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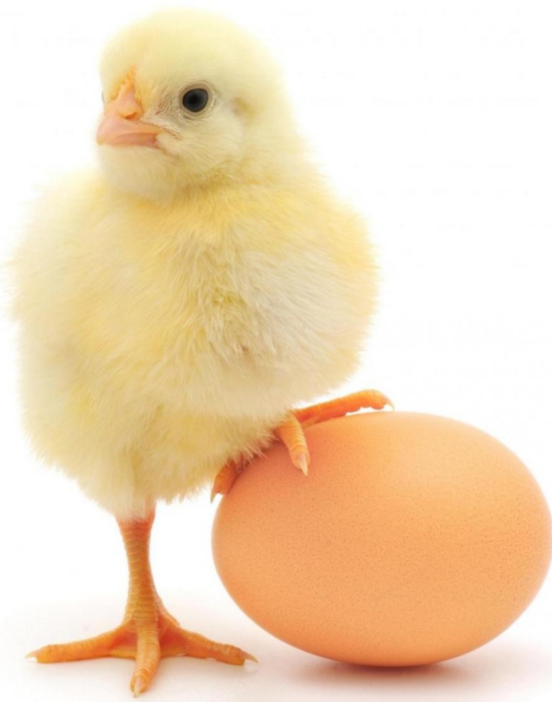

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# Research Article
# Nutritional Effects of Dietary Inclusion of *Manihot esculenta* Crantz Leaf on Isa Brown Older Layers Performance

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## Abstract

**Background and Objective:** The scarcity and seasonal fluctuation of conventional feedstuff srequire alternative sources in order to ensure optimum performance of poultry birds. This study investigated the effect of *Manihot esculenta* leaf meal (MELM) on blood parameters and productive performance of laying hens from 50-62 weeks of age. **Materials and Methods:** A total of two hundred Is a Brown layers of 50 weeks of age were assigned to 4 dietary treatments with 5 replicates of 10 birds each. Treatment diets were: 0% MELM (ME0), 2.5% MELM (ME2.5), 5% MELM (ME5%) and 7.5% MELM (ME7.5). During the experimental period, feed intake, egg production, feed conversion ratio as well as egg quality parameters were recorded weekly. The blood samples were collected from 16 birds (4/replicate) at 61th weeks of age for the determination of total protein, albumin and uric acid. **Results:** Results showed that feed intake (FI) and egg production were higher ($p<0.05$) in the birds of ME5 and ME7.5 than those of the other treatment. The birds in ME5 and ME7.5 also had the lowest ($p<0.05$) feed conversion ratio (FCR). Total proteins and albumin were significantly higher ($p<0.05$) in birds fed 5 and 7.5 % of MELM while layers in ME 7.5 group had the highest ($p<0.05$) uric acid concentration. Most external and internal egg quality parameters were not significantly affected except for yolk color score which was improved with increased levels of MELM. **Conclusion:** In conclusion, *Manihot esculenta* leaf meal (MELM) can be used up to 7.5% as feed ingredients in laying hens to improve performance.

Key words: *Manihot esculenta* meal, laying hens, production performance, egg quality, poultry meat

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Poultry meat and eggs are one of the most important and cheapest sources of quality protein for human consumption and quick returns on investment[1]. In intensive livestock production, feed is considered as the most important input in terms of cost[2] and according to Viennasay *et al.*[3] profit can be maximized by minimizing feed cost. Currently, poultry production is facing multiple problems such as escalating price and seasonal fluctuation in the cost of conventional energy and protein feed ingredients used in poultry diets[4]. Therefore, there has been an ongoing interest in evaluating alternative feedstuffs for poultry production in order to meet the demand for animal protein in the developing countries. The unconventional feed ingredients must be cheap, locally available and less competitive. One possible source of cheap protein is the leaf meal of tropical legumes. According to Makkar[5]vegetable products have been known to be a viable alternative source of proteins, vitamins and minerals. Studies have shown that cassava leaves are particularly rich in essential amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine) and in vitamins especially A, C and carotene[6]. Studies also revealed that *Manihot esculenta* leaves harvested at a younger stage of growth is a natural source of protein, up to 25% with a good profile of amino acids and can be considered as a suitable alternative in poultry diets[7]. Although, the use of cassava leaves in poultry diet is constrained by the presence of anti-nutritional factors such as condensed tannins and cyanogenic glycoside, these shortcomings can be moderately remedied through adequate processing[5]. The findings of Wanapat and Kang[7] has shown that *Manihot esculenta* leaves can be used in livestock nutrition strategies. Young leaves are used by farmers as cattle fodder to improve milk yields and milk composition[7]. Although, studies are under way in different laboratories to evaluate the effect of *Manihot esculenta* leaves meal on the production performance of poultry, these studies are limited on broilers and guinea fowl[8]. In commercial layers production, there is a paucity of information about the effect of *Manihot esculenta* leaves meal on the laying performance of hens[9]. Keeping in view the nutritional quality of *Manihot esculenta*, the present study was conducted to determine the optimum level of *Manihot esculenta* leaf meal inclusion in the diet of laying hens and its effects on egg production as well as biochemical parameters during the second period of egg production.

## MATERIALS AND METHODS

**Experimental design:** Two hundred, 50 weeks old Isa brown laying hens initially reared together were used. The hens were subsequently assigned randomly to four treatment groups according to the different levels of *Manihot esculenta* (*M. esculenta*) leaf meal in the diets. The groups were: (1) Control (ME0) diet without *M. esculenta*, (2) diet with 2.5% of *M. esculenta* (ME2.5); diet with 5% of *M. esculenta* (ME5) and diet with 7.5% of *M. esculenta* (ME7.5) having five replicates of 10 birds each and were reared for 12 weeks. *M. esculenta* leaves harvested from farmer's field were washed, dried under air-conditioned room for 3-4 days and pulverized with a blender before use. All the diets had similar levels of crude protein and metabolizable energy and met the requirement of the birds (Table 1). During the rearing period, the birds had access to water and feed *ad libitum*. At 61 weeks of age, blood samples were collected from wing vein of 16 birds per treatment (4 birds per replicate). Blood was collected into a blood storage tube with anticoagulant (EDTA) to determine biochemical parameters (protein total, albumin, uric acid).

**Data collection:**

**Production performance:** The feed intake was measured weekly as the difference between feed offered and remaining feed. Egg number (EN) and Egg Weight (EW) were recorded daily and data obtained were used to calculate egg production (%) and egg mass (EM):

$$\text{Egg production (\%)} = \frac{\text{EN} \times 100}{\text{Period (days)}}$$

$$\text{EM} = \frac{\text{EN} \times \text{EW}}{\text{Period (days)}}$$

Feed conversion ratio (FCR) was calculated as:

$$\text{FCR} = \frac{\text{FI (g of feed/hen/period)}}{\text{EM (g of egg/hen/period)}}$$

At the end of each week, thirty (30) eggs were randomly sampled from each dietary treatment and were individually weighed using digital balance. Eggs were further carefully broken and different components were carefully separated and weighed. Percentage of egg components (shell, yolk and albumin) were determined as a ratio to total egg weight according to Lee and Kenorr[10] using the equation:

Table 1: Gross composition of experimental diet (%)

| | Feed composition according to the group | | | |
|---|---|---|---|---|
| Feed staff | ME0 | ME2.5 | ME5 | ME7.5 |
| Maize | 54.00 | 54.50 | 55.50 | 56.00 |
| Wheat bran | 7.50 | 6.50 | 4.50 | 2.00 |
| Fish meal | 5.00 | 5.00 | 5.00 | 5.00 |
| Oilcake soy | 3.00 | 3.00 | 3.00 | 3.00 |
| Soya seed | 14.00 | 15.00 | 14.00 | 13.50 |
| Concentrate | 4.00 | 3.00 | 3.00 | 3.00 |
| Shell | 8.00 | 8.00 | 8.00 | 8.00 |
| Methionine | 0.20 | 0.20 | 0.50 | 0.50 |
| Lysine | 03.00 | 0.30 | 0.5.0 | 0.50 |
| Dresh of beer | 4.00 | 2.00 | 1.00 | 1.00 |
| MEL (%) | 0.00 | 2.50 | 5.00 | 7.50 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| **Calculated values** | | | | |
| E.M (kcal $kg^{-1}$) | 2800.18 | 2803.68 | 2805.83 | 2808.60 |
| Crude protein (%) | 18.30 | 18.32 | 18.33 | 18.30 |
| Fat (%) | 6.24 | 6.25 | 5.94 | 5.76 |
| Ash (%) | 2.50 | 2.32 | 2.32 | 2.37 |
| Crude fibre (%) | 3.51 | 3.45 | 3.44 | 3.54 |
| Lysine (%) | 1.13 | 1.25 | 1.51 | 1.62 |
| Methionine (%) | 0.61 | 0.69 | 0.88 | 0.88 |
| Meth.+cysteine (%) | 0.83 | 0.79 | 1.06 | 1.04 |
| Calcium (%) | 3.75 | 3.72 | 3.75 | 3.78 |
| Phosphorus (%) | 0.71 | 0.66 | 0.63 | 0.61 |

MEL: *Manihot esculenta* leaf, EM: Energy metabolisable, ME0: Diet containing 0% MEL, ME2.5: Diet containing 2.5% MEL, ME5: Diet containing 5% MEL, ME7.5: Diet containing 7.5% MEL

$$\text{Egg components percentages}(\%) = \frac{\text{Component weight}(g)}{\text{Egg weight}(g)} \times 100$$

Yolk color was scored using a colorimetric fan (Roch) and Haugh unit values were performed using Egg Multi Tester Haugh.

**Bio-chemical parameters:** The collected blood samples were centrifuged at 3000 rpm to obtain plasma which was stored in a freezer at -20°C for analysis. Plasma constituents were determined with BA-88A Mindray, an auto-biochemical analyzer using kits according to Murugan and pari[11] for total protein, albumin and uric acid.

**Statistical analysis:** Statistical analysis was performed using Graph Pad Prism 5. One -way ANOVA was used to evaluate the effects of cassava leaves on production performance and blood chemistry values. Tukey's HSD test was used for testing difference of means. The treatment effect was considered significant if p-value was less than 0.05.

## RESULTS

**Productive performance:** The effect of feeding *Manihot esculenta* leaf meal (MELM) on productive performance is shown in Table 2. Overall, feed intake increased as MEL inclusion level increased and value obtained in ME7.5 group was significantly higher ($p<0.05$) than those in ME0 and ME 2.5 treatment groups. Birds in the ME7.5 group had the lowest ($p<0.05$) feed conversion ratio value. The feed conversion ratio of the birds in ME0, ME2.5 and ME5 were comparable but significantly higher ($p<0.05$) than those of ME7.5. The eggs weight shows no significant difference between treatments.

**Eggs quality Parameters:** Table 3 Shows the effects of *Manihot esculenta* leaf meal on egg quality. Albumen ratio, yolk ratio, albumen heights, shell ratio and Haugh unit were not affected by *Manihot esculenta* meal leaf meal. The yolk colour of the eggs of the hens in ME7.5 and ME5 were similar but higher ($p<0.05$) than those of ME2.5 and ME0. The egg yolk colour of the hens of ME2.5 group was also higher than that of ME0.

**Biochemical parameters:** Table 4 shows the effects of *Manihot esculenta* leafmeal on biochemical parameters. The total protein and uric acids of the birds in ME0 were lower than those of the other treatment groups whose levels were similar. Plasma albumin of the birds in ME0 and ME2.5 was similar but lower ($p<0.05$) than those of ME5 and ME7.5.

Table 2: Effects of *Manihot esculenta* leaves on productive performance

| | Treatments | | | |
|---|---|---|---|---|
| Parameters | ME0 | ME2.5 | ME5 | ME7.5 |
| Daily feed intake (g) | 125.86±0.28[b] | 125.52±0.33[b] | 128.25±0.24[a] | 129.62±0.23[a] |
| Egg production (%) | 75.13±2.19[b] | 74.57±2.36[b] | 76.82±1.19[a] | 78.99±1.47[a] |
| Egg weight (g) | 60.57±0.69[a] | 60.03±0.43[a] | 60.36±0.63[a] | 60.56±0.78[a] |
| Feed conversion ratio | 2.80±0.06[a] | 2.90±0.008[a] | 2.80±0.08[a] | 2.74±0.09[b] |

[a,b]Means that within each row bearing same letter are not significantly different at p<0.05

Table 3: Effects of *Manihot esculenta* leave on egg quality

| | Treatments | | | |
|---|---|---|---|---|
| Egg parameters | ME0 | ME2.5 | ME5 | ME7.5 |
| Yolk color | 5.51±0.44[c] | 8.65±0.32[b] | 9.43±0.21[a] | 9.63±0.23[a] |
| Albumen ratio (%) | 63.97± 0.54[a] | 64.47± 0.32[a] | 64.37±0.26[a] | 63.93±0.31[a] |
| Yolk ratio (%) | 23.13±0.27[a] | 22.86±0.31[a] | 22.88±0.24[a] | 23.22±0.30[a] |
| Shell ratio (%) | 12.90±0.28[a] | 12.67±0.16[a] | 12.75±0.20[a] | 13.08±0.23[a] |
| Haugh Unit | 84.66±2.38[a] | 83.54±2.89[a] | 83.99±3.02[a] | 83.58±3.47[a] |
| Albumen height | 7.68±0.37[a] | 7.29±0.43[a] | 7.30±0.44[a] | 7.47±0.50[a] |

[a,b,c]Means that within each row bearing the same letter are not significantly different at p<0.05

Table 4: Effects of *Manihot esculenta* leaves on biochemical parameters

| | Treatments | | | |
|---|---|---|---|---|
| Parameters | ME0 | ME2.5 | ME5 | ME7.5 |
| Total protein (g $dL^{-1}$) | 4.79±0.50[b] | 6.09±0.55[a] | 6 .95±0.50[a] | 7.33±0.70[a] |
| Albumin (g $dL^{-1}$) | 2.94±0.21[b] | 2.88±0.50[b] | 3.52±0.29[a] | 3.45±0.34[a] |
| Uric acids (mg $dL^{-1}$) | 5.43±0.83[b] | 6.35±0.94[a] | 6.52±0.86[a] | 7.15±0.18[a] |

[a,b]Means that within each row bearing same letter are not significantly different at p<0.05

## DISCUSSION

The higher feed intake recorded in the birds offered 7.5% MELM in the present study implies that the level of MELM used in our study did not adversely affect the appearance and texture of the diet as poor appearance could lead to lowered palatability and, consequently decrease feed intake[12]. Similarly Dahouda *et al.*[8] showed that dietary inclusion of *Manihot esculenta* leaf meal at 7% increased feed intake in laying hens. *Manihot esculenta* leaves is a natural source of protein with great potential[7]. Thus the relatively greater total proteins and albumin in group ME5 and ME7.5 may be due to the nutritional value of cassava leave which improved nutrients uptake. Besides, this increment is also an indication of the absence of anti-nutrients in MELM that may induce health problems[5]. Indeed, albumin, one of the main serum proteins, serves as the most favorable source of amino acids for synthesis is produced by the liver and its concentration partly reflects the functional capacity of this organ in animals. Thus, an increase on its serum concentration indicates an improvement in the health status of the animals[13]. Uric acid is an important indicator of protein catabolism and its concentration largely depends on total proteins level. In the present study, this metabolite was higher in ME5 and ME7.5 groups which had more total proteins indicating intensive catabolism of protein for egg formation[14]. Moreover, higher egg production in ME5 and ME7.5 and improved feed conversion ratio in ME7.5 corroborate the earlier findings about the beneficial nutritional composition of MELM. Among all egg quality parameters analyzed in the current sturdy, only yolk color was affected by the inclusion of cassava leaves. The higher egg yolk colour score with increase of MELM in the diet in the present study may be due to the high content of beta-carotene and xanthophyll in MELM which suggests efficient absorption and utilization of the pigments present in *Manihot esculenta* leaf[15]. Similarly, Tesfayeand *et al.*[12] observed that dietary vegetable leaf meal inclusion such as *Moringa oleifera* had yellow coloration of egg yolk. Furthermore, the non-significant difference for the other egg quality parameters across the treatments in our study indicated that the diets containing MELM and the control diet were similar in supplying the nutrient requirements for egg production.

## CONCLUSION

MELM incorporation in the diet of laying hens improved feed intake, egg production, yolk weight and color. The leaves also increased the levels of total protein, albumin and uric acid. From the point of view of egg production, the use of *Manihot esculenta* leaves in the diet of laying hens up to 7.5% during the second phase of egg production should be encouraged.

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