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RESEARCH PAPER

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Effect of forage-based feeds at different levels on the growth performance of Rhode island chicken

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Abstract

The study evaluated the effect of forage-based feeds at different levels on the growth performance of chickens. Formulated forage-based feeds were used to substitute commercial grower feeds at different levels of 0, 25, 50 and 75% in ration. The results showed that no significant differences on the initial and final weight. However, as with the gain in weight the highest was observed in Treatment 1 with 1040.11 grams which is not significantly different to Treatment 3 (1021.96) and Treatment 2 (925.35). The highest mean ADG was recorded in Treatment 1 (11.56g) which is comparable to Treatment 3 (11.36g) and Treatment 2 (10.28g) better feed conversion ratio was recorded in control group, however, lowest feed cost to produce a kilogram gain weight was observed in Treatment 3 thus increasing the profitability in poultry production without an adverse effect on performance and blood hematological profile. In conclusion, commercial grower feeds can be replaced with forage – based feeds up to 50% level without adversely affecting the growth performance of chicken.

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Introduction

Poultry farming has become one of the most important aspects of agriculture. However, the major concern in the poultry industry is the continuously increasing cost and competition for conventional feed materials. A possible way to reduce poultry feed costs is finding alternatives to conventional feed sources such as locally available forage feedstuffs.

The potential of forages and their application in the nutrition of chicken to improve productivity could be considered. Forages can provide a significant amount of poultry nutrition and reduce the amount of feed that a poultry farmer feeds a flock, Ndelekwute *et al.* (2018).

The primary benefit of forage consumption is that plant matter is typically high in both vitamins and minerals. Moreover, forages contain components such as fiber, protein, energy and other compounds such as carotenoids and fatty acids having important metabolic functions in all animals, including poultry Tufarelli *et al.* (2018). Forage plants can be successfully processed to enhance palatability, intake, and digestibility moreover to conserve and detoxify the anti-nutritional factors or concentrate nutrients, Martens (2013).

Benefits of feed processing methods include reduction of feed wastage and feed selection by the animals, less time and energy spent feeding, a decreased segregation of feed ingredients, and reduction of pathogenic organisms as well as anti-nutritional factors, Amerah *et al.* (2007), Abdollahi *et al.* (2013) & Sellers *et al.* (2020). Pelleting is a physical treatment used in the processing of diets with the aim of enhancing feed efficiency, Oliveira *et al.* (2022).

With the continuously increasing cost and competition for conventional feed materials, there is a need to search for alternative locally available feed resources which are not directly used by humans and are cheaper substitutes. Thus, this study aimed to utilize locally available non-conventional feedstuffs such as forages and evaluate its effects on the growth performance of chicken when replaced at different levels with commercial grower feeds.

Materials and methods

Time and place of the study

The experiment was conducted at the Poultry Multiplier Farm Project, CLIARC-Upland Development Station Sto. Nino Magalang, Pampanga

Experimental animals

A total of one hundred twenty (120), seven to eight weeks old Rhode Island Red chickens were utilized in the study. Experimental birds were randomly selected and assigned into four (4) treatment groups with three replications of ten birds per replicate.

Experimental treatments

There were four treatments in the study as follows:

T1- 100 % commercial starter feeds (control)

T2- 75% commercial starter feeds + 25% forage-based feeds

T3- 50% commercial starter feeds + 50% forage-based feeds

T4- 25% commercial starter feeds + 75% forage-based feeds

Experimental design

The study was laid out in Randomized Complete Block Design (RCBD) and experimental animals were allocated randomly in four treatment groups replicated three times with ten animals per replicate.

Preparation of experimental diets

Feed ingredients used in the formulation were procured and gathered on station. In preparing the experimental feeds, fresh leaves of trichantera, moringa, mulberry, and ipil-ipil were harvested and air-dried for one week. Using a hammer mill, the dried leaves were ground into powder to make leaf meal.

Forage leaf meals and other feed ingredients namely; copra meal and rice bran, were submitted to the Feed laboratory for proximate analysis before formulation and pelleting. Experimental feeds were formulated to meet the requirements of a growing chicken, particularly on protein content. Formulated feeds were mixed with commercial feeds following the treatments then pelleted into 2-3 mm pellet size and sundried before feeding to the experimental animals.

Feeding trial

The feeding trial period lasted 3 months or 90 days with fourteen days adjustment period. Birds per treatment were fed with their corresponding rations throughout the duration of the study. Ad libitum feeding was practiced. Feeding was done twice a day, at 8:00 in the morning and 3:00 in the afternoon. Fresh drinking water was provided at all times. During the feeding trial, the amount of feeds given and the leftover feeds of each treatment were weighed and recorded to determine the actual amount of feed consumed by the animal.

Other management

The experimental animals were housed in a 6x8 feet cage, equipped with an automatic drinker and feeder with 2x2 mesh wire and chicken wire walls and flooring. The poultry house was provided with a fluorescent lamp to enable the chicken to eat and drink at night.

Experimental birds were vaccinated with NCD B1B1 strain, NCD Lasota strain, Infectious Bronchitis, and Gumboro/Infectious Bursal Disease (CH/80 and GM97 strain) prior to the start of the feeding trial. Each pen was equipped with a feeder and drinker to allow ad libitum access to feed and water throughout the experimental period. Feeder and water trough were washed and cleaned every day. Disinfection of housing, cages, and the surrounding premises was done regularly using chemical disinfectants.

Parameters

Chemical analysis

Exactly 200 grams samples from different experimental treatments was submitted to the feed laboratory to test the nutrient composition. Samples were submitted to the Regional Feed Laboratory and were analyzed through oven- drying method (Moisture), Kjeldahl method (crude protein), Furnace ignition method (Ash), ANKOM filter bag technology (crude fat and crude fiber).

Growth Parameters

Body weight (Initial and Final weight): The experimental birds were weighed at the beginning and end of the feeding trial to determine the initial weight and final weight. The gain in weight of the birds was measured by subtracting the initial weight of the birds from the final weight.

Feed Intake: The daily feed intake of the birds was measured by recording the total amount of feeds given and the left- over on a daily basis. The left-over was deducted from the total feeds given in order to determine the actual feed intake.

Average daily gain (ADG): ADG can be defined as the average amount of weight an animal will gain each day during the feeding period. ADG was calculated by taking the amount of weight an animal gained and divided by the total number of days the animal had been fed.

Feed Conversion Ratio (FCR): The feed conversion ratio of the experimental birds was estimated based on the ratio of the average amount of feed eaten over the mean gain in weight.

Blood Analysis

Blood collection was conducted at the end of the feeding trial for the hematological parameters. Exactly 2 ml blood was extracted from the wing vein using a 3ml sterile syringe. The blood was transferred into a rubber top vacutainers containing Ethylenediamine tetraacetic acid (EDTA) to prevent clotting. Hematology profile assessment included Hemoglobin (Hb), Packed Cell Volume (PCV), Total RBC count, Total WBC count, Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscle Hemoglobin Concentration (MCHC).

Feed cost to produce a kilo of gain in weight

The cost of feed was the sum total of the cost of each ingredient used in compounding 100 kg of a diet; from this, the cost per kg was calculated. Price per kilogram of ricebran, copra meal, molasses, salt, limestone, forage leaf meal (mulberry, trichanthera, ipil-ipil leaves), and moringa leaf meal used was P12.5, P19, P35, P20, P20, P5, and P10 respectively. The total computed cost of formulated forage-based feeds including the estimated labor cost for pelletizing was P12.5 while the commercial starter used was P30 per kilogram. Upon following the combination at a different level of experimental diet, the computed price per kilogram of feeds was P30, P25.63, P 21.25, and 16.88 for Treatment 1,2,3, and 4 respectively.

Results and discussion

Chemical analysis of experimental diet

The proximate analysis of the experimental treatments is presented in Table 1. Based on the result of the analysis, Treatment 1 (control diet) obtained the highest crude protein content with 18.7% while Treatment 4 (25% commercial feeds + 75% forage-based feeds) had the lowest with 15.9%. Crude protein decreased when the level of formulated feed increased. However, the ash content of the formulated diets increased as the replacement level of forage–based feeds in commercial feeds increased. The differences in the values could be attributed to differences in processing methods, harvesting time, and processing methods such as drying and pelleting methods employed, Abora (2013). The higher fiber content in feed sample was recorded in all diets with forage-based feeds ranging from 8.9 to 11%. Fiber is naturally present in plant- based feed ingredients and constitutes an important component in poultry diets, Saadatmand (2019).

Table 1. Chemical analysis of different experimental diet.

Components*	T1	T2	T3	T4
Crude Protein	18.7±0.1	18.4±0.6	17.4±0.3	15.9±0.3
Moisture Content	9.8±0.1	9.6±0.2	9.5 ± 0.2	9.5 ± 0.1
Ash Content	7.0 ± 0.2	8.8±0.1	10.0±0.4	11.7 ± 0.1
Crude Fat	4.4 ± 0.1	4.1±0.1	4.1 ± 0.2	4.2 ± 0.1
Crude Fiber	3.8 ± 0.1	10.6±0.1	8.9± 0.5	11.0 ± 0.1

* T1 -100% Commercial Feeds (CF), T2 - 75% CF + 25% Forage- based Feeds (FF), T3 - 50% CF + 50% FF, T4 - 25% CF + 75%FF

Mean Initial, Final weight, Gain in weight and Average Daily Gain in Weight (grams)

Mean Initial, Final weight, Gain in weight, and Average Daily Gain in Weight (grams)

The mean initial weight, final weight, gain in weight and average daily gain are presented in Table 2. No significant differences were observed by the study in terms of the Initial weight and final weight of the birds. However, birds gain in weight found significance among treatments. The highest was observed in T1 (1040.11g) which is not significantly different to T3 (1021.96) and T2 (925.35). The highest mean ADG was recorded in T1 (11.56g) which is comparable to T3 (11.36g) and T2 (10.28g). This implies that Treatment 2 and 3 could be used to replace Treatment 1.

Table 2. Mean Initial weight, final weight and gain in weight of birds, grams.

Treatment*	Initial Weight**	Final Weight**	Gain in Weight**	Average Daily Gain (ADG)**
T1	542.86	1582.96a	1040.11a	11.56a
T2	527.74a	1453.10a	925.35a	10.28a
T3	598.00a	1619.96a	1021.96a	11.36a
T4	607.37a	1312.38a	705.01b	7.83b
			CV-7.82%	CV-7.82%

* T1 -100% Commercial Feeds (CF), T2 - 75% CF + 25% Forage- based Feeds (FF), T3 - 50% CF + 50% FF, T4 - 25% CF + 75%FF

**Means having the same superscript do not vary significantly at 5% level of significance

Locally available feedstuffs and forages could be used as a substitute for commercial feeds due to the high vitamin and mineral content of forage including fiber, protein, energy (calories), and other compounds like carotenoids and omega-3 fatty acids that are important for metabolic functions in all animals. In addition, Ndelekwute *et al.* (2018) stated that farmers are encouraged to include forages at a recommended level in feeding due to its potential in chicken nutrition and production which was agreed upon by Tufarelli *et al.* (2018) recommending feeding forage as a substitute to conventional cereals/grains such as corn and soybean to reduce the dependence on these feedstuffs will benefit poultry production.

Feed Intake, Feed Conversion Ratio and Feed Cost to Produce a kg gain in weight

Table 3 shows the average mean feed intake, feed conversion ratio (FCR) and feed cost per kg gain in weight of different experimental treatments. The highest mean feed intake was recorded in Treatment 4 (5.96kg) and the lowest was observed in Treatment 1 with 5.04 kg/bird. The recorded feed conversion ratio was lowest in T1 and the highest was observed in T4.

The result shows that as the level of formulated forage-based feeds increased the feed intake of chicken increased ranging from 8.13 to 18.25% resulting in to significantly higher feed intake of birds in Treatment 4 as compared to the control group (T1). According to Chrystal *et al.* (2020), declining protein content in the diet increases the feed intake of the chicken to compensate for the nutrient deficit. Ferket and Gernat, (2006) stated that an increase in the fiber content of the diet diluted dietary energy where chickens acclimatize to the new condition by increasing the feed intake and thus increasing the feed conversion ratio. Rijaluzzaman *et al.* (2020) also reported that rations with high crude fiber significantly increased feed consumption and affected FCR which is a measure of how well a bird converted feed consumed into live weight.

Birds in Treatment 3, fed with 50% commercial feeds + 50% forage-based feeds, were recorded to have significantly lowest cost to produce per kilogram gain in weight amounting to P116.54 which is 22.78% to 29.53% lower than the other treatments. The results indicated that feed costs will be reduced with the utilization of locally available forages and agricultural by-products in the conventional feeds at a certain level without an adverse effect on the growth performance of chicken.

Table 3. Mean feed intake, feed conversion ratio and feed cost to produce a kilogram gain in weight.

Treatments*	Feed intake (kg)**	FCR (kg)**	Feed cost (peso)**
T1	5.04 b	4.87 c	146.08a
T2	5.45ab	5.89 b	150.95a
T3	5.59ab	5.48 b	116.54 b
T4	5.96a	8.48a	143.09a
	CV- 5.38%	CV- 4.74%	CV – 5.48%

* T1 -100% Commercial Feeds (CF), T2 - 75% CF + 25% Forage based Feeds (FF), T3 - 50% CF + 50% FF, T4 - 25% CF + 75%FF

**Means having the same superscript do not vary significantly at 5% level of significance

Effect of forage-based feeds at different levels on hematological profile

The effects of different levels of forage-based feeds on the hematology of Rhode Island Red chicken are presented in Table 4. Results show that there were no significant differences in the hematological parameters among all treatment groups. All values for the treatment diets were comparable to those of the control diet.

Table 4. Blood hematology of Rhode Island chicken fed with different levels of forage-based feeds.

Particulars	Treatments			
	1	2	3	4
RBC Count (cells x 106 /ul)	5.87	5.37	4.77	5.23
Packed Cell Volume (%)	31.00	27.67	25.67	25.33
Hemoglobin (g/dl)	10.33	9.23	8.57	8.43
MCV (fl)	52.63	51.54	56.23	48.35
MCH (pg)	17.54	17.20	18.76	16.10
MCHC (g/dl)	33.31	33.36	33.38	33.28
WBC count (cells/ul)	25080.00	47520.00	15180.00	15180.00

* T1 -100% Commercial Feeds (CF), T2 - 75% CF + 25% Forage- based Feeds (FF), T3 - 50% CF + 50% FF, T4 - 25% CF + 75%FF

**Means having the same superscript do not vary significantly at 5% level of significance

The Packed Cell Volume (PCV) value recorded in this study was found highest in birds fed with control diet (T1) at 31% but not significantly different among birds fed different levels of formulated feeds with 27.67%, 25.67%, and 25.33% for Treatment 2, 3 and 4 respectively. Hemoglobin (Hb) value was comparable among all treatment groups with the highest value recorded in T1 (10.33g/dl) though not significant, followed by T2 (9.23), T3 (8.57), and T4 (8.43). These results showed that formulated forage feeds at varying levels did not significantly affect the PCV (%) and hemoglobin (g/dl) of the experimental birds as the PCV and hemoglobin level was within the normal reference value of 25-45% and 7-13g/dl for healthy birds similar to the report of Bounous *et al.* (2000). Moreover, Adejumo (2004) reported that PCV and Hemoglobin were positively correlated with the nutritional status of an animal. A PCV value beyond the normal reference range is an indication of dehydration in most birds while low PCV and Hb values indicate an anemic condition in the birds as stated by Pendl (2001).

The total red blood cell count (RBC) obtained in this study varied from 4.77- 5.87 (cells x 106 /ul) was higher than the normal reference value of 2- 4 (cells x 106 /ul) Banerjee (2006). An increase in the number of red blood cells in this study might have been due to several factors such as sex, age, genus, temperature, geographical condition, management, physical activity, handling, and stress which affect the erythrocyte concentration in the blood. in excitable animals, it is difficult to get a correct picture of erythrocytes density from the examination of a blood sample.

Handling the animal and drawing blood samples activate the sympathetic nervous system to a varying degree, causing mobilization of stored erythrocytes. It takes an hour for the erythrocyte number in the circulating blood to attain the normal state after the animal has been frightened.

The mean corpuscular hemoglobin concentration (MCHC) value range of 33.28 - 33.38g/dl obtained in this study was within the normal reference Huff *et al.* (2008) (31- 33.38g/dl) (26-35g/dl). According to Howlett (2000) a low MCHC value of less than 29.0g/dl can be attributed to iron and other trace element deficiency as stated by Howlett, (2006).

The Mean Corpuscular Volume (MCV) (48.35-56.23fl) and Mean Corpuscular Hemoglobin (MCH) (16.10- 18.76 pg) values recorded were below the reference range of 90- 140fl for MCV and 33.0-47.0pg for MCH. The decrease in the MCV and MCH values might not be relative to the phytoconstituents or anti-nutritional factors that may be present in forage feeds because the values for MCV and MCH in the control diet were also below the normal range.

This result may suggest that the reduced MCV and MCH values recorded in the study may be a result of other factors that affected the blood indices in the experimental birds. According to Huff *et al.* (2008), the decrease in the MCV and MCH levels is an indication that the birds were exposed to stressors. Stress conditions cause unstable blood constituents such as high temperatures, time of blood collection, and handling of the animals.

The total white blood cell count (WBC) recorded for birds in the control diet, treatments 3 and 4 fell within the normal reference range of 4,167- 37, 121 cells/ul Carisch (2019). As stated by Eroschenko, (2000) this may imply that the immune system of the birds was not compromised because the white blood cells function primarily as defense system in the body. Furthermore, Yakubu, (2017) reported that animals with low white blood cells are exposed to a high risk of infection while those in normality have a high degree of resistance to diseases. WBC of experimental birds on treatment 2 however was above the normal reference range with 47,520 (cells/ul) and according to Saputro *et al.*, 2013, an increased white blood cell signifies bacterial infection or the presence of a foreign body or antigen in the circulating system.

Conclusion

Based on the result of the study, it was concluded that commercial grower feeds can be replaced with forage–based feeds up to 50% level without adversely affecting the growth performance of chicken. The use of locally available forage feedstuffs as an alternative to commercial feeds could be an input to lessen production costs in raising chicken. It is recommended to identify, utilize, properly process and formulate locally available low – cost effective feed material such as forages at a recommended level which have potential in chicken nutrition, cost reduction, profit maximization, and sustainable supply of feeds.

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References

Abdollahi MR, Ravindran V, Svihus B. 2013. Influence of grain type and feed form on performance, apparent metabolisable energy and ileal digestibility of nitrogen, starch, fat, calcium and phosphorus in broiler starters. Animal Feed Science and Technology **186(3-4),** 193-203.

Abora N. 2013 Growth performance, blood profile and carcass characteristics of growing pigs fed diets containing varying levels of soybean milk residue. Animal Nutrition and Management.

Adejumo DO. 2004. Performance, organ development and haematological of rats fed sole diets of graded levels of cassava flour and soybean flour (Soygari) as substitutes for energy and protein concentrates. Trop. J. Anim. Sci **7,** 57-63

Amerah AM, Ravindran V, Lentle RG, Thomas DG. 2007 Influence of feed particle size and feed form on the performance, energy utilization, digestive tract development and digesta parameters of broiler starters. Poultry Science **87(11),** 2320-8

Banerjee GC. 2006 Poultry (3rdedition). Oxford and IBH publishing Co. Pvt. Ltd. New Delhi pp. 168-172.

Bounous D, Stedman N. 2000 Normal avian hematology: chicken and turkey. In: Feldman BF, Zinkl JG, Jain NC, editors. Schalm's Veterinary Hematology. New York: Wileyp 1147-1154.

Carisch L, Stirn M, Hatt JM, Federer K, Hofmann-Lehmann R, Riond B. 2019 White blood cell count in birds: evaluation of a commercially available method. BMC Vet Res **15(1),** 93. DOI: 10.1186/s12917-019-1834-8. PMID: 30866927; PMCID: PMC6417236.

Chrystal PV, Moss AF, Khoddami A, Naranjo VD, Selle PH, Liu SY. 2020 Impacts of reduced-crude protein diets on key parameters in male broiler chickens offered maize-based diets. Poult Sci **99,** 505-16. DOI: 10.3382/ps/pez573

Eroschenko VP. 2000. Di Fiore's Atlas of histology with functional correlations, 9th ed. Lippincott Williams and Wilkins, USA.

Ferket PR, Gernat AG. 2006 Factors that affect feed intake of meat birds: A review. International Journal of Poultry Science **5(10),** 905-911

Howlett JC. 2000. Clinical and diagnostic procedures. In Samour JH (ed): Avian Medicine. London, Harcourt Publishers Ltd pp 28-50

Huff GR, Huff WE, Rath NC, Anthony NB, Nestor KE. 2008. Effects of Escherichia coli Challenge and Transport Stress on Hematology and Serum Chemistry Values of Three Genetic Lines of Turkeys1, Poultry Science **87(11),** 2234-2241.

Martens SD, Hoedtke S, Avila P, Heinritz SN, Zeyner A. 2013. Effect of ensiling treatment on secondary compounds and amino acid profile of tropical forage legumes, and implications for their pig feeding potential. Journal of the Science of Food and Agriculture. DOI: 10.1002/jsfa.6375

Ndelekwute EK, Enyenihi GE, Akpan IP. 2018 Potentials and Challenges of Utilizing Forage Resources for Chicken Production. Crit Care Obst & Gyne **2(1),** 4

Oliveira LMS, Silva PG, Silva MRS, Cordeiro DA, Souza LP, Minafra CS, Santos FR. 2022 Effect of Moisture, Particle Size and Thermal Processing of Feeds on Broiler Production Raz. J. Poult. Sci. **24(4)** 64-98 https://doi.org/10.1590/ 1806-9061-2020-1391

Pendl H. 2001 Avian hematology for practitioners. Proc Assoc Avian Vet, 2001, pp 387-400

Rijaluzzaman MA, Srianto P, Nidom CA Fajarwati R. 2020 Indian Journal of Forensic Medicine and Toxicology **14,** 2086-90

Saadatmand N, Toghyani M, Gheisari A. 2019 Effects of dietary fiber and threonine on performance, intestinal morphology and immune responses in broiler chickens. Anim Nutr **5(3),** 248-255. DOI: 10.1016/j.aninu.2019.06.001. Epub 2019 Jun 22. PMID: 31528726; PMCID: PMC6739262.

Saputro B, Santoso PE, Kurtini T. 2013. The effect of vaccine administration methods to broiler on antibody tither, total erythrocyte and leukocyte. J. Ilmiah Peternakan Terpadu. **(2)3,** 43-48

Sellers RB, Brown AT, Boney J, McDaniel C, Moritz JS, Wamsley KGS. 2020 Impact of feed form, liquid application method, and feed augering on feed quality, nutrient segregation, and subsequent broiler performance. Journal of Applied Poultry Research **29(4),** 895-916.

Tufarelli V, Ragni M, Laudadio V. 2018. Feeding Forage in Poultry: A Promising Alternative for the Future of Production Systems. Agriculture **8,** 81.

Yakubu MT, Akanji MA, Oladiji AT. 2017. Haematological evaluation in male albino rats following chronic administration of aqueous extract of Fadogia agrestis stem. Pharmacogn Mag **3,** 34.