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Effect of replacing maize with malted barley grain on fertility, hatchability, embryonic mortality and chick quality of white leghorn layers

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Abstract

The study was conducted to evaluate the effects of different levels of malted barley grain (MBG) on fertility, hatchability, embryonic mortality and chick quality of white leghorn (WL) layer for 90 days. Malted barley added to diets at levels of 0% (T1), 10% (T2), 20% (T3) and 30% (T3) of malted barley grain. One hundred eighty white leghorn layers with average initial body weight of 1036.20± 31.097 g (mean ± S.D) were randomly allocated into the 4 treatment groups with 3 replicates of 15 birds each in CRD design. The result showed that there was significant difference (P<0.05) in chick weight, but it had no significant effects on other traits. Therefore, MBG can be replaced for maize grain as a source of energy up to 30%, since the present experiment did not negatively affected fertility, hatchability, embryonic mortality and chick quality.

Keywords: Fertility, hatchability, layer diet, malted barley grain

INTRODUCTION

Poultry industry is a predominant source of animal protein in both developed and developing countries. Adenjimi *et al*. (2011) emphasized that the expansion of the poultry industry depends largely on the availability of good quality feed in sufficient quantity and at prices affordable to both producers and consumers. The production of ethanol from maize is increasing currently and expected to increase in the future as a result of rising cost of fossil oil and the environmental pollution issues (IFAD, 2008). Increased demands for domestically produced liquid fuel is increasing competition between animal feed and fuel production uses of maize. As a result, the recent rise in demand and consequent increase in the cost of maize has spurred interest in replacing it in poultry diets with locally grown other energy grains (Mehri *et al*., 2009). Barley utilization in poultry diet is limited due to high concentration of non Starch Polysaccharides (NSPs) and phytate (Moghaddam *et al.,* 2009). Although there is enough information on the utilization of barley by poultry However, there is a scarcity of complete information on feeding malted barley (water treated barley) to poultry birds. Accordingly, this study was designed to investigate the effects of feeding different proportions of malted barley grain on fertility, hatchability, embryonic mortality and chick quality of white leghorn layer.

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MATERIALS AND METHODS

The experiment was conducted at Haramaya University poultry farm. The study area is located, at a distance of

Table 1. Chemical composition of feed ingredients used to formulate experimental ration

Ingredients					
Chemical components	**Malted barley grain**	**Nouge seed cake**	**Soybean Meal**	**Maize grain**	**Wheat short**
Dry mater (%)	90.8	93.7	94.4	90.9	90.7
Crud protein (% DM)	11.5	31	38	8.8	15.4
Ether extract (% DM)	2.1	5.1	8.2	5.1	5.1
Ash (% DM)	3.7	7.8	7.6	4	4.84
Crud fiber (% DM)	6.2	17.9	5.9	4.9	8.1
Calcium (% DM)	0.1	0.7	0.3	0.02	0.1
Phosphorus (% DM)	0.3	0.3	0.7	0.3	0.4
ME (kcal/kg)	3366.7	2339.1	3563.7	3630.6	3312.3

Table 2. Ingredients and calculated chemical analyses of the layer rations

Ingredients (kg/100kg)	Treatments			
	T1	T2	T3	T4
Maize	48.0	38.0	28.0	18.0
Malted barley	0.0	10.0	20.0	30.0
Wheat short	14.0	14.0	15.0	15.0
Noug seed cake	18.8	18.8	18.8	18.8
Soybean meal	11.0	11.0	10.0	10.0
Lime stone	7.0	7.0	7.0	7.0
Salt	0.5	0.5	0.5	0.5
Vitamin premix	0.7	0.7	0.7	0.7
Total	100	100	100	100
Chemical composition				
Dry mater (%)	92.4	92.4	92.3	92.3
Crud protein (% DM)	16.5	16.8	16.8	16.9
Ether extract (% DM)	5.1	5.0	4.9	4.8
Ash (% DM)	10.7	11.8	10.0	10.4
Crud fiber (% DM)	9.4	9.5	10.4	10.4
Phosphorus (% DM)	0.4	0.4	0.4	0.5
Calcium (% DM)	3.1	3.1	3.2	3.2
ME (kcal/kg)	2959.4	2898.8	2887.1	2861.3

515Km from Addis Ababa capital city. The average annual temperature and rainfall ranges from 8 - 24^{o}C and 650 to 800 mm. respectively **(**Mishra *et al.,* 2004).

Malted barley Processing

Barley was mixed with water in the ratio of 1kg to 2 litters in a barrel, stirred/soaked gently and the container was tightly sealed and left for 24 h. Then water was removed after barrel covered with sieve and the moist barley left in the same container to germinate for 72 h. The grain were thinly spread on plastic sheet and dried under shade at room temperature for 72 h to prevent the seed internal enzymes activity. The grains were then ground into a leaf meal using a hammer mill of mesh size 3mm.

Experimental Diets

Four experimental diets at isocaloric and equiprotein composition were formulated, such that Diet 1 which served as the control had no malted barley (0%), Diet 2 had 10% malted barley, Diet 3: 20% and Diet 4: 30%, the ingredient composition of the experimental diets are shown in Table 1 and 2.

Experimental Animals/ Experimental Design

One hundred eighty white leghorn pullets used in the study were obtained from Haramaya university Farms. The birds were randomly allocated to four dietary treatment groups each treatment had three replicates comprising 15 pullets per replicate and 45 pullets per treatment in a CRD design which housed in 2 x 4m. During the eight week period of the study, the birds were subjected to similar managerial and sanitary conditions and equal quantities of feed and water were provided daily, such that the only source of variation was the levels of Malted barley in the diets.

Data Collection

The eggs for incubation was collected for seven consecutive days of the experimental period and stored under recommended temperature (14°C). Good shape, clean shell, no cracks and medium size eggs were selected by visual inspection and a sample of 240 eggs (60 eggs from each treatment and 20 from each replicate) were used for fertility and hatchability test. The temperature and relative humidity of the setter and hatchery unit was set at 37.5° C and 85-90% respectively. Egg was candled at Day 7 to remove the infertile ones. Fertility for each replication was computed according to formula given by Bonnier and Kasper (1990). Fertility (%) = No of fertile eggs/ Total no of eggs produced x 100%.

At the 21st and 22nd days of incubation, hatched chicks were collected and counted to determine hatchability in relation to the number of fertile eggs (North, 1984). The percentage hatchability for each replicate was computed according to the formula given by Rashed (2004) and Fayeye *et al*., 2005). Hatchability on fertile eggs (%) = No of eggs hatched out/Total no of fertile eggs x 100%, Hatchability on set eggs (%) = No of eggs hatched out/Total no of eggs set x 100%.

Embryonic mortality was determined by candling eggs at 14th and 18th days of incubation and the last three days of hatching. Eggs also opened for visual observation and dead embryos were categorized as dying at early (7 d), mid (8–14 d), late (15–18 d) and piped (>19 d). Percent embryo mortality was calculated as the number of embryos that died during one of the four mortality periods divided by the number of yolks with fertile germs x 100.

Chick quality was measured using three different methods, which includes visual scoring, measuring day old chick weight and measuring day old chicken length. Visual scoring employed grading of chicks by visual examination based on the quality standards outlined by North (1984), chicks that are not malformed, not dehydrated, physically active, stand up well and look lively. The visual assessment was made by the researcher and two other technicians, and the quality of the chicks was determined based on common decision by the three observers. The mean percentage of quality chicks was calculated by expressing the number of quality chicks as percentage of the total number of chicks hatched.

Chicks were randomly selected for chick weight and length measurement from each replicate. Chick length was determined by measuring the length of stretched chick from the tip of the beak to the tip of the middle toe in centimeters (cm) using a ruler for the same chick from which weight measurement was taken.

Statistical Analysis

The data collected for fertility, hatchability, embryonic mortality and chick quality during the period of the study was subjected to analysis of variance using SAS (2005, version 9.13) computer software. The following model was used for data analysis. Yij = μ + Ti + eij, Where: Yij = represents the jth observation (experimental unit) taken under treatment I, μ = over all mean, Ti = feed effect and e_{ij} = random error

Logistic regression analysis was used for data recorded on fertility, hatchability, embryonic mortality (alive/dead) and chick quality of visual score (poor/normal). The general logistic regression model used is given below:

Model: $\ln\left\{\frac{\pi}{1-\pi}\right\} = \beta_0 + \beta_1 * (X)$

Test H_0: No treatment effect (i.e., $\beta_1 = 0$) vs. H_A: Significant treatment effect ($\beta_1 \neq 0$).
Where, π = probability, β = slope and x = treatment.

RESULTS AND DISCUSSION

Fertility and Hatchability

Both the fertility and hatchability eggs were no significantly difference (pr >chisq 0.6570 and 0.9785 at α = 0.05) with Wald chiSq value of 1.6106 and 0.1943, respectively among the treatments (Table 3 and 4). Apparently, fertility was largest for T3 (98.3 %) followed by those of T4 and T2 (95.0 %) and T1 (93.3 %) without significant (p >0.05) difference among treatments. The mean fertility in the present study was slightly higher than Islam *et al.* (2002) who reported 94.78% for white leg horn chicken. Among the treatments, T3 had highest (81.4, 80.0) hatchability on fertile egg and hatchability on total eggs set respectively without significant (p >0.05) difference among treatments. The value obtained in this study is lower than Islam *et al.* (2002) who reported 90.15 and 86.08 for hatchability on fertile egg and hatchability on total eggs set respectively. The lower hatchability could be probably due to heat stress encountered during incubation, as greater part of the study was carried out during the dry season. Gabreil *et al*. (2006) reported that level of dietary protein significantly affected egg fertility and hatchability. The similarity in fertility and hatchability among treatment of the present study may be related to similarity in nutrient use or the efficiency of nutrients absorbed from the egg. Thus, the result indicated that replacing malted barley for maize up to 30% did not negatively affect fertility and hatchability.

Embryonic Mortality

Embryonic mortality results classified as early, mid, late and pips were analyzed using ANOVA and logistic regression (alive or dead) among the treatments (Table 3 and 4). The

Table 3: Fertility, hatchability and embryonic mortality of white leghorn chicken fed diets containing different proportion of malted barley grain as a substitute for maize

Treatments Parameters	T_1	T_2	T_3	T_4	SEM	SL
Fertility (%)	93.3	95.0	98.3	95.0	1.15	NS
H/ on fertile egg bass (%)	78.6	78.9	81.4	80.8	0.57	NS
H/ on total egg bass (%)	73.3	75.0	80.0	76.7	1.09	NS
Early E. M (%)	3.6	5.3	5.1	3.4	0.59	NS
Mid E. M (%)	5.4	7.0	5.1	6.9	0.56	NS
Late E. M (%)	7.1	5.3	5.1	7.1	0.63	NS
Pip E. M (%)	5.4	3.6	3.4	3.4	0.69	NS

T_1 = 0% MBG +100% maize, T_2 = 10% MBG + 90% maize, T_3 = 20% MBG + 80% maize, T_4 = 30% MBG + 70% maize, MBG = malted barley grain, H= Hatchability, NS=Non- significant at ($p > 0.05$), SEM = standard error of mean, SL = significant level, % = percent, EM = embryonic mortality

Table 4: Results of logistic regression of fertility, hatchability, chick quality and embryonic mortality in white leghorn chicken fed diet containing different levels of malted barley grain as a substitute for maize

Wald Parameter	DF	Chi-Square	Pr >ChiSq
Fertility	3	1.6106	0.6570
Hatchability	3	0.1943	0.9785
Chick quality of visual score	3	0.6281	0.8900
Early E.M	3	0.3635	0.9477
Mid E.M	3	0.3254	0.9552
Late E.M	3	0.3302	0.9543
Pip E.M	3	0.3866	0.9430

DF= Degree Freedom, EM = Embryonic Mortality

Table 5: Chick quality of white leghorn chicken fed diets containing different proportion of malted barley grain as a substitute for maize

	Treatments					
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**	**SL**
Chick weight	29.9^{b}	31.6^{ab}	32.8^{a}	31.9^{a}	0.39	*
Chick length	15.9	16.1	16.2	16.1	0.04	NS
Chick visual score	79.4	79.1	85.5	81.9	1.24	NS

Means with in a row with different superscripts are significantly different;*=Significant at ($P< 0.05$); NS=Non- significant

logistic regression result of early, mid, late and pip provided a Wald value of 0.36, 0.33, 0.33 and 0.39 with pr > ChiSq value of 0.95, 0.96, 0.95 and 0.94, respectively, which shows no significant difference at all stages of development among the treatments (Table 4). The percentage of dead embryo obtained in the present study is far lower than Singh *et al.* (1983) who reported 36.9%, but tend to slightly agree with Islam *et al.* (2002) who reported 6.2% dead in shell white leghorn. Similarly Hocking *et al.* (2002) reported that the embryonic mortality of eggs of the breeder hens' feed low protein was higher than that of hens fed on high protein diets.

Chick Quality Measurement

The statistical analysis showed that there was no significant ($P>0.05$) difference in chick length and chick visual score among treatments However, there was a significant difference ($P < 0.05$) in chick weight (Table 5). Hens fed diet consisting 0% malted barley grain (T_1) has lower day old chick weight than those fed diet with

20% malted barley grain (T_3) and 30% MBG (T_4). The logistic regression result of chick quality measured in terms of visual score provided a Wald ChiSq value of 0.62 with pr > ChiSq value of 0.89 (Table 4). Average chicks weight recorded in the study was slightly lower than Islam *et al.* (2002) who reported 39.36 g for white leg horn breeds of chickens. As documented by Tona *et al*. (2003) egg weight has a direct impact on the weight of chick and a positive correlation between egg and chick weight. Sahin *et al*. (2009) also reported variation in chick weight influenced by initial eggs weight incubated. Thus, the difference in chick weight recorded in the present experiment might be due to difference in egg weight used for incubation. Chick length may be an indicator for chick quality and potential growth because of longer chick would have better uniformity and might have better developed organs. Highest production of percent normal chicks (chick visual score) in this study is lower than Islam *et al.* (2002), who reported 97.9% for white leg horn breeds of chickens.

CONCLUSION

In general, the present experiment indicates that malted barley can replace maize economically up to 30% without adversely affecting egg fertility, hatchability, embryonic mortality and chick quality.

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