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RESPONSE OF COBB500 BROILER CHICKEN *(Gallus gallus domesticus)* TREATED WITH DIFFERENT BIO-BASED WATER ADDITIVES

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Abstract

Synthetic feed additives have been used for many decades, especially in the poultry industry, to enhance production and promote growth. However, continuous utilization of these products potentially compromises animal health and ultimately the health of consumers. This paper, therefore, aims to evaluate the response of Cobb500 chickens supplemented with different bio-based products used as water additives. Methods: The experiment was laid out using the Completely Randomized Design (CRD) with five treatments: T1 (Fermented Fruit Juice) T2 (Oriental Herbal Nutrient), T3 (Lactic Acid Bacteria Serum), T4 (Pure Water), and T5 (HumicVet) replicated thrice. Treatments were evaluated in terms of growth performance, carcass characteristics, and economic return. Findings: The supplementation of bio-based products in the water significantly enhanced the body weight, total weight gain, and daily weight gain of Cobb500 broiler chickens after 21-days of feeding which are considered important parameters since these are used in the economics analysis. Regarding return on investment (ROI), all treatments exhibited positive returns. The study offers an interesting alternative to synthetic feed additives that could be used in improving the growth of Cobb500 broiler chicken.

Keywords: *Bio-based additives, phytochemicals, cobb500, growth performance, economic analysis*

INTRODUCTION

The world population has tripled since the mid-20th century. Currently at 8 billion, it is expected to reach 9.7 billion by 2050 and could peak at 10.4 billion in the mid-2080s. Consequently, the need for animal protein is growing and highly regarded in most communities. In 2021, around 132.3 million tons of poultry meat were consumed worldwide, making it the most consumed type of meat globally. In the Philippines, the leading meat products among local consumers are pork and poultry meat. In fact, in 2022, the Philippines recorded a per capita consumption of 1.74 million tons of ready-to-cook poultry meat.

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Broiler chicken production is a progressive animal enterprise and one of the major and fastest-growing meat producers worldwide due to its inherent efficiency in feed conversion. Broiler chickens are considered one of the cheapest sources of protein and are widely consumed by people around the world. Broiler meat gains popularity due to its efficient feed-to-meat conversion, low cost, versatility, and perceived health benefits compared to red meat. Despite these advantages, the broiler industry faces challenges in terms of production systems, including the cost of production, and health and nutrition concerns.

In the Philippines, poultry has made a substantial contribution to the country's agricultural economy. The industry is characterized by diverse production and marketing systems, consisting of a few large integrated enterprises and many smallholder farmers.

Synthetic feed additives have been used for many decades, especially in the poultry industry, to enhance production and promote growth, even in small-scale operations. However, the continuous use of these products potentially compromises animal health and, ultimately, the health of consumers. Therefore, nowadays, there is a great demand for safe products due to health concerns and food safety considerations.

The enactment of Republic Act 10068, known as the "Organic Agriculture Act of 2010" in the Philippines, encourages farmers to produce organic products with fewer synthetic chemicals, thereby promoting good health. Organic concoctions, including Fermented Fruit Juice (FFJ), Fermented Plant Juice (FPJ), Lactic Acid Bacteria Serum (LABS), and others, are widely produced by local organic practitioners in the Philippines and utilized as supplements for crops, poultry, and livestock.

Organic concoctions can be used as feed additives to enhance the nutritional value of broiler chicken feed. They can also be added to the drinking water of broiler chickens to provide additional nutrients and improve their overall health. Furthermore, these concoctions can combat bacterial infections in poultry feeds, reducing the incidence of diseases caused by pathogens such as Salmonella and Campylobacter. Additionally, organic concoctions can serve as nutrient supplements during the brooding period of broiler chicks.

Plant extracts contain a diverse array of molecules that possess inherent bio-activities affecting animal physiology and metabolism. These extracts are key ingredients in numerous commercial preparations used in animal production, known for their antimicrobial, antioxidant, and digestive improvement properties, as well as their ability to stimulate enzyme activity and enhance immune functions. Other studies revealed that addition of plant product as feed additive might be considered as a potential natural growth promoter in broiler production.

Cultivated from millennia-old practices of natural remedies, the integration of bio-based additives into modern agricultural systems represents a promising frontier in enhancing the performance and well-being of poultry. In this context, the response of broiler chickens to bio-based drinking additives emerges as an important area of investigation, driven by the imperative to optimize growth parameters and economic impact while mitigating reliance to synthetic supplements.

Hence, this study was conducted to evaluate the growth response and economic returns of Cobb500 broiler chickens supplemented with fermented bio-organic additives mixed into their drinking water.

Specifically, the study aimed to:

1. Evaluate the growth performance of broiler chicken utilizing bio-based additives as dietary supplement;
2. Determine the carcass characteristic of broiler chicken supplemented with bio-based additives as dietary supplement; and
3. Evaluate the economic return of broiler chicken production utilizing bio-based additives as dietary feed supplements.

METHODOLOGY

This study was conducted on June 20, 2023 – August 04, 2023 at the Poultry Production Area of Cagayan State University, Lal-lo Campus. The study focused on the evaluation of bio-based additives on the growth performance and carcass quality of broiler chicken. The study was terminated when the experimental birds reach the recommended marketable weight of 1.5 kilograms.

The materials and supplies that were used in the study are 150 broiler chicken, commercial feeds, oriental herbal nutrients, lactic acid bacteria serum, fermented fruit juice, drinking and feeding troughs, experimental house and cages, weighing device, cleaning materials, and recording materials.

Experimental Design and Treatments

The study was laid out in a Completely Randomized Design (CRD) with the experimental treatments as follows:

T1 = 980 mL of water with 20 mL Fermented Fruit Juice (FFJ)

T2 = 980 mL of water with 20 mL Oriental Herbal Nutrients (OHN)

T3 = 980 mL of water with 20 mL Lactic Acid Bacteria Serum (LABS)

T4 = Pure Potable Water (Negative Control)

T5 = Commercial Organic Water Additives (Positive Control)

A. Construction of the Experimental House and Cages

A poultry house was constructed in an area measuring 7m x 4m enough to accommodate the five (5) moveable cages with a measurement of 3m x 1m per cage subdivided into 3 compartments. Each compartment accommodated 10 experimental birds per replication.

B. Collection and Preparation of Bio-based Additives

1. Fermented Fruit Juice (FFJ) – Banana

Ripened banana fruits (Damilig) were collected at Santa Ana, Cagayan. This were finely cut/chopped into smaller pieces. Crude (muscovado) sugar and water at the ratio of 1:1:1 were mixed properly with the chopped fruits. The mixture was placed in a pail/container leaving 25% air space. This was covered with clean manila paper and tied with plastic straw. The container was left undisturbed in a cool dry shady place for 7-10 days. Harvesting the FFJ liquid extract was done by straining with a clean cloth. The FFJ product was stored in a plastic jar.

2. Oriental Herbal Nutrients (OHN)

One kilo each of ginger and garlic were finely chopped. The chopped spices were transferred into a container and poured with 2 liters of coconut vinegar. The mixture was thoroughly mixed and covered with a clean manila paper and tied with plastic straw.

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Preservation for a duration of 12 hours was done and after which a kilo of muscovado sugar was added then again covered. The container was placed in a cool dry place away from direct sunlight. After 5 days of fermentation, beer was added. The cover was put back in place and returned it to the storage area and retrieved after 7 days. The liquid from the container was strained and it was placed in plastic jars.

3. Lactic Acid Bacteria Serum (LABS)

Rice washing (or first two rinses of cloudy water) from rice before cooking was collected. A 50-70% air space or 2/3 full with rice rinse-water in the container were provided. Loose covering of the container was done (not vacuum tight, allowing air penetration into the container). The container was then placed in a cool area with no direct sunlight. Rice wash was fermented for 7 days at a temperature of 20-25 degrees Celsius. After 7 days, rice bran floated like a thin film on the sour-smelling liquid was removed. The cloudy liquid (fermented rinse-water) was poured off discarding the mat layer and it was transferred into a bigger container. Ten parts of milk were poured to the strained sour-smelling liquid. Fermentation was done in 7 days. Carbohydrates, proteins and fat floated, leaving a yellow liquid (serum) fraction which contained the lactic acid bacteria. The pure lactic acid bacteria serum will be loosely capped and stored in the refrigerator or simply add equal amount of molasses. Molasses will keep the lactic acid bacteria alive at room temperature at 1:1 ratio serving as food for the bacteria.

C. Phytochemical and Active Metabolites Analysis of Bio-based Additives

The bio-based additives were forwarded to Central Analytical Laboratory particularly at Cagayan State University, Andrews Campus for phytochemical screening and active metabolites analysis. Based from the result of the laboratory analysis, it was found out that the concoctions used as treatment in the study were rich in flavonoids, saponins, steroids, tannins and terpenoids.

D. Procurement and Selection of Experimental Birds

A total of one hundred fifty (150) heads broiler chicks were secured from a reliable supplier at Dugo, Camalaniugan, Cagayan Valley. Upon the arrival of the chicks, they were treated with electrolytes dissolved in water to let them recover from transportation stress.

E. Brooding of Experimental Birds

An incandescent bulb was provided during the brooding period of the chicks in order to maintain warm body temperature. The researcher ensured that lights were available specially during night time in order for the experimental birds to visualize their feeding materials. Used newspapers were utilized as floor mat and change regularly to maintain hygiene and sanitation.

F. Assigning of Experimental Chicks to the Experimental Cages

One hundred fifty (150) broiler chicks were distributed to 5 treatments replicated 3 times. Ten (10) broilers correspond to one replicate. Each cage consists 10 broiler chickens.

G. Feeding and Provision of Water to the Experimental Birds

Commercial feeds and drinking water were offered ad libitum throughout the experimental period. Feeding and drinking troughs including the poultry cages were cleaned regularly to ensure the proper hygiene and sanitation inside the experimental area and to avoid the occurrence of diseases. Birds were provided with uniform care and management like protection from predators and stresses.

H. Flock Health Management

Regular disinfection was done at the experimental area in order to ensure the good health of the experimental animals. The researcher immediately does prevention techniques when there is unexpected disease occurrence.

I. Slaughtering the experimental birds

Upon termination of the study, random selection was done prior to slaughtering the experimental birds. A total of one (1) bird per replication and three (3) birds per treatments were slaughtered for the purpose of gathering the needed data for the carcass evaluation and meat characteristics.

DATA GATHERED

For a reliable result of the study, the following data were gathered:

A. Growth Performance

a. **Initial Weight** – this was gathered by weighing the experimental animals before distributing them to their respective cages.

b. **Weekly Weight Gain** – this was gathered by weighing the experimental animals every 7^{th} day of the week.

c. **Final Weight Gain** – this was gathered by weighing the experimental animals on the last day of the experimental period.

d. **Total Weight Gain** – this was gathered by subtracting the initial weight to the final weight.

e. **Average Daily Gain** - this was gathered using the formula given below:

$$\text{ADG} = \frac{\text{Final Weight} - \text{Initial Weight}}{\text{Number of Feeding Days}}$$

f. **Total Feed Consumption –** this was gathered by subtracting the amount of leftovers to the amount of feeds given to the experimental animals.

g. **Feed Conversion Ratio** - this was gathered using the formula given below:

$$FCR = \frac{Total\ Quantity\ of\ Feed\ Consumed\ /\ bird\ (kg)}{Mean\ Body\ Weight\ Gain\ (kg)}$$

h. **Feed Conversion Efficiency** - this was gathered using the formula given below:

$$FCE = \frac{\text{Total Weight Gain (kg)}}{\text{Total Feed Consumption (kg)}} \times 100$$

B. Meat Characteristics

a. **Slaughter / Live weight** – this was gathered by weighing the experimental birds before slaughtering.

b. **Dressed weight with giblets** – this was gathered by weighing the dressed chicken before removing the giblets.

c. **Dressed weight without giblets** – this was gathered by weighing the dressed chicken after removing the giblets.

d. **Primary cuts**

i. **Thigh** – this was gathered by weighing the thigh part of the chicken.

ii. **Leg/Drumstick** – this was gathered by weighing the leg part/drumstick of the chicken.

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iii. **Wings** – this was gathered by weighing the wing part of the chicken.
iv. **Breast** - this was gathered by weighing the breast part of the chicken.
v. **Back** - this was gathered by weighing the back part of the chicken.

e. Visceral Organs/Giblets

i. **Gizzard** - this was gathered by weighing the gizzard of the chicken.
ii. **Liver** - this was gathered by weighing the liver of the chicken.
iii. **Heart** - this was gathered by weighing the heart of the chicken.

Neck - this was gathered by weighing the neck of the chicken.

B. Cost and Return Analysis

Data Analysis

The data gathered was tabulated and statistically analyzed following the Analysis of Variance of the Completely Randomized Design (CRD). Statistical Tool for Agricultural Research (STAR) was used to analyze and find out the differences between the treatment tested.

RESULTS AND DISCUSSION

General Observation

Upon arrival of the Cobb500 chicks, they were noisy and displayed signs of stress caused by transportation. The chickens were then provided with water diluted with electrolytes to help the chickens recuperate from stress.

Before the application of different bio-additives to the experimental birds, the treatments were introduced during the brooding stage to acclimate them to the additives in their drinking water. During acclimatization, it was observed that all the experimental birds became accustomed to consuming the treated water provided during brooding.

Regarding the weight performance of Cobb500 chickens, it was observed that chickens supplemented with bio-based additives demonstrated improvements compared to those given pure water. It was also observed that there was a noticeable increase in feed consumption among the experimental birds treated with bio-additives. These observations could be attributed to the presence of terpenoids and saponins in their drinking water, which improve taste and digestion for the animals.

Furthermore, the behavior of Cobb500 chickens in the supplemented groups appeared more vigorous and active. This could be attributed to better health and nutritional status, reducing stress and promoting more natural behaviors.

At the conclusion of the study, there were no recorded mortalities among the experimental birds.

Initial Weight (g)

Table 1 displays the mean initial weights (g) of the experimental birds. The birds in Treatment 1 recorded the highest initial mean weight of 413.5 grams, followed by experimental birds in Treatments 5 and 3, with mean weights of 412.7 and 411.3 grams, respectively. The birds in Treatment 2 had the lowest initial mean weight at 409.6 grams.

The Analysis of Variance (ANOVA) revealed no significant difference among the initial weights of the birds across the different treatments. Therefore, the recorded initial weights ensure that all experimental birds were evenly distributed among the cages used in the study.

Table 1. ***Initial weight of the experimental birds (g)***

Treatment	Mean
T_1 (Fermented Fruit Juice)	413.5
T_2 (Oriental Herbal Nutrient)	409.6
T_3 (Lactic Acid Bacteria Serum)	411.3
T_4 - Control (Pure Potable Water)	410.5
T_5 + Control (HumicVet)	412.7
Statistical Inference	*NS*
CV(%)	1.89

Weekly Body Weight (g) and Final Weight of Experimental Birds

The weekly body weight of the experimental birds treated with different bio-based additives is presented in Table 2. During the first week of the study, the experimental birds in Treatment 1 achieved the highest weight of 859.67 grams. This was followed by the birds treated with the commercial water additive (HumicVet), which weighed 851.67 grams. The birds without any added treatment in the water recorded the lightest body weight of 808.23 grams. The analysis of variance revealed no significant differences among the treatments tested.

In the second week of the study, experimental birds treated with Lactic Acid Bacteria recorded the heaviest body weight of 1181.8g. This was followed by experimental birds in Treatments 1 and 5, which weighed 1163.5g and 1156.0g, respectively. The lightest group of experimental birds was recorded in Treatment 4 (pure water). Despite these numerical differences, the analysis of variance revealed no significant differences among the treatments tested.

During the third week of the study, the experimental birds treated with Fermented Fruit Juice as water additive obtained the heaviest weight of 1499.67g. This was followed by Treatment 3 (Lactic Acid Bacteria Serum) with 1452.33g, and Treatment 2 (Oriental Herbal Nutrient) with 1406.67g. The experimental birds with lowest body weight were obtained in the Treatment 4 (pure water) with 1327.67g. Analysis of variance reveals a highly significant differences among the treatments tested.

The result could be attributed to the presence of bioactive compounds in the different bio-based additives namely saponins, steroids, tannins, and terpenoids. According to the result of the study conducted by *Youssef, I.M. et al., (2020)*, supplementation of saponins to broiler chickens increased body weight, weight gain, and feed conversion. *Perin et al. (2018)* argued that the use of tannin in the diet of broiler chicks as an additive enhanced their bodyweight, weight gain and daily weight gain.

Additionally, inclusion of other phytochemicals in the diet of broilers yielded benefits in all aspects of meat production chain, such as improvements in productive performance and carcass and meat quality *(Valenzuela-Grijalva, N. V. et al., 2017).*

In the last week of the study, experimental birds treated with Lactic Acid Bacteria Serum achieved the heaviest final weight of

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1801.67g. This was followed by birds in Treatment 1 (Fermented Fruit Juice) and Treatment 2 (OHN), with mean values of 1793.33g and 1766.67g, respectively. The lowest final weight was recorded in birds treated with the commercial bio-additive HumicVet, with a mean value of 1646.67g. Based on the results of the study, the analysis of variance revealed no significant difference among the treatments evaluated. Despite this, all the experimental birds in all treatments achieved the ideal live weight of 1.5 to 1.8 kg *(DA-BAR, 2022)*.

Table 2. Mean weekly body weight (g) and final weight (g) of Cobb500 chickens treated with different bio-based water additives.

Treatment	Mean Body Weight (g)			Mean Final Weight
	1st Week	2nd Week	3rd Week	
T_1 (Fermented Fruit Juice)	859.67	1163.50	1499.67^{a}	1793.33
T_2 (Oriental Herbal Nutrient)	815.00	1125.67	1406.67^{bc}	1766.67
T_3 (Lactic Acid Bacteria Serum)	845.17	1181.83	1452.33^{ab}	1801.67
T_4 - Control (Pure Potable Water)	808.23	1111.50	1327.67^{c}	1703.33
T_5 + Control (HumicVet)	851.67	1156.00	1388.00^{bc}	1646.67
Statistical Inference	*NS*	*NS*	**	*NS*
CV (%)	4.03	3.99	3.08	4.82
$LSD_{.05}$			2.22	

*** highly significant at 5%*

Total Weight Gain (g) and Average Daily Weight Gain (g)

The total weight gain (g) and the average daily weight gain of the experimental birds treated with different bio-based water additives is presented in Table 3. The experimental birds treated with Lactic Acid Bacteria Serum achieved the highest weight increase of 1234.27g. This was followed by the experimental birds in Treatments 1, 2, and 5, with corresponding mean values of 1202.17g, 1145.60g, and 1107.10g, respectively. The lowest weight increase was observed in the experimental birds with no added treatment in their water, with a gain of 1090g.

On the other hand, the experimental birds treated with Lactic Acid Bacterial Serum recorded the highest average daily gain of 13.83g. This was followed by T1, 2, and 5 with a corresponding mean value of 38.8g, 36.97g and 35.70g, respectively. Thus, the lowest average daily gain was observed in T4 with a corresponding mean of 35.17g.

Based from the result of the study, the analysis of variance reveals significant difference among the treatments tested. Significant result could be attributed with the presence of phytochemicals in the formulated water additives namely saponins, steroids, tannins, and terpenoids. Phytochemicals also known as phytobiotics are natural bioactive compounds that are derived from plants and incorporated into animal feed to enhance productivity *(Gadde et al., 2017)*. With the availability of various phytochemical compounds in the bio-based additives, their combinations exert synergistic effects thereby improves body weight gains *(Lee et al., 2010)*.

Additionally, in the result of the study conducted by *Youssef, I.M. et al., (2020)*, supplementation of saponins to broiler chickens increased body weight, weight gain, and feed conversion. *Perin et al. (2018)* argued that the use of tannin in the diet of broiler chicks as an additive enhanced their bodyweight, weight gain and daily weight gain.

The bio-based additives evidently improved the palatability of the drinking water and the overall diet as it encouraged higher feed intake due to the presence of terpenoids and saponins. Increased feed consumption typically leads to higher growth rates as reflected in a significant result of the Average Daily Gain (ADG). This is an indication of the effectiveness of bio-based additives in enhancing growth performance of broiler chickens This outcome is likely due to improved nutrient absorption and utilization, boosted immune function, increased feed intake, consistent growth over time, reduced feed conversion ratio, and reduced stress levels.

It is then conclusive that supplementation of bio-based additives improves the total weight increments of experimental birds throughout the study.

Table 3. Total weight gain (g) and average daily weight gain of Cobb500 chickens treated with different bio-based water additives.

Treatment	Mean Total Weight Gain	Mean Average Daily Weight Gain
T_1 (Fermented Fruit Juice)	1202.17^{a}	38.8^{a}
T_2 (Oriental Herbal Nutrient)	1145.60^{ab}	36.97^{ab}
T_3 (Lactic Acid Bacteria Serum)	1234.27^{a}	39.83^{a}
T_4 - Control (Pure Potable Water)	1090.00^{b}	35.17^{b}
T_5 + Control (HumicVet)	1107.10^{b}	35.70^{b}
Statistical Inference	*	*
CV (%)	4.45	4.47
$LSD_{.05}$	93.57	3.03

Feed Consumption, Feed Conversion Ratio and Efficiency (g)

Table 4 shows the result of the feed consumption, FCR and FCE of the experimental birds treated with different bio-based water additives. Treatment 3 recorded the highest feed consumption of 23,273.33g. This was followed by T1, 2, and 4 with a corresponding mean value of 23,260g, 22,955g and 22,663,33g, respectively. Meanwhile, Treatment 5 recorded the lowest feed consumption of 22,521.67g. Despite numerical differences, the Analysis of Variance (ANOVA) revealed no significant differences among the treatments evaluated.

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The feed conversion ratio of the experimental birds treated with different bio-additives is also presented in Table 4. The experimental birds treated with Lactic Acid Bacterial Serum and Fermented Fruit Juice recorded the best feed conversion ratio among other treatments with a mean of 1.90. This was followed by T2, 5 and 4 with a corresponding means of 2.0, 2.03, and 2.10, respectively. The recorded FCR of T1 and 3 was still on acceptable level for the poultry raisers since the recommended FCR is 1.6-1.8 according to *Philippine Broiler Industry, 2009*. Furthermore, the Analysis of Variance (ANOVA) however reveals no significant differences existed on the different treatments evaluated. At the same time, the result of the analysis of variance for the feed conversion efficiency reveals no significant differences among the treatment tested.

Table 4. Feed Consumption (g), Feed Conversion Ratio (g), Feed Conversion Efficiency (g) of Cobb500 chickens treated with different bio-based water additives.

TREATMENTS	Feed Consumption	FCR	FCE
T1 (Fermented Fruit Juice)	23,260	1.90	5.2
T2 (Oriental Herbal Nutrient)	22,955	2.0	5
T3 (Lactic Acid Bacteria Serum)	23,273.33	1.90	5.3
T4 - Control (Pure Potable Water)	22,663.33	2.10	4.8
T5 + Control (HumicVet)	22,521.67	2.03	4.9
Statistical Inference	*NS*	*NS*	*NS*
CV (%)	1.42	5.20	4.71

Dressed weight with and without giblets (g)

Table 5 shows the result of the dressed weight with giblets treated with different bio-based water additives. The experimental birds treated with Lactic Acid Bacteria Serum recorded the highest mean value of 1713.33g. This was followed by T1, 2, and 4 with a corresponding mean value of 1705g, 1681.67g, and 1610g, respectively. Meanwhile, the lowest dressed weight with giblets was recorded in T5 with a mean value of 1561.67g. Furthermore, the Analysis of Variance (ANOVA) however reveals no significant differences existed on the different treatments evaluated.

Meanwhile, in the dressed weight without giblets (g) of the experimental birds treated with different bio- based water additives, the experimental birds treated with Fermented Fruit Juice recorded the heaviest mean weight of 1548.33g. This was followed by T3, 2, and 4 with a corresponding mean value of 1543g, 1511.67g, and 1462.33g, respectively. Meanwhile, Treatment 5 recorded the lowest dressed weight without giblets (g) with a mean value of 1410g. Despite numerical differences, the Analysis of Variance (ANOVA) revealed no significant differences among the treatments evaluated.

Table 5. Dressed weight with and without giblets (g) of Cobb500 chickens treated with different bio-based water additives.

TREATMENTS	Dressed weight with giblets	Dressed weight without giblets
T1 (Fermented Fruit Juice)	1705	1548.33
T2 (Oriental Herbal Nutrient)	1681.67	1511.67
T3 (Lactic Acid Bacteria Serum)	1713.33	1543
T4 - Control (Pure Potable Water)	1610	1462.33
T5 + Control (HumicVet)	1561.67	1410
Statistical Inference	*NS*	*NS*
CV (%)	5.04	5.14

Weight of primary cuts

Table 6 shows the weight of primary cuts of the experimental birds treated with different bio-based water additives. For the weight of thigh, the experimental birds treated with Lactic Acid Bacteria Serum recorded the heaviest weight with a mean value of 201.67g. This was followed by T2, T1, and T4 with a corresponding mean value of 173.33g, 165g, and 163.33g, respectively. Meanwhile, Treatment 5 recorded the lowest weight of thigh with a mean value of 151.67g. The Analysis of Variance (ANOVA) reveals that there is a significant difference existed among the treatments evaluated.

Meanwhile, the experimental birds treated with Lactic Acid Bacteria Serum recorded the heaviest drumstick with a mean value of 203.33g. This was followed by T4, 2, and 1 with a corresponding mean value of 190g, 188.33g, and 175g, respectively. Hence, the lowest weight of drumstick was recorded in Treatment 5 with a mean value of and 171.67g. Furthermore, the Analysis of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

Furthermore, the experimental birds treated with Lactic Acid Bacteria Serum recorded the heaviest weight of wings with a mean value of 210g. This was followed by T1, 2, and 5 with a corresponding mean value of 205g, 193.33g, and190g, respectively. Hence, the lowest weight of wings was obtained in Treatment 4 with a mean value of 185g. Furthermore, the Analysis of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

Moreover, the experimental birds treated with Lactic Acid Bacteria Serum obtained the heaviest mean weight of breast equivalent to 405g. This was followed by T1, 4, and 5 with a corresponding mean value of 393.33g, 370g, and 353.33g, respectively. Meanwhile, the lowest weight of breast was recorded in Treatment 2 with a mean value 345g. Despite numerical differences, the Analysis of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

The experimental birds treated with Lactic Acid Bacteria Serum obtained the heaviest mean weight of back equivalent to 206.67g. This was followed by T2, and 5 with a mean weight of 205g and 190g, respectively. Hence, the lowest weight in back was recorded in T1 and T4 with a mean weight value of 186.67g. The Analysis

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of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

Table 6. Weight of primary cuts (g) of Cobb500 chickens treated with different bio-based water additives.

TREATMENTS	Thigh	Drumstick	Wings	Breast	Back
T1 (Fermented Fruit Juice)	165[b]	175	205	393.33	186.67
T2 (Oriental Herbal Nutrient)	173.33[b]	188.33	193.33	345	205
T3 (Lactic Acid Bacteria Serum)	201.67[a]	203.33	210	405	206.67
T4 - Control (Pure Potable Water)	163.33[b]	190	185	370	186.67
T5 + Control (HumicVet)	151.67[b]	171.67	190	353.33	190
Statistical Inference	*	*NS*	*NS*	*NS*	*NS*
CV (%)	8.10	12.10	8.9	11.81	10.38
LSD	2.2				

Weight of visceral organs/giblets

Table 7 shows the weight of visceral organs/giblets gained by the experimental birds treated with different bio-based water additives. The experimental birds treated with Pure Potable Water obtained the heaviest weight of gizzard with a mean value of 38.33g. This was followed by T5 and T2 with a corresponding mean value of 35g and 33.33g, respectively. Thus, experimental birds in T1 and T3 recorded the lowest weight gain with a mean value of 31.67g. Despite numerical differences, the Analysis of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

Meanwhile, the experimental birds in T2 and T5 obtained the heaviest weight of liver with a mean value of 46.67g. This was followed by T3 with a corresponding mean value of 41.67g. Meanwhile, the lowest weight of liver was recorded in T1 and T4 with a mean value of 36.67. Furthermore, the Analysis of Variance (ANOVA) reveals no significant difference existed among the treatments evaluated.

Moreover, the experimental birds in T1 obtained the heaviest weight of heart with a mean value of 11.67g. This was followed by T2 and T4 with a mean value of 11g. Hence, the lowest weight of heart was recorded in T3 and T5 with a corresponding mean of 10.33g and 10g, respectively. The Analysis of Variance (ANOVA), however reveals no significant difference among the treatments evaluated.

The experimental birds treated with Oriental Herbal Nutrients recorded the heaviest weight of neck with a mean value of 61.67g. This was followed by T1 and T3 with a mean value of 58.33g. Meanwhile, the lowest weight of neck was obtained in T4 and T5 with a corresponding mean of 46.67g and 43.33g, respectively. The Analysis of Variance (ANOVA), however reveals no significant difference among the treatments evaluated.

Table 7. Weight of visceral organs/giblets (g) of Cobb500 chickens treated with different bio-based water additives.

TREATMENTS	Gizzard	Liver	Heart	Neck
T1 (Fermented Fruit Juice)	31.67	36.67	11.67	58.33
T2 (Oriental Herbal Nutrient)	33.33	46.67	11	61.67
T3 (Lactic Acid Bacteria Serum)	31.67	41.67	10.33	58.33
T4 - Control (Pure Potable Water)	38.33	36.67	11	46.67
T5 + Control (HumicVet)	35	46.67	10	43.33
Statistical Inference	*NS*	*NS*	*NS*	*NS*
CV (%)	13.69	14.86	14.74	23.81

Cost and Return Analysis

The cost and return analysis of Cobb500 chicken supplemented with different bio-based additives is presented in Table 8. Experimental birds in T3 recorded the highest total cost of production considering labor, supplies, experimental cages and equipment having an amount of ₱7,400.00. This was followed by T1, T2 and T5 with ₱7,320.00, ₱7,300.00 and ₱7,240.00, respectively. Meanwhile, T4 recorded the lowest cost of production with ₱7,230.00.

Evaluation of total revenue or estimated sales was based on the final weight of the experimental birds. Experimental birds in T1 generated the highest gross income, reaching ₱8,886.00, while T1, T2 and T5 yielded a gross income of and ₱8,724.60, ₱8,397.90, and ₱8,207.10, respectively. Conversely, T4 yielded the lowest gross income, amounting to ₱8,048.70.00.

Assessing the net income, T3 emerged as the most profitable, realizing a profit of ₱1,486.00. This was followed by T1, T2, and T5 with a net income of ₱1,404.60, ₱1,097.90, and ₱967.10, respectively. Conversely, T5 recorded the lowest revenue, with a net income of ₱818.70.

In terms of return on investment (ROI), all treatments exhibited positive returns. However, when considering the highest ROI, investing one peso in T3 would yield a return of 20.08 pesos over the course of one production cycle.

In summary, the findings demonstrate that T3 offers the highest gross income, and greatest net income, making it the most financially favorable option. T1 and T3 also provides promising returns, while T5 and T4 shows relatively lower profitability. These results offer valuable insights for investors seeking to maximize their returns in Cobb500 chicken production.

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Table 8. Cost and return analysis of Cobb500 chicken treated with different bio-based additives.

TREATMENTS	Total Variable Cost (₱)	Gross Income (₱)	Net Income (₱)	ROI (%)
T1 (Fermented Fruit Juice)	7,320	8,724.60	1,404.60	19.18%
T2 (Oriental Herbal Nutrient)	7,300	8,397.90	1,097.90	15.04%
T3 (Lactic Acid Bacteria Serum)	7,400	8,886.00	1,486.00	20.08%
T4 - Control (Pure Potable Water)	7,230	8,048.70	818.70	11.32%
T5 + Control (HumicVet)	7,240	8,207.10	967.10	13.36%

CONCLUSION

The result of this study highlights the remarkable impact of bio-based drinking additives on the growth performance of broiler chickens, as evidenced by the significant improvements in third weekly weight gain, total weight gain (TWG) and average daily gain (ADG) and highly significant improvement in the weight of thigh. These findings not only validate the efficacy of incorporating bio-based additives in poultry management practices but also underscore the potential for enhancing productivity and profitability in the poultry industry. By leveraging natural, sustainable alternatives, such as the drinking additives examined in this research, producers can optimize growth outcomes while minimizing environmental impact and ensuring the welfare of the animals as well. As we navigate towards more sustainable agricultural practices, the insights gleaned from this study provide valuable guidance for future endeavors aimed at improving both the efficiency and sustainability of broiler chicken production.

RECOMMENDATIONS

In light of the compelling results obtained in this study, the researcher recommends the widespread adoption of bio-based drinking water additives in broiler chicken production systems. These additives have demonstrated not only significant improvements in growth parameters but also potential benefits for overall bird health and welfare. Integrating these additives into poultry management protocols can lead to enhanced productivity, reduced reliance on synthetic additives, and a more sustainable approach to poultry farming.

In addition, further research into the optimal dosage and application methods of these bio-based additives is warranted to maximize their effectiveness and ensure consistent results across different production settings. Ultimately, by embracing bio-based drinking water additives, producers can achieve a balance between profitability, environmental stewardship, and animal welfare in the broiler chicken industry.

Declaration of no conflict of interest

The author hereby declares no conflict of interest and this article is his original work.

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