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Effects of Frangipanni (*Plumeria Rubra*) Leaf Meal as Feed Additive on the Performance and Egg Laying Index of Hy-Line Brown Birds

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ABSTRACT

A study was conducted to investigate the effect of dietary Plumeria rubra leaf meal (PRLM) as a natural alternative to antibiotic on the performance, egg laying and carcass yield of Hy-Line Brown Layerbirds. A total of sixty points of lay birds were randomly weighed and assigned to four dietary treatments having 15 birds in each. Each dietary treatment had three replicates of 5 birds and was reared in floor pens. Birds were distributed in 4 different inclusion levels of PRLM in diets; 0.0%, 10%, 15% and 20% respectively. The birds were fed the experimental diets and water was provided ad-libitum throughout the experimental period. The results showed that significant (P<0.05) effect on final body weight and weight gain in dietary supplementation of 15% PRLM as compared to that of control group. Better feed conversion (1.53) was observed at 15% PRLM group. Different levels of PRLM exhibit significant influence on egg laying performance of layers. There was no significant difference (P>0.05) observed among the average live weight, thigh meat, wing meat and drumstick meat. Lower mortality was found on diet supplemented with PRLM. It is concluded that 15% PRLM in layer diets can be used as natural feed additive for enhancing performance and egg lay in layer production.

Keywords: *Plumeria rubra leaf meal (PRLM), Natural alternative to antibiotic,Growth performance, Egg laying,Carcass yield,Hy-Line Brown Layerbirds.*

INTRODUCTION

The very high cost of poultry feed has limited the expansion of the poultry industry as this has forced many poultry producers to folding. This has further drawn the already low intake of animal protein by Nigerians. Feed additive is however expensive as a feed ingredients and this therefore increased the cost of poultry production. In order to prevent this trend, efforts are being directed towards the use of some unconventional and cheaper feed ingredients as additives with locally available, cheaper and quality feed ingredients. The use of *Plumeria rubra* leaf meal to replace feed additives in layer diets is a possible way of reducing feed cost and producing cheaper eggs and meat for the populace.

The productivity of Nigerian livestock is well below their genetic potential mainly due to poor nutrition and inadequate quality feed. The high cost and poor quality of finished feed in the recent past have caused serious economic losses in poultry in Nigeria (Gupta *et al.*, 2007). Effort to improve this situation according to (Ahaotu *et al.*, 2019b), include harnessing the potentials of good quality and relatively inexpensive feed ingredients as replacements of the more expensive feed ingredients.

Plumeria rubra L. a member of family Apocyanaceae is a common ornamental plant distributed throughout the tropics and cultivated near gardens. The plant is used as medicinal agents to cure infections and digestive diseases in farm animals (Ahaotu *et al.*, 2019a).The leaves were reported to have analgesic-antipyretic, anti-inflammatory, anti-tumor potential and antioxidant properties (Rupali and Alka, 2014).

The plant is reported to contain amyrinacetate, mixture of amyrins, ß-sitosterol, scopotetin, the

iriddoids isoplumericin, plumieride, plumieride coumerate and plumieride coumerate glucoside (Kumar *et al.,* 2009).Phytochemical screening showed that *P. rubra* contained several biologically active compounds such as plumericin and isoplumericin that displayed molluscicidal, cytotoxic and antibacterial activities as well as cyanidin 3-*O*-β- (2″-glucopyranosyl-*O*-β-galactopyranoside) and cyanidin-3-*O*-β-galactopyranoside (Gupta *et al.*, 2007) which were responsible for the attractive colours of the flowers of red *P. rubra*. Antimicrobial iriddoids, plumeridoids A-C, epiplumeridoid C (Sharma and Kumar, 2012) and cytotoxic iriddoids, fulvoplumerin, allamcin, plumericin and allamandin were the other constituents of *P. rubra* (Asolkar *et al.*, 1992).

Extract of leaves of *Plumeria rubra* (L.) showed significant antibacterial activity against *Streptoccocus, Epidermidis* and *Escherischia strains* (Gopi *et al.*, 2011). Methanolic extract showed antimicrobial activity against *Bacillus anthracis, Pseudomonas aeruginosa* (Ramayana *et al.*, 2012). Leaves are found to have antiulcer activity, whereas flowers have profound antioxidant effects (Ogunwande *et al.*, 2015). Leaves of *Plumeria rubra* were found to be a good source of natural dye for producing various green, ivory and brown shades on silk cloth (Byamukama *et al.*, 2011).

Various parts of the plant are useful as medicine. In Ayurveda it is used in malarial fevers, antiseptic and stimulant. Ilyas *et al.*, (2016) stated that the leaves of *Plumeria rubra Linn* is used to cure ulcer, leprosy, inflammation, rheumatism, bronchitis, cholera, rubifacient, cold and cough while Farooque *et al.*, (2012)stated that *Plumeria rubra Linn* plant is traditionally used for the treatment of diarrhea, dysentery and typhoid.

Using *Plumeria rubra* leaf meal as a feed additive in layer diets will go a long way in reducing the cost of production in poultry enterprise thereby making animal protein more available to the populace and also improving the profitability of the poultry farmers.

The study evaluated the addition of *Plumeria rubra* leaf meal as feed additive to laying hens for a period of 4 weeks and assessed the inclusion of *Plumeria rubra leaf* meal as a feed additive to improve performance and hen day egg production of Hy-line brown laying birds.

Figure1. *Dorsal View of the leaf*

Figure2. *Ventral view of the leaf*

MATERIALS AND METHODS

Preparation of Frangipani Leaf Meal

Plumeria rubra leaf *was* collected from the botanic garden of Forestry Department, Imo State Polytechnic Umuagwo, Nigeria and stored in polythene bags after shade drying and grinding for further analysis and addition to feed. The flowers were stripped off, washed, allowed to drain and spread in a well-ventilated room to dry for five days. Shade- dried *Plumeria rubra* leaf was milled into powder using a blender (National Mx-795N), sieved with a muslin cloth and stored for used.

The leaf meal was then be analysed for chemical composition in the department of science laboratory technology, lmo State Polytechnic Umuagwo, according to standard procedures (AOAC, 2005).

Preparation of Crude Extract

The leaves collected were dried under shade and then powdered with a mechanical grinder and stored in airtight container. The dried powder material of the leaves was defatted with n-hexane and allowed to dry. The product thus obtained was then extracted with methanol in a Soxhlet apparatus. The solvent was completely removed under reduced pressure and a semisolid mass was obtained.

Experimental Animals

Sixty (24 weeks old) Hy-line brown laying birds was assigned to four treatments and three replicates with five birds each in a completely

randomized design. PRLM were added at (0, 5, 10 and 20g PRLM /kg) levels to the four experimental diets.

Data Collection

A daily feed allowance of 100g per bird was offered. Feed offered, feed refused, feed intake and mortality were recorded daily and tabulated cumulatively for FCR every week. Daily egg production was recorded from each experimental unit separately to calculate various parameters, including egg weight, feed per dozen eggs and feed per kg eggs. Egg laying was taken at the start of the experiment and then every day throughout the experimental period. Three eggs were picked at random from each unit and subjected to egg circumference measurement. Bird handling and collection of samples were carried out.

Data Analysis

Data collected were analysed through one-way ANOVA (Steel *et al*., 1997) using PROC GLM in SAS software (SAS Inc. 9.4). Significant means were separated through Duncan's multiple range tests (Gordon and Gordon, 2004).

Table1. *Composition of the Experimental Diets (Layers 24-32 weeks)*

Ingredients	Treatments			
	$T_1$0	$T_2$5	$T_3$10	$T_4$20
Maize	40.0	40.0	40.0	40.0
Wheat Offal	20.0	15.0	10.0	20.0
Palm Kernel Meal	7.0	7.0	7.0	7.0
Porzyme SF	0.10	0.10	0.10	0.10
Fish Meal	9.0	9.0	9.0	9.0
Soya bean Meal	16.5	16.5	16.5	16.5
Bone Meal	6.5	6.5	6.5	6.5
Lysine	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15
Common Salt	0.25	0.25	0.25	0.25
Layers Premix	0.25	0.25	0.25	0.25
Total (Kg)	100	100	100	100
Plumeria rubra Leaf Meal	0.0	5.0	10.0	20.0
Crude Protein (%)	17.9	18.3	18.2	17.9
Crude Fiber (%)	2.45	2.47	3.01	3.70
Ether Extract(%)	4.00	4.50	5.00	5.45
Ash Content (%)	11.0	12.0	12.0	12.50
Moisture Content (%)	13.00	13.00	12.50	13.00
ME (Kcal/Kg)	2665.0	2676.2	2677.9	2647.3
Calcium	3.7	3.7	3.7	3.6
Phosphorus	0.7	0.9	0.7	0.7

Layer Vitamin/mineral premix containing the following per kg. Vitamin A 10,000000I.U; Vitamin D_3 2,000000IU; Vitamin E 10,000IU; Vitamin K 2,000mg; Thiamine 1,500mg; Riboflavin B 4,000mg; Pyridoxine B_6 1,500mg; Anti-oxidant 125g; Niacin 15,000mg; Vitamin B12, 10mg; Pantothenic acids 5,000mg; Biotin 50mg; Choline chloride 400g, manganese 80g; Zinc, 20g; 1ron, 50g; copper, 20g; Iodine 1.5g; Selenium 200mg; Cobalt 200mgr; Folic acid 500mg; Vitamin C 100mg.

Results and Discussions

Table2. *Laying Performance and Egg Quality Evaluation of Pullets fed Diets Containing Plumeria rubraLeaf Meal*

Parameters	Replacement levels (%)				
	T_1	T_2	T_3	T_4	SEM
Hen day production (%)	64.67^{b}	83.33^{a}	69.25^{b}	72.34^{b}	± 2.09
Feed efficiency (kg feed/kg egg)	2.65	2.91	3.32	3.33	± 0.21
Average weekly Egg weight (g)	54.99^{b}	57.07^{ab}	57.53^{a}	58.42^{a}	± 0.50
Shell weight (g)	6.71	7.07	6.52	6.58	± 0.08
Mortality	0.00	0.00	0.00	0.00	0.00

Means with different superscripts within the same row are significantly ($p<0.05$) different SEM- standard error of mean.

Percentage Hen Day Production

Comparatively, birds on T_2 PRLM diet recorded a significant ($p<0.05$) higher percentage hen day production of 83.33. Values between birds fed control diet and those on diets with T_3 and T_4 PRLM were however not significant ($p>0.05$). The lower values observed among pullets on the control diet and those eating higher levels of PRLM could be attributed to the reduced feed intake, resulting in relatively lower nutrient intake. This translates to lower nutrient availability for egg production (Okonkwo and Ahaotu, 2019). The birds thus reduced egg production because the only available nutrients would also be required for other physiological needs of the birds. Ahaotu *et al,*. (2019c) reported an average percentage hen day production of 94.34, 76.38 and 55.32, respectively whereas Hong *et al.*, (2012), reported 55.32 and 35 – 82.1 as the percentages hen day production. Values reported by these authors were comparable with those obtained in this experiment.

Feed Efficiency

Result of the feed efficiency (kg feed/kg egg) revealed that birds on T_3 PRLM diet were more efficient in converting their feed to unit weight of egg followed by group fed T_2 PRLM. The least feed efficiency was recorded by birds fed the control diet. The variation in feed efficiency was however not significant ($P>0.05$) among the groups. Ravindran,(2005) reported feed conversion ratio/kg egg mass of 2.33 and 2.61 for pullets and spent layers, respectively; while Ucan *et al.* (2001) gave a range of 1.90 to 2.06 as feed efficiency (kg feed kg-1 egg) for laying hens fed diet containing sprouted malted sorghum. Values reported by these authors were lower than those observed in this experiment.

Average Egg Weight

The effect of treatment on average egg weight was significant ($P<0.05$). Egg weight increased as the inclusion level of PRLM in the diets increased. Bird eating T_4 PRLM diet had the highest average egg weight of 58.42g, while the least egg weight of 54.99g was observed in birds fed the control diet. Egg weight is a function of so many factors, notably; quality and quantity of feed, strain of the birds, stage of lay and management system. In the instant case, it seems there is a factor that increases egg weight as level of PRLM in the diets increased. It appears that the level of lysine increased with increasing level of PRLM in the diets. There is evidence (Mueller *et al.*, 2015), that each 0.1 unit of extra lysine increased egg weight by 1.16g.

Table3. *Effect of dietary supplemental PRLM on Performance of Hy-Line Brown Laying Hens from Point of Lay to 8 Weeks*

Parameter ± SE*	**Treatment**			
	T_1	**T_2**	**T_3**	**T_4**
Body weight gain ± SE (g)				
24 weeks (POL)	1276±5.3^{ab}*	1331±5.6^{a}	1257±5.7^{b}	1264±6.7^{b}
25-28th week	1548±7.7^{c}	1432±4.6^{ab}	1474±5.1^{ab}	1457±11.7^{b}
29-32nd week	1723±9.1^{b}	1662±3.2^{a}	1631±6.0^{a}	1622±13.5^{a}
Weekly Feed intake ± SE (g/bird)				
24 weeks	676±0.0^{a}	775±0.0^{a}	641±0.0^{a}	763±0.0^{a}
25-28th week	1901±12.6^{a}	2046±5.8^{a}	2052±8.9^{a}	1983±11.5^{a}
29-32nd week	2577±12.6^{b}	2822±5.8^{a}	2694±8.9^{ab}	2747±11.5^{ab}
FCR ± SE				
24 weeks	2.47±0.6^{ab}	2.36±0.5^{b}	2.53±0.6^{ab}	2.96±0.8^{ab}
25-28th week	2.95±0.6^{a}	2.04±0.6^{b}	2.35±0.3^{b}	2.19±0.6^{b}
32nd week	2.80±0.5^{a}	2.24±0.2^{bc}	2.38±0.3^{bc}	2.49±0.6^{b}

** Means within the same row having different letters are significantly different (P<0.05).*

Performance

The effects of *Plumeria rubra* leaf meal as feed additives on body weight gain, feed consumption and feed conversion ratio of Hy-line brown laying birds from point of lay (24th week) through the 32nd week periods are presented in Table 3. There were significant differences recorded in the body weight gain and FCR during the experimental periods. Significant differences in feed intake of the hens were observed.

The diets supplemented with *Plumeria rubra* leaf meal feed additives significantly improved the body weight gain and FCR of the birds

during the experimental periods compared to the control.

Plumeria rubra leaf meal feed additives improved the FCR of the laying birds. Several research findings reported that herbal extracts could increase the layer performance by improving live weight gain and FCR of laying birds (Kotrbacek *et al.,* 2013). The laying birds fed the control diets recorded the lowest FCR and the highest body weight gain during the experimental period even though it was not statistically different from the birds fed with *Plumeria rubra* leaf meal based feed additives except at 5% PRFM level.

This might be due to the digestion stimulatory and the gastro-protective effects as reported by Abdulla *et al*. (2010), for the herbal components *Andrographispaniculata* and *Phylanthusniruri*in the commercial herbal products. Furthermore, the body weight gains of hens were increased with the increasing percentages of *Plumeria rubra* leaf meal during the entire experimental periods. Moreover, numerically lower FCR was recorded in the laying birds when the percentage of *Plumeria rubra* leaf meal in the diet was increased.

CONCLUSION

The addition of the phytogenic feed additives (*Plumeria rubra* leaf meal at 10%) had no positive effects on various indices of performance and hen day egg criteria of Hy-line brown laying hens**.** Dietary levels of *Plumeria rubra* leaf meal favours increase in the egg weight and shell weight in layers.

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