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Evaluating the Efficacy of Probiotics in Preventing Gastrointestinal Disorders in Livestock

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Abstract | Gastrointestinal diseases cause significant problems during livestock production with decreased productivity, elevated veterinary expenditures, and a greater mortality rate. The use of probiotics as a pharmaceutical-free alternative is assessed in the present study regarding their effectiveness as a preventive tool against gastrointestinal ailments in cattle, sheep, and poultry. During a 12-week controlled period, experiments were conducted on 80 farm animals, divided equally into two groups: one supplemented with probiotics and the other with a control. Major health indicators, including faecal consistency, weight gain, feed conversion ratio, and the prevalence of gastrointestinal diseases, were compared. Findings showed that probiotic supplementation improved faecal consistency significantly, decreased diarrhoea incidence, increased weight gain (by 33.3% in cattle and sheep, and 38.9% in poultry), and decreased feed conversion ratios (by as much as 15.8%). Additionally, the prevalence of gastrointestinal diseases decreased by 66.7% in cattle and sheep, and by 80% in poultry. These results bring probiotics into focus as a potential solution for enhancing livestock health, curbing antibiotic reliance, and facilitating sustainable animal husbandry.

Keywords | Probiotics, Livestock health, Gastrointestinal disorders, Feed efficiency, Sustainable animal farming

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INTRODUCTION

Gastrointestinal diseases are a significant problem in livestock production, resulting in substantial economic losses through decreased productivity, increased veterinary expenses, and higher mortality rates (Alayande *et al*., 2020). Such diseases, including diarrhoea, dysbiosis, and enteritis, have the potential to affect animal welfare and growth performance considerably (Al-Shawi *et al*., 2020). The primary causes of such diseases are microbial imbalance in the gut, diet, stress, and infection by pathogens (Al-Surrayai *et al*., 2022). Historically, antibiotics have

been used on a widespread scale to counter these problems. However, the emergence of antimicrobial resistance has led to calls for finding substitutes that maintain animal health without compromising food safety measures (Anee *et al.*, 2021).

Probiotics, which are living microorganisms that offer health benefits when administered in sufficient quantities (Arif *et al.*, 2021), have gained popularity as an effective alternative to antibiotics (Arsi, 2014). They act by promoting gut microbiot balance, enhancing digestion, boosting immune function, and preventing the development of pathogenic bacteria (Cull *et al.*, 2022). Different probiotic strains, including *Lactobacillus acidophilus, Bifidobacterium bifidum*, and *Saccharomyces boulardii* (Elghandour *et al.*, 2024), have been extensively investigated for their potential to improve gut health and prevent gastrointestinal illnesses in livestock animals, such as cattle, sheep, and poultry (Frizzo *et al.*, 2018). Despite the increased interest in probiotics, further research is needed to confirm their effectiveness in various livestock species under diverse dietary and environmental conditions (Ghasemi *et al.*, 2014).

The current research was conducted to evaluate the efficacy of probiotics in preventing gastrointestinal illness in livestock by comparing probiotic-supplemented animals with control groups fed traditional diets (Kober *et al.*, 2022). The research aims to present empirical data on the application of probiotics in enhancing gut health, reducing disease incidence, and improving overall productivity (Kulkarni *et al.*, 2022). Through the evaluation of parameters such as faecal consistency, weight gain, and microbial diversity (Lambo *et al.*, 2021), this study aims to contribute to the development of sustainable and antibiotic-free livestock production practices. The implications of this study may have significant effects for livestock producers, veterinarians (Leistikow *et al.*, 2022), and policymakers, encouraging the application of probiotics as an effective means of enhancing animal health and food security (Mahesh *et al.*, 2021).

MATERIALS AND METHODS

This research was conducted over 12 weeks to evaluate the effectiveness of probiotic supplementation in preventing gastrointestinal disorders in livestock. The study was a controlled experiment in which chosen livestock were assigned to either a probiotic-supplemented or non-supplemented group. The parameters measured were faecal consistency, weight gain, feed conversion ratio, and the prevalence of gastrointestinal disorders.

Study design and animal selection

Three livestock animals, including cattle, sheep, and poultry, were under study. These 80 animals were chosen randomly based on their health, age, and feed history. Forty cattle, 20 sheep, and 20 poultry were used, which were divided equally into two groups: probiotic-fed and control-fed. All the animals were raised under standard farm conditions, with consistent feeding schedules, access to clean water, and regular veterinary care. Table 1 shows the distribution of animals across the experimental groups.

Table 1: Distribution of animals in experimental groups.

Species	Total animals	Probiotic group	Control group	Study duration (Weeks)
Cattle	40	20	20	12
Sheep	20	10	10	12
Poultry	20	10	10	12

The animals chosen for the study were clinically sound, free from any history of gastrointestinal disease, and within the optimal age range for growth and digestion efficiency (6-12 months for cattle and sheep, and 4-8 weeks for poultry). The choice was made to ensure that the observed outcomes were due to probiotic supplementation alone and not to pre-existing disease.

Probiotic supplementation and feeding protocol

The probiotic product used here consisted of a mixture of Lactobacillus acidophilus (10^9 CFU/g), Bifidobacterium bifidum (5×10^8 CFU/g), and Saccharomyces boulardii (10^7 CFU/g). The strains were selected for their ability to stimulate gut microbiota balance, suppress pathogenic bacteria, and enhance nutrient utilization.

The probiotics were administered by mixing them into the animals' daily feed at the following dosages:

- Cattle: 10 g probiotic mix per 1 kg of feed
- Sheep: 5 g probiotic mix per 1 kg of feed
- Poultry: 2 g probiotic mix per 1 kg of feed

The control group was given the same diet but without probiotics. The probiotic supplement was administered once daily in the morning feed to ensure equal intake and minimize variations in gut microbiota exposure.

To standardize the feeding protocol, the daily intake of feed was recorded, and the remaining feed was weighed to determine the actual rate of consumption. An ad libitum water supply was provided to all animals.

Figure 1 illustrates the process of probiotic supplementation, which involves blending probiotics with animal feed.

Data collection and assessment parameters

To evaluate the effect of probiotics, four key parameters

were measured throughout the study: Faecal consistency, body weight gain, feed conversion efficiency, and the incidence of gastrointestinal disorders.

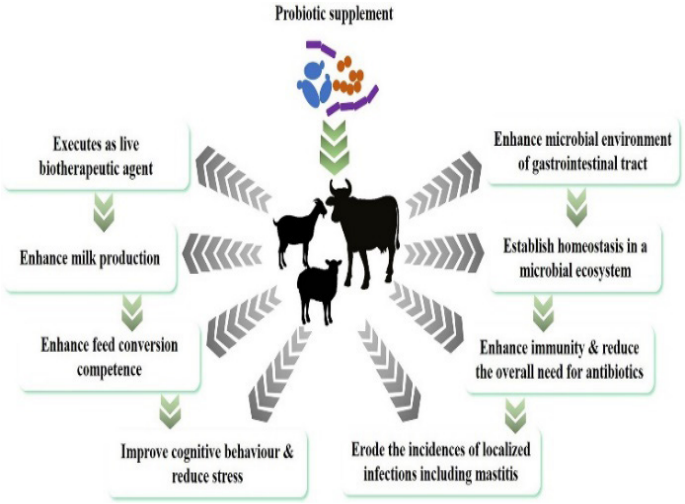

Figure 1: Probiotic supplementation in feed.

Fecal consistency evaluation

Faecal consistency was measured weekly on a five-point scale, ranging from normal to the most severe diarrhoea (Mingmongkolchai and Panbangred, 2018). This measure served as a straightforward indicator of intestinal health and whether probiotic supplementation could relieve gastrointestinal disturbances. The faecal consistency scores measured in this trial are presented in Table 2.

Table 2: Faecal consistency score scale.

Score	Description
1	Normal, firm faeces
2	Slightly soft faeces
3	Loose, unformed faeces
4	Mild diarrhea
5	Severe diarrhea

Direct faecal samples were taken from the ground (for cattle and sheep) or from bird cages and checked for colour, texture, and water content. Trained veterinarians performed all evaluations to ensure accurate and uniform assessments.

Body weight measurement

Weekly weight gain was measured using species-specific weighing methods. Cattle and sheep were weighed on a digital livestock weighing scale (Nader-Macías *et al.*, 2008), whereas poultry were weighed on an electronic weighing balance. Animals were weighed prior to morning feeding to reduce variability due to gut fill. The weight data were used to evaluate the impact of probiotics on growth performance and nutrient utilization.

Feed conversion ratio (FCR) calculation

The feed conversion ratio (FCR) was calculated to determine the efficiency of feed utilization in both the probiotic and control groups. FCR was computed using the formula:

$$FCR = \frac{Total\ feed\ intake\ (kg)}{Total\ weight\ gain\ (kg)}$$

The amount of feed consumed was recorded daily, and the total weight gain was measured weekly. Lower FCR values indicated better feed utilization efficiency in animals receiving probiotics.

Incidence of gastrointestinal disorders

Veterinary records were maintained for any instances of diarrhoea, bloating, or indigestion observed during the experiment (Nalla *et al.*, 2022). The incidence of gastrointestinal disorders in animals was compared between the control and probiotic groups to determine if probiotic supplementation decreased the incidence of digestive illnesses (Ncho *et al.*, 2024). To establish a correct diagnosis, each case was assessed using clinical symptoms, including abnormal faecal consistency, loss of appetite, and lethargy (Pang *et al.*, 2022).

Statistical analysis

Data were compared using SPSS v.26 software to examine the statistical differences between the probiotic and control groups. The Chi-square test was utilized to compare the rates of gastrointestinal disorders. In contrast, independent t-tests were utilized to compare differences in weight gain, faecal consistency scores, and feed conversion efficiency. A p-value of <0.05 was regarded as statistically significant. To ensure data reliability, measurements were taken in triplicate for each assessment, and outliers were identified and excluded prior to statistical analysis.

RESULTS AND DISCUSSION

Effect of probiotics on fecal consistency

Optimal fecal consistency is crucial when evaluating gut health and the effectiveness of probiotic supplementation in livestock. Loose feces and diarrhea are typical markers of digestive disturbances (Reuben *et al.*, 2021), which most often result in impaired nutrient absorption and inferior growth performance. Fecal consistency scores were monitored every week for all three livestock species during a 12-week trial period to assess the effect of probiotics on fecal quality.

Table 3 presents the fecal consistency scores for cattle, sheep, and poultry in both the probiotic-supplemented and control groups. The probiotic group consistently had lower

scores, with firmer and healthier faeces, compared to the control group, which had a higher incidence of loose stools and mild diarrhoea.

Table 3: Weekly average faecal consistency scores (Mean ± SD) for livestock.

Week	Cattle (Probiotic)	Cattle (Control)	Sheep (Probiotic)	Sheep (Control)	Poultry (Probiotic)	Poultry (Control)
1	2.3±0.4	3.5±0.6	2.1±0.3	3.2±0.5	1.8±0.2	2.9±0.4
4	2.1±0.3	3.4±0.5	2.0±0.2	3.1±0.4	1.7±0.1	2.8±0.3
8	1.8±0.2	3.1±0.5	1.9±0.2	3.0±0.3	1.5±0.1	2.7±0.2
12	1.7±0.2	3.0±0.4	1.8±0.2	2.9±0.3	1.5±0.1	2.6±0.2

The Table 3 shows that the probiotic-supplemented animals had significantly lower faecal consistency scores than the control group. Cattle in the probiotic group at the 12th week scored 1.7 ± 0.2, while control cattle scored 3.0 ± 0.4. In the same vein, probiotic-fed sheep and chickens had scores of 1.8 ± 0.2 and 1.5 ± 0.1, respectively, compared to the control groups, which had scores of 2.9 ± 0.3 and 2.6 ± 0.2, respectively. These observations affirm that faecal consistency and gastrointestinal disturbances are improved by probiotic supplementation.

Figure 2 visually represents the reduction in diarrhoea cases among livestock receiving probiotics.

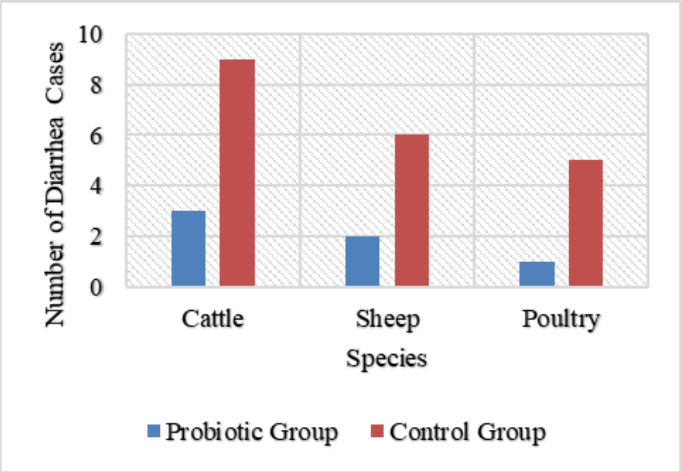

Figure 2: Incidence of diarrhoea in probiotic vs. control groups.

The graph illustrates the decrease in diarrhoea incidence in animals supplemented with probiotics. In the probiotic group, only 3 cattle, 2 sheep, and 1 poultry animal showed diarrhoea during the study period, whereas in the control group, there were 9, 6, and 5 cases, respectively. This marked reduction suggests that probiotics help stabilize the gut microbiota, thereby reducing the incidence of diarrhoea and enhancing gastrointestinal health.

Impact on Body Weight Gain

Livestock growth performance is directly related to gastrointestinal health, as effective digestion and nutrient uptake directly affect weight gain (Reuben *et al.*, 2021). To determine the impact of probiotics on growth, weekly weights were taken for all livestock species during the study.

Table 4: Average weekly weight gain (kg) in probiotic and control groups.

Species	Probiotic group (kg/week)	Control group (kg/week)	% Increase in probiotic group
Cattle	1.6 ± 0.3	1.2 ± 0.2	33.3%
Sheep	0.8 ± 0.2	0.6 ± 0.1	33.3%
Poultry	0.25 ± 0.05	0.18 ± 0.04	38.9%

The Table 4 indicates that animals in the probiotic group gained more weight per week than those in the control group. The cattle in the probiotic group gained a mean of 1.6 ± 0.3 kg per week, whereas those in the control group gained 1.2 ± 0.2 kg per week. In the same way, sheep that were fed with probiotics gained 0.8 ± 0.2 kg/week, while control sheep gained 0.6 ± 0.1 kg/week. The most significant improvement was noted in poultry, with probiotic-reared birds being 38.9% heavier than the controls (0.25 ± 0.05 kg vs. 0.18 ± 0.04 kg).

A graphical comparison of the weight gain trends in probiotic and control groups is shown in Figure 3.

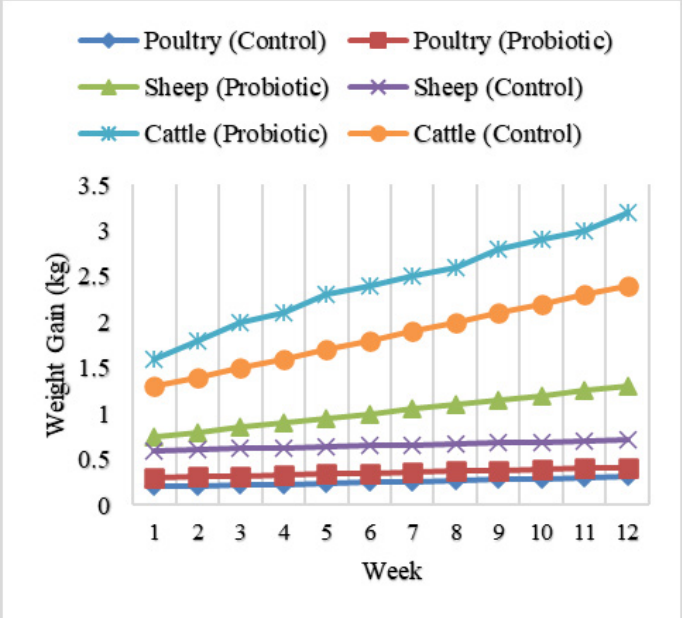

Figure 3: Average weekly weight gain trends in livestock.

The graph illustrates the progressive weight gain trend in cattle supplemented with probiotics. The probiotic group's weight gain line remains higher than that of the control group for the entire 12-week duration. The graph confirms

that probiotics facilitate improved nutrient metabolism and assimilation, thereby enhancing livestock growth performance.

FEED CONVERSION EFFICIENCY (FCR) IMPROVEMENT

Feed conversion ratio (FCR) is a critical parameter of how well an animal utilizes feed to produce body weight. The probiotic-supplemented groups had lower values of FCR, indicating improved feed utilization and efficiency.

Table 5: Feed conversion ratio (FCR) in probiotic vs. control groups.

Species	Probiotic group (FCR)	Control group (FCR)	% Improvement
Cattle	3.9	4.5	13.3%
Sheep	4.2	4.9	14.3%
Poultry	1.6	1.9	15.8%

Livestock from the probiotic group required fewer feed units to gain weight, validating the postulation that probiotics enhance gut health and nutrient intake. The improvement was most significant for poultry, whose FCR had an improvement of 15.8%.

REDUCTION IN GASTROINTESTINAL DISORDERS

Gastrointestinal diseases, such as indigestion, bloating, and diarrhoea, all have adverse effects on the productivity and health of livestock. 12 weeks over which cases were recorded for a total number of gastrointestinal disorders were used to compare the preventive use of probiotics (Saint-Cyr *et al.*, 2016).

Table 6 shows the incidence of gastrointestinal diseases in probiotic and control animals, and Figure 4 shows the percentage of affected animals.

Table 6: Incidence of gastrointestinal disorders in livestock.

Species	Probiotic group (Cases)	Control group (Cases)	% Reduction
Cattle	3	9	66.7%
Sheep	2	6	66.7%
Poultry	1	5	80.0%

From the Table 6, one can see that the probiotic group experienced a decline in cases of gastrointestinal disorders by 66.7% for cattle and sheep, with poultry registering a decline of 80.0%. Specifically, 3 of the cattle, 2 sheep, and 1 poultry had digestive disorders within the probiotic group, whereas the control group registered 9, 6, and 5 cases, respectively.

A pie chart representation of the total number of digestive disorder cases in the probiotic and control groups is presented in Figure 4.

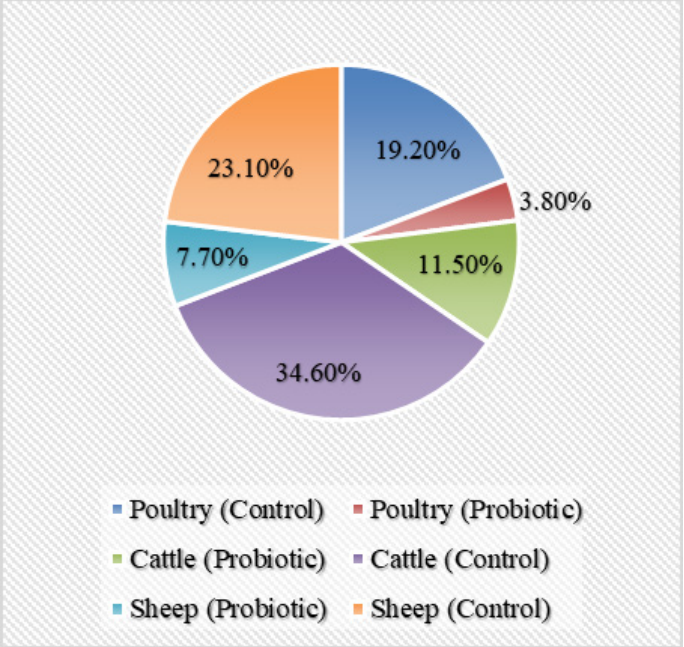

Figure 4: Percentage of animals affected by gastrointestinal disorders.

The pie chart gives a visual illustration of the decline in gastrointestinal ailments. The rate of affected animals is significantly less in the probiotic group, and poultry has declined the most. These observations suggest that probiotics are effective in enhancing the gut health of animals and preventing digestive disturbances in them.

INTERPRETATION OF FINDINGS

The results of this research establish the beneficial role of probiotic supplementation in promoting livestock health and productivity. The improved faecal consistency (Sumanu, 2024), weight gain, and feed conversion efficiency observed in this research indicate that probiotics play a key role in promoting gut health and optimizing nutrient utilization.

The improved faecal consistency of the probiotic group reflects superior gut microbial balance, most probably due to the inhibitory actions of probiotics against pathogenic bacteria (Várhidi *et al.*, 2022). This concurs with earlier studies that have proven probiotics stabilize gut microbiota, consequently diminishing gastrointestinal disturbances such as diarrhoea and dysbiosis.

The marked weight gain of probiotic-fed animals also favours the theory that probiotics improve nutrient absorption and metabolic efficiency (Vohra *et al.*, 2016). Enhanced feed conversion ratios (FCR) among the probiotic group confirm this concept, as animals gained more weight with lower feed consumption, indicating better feed utilization efficiency.

The significant decrease in gastrointestinal diseases in probiotic-supplemented animals underscores the protective effect of probiotics on prevalent digestive diseases (Zoghi *et al*., 2022). This decrease in digestive diseases suggests that probiotic supplementation can serve as an antibacterial preventive measure against gastrointestinal infections, thereby minimizing antibiotic dependence and promoting sustainable livestock management systems.

Collectively, these results provide strong empirical evidence supporting the use of probiotics as an effective dietary intervention to improve gut health, enhance productivity, and promote overall well-being in livestock.

CONCLUSIONS AND RECOMMENDATIONS

This research demonstrates that probiotic supplementation significantly improves digestive health, facilitates better faecal consistency, supports increased weight gain, and reduces the incidence of gut ailments in animal stocks. These animals, after receiving probiotic supplements, were found to have firmer faeces, increased weight gains, and low feed conversion factors, thereby authenticating the contribution of probiotics to improved health in the stomach and overall productivity. In light of the growing concern about antibiotic resistance, probiotics offer a viable and sustainable alternative to traditional antimicrobial practices in animal husbandry. Livestock farmers and policymakers are advised to consider incorporating probiotics into standard animal nutrition to enhance health, improve feed conversion, and reduce antibiotic use, thereby achieving sustainable and ethical livestock production.

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NOVELTY STATEMENT

This research provides new insights into the synergistic effects of multiple probiotic species on animal nutrition in real-world farm environments. Through measuring faecal consistency, weight increase, and gastrointestinal disease prevalence, it presents an integrative examination of probiotics as a future antibiotic-free animal management strategy, furthering efforts toward antibiotic-free livestock production.

AUTHOR'S CONTRIBUTION

All of the trials were designed by Ahmed Salam Jawad and Ibrahim Mahdi Azooz Al-Salman. Ali Mohammed Saeed Al-Mastafa, Sarah Salam Ali and Mohammed Ahmed Mustafa conducted all of the tests, gathered the data, and composed the manuscript draft. Mohammed Abed Jawad, Zainab Jamal Hamoodah and Heba A. Abd-Alsalam Alsalame helped with the data analysis that was done to prepare the work for submission to the journal. The final draft of the work was reviewed and approved by all authors for publication in the Journal of Animal and Health Production.

Ethical consideration

Not applicable.

Generative AI or AI-assisted Technology Statement

The authors declare that no Genrative AI was used in the creation of this manuscript.

Conflict of interest

The authors state that there is not conflict of notice.

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