

Effects of Substituting Soybean with *Moringa oleifera* Meal in Diets on Laying and Eggs Quality Characteristics of KABIR Chickens

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Abstract

Objective: This study was designated to evaluate the effect of *Moringa oleifera* leaf meal on laying performance of the KABIR strain hens.

Methods: A total of 27 pullets and 3 cockerels were randomly distributed into 3 groups and randomly fed with diets T0, T5 and T10 in which soybean was gradually substituted at 0, 50 and 100% with *Moringa oleifera* leaf meal (MOL).

Results: The results showed that feed intake decreased with increasing level of MOL. The first egg was laid at 25 weeks in the group of chicks fed with 5% of MOL. The lowest feed conversion ratio (FCR) and the highest egg production were recorded with 5% MOL, while the highest FCR and the lowest egg production were recorded with the highest MOL level (10%). Except for circumference of eggs and the yolk weight, eggs characteristics and hatchability were not significantly affected ($P>0.05$) by the inclusion levels of MOL in the diet. The mortalities recorded in this study (21, 30 and 37.5% for 0, 5 and 10% of MOL respectively) were above 12% recommended by the IPH (International Practices Hatchery).

Conclusion: It was concluded in the conditions of this study that using *Moringa oleifera* leaves at 5% in the diet as protein source ingredient can improve egg production in KABIR hens.

Keywords: Eggs incubation; KABIR chickens; Laying; *Moringa oleifera*

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Introduction

In intensive poultry farming, feed remain the major challenge especially in Sub-Saharan Africa where the price of the conventional feed resources increase continuously. In addition, village chickens faced quantitative and qualitative food shortage particularly in poor agricultural or household residues environment [1-3]. Because of the increasingly cost of common protein ingredient (groundnut cake, soybean and fish meal), stockholders have little access to such resources. With the present trend of rising prices of feedstuffs, alternative locally available and cheap non-conventional feedstuffs like leguminous trees are increasingly being used as substitute of conventional resources in the formulation of poultry diets. Several studies revealed that leaves of *Alchornea cordifolia*, *Chronomolaena odorata*, *Leuceana leucocephala* and *Moringa oleifera* are important feed resources which are relatively rich in crude protein (25-44%), essential amino acids, minerals, carotenoids and vitamins [4-8].

Amongst those resources, *Moringa oleifera* is an excellent feedstuff due to its adaptability to varieties of climatic conditions, high leaf yield and a great deal of active substances of health care [9,10]. The MOL contain 29.7% of crude protein, 4.38% fiber, 3056 kcal/kg metabolizable energy, 0.26% calcium and phosphorus and a negligible quantity of tannin (1.23 g/kg) [9,11,12]. Previous study showed that the inclusion of MOL up to 24% in the diet did not cause any adverse impact on live body weight, average daily weight gain, feed conversion ratio (FCR), mortality, carcass and organs characteristics in birds compared to the controls birds in growing indigenous Senegal chickens [13,14]. In a related study, Olugbemi *et al.* [7] found that MOL can be safely included in layer diets up to 10% without negatively affecting productivity. Ebenebe *et al.* [15] concluded from their study on the effect of various levels of MOL in the diet that inclusion of MOL at lower levels improved egg production and egg quality but higher levels of inclusion resulted in lower productivity and poorer egg

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quality indices of Isa Brown Breed of layers. The main objective of this work is to evaluate the effect of MOL meal on laying performances, egg characteristics and hatchability of KABIR hens.

Material and Methods

Study site and preparation of test ingredients

This study was conducted at AGR-Science-Action and Development Research Farm located in Buea South West Cameroon. Buea is situated in the humid forest area in the South West region of Cameroon at 400 m above sea level. Annual rainfall varies between 2000 and 2200 mm. Temperatures varies between 23 and 24.4°C and relative humidity is 87%.

Moringa oleifera leaf used in this study was obtained from Yaoundé in the Center Region of the Country. Other ingredients were obtained from Buea local market.

Diets and management of birds

Three experimental diets (T0, T5 and T10) in which soybean were gradually replaced by MOL at 0, 50 and 100% were respectively formulated to meet the nutritional requirements of birds according to the standards of NRC [16]. The chemical composition of MOL [17] was as follows: Crude protein, 26.05%; crude fiber, 1.3%; Calcium, 2.05% and phosphorous, 0.30%. Diet without MOL containing 10% of soybean meal was used as control diet (Table 1).

A total of 27 pullets and 3 cockerels, all of KABIR strain obtained from the parent stock in the AGR-Science-Action and Development Research Farm in Buea were divided into 03 experimental groups of 09 pullets and 01 cock per group. Each group was replicated 09 times with each pullet constituting an experimental unit. Each experimental diet was randomly allocated to one group in a completely randomized design. The average weight and age of pullets at the beginning of the experiment was 2066.66 g and 21.5 weeks respectively. The experiment lasted for a period of 03 months and birds were managed in deep litters.

Data collection

Throughout the experiment, the following parameters were evaluated: feed intake (g/bird/day), egg production (%/hen-day), egg weight (g), egg mass (g/hen/day), and feed conversion ratio (g feed/g egg). Egg production was recorded daily, and the results were expressed as a percentage of the number of hen's house. Once a day per week, all eggs collected were used to evaluate egg characteristics. Eggs were weighed in a 0.01-g precision scale.

Albumen height was measured at 1 cm from the yolk, using a 0.1-mm precision micrometer. Yolk and albumen were separated manually, weighed and expressed as percentages of egg weight. Eggshells were first dried for 72 hours at room temperature, and then the thickness was measured using a 0.01-mm precision micrometer. Eggs fertility, hatchability and embryo mortality were recorded.

Statistical analysis

Data obtained from eggs characteristics were subjected to one ways ANOVA and Duncan's Multiple Range Test [18] was used to

separate the means when differences were declared significant. Regression coefficient among different performance trait was also performed. The analyses were performed using SPSS 20.0 statistical software.

Results

Growth performances

The curves of feed intake were similar in all groups of hens (Figure 1). However, it can be noticed that from the 5th week until the end of experiment, feed intake of pullets fed on control diet without MOL was higher than those of pullets fed on diets containing 5 and 10% of MOL. However, the regression coefficient ($R^2=0.07$) revealed that the variation of feed intake is not linked to MOL incorporation level in the diet.

In the same trend, variation of life body weight was not significantly ($P>0.05$, $R^2=0.05$) affected by MOL inclusion level in the rations. Throughout the experiment, the hens fed on control diet recorded the highest body weight followed by hens fed on diets containing 10 and 5% of MOL (Figure 2).

Feed conversion (FCR) was significantly ($P<0.05$, $R^2=0.62$) affected by MOL inclusion in the diets. As shown in Figure 3, FCR decreased up to 5 weeks from the beginning of the experiment in all the groups and remain constant until the end of the study after 12 weeks. However, hens respectively fed on diets containing 10% and 5% of MOL exhibited the highest and the lowest FCR throughout the experimental period.

Laying performances

Age at the first egg was significantly affected by MOL incorporation in the diet. Hens fed on diet containing 5% of MOL laid their first egg one week earlier (25 weeks) than hens fed with 10% of MOL (26 weeks). Hens fed with 5% MOL reached their production peak one week earlier and recorded the highest egg percentage peak production as compared to hens fed on control diet and diet containing 10% MOL. As shown in Figure 4, inclusion of 5% of MOL in the diet induced the highest egg production (81%) as compared to 10% (71.42%) and control diet without MOL (62.85%).

Egg characteristics

The relation between egg weight and inclusion level of MOL in the diet was very high ($R^2=0.99$). Egg weight, egg width, yolk weight and yolk diameter significantly ($P<0.05$) decreased with increasing levels of MOL in the diets whereas, egg length, yolk length, yolk index and shell weight and thickness were not significantly affected by MOL in the rations (Table 2).

Fertility, hatchability and mortality

Although not significantly different, eggs laid by pullets fed on control diet were least fertile and the fertility tends to increase with increasing level of MOL in the diets (Table 3). In the same trend, embryo mortality tends to increase with increasing level of MOL in the diet. Contrary to the egg fertility and embryo mortality, the highest hatchability was recorded with eggs laid by hens fed on control diet without MOL.

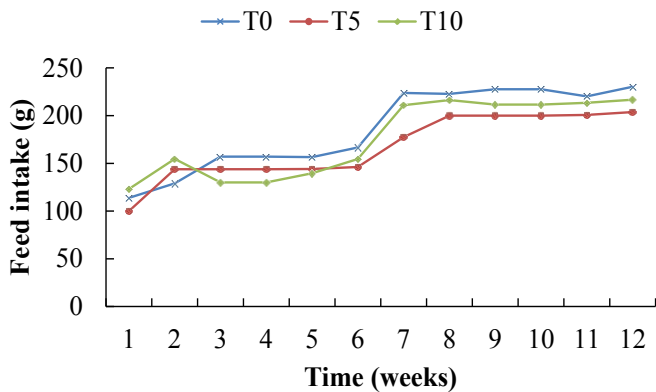


Figure 1 Feed intake curve of KABIR hens fed graded levels of MOL.

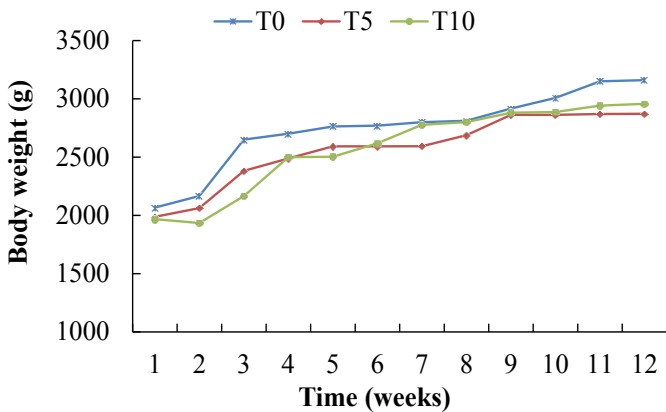


Figure 2 Growth curve of KABIR hens fed graded levels of MOL

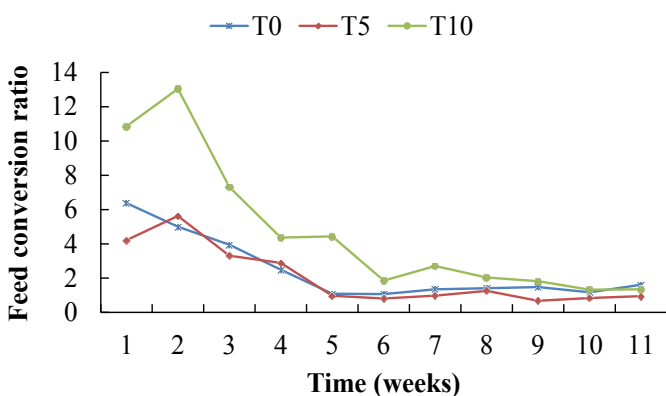


Figure 3 Curve of feed conversion ratio of KABIR hens fed graded levels of MOL

Discussion

Incorporation of MOL in the diet lead to a decrease in feed intake as compared to the control. This agreed with the founding of Abou-Elezz *et al.* [19] who came out with the conclusion that the inclusion of MOL at 0%, 5%, 10% and 15% in the diet of commercial layers linearly decreased feed intakes from 111 to 100 g/hen/d. The decrease in feed intake by incorporation of MOL in the diet

could be due to the increasing level of antinutritional factors and dustiness of MOL [20] and low digestibility of energy and protein [21].

The study revealed that incorporation of MOL in the diet tends to decrease body weight of KABIR hens. This result is in close agreement with the result of Kwedibana [22] who found that commercial broiler diet significantly ($P < 0.05$) promoted weight gain than diet containing 10% of MOL. The present result disagrees with the founding of Ayssiwede *et al.* [23] who reported a significant increase in body weight of Senegalese native hens with the incorporation of *Cassia tora* leaves as feed ingredient in the ration. The difference can be attributed to rearing conditions, environment and genetic variability.

Feed conversion ratio decreased with increasing level of MOL in the diet. This can be explained by the decreased in feed intake associated with increasing level of MOL in the diet. This result agrees with the conclusion of Ayssiwede *et al.* [23] and Houndonougbo *et al.* [8] who respectively reported that incorporation of 10% and 15% of *Cassia tora* and cassava leaves in the Senegalese native hens diet improved feed conversion ratio.

Incorporation of MOL in the diet decrease the age at first egg and increase egg production as compared to the diet without MOL. This founding contradicts the founding of Houndonougbo *et al.* [8] who reported that egg production decreased with incorporation of cassava leaf meal in the ISA Brown layer diet. The mean age at sexual maturity (25.5 weeks) recorded in the present study was higher than the age recorded in local bared hens in western Cameroon (22.5 weeks) by Mube *et al.* [24]. The difference could be explained by the fact that KABIR hens used in this study are heavier than Cameroonian local barred chickens. Egg production curve was tooth like shape throughout the experimental period. This suggests a wide individual variation as it can be expected in an unselected flock [24-26].

Incorporation of MOL in the diet significantly decreased egg weight, egg width, and yolk weight and yolk diameter. This finding is in agreement with the findings of Bhatnagar *et al.* [27] who reported that eggs characteristics of commercial layer ISA Brown were not significantly affected by the incorporation of *Leuceana leucocephala* leaf in the diet. The present result is also in close agreement with the finding of Kakengi *et al.* [28] who

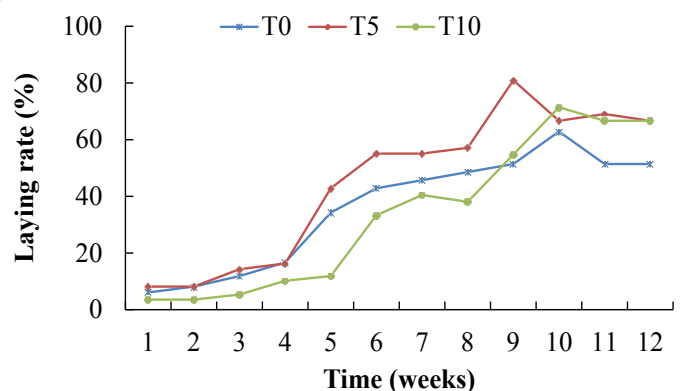


Figure 4 Weekly evolution of egg production (%).

Table 1 Composition (%) of experimental diets.

Ingrédients	T0	T5	T10
Maize	56	58	57.5
Wheat bran	20	15.5	14
MOL	0	5	10
Soybean meal 48%	10	5	0
Fish meal 60%	1.5	4	6
Oyster shell	6.5	6.5	6.5
Bone meal	1	1	1
Premix 5%	5	5	5
Total	100	100	100
Calculated chemical composition			
Crude protein (%)	15.72	15.52	15.30
ME (kcal/kgMS)	2883.04	2844.82	2803.98
Calcium (%)	3.27	3.52	3.75
Phosphorus (%)	0.58	0.62	0.67
Calcium/Phosphorus	5.68	5.69	5.60
Energy/Protein	183.44	183.26	183.32
Lysine (%)	0.86	0.88	0.88
Methionine (%)	0.35	0.38	0.40
Lys/meth	2.44	2.31	2.20
Cost /kg (FCFA)	239.25	232.63	222.75

*Premix 5%: Crude protein=40%; Metabolizable energy (ME)=2078 kcal/kg; Calcium=8%; Phosphorous=2.05%; Lysine=3.30%; Méthionine=2.40%. MOL: *Moringa oleifera* leaves.

Table 2 Effects of MOL levels in the diet on egg characteristics.

Parameters	MOL incorporation (%)			P
	0	5	10	
Egg weight (g)	51.86 ± 0.91 ^a	49.22 ± 0.74 ^a	45.86 ± 0.03 ^b	0.019
Egg length (mm)	53.15 ± 0.08	53.60 ± 0.46	51.23 ± 2.60	0.43
Egg width (mm)	41.52 ± 0.07 ^b	41.25 ± 0.53 ^b	40.20 ± 0.18 ^a	0.05
Egg index	0.78 ± 0.04	0.77 ± 0.03	0.78 ± 0.03	0.12
Yolk weight (g)	15.24 ± 0.20 ^b	13.35 ± 0.04 ^a	13.70 ± 0.38 ^a	0.009
Yolk diameter (mm)	37.60 ± 0.49 ^a	35.72 ± 1.35 ^{ab}	32.89 ± 2.15 ^b	0.010
Yolk length (mm)	15.04 ± 0.18	15.02 ± 0.60	17.23 ± 2.03	0.267
Yolk index	2.5 ± 0.78	2.38 ± 0.63	1.90 ± 0.77	0.412
Shell weight (g)	4.69 ± 0.20	4.55 ± 0.15	4.67 ± 0.23	0.451
Shell thickness (mm)	0.37 ± 0.01	0.37 ± 0.01	0.40 ± 0.00	0.125

^{a,b}Means within the same line with the different letter are significantly different (P<0.05).

Table 3 Effects of MOL levels on eggs fertility, hatchability and embryo mortality (mean ± SD).

MOL Incorporation (%)	Fertility (%)	Hatchability (%)	Embryo mortality (%)
0	75.31 ± 15.31	66.16 ± 30.67	2.12 ± 1.87
5	78.75 ± 18.60	53.78 ± 34.61	3.02 ± 1.93
10	81.8615 ± 26.19	54.07 ± 27.53	3.74 ± 1.67
P	0.90	0.48	0.56

recorded heavier egg with 5% of MOL in the diet as compared to 10% inclusion. Generally, many authors [7,19,28] agreed that use of MOL up to 10% had no negative effect on the productive performance of laying hens, but levels above that (>10%) are expected to produce adverse effects.

The egg shape index recorded in this study range between 77 and 78. This is in agreement with those reported in commercial layers by Ayanwale *et al.* [29]. The present shape index is very

high compared to the index reported in local barred chickens (74 to 76) in Cameroon by Kana *et al.* [30].

MOL did not significantly affected fertility, hatchability and mortality of KABIR hens. However, the values recorded for fertility and hatchability were very low compared to the values reported in the commercial breed of layers (98 and 88% respectively for fertility and hatchability) by IHP [31]. This can be explained by the fact that KABIR hen is heavier (2300 g) than commercial layers

breeders (2000 g). In fact, it is well established that increase in body weight in poultry negatively affect fertility.

Conclusion

Incorporation of 5% of MOL in the diet did not impaired growth, and laying performances and egg characteristics of KABIR hens. MOL can advantageously replace up to 50% conventional and expensive plant proteins sources like soybean in poultry diet especially in village area where farmers suffered from quantitative and qualitative food shortage particularly in poor agricultural or household residues environment.

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