Evaluation of Corn-Duckweed Meal (*Lemna minor*) Based Diets as Practical Ration for Native Chicken (*Gallus domesticus* Linn.)

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***Abstract*—The study was conducted to determine the growth performance of the Rhode Island Red Chicken fed duckweed meal as a protein ingredient of the organic feeds for free-range chicken. The 75-day old experimental birds were subjected to the three (3) dietary treatments consisted with the control, 10%, and 15% duckweed meal of corn-duckweed meal based organic chicken diets. The nutrient composition of the experimental diets was 14.0% CP, and 2639-2697 ME, kcal kg-1. The feed consumption, FCR, gain in weight, final weight, ADG, average cost per kg of LW produced, mortality rate, and haematology values which include: Hemoglobin (HGB); Hematocrit (HCT); Leucocyte count, Segmenters (Neutrophils) and Lymphocytes were the parameters used to evaluate the effects of the treated diets on the growth performance of the 75-day old Rhode Island Red. The results revealed that no significant effect was observed on the growth performance of 75-136 days old Rhode Island Red (RIR) as affected of the corn-duckweed meal-based feed formulation. Nevertheless, diets containing 15 % duckweed meal recorded to have the least FCR value of 5.23 and cost per kg of LW produced of Php 105.52/ $2.28. The haematological values were comparable among treatment groups. Further study to evaluate the efficacy of the same feed formulation to starter and grower chicks on digestibility of feed and carcass quality can be conducted.**

***Index Terms*—Bataan, duckweed meal, feed formulation, free–range chicken, organic feeds**

I. Introduction

Native chickens have a competitive edge over the conventionally produced strains basically for a strong niche market for free-range meat and eggs. Native chicken farming is considerably a less-cost venture. With the growing demand for organic foods, consumers are prepared to pay higher prices to get free range native chicken and eggs primarily for better taste and quality. It is therefore, imperative that development effort has to be undertaken to make native chicken farming to be as efficient and sustainable as possible. To widen and strengthen the opportunities for native chicken, the key players and actors in the industry must be able to have the technologies and support mechanisms that will warrant the sustainability of the enterprise. Apart from the improved local breeds, the unavailability of compound feeds for native chicken in the market remains to be an issue and gap in-terms of production efficiency and sustainability of the sector.

The development of compound feeds for native chicken using locally available indigenous ingredients as pressing the needs and demand of the native chicken sector must be undertaken. The organic based formulated feeds once developed and become available in the market will definitely create improvement on the efficiency and competitiveness of native chicken sector and possibly would encourage more players in the industry. It is therefore, imperative that the other potential indigenous protein plant sources which are cheap and easy to establish be explored [1]. Duckweed has a potential as protein-based ingredient for native chicken diet [2]. Generally, duckweed is suitable for human and animal consumption and is rich in invaluable nutrients [3]. The commercial feeds is relatively costly, thereby, supplemental feeding is more economical [4].

The plant is rich in macro and micro- elements such as calcium and chlorine has a protein content ranges between 6.8 to 45.0% DM [5]. The potential of using duckweed as feed for chickens is based on the high protein content and fast accumulation of biomass of this plant compared to other terrestrial plants [1]. The low fibre content (2.7 to 18.7% makes the plant to be easily digested by chickens [6], [7]; reported that duckweed has 0.5% Phosphorous DM content of the plant. Duckweed has also a higher calcium content than soybean meal which indicates that duckweed is a better source of minerals than soyabean [7]. However, using duckweed as feed has to establish whether the mineral content in the

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duckweed matches the requirement of the stock and act accordingly as incorrect levels might be detrimental to the health or development of the birds [8]. Duckweed species have been proven to be high in amino acids that are required for the growth of chicken [9]. In addition to the favourable array of amino acids, the plant has high concentration of pigments and xanthophyll that make this plant a valuable supplement for poultry and livestock [10]. The duckweed therefore becomes economically important because of the costly high value protein feedstuffs in chicken diets. This study focuses on compounding complete rations that have duckweed as ingredient. Further, the study conducted evaluate the growth performance and haematological values of the free-range chicken as affected by corn-duckweed meal based organic feeds.

II. Materials and Methods

A. Description of the Study

The practical feed for free -range chicken consisted of duckweed meal as plant protein ingredient was formulated and evaluated for 75 day- old Rhode Island Red (RIR) chicken. The experimental plant (Lemma menor sp) was cultured in the 2m × 10m (60cm deep) growing pond. The fresh duckweeds were converted into meal form by sun -drying and oven-drying. The plant was sun-dried for five (5) days followed by oven -drying at 100°C for 15 minutes. The experimental diets were formulated to have a similar nutrient content. The feed formulation differs on the levels of the feed ingredients used in the mixture.

B. Feed Analysis

The nutrient composition of the experimental feeds was analyzed through Kjeldahl method for moisture and crude protein contents; furnace-ignition method for ash; ANKOM filter bag technology for crude fat and ANKOM filter bag technology for Crude Fiber.

C. Experimental Design, Treatments and Layout

A total of 150 heads of 75 -day old Rhode Island Red Breed was used and subjected for 60-day feeding trial under the three (3) major dietary treatments at five (5) replications having 10 birds for each replication. The experimental diets were composed with rice bran, yellow corn, molasses, limestone, salt, fish meal and duckweed meal. The experimental treatments were as follows.

T1- Control (no duckweed)
T2- 10% DWM corn -based formulated diets
T3- 15% DWM corn -based formulated diets

D. Production Parameters

The efficacy of the formulated diets as affected by Fermented Duckweed Meal (FDM) at varying levels was evaluated for Rhode Island Red free -range chicken. The data gathered and evaluated were: Average Daily Gain (ADG), Average Feed Consumption, Feed Conversion Ratio, Average Final Weight, Mortality, Cost per kg of bird Produced and Haematology.

E. Blood Collection and Haematological Measurements

At 100 days of age two birds were used from each replicate for bleeding. Blood was extracted from wing vein into anticoagulant EDTA treated tubes for determination of haematological parameters. The haematological parameters will be analyzed using Automatic Fully Digital haemetological Analyzer, BC 3000 Plus, ShenzhenbMinday, Bio-Medical Electronics Co. LTD. These include: Total Red Blood Cell (RBC); Total White Blood Cell (WBC); Hemogrlobin (HGB); Hematocrit (HCT); Mean Corpiscular Volume (MBC); and Mean Corpuscular Hemoglobin (MCH) and Thrombocyte (T), [11].

F. Statistical Analysis

All the data was subjected to Analysis of variance (ANOVA) for single factor experiment (CRD) using the Statistical Tool for Agriculture Research. Significant differences among treatments were determined at 0.5% and 1.0% level by Least Significant Difference (LSD).

TABLE I. Nutrient Composition of the Experimental Diets[1]

Ingredients	Treatment 1	Treatment 2	Treatment 3
Yellow corn	56.9	45.27	48.538
Fish meal, 60%	2.10	4.93	5.763
SO meal (full fat)	19.8	9.60	7.253
Duckweed meal	-	**10.00**	**15.00**
Rice bran (D1)	15.0	24.00	17.561
Molasses	5.0	5.00	4.683
Limestone	1.0	1.00	1.00
Salt	0.20	0.20	0.20
Total	100.00	100.00	100.00
Calculated Analysis			
Crude Protein, %	14.0	14.0	14.2
ME, Kcal/kg	2639	2629	2697
Moisture Content, %	12.5	12.9	13.7
Crude fat, %	1.0	1.5	2.3
Ash, content %	11.1	12.6	4.9
Crude Fiber, %	4.0	6.0	8.5
Phosphorus, %	0.28	0.53	.61
NFE, %	61.3	66.03	59
Calcium, %	0.826	0.78	0.826
Lysine, %	1.3	1.16	1.31
Methionine, %	0.410	0.382	0.411
Met + Cysteine, %	0.923	0.824	0.924

[1] The nutritive values of these experimental diets were determined through standard feed analysis procedure at Feed Chemical Analysis Laboratory with laboratory report no. 2020-283, Department of Agriculture-Regional Field Unit, San Fernando, Pampanga, Philippines.

As seen in Table I, as closely related to the chemical composition of deoiled rice bran [12] the corn-duckweed meal based experimental diets uses the locally available feed ingredients. The 10 and 15 percent inclusion levels of duckweed meal in the formulated diets were used to determine the efficacy and practicality of the feed for free-range chicken by partial reduction of soya bean meal in the ration.

III. Results and Discussion

As reflected in Table II, the growth performance of the experimental birds from 75-136 days of age fed with the formulated diets containing 10 and 15 percent duckweed meal did not affect significantly (P>0.05) on body weight gain, ADG and feed consumption during the two (2) months feeding period. Observably, the weight gained, daily gained and feed intake of 75 -106 days of age birds at the control group were higher from the duckweed meal treated diets (Table III). However, it was observed that higher mean values were obtained at feed formulation with 15% duckweed meal. The present findings support the claimed of Putra and Ritonga (2018) that body weight, feed efficiency and body weight gain of the growing native chicken were similarly affected of the varying inclusion levels of duckweed meal in the diet [13]. The same results was observed on the daily gains and feed efficiency of ducks at the reduced levels of soybean in the diets [7]. Meanwhile, it was claimed that the feed conversion ratio, feed intake and yolk pigment were affected by feeding of different forms of duckweed [14]. Duckweed had generally a positive effect on daily gains of chicks at diets at 22% CP [15].

The comparable results among treatments means of the 75 to 136 days old Rhode Island Red (RIR) were observed from the measured performance variables. The feed formulation with 15% duckweed meal had a FCR value of 5.23 and cost per kg of LW produced of Php 105.52/ $2.28. The present findings prove that feed efficiency affects the cost of producing per kg of live weight of growing birds. The liveweight gained of the RIR growers were not affected of the reduced feed intake. The formulated diets with reduced levels of soybean meal did not alter the growth performance of the 75-136 days old RIR. The results simply imply that soybean meal can be substituted by duckweed meal for compound feed of the dual-type chicken breed. In related works, duckweed as a source of protein for laying hens is possible to replace up to 40% of the diet with duckweed without problems (Bacerrra *et al.* 1995).

The data on haematological values are presented in Table III. No significant difference in the complete blood analyses were found among the experimental birds fed of the treated groups. The hematocrit and hemoglobin values were significantly higher in diets without duckweed meal (P<0.05), while the leucocyte count was higher in 10% duckweed meal formulated diets (P<0.05). Similarly, the control group and treatment 2 (10% duckweed meal) had obtained the same lymphocytes value of 0.59. The haematological parameters were lower than the normal numeric values of each test. The numeric difference between the results and the normal homological values confirms the efficiency of the feeds formulated solely out of the feedstuffs with no added supplements and additives.

TABLE II. Average Growth Performance of Rhode Island Red (RIR) from 75 to 136 Days of Age[2]

Treatments	FCR	Gain in weight (g)	Final weight (g)	Feed intake (g)	Mortality%	Cost/kg LW produced, (PhP)
Treatment 1- no duckweed meal in the formulated diets	6.07	1.26	2.41	119	7.72	115.86
Treatment 2- 10% duckweed meal of the formulated diet	7.39	1.00	2.10	121	4.09	145.11
Treatment 3- 15% duckweed meal of the formulated diet	5.23	1.19	2.31	102	7.19	105.52
CV (%)	22.45	9.09	9.01	3.89	108.01	22.13

TABLE III. Hematological Parameters as Affected with Varying Inclusions of Duckweed Meal

Treatments	Hematocrit (0.37-0.47)	Hemoglobine (120-150 g/l)	Leucocyte Count (10×10^9 g/I)	Segmenters (0.50-0.70)	Lymphocytes (0.10-0.40)
Treatment 1- no duckweed meal in the formulated diets	0.3560	118.80	3.12	0.4020	0.5900
Treatment 2- 10% duckweed meal of the formulated diet	0.3420	114.00	4.90	0.3900	0.5980
Treatment 3- 15% duckweed meal of the formulated diet	0.3420	114.00	4.32	0.4960	0.4920
CV (%)	11.44	11.39	26.40	48.86	37.31

[2] Not significant at the level 0.50% by LSD

IV. Conclusion and Recommendations

The present study demonstrated that corn-duckweed practical diets have potential to replace the soybean meal without compromising the growth performance and haematological profile of Rhode Island Red. This information is indispensable in the light of selecting the most cost-effective organic-based diet for free-range chicken and possibly, other avian commodities. Further culture trial is necessary to verify the efficacy of duckweed of higher proportion, and other species of Lemna spp., with emphasis on appraising the reproductive performance and carcass nutritional quality of the treated chicken.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Hemogenes Paguia led the conduct of the research study; Ma. Florinda O. Rubiano facilitated the logistical support; Abigail G. Abuan assisted the validation of the research parameters; Eleazar G. Marabe was the one responsible to gather and consolidate the research data; Cherlyn Gripo was assigned to conduct the statistical analysis of the data for the study; and Gregorio J. Rodis assisted the validation of the research parameters; all authors had approved the final version of the research paper.

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