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Exploring the Potential of Herbal and Organic Minerals as Feed Additives for Beef Cattle Production

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Abstract
An estimated global population of beef cattle is one billion, and when contrasted to swine and poultry, beef cattle have the lowest feed-to-meat conversion rates. Yet, these estimates need to consider beef cattle's ability to provide great-quality protein from sources which may be improper for other livestock species. Critical approaches to raising beef cattle's productivity include feed shape and composition, host genetics, the functionality of the rumen and respiratory microbes, and operational and breeding control. The aim of this research was to observe the impacts of adding Sapindus rarak (SR), powdered garlic, and their combinations to feed for beef cattle that had been supplemented with organic minerals of Cr and Zn on feed consumption, digestion, effectiveness, and performance, as well as expected growth. In the study, 16 male Brahman cross cows were used, and their diets were accompanied by 250 ppm SR powder, 250 ppm garlic powder, and 250 ppm SR-garlic fortified with Cr and Zn minerals. The outcomes presented that adding SR, garlic, and enhanced organic minerals to the diet increased feed efficiency, daily improvement, and the intake of dry and organic matter while reducing the number of rumen bacteria and protozoans. The researchers found that the best strategy to boost daily growth and feed efficiency was to add 250 ppm of organic minerals Cr-Zn and garlic powder to the beef cattle diet.

Keywords: Feed efficiency, Sapindus rarak (SR), garlic, Cr-Zn, Beef cattle.

Introduction

The possible inclusion of particular extracts rich in secondary chemicals to animal feeds is a current issue among researchers. This could modify ruminal fermentation, enhance fiber utilization, minimize methane emissions, and reduce nitrogen excretion. However, the impact of plant secondary metabolites on methanogenesis and rumen function varies and depends on the source. Therefore, research into novel herbal feed additives (HFA) is necessary to evaluate their capacities (1). In contrast to other livestock, cattle are the only animals that can transform lignocellulosic biomass into helpful protein. However, beef cattle have the lowest production efficiency. It is stated that 45 percent of the world's supply of protein for people comes from the meat and milk of cattle and bison. Despite frequent criticism for the beef industry's high grain consumption, only 7%–13% of the world's beef output depends on grain-feeding techniques (2). The production of beef requires a lot of emissions, and it has one of the highest GHG footprints of all commonly consumed foods. Subsequently, the total amount of emissions and the makeup of the various GHGs produced by different beef production systems vary significantly, which impacts the climate. There must be enough accurate emissions data accessible (3). The complicated beef production system to be made

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more productive in an environmentally, economically, and socially sustainable way. One of the largest global supply chains is the one for it is not easy to measure the sustainability of beef. An approach has been devised to describe beef production systems, evaluate their effectiveness, and consider their effects on the environment (4). The quantification of water usage in beef meat production is crucial because this product is frequently criticized for the inefficiency of its input conversions. Understanding the freshwater needs due to intensifying water demands for beef production systems from the viewpoint of a single farm is possible with the help of water footprint research. There are many unknowns concerning the water footprint of beef production as this field of study is still relatively young and because there are few management techniques that could improve the effectiveness of water conversion to sold meat. The amount of water utilized in ruminant production must be measured to develop strategies for its usage in other meat production (5). Although playing a crucial role, incorrect use of antibiotics in animal farming has been shown to raise the threat that antimicrobial resistance bacteria pose to the public's health, leave residues in animal products, and pollute the environment. Antibiotics were subsequently prohibited from being used to stimulate development. Consumers' strong preferences for conventional broiler meat have led to a global change in the production of antibiotic-free broiler meat to reduce health hazards. Researchers began looking for antibiotic substitutes as an outcome of the ban on the use of antibiotics and customer preferences. Applying sustainable feeding techniques of prospective antibiotic substitutes is crucial to raising the output of antibiotic-free broiler meat (6). This study's goal was to describe the current situation, the actions being taken, the ameliorative effects, and the feeding methods for various antibiotic substitutes, such as phytogenic groups (marine algae, herbs, plant extracts, and vital oils), prebiotics, probiotics, and enzymes in the production of broilers. The research (7) described an emission evaluation framework created to calculate the quantity of area GHGs provided during the increasing beef cattle. Depending on the beef production in Saskatchewan was carried out. The findings showed that in 2014, Saskatchewan's annual marketed beef cattle produced GHG emissions with cow-source GHGs (manure CH4, manure N2O emission, and enteric CH4) accounting for more than ninety percent of the overall emissions. The study (8) highlighted issues related to sustainable beef cattle production, such as the contribution of ruminant livestock to the world protein demand, the environmental implications of high-tech beef cattle production, and the use of big data and machine learning in beef cattle production. Such developments are essential for creating cutting-edge beef cattle production applications and prediction approaches that will decrease costs and liabilities and improve industry sustainability, given the number of properties required to provide this protein. This is not just a moral imperative. By using this data to find developments in beef water efficiency, farmers and policymakers can support beef systems in areas vulnerable to climate changes and water scarcity. The research (9) described that Citrullus colocynthis was assessed at various stages with total mixed ration as substrate in a 37-factor design using an in vitro gas production method to determine its ability as an herbal feed additive for ruminants. A phytochemical examination showed that the amounts of overall phenols, flavonoids, non-tannin phenols, saponins, real tannins, and vitamin C varied significantly (P 0.01) between the various regions of the colocynth fruit.

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The study (10) given a thorough description of M. flabellifolius' possible application in animal feeding. Restrictions on the uses of this plant for animal feeding are explored, which involves its toxicity and related economic and budgetary concerns. As the final phase toward the ability uses cutting-edge techniques and strategies, such as microencapsulation, fermentation of microbial, and vital oil extraction, are addressed in detail. The study (11) focused on in vivo investigations and analyzed some of the significant feed additives that could lower enteric CH4 emissions. To minimize the synthesis of CH4 (g/day), feed additives limit methanogens or alter the rumen environment. The study (12) explored the socioeconomics, environmental, animal supplements, and management elements of intensifying grasslands. Brazil, the second-largest beef producer in the world, prioritizes reducing environmental effects, such as greenhouse gas (GHG) emissions. However, most Brazilian grasslands are damaged, which presents a significant opportunity for the mitigation and expansion of beef-cattle production and, as a result, for expanding the supply of protein globally.

Materials and Methods

Production management

Improvements in carcass weight, a reduction in age at slaughtering, the maintenance of appropriate heterogeneity, and the use of multi-trait choice indices for feeder cattle and fertile replacement heifers are organization practices which have a significant negative influence on the sustainability of beef production. By concentrating beef breeding efforts on selection for quick-development, moderate- to huge-mounted crossbred cattle, the quantity of beef needed to provide a similar amount of meat can be decreased. Furthermore, bigger-shaped cows are less productive in open grazing regions where there is a need for more appropriate quality fodder and have higher feed costs. Lack of the optimal time for slaughter, moving cattle from the cow-calf method to a feeder structure, and selling cattle before their development rate attains a plateau all help achieving that consumed energy is utilized for gain lacking the utilization of dubious improvement promoters like hormonal implants and beta-agonists. The division of the cattle sector is a significant roadblock to increasing efficiencies. For the beef business, issues with the need for cooperative data integration throughout the manufacturing cycle are common. No uniform coordinated breeding technique exists because every breed organization and seed stock provider has its own breeding purposes. The limited utilization of artificial insemination and other breeding techniques also reduces the rate of genetic development. Because the cow-calf and feedlot businesses are geographically dispersed, and there are many cow-calf producers, vertical integration is an issue. The main benefits of cooperation integration is the capacity to combine information from different industries, allowing for the application of advanced data analytics to meet shared breeding and production objectives. It would be more efficient to implement a sizable, specialized program that pushes efficiency enhancements in a systematic, coordinated way as opposed to the various breeding objectives currently used in the cattle sector. Large-scale genetic referencing pools and integration would enhance the predictability of performance- and efficiency-related features and allow for greater product uniformity. The varied production aim of every

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division (cow-calf, feedlot, and packing divisions) present the biggest challenge to vertical cooperation in the beef business, on the other hand. Often, the biological optimal for the grain-dependent on feedlot and the grazing cow-calf sectors are at odds with each other. In the same way, if the cow-calf industry is unwilling to share the financial burden, breeding decisions won't be made in the feedlot industry's best interests.

Breeding management

Retaining heterozygosity is an evaluation of the relative proportion variance in the progeny contrasted to the initial generations' heterosis, defined as the progeny of crossbred animals' greater effectiveness over the average of their parents. Utilizing breeding control methods to manage heterosis in a herd may significantly develop the performance of beef cattle. A genomic approach called SNP panels can assume the retained heterozygosity, heterosis of beef cattle and genomic breed composition. Additionally, there was a positive and linear association among genomic retained heterogeneity and controlled heterosis and cow fertility, lifespan, and lifetime productivity. Maintaining hybrid vigor could increase the sustainability of the beef cattle sector by favoring animals which is additionally resistant to the conservational alterations carried on by climate variations. For instance, although B. Taurus variants can withstand cold temperatures and produce beef of the highest quality, B. indicus exhibits innate genetic resistance to heat and parasites. It could effectively introduce genes from B. indicus strains that boost their resilience to nutrient and environmental stress through judicious cross-breeding. The whole genome sequencing approach, as well as marker-assisted choice, can be utilized to speed up the choice of beef cattle that are climate-adapted without having an adverse effect on productivity attributes. 16 Brahman Cross males with starting body weights averaging 30012.26 kg were the materials utilized. Cows were kept separately in 1.5 x 2.60 m quarters equipped with grain and water. Forty percent rice straw ammoniation and 60 percent focus made up the feeds. A four percent of body weight needed for feed dry matter was established. Feeds were provided twice daily at 07:00 and 15:00 in the morning and afternoon, respectively. Daily weights of the aorta and feeds were taken, and water was always available. A two-week-long feed adaption phase was done. During ten weeks, cows were weighed once a week using top-of-the-line computerized scales with a 1-ton ability. Rumen samples were taken at week 10 to estimate rumen bacteria and protozoa. The SR was heated to seventy degrees Celsius for four days of drying; the dry fruits were ground up after the seeds were taken out. Garlic powder was created by peeling, drying, and grinding the garlic. **Analyze your digestion:** During the tenth week of the investigation, studies on feed digestibility were conducted for seven days. The total collection technique took samples of feeds, feeding residues, and feces. Each day, the weight of the feed and aorts feed was taken. Tests of feeds and aorts were gathered for 7-day research. The stool samples were collected from morning, lunch, evening, and night.

Results and discussion

The market demand for beef is a requirement for domestic production, and mitigation methods to lower nationwide greenhouse gas emissions from beef production must be looked

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into in proportion to the production level. By reducing the overall number of beef cows and farm-level emission intensity, improved animal production efficiency may help cut national emissions.

Table 1: Effects of herbal supplements on total digestible nutrients (TDN), dry matter (DMI), and organic matter (OMI) consumption

Items	AS-MO	A-MO	P	CTL	S-MO
DMI	0.48	0.66	0.007	0.88	1.03
DMI	0.07	0.17	0.005	0.17	0.25
OMI	0.41	0.81	0.001	0.95	0.66
TDN-	0.15	0.21		0.25	0.24

Table 1 displays the impact of supplementing with SR, garlic, and a grouping of garlic-SR enhanced with Cr-Zn on the intake of OMI, DMI, and TDN. According to these findings, adding SR, garlic, or a combination of SR and garlic enhanced with organic minerals (Cr and Zn) to the diet boosted intake of both DMI and OMI compared to the diet management. The rise in DMI and OMI showed which feed additives increased feed digestion because they promote the rumen microorganisms' activities and maintain a comfortable environment. Other investigations revealed that Sapindus rarak powder did not impact DMI in beef cattle feed. The impact of adding garlic, garlic powder, and SR to a diet. Table 2 displays the dry matter digestibility (DMD), organic matter digestibility (OMD), and crude fiber digestibility (CFD) of SR enhanced with Cr-Zn.

Table 2: Supplemental herbal effects on DMD, OMD, and CFD

Items	AS-MO	CTL	P	S-MO	A-MO
DMD (%)	1.28	0.88	0.001	1.75	1.27
OMD (%)	1.95	1.15	0.000	1.09	1.95
CFD (%)	2.05	1.61	0.000	1.79	2.04

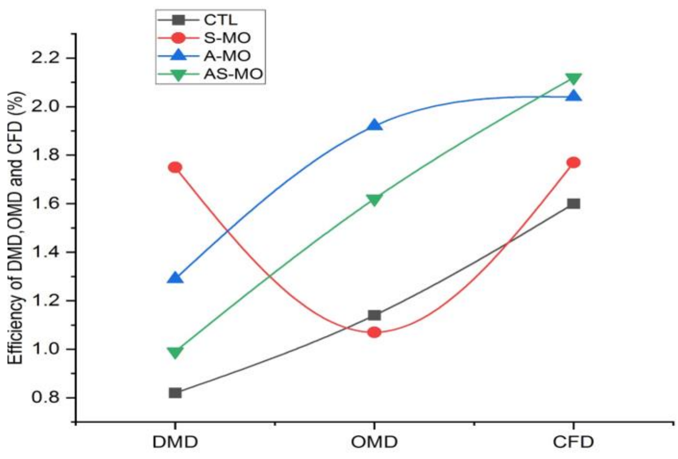

Figure (1): Performance of DMD, OMD, CFD.

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Table 2 indicates that supplemented with a blend of SR and garlic enhanced with Cr and Zn had greater digestibility for OMI, DMI, and crude fiber than other therapies. Figure 1 indicates the efficiency of DMD, OMD, and CFD. Improved DMI and OMD denoted an enhanced rumen ecology while developed feeding (dry matter and organic matter) digestibility offered possibilities and made enough nutrients for muscle synthesis accessible. A higher rumen microbial activity was responsible for enhanced meal digestibility. Another investigator determined the DMI and CFD of beef cattle feeding accompanied with SR powder to be between 68.76, 78.87%, and 29.40 to 47.55%, correspondingly.

Table 3: Effects of herbal supplemented on the populations of bacteria and protozoa in the rumen

Items	A-MO	CTL	AS-MO	P	S-MO
Bacteria (log CFU)	0.715	0.524	0.212	0.044	0.622
Protozoa (log CFU)	0.091	0.234	0.065	0.002	0.063

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Table 4: Effects of herbal supplemented on the populations of bacteria and protozoa in the rumen

Items	A-MO	CTL	AS-MO	P	S-MO
Bacteria (log CFU)	0.715	0.524	0.212	0.044	0.622
Protozoa (log CFU)	0.091	0.234	0.065	0.002	0.063

Table 4 displays how the rumen protozoa and bacteria population is affected by the addition of SR, garlic, and a combination of garlic and SR enhanced with Cr-Zn. Figure 2 denotes the efficiency of bacterial populations and rumen protozoa. By the dramatic decrease in protozoa populations, sapindusrarak, garlic, or a grouping of both with organic, mineral-rich diets were successful defaunation agents. Due to the fact that 37 percent of methanogens were symbiotic with protozoa, the fall in the protozoa population made it possible for methanogen populations to be reduced. While supplementing with garlic or mixing it with an OMD did not influence rumen bacterial populations, organic mineral- and garlic-enriched meals reduced rumen bacteria.

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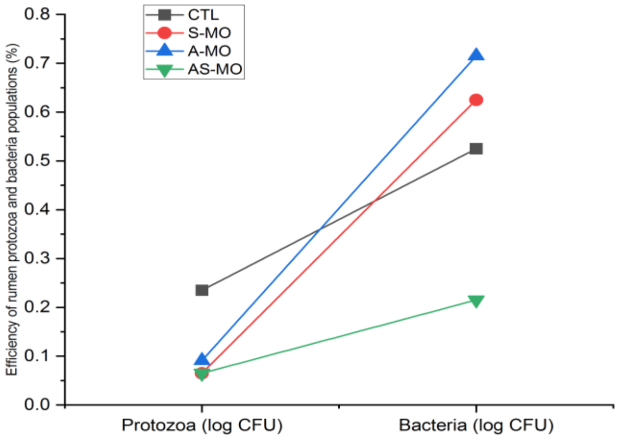

Figure (2): Percentage of bacterial populations and rumen protozoa.

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Table 5: Impacts of supplemental herbal medicine on daily gain and feed effectiveness

Items	AS-MO	A-MO	P	S-MO	CTL
Initial body weight (kg)	6.71	22.15		23.15	15.72
Daily gain (kg)	0.07	0.06	0.00	0.02	0.04
Feed efficiency (%)	0.27	0.19	0.04	0.75	1.63
Final body weight (kg)	6.00	19.05		31.55	4.65

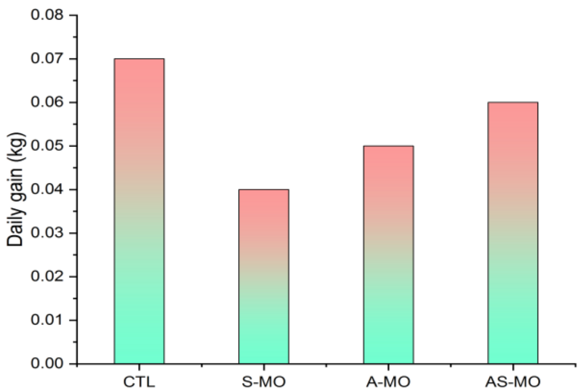

Figure (3): Performance of daily gain.

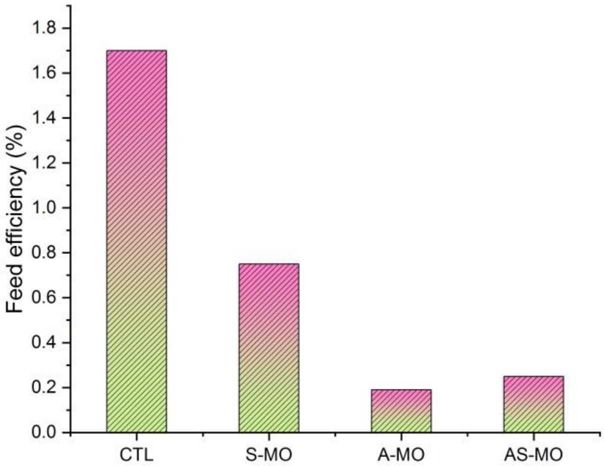

Figure (4): Performance of feed efficiency.

Table 5 shows the impacts of including garlic, SR, and a blend of these ingredients augmented with Cr-Zn on everyday growth and feed effectiveness. Figures 3, 4 show daily gain and feed effectiveness performed. Table 5 demonstrates that information supplementing with SR along with organic minerals did not result in a rise in daily body weight growth. However, supplementing with garlic or garlic and SR along with organic minerals. These outcomes demonstrated that SR, a protozoa defaunation agent, successfully decreased protozoa count (Table 3), considerably reducing protozoa, but had no beneficial effects on the gastrointestinal tract's capacity to absorb nutrients. Both garlic and SR mixed with organic minerals nor did garlic and SR alone significantly improve daily body weight development. As an alicin source, garlic lowers methane, which frees up energy that would have been used to synthesize methane to be used for the syntheses of meats and muscles. A big part of the rise in body weight growth is assumed to be played by the mineral chromium. The findings of this research also demonstrated that adding garlic and garlic combined with SR enhanced with OMI raised body weight gain by 31.71% and enhanced feed effectiveness by 12.39% when contrasted to the control diets. In order to reduce feed costs per kilogram of body weight gain, beef cattle feed was augmented with 250 ppm garlic powder. This syndrome supposedly developed due to enhanced food usage or glucose metabolism.

Conclusion

In order to support standards, laws, and regulations which improve water usage effectiveness and preserve waters in quantity and quality, the impacts of beef cattle production on the surroundings, the economy, and society must be precisely quantified. The findings of this research highlighted animal-individual characteristics and dietary habits which affect the footprint values. It was possible to increase the effectiveness of rumen fermentation, feed effectiveness, and everyday body weight growth in beef cattle by supplementing garlic and combining it with SR, which was enhanced with organic minerals (Cr and Zn). By using this data to find developments in beef water performance, farmers and policymakers may be able to support beef systems in areas that are vulnerable to climate variations and lack of water.

The study produced benchmarking water footprint data in two reference units and information on water usage within the beef food chain, which may be used to examine how people's consumption habits affect their surroundings. Misunderstandings and/or incorrect interpretations of study findings are two factors that contribute to conflicts among farmers, agroindustries, and consumers. Therefore, disseminating knowledge regarding the water footprint of meat and techniques that can improve the product's water efficiency will aid in minimizing these problems. This data can be used by public and private entities to comprehend and illustrate the connection among beef cow production and water consumption, enhancing the conservational marketability of meat to domestic and foreign markets. Our findings can be helpful with future studies on water utilization in beef production because of the well-measured consumption statistics. This would enable animal biologists to recommend breeding research which includes animal efficiency and water effectiveness. The findings are thus immediately useful for decisions on the sustainability of beef meat in the present and the future.

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