Effect of dietary energy and protein combination on egg production performance of Fayoumi chickens

Tesfa Geleta,* Samson Leta*

Oromiya Agricultural Research Institute, Adami Tulu Research center P.O. 35, Ziway Ethiopia

*Corresponding author email: ngtesfa@gmail.com

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Abstract

The effect of dietary energy and protein combination on dry matter feed intake and production performance of Fayoumi chickens was determined through 180 days feeding trial in Adami Tulu Research center. Experimental diets/treatments (T) were formulated from maize, wheat bran, fish meal, layer premix, salt and limestone. In the trial 96 Fayoumi chickens with 18 weeks of age were distributed according to completely randomized experimental design with 2x2 factorial arrangement, consisting of two crude protein (CP) levels (14% and 16%) and two metabolizable energy contents (3322 and 2992) kcal/kg diet with three replicates per treatment and eight (8) birds in each replicate. Chickens were reared in group in pens and feed offer and refusal measured daily. Egg laid collected daily. Significantly higher (<0.05) dry matter feed intake in gram per day was recorded in T2 (102.7±10.6) compared to T1 (89±9.5), T3 (87±8.1) and T4 (89±9.6). Differences in dry matter feed intake was not statistically significant (P>0.05) between T1 (89±9.5), T3 (87±8.1) and T4 (89±9.6). Significantly higher (P<0.05) egg production was observed in T3 (67±11.6) compared to T1 (47±10.1), T2 (44±9.14) and T4 (53±9.4). Significantly different (P<0.05) egg production was observed between T4 (53±9.4) and others. There is no significant difference (P>0.05) between T1 (47±10.1) and T2 (44±9.14) in egg production. Egg weight difference between T1 (39.5±2.2) and T3 (41.32±3.8), between T1 (39.5±2.2), T2 (37.89±3.57) and T4 (38.26±3.84) in gram was not statistically significant (P>0.05). Non significant (P>0.05) different egg shell weight in gram was observed between T1 (4.75±0.45), T3 (4.78±0.52) and T4 (4.56±0.55). No significant difference (P>0.05) in egg shell weight was observed between T2 (4.78±0.52) and T4 (4.56±0.55). Egg shell thickness in millimeter and yolk color score on DSM yolk color fan were not statistically significant (P>0.05) between treatments. In the study done 67.27, 33.29, 21.7 and 7.42 net Ethiopian Birr was obtained per chicken from T3, T4, T1 and T2 respectively within six months. From the biological and economic data analysis, we can conclude and recommend that feed with 16% CP and 3322kcal/kg diet could be used for layer Fayoumi chickens in mid rift valley of Ethiopia.

Keywords: Dietary, Diet, Crude protein, performance, Energy,

INTRODUCTION

Fayoumi chickens are light and egg producers breed among the introduced chickens to Ethiopia. They have single medium comb, red earlobes and slate blue legs. They are adaptable and resistance to hot and very dry area of tropical and sub-tropical conditions and originated from Egypt. Naturally the breed prefers perch and very flighty, do not like being handled at all and will become very vocal when picked up.

Availability, quality and cost of feed are the major constraints for fayoumi chickens and for all poultry
production in mid rift valley of Ethiopia. Because of these poultry production in mid rift valley of Ethiopia characterized with inadequate feeding system. There are shortages of protein supplements and micro-nutrients including vitamins and minerals in poultry feed which are needed for the preparation of balanced rations (Solomom, 1996) and energy content of the diet is the other crucial nutrient that control feed intake and need consideration during ration formulation (Smith, 2001). Economically as well as nutritional it is imperative that balanced diet that contains optimum protein and energy should be provided during laying stage. Optimum use of protein is essential in any feeding system because protein supplements are more expensive and wasteful usage increases the cost of production. Unless balanced diet (optimum protein, energy and mineral) provided chickens lose their production potential and highly exposed to disease. Regular supply of feed over and above maintenance requirements is essential to improve productivity in family of poultry production (FAO, 2004). The price of commercial poultry feed produced by private company is too expensive for small holder farmers to regularly feed their chickens and rises from time to time. In low income, food-deficient countries surplus of cereals are generally not available and not advisable to develop a wholly grain-based feeding system (Aganga et al., 2005). Although (Smith, 2001) and National Research Council (NRC,2003) recommended general feeding standard for chickens these have not been totally practiced in the tropics for the reason of environmental differences, types and quality of available feed resources. Using locally available feed resource to formulate optimum protein and energy for layers chickens used to reduce wasteful use and limitation in nutrient intake and supports the success of poultry extension. Therefore the study was done to:

1. Formulate dietary energy and protein requirements for layers Fayoumi chickens from locally available feed resources.
2. To identify dietary energy and protein combination required for layers Fayoumi chickens in mid-rift valley of Ethiopia

**MATERIAL AND METHOD**

**Description of the study area**

The experiment was conducted at Adami Tulu Research Center, located in the mid rift valley of Ethiopia at an altitude of 1650 m.a.s.l. and latitude of 7°9’N and 38°7’E. The average annual rain fall of the area is 834.6mm and the mean maximum and minimum temperature are 28.5°C and 12.5°C respectively and average relative humidity of the year is 58% (ATARC 2013 Meteorological Data).

**Feed management**

Locally available feed resources (maize, wheat bran, fish meal and mineral) source feed were used to formulate experimental diets. Maize is rich in carbohydrate and fat, contains 8% CP and 14.5 KJ/g metabolizable energy (Smith, 2001) and highly produced cereal grain in mid rift valley of Oromia, Ethiopia. Fish meal is the most important animal protein supplement used in poultry ration that contributed protein especially essential amino acid, vitamin (B12), and minerals like calcium, phosphorus, sodium, manganese, potassium, chlorine (Richard and Church, 1998; Smith, 2001; Nan and Mohanal, 2004). Wheat bran is the outer fibrous layers separated from the rest grain and germ with protein content of 14-18%, 12MJ/kg metabolizable energy and quite palatable and well known for its laxative characteristic (Adugna et al., 2007). Maize and wheat bran were purchased from local markets. Boiled and dried fish meal was brought to Adami tulu research center from processing area and used as ration ingredient. Limestone, layers premix, and salt were purchased and added in to the ration. Chemical composition analysis was done for each ingredient and using double Person square ration formulation method four dietary treatments were formulated for layers. Using completely randomized factorial arrangement design two levels proteins and two levels energies diets were formulated to be used. Table 1.

From each formulated treatment diet 120 g/head/day was calculated and provided each day. Left over of the treatments diets were collected next day morning before providing feed for the next day. Water was provided ad libitum. Chickens were randomly allotted to four dietary treatments replicated each three times. For each replicate eight chickens (7 females and 1 male) were assigned.

**Chickens and house management**

An atomically non-defects ninety-six (96) pullet Fayoumi chickens with age of eighteen (18) weeks were selected from chickens reared in Adami Tulu research center. Chickens were vaccinated for NCD using HB1at 2nd day and lasota at 23 days through ocular route and Gumboro at 7 and 21 with drinking water. Litter system housing that partitioned in to 12 equal size pens (4m²) was used. Before placing the experimental birds in to the pens the whole units were cleaned disinfected with dizinon and littered with properly dried tef (Ergrostic tef) straw. The house was electrically heated during night.

**Statistical analysis**

Analysis of variance of feed intake, egg production and
Table 1. Compositions of feed ingredients used in experimental diets (% on DM basis)

<table>
<thead>
<tr>
<th>Feed stuff</th>
<th>Treatment (T)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td></td>
<td>24.00</td>
<td>17.50</td>
<td>32.10</td>
<td>28.80</td>
</tr>
<tr>
<td>Fish meal</td>
<td></td>
<td>2.50</td>
<td>1.20</td>
<td>5.10</td>
<td>3.50</td>
</tr>
<tr>
<td>Wheat bran</td>
<td></td>
<td>71.50</td>
<td>79.30</td>
<td>60.80</td>
<td>65.70</td>
</tr>
<tr>
<td>Limestone</td>
<td></td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Salt</td>
<td></td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Layers premix</td>
<td></td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Crude protein (CP) % 14 14 16 16
ME (Kcal/kg diet) 3322 2992 3322 2992

DM= Dry matter, CP= crude protein

Table 2. Nutritional compositions of experimental diets used in layers Fayoumi chickens rearing

<table>
<thead>
<tr>
<th>T</th>
<th>DM%</th>
<th>MM%</th>
<th>CF%</th>
<th>Fat%</th>
<th>Ca%</th>
<th>P%</th>
<th>CP%</th>
<th>ME(kcal/DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>89.83</td>
<td>7.05</td>
<td>5.56</td>
<td>2.71</td>
<td>0.92</td>
<td>0.88</td>
<td>14</td>
<td>3322</td>
</tr>
<tr>
<td>2</td>
<td>89.93</td>
<td>6.70</td>
<td>10.11</td>
<td>3.75</td>
<td>0.55</td>
<td>0.90</td>
<td>14</td>
<td>2992</td>
</tr>
<tr>
<td>3</td>
<td>89.33</td>
<td>10.33</td>
<td>8.61</td>
<td>4.09</td>
<td>0.74</td>
<td>0.89</td>
<td>16</td>
<td>3322</td>
</tr>
<tr>
<td>4</td>
<td>89.86</td>
<td>6.83</td>
<td>9.01</td>
<td>3.73</td>
<td>1.11</td>
<td>0.87</td>
<td>16</td>
<td>2992</td>
</tr>
</tbody>
</table>

T=treatment, DM%= dry matter percentage, MM%= mineral matter percentage, CF%= crude fiber percentage, Ca= calcium percentage, P = phosphorus percentage, ME= metabolizable energy

Table 3. Feed intake, egg production and egg weight, shell thickness, yolk color score (Mean ± SD) of Fayoumi chickens reared using different protein and energy combination

<table>
<thead>
<tr>
<th>T</th>
<th>Feed intake (g)</th>
<th>Egg production within six months</th>
<th>Egg Weight (g)</th>
<th>Shell weight (g)</th>
<th>Shell thickness (mm)</th>
<th>Yolk color score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>89±9.5^a</td>
<td>47±10.1^a</td>
<td>39.5±2.2^a</td>
<td>4.75±0.45^a</td>
<td>0.29±0.04^a</td>
<td>1.62±0.62^a</td>
</tr>
<tr>
<td>2</td>
<td>102.7±10.6^b</td>
<td>44±9.14^c</td>
<td>37.89±3.57^b</td>
<td>4.38±0.53^b</td>
<td>0.29±0.04a</td>
<td>1.45±0.50^b</td>
</tr>
<tr>
<td>3</td>
<td>87±8.1^b</td>
<td>67±11.6^b</td>
<td>41.32±3.8^a</td>
<td>4.78±0.52^a</td>
<td>0.30±0.03a</td>
<td>1.77±0.73^a</td>
</tr>
<tr>
<td>4</td>
<td>89±9.6^b</td>
<td>53±9.4^c</td>
<td>38.26±3.84^a</td>
<td>4.56±0.55^b</td>
<td>0.31±0.04^a</td>
<td>1.6±0.72^a</td>
</tr>
</tbody>
</table>

SD = standard deviation, TR= treatment

RESULTS

Chemical composition of the diets

Nutritional compositions of the experimental diets were analyzed at National veterinary Institute. The dry matter (DM%), mineral matter (MM%), crude fiber (CF%), crude fat (%), calcium (Ca%), Phosphorus (P%) and crude protein (CP%) composition of formulated treatment diets were analyzed using the method AOAC (1990) proximate principle and given in (table 2). Metabolizable energy of each treatment diet was estimated using the formula proposed by Wiseman (1987).

Production performance of chickens

Dry matter feed intake and production performance of Fayoumi chickens affected by energy and protein combination of the formulated diet. Mean value of egg quality parameters were done according to the general linear model (GLM) procedure of the Statistical Analysis System (SAS, 2001) software. When the results were significant, mean comparisons were made using Duncan multiple range test procedure of the SAS package.

Economic analysis

Average dry matter feed intake per bird, price of feed used per bird, cost of vaccine, medicine and disinfectant used were used to calculate the variable costs. Net return was obtained from egg produced sold. The economic benefit was estimated by considering partial budget analysis assumptions, according to the formula developed by CIMMT (1988); Ehui and Rey (1992).

\[ NI = TR –TVC \]

Where, NI = Net income, TR = Total return, TVC = Total variable cost.

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experimental feed intake, egg production, egg weight, shell thickness and yolk color are shown in (table 3).

**Economic efficiency**

The economic efficiency of energy and protein combination used for rearing layers Fayoumi chickens was done using partial budget analysis and given (in table 4).

**DISCUSSION**

Dry matter feed intake was significantly (P<0.05) affected by dietary proteins and dietary energies combinations. Significantly (P<0.05) higher dry matter intake was observed from the combination of feed with higher CP and lower energy content most probably the combination has good palatability that increased the apatite of chickens. The current finding agrees with Almeida et al. (2012) who found higher feed intake from using low energy and high protein combination diet compared to higher energy and low protein contents feed. The probably was also related to the possibility of that, the palatability of the diets were not affected by CP levels (Olumu et al., 1983; Wolde et al., 2011), higher dietary energy depressed feed intake (Olumu et al., 1983; Almeida et al., 2012). Higher feed intake in T2 similar with the intake reported (102.77g) by Khan et al. (2006) for the Fayoumi chicken breed. Significantly higher (P<0.05) egg production was obtained from T3 compared to the rest treatments due to higher protein and energy content of the diet and the finding in agreement with Almeida et al. (2012) who found higher egg production from using higher energy and higher protein combination of experimental diets compared to lower energy and lower protein diet combination. Harms et al. (1957) also found that single- comb white leghorn hens fed higher energy diet laid more eggs compared to chickens received low energy diets that agree with the current finding most probably the chickens received more nutrition above maintenance for production. Here it was found that egg production of Fayoumi chicken in present research work were lower than the egg production reported by Khan et al. (2006), by Abrahm et al. (2010); Tesfa et al. (2013) this might be due to different nutritional quality feed used and environmental differences.

Higher protein and higher energy combination diets (T3) also contributed for higher egg weight because higher protein increased albumin percentage that may increased egg weight. The current result agrees with the finding of Hussein et al. (1996) who reported significantly higher egg weight because of raising crude protein in the layer diet from 16 to 19% and with Almeida et al. (2012) who reported significantly higher egg weight because of higher protein content of the experimental diet used. Most probably the optimum combination of CP and dietary energy (T3) improved the utilization CP in (T3) that resulted for higher albumin percentage and egg weight compared to (T4). No significant difference (P>0.05) in shell thickness and yolk color were observed between treatments because limestone and green feed that influenced shell thickness and yolk color provided uniformly for all treatments. The finding in agreement with the report’s of Solomon (2004) who indicated yolk color as a function of green feed.

Feed costs are the major costs that influenced the profitability of chicken rearing in the current study. In the current study 67.27, 33.29, 21.57 and 7.42 net Ethiopian Birr was obtained per bird from T3, T4, T1 and T2 respectively from sale of eggs within six months experimental period. Net return increased as the level of dietary protein and dietary energy increased because these nutrients improved the egg production and egg weight of chickens and slightly reduced dry matter intake (Table 3). Ration with 16% CP and 3322 kcal/DM metabolizable energy formulated from locally available feed resources reduced feed cost by three fold and increased net income by four fold compared to the commercial feed used in previous work (Tesfa et al., 2013) and a good option for farmers.

**CONCLUSION**

It is concluded that locally available feed resources in mid rift valley of Ethiopia used to formulate protein and

<table>
<thead>
<tr>
<th>Partial budget cost</th>
<th>Treatments (T)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total feed consumed in six months, kg/chick</td>
<td></td>
<td>16.02</td>
<td>18.36</td>
<td>15.66</td>
<td>16.02</td>
</tr>
<tr>
<td>Total feed cost(ETB)</td>
<td></td>
<td>48.93</td>
<td>55.58</td>
<td>52.73</td>
<td>52.21</td>
</tr>
<tr>
<td>Cost of Vaccine, Medicine and Disinfectant(ETB)</td>
<td></td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
<td>12.00</td>
</tr>
<tr>
<td>Cost of construction pen(Mish wire, poles and Bedding material/teff straw/) (ETB)</td>
<td></td>
<td>35.00</td>
<td>35.00</td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>Total variable cost(TVC) (ETB)</td>
<td></td>
<td>95.93</td>
<td>102.58</td>
<td>99.73</td>
<td>99.21</td>
</tr>
<tr>
<td>Cost of total eggs laid(GR)(ETB)</td>
<td></td>
<td>117.50</td>
<td>110.00</td>
<td>167.00</td>
<td>132.50</td>
</tr>
<tr>
<td>NR (GR-TVC)</td>
<td></td>
<td>21.57</td>
<td>7.42</td>
<td>67.27</td>
<td>33.29</td>
</tr>
</tbody>
</table>

ETB = Ethiopian Birr, TVC= Total variable cost, NR = Net return, GR= Gross return.
energy requirements for exotic chicken and using it has a remarkable profit for farmers. Therefore, feeding layers fayoumi chickens with 16% CP and 3322 kcal ME/ kg dry matter is recommended for similar climatic condition (semi-arid) area.

REFERENCE