BJAS_Submit-1759208162789

by Turnitin Checker

Submission date: 30-Sep-2025 11:57AM (UTC+0700)
Submission ID: 2766526948
File name: BJAS_Submit-1759208162789.docx (24.85K)
Word count: 2709
Character count: 16847

The Utilization of Fermented Agricultural By–Products as Fibrous Feed for Beef Cattle: A Review

Ajeng Aullia Martina*, Eka Rizky Vury Rahayu, and Lisa Aprilia

Department of Animal Husbandry, Politeknik Negeri Lampung, Rajabasa, Indonesia

*Corresponding author : Ajeng Aullia Martina

Email : ajengaulliam@gmail.com

Abstract

Fermentation of agricultural by–products is considered a strategic and sustainable alternative for providing fibrous feed sources for beef cattle, especially in regions where the high cost of conventional feed and the limited nutritional value of unprocessed agricultural residues often pose significant challenges to livestock productivity. Through the action of beneficial microorganisms, the fermentation process effectively modifies the chemical composition of the raw materials by breaking down crude fiber components such as cellulose, hemicellulose, and lignin, thereby enhancing the overall nutritional profile of the feed. As a result, the fermented product not only exhibits higher crude protein content, improved digestibility, and better palatability, but it also contributes positively to rumen fermentation efficiency and animal performance. The consistent use of fermented agricultural by–products has been shown to significantly support the growth and health of beef cattle, lower production costs for farmers by reducing dependency on expensive commercial feeds, and simultaneously minimize the risk of environmental pollution caused by improper disposal of agro-industrial waste. Moreover, the abundant and continuous availability of diverse agricultural residues across farming regions provides a reliable supply of raw materials, making fermented by–products highly promising as a feed resource that aligns with the principles of circular economy. Thus, the integration of fermentation technology into livestock production systems holds great potential not only to enhance farm profitability and resource efficiency but also to contribute to long-term sustainability in animal agriculture and strengthen national food security.

Keywords : Agricultural by–product; beef cattle; fermentation; fibrous feed.

Introduction

Beef cattle production is recognized as a vital component of the livestock sector, providing an essential source of animal protein and contributing significantly to national food security. In the

Indonesian context, this industry serves as a cornerstone in meeting the growing demand for beef as a primary protein source. Rising population numbers, improved income levels, and evolving dietary preferences have collectively intensified the need for beef. To address these challenges, it is imperative to strengthen the productivity of beef cattle operations through husbandry systems that are efficient, sustainable, and competitive. A major factor influencing the performance of fattening enterprises is the reliable supply of feed that is both nutritionally adequate and economically sustainable.

In livestock systems, feed plays a decisive role because both its supply and quality are directly connected to animal productivity. Inadequate feed availability reduces the land's carrying capacity and can hinder growth performance as well as reproductive outcomes. Since feed also accounts for the largest share of production expenses, its proper management is crucial for maintaining efficiency and profitability. This is particularly true in beef cattle fattening operations, where consistent access to affordable and high-quality feed is fundamental to overall success (Harly & Mulyani, 2024).

The supply of forage is often insufficient in terms of both quality and quantity, especially during the dry season when grass yields decline sharply. This shortage highlights the need for alternative sources of roughage that can either complement or substitute conventional forage. A range of agricultural residues including rice straw, corn cobs, banana pseudostems, and cassava by–products offer considerable potential as substitutes. Despite their abundance, these materials generally possess low nutritional value when used directly in their fresh state (Krishaditersanto, 2021).

Fermentation is considered an effective method for upgrading the nutritional profile of agricultural by−products. By utilizing the activity of selected microbes, this process can enhance fiber digestibility, lower lignin concentration, elevate protein content, and improve both the aroma and palatability of feed (Suningsih et al., 2019). As a result, agricultural by−products that were previously viewed as low-value waste can be converted into high-quality fibrous feed resources for beef cattle.

Using fermented agricultural by-product offers environmental advantages by reducing pollution risks arising from the buildup of untreated organic matter. Such an approach supports sustainable agriculture by converting materials previously regarded as waste into feed resources with improved nutritional value.

Materials and Methods

This review systematically examines the role of fermented agricultural by−products as a fibrous feed resource for beef cattle, aiming to compile, analyze, and interpret evidence reported in previous studies. The literature search was carried out in an organized manner using Google Scholar, chosen due to its extensive coverage of peer-reviewed research across diverse relevant disciplines, including animal science, ecology, zoology, and agriculture. To achieve both accuracy and breadth in the search results, a set of targeted keywords combined with Boolean operators: such as “fermentation” AND (“fibrous feed” OR “fiber source” OR “nutrition”) AND “agricultural by−products” was applied in multiple configurations to capture the most pertinent publications. In order to maintain the timeliness and relevance of the information, only articles published within the last year were considered. The collected studies were subsequently evaluated and selected according to their relevance to the review topic, the robustness of their methodology,

and their scientific contribution to understanding how fermentation of agricultural residues can enhance nutritional content, improve digestibility, and serve as a practical feed alternative for beef cattle.

Results and Discussion

The fermentation of agricultural residues offers a practical approach to providing fibrous feed for beef cattle, as it enhances nutritional value while simultaneously lowering production costs. This practice is particularly relevant because feed accounts for the largest share of livestock production expenses, whereas forage resources are often limited both in quantity and quality.

The use of agricultural by–products as sources of roughage for beef cattle has been extensively studied, primarily due to their wide availability and relatively low cost. Nonetheless, their direct use is restricted by poor nutritional properties, including high concentrations of crude fiber fractions (cellulose, hemicellulose, and lignin) coupled with low crude protein content (Wahyono & Hardianto, 2004). As a result, considerable research has focused on improving their feed value through various processing methods, with fermentation emerging as one of the most effective strategies. This technique has repeatedly been shown to improve the nutritional characteristics of agricultural residues, making them a promising and sustainable alternative for fibrous feed in beef cattle production.

Fermentation driven by microbial activity has been shown to reduce lignin concentration, increase fiber digestibility, raise protein content, and improve the palatability of feed (Hamdi Mayulu, 2023). Through this process, agricultural residues such as rice straw, corn cobs, cassava peels, and tofu by–products, previously considered nutritionally inferior can be converted into higher-quality feed ingredients. This transformation allows underutilized materials to serve as

valuable sources of fiber and supplementary protein for beef cattle. In addition, the use of fermented residues enhances farmers' independence in feed provision, since these raw materials are widely available around farming areas at relatively low cost (Anisah et al., 2021). Beyond improving nutrient composition, fermentation also refines the aroma and texture of feed, thereby increasing palatability, stimulating higher intake, and contributing to improved daily weight gain. Accordingly, agricultural by−products are increasingly viewed not as waste or environmental challenges but as strategic resources that can be optimized to support the sustainability of beef cattle production.

According to Kusumaningrum et al. (2012), the supply of local feedstuffs derived from agricultural residues is relatively abundant in Indonesia, a result of its extensive agricultural land and substantial food crop output. This abundance highlights significant opportunities for their use as fibrous feed in beef cattle diets. Nonetheless, the nutritional profile of these materials is generally poor, as they contain high levels of crude fiber fractions (cellulose, hemicellulose, and lignin), elevated silica content, and low crude protein. Comparable limitations are also evident in other crop by−products, which, when fed without processing, offer little nutritional benefit and are often poorly consumed by livestock.

Hafid and Yamin (2024) observed that the inclusion of fermented rice straw supplemented with probiotics in cattle diets promotes better growth performance and stimulates higher feed intake. One of the main advantages of fermented rice straw is its greater energy value compared to untreated straw. The addition of probiotics further enhances growth efficiency, producing a stronger performance response in cattle. Fermentation also improves feed palatability, leading to increased consumption and offering distinct benefits over unprocessed rice straw.

Similarly, Lamid et al. (2017) demonstrated that the integration of rice straw into complete feed formulations derived from agricultural residues can improve both the nutritional profile and productive performance of beef cattle. This feeding strategy elevates crude protein content and enhances fiber digestibility, thereby allowing more effective use of materials traditionally regarded as low-quality feed. Furthermore, rations formulated with fermented rice straw as a major component have been reported to increase average daily gain to 0.4–0.5 kg/head/day, whereas conventional green forage diets achieve only 0.1–0.2 kg/head/day. These results indicate that fermentation not only enhances feed quality but also plays a direct role in boosting beef cattle productivity.

In line with these findings, Ali and Muwakhid (2017) reported that fermenting rice straw markedly improves the quality of basal feed for beef cattle. Their community-oriented program demonstrated that rice straw inoculated with cellulolytic bacteria was more nutritious, more digestible, and more palatable compared to untreated straw. Moreover, applying fermentation techniques to agricultural residues has been shown to enhance production performance by increasing average daily gain (ADG) while at the same time lowering feeding costs. Taken together, these results highlight that the integration of fermentation technology with agricultural by–products delivers not only nutritional improvements but also promotes the sustainability of livestock systems through more efficient use of locally available resources.

Similarly, Nilawati and Suryadi (2018) found that fermenting agricultural residues can significantly enhance the performance of beef cattle. Their study revealed that women's farmer groups in Lima Puluh Kota Regency who fed fermented rice straw combined with fermented quail manure achieved average daily gains of 700 g/head/day, compared with only 320 g/head/day before treatment. These outcomes demonstrate that fermentation improves the nutritive value of

feedstuffs that are otherwise of low quality, making them more digestible and better utilized by cattle. Additionally, rice straw fermentation has been shown to increase crude protein levels from 2–3% to 7–9% while simultaneously reducing crude fiber content, thus making straw a viable replacement for green forages, particularly during the dry season when natural pasture is scarce. Beyond boosting productivity, the use of fermented agricultural residues also yields economic benefits by reducing feed expenditures and ecological gains by lowering pollution associated with organic waste accumulation.

Salam and Safitri (2025) found that locally formulated fermented feeds, such as silage, can substantially improve nutritional value. In their study, crude protein levels rose from about 12% to 18%, while digestibility improved from 60% to 80%. These enhancements occur because the fermentation process enables microbes to break down complex fibrous components into simpler, more digestible forms, while at the same time increasing protein content through microbial biomass accumulation. The silage recipe generally includes 70–75% rice straw or elephant grass as the main fiber source, 5% rice bran for added energy, 3% molasses to provide soluble carbohydrates, sufficient water to maintain 60% moisture for effective fermentation, and 1–2% microbial starter as an inoculant.

In a similar context, residues such as rice bran treated with cellulolytic microbes have also been reported to enhance both the nutritional quality and palatability of basal rations for beef cattle. Fermented agricultural by−products, particularly rice straw can be further combined with simple concentrates (such as rice bran, pollard, or soybean meal) along with Urea Molasses Block Plus (UMBP) supplements. Such formulations have been shown to improve the growth performance of intensively reared beef cattle, yielding higher weight gains compared with rations based solely on unprocessed forages (Ali & Muwakhid, 2017).

Partner beef cattle farms generally provide rations composed of rice and corn straw, complemented by other forages such as field grasses, legume by–products (e.g., bean residues), and pigeon pea leaves gathered from paddy bunds or idle dryland fields. Basal feed is typically supplied ad libitum in troughs, with drinking water made available during both daytime and nighttime. Farmers also often enrich the ration by mixing in bran.

In most cases, forage as the main feed source is provided at around 10% of live body weight, while concentrate supplements range from 1 to 2%. Nevertheless, the recommended requirement for dry matter (DM) intake in beef cattle is 2 to 3% of body weight. Meeting this target is difficult in practice because farmers must estimate the DM content of the forage offered (Yakin, Ngadiyono, & Utomo, 2013).

Incorporating fermented agricultural residues such as rice straw, corn cobs, and legume foliage can enhance the nutritional value of basal feed. Fermentation lowers crude fiber content, improves digestibility, and raises protein levels, thereby making rations more effective in meeting cattle DM requirements. Thus, the use of fermented feeds not only streamlines feed preparation for farmers but also contributes to improved growth performance and overall productivity in beef cattle.

Fermented agricultural residues have been widely recognized as an effective means of providing fibrous feed for beef cattle. A number of studies have confirmed that this approach helps overcome two major constraints in cattle production: the low nutritive value of unprocessed crop by–products and the high expense of feed. Through the action of microorganisms, fermentation decreases crude fiber components (cellulose, hemicellulose, and lignin), raises crude protein levels, enhances digestibility, and improves overall palatability. Consequently, resources such as rice

straw, corn cobs, cassava peels, and tofu waste once regarded as nutritionally inadequate—can be efficiently converted into basal feed suitable for beef cattle.

Conclusion

Fermenting agricultural by-product offers a practical alternative for supplying fibrous feed to beef cattle, as the process enhances nutritional value by decreasing crude fiber and lignin content, increasing protein levels, improving digestibility, and enhancing palatability. Feed ingredients such as rice straw, corn cobs, cassava peels, and tofu by–products, when fermented, not only promote improved growth performance and higher weight gain in cattle but also lower feed expenses and reduce environmental problems arising from the buildup of organic waste. With the wide availability of these raw materials in Indonesia, the integration of fermentation technology into livestock systems presents significant potential for broad application as a cost-effective, efficient, and eco-friendly feeding strategy, while at the same time contributing to the sustainability of cattle production and reinforcing national food security.

Acknowledgements

The author would like to thank everyone who helped publish this review article.

References

Ali, Usman, and Badat Muwakhid. 2017. "Upaya Pengembangan Sapi Potong Menggunakan Pakan Basal Jerami Padi Di Desa Wonokerto, Dukun, Gresik." *Jurnal Dedikasi UMM Malang* 14(1).

Anisah, Zulfatun, Siti Fatimah, Rizal Abdul Aziz, Misbahul Anam, and Khoirul Fata. 2021. "Pendampingan Pengolahan Pakan Ternak Melalui Fermentasi Di Desa Sidorejo Kecamatan Kenduruan Kabupaten Tuban: Pengabdian Berbasis Participatory Action Research." *I-Com: Indonesian Community Journal* 1(1). doi: 10.33379/icom.v1i1.952.

Hafid, Hendra, and M. S. Yamin. 2024. "Pemanfaatan Fermentasi Limbah Padi Sebagai Bahan Pakan Ternak Berkualitas Dan Bernilai Ekonomi Tinggi." *Pengabdian Kepada Masyarakat* 2(2):64–70.

Hamdi Mayulu, S. Pt. 2023. *Karakteristik Pakan Ruminansia*. PT. RajaGrafindo Persada-Rajawali

Pers.

Harly, R., and S. Mulyani. 2024. “Pemanfaatan Limbah Pertanian (Padi Dan Jagung) Sebagai Pakan Ternak Sapi Di Kecamatan Harau Kabupaten Lima Puluh Kota: The Utilization of Agricultural”. *Journal of Livestock and Animal Health* 7(1):7–12.

Krishaditersanto, Rip, and S. Pt. 2021. *Potensi Hasil Samping Produksi Pertanian Dan Perkebunan Sebagai Pakan Ternak*. Cipta Media Nusantara.

Kusumaningrum, Mariana, Cornelius Imam Sutrisno, and Bambang Waluyo Hadi Eko Prasetyono. 2012. “Kualitas Kimia Ransum Sapi Potong Berbasis Limbah Pertanian Dan Hasil Samping Pertanian Yang Difermentasi Dengan Aspergillus Niger.” *Animal Agriculture Journal* 1(2).

Lamid, Mirni, Tri Nurhajati, and Retno Sri Wahjuni. 2017. “IbM AplikasiFormula Pakan Lengkap Herbal Berbasis Limbah Pertanian Strategi Penggemukan Sapi Potong Di Kecamatan Konang Kabupaten Bangkalan-Madura.” *Agroveteriner* 6(1).

Nilawati, N., and I. Suryadi. 2018. “Penggunaan Limbah Pertanian Dan Peternakan Pada Kelompok Wanita Tani.” *Lumbung* 17(1).

Salam, Abdul, and Oryza Safitri. 2025. “Pemberdayaan Kelompok Ternak Poto Melalui Pakan Fermentasi Berbasis Green Economy.” *Jurnal Abdi Panca Marga* 6(1).

Suningsih, N., W. Ibrahim, O. Liandris, and R. Yulianti. 2019. “Kualitas Fisik Dan Nutrisi Jerami Padi Fermentasi Pada Berbagai Penambahan Starter.” *Jurnal Sain Peternakan Indonesia* 14(2).

Wahyono, D. Eko, and RULY Hardianto. 2004. “Pemanfaatan Sumberdaya Pakan Lokal Untuk Pengembangan Usaha Sapi Potong.” *Lokakarya Nasional Sapi Potong* .

Yakin, Engkus Ainul, Nono Ngadiyono, and Ristanto Utomo. 2013. “Pengaruh Substitusi Silase Isi Rumen Sapi Pada Pakan Basal Rumput Dan Konsentrat Terhadap Kinerja Sapi Potong.” *Buletin Peternakan* 36(3):174. doi: 10.21059/buletinpeternak.v36i3.1626.

BJAS_Submit-1759208162789

ORIGINALITY REPORT

2%	1%	1%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ejournal.uniramalang.ac.id Internet Source	1%
2	Laode Muh. Munadi. "PRODUCT TESTING STRATEGY IMPLEMENTATION RESULTS BIOTECHNOLOGY FEED: PAPER", Open Science Framework, 2021 Publication	1%
3	worldwidescience.org Internet Source	<1%
4	J S Mandey, B Tulung, J R Leke, B F J Sondakh. "Performance and carcass quality of broiler chickens fed diet containing pineapple waste meal fermented by “ragi tape”", IOP Conference Series: Earth and Environmental Science, 2018 Publication	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

BJAS_Submit-1759208162789

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10