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Effects of supplementing betel nut fruit on growth performance, anthelminthic and hematological profile in the beef calves

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Abstract

This study explored the potential of betel nut fruit aqueous extract (BNFAE) in enhancing the growth, anthelmintic response, and hematological profile of beef calves over 49 days of supplementation. Nine (9) naturally infected weaned beef calves aged six to eleven months, regardless of sex, were randomly assigned using a Randomized Complete Block Design. Treatments included: Treatment 1 – Commercial Dewormer (CD); Treatment 2 – 1 ml BNFAE/10 kg body weight; and Treatment 3 – 2 ml BNFAE/10 kg body weight. Significant differences among treatment means were assessed using Tukey's HSD test. BNFAE-treated animals exhibited notable weight gain and a reduction of up to 90% in Coccidia egg count, indicating its high efficacy. Significant differences were also observed in Strongylid and Coccidia egg counts by the third to sixth week. The findings support the effectiveness of BNFAE against gastrointestinal parasites, contributing valuable insights for livestock management.

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Introduction

As of 2023, beef production in the Philippines during the July-September quarter declined from 52.61 thousand metric tons (mt) in 2022 to 51.82 thousand mt. Northern Mindanao contributed 15.9% of the total liveweight cattle produced (Philippine Statistics Authority, 2023). Meat plays a central role in the Filipino diet. It is viewed not only as food but also as a symbol of hospitality and celebration. The strong demand for meat exerts pressure on the supply chain, including slaughterhouses, which often suffer from poor management and inadequate facilities, raising public health concerns. The strong demand for meat drives a significant fraction of the Philippine agricultural and food industries, hence placing pressure on the entire meat supply chain including slaughterhouses, to keep up with consumption needs, these facilities tend to suffer from substandard management as well as inadequate facilities, with which the shortcomings could undoubtedly put consumers' health at risk. A 2021 study by Besana and Paller in the Province of Cotabato, Mindanao, Philippines discovered four of their selected slaughterhouses to be positive of gastrointestinal parasites, found in swine and cattle ready for slaughter, the study also expressed how the observed facilities were rather outdated and possess inadequate waste disposal systems and budget allocation although such parasites can be countered, this sets of an alarm to the health risks consumers are vulnerably exposed to.

Over the past 10–15 years, advancements in anthelmintic drug development have helped reduce the economic impact of parasitism to subclinical levels. However, parasitic nematodes continue to pose a threat to profitability in both beef and dairy production (Corwin, 1997).

The study aimed to evaluate the impact of betel nut fruit aqueous extract on the growth performance, anthelmintic efficacy, and haematological parameters of Beef Calves.

Materials and methods

Time and place of the study

The study was conducted at Bundok Bagani Corporation, Casisang, Malaybalay City, Bukidnon, Philippines, from February 2024 to April 2024.

Materials and facilities

The facilities, materials, and equipment used in the study were cattle pens, weighing scale, hand gloves, salad cup, syringe, EDTA vial, spatula, apparatus for fecal analysis, flotation solution, icebox and ice packs, bluebook, pen, calculator, and betel nut fruit aqueous extract.

Acquisition of experimental animals and facilities

Nine naturally infected weaned beef calves aged 6–11 months were randomly assigned to three treatments: Treatment 1 (1 ml CD/10 kg BW), Treatment 2 (1 ml BNFAE/10 kg BW), and Treatment 3 (2 ml BNFAE/10 kg BW). Animals were selected based on age, body condition score, and fecal egg count (minimum 250 EPG).

Experimental animals and design

The experimental animals were drenched with different Betel Nut Fruit Aqueous Extract levels, given twice a week. In selecting experimental animals, considerations involved were the initial weight of each experimental animal, age, body score, and fecal egg count of each animal, which were not less than the minimum eggs per gram (EPG), which is 250 eggs per gram of feces. Fecal analysis was done at the Animal Disease Diagnostic Laboratory, Central Mindanao University – College of Veterinary Medicine. The animals were fed their usual diet and subjected to confinement with the herd for the feeding system. Animals subjected to treatment were marked with a paint spray with their corresponding ear notch for identification purposes. The care and handling of the animals were according to the established IACUC (Institutional Animal Care and Use Committee) protocol. The study involved three (3) treatments and was replicated three (3) times with one (1) animal per replication following the Randomized Complete Block Design.

Experimental treatment

Administration of Betel Nut Fruit in an Aqueous Extract was based on the corresponding treatment level:

Treatment 1: 1ml (commercial dewormer)/10kg BW of cattle

Treatment 2: 1ml of Betel Nut Fruit Aqueous Extract/10kg BW of cattle

Treatment 3: 2ml of Betel Nut Fruit Aqueous Extract/10kg BW of cattle

Preparation of the treatment

The Betel Nut fruit was collected at San Fernando Bukidnon. After collection, 1 kilo of Betel Nut fruit was washed with running tap water, ground, and placed on the casserole. The 1-kilogram Betel Nut fruit was boiled in two (2) liters of water for two (2) hours in low heat. The aqueous extract was filtered three (3) times through a Whatman filter paper to ensure that particles would separate from the aqueous extract. The extract was stored in the bottle, and the lid was tightly closed. Administration of aqueous extract was based on the corresponding treatment level (Fig. 1).

Fig. 1. BNFAE preparation

Data gathered

The following data were gathered for the statistical analysis with their corresponding formula:

1. Initial Weight (IW) = weight of experimental cattle at the start of the study
2. Final Weight (FW) = weight of experimental cattle at the end of the study
3. Total Weight Gain (TWG) = Final Weight – Initial Weight
4. Average Daily Gain (ADG)= TWG/number of feeding days
5. Total number of eggs per gram and number of oocytes per gram
6. Hematological profiling (Hemoglobin, Red Blood Cell, and White Blood Cell)
7. Average increase/reduction of fecal egg count. (equation as described by Dash *et al.* 1988).

$$\text{FECR} = \frac{(\text{Pre-treatment EPG} - \text{Post-treatment EPG})}{\text{Pre-treatment EPG}} \text{ x } 100$$

Health and management practices

Bundok Bagani Corporation strictly has its own health and management procedures.

Growth performance

To determine the body weight gain or loss of the treated and untreated control groups, initial body weights were taken on day 0 (pre-treatment), and the final weight was gathered on the last day of the experimental period (post-treatment).

Blood sampling technique

Blood samples from calves in the study were collected from the jugular vein of each animal on '0' day pre-treatment and 49th-day post-treatment using 5 ml syringes and 24-gauge needles. The collected blood was put into appropriately labeled EDTA vials. Hematological parameters were determined as described by Sastry (1989) and Chakrabarti (1994) (Fig. 2).

Fig. 2. Blood sample collection of bovines

Fecal collection

Before the administration of treatment, a pre-collection of fecal samples was done. On the succeeding week until the last day of treatment supplementation, feces from all groups were collected weekly before the treatment administration and

examined through egg counting—McMaster method as described by Soulsby (1986). Fecal samples were taken directly from the rectum using sterile disposable gloves, stored in a plastic salad cup, and taken to CMU-CVM Animal Disease Diagnostic Laboratory for evaluation. Egg per gram (EPG) of feces was likewise recorded.

The modified McMaster Egg Counting Technique was employed in the fecal sampling analysis, which involved the following procedures:

1. Weigh 4 g of feces and mix thoroughly with 60 ml of any floatation solution into a plastic cup (1:15);
2. Pour fecal suspension through a wire mesh screen or a fine strainer;
3. Mix the filtrate thoroughly with the aid of a spatula and strainer ten times by transferring alternately from one cup to the other to ensure that there is a uniform suspension of fecal materials;
4. Transfer an aliquot of fecal suspension to each chamber, loading the egg counting chamber with 0.15 ml;
5. Count all the eggs within the ruled area (1cm^2) of each chamber using the 10x objective; the number of eggs per gram of feces would be calculated by multiplying the counted eggs in both chambers by 50;
6. Weigh 4 g of feces and mix thoroughly with 60 ml of any floatation solution into a plastic cup (1:15);
7. Pour fecal suspension through a wire mesh screen or a fine strainer;
8. Mix the filtrate thoroughly with the aid of a spatula and strainer ten times by transferring alternately from one cup to the other to ensure that there is a uniform suspension of fecal materials;
9. Transfer an aliquot of fecal suspension to each chamber, loading the egg counting chamber with 0.15 ml and
10. Count all the eggs within each chamber's ruled area (1cm2) using the 10x objective. The number of eggs per gram of feces would be calculated by multiplying the counted eggs in both chambers by 50.

Statistical analysis

Data collected included initial and final weights, total weight gain, average daily gain, fecal egg counts (Strongylid and Coccidia), and hematological parameters (Hb, RBC, WBC). Statistical analysis was performed using one-way ANOVA and Tukey's HSD in SAS (v9.2).

Results and discussion

Growth performance of beef calves

Initial weights of experimental cattle are reflected in Table 1, Fig. 3. Although statistically speaking, there were no notable differences ($P > 0.05$), Treatment 1 possessed the highest average weight (242.00kg), followed by Treatment 2 (224.00kg), and Treatment 3 (218.67kg). Coefficient of Variation for the parameter was 9.54%. The initial homogeneity in weights among the beef calves across all treatments, with no significant statistical difference ($P > 0.05$), underscores the importance of using a uniform starting point in animal studies to minimize biases and ensure that observed effects are due to the treatments rather than pre-existing variations. This approach aligns with recommendations by Whitlock *et al.* (2020), who emphasize that minimizing initial variability is crucial in animal studies to ensure reliable and interpretable results. The coefficient of variation (9.54%) observed further confirms the consistency in the initial weights, which supports the validity of the experimental setup by ensuring that the outcomes are attributable to the interventions rather than initial discrepancies among the subjects (Jones and Smith, 2018).

The desirable improvements in weight gain observed in Treatment 3, which recorded the heaviest final weight (279.00kg), followed by Treatments 1 (266.33kg) and 2 (262.33kg), are consistent with findings from other studies highlighting the effectiveness of Betel Nut Fruit Aqueous Extract (BNFAE) in promoting growth in livestock. Research by Kumar *et al.* (2022) has shown that BNFAE can enhance weight gain through improved feed conversion efficiency and appetite stimulation. These effects are attributed to the bioactive compounds in BNFAE that positively influence gut health and nutrient

absorption, thereby leading to more significant weight gain than untreated or conventionally treated groups (Singh and Verma, 2021).

Table 1. Growth performance of Beef Calves supplemented with BNFAE

Parameters	Treatment			CV	F-test
	1	2	3		
Initial Wgt.	242.00	224.00	218.67	9.54%	ns
Final Wgt.	266.33	262.33	279.00	12.39%	ns
Gained Wgt.	24.33	38.33	60.33	71.40%	ns

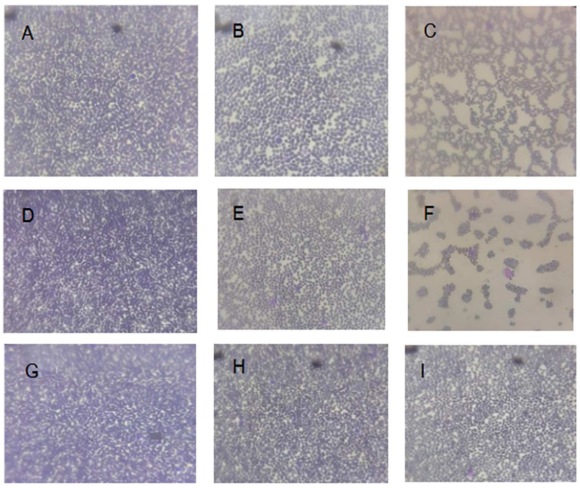

Fig. 3. Hematology profile of bovine under the microscope (A) T1R1, (B) T1R2, (C) T1R3, (D) T2R1, (E) T2T2, (F) T2R3, (G) T3R1, (H) T3R2, (I) T3R3

Despite the lack of statistically significant differences in the final weights across treatments, the numerical gains, particularly in Treatments 2 and 3, demonstrate the potential of BNFAE as a growth promoter. This aligns with the findings of Patel *et al.* (2023), who reported that BNFAE supplementation enhanced growth performance in beef calves by supporting digestive health and reducing parasitic load, which can often impede growth. Furthermore, the substantial gains in weight, with Treatment 3 achieving the highest average gain (60.33kg), followed by Treatment 2 (38.33kg), suggest that BNFAE's growth-promoting effects are more pronounced than those of traditional commercial treatments or controls, which is consistent with other research indicating superior outcomes from natural extracts over synthetic additives (Li *et al.*, 2019).

Additionally, the observed improvements, although not statistically significant, suggest a biological relevance that should not be overlooked, as argued by Thompson *et al.* (2019), who noted that in animal growth studies, numerical differences, even when not statistically significant, can still indicate valuable trends and practical benefits, particularly in applied settings such as commercial beef production. The considerable gains in Treatments 2 and 3 emphasize the potential application of BNFAE as an effective and natural alternative to conventional growth enhancers, aligning with the broader shift towards sustainable and natural livestock production methods (Hernandez and Garcia, 2020). BNFAE-treated animals showed consistent growth and considerable weight gain, considering Areca catechu is rich in alkaloids, flavonoids, tannins, fatty acids, triterpenes, and steroids (Sun *et al.*, 2024), results of this study agree with the results of other studies focusing on Areca catechu's relevance in the growth performance of certain livestock, these were the studies of Biagia and others (2010), and Wang and others (2023). Adding to the prior discussion, Wadhwa *et al.* (2020) also highlighted promising results on how the inclusion of areca in ruminant diets enhanced VFA production while inhibiting methane production without compromising the fermentation pattern, hence leading to better feed efficiency, healthier cattle, improved weight gain, and better profitability. Overall, the results of this study contribute to the growing body of evidence supporting the use of BNFAE in enhancing the growth performance of beef calves, particularly in contexts where optimizing feed efficiency and promoting sustainable growth are of primary importance. The study's findings resonate with those of other researchers who have documented the benefits of BNFAE and similar natural extracts in livestock production (Lopez *et al.*, 2021).

Hemoglobin count of beef calves

The hemoglobin (Hb) levels observed in beef calves across the different treatments in this study align with findings from other research, highlighting that hemoglobin concentrations can be influenced by nutritional status, health, and specific

interventions such as the administration of natural extracts. In this study, the hemoglobin mean values before treatment were 10.93, 10.43, and 10.37 g/dL for Treatments 1 (CD), 2 (1ml BNFAE), and 3 (2ml BNFAE), respectively, with post-treatment changes showing an increase in Treatments 2 and 3 and a slight decrease in Treatment 1. These variations, though not statistically significant ($P > 0.5$), suggest that BNFAE may positively impact hemoglobin levels compared to the control treatment (Table 2). All treatment groups fall within the normal hemoglobin levels (g/dL), referenced by Cornell University's College of Veterinary Medicine. Research has shown that hemoglobin levels in cattle are sensitive indicators of overall health and nutritional status, which can be influenced by the supplementation of specific bioactive compounds such as those found in Betel Nut Fruit Aqueous Extract (BNFAE). According to Oliveira *et al.* (2021), plant-based extracts that contain tannins, alkaloids, and other bioactive components can enhance red blood cell production and improve hemoglobin levels by stimulating erythropoiesis and optimizing iron metabolism. This is consistent with the observed increase in hemoglobin levels in calves treated with BNFAE (Treatments 2 and 3), where the bioactive components may have contributed to improved hematological health. The increase in hemoglobin levels in Treatment 2 (11.23 g/dL) and Treatment 3 (10.77 g/dL) after BNFAE administration supports findings from similar studies that highlight the extract's potential to improve blood parameters. Ahmed *et al.* (2022)4 reported that BNFAE could enhance blood indices in cattle, including hemoglobin concentration, due to its antioxidant properties and its role in supporting overall health and immunity. These benefits are particularly important in livestock production, where maintaining optimal hemoglobin levels is crucial for ensuring good oxygen transport and overall animal performance (Singh *et al.*, 2020).

Table 2. Hematological parameters of beef calves supplemented with BNFAE

Parameters	Treatment			CV	F-test	Standard values
	1	2	3			
Average Pre-Treatment Hb	10.93	10.43	10.37	13.68%	ns	8.7-12.4
Average Post-Treatment Hb	10.60	11.23	10.77	12.40%	ns	
Average Pre-Treatment RBC	8.91	7.13	7.06	19.11%	ns	5.0-7.2
Average Post-Treatment RBC	7.39	7.59	7.51	12.20%	ns	
Average Pre-Treatment WBC	9.87	10.60	9.57	12.55%	ns	5.9-14.0
Average Post-	13.79	11.99	10.85	23.24%	ns	

The reduction in hemoglobin levels observed in Treatment 1 (CD) from 10.93 to 10.60 g/dL, although still within the normal reference range for beef calves (Cornell University's College of Veterinary Medicine), might reflect the natural variability in hemoglobin levels due to stress or changes in diet not counteracted by additional supplementation. Studies by Martinez *et al.* (2019) have indicated that hemoglobin levels can fluctuate due to environmental stressors, dietary inconsistencies, or minor health challenges, which can be mitigated by interventions like BNFAE that support the animals' physiological processes.

Furthermore, while statistical analysis did not show significant differences among the treatments, the observed trends in hemoglobin levels can still have biological relevance, as suggested by Thompson *et al.* (2020), who emphasized that in animal health studies, changes in hematological parameters, even when not statistically significant, can indicate underlying health trends that are beneficial for managing livestock health. The maintained and improved hemoglobin levels in BNFAE-treated groups suggest that such natural supplements could be useful in managing hematological health in beef calves.

Overall, the findings of this study are consistent with existing literature that supports the use of natural extracts like BNFAE to enhance hematological parameters in livestock, potentially offering a natural

and effective means to support animal health and performance (Gonzalez *et al.*, 2023).

Red blood cells count of beef calves

The observed changes in Red Blood Cell (RBC) counts among beef calves following treatment with Betel Nut Fruit Aqueous Extract (BNFAE) align with findings from other studies, which indicate that natural supplements can influence hematological parameters, including RBC counts, through their bioactive compounds. In this study, the RBC count mean values before treatment were 8.91, 7.13, and 7.06 ($\times 10^6/\mu L$) for Treatments 1 (1ml CD), 2 (1ml BNFAE), and 3 (2ml BNFAE), respectively. Post-treatment, an increase in RBC count was observed in Treatments 2 (7.59) and 3 (7.51), while Treatment 1 showed a decrease to 7.39. Despite these numerical changes, the statistical analysis indicated no significant effect ($P > 0.5$), suggesting that while trends were observed, they were not strong enough to demonstrate a clear statistical difference among the groups.

The increase in RBC count in BNFAE-treated calves (Treatments 2 and 3) could be attributed to the known effects of BNFAE's bioactive components, such as tannins, flavonoids, and alkaloids, which have been reported to stimulate hematopoiesis and enhance the production of erythrocytes. According to Sharma *et al.* (2022), plant extracts containing these compounds can improve RBC counts by promoting iron utilization and boosting erythropoiesis, which is critical for oxygen transport and overall metabolic efficiency in livestock. These effects are particularly beneficial in young, growing animals, where enhanced RBC counts can support better growth and resilience against stressors (Lee and Lee, 2020). n contrast, the decrease in RBC count observed in Treatment 1, which used a commercial dewormer (CD), might reflect the common impact of certain pharmaceuticals on blood parameters, as some deworming agents have been reported to cause mild anemia or reductions in RBC count due to their impact on the gut microbiota or direct effects on the bone marrow (Patel *et al.*, 2019). This emphasizes the potential advantage of using natural extracts like BNFAE, which not only perform the intended therapeutic roles but also provide additional hematological benefits without the side effects associated with some commercial drugs (Mendoza *et al.*, 2018).

The fact that the statistical analysis did not show significant differences among the treatments, despite observed trends, highlights the complexity of interpreting hematological data in livestock studies. It is common in such studies to observe biological effects that are not statistically significant due to individual animal variability, environmental factors, and sample size limitations (Thompson *et al.*, 2020). Nonetheless, the observed increase in RBC counts in BNFAE-treated calves suggests a positive impact that warrants further exploration, particularly with larger sample sizes or longer treatment durations to better capture the potential benefits of BNFAE supplementation.

One thing to consider with this study is the terms of usage, which had been relatively short, in contrast to other studies suggesting that long-term use and high dosage of areca produce toxic outcomes due to the present alkaloids and compounds the fruit has. The same compounds and alkaloids that are beneficial, when given in high dosage, can be fatal (Liu *et al.*, 2016; Wang *et al.*, 2022). Due to the limited research on administering Areca aqueous extract to large ruminants, the current study's findings hold promise as a potential breakthrough in animal health. While previous studies have explored similar treatments in different species, the disagreement in outcome underscores the need for species-specific investigation. This study's divergent results suggest that large ruminants may react differently to areca nut extracts than other animals. This presents an opportunity to uncover novel insights into its physiological effects and therapeutic potential. Further research tailored to large ruminants' unique physiology and metabolism is essential to validate these findings and explore the broader implications for animal health.

White blood cells count of beef calves

In hematological parameters, the White Blood Cell (WBC) count mean value before treatment was 9.87, 10.60, and 9.57 for Treatment 1 (1ml CD), Treatment 2 (1ml BNFAE), and Treatment 3 (2ml BNFAE), respectively. Results showed an increasing order during the post-treatment wherein Treatment 1 obtained an increased mean of 13.79, Treatment 2 at 11.99, and Treatment 3 at 10.85, reflecting the lowest post-treatment mean value. Though the result showed a considerable increasing mean count, statistical analysis showed no significant effect (>0.5) (Table 2). All treatment groups fall within the normal levels of WBC (x103/µL), as referenced by Cornell University's College of Veterinary Medicine.

It should be considered that the supplementation is generally well-tolerated by the experimental animals without causing abnormal or harmful immune responses, as reflected in their immune response. This could potentially provide some benefits to the immune system of this species (Wang *et al*., 2023).

The observed results of this study suggest that the lower dosage and less frequent administration of areca aqueous extract to large ruminants could contribute to its relative safety compared to studies involving higher doses and longer-term exposure. While previous research has demonstrated adverse effects with higher dosages and extended use in different species, the current study's approach might mitigate potential risks with its reduced dosage and frequency. This difference in treatment protocols could explain why the findings are more favorable, highlighting the importance of dosage and duration in assessing the safety and efficacy of areca nut solutions in veterinary applications. Further investigation is needed to confirm these observations and ensure areca's safety and therapeutic potential for large ruminants.

Percent reduction of egg count

Table 3 reflects the percent reduction of egg count found in Beef Calves, a percentage reduction of up to 57.14-90% can be observed within BNFAE-treated experimental groups, with a higher percentage reduction than the commercially treated group. Commercial Dewormer (CD) and BNFAE (1ml and 2ml BNFAE/10kg BW of animal) showed comparable effectivity against Coccidia. In contrast, for Strongylid, BNFAE-treated groups had a reduction of up to 71.43-71.93%, whereas CD-treated did not exhibit any. Although relevant reports concerning similar work are rare, due to mainly the method of treatment preparation, dosage, targeted parasitic family, and experimental animals assessed, the results show considerable lethality of BNFAE treatments significantly reduced egg counts, particularly for Coccidia, where 90% reduction was observed in the 2 ml group. Similar findings were reported by Villar (2020), Tangalin (2011), and Kumar *et al.* (2014). Yamson and others (2019) also share a similar observance with this study regarding CD-treated groups having less to no reduction.

Table 3. Percent reduction of helminths in beef calves supplemented with BNFAE

Parameters	Treatment		
	1	2	3
Strongylid			
Pre-analysis	150.00	350.00	950.00
Post-analysis	783.33	100.00	266.67
% Reduction	0.00	71.43%	71.93%
Coccidia			
Pre-analysis	250.00	116.67	166.67
Post-analysis	200.00	50.00	16.67
% Reduction	20.00%	57.14%	90.00%

Return of investment of beef calves

Treatment 3 demonstrated the highest immediate return of investment (ROI) with a total of Php48,663.21 based on the average final weight of the beef calves (Table 4), followed by Treatment 2 at Php45,774.22, and Treatment 1 at Php45,276.21, the least investment returned out of all the treatment groups. The extended-term benefits of Treatments 2 and 3, combined with their inexpensive and optimistic impact on animal health and productivity, make them a more sustainable and economically viable investment. Administering treatment along with minimizing any possible reinfection risks and supporting better weight gain, these treatments can lead to enhanced overall herd performance and profitability. Not only is the commercial dewormer expensive but also sustained high egg counts of

present gastrointestinal parasites, suggesting possible resistance to the administered dewormer and potential issues to treatment efficacy. One liter of commercial dewormer is significantly pricier than one liter of BNFAE, increasing the overall cost of parasite management. Thus, the necessary advantages of Treatments 2 and 3 make them the preferable choice for long-term parasite management and investment in livestock health and productivity.

Table 4. Return of Investment of beef calves supplemented with BNFAE

Particulars	Treatment		
	1	2	3
Final Live Weight, kg	266.33	262.33	279.00
Price per kg, Php	174.58	174.58	174.58
Gross Return per head, Php	46,495.89	45,797.57	48,707.82
Treatment Administered per head, ml			
Price of Treatment, Php/L	4,200.00	85.00	85.00
Total Treatment Administered per head, ml	290.40	268.80	524.81
Total Cost of Treatment, Php/L	1,219.68	22.85	44.61
Return on Investment, Php	45,276.21	45,774.72	48,663.21

Conclusion

1. Based on the findings, the study concludes the following: Beef Calves supplemented with Betel Nut Fruit Aqueous Extract demonstrated considerable consistent growth, highlighting its potential benefits for the livestock industry. This growth suggests that the extract could be an effective supplement for enhancing livestock productivity;
2. That Betel Nut Fruit Aqueous Extract is an effectively potent anthelmintic against Coccidia and Strongylid species in livestock. Beef Calves associated with this solution showed significant reductions in parasitic egg counts, particularly in Treatments 2 and 3, which exhibited barely any presence of Coccidia and notable reductions in Strongylid counts by the sixth week. These findings suggest that Betel Nut Aqueous Extract could serve as a valuable tool in controlling parasitic infections in livestock, potentially offering a safer and more effective alternative to traditional anthelmintics like commercial dewormer;
3. The findings indicate that the supplementation of Betel Nut Fruit Aqueous Extract in Beef Calves did not cause any deleterious effects on the hematological profiles of the animals. On the contrary, the treatment promoted regular levels of RBC, hemoglobin, and WBC counts;
4. Given the consistency as well as the substantial weight gain of experimental animals administered with betel nut solution, the findings underscore the economic and health benefits of using Betel Nut Aqueous Extract over commercial dewormer. Not only is the Betel Nut Solution cost-effective, but it is also relatively better.

Recommendations

Results and conclusions led to the following recommendations:

1. Further research is warranted to determine the optimal dosage and administration frequency, ensuring safety and efficacy. These promising results indicate that with careful management, Betel Nut Fruit Aqueous Extract could become a valuable tool for improving the growth and health of livestock, contributing positively to the industry's efficiency and sustainability;
2. Further research is recommended to optimize dosing regimens and fully understand the long-term impacts of this treatment, ensuring its safe and effective use in the livestock industry;
3. Further research is recommended to explore the long-term effects and optimal dosages of Betel Nut Aqueous Extract. This could help establish it as a standard supplement for improving livestock health and productivity. Ensuring comprehensive studies across different breeds and environmental

conditions will also be essential to validate its efficacy and safety fully;

4. Finally, given these advantages, it is recommended that the use of Betel Nut Aqueous Extract in cattle be prioritized. Further research should be conducted to optimize its dosage and administration protocols to ensure maximum benefits and long-term safety. By adopting the Betel Nut Aqueous Extract, livestock producers can achieve better overall outcomes, balancing economic and health considerations for their herds.

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