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Popular Article

Effect of Cabbage Leaves As Supplemental Feeding on Performance of Livestock and Poultry

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Abstract:

Brassicaceae (crucifers) is one of the most extensive families and distributed worldwide. *Brassica oleracea*, includes varieties such as broccoli, cauliflower, kale, kohlrabi, and cabbage. Cabbage particularly has a high nutritional value, mainly due to its content of fiber, minerals (Ca, P, and K) and vitamins (C, K, A, and folate). In addition, it contains a large number of secondary metabolites that act as rumen modulators and antimicrobial agents to reduce methane and boost protein efficiency, provide antioxidants, and offer immune support in livestock. These chemicals serve in defence mechanism, improves overall growth performance and production in animals. Researches indicate that feeding cabbage-based diets to livestock enhances nutrition and health due to high metabolizable energy, crude protein, and antioxidant-rich compounds. Up to 12% of inclusion in monogastric diets reduces feed costs without compromising growth. Ruminant studies show that cabbage waste fermentation increases volatile fatty acids, which directly boost energy supply, enhance milk and meat production, and support overall gut health. Feeding cabbage waste to ruminants like cows and sheep is a win-win for farmers and the environment. When they eat cabbage, their stomach microbes turn it into volatile fatty acids, a powerful natural fuel which provides up to 80% of the ruminants' daily energy and cuts the emission of methane from livestock. Methane is a potent greenhouse gas, and livestock are one of the largest agricultural sources; therefore, cutting these emissions improves sustainability. Incorporating fresh, dried, or discarded cabbage into livestock and poultry diets provides a cost-effective, sustainable, nutrient-rich feed source that can enhance growth and meat quality.

Keywords: Cabbage, livestock feeding, production benefit

Introduction:

Brassica oleracea has been cultivated since ancient times. According to Sanskrit records, crops of the genus *Brassica* were utilized in India as far back as 3000 BC (Šamec *et al.*, 2017). White cabbage is among the oldest cultivated plants known and commercially widely spread. India's total cabbage production for fiscal year 2022-23 reached 10,048,620 tonnes making the country second-largest producer of cabbage globally. Cabbage contains a diverse range of bioactive compounds, primarily falling

into the categories of glucosinolates and their breakdown products, anthocyanins, various polyphenols and essential vitamins (Vargas *et al.*, 2000; Cartea *et al.*, 2011).

India's livestock population is approximately 536.76 million, based on the 20th Livestock Census. The escalating livestock population has intensified the demand for nutritional inputs. Animal husbandry is heavily constrained by a reliance on crop residues and minimal dedicated fodder cultivation, which remains below 5% of the gross cropped area thus this shortfall results in a chronic nutrient deficit and causes production to fall 26–51% below attainable levels, highlighting nutrition as a primary obstruction for productivity (Dixit and Birthal, 2010). According to the Food and Agriculture Organization of the United Nations (FAO), nearly 50% of the initial production of vegetables is lost or wasted. Losses can happen at different stages of the food chain supply including at agricultural production, postharvest handling, in storage, processing, distribution, and consumption. A bumper harvest often leads to oversupply in local markets. With limited storage and transport facilities, farmers cannot hold or move their produce, forcing them to destroy it. These wastes represent a significant volume that could be used for animal feeding, thus generating economic benefits for the farmers due to reduced feeding costs and contributing to alleviate the environmental problems associated with their elimination like air, water, and soil contamination, greenhouse gas emissions (methane and CO₂), toxic leachate polluting water and the attraction of disease vectors.

Only 60-70% of the whole cabbage is consumed by human and rest is thrown as waste. It is a low-energy but mineral-rich feed source. The predominance of moisture reduces its caloric density, yet the presence of carbohydrates and crude fiber make it suitable for maintaining rumen function. Being highly fermentable and rapidly perishable is the most important limitation for its further utilization in animal feeding. However, they can be fed freshly chopped or processed, such as dried, composited or in feed blocks. Cabbage and its waste could be transformed into value added products. This non-conventional feed is highly sought, especially as maintenance feed during the dry season.

The outcome of cabbage feeding vary according to the form of supplementation whether dry or fresh, and on the species. Here in this article, the effect of feeding cabbage as a feed supplement has been explored and its impact on livestock production, reproduction and health has been described.

Cabbage As Dietary Supplements in Ruminants:

In ruminants, cabbage and brassica by-products serve as valuable alternative feed resources. In goats, cabbage leaves are nutritionally equivalent to conventional fodder and are highly palatable, while cabbage waste supports growth comparable to para grass diets and is safe from pesticide residues as well. Broccoli by-products improve digestibility, milk yield, and milk composition in milking goats, making them a viable partial replacement for berseem hay. Meanwhile, red cabbage extract in beef bulls beneficially altered rumen fermentation patterns without affecting nutrient digestibility or health.

In Bucks, cabbage leaves as complete diet showed their worth as a good source of nutrients when compared to conventional green oats fodder. Chemical composition, digestibility of nutrients and efficiency of utilization of the nutrients were equivalent to any conventional green fodder. The dry matter intake as % of body weight was higher in cabbage than for green oats fodder, indicating their excellent palatability (Wadhwa *et al.*, 2006).

Male goats fed cabbage waste with 100-200g dry matter concentrate showed almost similar, daily intake of feed with growth 70-88g/day when compared to a diet containing same concentrate and para grass. Increased concentrate in the diet improved intake but did not enhance growth, making cabbage waste a viable substitute for expensive forage. Despite residues of pesticide or insecticide in fresh cabbage, goat meat and its edible tissues were safe for consumption and free of residues (Ngu and Ledin, 2005).

In Damascus goats, a month prior to kidding, broccoli by-product 10 % to 20 % added in the diet as replacement of berseem hay. A significant increase in the digestion coefficients and feeding values was observed this reflects goats extracted more nutrients from the same feed, improving efficiency. It also increased yield and composition of milk fat, total solid and lactose, directly improving dairy output, making the milk richer, more nutritious, and more valuable in the market. Dried broccoli by-products can effectively replace up to 20% of berseem hay in the diet of lactating goats, supporting their overall nutritional efficiency and productive performance (Mahmoud, 2022).

In South African Dorper lambs, *ad libitum* diets containing 100 to 200 g of discarded cabbage per kilogram of dry matter, decreased the growth performance as the level of cabbage inclusion increased. Feed conversion efficiency affected with higher cabbage proportions, lambs gain less weight per unit of feed consumed. Because cabbage has high moisture content, the lambs consumed and retained less nitrogen. Although the use of discarded cabbage in finishing rations is feasible, it should be incorporated at limited levels and balanced with other energy and protein feeds to maintain productivity and growth (Nkosi *et al.*, 2016).

Simmental beef bulls were allocated 120 g/day of red cabbage extract. The dietary addition increased the ruminal concentration of total volatile fatty acids, which potentially improved the energy supply for growth and maintenance. It also decreased the acetate-to-propionate ratio, indicating a shift toward greater propionate production, thereby enhancing energy efficiency and supporting lean tissue growth rather than fat deposition. In addition, it slightly modified the rumen bacterial community without affecting nutrient digestibility or plasma antioxidant levels, reflecting that the diet did not induce metabolic stress or compromise animal health (Gao *et al.*, 2022).

Inclusion of cabbage in diet can serve as economical livestock feed where they improve palatability, digestibility, and milk yield while maintaining safe growth performance. Overall, cabbage and brassica residues are promising, sustainable feed options for goats and cattle, but excessive use in lamb diets can

compromise performance, indicating that inclusion must be carefully managed by partial replacement.

Effect of Supplemental Cabbage Meals on Swine:

In piggery, the main feed is concentrate-based; this ensures rapid growth, efficient feed utilization and high-quality production but concentrate forming the core of feed, it's over reliance can create financial and health risks such as obesity, poor carcass quality and affect gut health, if not managed properly. For smallholder systems, concentrates are often supplemented with kitchen waste but its nutritional inconsistency and poor-quality results in suboptimal performance.

In grower-finisher pigs, dried cabbage waste meal was added up to 200 g/kg dry matter in diets. Feed intake increased, but weight gain and feed conversion improved only at inclusion levels up to 100 g/kg dry matter. Pigs fed dried cabbage waste meal diets showed higher haemoglobin, neutrophil counts, and aspartate aminotransferase levels which suggests physiological changes are linked to improved oxygen transport, immune and metabolic activity. Feeding costs decreased (61.19–56.27 \$) while gross benefits remained similar (48.97–52.30 \$). Therefore, incorporating dried cabbage waste meal up to 100 g/kg dry matter in pig diets can enhance growth performance and reduce feeding costs, supporting profitable pig production (David *et al.*, 2024).

Finely chopped (comminuted) cabbage used in diets for growing pigs replacing either 15 or 30% of the dry matter from the conventional feed mixture. The use of cabbage in the diet at these inclusion levels reduced the rate of carcass-weight and daily weight gain. The reason is cabbage replaced too much of the nutrient-rich concentrate, reducing energy and protein availability while increasing fiber and moisture content (Livingstone *et al.*, 1980). Growing pigs require diets that are primarily rich in protein and energy to achieve fast, efficient, and healthy growth, ensuring strong immunity and effective conversion of feed into weight gain. Hence, excessive inclusion can undermined growth in pigs.

When consuming excess of cabbage, animal feel full faster due to stomach distension, but the energy intake becomes relatively low. This leads to reduced consumption of other, more energy-dense feeds, which compromises the growth rate. At moderate levels, cabbage adds fiber and micronutrients without diluting energy and protein too much. It improves feed intake and supports digestive health. Nutrient balance remains intact; so, growth performance is not compromised. Thus, 10-15% cabbage in feed can enhance diets while keeping pigs healthy and efficient.

Cabbage Leaf Meal as Poultry Feed Supplement:

Concentrates are the backbone of broiler diets, ensuring rapid growth and efficiency, but they come with high costs, supply risks, contamination issues, nutrient imbalance, and environmental concerns. Their disadvantages lie in being too energy-rich, low in fiber, high cost, competition with human food, dependent on additives, and vulnerable to spoilage. Supplementing poultry diets with alternatives like cabbage helps lower costs and adds nutrients.

Diets containing up to 9% dried cabbage leaf residues, partially replacing soyabean and corn meal were formulated for broiler chickens. Dietary inclusion retained the average daily gain (53.4 g/day), feed intake (94.9 g/day) and feed conversion ratio (1.78 g/g). In 35-day-old birds, the apparent total tract digestibility of dry matter, organic matter, and crude protein increased linearly, indicating improved nutrient utilization. This dietary change is consistently beneficial, helping animals grow optimally, maintain better health, and use feed resources more sustainably. These results indicate that inclusion up to 9% maintains growth performance, preserves ileal digestibility in older broilers, and enhances overall nutrient uptake (Mustafa and Baurhoo, 2017).

Diets utilizing 5% dry cabbage leaf residues in broilers recorded weight gain of 2299.53 grams in 39 days. The feed costs for the 5% inclusion are Rs. 8550 and for the commercial diet it is Rs. 8815 for total of 45 broilers. A benefit of about 6 rupees (~5.88) per broiler have been noted (Pandey *et al.*, 2025).

Impact of Cabbage Leaf Supplementation in Rabbits:

Rabbits thrive on diets that are high in fiber, with the bulk of their nutrition coming from grasses and hay. These fibrous feeds are essential for maintaining healthy digestion and preventing dental problems. But the traditional roughage feeding faces problems related to secure storage and steady supply. Alongside this, rabbits should be offered measured amounts of pellets to provide concentrated protein and energy.

Cabbage leaves as a roughage source to growing rabbits fed *ad libitum*, along with 100 g of concentrate. The results showed that average daily gain (20 g), feed intake (125 g/day), dry matter intake (65 g/day) and feed conversion ratio (2.9 g/g gain) were comparable between diets containing lucerne and those containing cabbage as roughage. Serum biochemical profiles remained within the normal range, with the exception of creatinine content. These findings support that cabbage leaves can be used as a roughage source for growing rabbits without compromising growth performance or health. Cabbage leaves can confidently be used as a roughage source for growing rabbits, supporting steady growth, balanced metabolism, and sustainable feed utilization. The maintenance of normal serum biochemical profiles, aside from a slight variation in creatinine, demonstrates that this dietary inclusion does not compromise health. It provides a reliable alternative to conventional roughages such as lucerne, ensuring comparable growth performance and feed efficiency (Kunnath *et al.*, 2013).

Beyond animal health, the use of cabbage leaves offers economic advantages by reducing feed costs and environmental benefits through the utilization of locally available vegetable by-products, thereby minimizing waste and promoting sustainable farming practices. Overall, incorporating cabbage leaves into rabbit diets represents a practical, health-friendly, and eco-conscious feeding strategy.

Conclusion:

Cabbage and its leafy waste, serves as a highly nutritious, low-cost alternative to traditional forages,

particularly in smallholder and sustainable farming systems. While its high moisture content remains a physiological barrier to maximum intake, strategic supplementation with concentrates or fibrous roughage (like para grass) can stabilize the diet and maintain consistent growth rates. Processing methods such as drying or ensiling are recommended to manage moisture and extend shelf life. These diets offer a nutritionally dense, cost-effective non-conventional feed source for livestock. Ruminant trials suggest that while cabbage maintains steady protein intake and body weight gain, its high moisture content can limit total dry matter intake. Supplementation with concentrates is often necessary to achieve optimal growth rate. In poultry broiler, dried cabbage leaf residue can replace up to 5–12% of commercial feed without negatively impacting growth performance or feed conversion ratios. Inclusion at these levels has even been shown to improve nutrient retention and gizzard function. Pigs can tolerate cabbage waste inclusion up to 10–15% of their diet, though higher levels may lead to reduced weight gain. In rabbits it acts as a trustworthy option to common roughages like lucerne, maintaining growth rates and feeding effectiveness.

The rising cost of conventional feed and the environmental burden of agricultural waste have prompted the exploration of vegetable by-products as alternative nutrients. Cabbage (*Brassica oleracea*), a major global crop, generates 30–50% waste in the form of outer leaves, stems, and cores during processing. By adopting these by-products, producers can achieve a sustainable balance between optimal growth rates of livestock and poultry, enhanced food safety, and significantly reduced feed costs, ultimately supporting a more resilient livestock production.

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