International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
NAAS Rating: 4.61
VET 2025; SP-10(6): 34-38

www.veterinarypaper.com
Received: 11-04-2025
Accepted: 13-05-2025

Cherryl DM
Department of Livestock Production Management, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka, India

Paramesha SC
Department of Livestock Farm Complex, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka, India

Shwetha HS
Department of Veterinary Physiology & Biochemistry, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka, India

Bharat Bhushan M
Department of Livestock Farm Complex, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka, India

Sushant Handage
Department of Animal Husbandry and Extension, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

Corresponding Author:
Cherryl DM
Department of Livestock Production Management, Shri Bhaurao Deshpande Veterinary College, Athani, Karnataka, India

Ensiled sugarcane byproducts: A sustainable solution to livestock feeding

Cherryl DM, Paramesha SC, Shwetha HS, Bharat Bhushan M and Sushant Handage

DOI: https://www.doi.org/10.22271/veterinary.2025.v10.i6Sa.2353

Abstract
Sugarcane is one of the most widely grown crops in the world, primarily cultivated for sugar and bioethanol production. A large portion of the sugarcane plant, including leaves, tops, and bagasse, remains unutilized or is discarded, contributing to agricultural waste and environmental pollution. Recent developments in agricultural sustainability have drawn attention to the potential of converting sugarcane byproducts into valuable feed for livestock. One promising solution is the conversion of these byproducts into silage, which can serve as a sustainable feed option for livestock, particularly in tropical and subtropical regions where sugarcane is widely grown. Sugarcane byproduct silage not only reduces agricultural waste but also provides a cost-effective, high-fiber, and carbohydrate-rich feed for ruminants, contributing to more efficient livestock production. However, challenges such as low protein content, fermentation quality, and proper storage conditions must be addressed to optimize its nutritional value. This review explores the potential of sugarcane byproduct silage as an innovative approach to livestock feeding and waste valorization. By improving fermentation techniques and promoting proper storage, sugarcane byproduct silage can become a sustainable way forward. This review examines the nutritional value, production methods, uses, and constraints of sugarcane byproduct silage, offering an in-depth discussion of its role in sustainable agricultural practices.

Keywords: Silage, Sugarcane, Sustainable, Fermentation, Carbohydrates

Introduction

India is known for its delicate biomes and genetically diverse flora and wildlife. An essential part of green eco-sustainability is livestock. India boasts a wealth of animal genetic diversity. With the greatest human and livestock population, country requires a well planned approach to meet the growing need for food, feed, and fodder in sufficient quantity and quality. While technological intervention, government policy, and farmer effort have greatly contributed to the success of food production, dedication is still required to meet the nutritional needs of animals when it comes to livestock feed. India is currently facing a fodder problem, with the difficult task of producing enough nourishment and fodder for its animals from a land supply that is already running low. A shortcoming in the supply line is also caused by the unpredictable feed supply during the summer or drought. There is a current estimated 11.24% shortfall in green fodder, a 23.4% shortfall in dry fodder, and a roughly 29% shortfall in concentrates (Roy *et al*., 2019) [36]. In order to bridge the gap between demand and supply, it is crucial to utilize the unconventional alternate feed resources, more precisely the byproducts of agriculture. One such significant agricultural crop with efficient feed purpose byproduct globally is sugarcane (*Saccharum officinarum*) with a production of over 1.92 billion tons (FAO, 2022) [42]. In the dry season, when forage output is both qualitatively and quantitatively inadequate, sugar cane serves as an alternate roughage supplement (Fernandes *et al*., 2003) [20]. Sugar cane is distinguished among fodder grasses due to its substantial output, ranging from 60 to 120 fresh tons per hectare, and its capacity to sustain energy potential even throughout the dry season (Mariano and Trivelin 2023) [29]. One hectare of sugarcane yields roughly 5-8 tonnes of trash or byproduct after harvest. However, burning sugarcane waste destroys the majority of its organic content and nutrients, which causes terrible contamination of the environment (Mitchell *et al.,* 2000) [31]. Farmers typically burn the rubbish because they believe it will be difficult to maintain, disrupt regular cultivating methods, and decrease germination. Hence, this review is intended to comprehend the potential use of different byproducts of sugarcane as animal feed resource especially during feed shortage as a potential nutritious feed.

Sugarcane byproducts as livestock feed

Sugarcane is grown primarily for its juice, which is then used to make sugar, ethanol, and other byproducts. However, much of the plant, such as the leaves, tops, and bagasse (the fibrous residue left after juice extraction), is not utilized to its full potential. Sugarcane tops is the major byproduct of sugarcane and comprises about 15-25% of the aerial part of the plant which is commonly left in the field unutilized, burnt or improperly used after harvest by large scale producers and most of the small-scale farmers try to feed fresh tops to the livestock which is nutritionally not efficient enough for the livestock to relish thus reducing the palatability (Kaur *et al*., 2022) [25]. Likewise, once the juice is extracted, bagasse is obtained and about 300 kg of bagasse is produced from one ton of raw sugarcane. Through methods like burning or inappropriate disposal, these byproducts frequently wind up as waste and contribute to environmental contamination. In response to growing environmental concerns and the need for sustainable farming practices, there has been an increasing focus on utilizing sugarcane byproducts for alternative purposes, particularly as livestock feed (Wong, 2000) [42].

Due to high fermentable sugar content in sugarcane tops and bagasse, it could be easily ensiled with additives to uplift the quality of by-product and be used for animal feeding especially in drought prone tropical areas. Ensiling is the process of preserving feed through regulated bacterial fermentation without air, which turns sugar and sugar-like substances into organic acids, primarily lactic acid. This lowers the pH and thus inhibits the growth of undesirable microorganisms hence prevents spoilage (Brar *et al.,* 2019) [8].

Value addition during ensiling sugarcane byproducts:

Though sugarcane tops is one of the most agronomical and economically suitable forage sources for ruminants in tropical and sub-tropical regions, the question is how to improve the quality before utilizing it as a feed source. Ensiling is one of the effective processes that enhance the feeding and keeping quality of the sugarcane tops targeting sustainability. Silage from sugarcane tops could be the best alternate quality livestock feed to support and nourish the livestock production. Farmers can prepare silage and utilize for feeding livestock whenever required instead of feeding fresh tops. Feeding of fresh sugarcane tops after harvest is not promising as it contains just 3% CP and 45% TDN or even silage from sole sugarcane tops is considered to be poor quality roughage (Bodare *et al*., 2020) [7]. Therefore, various silage additives could be utilized to improve animal performance, decrease fermentation losses, increase the nutrient and energy retrieval, and promote quick fermentation. It is commonly acknowledged that additives used in ensiling can improve animal performance and intake by altering the quality of the silage (Kaur *et al*., 2022) [25]. Edible substances like urea, molasses, and bacterial inoculants are typically used as silage additions (Amer *et al*., 2012). Several studies have shown that molasses enhances lactic acid fermentation and decreases the pH of silage (Wang *et al*., 2017) [39]. These additions (urea, molasses) are beneficial when microorganisms can readily ferment them.

The nutritional value of sugarcane byproducts varies based on the type and processing method. For instance, it shows high dry matter (DM) production of about 25-40 t/ha and presents up to 571 g/kg total digestible nutrients after being ensiled (Avila *et al.,* 2014) [6]. The sugarcane tops and peels are rich in fiber, sometimes exceeds 600 g/kg of DM (Andrade *et al*., 2016) [3] but low in protein and energy which impairs digestibility (Aroeira *et al*., 1993) [4]. According to Mohd-Setapar*et al.* (2012), the DM concentrations of the material used to make high-quality silage should be between 28 and 42% and accordingly it was observed that sugarcane top silage treated with different additives like urea, molasses contained quite sufficient DM between 30.13-41.89% (Getiso *et al*., 2022) [4]. Martins *et al*., 2021[30] inferred that sugarcane silage treated with CaO at a concentration of 10 g/kg CaO or with a combination of 5 g/kg urea + 5 g/kg CaO was recommended for feeding the dairy cows.

Additionally, sugarcane byproducts' low crude protein content lowers the quality of the feed; however, this nutrient deficit may be addressed by adding urea during ensiling (Maeda *et al*., 2011) [27]. Compared to treatments without additions, sugarcane tops ensiled with urea-based additives has demonstrated a higher crude protein content. Getiso *et al.* (2022) [4] found that sugarcane top treated with 4% urea and then 4% urea + 1% molasses had higher CP (12.5%) than untreated sugarcane tops (7.85%) and sugarcane tops treated with 1% molasses (5.33%) which were below the crude protein needed for ruminant maintenance. This suggests that in order to improve sugarcane tops as a feed source for ruminants, they must be supplemented with nitrogen-rich materials. In a comparable way, Iranian researchers Noroozy and Alemzadeh (2006) [34] found that following urea treatment, the CP content of sugarcane top rose from 1.25 to 6.75. This might be because urea, a nitrogenous non-protein molecule, may raise the silage's CP and ammonia nitrogen concentration. The higher CP content in sugarcane top silage treated with additives may be due to the microbial growth of lactic acid bacteria during the fermentation period, which causes them to become a part of the medium where in the pH drops to 4. Bacteria are proteins by nature, and over 75% of their cell mass is made up of true protein. Through ammonification, urea, a nitrogen source, also acts as a delignifying agent and has been shown to remove polymerized silica from leaf blades and sheaths (Man and Wiktorsson, 2001) [28].

Furthermore, adding carbohydrate sources such soybean husks and cassava waste may lower effluent production while raising the nutritional content of silage (Gandra *et al.,* 2022) [22]. Loss during fermentation operations is another limitation that has been documented in the sugarcane ensilage process. It was discovered that the use of additives was crucial for preventing the growth of yeast, fungus, and ethanol production, hence lowering the total losses (Ribeiro *et al.,* 2010) [35]. However, alcoholic fermentation during ensilage may result from the plant's high soluble carbohydrate and yeast content, potentially leading to significant dry matter losses (Carvalho *et al*., 2015) [10]. When sugarcane byproducts are ensiled, chemical treatments can improve fermentation and preserve the dry matter (Andrade *et al*., 2016) [3]. Furthermore, according to Chizzotti*et*, these additions may suppress undesired microorganisms like yeasts and clostridiums or favour advantageous microorganisms like lactic acid bacteria. Furthermore, enzymatic additives like fibrolytic enzymes are a recent addition to silage that improves the digestion of fibre (Arriola *et al*., 2017) [5]. Gandra *et al.* (2022) [22] discovered that adding cellulase and xylanase (XYL) to sugarcane silage increased the digestibility of the fibre. Acetic acid is the main result of xylan breakdown during fermentation (Dehghani *et al*., 2012) [16]. Since it lowers pH and inhibits the proliferation of spoiling organisms, acetic acid is associated with increased aerobic stability (Danner *et al.,* 2003) [14]. According to Dehghani *et al.* (2012) [16], adding fibrolytic enzymes to sugarcane silage changes the chemical composition and fermentative profile without compromising aerobic stability. Additionally, ensiled sugarcane byproducts contained 426 g/kg of non-fibre carbohydrates, mostly sucrose. These carbohydrates can be fermented by lactic acid bacteria, which will reduce the pH and create organic acids (Del *et al*., 2019) [17].

In the same direction, Liu *et al*., (2020) [26] found that adding molasses during the ensiling process could increase the fermentation quality of silage and lower pH by encouraging the growth of lactic acid bacteria. According to a study by Kaur *et al*., (2022) [25], the silage prepared from sugarcane tops had an ammonical nitrogen concentration of 7.70% and a pH of 5.03. Low NH3-N levels in silage imply prevention of proteolysis during fermentation and, as a result, higher efficiency of rumen microbial N synthesis. The ammonical nitrogen concentration in silage serves as an indicator of protein degradability (Wilkinson, 1999) [41]. In general, gas production is a reliable predictor of fermentability, digestibility, and the generation of rumen microbial protein. Sugarcane top silage treated with urea and urea plus molasses had ADF and NDF concentrations of 38.80-46.00 and 66.20-77.80 percent, respectively (Getahun *et al*., 2018) [23]. The NDF levels in sugarcane top silages increase when urea and urea plus molasses are applied, although the ADF contents somewhat decrease. This decline occurs as a result of the additives decreased ADF content. Sugarcane top silage's nutritional content was generally enhanced by the addition of only urea and urea with molasses additives (Suarez *et al.,* 2011) [38]. According to an earlier study of Alemayehyu *et al*., (2014) [1] untreated sugarcane top had a greater oxalate concentration (3.94 g/kg) than urea-treated sugarcane tops silage (1.88 g/kg). Kaur *et al*., (2022) [25] observed that the oxalate content was reduced by 6.33%, 15.19%, 15.82%, and 10.13% using 2% urea, 1% molasses, 2% molasses, and 1% urea plus 1% molasses, respectively.

Comparably, raw sugarcane bagasse has a total digestible nutrient (TDN) value of roughly 35%, comprising roughly 36-43% crude fibre, 0.5-1.7% ether extract, and 3.5% crude protein. These qualities reduce their palatability and jeopardize the performance and intake of animal feed (Correa *et al*., 2004). Although bagasse has a high fibre content and low protein content, once the quality is improved, the biomass could be used as animal feed. Bagasse typically contains crude protein, cellulose, hemicelluloses, lignin, ash, and waxes varying from 1-1.3, 45-55, 20-25, 18-24, 1-4, less than 01 percent, respectively (Fadel *et al*., 2003). Bagasse's low digestibility, which ranges between 45 and 50 percent, is the largest obstacle to its usage as animal feed (Mohammed *et al*., 2013) [32]. This is mostly due to the increased cellulose and lignin concentrations. Fermenting bagasse with molasses may improve its digestibility, but the true problem is economics because bagasse fermentation is costly because certain chemicals are needed (Dayana *et al*., 2015) [15]. Nonetheless, scientists have discovered that some yeasts are useful for fermenting bagasse with molasses, which somewhat improves bagasse's digestibility (Caneque *et al*., 1998) [9]. According to another study, bagasse silage produced by treating it with molasses, urea, and regular salt and storing it under anaerobic circumstances was of a respectably good caliber (Mohammed *et al.,* 2013) [32]. Specifically, as it ferments in the rumen, sugarcane bagasse has a high cellulose and hemicellulose content and hence offers a slower-released energy source (White *et al*., 2020) [40]. This gradual release of energy keeps ruminants' blood sugar levels steady and helps avoid problems like acidosis that might arise from giving them a lot of quickly fermentable carbohydrates.

Molasses, another by-product of sugarcane processing, is an additional by-product (Dayana *et al*., 2015) [15]. Sugarcane molasses is chemically free of fat, crude fibre, and crude protein. In addition to several minerals like calcium, magnesium, and iron, it also has carbohydrates such as sucrose, glucose, and fructose (Cox *et al.,* 2014) [13]. Large and small ruminants can be freely fed molasses to lick, but only up to 5-10% of their total feed. Additionally, it can be used to make cereal straws like rice straw more palatable when fed to animals during times when there is a shortage of forage. It can also be added to silage to make it more palatable, and the same is true for hay (Mohammed *et al.,* 2013) [32].

Constraints in the Production and Utilization of Sugarcane Byproduct Silage

Despite the advantages, there are a number of issues that must be resolved in the production as well as use of sugarcane byproduct silage.

Fermentation Quality

The fermentation process has a significant impact on the quality of silage, a byproduct of sugarcane. Lactic acid bacteria must proliferate in order to control the fermentation process, which lowers the silage's pH and retains its nutrients. However, because of their high moisture content and relatively low sugar content, sugarcane byproducts—especially leaves and tops—make it challenging to accomplish ideal fermentation. The nutritional value of the silage can be increased and fermentation quality improves by adding fermentative chemicals or co-fermenting with other high-sugar materials like molasses (Deville *et al.,* 2018). Maintaining the quality of silage also requires making sure that the right storage conditions are met, such as sealing the silage in airtight containers.

Low Protein Content

One of the primary obstacles to using sugarcane byproducts as the exclusive source of feed is still their low protein content. As previously stated, in order to guarantee that cattle acquire sufficient nutrients for development and productivity, protein supplementation is required. This can be accomplished by using protein concentrates like soybean meal or cottonseed cake, or by adding crops high in protein, like legumes or by enriching the sugarcane silage using nitrogenous compounds as dealt in this review.

Storage and Handling Issues

Proper storage is crucial to maintaining the quality of sugarcane byproduct silage. The bulky and fibrous nature of sugarcane residues can make it challenging to compact and seal the silage in pits or plastic bags. If silage is exposed to oxygen, it can lead to spoilage and nutrient loss. Moreover, improperly stored silage may develop mold or bacterial contamination, rendering it unsafe for livestock consumption (White *et al*., 2020) [40].

Conclusion

The Crude Protein concentration of sugarcane tops ensiled with urea-based additives was higher than that of the molasses and additive-free treatments. In addition to sugarcane top being widely available, it may be a substitute source of roughage for cattle production by lowering the main barriers to its use. Therefore, based on their chemical compositions and silage properties, sugarcane top was determined to be a good substitute silage crop. Particularly in tropical and subtropical areas, silage made from sugarcane byproducts offers a viable and sustainable feed alternative for animals. For ruminants, its high fibre and carbohydrate content provides substantial nutritional advantages, and its capacity to recycle agricultural waste promotes farming sustainability. The potential of silage made from sugarcane byproducts can be maximized with continued study and advancements in fermentation methods and supplementation tactics, even in the face of low protein content and poor fermentation quality. Silage, a byproduct of sugarcane, can be a significant contributor to waste reduction, animal production, and environmental sustainability in agriculture if it is managed carefully and used into agricultural systems.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Alemayehyu T, Fulpagare YG, Gangwar SK. Effect of urea treatment on chemical composition and oxalate content of sugarcane tops. International Journal of Science and Nature. 2014;5:15-18.
2. Amer S, Hassanat FR, Berthiaume P, Seguin M, Mustaf AF. Effects of water-soluble carbohydrate content on ensiling characteristics, chemical composition and in vitro gas production of forage millet and forage sorghum silages. Animal Feed Science and Technology. 2012;177:23-29.
3. Andrade FL, Rodrigues JPP, Detmann E, Valadares FSC, Castro MMD, Trece AS, *et al*. Nutritional and productive performance of dairy cows fed corn silage or sugarcane silage with or without additives. Tropical Animal Health and Production. 2016;48(4):747-753.
4. Aroeira LJM, Silveira MI, Lizieire RS, Matos LL, Figueira DG. Rumen degradability and rate of passage of sugarcane with urea, cottonseed meal and rice meal in crossbred Holstein-Zebu steers (in Portuguese). Journal of the Brazilian Society of Animal Science. 1993;22:552-564.
5. Arriola KG, Oliveira AS, Ma ZX, Lean IJ, Giurcanu MC, Adesogan AT. A meta-analysis on the effect of dietary application of exogenous fibrolytic enzymes on the performance of dairy cows. Journal of Dairy Science. 2017;100(6):4513-4527.
6. Avila CLS, Carvalho BF, Pinto JC, Duarte WF, Schwan RF. The use of Lactobacillus species as starter cultures for enhancing the quality of sugar cane silage. Journal of Dairy Science. 2014;97(2):940-951.
7. Bodare PA, Khanvilkar AV, Bhalerao SM, Hande ST, Doiphode AY, Rangnekar MN. Effect of different combinations of urea-treated sugarcane top silage on its oxalate content and blood mineral profile in Murrah buffaloes. Haryana Vet. 2020;59(2):189-191.
8. Brar NS, Kumar B, Kaur J, Kumar A, Verma HK, Singh R, *et al*. Qualitative study of corn silage of cattle farms in subtropical conditions of Indo-Gangetic plains. Range Management and Agroforestry. 2019;40(2):306-312.
9. Caneque S, Velasco S, Sancha JL. Nutritional value and use of ligno-cellulosic feed treated with urea in the ruminant diet. In: Antongiovanni M, editor. Exploitation of Mediterranean roughage and by-products. Options Méditerranéennes B: Etudes et Recherches. 1998;32-17:17.
10. Carvalho BF, Avila CLS, Miguel MGCP, Pinto JC, Santos MC, Schwan RF. Aerobic stability of sugar-cane silage inoculated with tropical strains of lactic acid bacteria. Grass and Forage Science. 2015;70(2):308-323.
11. Chizzotti FHM, Pereira OG, Valadares FSC, Chizzotti ML, Rodrigues RTS, Tedeschi LO *et al*. Does sugar cane ensiled with calcium oxide affect intake, digestibility, performance, and microbial efficiency in beef cattle? Animal Feed Science and Technology. 2015;203:23-32.
12. Correa JL, Graminho DR, Silva MA, Nebra SA. Cyclone as a sugar cane bagasse dryer. Chinese Journal of Chemical Engineering. 2004;12(6):826-830.
13. Cox KM, Renouf M, Dargan C, Turner C, Klein-Marcuschamer D. Environmental life-cycle assessment (LCA) of aviation biofuel from microalgae, Pongamia pinnata and sugarcane molasses. Biofuels, Bioproducts and Biorefining. 2014;8(4):579-593.
14. Danner H, Holzer M, Mayrhuber E, Braun R. Acetic acid increases stability of silage under aerobic conditions. Applied and Environmental Microbiology. 2003;69:562-567.
15. Dayana AC, Souza CL, Saliba EOS, Carneiro JC. By-products of sugar cane industry in ruminant nutrition. International Journal of Advanced Agricultural Research. 2015;3:1-9.
16. Dehghani MR, Weisbjerg MR, Hvelplund T, Kristensen NB. Effect of enzyme addition to forage at ensiling on silage chemical composition and NDF degradation characteristics. Livestock Science. 2012;150(1-3):51-58.
17. Del VTA, Antonio G, Zenatti TF, Campana M, Zilio EMC, Ghizzi LG *et al*. Effects of xylanase on the fermentation profile and chemical composition of sugarcane silage. The Journal of Agricultural Science. 2019;1:1-7. DOI:10.1017/S0021859618001090.
18. Deville J, Cheong YWY, Leclezio P, Duvivier P. Silage production from sugarcane tops and leaves for ruminant feeding. Animal Feed Science and Technology. 2018;241:85-94.
19. Fadel AMA, Sekine J, Hishinuma M, Hamana K. Effects of ammonia, urea plus calcium hydroxide and animal urine treatments on chemical composition and in sacco degradability of rice straw. Asian-Australasian Journal of Animal Sciences. 2003;16(3):368-373.
20. Fernandes AM, Queiroz AC, Pereira JC. Chemical and bromatological composition of sugarcane (*Saccharum* spp. L.) with different production cycles (early and intermediate) at three cutting ages. Revista Brasileira de Zootecnia. 2003;32(4):977-985.
21. Food and Agriculture Organization of the United Nations. — [Provide report title, year, and pagination].
22. Gandra JR, Machado FS, Pedrini CDA, Oliveira ER, Goes RHDTB, Gandra ERDS, *et al*. Sugarcane total mixed ration silage ensiling with chitosan and homolactic microbial inoculant: characteristics of silage and animal digestion. Revista Brasileira de Saúde e Produção

Animal. 2022;23:e20220014.
23. Getahun K, Ashenafi M, Getnet A, Getachew A. Nutritional and fermentative quality of sugarcane (*Saccharum officinarum*) top ensiled with or without urea and molasses. African Journal of Agricultural Research. 2018;13(20):1010-1017.
24. Getiso A, Mijena D, Shanku E. Evaluation of the nutritive value of sugar cane tops and its silage at Wondogenet, Sidama, Ethiopia. International Journal of Scholarly Research and Reviews. 2022;1(1):26-33.
25. Kaur J, Goyal M, Lamba JS, Agrawal RK. Sugarcane tops and additives influence nutritional quality and fermentation characteristics of mixed silage prepared with rice straw. Range Management and Agroforestry. 2022;43(2):309-316.
26. Liu B, Yang Z, Huan H, Gu H, Xu N, Ding C. Impact of molasses and microbial inoculants on fermentation quality, aerobic stability, and bacterial and fungal microbiomes of barley silage. Scientific Reports. 2020;10:1-11.
27. Maeda EM, Zeoula LM, Jobim CC, Bertaglia F, Jonker RC, Geron LJV, *et al*. Chemical composition, fermentation, in vitro digestibility and in situ degradability of sugar cane silages with Lactobacillus, urea and agricultural by-product. Revista Brasileira de Zootecnia. 2011;40:2866-2877.
28. Man NV, Wiktorsson H. The effect of replacing grass with urea-treated fresh rice straw in dairy cow diet. Asian-Australasian Journal of Animal Sciences. 2001;14:1090-1097.
29. Mariano E, Trivelin PCO. Biomass accumulation and growth curve in sugarcane fertigated with nitrogen doses. Australian Journal of Crop Science. 2023;17(3):244-253.
30. Martins SCDSG, Carvalho GGPD, Pires AJV, Leite LC, Lago-Novais D, Oliveira RL, *et al*. Preservation of sugarcane silage with urea and calcium oxide: Performance and metabolic efficiency of dairy cows. Revista Colombiana de Ciencias Pecuarias. 2021;34(4):305-315.
31. Mitchell RDJ, Thorburn PJ, Larsen P. Quantifying the loss of nutrients from the immediate area when sugarcane residues are burnt. In: Proceedings of the Australian Society of Sugar Cane Technologists. 2000;22:206-211.
32. Mohammed HA, Babiker SA, Elnasir A, Elseed MAF, Mohammed AM. Effect of urea-treatment on nutritive value of sugarcane bagasse. ARPN Journal of Science and Technology. 2013;3(8):834-838.
33. Mohd-Setapar SH, Abd-Talib N, Aziz R. Review on crucial parameters of silage quality. APCBEE Procedia. 2012;3:99-103.
34. Noroozy S, Alemzadeh B. Effect of different amounts of treated sugarcane top silage on performance of milch buffaloes. In: Sophon S, editor. Buffalo Bulletin. 2006;25(1):7-9. Retrieved July 15, 2007, from http://ibic.lib.ku.ac.th/e-Bulletin/2006-1.pdf
35. Ribeiro LSO, Pires AJV, Carvalho GGPD, Santos ABD, Ferreira AR, Bonomo P, Silva FFD. Chemical composition and fermentation losses of sugarcane silage treated with urea or sodium hydroxide. Brazilian Journal of Animal Science. 2010;39:1911-1918.
36. Roy AK, Agrawal RK, Bhardwaj NR, Mishra AK, Mahanta SK. Revisiting national forage demand and availability. In: Roy AK, Agrawal RK, Bhardwaj NR, editors. Indian Fodder Scenario: Redefining State Wise Status. Jhansi, India: ICAR-AICRP on Forage Crops and Utilization; 2019. p.1-21.
37. So S, Cherdthong A, Wanapat M. Improving sugarcane bagasse quality as ruminant feed with Lactobacillus, cellulase, and molasses. Journal of Animal Science and Technology. 2020;62(5):648.
38. Suarez R, Mejia J, González M, Garcia DE, Perdomo DA. Evaluation of mixed silages of *Saccharum officinarum* and *Gliricidia sepium* using additives. Pastos y Forrajes. 2011;34(1):69-86.
39. Wang J, Chen L, Yuan X, Guo G, Li J, Bai Y, *et al*. Effect of molasses on fermentation characteristics of mixed silage prepared with rice straw, local vegetable by-products and alfalfa in Southeast China. Journal of Interactive Agriculture. 2017;16:664-670.
40. White JPM, Viator RP, Webber CL. Temporal and varietal variation in sugarcane post-harvest residue biomass yields and chemical composition. Industrial Crops and Products. 2020;154:112616.
41. Wilkinson JM. Silage and animal health. Natural Toxins. 1999;7(6):221-232.
42. Wong CC. The place of silage in ruminant production in the humid tropics. FAO Plant Production and Protection Paper. 2000;(pp 5-6).

How to Cite This Article
Cherryl DM, Paramesha SC, Shwetha HS, Bhushan MB, Handage S. Ensiled sugarcane byproducts: A sustainable solution to livestock feeding. International Journal of Veterinary Sciences and Animal Husbandry. 2025;SP-10(6):34-38.