International Journal of Research in Agriculture and Forestry
Volume 7, Issue 3, 2020, PP 1-7
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Effects of Frangipanni (*Plumeria Rubra*) Flower Meal as Feed Additive on the Performance and Egg Laying Index of Isa Brown Birds

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ABSTRACT

The effects of Plumeria rubra flower meal on the growth performance and Isa brown hen day egg production of layer birds were investigated. Sixty points of lay birds were randomly allotted to four experimental diets namely negative control, 0.0% PRFM (positive control), 5% Plumeria rubra flower meal (PRFM), 10% PRFM and 20% PRFM in a complete randomized design. Each treatment contained 15 birds with three replicates of 5 birds each. The body weights and feed consumption was recorded at weekly intervals. Body weight gains and feed conversion ratio (FCR) were calculated. The study revealed Plumeria rubra flower meal (PRFM) significantly (P<0.05) improved the growth performance and hen day egg production compared to the control. Among the PRFM feed additives, the T3 was the most effective in improving the growth performance and hen day egg production. This study revealed that incorporating PRFM as feed additives has beneficial effects on the growth performance and hen day egg production of layer birds.

Keywords: *Plumeria rubra flower meal (PRFM), Feed Additive, Feed Consumption, Growth performance, Hen Day Egg Production, Carcass yield, Isa Brown Layer birds.*

INTRODUCTION

The unprecedented upward movement of feed prices, which alone accounts to 70% of the cost of layer production (Barletta, 2010), has forced the nutritionists to formulate and provide economical diet and to ensure optimum performance. Use of chemical feed additives as growth promoters to save feed and production costs by increasing the feed efficiency has got criticism due to adverse effect on consumers. Natural feed additives particularly herbal growth promoters are generally liver tonics which optimize hepatic functions of the birds (Wu *et al.*, 2005). They help in better feeding, synthesis of amino acids and minimize the aflatoxin effects.

Feed additives are ingredients added to poultry diets to enhance production efficiency, improve health and reduce morbidity (Cheng *et al.*, 2005). Feed additives are added to diets for reasons other than to supply nutrients to the animals for example antibiotics added at sub-therapeutic level in order to improve feed utilization by lowering the population of some unwanted microbes can be considered as feed additives (Gunawardana *et al.*, 2009). The economic benefit of feed additives is typically to lower production cost as a result of an improvement in poultry efficiency. Phytogenic feed additives are plant extracts derived from herbs or spices, which have the potentiality to improve feed intake and digestion (Windisch *et al.* 2008) and to maintain micro biota balance in the gut (Mountzouris *et al.* 2007) so beneficially affect animal production and health. Feed additives are typically used in small quantities and are classified into both organic and inorganic in poultry industry. The organic feed additives are products derived from plants which are used in feeding animals to improve their performance (Harms and Russell, 2004). The inorganic feed additives are agrochemicals such as antibiotics. Other feed additives used in poultry diets include antioxidants, emulsifiers, binders, pH control agents and enzymes (Valkonen *et al.,* 2008).

Conventional synthetic feed additives such as antibiotic growth promoters, antioxidants, anti-parasitic agents and anti-fungal agents have been used in poultry feed for decades. However, they created multiple complications, such as traceability in animal products and resistance to antibiotics in the consumer, which became public health issues (Ao *et al*., 2011). On these grounds, the use of all kinds of antibiotic growth promoters was banned in animal feed in Europe (Wu *et al.,* 2005). Revolutions in animal feed production gave rise to the idea of phytogenic feed additives (Ucan *et al.,* 2001). Plants and their metabolites, known as bioactive compounds, play a key role because of their feed additive attributes. These bioactive compounds, such as carotenoids, flavonoids, and essential oils, help to maintain animal health and productivity, and to produce safe and healthy chicken eggs (Francis *et al*., 2001). The primary mode of action of these active ingredients is inhibition of pathogenic microbes and endotoxins in the gut and enhanced pancreatic activity, resulting in better nutrient metabolism and utilization (Murugesan and Persia, 2013).

Among the plants, *Plumeria rubra* is one of the best choices as it meets all the necessary parameters of a phytogenic feed additive (Ahaotu *et al.,* 2019a). *Plumeria rubra* is widely distributed in the tropical and subtropical areas of the world. Based on potential nutrient and bioactive compounds, *Plumeria rubra* is a versatile tree and is given considerable importance in poultry feed and human consumption (Devprakash *et al.,* 2012). Its pods are rich in bioactive compounds, especially carotenoids (B-carotene), flavonoids (quercetin), polyphenols, vitamins and nutrients (Ahaotu *et al*., 2019a). *Plumeria rubra* could be used as feed additive based on its bioactive compounds, which might add value to eggs and have positive impacts on animal health and performance (Egwaikhide *et al.,* 2009). B-carotene and quercetin in *Plumeria rubra* ranges from 2.7 to 3.10 mg/100 g and 80 to 150 mg/100 g of dried pods, respectively (Ashayerizadeh *et al.,* 2009). When added to the feed, these bioactive, along with phytochemicals, enrich eggs and have positive effects on the health and well-being of birds. Due to its higher protein concentration (22-25%) and high profile of essential amino acids, Moringa pods can be used as a protein source in animal feed (Abd-El-Motaal *et al*., 2008).

Plumeria belongs to the Apocynaceae family and is native to the New World. Apocynaceae is a chemically interesting family, containing bioactive alkaloids, glycosides and triterpenoids. Many alkaloids isolated from Apocynaceae members are known to possess anti-cancer activity. Irriddoid glycosides and cardiac glycosides isolated from Apocynaceae members have also been found to be cytotoxic (Ashayerizadeh *et al.,* 2009).

The plants from this genus are widely cultivated in the tropical and subtropical regions throughout the world. They are recognized as excellent ornamental plants and often seen in the graveyards (Lim, 2014). *Plumeria* plants are famous for their attractiveness and fragrant flowers. The essential oils from the flowers are used for perfumery and aromatherapy purposes. The decoction of the bark and roots of *P. rubra* is traditionally used to treat asthma, ease constipation, promote menstruation and reduce fever. The latex is used to soothe irritation (Das *et al.,* 2013).

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 to the expensive feed ingredients.

This study therefore evaluated the addition of *Plumeria rubra* flower mealas a feed additive to correct apparent metabolizable energy of laying hens fed with diets differing in energy concentration for a period of 4 weeks. Also the inclusion levels of *Plumeria rubra* flower mealas a feed additive to improve performance and hen day egg production of Isa brown laying birds was assessed.

MATERIALS AND METHODS

Preparation of Frangipani Flower Meal

Plumeria rubra flower was collected from the botanic garden of forestry department, Imo State Polytechnic Umuagwo 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* flower was milled into powder using a blender (National Mx-795N), sieved with a muslin cloth and stored for used.

The flower meal was then be analysed for chemical composition in the Department of Science Laboratory Technology, Imo State Polytechnic Umuagwo, according to standard procedures (AOAC, 2005).

Preparation of Crude Extract

The flowers collected was dried under shade and then powdered with a mechanical grinder and stored in airtight container. The dried powder material of the flowers 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) Isa brown laying birds were assigned to four treatments and three replicates with five birds each in a completely randomized design. Four levels substitution levels (0, 5, 10 and 15g PRFM /kg) will be added to the four 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).

Feed samples were analysed to estimate moisture, crude protein, crude fibre, ether extract and ash (AOAC, 2005). Ash samples were used for mineral analysis.

Table1. *Chemical Composition of Plumeria rubra Flower Meal*

Chemical Composition	**Proportion**	**Unit**
Dry Matter	20.91	g/100 g
Crude Protein	14.00	g/100 g
Ether Extract	2.34	g/100 g
Ash	13.5	g/100 g
Crude Fibre	21.76	g/100 g
Minerals		
Sodium	805	mg/100 g
Chlorophyll	44	%
Calcium	4.3	mg/100 g
Carbohydrate	12.34	%
Phosphorus	1.98	mg/100 g
Iron	6720	mg/100 g
Zinc	02	mg/100 g
Manganese	95	mg/100 g

Table2. *Percentage Ingredient Composition of Experimental Pullet Layer Diets*

Ingredients	T_1	T_2	T_3	T_4
Fish Meal	10	10	10	10
Maize Grain	45	45	45	45
Soybean Meal	13	13	13	13
Wheat offal	10	10	10	10
Palm Kernel cake	5	5	5	5
Spent Grain	6	6	6	6
Bone Meal	10.15	10.15	10.15	10.15
*Vitamin/Mineral Premix				

DL – Methionine – HCL	0.40	0.40	0.40	0.40
Lysine	0.25	0.25	0.25	0.25
Common Salt	0.20	0.20	0.20	0.20
Total	100	100	100	100
PRFM	0.00	5.00	10.00	20.00

**2.5kg Premix/tonne contain; Vitamin A 10,000 I.U; Vitamin D_3 2000,000 I.U, Vitamin E 12,000 I.U. Vitamin K 2.5gm, Thiamine 1.5g, Riboflavin 5g, Pyriboflavin (B6) 1.5g, VitaminB_{12} 10mg, Biotin 2mg, Niacin 15g,Pantothenic acid 5g, Zinc 50g, Iron 25g, Copper 5g, Iodine 1.4g, Selenium 100mg, Cobalt 300mg, B. H.T.125g. PRFM = Plumeria rubra flower meal.*

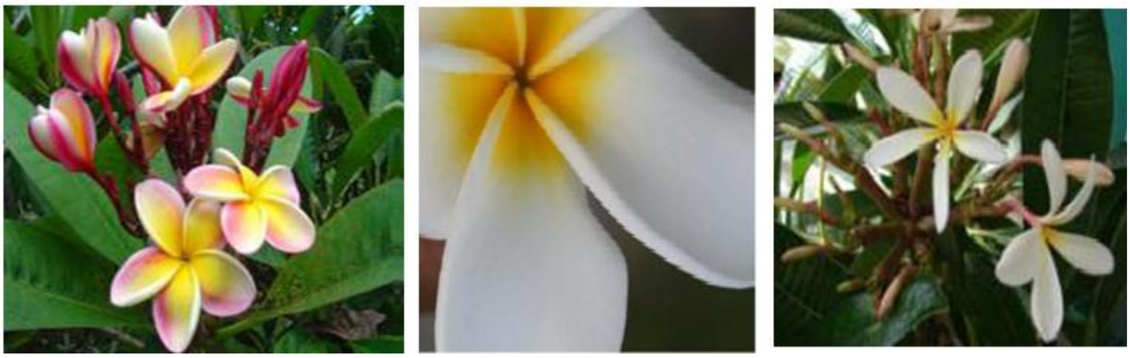

FIGURE1. *Plumeria rubra flowers*

RESULTS AND DISCUSSIONS

Table3. *Effects of Plumeria rubra as feed additives on Egg Production and Egg Weight of Isa Brown Layers*

Egg production (number)					
Age (Weeks)	**T_1**	**T_2**	**T_3**	**T_4**	**Significance**
24-28	19.70±0.64	19.78±0.61	18.76±0.56	18.51±1.25	NS
28-32	22.81±0.67	22.67±0.70	23.56±0.87	21.56±0.67	NS
32-36	18.44±0.45	20.09±0.38	17.91±0.56	17.62±0.26	S
36-40	14.61±0.69	15.83±1.65	15.16±0.46	14.42±0.79	NS
Egg weight (g)					
24-28	59.65±0.20	60.06±0.71	58.52±0.77	57.89±0.06	NS
28-32	58.07±0.33	58.34±0.55	58.13±0.86	57.96±0.27	NS
32-36	60.76±0.86	62.67±0.09	60.02±1.00	59.86±0.48	S
36-40	66.70±0.24	68.16±0.62	65.46±0.63	64.36±0.91	S

S means Significant, NS means Non-Significant

Egg Production

The egg production of Isa brown layers was recorded in Table 3. There was significant difference ($p<0.01$) between the treated group and control group in 32-36 weeks of age. Plumeria rubra as feed additives enhance the increasing of egg production in birds. The present findings were almost similar with the findings of Ahmad et al., (2013). They reported that laying birds had high egg productivity than other breed when supplied feed additives with basal breed. Ahmad et al. (2013) reported that egg number per bird were not significantly higher for birds fed the control diet.

Egg Weight

The egg weights of Isa brown layer birds were recorded in Table 3. Significance differences ($p<0.01$) were observed in 32-36 weeks and 36-40 weeks of age. Plumeria rubra flower meal as feed additives have direct effect on egg weight of layers. The treatment 2 gave the highest weight of eggs compared with the other treatments.

The results was in agreement with those reported by Ahmad et al., (2013) who reported that brown laying birds laid higher weights of egg required compared with other breeds. Ahmad et al. (2013) reported that the egg weight of birds increased when supplemented feed additives with basal feeds. They found egg weight at 24 weeks and 40 weeks of age as 59.89±0.06, 58.52±0.77, 59.65±0.20, 60.06±0.71g and 70.46±0.63, 70.36±0.91, 71.70±0.24, 71.16±0.62g respectively.

Table4. *Effect of Dietary Treatments on the Performance of Laying Hens*

Parameters	T_1	T_2	T_3	T_4	SEM
Average feed intake (g/bird/day)	123.75[a]	138.75[b]	135.00[b]	149.2[c]	2.18*
Average initial body weight (kg/bird)	1.52	1.51	1.52	1.51	0.01ns
Average final body weight (kg/bird)	1.69	1.67	1.65	1.56	0.04ns
Average body weight gain (kg/bird)	0.17	0.16	0.13	0.11	0.004ns
Mortality (%)	0.00	0.75	0.25	0.50	0.19ns
Number of (egg breakages cracks (%)	12.04	12.04	16.19	18.34	2.44ns

SEM - Standard error of mean; NS - Not significantly different ($p < 0.05$); *significantly different ($p > 0.05$)

The overall performance of the Isa brown layer hens with respect to the parameters measured is presented in Table 4. Though dietary treatments one (control) and *Plumeria rubra* flower meal as feed additives in ($T_{2,}$ T_3 and T_4) were different with regards to the feed additive in the control diets, they supported similar performances. There were significant differences ($P < 0.05$) in the average daily feed intake among the various treatments (Table 4). Average daily feed Intake of birds on dietary treatments $T_{2,}$ T_3 and T_4 were higher ($P < 0.05$) than those on the control diet (T_1). The feed intakes of birds recorded in this study were higher than the 110 g/bird/day recommended by Botsoglou *et al*., (2006).

Throughout the experimental period, feed intake of experimental birds was affected by the inclusion of *Plumeria rubra* flower meal. In a similar experiment conducted by Babatunde and Oluyemi (2000), it was indicated that feed consumption increased correspondingly with incremental levels of these agro-industrial by-products. The difference in feed intake between dietary treatment T_1 (control diet) and the other three dietary treatments might be due to the high fibre contents of *Plumeria rubra* flower meal diets. Shim *et al.* (1989) reported that feed intake is high on fibrous diets. Donkoh *et al*. (2004) reported mean daily feed intake of 116.4 to 120.5 g when they fed diets with feed additives to laying chickens.

The initial body weights of the experimental birds were similar, averaging 1.52 kg. During the feeding trial, body weight gain was not significantly ($P < 0.05$) affected by dietary treatments. However, the slightly depressed weight gain for birds on dietary treatment T_3 could be attributed to the high levels of fiber in the diet. Nelson *et al.* (2007) reported reduction in body weight for birds fed on agro-industrial by-products based diet compared with that of birds on a proprietary commercial diet. The addition of fibre to the diet can lead to a lower apparent digestibility of starch and minerals and thereby depress weight gain (Pond *et al*. 1989)).

Generally, birds fed diets containing Plumeria rubra flower meal (dietary treatments 2, 3 and 4) produced the highest number of eggs, even though the differences were not significant. According to Polin and Wolford (1972), there is a correlation between feed intake and the rate of egg production, and that as feed consumption increased egg production also increased significantly. The mean egg weight recorded for birds on dietary treatments T_1, $T_{2,}$ T_3 and T_4 were similar, indicating that inclusion of *Plumeria rubra* flower meal in nutritionally-balanced laying hens' diets had no adverse effect on egg weight. The appreciable level of fat in the *Plumeria rubra* flower meal based diets as additives might have accounted for the egg weight of birds fed these diets.

CONCLUSION

Feed additives had tremendous effect on productive and reproductive performance of Isa brown birds. Specifically *Plumeria rubra* flower meal had very good result when mixed with the basal feed and provided daily to the laying birds. Therefore, it can be concluded that use of vitamin, mineral and amino acid containing feed additives with basal feed might be helpful for enhancing the productive and reproductive performance of laying birds.

The possibilities of using phytogenic additives are various. Their use does not entail as many major hazards as for example the use of antibiotics or chemical compounds. Phytogenic additives and their wider practical application will undoubtedly be subject to further research. However, long term studies will be crucial, proving mainly the efficacy of these additives, their safety with regard to animal health, the quality of animal products and environment, and, subsequently, their availability in terms of their anticipated regular use.

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Citation: *Uduji, M.A, Uche, M1, Simeon-Ahaotu, V.C, Patricio De Los Ríos and Ahaotu, E.O, "Effects of Frangipanni (Plumeria Rubra) Flower Meal as Feed Additive on the Performance and Egg Laying Index of Isa Brown Birds", International Journal of Research in Agriculture and Forestry, 7(3), 2020, pp 1-7.*