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Potential of Enhanced Probotic (PROVET) as Substitute to Antibiotic Growth Promoters (AGP) on the Growth, Hematological Analysis and Carcass Characteristics of Broiler Chicken

Menardo D. Villanueva[1]

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ABSTRACT

Background: This study was conducted to evaluate the potential of enhanced Probiotic (Provet) as substitute to antibiotic growth promoters in broiler chicken production. Antibiotics have been widely used to promote growth and prevent disease both to backyard and commercial production. Though effective, their prolonged and excessive use has been linked to serious concerns such as antibiotic resistance, drug residues in the poultry meat and harmful impacts on consumer health. The use of probiotic technology in broiler production is gaining admiration as a sustainable and health-conscious alternative to synthetic antibiotic. To verify its efficacy to broiler chicken, this study was conducted.

Methods: The study was laid out using the completely randomized designed (CRD). The least significance difference (LSD) was used for the comparison of means, if the result is significant. The treatments were Treatment 1- Control (No Probiotic), Treatment 2- Commercial, Treatment 3-10 ml of enhanced probiotic (Provet) per liter water, Treatment 4-20 ml of enhanced probiotic (Provet) per liter.

Result: Significant ($P<0.05$) result was observed at final body weight, gain in weight, percentage rate of growth, the feed conversion ratio and efficiency in broiler chicken treated with 20 ml enhanced probiotic (Provet) was significantly higher compared with those broiler chickens in control and commercial antibiotics treatments. While hematological parameters revealed no significant differences across all treatments and still within the normal ranges proving that probiotic treatments had no adverse effects on blood health. Only the drumstick weight of broiler chickens treated with 20 ml enhanced probiotic (Provet) showed significant differences in terms of carcass. These findings found that 20 ml enhanced probiotics (Provet) can be an effective, safe and economically viable substitute to antibiotics use in broiler production.

Key words: Antibiotic, Carcass, Growth, Hematological analysis, Probiotic.

INTRODUCTION

With the current practices mostly of our poultry raisers both commercial and backyard, antibiotics have been widely used to promote growth and prevent disease. Though effective, their prolonged and excessive use has been linked to serious concerns such as antibiotic resistance, drug residues in the poultry meat and harmful impacts on consumer health. The use of probiotic technology in broiler production is gaining admiration as a sustainable and health-conscious alternative to synthetic antibiotic Probiotics are known with their beneficial effects to broiler chicken, it enhances gut health, improve nutrient absorption and boost natural immunity without leaving harmful residues in meat products. Ferdous *et al.* (2019) stated from their finding that supplementation of probiotic in feed could be one of the best candidates as an alternative to antibiotics as growth promoter for safe broiler production. Junaid *et al.* (2018) shared their findings that antibody titres were higher ($P<0.05$) after feeding probiotics supplemented diets and conclude that supplementing the diets with probiotics had a beneficial effect on immune responses. Furthermore, Monika *et al*. (2025) stated based on their research findings that lactobacillus at the dose of 0.2% can enhance meat tenderness, moisture retention and carotenoid deposition, potentially improving the overall quality of boiler meat can be used as a substitute for antibiotics in diets of broiler chickens. From the consumer's perspective, probiotic-fed broilers offer safer and healthier poultry meat free from antibiotic residues, antimicrobial resistance being transferred to human. Environmentally, probiotics reduce the need for synthetic chemicals and minimize pollution caused by drug residue entering soil and water systems. Through the Research Innovation for

[1]Department of Agriculture, Apayao State College-Conner Campus Malama, Conner, Apayao, Philippines.

Corresponding Author: Menardo D. Villanueva, Department of Agriculture, Apayao State College-Conner Campus Malama, Conner, Apayao, Philippines.
Email: menardovillanueva517@gmail.com
ORCID: 000-0002-3197-9990

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Community and Environment-Profitable Innovation Growing Technology (RICE-PIGTech) Program, the Enhanced Probiotic (Provet) was innovatively formulated with the used of different substrates known with its nutritive and medicinal properties that increases its efficacy as immunity booster and growth enhancer. This enhanced Probiotic (Provet) is an innovative technology, a natural and non-toxic, non-chemical or synthetic done through the process of fermentation that substituting the use of commercial Antibiotic Growth Promoters (AGP). The enhanced Probiotic (Provet) underwent clinical laboratory testing by the Bureau of Animal Industry (BAI) on the Bacterial isolation and Identification in which result revealed the presence of Bacillus spp. The use of Provet Probiotic Technology is not only a scientific innovation but also a responsible choice that safeguards consumer health, ensures animal welfare and protects the environment. It reflects a shift towards more ethical and sustainable poultry production, aligning with global demands for safe, green and residue-free food sources. To verify its efficacy to broiler chicken as substitution to antibiotic growth promoters (AGP), this study was conducted to find out its comparable or significant effect on broiler production.

Objectives

Generally, the study was conducted to evaluate the potential of Enhanced Probiotic (Provet) as substitute to antibiotic growth promoters in broiler chicken production.

Specifically, aimed to determine the significant impact of enhanced probiotic (Provet) on the growth performance and Return on Cash Expense (RoCE), hematological analysis and carcass characteristics of broiler chicken.

MATERIALS AND METHODS

This study was conducted on April 28 - May 19, 2025 at the Agriculture Instructional, Research and Production Unit, Agriculture Department, Apayao State College, Cubet-Malama, Conner, Apayao. A One Hundred twenty (120) class A broiler chicks were purchased as experimental animals from a reputable dealer at San Mateo, Isabela. A ring-type brooder was used for 14 days brooding equipped with electricity as source of heat, properly disinfected and thoroughly prepared before the arrival of the chicks. To ensure less percentage of mortality during brooding period, the brooder was installed with complete set of heat source to maintain the require temperature for the chicks. Rice hull was placed in the floor with cover newspaper for one week to facilitate easy feeding of chicks. No feed offered at the arrival of the birds. Water with molasses was immediately offered to refresh and restore their strength from travel. Thereafter, chick booster feeds shall be offered in an ad libitum method placed in the newspaper. 14 days brooding duration was adapted in this study. The experimental birds in all the treatments were fed in an Ad libitum basis. The feeds placed in the semi-automatic feeder. Chick booster feeds shall be given for 7 days and eventually shifting into starter following the recommended shifting percentage of 75% booster: 25% starter, 50% booster: 50% starter, 25% booster: 75% starter and finally 100% starter. The birds consumed starter feeds for two weeks and finally grower feeds until market age. The enhanced probiotic (Provet) is an innovative formulated product of the Agriculture Department, Apayao State College and was prepared and produced based on the recommended ingredients thoroughly mixed and done in a proper fermentation process. Said probiotic was subjected for laboratory testing at the Bureau of Animal Industry, Quezon City, Philippines and found with *Bacillus* spp., a beneficial bacterium that could help animals on digestibility and nutrient utilization. The Enhanced Probiotic (Provet) is recommended to offer based on the treatments of the study and was given at the first day after 14 days brooding to termination date of the study. Best to offer mixed with water in the morning and replace it the following day. The study was laid out using the completely randomized designed (CRD). The least significance difference (LSD) was used for the comparison of means if the result is significant. The comparative treatments were as follows: Treatment 1. Control (Pure Water), Treatment 2. Commercial, Treatment 3. 10 ml Enhanced Probiotic (Provet) per liter of water, Treatment 4. 20 ml Enhanced Probiotic (Provet) per liter of water. The following data was recorded, tabulated and interpreted showing the potential of enhanced probiotic (Provet) as growth enhancer and immunity booster, no toxic effect on the blood and improved carcass characteristics of broiler chicken. The initial weight of the experimental birds was taken at 14 days which ended the brooding period and they were distributed to the assigned experimental pens. Thereafter, the body weight was recorded weekly up to the last day of the study. The gain in weight of the experimental birds was taken by subtracting the initial weight from the final weight. Percentage Rate of Growth. This was taken using the Asmundson and Leiner's formula:

$$\text{Growth rate (\%)} = \frac{W_2 - W_1}{½\,(W_2 + W_1)} \times 100$$

Where:

W_1 = The previous weight of the birds at a given period.

W_2 = The current weight of the birds at a given period.

The feed consumption of the birds in the different treatments was done by taking into account the volume of feeds consumed and the volume of feeds offered. The volume of feed leftover will be subtracted from the feeds offered to determine the actual feed consumption. The Feed Conversion Ration and Efficiency were computed through the formula below.

$$\text{FCR (kg)} = \frac{\text{Feed consumption}}{\text{Gain in weight}}$$

$$FCE\ (\%) = \frac{\text{Gain in weight}}{\text{Feed consumption}} \times 100$$

To determine the actual water consumption of the birds, the volume of water offered subtracted by the volume of water left over. These was computed based on the actual production cost during the whole duration of the study per bird. Red blood cell (RBC) and white blood cell (WBC) samples were taken and subjected for blood examination to found out if the enhanced probiotic (Provet) cause no toxic effect on the blood of the animals. Cut Up Parts. The different cut up parts of the dressed chicken taken from the different replication which composes the breast, back, thigh, drumstick, wings and neck. All the data gathered were tabulated and analyzed using the analysis of variance following the completely randomized design (CRD). Comparison between treatment means was conducted using the least significant difference (LSD); if the means for the F-values was significant.

RESULTS AND DISCUSSION

Growth parameters

Initial and weekly body weight

The Initial and Weekly Body Weight of broiler chicken treated with enhanced probiotic is presented in Table 1. Comparable body weight was observed on birds in all treatments at the initial weight, 14 days after brooding. After a week of treatment, no significant differences was found with a mean ranging from 803.37 grams to 842.70 grams. Highly significant differences ($P<0.01$) were observed on the body weight of broiler chicken at the second week of the study. Broiler chickens treated with 20 ml enhanced probiotic garnered the highest body weight with 1356.03 grams at only 28 days of rearing. Further observed, that birds treated with 10 ml and 20 ml enhanced probiotic (Provet) was statistically comparable but significantly different from birds treated with commercial and the control treatments with a body weight of 1136.33 grams and 1139.47 grams respectively. Finally, the birds consumed 10 ml and 20 ml enhanced probiotic (Provet) significantly different ($P<0.05$) in terms of body weight at the study compared to the birds in treatments 1 and 2. The study implies that the enhanced probiotic (Provet) revealed significant impact and contributed to the body weight of broiler chicken for only 35 days of rearing, this is in consonance with the conclusive statement of Ogbuewu *et al* (2022) that Bacillus probiotics supplementation improve growth. Likewise, Nyamagonda *et al.* (2011) concluded that the inclusion of prebiotics and probiotics could be used as physiological growth promoters in broiler chickens.

Weekly cumulative gain in weight

Table 2 presented the weekly cumulative gain weight of broiler chicken treated with enhanced probiotic (Provet). Analysis of variance revealed no significant impact on the treatment of enhance probiotic (Provet) at the first week gain in weight of broiler chicken. At the second week of the study, it was indicated that the treatments of both 10 ml and 20 ml enhanced probiotic (Provet) to broiler chicken had a highly significant impact ($P<0.01$) when compared to both commercial and control treatments; specifically on the body

Table 1: Initial and weekly body weight (g) of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Initial weight	Weekly body weight per bird (g)		
		1	2	3
1- Control (Pure water)	366.37	803.37	1139.47[b]	1588.53[b]
2- Commercial antibiotic	378.83	842.70	1136.33[b]	1577.73[b]
3- 10 ml provet per liter of water	377.87	810.27	1200.90[a]	1660.80[a]
4- 20 ml provet per liter of water	374.10	831.77	1356.03[a]	1761.87[a]
ANOVA	ns	ns	**	*
LDS			165.04	128.63
C.V.	2.58	4.85		

Table 2: Weekly cumulative gain in weight (g) of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Weekly cumulative gain in weight per bird (g)		
	1	2	3
1- Control (pure Water)	437.00	773.10[b]	1222.17[b]
2- Commercial antibiotic	463.87	757.50[b]	1198.90[b]
3- 10 ml provet per liter of water	432.40	823.03[a]	1282.93[a]
4- 20 ml Provet per liter of water	457.67	981.93[a]	1387.77[a]
ANOVA	ns	**	*
LDS		169.03	133.18
C.V.	7.58		

weight gain with 981.93 grams (T_4) and 823.03 grams (T_3) respectively. Likewise, significantly different (P< 0.05) was observed at the final week of the study, wherein birds in treatment 4 (20 ml Provet) garnered the highest gain in weight with 1387.77 grams, followed by birds in treatment 3 with 1282.93 grams. Confirming that the enhanced probiotic treatments had a substantial and beneficial effect on the gain in weight of broiler chicken compared to the treatments. This is in conformed with the findings of Madhuri *et al.* (2020) wherein body weight gain, feed intake and feed conversion ratio were significantly (P<0.05) affected at 4th week of age. Overall, highest body weight gain was recorded in birds fed with basal diets with antibiotic (AB) and basal diets with probiotic (PB).

Percentage rate of growth

The percentage rate of growth of broiler chicken treated with enhanced probiotic (Provet) as substitution to antibiotic growth promoters (AGP) is presented in Table 3. No significant different was observed at the first week of the study. However, after second week of treatment of the Enhanced Probiotic (Provet), 20 ml enhanced probiotic (Provet) gained the highest growth rate with a mean of 47.90 per cent and significantly different (P<0.05) to birds in the control treatment and of the commercial one. On the other hands, birds treated with 10 ml enhanced probiotic (Provet) found comparable both the birds in control and commercial treatments. Study implies that the 20 ml enhanced probiotic (Provet) significantly affecting the percentage rate of growth of broilers and it was confirmed and concluded by Ferdous *et al.* (2019) from their study on the beneficial effects of probiotic as growth promoter alternative to antibiotic for broiler production that the biological supplements have a significant positive impact on the growth performance in broiler chicken.

Feed consumption

Table 4 presented the result of the weekly feed consumption of broiler chicken treated with enhanced probiotic (Provet) as substitution to antibiotic growth promoters (AGP). The

Table 3: Percentage rate of growth of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Weekly growth rate per bird (%)		
	1	2	3
1- Control (Pure water)	74.67	34.56^{b}	33.01^{b}
2- Commercial antibiotic	75.88	29.66^{b}	32.56^{b}
3- 10 ml provet per liter of water	72.77	38.80^{b}	32.13^{b}
4- 20 ml provet per liter of water	75.79	47.90^{a}	42.68^{a}
ANOVA	ns	*	*
LDS		12.29	5.99
C.V.	1:26		

Table 4: Weekly feed consumption of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Weekly feed consumption per bird (kg)			Cumulative
	1	2	3	
1- Control (Pure water)	0.646	0.723	0.747	2.116
2- Commercial antibiotic	0.648	0.754	0.745	2.147
3- 10 ml provet per liter of water	0.647	0.720	0.747	2.113
4- 20 ml provet per liter of water	0.646	0.722	0.749	2.117
ANOVA	ns	ns	ns	ns
C.V.	0.24	3.65	0.27	1.36

Table 5: Weekly water consumption of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Weekly water consumption per bird (L)			Cumulative
	1	2	3	
1- Control (Pure water)	1.57	2.37	3.13	3.125
2- Commercial antibiotic	1.57	2.46	3.18	3.183
3- 10 ml provet per liter of water	1.60	2.48	3.15	3.150
4- 20 ml provet per liter of water	1.60	2.51	3.25	3.250
ANOVA	ns	Ns	ns	ns
C.V.	3.04	3.92	3.07	2.09

no significant differences among treatments revealed that replacing antibiotic growth promoters with enhanced probiotic (Provet) in both 10 ml and 20 ml, did not affect the overall feed intake of broiler compared to both the control and the commercial. All treatments including the enhanced probiotic and commercial resulted in similar feed intake. The comparable consumption found that the enhanced probiotics could be viable substitute for commercial in terms of not negatively impacting feed intake behavior of broiler. Finally, the use of enhanced probiotics did not significantly affect the cumulative feed consumption of broiler chickens. The palatability and digestion of enhanced probiotics was comparable to the commercial and control. This indicates that probiotics did not interfere with the feeding behavior of the birds; a positive sign for producers to shift away from antibiotics.

Water consumption

The weekly water consumption of broiler chicken treated with enhanced probiotic (Provet) as substitution on antibiotic growth promoters (AGP) is presented in Table 5. Study showed no significant effect as to the inclusion of enhanced probiotic (Provet) on water intake of broiler chicken from the first week up to last week of the study among treatments. This implies that the enhanced probiotic (Provet) at 10 ml and 20 ml did not perform significantly better or worse that the commercial or the control in terms of the water consumption. Even though the result of the study revealed not statistically significant, the enhanced probiotic may still offer, because it improved weekly body weight, gain in weight, percentage rate of growth and the feed conversion ratio and efficiency.

Feed conversion ratio (Kg) and efficiency (%)

Table 6 shown the data gathered on the feed conversion ratio and efficiency of broiler treated with enhanced probiotic (Provet) as substitution to antibiotic growth promoters (AGP). Analysis of variance revealed significant difference ($P<0.05$) on the feed conversion ratio wherein birds that consumed 20ml enhanced probiotic (Provet) consumed feeds in lower amount compared with birds that consumed commercial probiotic and in the control treatment. While on the feed conversion efficiency, birds that consumed lower volume of feeds (T_4) recorded the highest feed conversion efficiency and statistically different ($P<0.05$) compared with the birds that consumed commercial and the control treatments. The study implies that the enhanced probiotic (Provet) has something to do in conversion of feed intake of broiler chicken into a high percentage performance of body weight. Result of the study is in conformed with the findings of Susanti *et al.* (2021) that inclusion of probiotic significantly improved feed conversion ratio.

Income above chick, feed and supplement cost

The return above chick, feed and supplement costs of broiler chicken as treated with enhanced probiotic (Provet) as substitution to antibiotic growth promoters (AGP) is presented in Table 7. Data showed that enhanced probiotic (Provet) with 20ml garnered the highest income with 178.51 per head of broiler chicken, followed by enhanced probiotic

Table 6: Feed conversion ratio and efficiency of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Treatment	Feed conversion ratio and efficiency	
	FCR (kg)	FCE (%)
1- Control (Pure water)	893.97^{b}	57.75^{b}
2- Commercial antibiotic	948.03^{b}	55.87^{b}
3- 10 ml provet per liter of water	830.47^{ab}	60.72^{a}
4- 20 ml provet per liter of water	729.37^{a}	65.54^{a}
ANOVA	*	*
LDS	147.01	6.5

Table 7: Return above chick, feed and supplement cost of broiler chicken treated with enhanced probiotic (Provet) as substitute to antibiotic growth promoters (AGP).

Particulars	Treatments			
	1	2	3	4
Price of broiler chick	55.00	55.00	55.00	55.00
Total of feeds consumed per bird	2.116	2.147	2.113	2.117
Price per kilogram of feed	39.00	39.00	39.00	39.00
Feed expense per broiler	82.52	83.73	82.41	82.56
Volume consumed commercial probiotic (L) and provet (ml) per bird	0	3.19	31.5	65
Price of commercial @ P35.00/Sachet per gallon and provet P16.40/liter	0	35	16.40	16.40
Supplement expenses (Pesos)	0	27.88	0.58	1.07
Total expenditures on feeds and supplement	137.52	166.61	137.99	138.63
Final weight of broiler (kg)	1.59	1.58	1.66	1.76
Price per kilogram body weight (Liveweight)	180	180	180	180
Gross income (sold liveweight per broiler)	285.94	293.99	298.94	317.14
Net income	148.42	127.38	160.95	178.51
Return on cash expense (RoCE)	51.91	43.33	53.84	56.29

(Provet) with 10ml reached the amount of 160.95 pesos were significantly distinguished its income advantaged over the treatments in the control and commercial probiotics with 148.242 and 127.38 respectively. It is clearly implicated that when enhanced probiotic (Provet) be used to broiler chicken, it increases income because it enhances digestibility due to *Bacillus* spp. found in the enhanced probiotic (Provet) leading to significant body weight advantaged of the broiler chicken. The margin of profitability is higher to the broiler chicken that consumed enhanced probiotic (Provet) which evidently observed from the return of cash expense (RoCE), wherein Broiler chickens that consumed 20 ml enhanced probiotic (T_4) reached out the highest RoCE with 56.29 per cent, followed by broilers chickens that consumed 10 ml (T_3) with a RoCE of 53.84 per cent, compared with broiler chicken in treatments 1 and 2 with 51.91 and 43.33 per cent of return on cash expenses (RoCE) respectively. The study was in conformed with the previous study of Villanueva, (2023) that the used of probiotic and fermented fruit juice in raising broiler chicken is safe and recommended to use as it increases the income over feed, additive and chick costs.

Hematological analysis

The hematological analysis of broiler chicken treated with enhanced probiotic (Provet) is presented in Table 8. Analysis of variance revealed no significant difference in all treatments means. Broilers that consumed 20 ml (T_4) and 10 ml (T_3) enhanced probiotic (Provet) were found comparable on broilers both in control and the commercial probiotic as to the white blood cells (WBC) and the red blood cells (RBC). This implies that no toxic effect in the used of enhanced probiotic (Provet) to broiler chickens and did not cause anemia and other blood infections; since data from all the treatments were found within the normal condition based on the result of blood analysis following the reference range set for avian. Zhu *et al.* (2020) supported the result of the study that potential of heat-inactivated probiotics used as alternatives to antibiotics for improvement of broiler health and productivity. Further confirmed by Ramini and Khaksefidi (2006) that supplementation with various levels of probiotic had no significant effect on the antibody titre against SRBC, NDV vaccine and hemoglobin content. However, supplementation of the diet with 0.1% probiotic significantly increased WBC count and decreased H/L as compared to the control group ($P<0.05$) which is important in reducing the harmful effect of heat stress in birds.

Carcass characteristics

Cut up parts of broiler chicken

The carcass characteristic of broiler chicken treated with enhanced probiotic (Provet) is presented in Table 9. Generally, result of the study revealed no significant difference among treatment means of most of the cut-up parts of broiler chicken that were subjected to experiment. Although the 20 ml enhanced probiotic (Provet) garnered highest performance compared with the other treatments, statistically; no weight increments were found on the breast, back, thigh and neck. On the other hands, only the drumstick among the cut-up parts showed significant different ($P<0.05$) wherein broiler chicken that consumed 20 ml of enhanced probiotic (Provet) were advantaged compared with the control and commercial treatments. This implies that increasing the dosage of enhanced probiotics in 20 ml can improve muscle deposition, may be due to enhanced nutrient absorption and gut

Table 8: Hematological analysis of broiler chicken treated with enhanced probiotic (Provet).

Treatment	Blood analysis	
	White blood cell	Red blood cell
1- Control (Pure water)	13.00	6.57
2- Commercial antibiotic	15.41	7.46
3- 10 ml provet per Liter of water	13.13	6.67
4- 20 ml provet per liter of water	15.42	7.03
ANOVA	ns	ns
C.V.	17.05	39.50
Reference range:	6.00-17.00	5.10-8.50

Table 9: Carcass characteristic of broiler chicken treated with enhanced probiotic (Provet).

Treatment	Carcass characteristics (G)					
	Breast	Back	Thigh	Drumstick	Wings	Neck
1- Control (Pure water)	519.00	193.50	191.17	170.17[b]	155.50	79.50
2- Commercial antibiotic	519.67	204.33	190.50	174.83[b]	157.50	91.17
3- 10 ml provet per liter of water	520.50	190.67	192.83	172.00[b]	150.67	75.83
4- 20 ml provet per liter of water	568.17	225.50	211.00	188.00[a]	154.33	93.50
ANOVA	ns	ns	ns	*	ns	ns
LDS				10.14		
C.V.	7.44	7.63	7.05		11.29	9.30

microbiota modulation facilitated by the bacillus probiotic bacteria.

CONCLUSION

The study revealed that broiler chickens administered with 20 ml enhanced probiotic (Provet) exhibited significant higher performance in weekly body weight, gain in weight, percentage rate of growth and feed conversion ratio and efficiency compared to those under control and commercial antibiotic. Notably, broiler chicken in treatment 4 also achieved the highest return on cash expense (RoCE), indicating superior economic profitability. While hematological parameters across all treatments showed no significant differences and remained within normal ranges revealing that probiotic treatments had no adverse effects on blood health of broiler chicken, carcass evaluation showed improvement only on the drumstick weight of broiler chickens treated with 20ml enhanced probiotic (Provet). These finding showed that enhanced probiotics (Provet), particularly 20ml dosage can be an effective, safe and economically viable, substituting to the use of antibiotic growth promoters (AGP) in broiler production.

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Disclaimers

The vies and conclusion expressed in the article are solely of the author and do not necessarily represent the view of his affiliated institution. The author is responsible for the accuracy and completeness of the information provided but do not accept any liability for any direct or indirect losses resulting from the use of this content

Informed consent

All animal procedures for experiments were approved by the members of research unit and handling techniques were approved by the College Animal Care Committee.

Conflict of interest

The author declares that there is no conflict of interest.

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