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Hebert, J.[1], Bongarzone, P.[2], Deshotel, V.[3], Dufour, J.[4], Fontenot, J.[5], Edwards, A.[6], Han, K.[7], Pousson, B.[8]

[1]Extension Agent, LSU AgCenter, Crowley, Louisiana, 70526
[2]Extension Agent, LSU AgCenter, Crowley, Louisiana, 70526
[3]Extension Agent, LSU AgCenter, Ville Platte, Louisiana, 70586
[4]Extension Agent, LSU AgCenter, Mansura, Louisiana, 71350
[5]Extension Agent, LSU AgCenter, Crowley, Louisiana, 70526
[6]Extension Livestock Specialist, LSU AgCenter, Alexandria, Louisiana, 71302
[7]Associate Professor, LSU AgCenter, Baton Rouge, Louisiana, 70803
[8]Extension Agent, LSU AgCenter, Lake Charles, Louisiana, 70607

Evaluation of Rice Straw as an Alternative Forage Source for Beef Cattle During Hay Shortages in Louisiana

Abstract

In 2023, Louisiana experienced one of the hottest and driest summers on record, leading to substantial declines in the quality and availability of grazing and hay pastures. This situation pushed many cattle producers to turn to rice straw as an alternative forage. This study aimed to evaluate the nutritional value of rice straw, collecting 52 samples from various cultivars across the state and analyzing them for dry matter, protein, fiber, minerals, and energy. These results were compared with 13 warm-season perennial grass forage samples harvested within the same two-month period in July and August. The analysis revealed that rice straw had lower crude protein content and relative forage quality than traditional grass forages, underscoring the need for supplementation when used as a primary feed source. This study offers critical insights for producers considering rice straw for winter feeding, emphasizing the importance of adequate supplementation to meet nutritional needs of beef cattle.

Abbreviations: CP - Crude Protein; DMI - Dry Matter Intake; N - Nitrogen; RFQ - Relative Forage Quality; TDN - Total Digestible Nutrients

Keywords: cattle nutrition, forage quality, hay shortage, Louisiana, rice straw

Introduction

The extreme heat and drought conditions of 2023 in Louisiana significantly reduced the availability and quality of traditional grazing and hay pastures. The drought was among the most intense in recent history, with prolonged dry spells and sustained high temperatures severely impacting forage production across the state. Faced with a severe hay shortage, many beef cattle producers sought alternative forage options, including the use of rice straw. As a byproduct of rice production, rice straw has potential as an emergency forage source, but its nutritional profile and suitability for cattle feeding need careful evaluation (Wanapat, M., et al., 2009). The objective of this study was to compare the nutritional values of rice straw and grass forages harvested at the same time to inform producers about the feasibility of incorporating rice straw into winter beef cattle feeding programs.

Materials and Methods

A total of 52 rice straw samples from multiple cultivars were collected statewide and analyzed for key nutrient parameters, including dry matter, crude protein (CP), fiber, mineral content, and total digestible nutrients (TDN). Rice straw samples were dried at 55°C for 72 hours to determine dry matter (DM) concentration and preserved for nutritive value analysis. The dried biomass samples were initially ground to pass through a 2-mm screen using a Wiley mill (Arthur H. Thomas Company, Philadelphia, PA), and then further ground to pass through a 1-mm screen using a cyclone mill (Udy Corporation, Fort Collins, CO, USA). A 1-gram subsample was used to determine absolute DM by crucible drying in a 105°C oven for three hours. Acid Detergent Fiber

(ADF) and Neutral Detergent Fiber (NDF) were analyzed according to the method described by Goering and Van Soest (1970). Total nitrogen (N) was measured using a combustion method (Bremner, 1965) with a LECO® FP-528 N analyzer (LECO Corp, St. Joseph, MI), and converted to crude protein (CP) by multiplying by 6.25. Thirteen grass forage samples, predominantly bahiagrass and bermudagrass, were also collected and analyzed under similar conditions. This comparative approach aimed to identify differences in nutrient values between rice straw and traditional grass forages.

The rice straw samples had varying nitrogen application rates, ranging from 90 to 165 units per acre, with a mean of 134.3 units per acre, whereas the grass forages had nitrogen applications between 0 and 100 units per acre, with a mean of 39.4 units per acre. Two primary harvesting methods were used for rice straw: baling foliage directly from the combine at the completion of rice harvest and cutting post-harvest stubble, which was then combined with foliage from the initial harvest. However, the impact of harvesting methods on forage quality was not captured in the data.

Results

The analysis of forage quality revealed significant differences between the grass forages and rice straw cultivars (Table 1). Grass forages had notably higher CP and TDN levels as well as a higher relative forage quality (RFQ) than rice straw. Bermudagrass, for instance, exhibited an average CP of 7.84% on a dry matter basis, compared to the lower CP values observed in rice straw varieties, which ranged from 2.80% to 4.58%. These findings indicate that perennial warm-season grass forages have the potential to provide optimal nutrition for beef cattle (Mississippi State University Extension, 2018). This evaluation focused solely on forages suitable for beef cattle; forage suitability for dairy cattle was not assessed in this study.

Table 1. Mean nutritive values of forages by cultivar.

Perennial Grass Cultivars	**Crude Protein (CP), %DM**	**Total Digestible Nutrient (TDN), %DM**	**DM Intake, % body weight**	**Relative Forage Quality (RFQ)**
Bahiagrass	7.71AB	56.78AB	2.08AB	96AB
Bermudagrass	7.84A	62.37A	2.52A	129A
Rice Cultivars				
CLL16	3.51C	46.43C	0.96C	36C
CLM04	2.80C	49.54BC	1.23C	50C
Cheniere	4.58BC	52.64BC	1.55BC	68BC
Jasmine	3.25C	49.36C	1.20C	49C
Jupiter	3.70C	49.62C	1.27C	52C
PVL03	4.01C	50.75BC	1.40C	58C
RT7321	3.69C	47.98C	1.14C	45C
P-value	<0.0001	<0.0001	<0.0001	<0.0001

Statistical analysis was conducted using PROC GLIMMIX in SAS, with mean comparisons by Tukey's multiple tests. Some cultivars, such as brown top, CL111, CL153, and Mermentau, were excluded due to insufficient replication.

The association between nitrogen application rates and forage quality was further examined to understand the potential impact of fertilization on the nutritional value of rice straw (Table 2). Results indicated a general trend where increasing nitrogen application led to higher CP, TDN, and RFQ values. For example, the average CP increased from 2.63% at 90 units of nitrogen per acre to 4.60% at 145 units, suggesting that nitrogen application can positively influence forage quality. Similarly, there were upward trends in TDN and RFQ with higher nitrogen levels.

However, despite these observed trends, the variations in forage quality across different nitrogen rates were not statistically significant for all parameters, with P-values exceeding 0.05 for TDN, dry matter intake (DMI), and RFQ. The lack of statistical

significance indicates that while nitrogen application may have some effect on nutritive value, other factors may also play a substantial role in determining the quality of rice straw. The results suggest that nitrogen fertilization alone may not guarantee consistent improvements in forage quality, emphasizing the need for a more holistic approach when using rice straw as a cattle feed. Further studies with larger sample sizes could help clarify these effects and better inform nutrient management strategies.

Table 2. Effect of nitrogen fertilization on nutritive values of rice straw.

N Units	Crude Protein (%DM)	TDN (%DM)	DM Intake (%BW)	RFQ
90	2.63A	48.01A	1.10A	43A
118	2.55A	49.05A	1.17A	47A
125	3.89A	50.24A	1.30A	54A
140	4.14A	49.74A	1.34A	54A
145	4.60A	51.99A	1.51A	65A
P-value	0.0154	0.1165	0.0618	0.0913

Statistical analysis was conducted using PROC GLIMMIX in SAS, with mean comparison by Tukey's multiple tests. Some N rates were excluded due to insufficient replication as well as non-rice straw samples.

Discussion

This study confirms that rice straw could be considered as an alternative forage during drought conditions with precautions, though it falls short of the nutritional quality found in traditional forages like bahiagrass or bermudagrass. Rice straw's lower levels of crude protein, total digestible nutrients (TDN), and relative forage quality (RFQ) mean that producers will need to supplement beef cattle diets, particularly for protein and energy, to meet their nutritional needs (University of California Agriculture and Natural Resources, 2007). Suitable supplements might include high-protein feedstuffs or energy sources to balance the ration.

Despite these limitations, rice straw remains an option in extreme weather conditions, such as the drought of 2023, due to its availability in Louisiana and cost-effectiveness. It is often more affordable and readily accessible compared to traditional hay, especially when sourced locally, and can be harvested as a by-product with minimal added expense. By using rice straw, producers can extend existing hay supplies.

Regarding the rice farmers that are baling rice straw within their fields, they are removing important nutrients from the field. Nutrients that would normally be recycled back into the soil as the straw decomposes are instead being removed from the field. Because of this, it's important for farmers baling rice straw to conduct regular soil sampling to assess any nutrient deficiencies. Based on these soil tests, they may need to adjust fertilizer applications the following season to offset the nutrients lost with the straw. Soil sampling and proper fertilization planning are essential to maintaining both soil health and crop yields.

Conclusion

This study provides valuable baseline data on the use of rice straw as an emergency forage source in Louisiana, particularly during extreme weather events like the drought of 2023. The findings emphasize that while rice straw can be a cost-effective and readily available feed option, it lacks sufficient nutritional content to serve as a standalone forage source. Therefore, beef cattle producers must plan for supplementation to meet the protein and energy needs of their livestock when relying on rice straw as the primary feed.

To build on these initial findings, further research should explore the effects of different harvesting methods on the quality of rice straw. Understanding how specific techniques impact nutritional values can guide producers in choosing the most effective practices. Additionally, investigating strategies to enhance the nutritional profile of rice straw, such as through post-harvest treatments or blending with higher-quality forages, could help make it a more viable and nutritionally balanced option for winter feeding programs

(Dixon & Coates, 2005). These efforts would provide producers with practical recommendations for improving the use of rice straw as a forage resource.

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Conflicts of Interest

The authors declare no conflicts of interest.

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