointestinal.
Palavras-chave: Adaptação, ceco, pasto, produção intensiva de carne, rumen.

ABBREVIATIONS

ADG - average daily gain

ASA - absorptive surface area

BW - body weight

CDMI – Concentrate dry matter intake

CH4 - methane

CP- crude protein

DM - dry matter

DP - dressing percentage

EE - ether extract

F: G - feed-to-gain ratio

HCW - hot carcass weight

IDM - Dry matter intake

IDM - dry matter intake

inNDF- indigestible neutral detergent fiber

IPF - intensive pasture finishing

LM - longissimus muscle

MPA - mean papillae area

NASEM - National Academies of Sciences, Engineering, and Medicine

NDF - Neutral detergent fiber

NOP - number of papillae per square centimeter of rumen wall

NMDS - non-metric multidimensional scaling

OM – organic matter

PDMI - Pasture dry matter intake

RASA - papillae area expressed as percentage of ASA

SARA - subacute ruminal acidosis

SCFA - short-chain fatty acid

TiO2 - titanium dioxide

TABLES

FIGURES

1. Introduction

Intensive pasture finishing **(IPF)** has emerged as an effective strategy to improve productivity in tropical grazing systems; however, scientific evidence on adaptation protocols for high-concentrate diets under grazing conditions remains scarce (Rosanova et al., 2025). Current recommendations are extrapolated mainly from feedlot systems, despite significant differences in roughage sources, fiber intake regulation, and diet transition dynamics (Rosanova et al., 2025).

Pasture-based beef production systems dominate cattle finishing in tropical regions, particularly in Brazil, where more than 80% of slaughter cattle originate from grazing systems, and only approximately 20% come from feedlots (ABIEC, 2025). These systems rely on forage resources that vary seasonally in quantity and quality, imposing nutritional constraints during the finishing phase (Barbero et al., 2014). Despite these challenges, pasture-based systems offer advantages such as lower feeding costs, improved nutrient cycling, and better opportunities for animals to express natural behaviors (Souza de Almeida et al., 2023;Temple; Manteca, 2020) which collectively contribute to both economic efficiency and cattle welfare.

Increasing grass-fed beef production in Brazil is essential for advancing sustainable livestock systems (Chang et al., 2015), and IPF has emerged as a promising nutritional strategy capable of achieving performance levels comparable to feedlot systems. IPF involves the provision of concentrate in pasture-based bunks at levels ranging from 1.5% to 2.0% of body weight (BW), particularly during the dry season, when forage availability declines (Rosanova et al., 2025).

In 2025, nearly 9.5 million animals were finished under high-concentrate supplementation on pasture or in IPF systems, receiving concentrate feed equivalent to or greater than 1% of their body weight (ATHENAGRO, 2026). In IPF systems, forage plays a fundamental role in supplying fiber necessary for rumen health, and its availability must be guaranteed throughout the feed period (Rosanova et al., 2025). Conversely, concentrate is the primary source of energy and protein for cattle (Rosanova et al., 2025). This is particularly relevant because nutritional requirements increase during the finishing phase compared with earlier stages. As body weight increases, the composition of gain shifts toward greater fat deposition and reduced protein accretion, altering nutrient requirements (Owens et al., 1995).

In this context, bulls in IPF systems typically experience a substantial increase in

concentrate intake compared with earlier production phases, necessitating a structured adaptation period to high-energy diets (Barducci et al., 2019). This transition requires adjustments in ruminal microbiota and epithelial function (Estevam et al., 2020).

During adaptation to high-energy diets, shifts in ruminal microbial communities and fermentation end-products occur, along with increased development of the ruminal epithelium to enhance short-chain fatty acid (SCFA) absorption (Pinto et al., 2023). Although adaptation typically represents less than 20% of total feeding duration, it is a critical phase that directly affects cattle health and performance (Pinto et al., 2023). Numerous studies in Brazilian feedlot systems demonstrate that a minimum adaptation period of 14 days is required (Estevam et al., 2020;Parra et al., 2019; Barducci et al., 2019). While 14-day protocols may improve finishing performance, longer protocols (e.g., 21 days) may promote greater rumen development (Owens et al., 1995).

As IPF adoption expands among producers and nutritionists seeking to increase productivity under grazing conditions, developing adaptation protocols tailored to this system becomes essential, not only to optimize performance and profitability but also to preserve ruminal and systemic health.

In most existing Brazilian studies on IPF, adaptation protocols have been largely adopted from feedlot cattle management (Rosanova et al., 2025). Unlike feedlot systems, in IPF pasture is the primary source of roughage, and its quantity and quality vary throughout the 80 - to 120-day finishing period (Barbero et al., 2014). Furthermore, these animals exhibit distinct feeding behavior, including more rapid concentrate intake due to the absence of roughage in feed bunks. IPF systems do not allow daily monitoring of forage intake through grazing, which may influence rumen dynamics and the adaptation process (Estevam et al., 2020).

Therefore, this study aimed to assess various adaptation protocols for Nellore cattle on intensive pasture-finished diets (IPF), focusing on performance, ruminal and cecal integrity, carcass traits, and the ruminal microbial community. We hypothesized that Nellore cattle in IPF systems require 21 days of adaptation to enhance performance without adversely affecting rumen and cecal health.

6 Conclusion

The hypothesis of this study was partially confirmed. A shorter adaptation period of 14 days, combined with a higher initial concentrate supply, 1% of BW, improves performance and carcass traits of Nellore bulls in IPF system. However, a 21-day adaptation period is necessary to minimize ruminal and cecal lesions and promote gastrointestinal health during the finishing phase. In well-managed IPF systems, 14 days may be an alternative; however, adopting 21 days of adaptation is recommended for farmers initiating IPF systems or still evolving toward better management.

7 References

ANDRÉ, Romisio Geraldo Bouhid; GARCIA, Anice. ALGUNS ASPECTOS CLIMATICOS DO MUNICÍPIO DE JABOTICABAL – SP. **Nucleus**, v. 12, n. 2, 2015.

AOAC (ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS). *Official methods of analysis*. 15. ed. Arlington: AOAC, 1990.

ASSOCIAÇÃO BRASILEIRA DAS INDÚSTRIAS EXPORTADORAS DE CARNES (ABIEC). *Beef Report 2025: Brazilian beef profile*. São Paulo: ABIEC, 2025. Disponível em: Beef Report 2025. Acesso em: 14 abr. 2026.

ATHENAGRO CONSULTORIA. *Material resumido compartilhado nos grupos e redes do Rally da Pecuária/Athenagro*. São Paulo: Athenagro, 2026. Disponível em: Resumo Athenagro Rally da Pecuária. Acesso em: 14 abr. 2026.

BARBERO, R. P. *et al.* Combining Marandu grass grazing height and supplementation level to optimize growth and productivity of yearling bulls. **Animal Feed Science and Technology**, v. 209, 2015.

BARBERO, R. P. *et al.* Desempenho de novilhos de corte em pastos de capim-tanzânia sob quatro alturas de desfolha. **Arquivo Brasileiro de Medicina Veterinaria e Zootecnia**, v. 66, n. 2, 2014.

BARBERO, Rondineli Pavezzi *et al.* Production potential of beef cattle in tropical pastures: a review. **Ciência Animal Brasileira**, v. 22, 2021.

BARDUCCI, R. S. *et al.* Restricted versus step-up dietary adaptation in Nellore bulls: Effects over periods of 9 and 14 days on feedlot performance, feeding behavior and rumen morphometrics. **Animal Feed Science and Technology**, v. 247, 2019.

BARTHRAM, G. T. Experimental techniques: the HFRO sward stick. *The Hill Farming Research Organization Biennial Report 1984/1985*, 1985.

BODDEY, Robert M. *et al.* **Forage legumes in grass pastures in tropical Brazil and likely impacts on greenhouse gas emissions: A review**. **Grass and Forage Science**, 2020.

BROWN, M. S.; PONCE, C. H.; PULIKANTI, R. **Adaptation of beef cattle to high-concentrate diets: performance and ruminal metabolism. Journal of animal science**, 2006.

CHANG, Jinfeng *et al.* Modeled changes in potential grassland productivity and in grass-fed ruminant livestock density in Europe over 1961-2010. **PLoS ONE**, v. 10, n. 5, 1 maio 2015.

COSTA, S. F. *et al.* Alterações morfológicas induzidas por butirato, propionato e lactato sobre a mucosa ruminal e a epiderme de bezerros - I Aspectos histológicos. **Arquivo Brasileiro de Medicina Veterinaria e Zootecnia**, v. 60, n. 1, 2008.

COSTA, Viviane Aparecida Carli *et al.* Consumo e digestibilidade em bovinos em pastejo durante o período das águas sob suplementação com fontes de compostos nitrogenados e de carboidratos. **Revista Brasileira de Zootecnia**, v. 40, n. 8, 2011.

DE FREITAS BARBOSA, Marco Aurélio Alves *et al.* Produção de forragem e composição estrutural de pastos de Brachiaria brizantha cv. Xaraés manejados em diferentes alturas de pastejo. **Semina:Ciencias Agrarias**, v. 34, n. 6 SUPPL. 2, 2013.

DE RESENDE-JUNIOR, João Chrysostomo *et al.* Effect of the feeding pattern on rumen wall morphology of cows and sheep. **Brazilian Journal of Veterinary Research and Animal Science**, v. 43, n. 4, 2006.

DEHORITY, B. A. *Classification and morphology of rumen protozoa*. Department of Animal Science, Ohio State University, v. 11, 1977.

DEVANT, M. *et al.* Behavior and inflammation of the rumen and cecum in Holstein bulls fed high-concentrate diets with different concentrate presentation forms with or without straw supplementation. **Journal of Animal Science**, v. 94, n. 9, 2016.

DIAS, Ana Veronica Lino *et al.* Assessing the impact of non-protein nitrogen or rumen undegradable protein supplementation on rumen bacterial diversity and ruminal fermentation in grazing steers during the dry season. **Frontiers in Microbiology**, v. 16, 6 out. 2025.

DILL-MCFARLAND, Kimberly A.; BREAKER, Jacob D.; SUEN, Garret. Microbial succession in the gastrointestinal tract of dairy cows from 2 weeks to first lactation. **Scientific Reports**, v. 7, 2017.

ESTEVAM, D. D. *et al.* Feedlot performance and rumen morphometrics of Nellore cattle adapted to high-concentrate diets over periods of 6, 9, 14 and 21 days. **Animal**, v. 14, n. 11, p. 2298–2307, 1 jan. 2020.

FERNANDES, Leonardo de Oliveira; REIS, Ricardo Andrade; PAES, José Mauro Valente. Efeito da suplementação no desempenho de bovinos de corte em pastagem de Brachiaria brizantha cv. Marandu. **Ciência e Agrotecnologia**, v. 34, n. 1, 2010.

FRANZOLIN, R.; DEHORITY, B. A. Effect of Prolonged High-Concentrate Feeding on Ruminal Protozoa Concentrations. **Journal of Animal Science**, v. 74, n. 11, 1996.

GOOD, I. J. The Population Frequencies of Species and the Estimation of Population Parameters. **Biometrika**, v. 40, n. 3/4, 1953.

GREENWOOD, Paul L. **Review: An overview of beef production from pasture and feedlot globally, as demand for beef and the need for sustainable practices increase**. **Animal**, 2021.

GRESSLEY, T. F.; HALL, M. B.; ARMENTANO, L. E. Ruminant nutrition symposium: Productivity, digestion, and health responses to hindgut acidosis in ruminants. **Journal of Animal Science**, v. 89, n. 4, 2011.

HALLS, L. K. *The approximation of cattle diet through herbage sampling*. Society for Range Management, v. 7, 1954.

HAMILTON, Carly A. *et al.* Development of in vitro enteroids derived from bovine small intestinal crypts. **Veterinary Research**, v. 49, n. 1, 2018.

JANK, Liana *et al.* The value of improved pastures to Brazilian beef production. *In*: 2014.

KIM, Young S.; HO, Samuel B. **Intestinal goblet cells and mucins in health and disease: Recent insights and progress**. **Current Gastroenterology Reports**, 2010.

KOVACS, P. L.; SUDEKUM, K.-H.; STANGASSINGER, M. *Effects of intake of a*

mixed diet and time postfeeding on amount and fibre composition of ruminal and fecal particles and on digesta passage from the reticulo-rumen of steers. v. 71, 1998.

MERTENS, David R. *et al.* Gravimetric determination of amylase-treated neutral detergent fiber in feeds with refluxing in beakers or crucibles: Collaborative study. **Journal of AOAC International**, v. 85, n. 6, 2002.

MONSALVE, Julia Gabrielle; MILLEN, Danilo Domingues. A snapshot of nutritional recommendations and management practices adopted by feedlot cattle nutritionists in Brazil in 2023. **Frontiers in Veterinary Science**, v. 12, 2025.

NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE (NASEM). *Nutrient requirements of beef cattle*. 8. rev. ed. Washington: National Academies Press, 2016. DOI: https://doi.org/10.17226/19014.

ODONGO, N. E. *et al.* Effects of mild heat stress and grain challenge on acid-base balance and rumen tissue histology in lambs. **Journal of Animal Science**, v. 84, n. 2, 2006.

ØRSKOV, E. R.; FRASER, C.; McDONALD, I. Whole wheat grain feeding of lambs. V. Effects of roughage and wheat grain mixtures. *British Journal of Nutrition*, v. 26, p. 477–486, 1975.

OWENS, F. N. *et al.* **Acidosis in Cattle: A Review**. **Journal of Animal Science**, 1998.

OWENS, F. N. *et al.* **Review of some aspects of growth and development of feedlot cattle. Journal of animal science**, 1995.

PARRA, F. S. *et al.* Nellore bulls in Brazilian feedlots can be safely adapted to high-concentrate diets using 14-day restriction and step-up protocols. **Animal Production Science**, v. 59, n. 10, 2019.

PEDREIRA, Carlos G. S. *et al.* Herbage accumulation and organic reserves of palisadegrass in response to grazing management based on canopy targets. **Crop Science**, v. 57, n. 4, 2017.

PERDIGÃO, A. *et al.* Effects of restricted vs. step up dietary adaptation for 6 or 9 days on feedlot performance, feeding behaviour, ruminal and blood variables of Nellore cattle. **Journal of Animal Physiology and Animal Nutrition**, v. 102, n. 1, 2018.

PEREIRA, M. C. S. *et al.* Feedlot performance, feeding behavior, carcass and rumen morphometrics characteristics of Nellore cattle submitted to strategic diets prior the adaptation period. **Livestock Science**, v. 234, 2020.

PETERSON, Lance W.; ARTIS, David. **Intestinal epithelial cells: Regulators of barrier function and immune homeostasis**. **Nature Reviews Immunology**, 2014.

PEZZATO, Luiz Edivaldo *et al.* Avaliação de dois métodos de determinação do coeficiente de digestibilidade aparente com a tilápia do Nilo (Oreochromis

niloticus L.). **Acta Scientiarum. Animal Sciences**, v. 24, n. 0, 2008.

PINTO, Ana Carolina Janssen *et al.* Influence of nutritional management prior to adaptation to a feedlot diet on ruminal microbiota of Nellore cattle. **Revista Brasileira de Zootecnia**, v. 52, 2023.

POORE, M. H. *et al.* Effect of Fiber Source and Ruminal Starch Degradability on Site and Extent of Digestion in Dairy Cows. **Journal of Dairy Science**, v. 76, n. 8, 1993.

POPOVA, Milka *et al.* The structural and functional capacity of ruminal and cecal microbiota in growing cattle was unaffected by dietary supplementation of linseed oil and nitrate. **Frontiers in Microbiology**, v. 8, n. MAY, 2017.

REIS, Ricardo Andrade *et al.* Suplementação da dieta de bovinos de corte como estratégia do manejo das pastagens. **Revista Brasileira de Zootecnia**, v. 38, n. SUPPL. 1, 2009.

RIBEIRO, Pedro Henrique Cavalcante *et al.* Cecal acidosis: an emergent digestive disorder in ruminants. **Livestock Science**, v. 303, 2026.

ROSANOVA, Clauber *et al.* AVALIAÇÃO DO DESEMPENHO E ULTRASSONOGRAFIA DE CARCAÇA DE BOVINOS NELORE PINTADO EM SISTEMA DE TERMINAÇÃO INTENSIVA A PASTO (TIP). **Revista Multidisciplinar do Nordeste Mineiro**, v. 14, n. 1, p. 1–20, 30 jul. 2025.

SCHWARTZ, W. Robert E. Hungate, The Rumen and its Microbes. X u. 539 S., 62 Abb., 72 Tab. New York-London 1966: Academic Press $ 19.75. **Zeitschrift für allgemeine Mikrobiologie**, v. 9, n. 6, 1969.

SOUZA DE ALMEIDA, Victor Gabriel *et al.* Parâmetros sobre ciclagem de nutrientes em pastagens. **Pubvet**, v. 18, n. 01, p. e1539, 14 dez. 2023.

SQUIZATTI, Mariana M. *et al.* Nutritional protocols that alter ruminal fermentation and nutrient disappearance to increase marbling precursors in Nellore cattle. **Livestock Science**, v. 299, 1 set. 2025.

STEELE, M. A. *et al.* An increase in dietary non-structural carbohydrates alters the structure and metabolism of the rumen epithelium in lambs. **Canadian Journal of Animal Science**, v. 92, n. 2, 2012.

STEELE, Michael A. *et al.* Bovine rumen epithelium undergoes rapid structural adaptations during grain-induced subacute ruminal acidosis. **American Journal of Physiology - Regulatory Integrative and Comparative Physiology**, v. 300, n. 6, 2011.

STEELE, Michael A. *et al.* Development and physiology of the rumen and the lower gut: Targets for improving gut health. **Journal of Dairy Science**, v. 99, n. 6, 2016.

STROM, E.; ØSKOV, E. R. The nutritive value of rumen micro-organisms in ruminants. **British Journal of Nutrition**, v. 52, n. 3, 1984.

TEMPLE, Déborah; MANTECA, Xavier. **Animal Welfare in Extensive Production Systems Is Still an Area of Concern**. **Frontiers in Sustainable Food Systems**Frontiers Media S.A., , 22 set. 2020.

VALENTE, Tiago Neves Pereira *et al.* In situ estimation of indigestible compounds contents in cattle feed and feces using bags made from different textiles. **Revista Brasileira de Zootecnia**, v. 40, n. 3, 2011.

VAN SOEST, P. J.; ROBERTSON, J. B.; LEWIS, B. A. Methods for Dietary Fiber, Neutral Detergent Fiber, and Nonstarch Polysaccharides in Relation to Animal Nutrition. **Journal of Dairy Science**, v. 74, n. 10, p. 3583–3597, 1991.

ZHANG, Jun *et al.* Effects of limit-feeding diets with different forage-to-concentrate ratios on nutrient intake, rumination, ruminal fermentation, digestibility, blood parameters and growth in Holstein heifers. **Animal Science Journal**, v. 89, n. 3, 2018.