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# The Potential of Vegetable Waste-Based Pellets on Broiler Production Performanceand Nutrient Digestibility

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***Abstract:*** *Vegetable waste causes problems for environmental and air pollution if only wasted. The purpose of this study was to determine the level of vegetable waste in feed formulations on the performance of broiler chicken production and nutrient digestibility. The research method was using a completely randomized design (CRD) with 5 treatments, namely P1 (control feed without vegetable waste), P2 (using 5% vegetable waste in 100% feed formulation), P3 (using 10% vegetable waste in 100% feed formulation), P3 (using 15% vegetable waste in 100% feed formulation), and P4 (using 20% vegetable waste in 100% feed formulation). The parameters observed consisted of 2 groups, namely the performance of production by measuring feed consumption, body weight gain, and FCR, the second was on nutrient digestibility, consisted AMEn parameter, N retention, metabolic CP digestibility, and CF digestibility parameter. The results showed that the level of vegetable waste gave significantly different results (p <0.05) on live weight and FCR, AMEn, and metabolic crude fiber digestibility and gave very significant differences in feed consumption, N retention, and metabolic protein digestibility (p<0.01). ). The highest weight of broiler resulted from the use of 15% vegetable waste, then decreased at a higher level and resulted in a decrease in nutrient digestibility. It is recommended to use vegetable waste treatment so that the particles are smaller before being used in mixing feed formulations in the pelleting process.*

***Keywords:****Vegetable waste, Pellet, Broiler, Performance, Digestibility*

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## I. Introduction

The increasing number of people globally demands a supply of protein sources at affordable prices. So far, the need for animal protein has been fulfilled by ruminants and poultry. However, compared to the price per kilogram of beef, the price of poultry meat is much cheaper. This causes the number of broiler chicken populations around the world to become increasingly every year to meet the demands of meat and animal products [1]. Even in developing countries and modern countries, the development of the broiler poultry industry has increased rapidly along with the increase in other production sectors [2], this shows that people are increasingly aware of the importance of protein intake in food for intelligence and growth. Broiler chicken has a very favorable flavor, tenderness, and juiciness [3] due to the subcutaneous and marbling fat content in the meat and skin, which makes the chicken taste more savory when processed.

The high demands for animal products must be balanced with the availability of sufficient feed sources. Almost all of the feed used by poultry comes from agricultural waste, whether in the form of grains, cereals, processed animal waste, or industrial or household waste. Vegetable waste can be defined as "food waste", which is a waste product obtained from production, crop residues, or can come from the market chain which is rejected vegetable waste with low-grade quality [4]. Vegetable waste is a problem because of its high amount every day because the harvest and sale of vegetables occur every day and vegetables are a type of commodity that cannot be stored for a long time, and if left untreated, it will cause air pollution, environmental pollution, and garbage accumulation. Several studies have shown that food waste can as a substitute for grains from cereals and protein feed sources, for example in poultry and pork feed [5, 6]. So that the ultimate goal of feeding is to reduce production costs related to feed costs.

Feeding vegetable waste for poultry needs attention in terms of its shape, because poultry, especially broilers are used to crumble, pellet, or mass feed forms, while in its original form vegetable waste is still in the form of leaves or stems in a wide size. Based on the results of the analysis of nutritional content for the year (2020) on some vegetable waste that has been analyzed in the form of flour, broccoli leaves with dry matter content (DM) 92.28%, crude protein (CP) 30.77%; mustard greens 90.79% DM, 24.51% CP; Cauliflower leaves 86.7% DM, 38.82% CP; Cabbage 88.55% DM, 26.07% CP; chicory 86.31% DM, 16.37% CP; lettuce has 87.66% DM, 21.67% CP. However, problems will arise when using fresh vegetable waste in poultry feed, because its content of crude fiber was higher and also has very high water content. Feed sources of energy and protein still need to be added, so that protein deficiency from vegetable waste can be fulfilled. Therefore, it was necessary to use vegetable waste processing technology so that it can be consumed properly by chickens. One form of technology used was to process it into pellets and then process it into a crumble form

Pelleting is a technology commonly used in poultry feed processing which aims to unify particles of various types of feed to form a specific size called a "pellet" shape, its use in livestock is to increase production by increasing feed consumption, increasing production, and economically increasing feed efficiency. A pellet is a complete feed, it has a compact form of feed formed with a diameter of 1/8 inch and a length of ¼ inch. Mechanically, in making pellets there is a pressing process to form a pellet [8]. In poultry feed, almost all of the feed ingredients are in the form of small grains or mass form, so that during the pelleting process all the feed particles come together in a compact and stable formso that when stored the feed will stable in the form of a pellet. Research on the use of pellets and crumble forms in broiler chickens strain Ross 308 showed that these two types of feed gave the same good results on body weight, feed consumption, and FCR of 6 weeks old chickens [9].

The purpose of this study was to determine the effect of vegetable waste in poultry feed formulation on broiler production performance and feed digestion. All feed used is arranged in a formulation according to the needs of the broiler and then made in pellet form.

## II. Materials and Methods

This research consists of several stages, the first stage was research to determine the appearance of livestock production and the second stage was the study aimed to determine the digestibility of nutrients from the conduct of the study. The first stage of research was to use a litter cage, where the chickens were kept for 39 days, then continued with the use of a metabolic cage where during the maintenance the feed consumption and fecal storage were measured.

The study was conducted at the broiler experimental unit, Integrated Field Laboratory, Tribhuwana Tunggadewi University, Indonesia. 100 one-day-old chicks (Cobb-500) were acquired from a local hatchery and fed a conventional diet (according to standard commercial broiler feed) for the first two weeks namely BR0 (broiler one). Birds were vaccinated regularly following standard for maintenance of broiler chickens including ND-IB at 5 days of age, Gumboro at 7 days of age, and ND vaccine at 14 days of age. At the age of 14 days, the chickens were selected and placed in litter plots (first stage research) with a size of 80x80 cm, which was equipped with a 25 W lamp which functions as a heater and light source. Daily ambient temperature was around 25 - 28 $^{o}$C, with 70% humidity. The experimental design was using Completely Randomized Design (CRD) [10] with 5 treatments repeated 5 times. Each cage contains 4 chickens. The treatments consisted of P0 (feed formulation without vegetable waste), P1 (100% feed formulation with 5% vegetable waste level), P2 (100% feed formulation with 10% vegetable waste level), P3 (100% feed formulation with 15 % vegetable waste level), and P4 (100% feed formulation with 20% vegetable waste level). All feeds were arranged based on iso energy and iso protein (Table 2). The type of vegetable used 3 types of vegetables, namely cauliflower leaves, mustard leaves, and cabbage. These three vegetables were selected from the results of a preliminary proximate analysis of 6 types of vegetables (Table 1). The selection of 3 types of vegetables was based on the protein content of the three types of vegetables which were higher than other vegetables, and the ease of drying and storage in wilted form. The nutritional content of the six types of vegetables has been analyzed in a proximate manner according to AOAC (1980) which is shown fully in Table 1.The basis for making feed formulations was based on dry matter content in the dry form of vegetables presented in table 2, and the content of feed ingredients. as a whole (table 3), then arranged in feed formulations (Table 4).

**Table 1.** The nutritional content of 6 types of vegetable waste

| Vegetablewaste | The nutritional content | | | | |
|---|---|---|---|---|---|
| | DM (%) | Mineral (%) | CP (%) | CF (%) | CF (%)* |
| Cabbage | 2.835371 | 0.693553 | 0.834761 | 0.469733 | 0.124238 |
| Cauliflower leaves | 14.71588 | 1.85858 | 6.589048 | 2.038497 | 0.977664 |
| Broccoli leaves | 5.344858 | 1.20879 | 1.782198 | 0.785974 | 0.337094 |
| Lettuce | 3.085632 | 0.4752 | 0.762784 | 0.47696 | 0.177408 |
| White mustard | 5.38747 | 0.988733 | 1.059267 | 0.820199 | 0.142942 |
| Green mustard | 4.499552 | 1.109648 | 1.214716 | 0.625447 | 0.213604 |

DM (dry matter), CP (crude protein), CF (crude fat), CF* (crude fiber)

**Table 2.** Proximate nutrient of 3 types of vegetables based on dry matter

| Vegetable waste | Formulation % | DM (%) | EM (kcal/kg) | CP (%) | CF (%) | CF* (%) |
|---|---|---|---|---|---|---|
| White mustard | 25 | 21.58 | 612.5 | 4.2425 | 0.5725 | 3.285 |
| Cauliflower leaves | 50 | 43.35 | 1225 | 19.41 | 2.88 | 6.005 |
| Cabbage | 25 | 22.14 | 612.5 | 6.5175 | 0.97 | 3.6675 |
| | 100.00 | 87.07 | 2450 | 30.17 | 4.4225 | 12.958 |

DM (dry matter), EM (energy metabolism) CP (crude protein), CF (crude fat), CF* (crude fiber)

**Table 3.** The content of each feed ingredient to arrange the feed formulation

| No | Feed source | DM (%) | GE (kcal/kg) | CP (%) | CF (%) | CF*(%) |
|---|---|---|---|---|---|---|
| 1 | Yellow corn | 89.1 | 3370 | 8.6 | 3.9 | 2 |
| 2 | Soybean meal | 87.16 | 2240 | 42 | 0.9 | 6 |
| 3 | Cane molasses | 77 | 2280 | 4.2 | 0.2 | 7.7 |
| 4 | Cassava flour | 85 | 129.5 | 6 | 27 | 0.6 |
| 5 | Meat Bone Meal | 91.14 | 2590 | 49.58 | 5.84 | 3.39 |
| 6 | Vegetable waste[a] | 87.07 | 3237.6 | 30.17 | 4.4225 | 12.958 |
| 7 | PREMIX | 98 | 0 | 0 | 0 | 0 |
| 8 | Palm oil | 0.18 | 8000 | 0 | 100 | 0 |

DM (dry matter), GE (gross energy) CP (crude protein), CF (crude fat), CF* (crude fiber),

**Table 4.** Formulation of treated feed and its nutritional content

| No | Feed Source | Feed Formulation (%) | | | | |
|---|---|---|---|---|---|---|
| | | P0 | P1 | P2 | P3 | P4 |
| 1 | Yellow corn | 60 | 58 | 58 | 56.5 | 55 |
| 2 | Soybean meal | 3 | 0 | 0 | 0 | 0 |
| 3 | Cane molasses | 1.2 | 1.2 | 1 | 1 | 1 |
| 4 | Cassava flour | 5.9 | 5.9 | 5 | 4.5 | 4 |
| 5 | Meat Bone Meal | 27.2 | 27.2 | 23.3 | 20.3 | 17.3 |
| 6 | Vegetable waste# | 0 | 5 | 10 | 15 | 20 |
| 7 | Premix | 2 | 2 | 2 | 2 | 2 |
| 8 | Palm oil | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| | Total | 100% | 100% | 100% | 100% | 100% |
| Nutrien Content of Each Feed Formulation | | | | | | |
| | DM (%) | 88.77 | 88.72 | 88.60 | 88.46 | 88.32 |
| | GE (kcal/kg) | 2884.7 | 2912 | 2967.1 | 3000.1 | 3033.1 |
| | CP (%) | 20.31 | 20.481 | 20.088 | 20.045 | 20.001 |
| | CF (%) | 6.2509 | 6.3909 | 6.1647 | 6.041 | 5.9173 |
| | CF* (%) | 2.4299 | 2.8499 | 3.3369 | 3.8422 | 4.3475 |

# Vegetable waste is composed of 3 types of vegetables, namely 50% cauliflower leaves, 25% mustard greens, and 25% cabbage.

Feed Producing and Processing

Before producing feed, the broiler feed needs were calculated. Vegetable waste was obtained from vegetable farmers who have the main job of delivering vegetables to supermarkets and for this research, the researcher selected 3 types of vegetables (Table 2). Poultry feed formulation was prepared in advance based on Table 4. Each feed preparation was arranged for 10 kg based on dry matter. Then the conversion was carried out for 3 types of vegetables based on the actual dry ingredients with the formula :

$$\frac{100}{DM\ of\ vegetables} \text{ x vegetables formulation in kilograms}$$

It means, that we need to change the portion of the feed formulation in the form of dry matter ingredients (table 4) into the form of fresh ingredients or fresh weight in kilograms. This formula was then adjusted to the portions of each type of vegetable. After counting in fresh form, the vegetables are dried for 8 hours in the sun.Furthermore, all feed ingredients (Table 3) and vegetable waste are processed into pellets using a gasoline-fueled pelleting machine. All ingredients were mixed and then gradually put into the pellet machine without any heating process in the machine. For the ingredient binding in pellets, we usedcassava starch and molasses The result that comes out was pellet form feed which was expected but still in the form of wetso that the pellet-shaped feed must be dried in the sun for 1 day until the shape becomes hard. Once hard, the pellets were lightly hit so that they become pellet shards or called crumble. This size was given because it is adjusted to the size of the broiler beak. The treatment was given from the age of 14 days until harvest.

Housing and Management

The chickens used in the research were reared since DOC, used a litter system cage, litter was covered by 5 cm rice husk, and then covered with newspapers, and all around the cage was covered with newspaper and the top was covered with plastic. Each cage box was equipped with a 25 W lamp that functions as brooding and each cage was given a canopy so that the ambient temperature was maintained 30-32 $^{o}$C. Each plot was also equipped with a place to feed and drink for a capacity of 4 chickens. Every day the chickens were checked regularly on the development of chickens and the effect of environmental temperature on feed consumption. Each box was given a hanging feed holder and a drinking area so that the chicks can eat freely. At the age of 14 days, the brooding phase ends and the chickens begin to get used to the ambient temperature without the need for heating. At this age, the chickens were introduced to the treated feed

Growth Performance

The chicken maintenance from DOC (1 day of age) to 39 days of age was purposed to measure the growth of broilers. During the growth performance of birds, feed offers and feed residues were recorded to calculate feed intake (g) and weight gain (g) on weekly basis. Daily consumption was measured by the feed amount was given minus the amount of daily leftover feed. The weight measurements were carried out per week during the study. Furthermore, the measurement of these 2 parameters will be used to measure feed efficiency. Feed efficiency was calculated:

$$\text{FCR} = \frac{feed\ intake}{live\ weight}$$

Measurement of consumption, weekly body weight, and FCR was carried out until the age of 39 days. Mortality (if any happened) was recorded on daily basis to calculate percent mortality. At 40 days of age, 25 chickens were moved to a metabolic cage, where the feces consumption and storage were measured. Its purpose was to measure AME and digestibility of protein and fat.

Sample Collection and Chemical Analysis

A total of 25 chickens were transferred to metabolic cages. The adaptation process lasts 3 days, Total excreta were collected from 42 to 45 Day post-hatch from each cage to determine parameters of nutrient utilization which included apparent metabolizable energy (AME) based on the correction of N, nitrogen retention, metabolic crude protein, and crude fiber digestibility. Excreta were dried and GE of diets and excreta was determined by bomb calorimetry using C 200 brand IKA. AMEn (Apparent Metabolizable Energy) values with correction for N were calculated according to that given by Terpstra and Janssen (1976) [11] as follows:

AMEn = C – dW – 8,73 (N – dT) ckal/kg.

AMEn = ” Apparent Metabolizable Energy ” based on the correction of N
C = Gross energy of the studied feed per kg (kcal)
d = amount of excreta produced per kg of feed ingredients
W = excreta gross energy produced per kg (kcal)
8,73 = nitrogen energy value per g
N = the amount of g nitrogen in 1 kg of feed ingredients
T = amount of g of nitrogen excreta produced by 1 kg of feed material.

N-corrected AME (AMEn MJ/kg DM basis) valueswere calculated by correcting N retention to zero using the factor of 8.73 kcal/g N retained in the body (Hilland Anderson, 1958)[12].
The retention calculation for N is to use the formula:

$$\text{Retention (\%)} = \frac{(\text{Feed intake} \times \text{Nutrient}_{\text{diet}}) - (\text{Excreta output} \times \text{Nutrient}_{\text{excreta}})}{(\text{Feed intake} \times \text{Nutrient}_{\text{diet}})} \times 100$$

Research Design and General Experimental Procedures

Proximate analysis testing includes dry matter, crude protein, crude fat, and crude fiber, using the AOAC method (1980). Proximate analysis was carried out on vegetable waste, feed ingredients, and feces. The best treatment testing uses the LSD method according to DeGarmo et al. (1984).

## III. Results and Discussion

Growth Performance

The treatment of using 4 concentrations of vegetable waste was used in broiler chickens from the age of 14 days. Starting from DOC (Day Old Chick) until the age of 14 days, researchers used Commercial Feed (BR0) with an EM content of 2900 kcal/kg and 21-23% protein. At the age of 15 to 39 days, the researchers gave 4 levels of vegetable waste (5%, 10%, 15%, and 20%) as treatment feed. Based on table 2, it shows that the use of vegetable waste levels could replace the use of soybean meal used in control feed, likewise this treatment also reduces the use of the MBM portion up to treatment P4. This shows that vegetable waste could substitute protein sources. The results of research on poultry growth are presented in Table 5.

Table 5, shows that feed consumption and body weight did not show significant differences in commercial feeding until the age of 14 days. This shows that the poultry has a uniform body weight, which means that the effect of feed was not seen in all the chickens tested during the use of BR0 feed. At the age of 15 days, the chickens were introduced to treated feed (4 treatment levels of vegetable waste) and 1 control feed based on MBM soybean meal. To facilitate the adaptation phase, at first, the commercial feed was mixed with 1: 1 treatment feed, then every 2 days it was replaced by 3: 1 (treated feed: commercial feed), then 2 days later the full treated feed was started. From the results of the study, the use of vegetable waste treated feed showed very significantly different results ($p<0.01$) on feed consumption compared to controland showed a significant increase ($p<0.05$) in the weight of the harvest. This shows that the use of vegetable waste can improve the nutrition of the meat bone meal-MBM based feed formulation. The increase in weight gain and reduction in FCR has resulted from the use of a 15% vegetable waste level (P3) which showed significantly different results compared to the control ($p<0.05$), although the overall results on body weight gain during the study from baseline to harvest did not show any results. which was significantly different in all treatments.

The results of this study were still not able to reach the maximum standard, which should be at the age of 35 days the chickens should reach a standard weight of 1.7-1.9 kg per head (Broiler standard)[13]. The difference in nutrition was the reason the maximum weight has not been achieved. The use of vegetable waste caused an increase in crude fiber content in the treated feed thereby reducing digestibility [14.15]. An-depth study of the use of vegetable waste in feed has shown to reduce protein and globulin serum contents compared to commercial feed [16]. The correlation of decreased serum protein and globulin is the result of defatted parts of the vegetable due to high levels of fiber and low protein, thus decreasing absorption in the intestine [17]. Even though the feed formulation was based on a dry matter (Table 4) that the crude fiber and protein content has met the needs of broilers, it is suspected that during the pellet-making process, the mixing process in the machine which consists of mixing and pressing feed ingredients and vegetable waste, was not. able to reduce the length of fiber chain from vegetable waste fibers so that long polysaccharide chains from vegetable waste could not be digested in the intestine, which is influenced in the absorption of other nutritional components such as protein, fat, and energy. The pellet machine used in this research was a simple pellet machine without heating in it. From these results, the researchers suspect that it should be necessary to do the grinding process first on all vegetablesso that smaller particle sizes can be obtainedso that it will break down the length size of the polysaccharide from the vegetable fiber.

The results showed that the level of vegetable waste in the feed decreased the absorption of nutrients and had an impact on growth. This condition can be seen in feed consumption after 14 days to 39 days, which showed that consumption tends not to increase significantly. High crude fiber content reduces feed efficiency (causes poor efficiency) and causes broiler growth to slow down [18, 19]. This can be seen from the high FCR value in all treatments (Table 5). During the maintenance, no livestock was found that experienced illness or death. This was supported by the results of research on the use of Moringa leaves (*Moringa oliefera*) in poultry feed as much as 5%, 10%, and 20% which do not cause death in livestock [20].

Nutrient Digestibility

Measurements of the digestibility level of vegetable waste were measured against the measurement of Apparent Metabolizable Energy (AME), N retention, and metabolic crude protein and crude fiber digestibility (Table 6). The results showed that the treated feed gave significantly different results ($p<0.01$) on AME than the control feed. This showed that the poultry could able to digest the energy from the feed given, including the formulation of feed containing vegetable waste. Energy sources can be in the form of saccharides or polysaccharides, and when birds lack energy, poultry can convert some protein into energy. These results were comparable to the N retention values and Crude Protein Digestibility which also showed significantly different results ($p<0.01$) and significantly different on crude fiber digestibility ($p<0.05$) compared to the control feed. Crude protein and crude fiber digestibility values were very low. This was because the fiber content in waste feed blocks the digestion of protein [18]. Compared with the control, the use of vegetable waste gave higher results on all crude fiber digestibility and N retention. This is in line with the results of other research studies, where the use of a high level of vegetable waste, namely 25% in broiler feed, gave a higher body weight than control. [21] and the use of 0%, 10%, 20%, 30% gave the same weight results compared to control in ostriches, whereas using levels of 20% and 30% gave the best results

Based on the results of research, the use of vegetable waste from P4 treatment shows a decrease in nutrient digestion, influenced on AME, crude fiber digestion, and N retention. This means that the use of vegetable waste (a combination of 3 types of leaves, cauliflower, cabbage, and mustard greens) could be used up to a level of 15% in feed formulations.The highest outcome for the weight gain was achieved by P3 treatment, but not significantly different from P4, although at P4 treatment the body weight began to decrease. The use of vegetable waste could be a choice of feed raw materials, but based on the discussion, the initial treatment process should be done, so that the nutritional components of feed can be digested and absorbed in the digestive system of birds

**Tabel 3.** Growth performance of broilers fed increasing levels of vegetable waste (means±SEM).

| Treatments | Feed Intake | | Live Weight | | Weight Gain | | FCR$^{(+)}$ | | FCR$^{(-)}$** |
|---|---|---|---|---|---|---|---|---|---|
| | Age 0-14 days$^{+}$ | VW$^{\$}$ (15-39 day)** | Initial Weight (at 14 days) | Final weight (age 39 days)* | Weight Gain of 14 days | Weight Gain of treatments (25 days) | FCR (initial 14 days) | FCR (final 25 days) | Total (39 days) |
| P0 | 689.42±27.2 | $2083.21^{a}$±133.01 | 509±7.5 | $1171.2^{a}$±38.8 | 462.7±7.5 | 662.2±35.4 | 1.4±0.1 | 3.2±0.27 | $2.44^{a}$±0.1 |
| P1 | 666.67±37.3 | | 483.4±43.1 | | 437.1±43 | 661.2±78.1 | 1.53±0.2 | | |
| | | $2599.45^{b}$±261.8 | | $1144.7^{a}$±96.01 | | | | 3.9±0.23 | $2.86^{b}$±0.2 |
| P2 | 672.9±9.2 | $2536.05^{b}$±14.5 | 485.7±10.3 | $1165.7^{a}$±8.1 | 439.4±10.3 | 679.9+15.8 | 1.55±0.04 | 3.8±0.1 | $2.76^{b}$±0.04 |
| P3 | 689.72±25.2 | $2710.15^{b}$±268.9 | 502.4±20.1 | $1291.7^{b}$±81.5 | 456.05±20.1 | 789.3±86.4 | 1.51±0.1 | 3.5±0.5 | $2.64^{a}$±0.13 |
| P4 | 647.9±39.8 | $2623.45^{b}$±96.9 | 482.8±44.7 | $1245.3^{b}$+74.4 | 436.45±44.7 | 762.3±75.9 | 1.49±0.1 | 3.5+0.4 | $2.63^{a}$±0.4 |

* Means followed by different superscripts indicate significant differences ($p$<0.05) among treatments.
** Means followed by different superscripts indicate very significant differences ($p$<0.01) among treatments.
+CF: Commercial Feed)
$VW: Vegetable Waste)
§Feed efficiency based only on commercial feed intake

$$^{(+)}FCR = \frac{Feed\ Intake}{Wight\ Gain}$$

$$^{(-)}FCR = \frac{Feed\ Intake}{Final\ Live\ Weight}$$

**Tabel 4.** Effect of Treatments on Nutrient Digestibility

| Treatments | AMEn (kkal/kg)* | Nitrogen Retention (%)** | Crude Protein Digestibility (%)** | Crude Fiber Digestibility (%)* |
|---|---|---|---|---|
| P0 | $2745.8^{a}$±215.4 | $84.85^{b}$±7.4 | $41.48^{b}$±1.36 | $65.06^{b}$±16.3 |
| P1 | $2764.2^{a}$±164.6 | $73.46^{a}$±5.7 | $28.84^{a}$±7.81 | $28.92^{a}$±15.24 |
| P2 | $3092.12^{b}$±30.5 | $80.83^{a}$±0.9 | $34.85^{a}$±0.81 | $47.18^{a}$±2.52 |
| P3 | $3085.7^{b}$±257.2 | $86.73^{b}$±4.3 | $40.09^{b}$±4.8 | $54.64^{b}$±14.57 |
| P4 | $2824.6^{a}$±191.3 | $82.94^{a}$±3.4 | $39.86^{b}$±5.58 | $47.39^{a}$±10.58 |

* Means followed by different superscripts indicate significant differences ($p$<0.05) among treatments.
** Means followed by different superscripts indicate very significant differences ($p$<0.01) among treatments.
P0= Feed formulation without vegetable waste
P1= treatment of the used 5% vegetables waste in 100% feed formulation
P2= treatment of the used 10% vegetables waste in 100% feed formulation
P3= treatment of the used 15% vegetables waste in 100% feed formulation
P4= treatment of the used 20% vegetables waste in 100% feed formulation

## IV. Conclusion

The results showed that the use of vegetable waste levels in broiler feed gave significantly different results on feed consumption, final body weight, FCR, and nutrient digestibility which are AME value, N retention, metabolic crude protein, and crude fiber digestibility compared to the control. The best use of vegetable waste is generated at a level of 15%

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