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Increasing lysine and methionine density improves broiler breeder performance

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ABSTRACT

A study was conducted to determine the effects of 4 different lysine and methionine densities diets, Very high (VH), high (H), medium (M) and low (L) on performance of broiler breeders 50 to 64 weeks of age. 168 female and 24 male breeders in four treatments with six replicates (7 females: 1 male) were used in the completely randomized design. Four experimental diets were formulated iso-nitrogenous and iso-energetic based on AMEn requirements. In broiler breeders receiving very high diet significantly improved egg weight, egg production, egg mass and feed conversion ratio compared with other treatments. Fertility decreased in broiler breeders fed VH density diet ($P<0.05$). Body weight unaffected by lysine and methionine density levels. This study of Arian boiler breeders showed that higher egg weight, egg production and egg mass can be achieved by feeding very high diet. The results of this study suggested that increasing lysine and methionine densities maximized performance of broiler breeders from 50 to 64 weeks.

Key words: Broiler breeders, Lysine, Methionine, Reproductive performance

Nutrition of broiler breeder hens can influence egg quality and is therefore extremely important for the development of the embryo and the successful hatching of a high quality chick (Deeming 2002). The developing embryo and the hatched chick are completely dependent for their growth and development on nutrients deposited in the egg.

Energy and amino acids are the most important factors in broiler breeder hen's diet. Any changes in the daily nutrients intake in broiler breeder hens must be done based on their requirements (Leeson and Summers 2000). Therefore, knowing the requirements of metabolizable energy (ME) and amino acids in broiler breeders at any age, phase of production and metabolizable energy value of foodstuffs in the diet is essential for their optimal production (NRC 1994). Leeson and summers (2000) reported as much as 10–15% differences in broiler breeder protein and amino acid requirements suggested by different breeding companies. Leeson and summers suggested that the differences could possibly be true breed differences but believes it is hard to rationalize considering our knowledge of breed-nutrition interactions.

The objective of this experiment was to determine the effect of increasing lysine and methionine density on broiler breeder's performance.

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MATERIALS AND METHODS

Arian broiler breeder hens (168), 50-wk old, were used in this experiment. Broiler breeders were weighted at the beginning of the experiment, and allocated to treatment groups on the basis of mean body weight (g), female (3531±55 g) and male (4390±70 g). The hens were weighed at the end of 58 and 64 weeks. They had been provided a daily allowance of 150 g of feed/day formulated to meet their daily requirement. The hens were placed randomly in 24 pens (1.2×2 m), each containing seven hens and one male, with pine shavings used as litter. Each pen contained a tube feeder, with 1 bell-type automatic drinker, and four individual nests. Six pens of hens were fed each diet. Light program provided for 16 hours of light per day from 7 AM to 23 PM. Broiler breeders vaccinated to a standard vaccination program.

The basic chemical composition of the feed materials was determined according to AOAC (1990). Before formulation of the experimental diets, samples of the protein-contributing ingredients (corn, soybean meal) were analyzed for total amino acid concentration. The total amino acid values of the ingredients were assayed by high-pressure liquid chromatography analysis. Four experimental diets were fed (Table 1). All diets contained 14% crude protein and were maintained isocaloric (2700 kcal/kg). Diet 1 (low) contained 0.501% lys and 0.27% met. Diet 2 (Medium) contained 0.551% lys and 0.298% met. Diet 3 (High) contained 0.601% lys and 0.325% met. Diet 4 (Very high) contained 0.65% lys and 0.351% met. The average analyzed differences between

Table1. Composition and calculated contents of the experimental diets

Items \ Treatment	Low	Medium	High	Very High
Corn, grain	54.00	53.61	53.31	54.20
Wheat	12.00	12.00	12.00	12.00
Wheat bran	13.00	13.00	12.62	11.56
Soybean meal -48%	12.36	12.50	13.09	13.19
Oyster shells	7	7	7	7
Dical. phos.	1	1	1	1
Common salt	0.03	0.20	0.20	0.20
Vitamin premix*	0.25	0.25	0.25	0.25
Mineral premix*	0.25	0.25	0.25	0.25
DL-methionine	0.057	0.11	0.16	0.2
L-lysine HCl	0.052	0.082	0.12	0.15
Total (kg)	100	100	100	100
Calculated contents				
MEn (Kcal/kg)		2700		
Protein (g/kg)		140		
Ether extract (g/kg)		22.9		
Linoleic acid (g/kg)		11.5		
Calcium (g/kg)		30		
Avail. phosphorus (g/kg)		4		
Potassium (g/kg)		6		
Chloride (g/kg)		2		
Sodium (g/kg)		1.6		
Analyzed contents				
Lys (g/kg)	5.01	5.51	6.01	6.5
Met (g/kg)	2.7	2.98	3.25	3.51
Cys (g/kg)	2.5	2.5	2.8	2.7
Arg (g/kg)	8.3	8.4	8.7	8.6
Gly (g/kg)	6.4	6.4	5.1	5.1
Ser (g/kg)	7.0	7.0	6.7	6.8
His (g/kg)	3.5	3.5	3.7	3.6
Ile (g/kg)	5.5	5.5	5.3	5.3
Leu (g/kg)	12.3	12.4	11.2	11.3
Tyr (g/kg)	5.1	5.1	5.1	5.1
Thr (g/kg)	4.9	4.9	4.8	4.8
Trp (g/kg)	1.8	1.9	1.7	1.7
Val (g/kg)	6.2	6.2	5.9	5.9

*Premix (kg): 4.4g of vitamin A, 0.72g of vitamin D3, 7.2g of vitamin E, 1g of vitamin K, 0.306g of thiamin, 0.306g of pyridoxine, 1g of riboflavin, 6.08g of pantothenic acid, 2.48g of niacin, 0.306g of folic acid, 1g of biotin, 220g of choline, 2g of Mn, 13g of Zn, 10g of Fe, 0.02g of Cu, 0.2g of I, and 0.04g of Se.

VH, H and M vs. L for lys and met density were 10, 20 and 30%, respectively. Feeds provided were in mash form and were milled with a 3 mm screen to obtain a similar particle size in all diets. Both male and female broiler breeders received the same diets at 8 am. The intake of protein and amino acids was calculated by multiplying feed intake by amino acid content of the diet.

Egg production (EP) was recorded daily on a pen-by-pen basis. All eggs produced on the day were weighed (EW). Egg production was multiplied by EW to obtain daily egg mass (EM). Eggs were collected at 52, 56, 60 and 64 week of age. Eggs laid before 08:00 h were removed from the nest boxes and discarded from the experiments. Eggs were collected from nests between 08:30 and 12:30 h, placed in setter trays (150 eggs per tray), and transported in to the storage room near the poultry houses. 240 eggs were collected in every day and stored for in the room at 16°C and 78% relative humidity. Eggs were culled to exclude from the experiment including those that were cracked, visibly dirty or extreme size (those weighing less than 51 g or more than 75 g). After removing culled eggs, a random sample of egg production per day from each replicate (48 eggs total/day) were collected for determine egg characteristics, 336 eggs utilized to measure egg characteristics in the week (7 eggs/replicate).

Eggs (about 30 eggs for every replicate) were set in a Maino, force-draft incubator. On the 18th d of incubation, eggs were individually candled in the transfer-room (around 24°C and 60% relative humidity), using a hand candling lamp. Remaining eggs with apparently living embryos, were transferred to hatching baskets and randomly distributed in the same trolley. All chicks were removed at 21.5 d of incubation. The numbers of saleable chicks and culls were determined. From the data, both hatchability (number of saleable chicks hatched per all eggs set×100), and fertility (number of fertile eggs set per all eggs set×100) were calculated.

Data were analyzed by completely randomized designed (GLM procedure) and where significance occurred, means were compared with the Duncan multiple range tests (DMRT 1955). Output data were expressed as means with SEM.

RESULTS AND DISCUSSION

The results of broiler breeder's performance from 50 to 64 week are given in Table 3. Different levels of supplemental lysine and methionine (+10, +20% and +30%) significantly increased egg weight, egg production and egg mass from 50 to 64 weeks of age ($P<0.01$).

These results indicated that the lys and met requirements of Arian broiler breeders (ABMG 2000) for maximum performance were higher than those of values reported for other authors (Wilson and Harms 1984 and 1986, Soares *et al.* 1988).

The egg weight was significantly heavier on treatment

Table2 Consumption of nutrient (units/hen/day)

Items \ Treatment	Low	Medium	High	Very high
Energy MEn (Kcal)			405	
Protein (g)			21	
Lys (mg)	771	826	901	975
Met (mg)	405	447	488	527
Cys (mg)	387	388	433	426

Table 3. Productive performance of broiler breeder (50 to 64 weeks)

Treatment	Hen number	Body weight (64 wk-kg)	Egg weight (g)	Egg production (%)	Egg mass (g/hen/day)	Feed conversion ratio	Fertility (%)	Hatchability (%)
Low	42	3.658	66.79^{c}	50.50^{c}	33.74^{c}	4.73^{a}	81.51^{ab}	68.02^{b}
Medium	42	3.546	67.71^{bc}	52.65^{bc}	35.67^{bc}	4.39^{bc}	85.87^{ab}	78.37^{a}
High	42	3.625	67.35^{b}	55.05^{b}	37.06^{b}	4.21^{b}	90.87^{a}	70.87^{b}
Very high	42	3.531	68.97^{a}	62.45^{a}	43.10^{a}	3.59^{a}	77.26^{b}	65.50^{b}
SEM		0.117	0.299	1.470	1.013	0.120	3.75	1.04
Sign		0.315	0.000	0.000	0.000	0.000	0.000	0.000

[a-c]Means within the same column not sharing a common superscript differ significantly (P<0.05).

fed VH diet by 68.97 g than other treatments (P<0.01). Broiler breeder hens fed L diets had lowest egg weight by 66.79 g (P<0.01).

There were a significant increase in egg weight, egg production and egg mass in broiler breeders fed VH diet in all of weeks from 56 to 64 (Table 3).

Several factors are effective on the size of eggs of broiler breeder, including genetics (Chamber *et al*. 1974), chronological age (Pearson and Herron 1981,Spratt and Leeson 1987), photoperiod (Brake *et al.* 1989), sexual maturity (Blair *et al.* 1976, Leeson and Summers 1983). But other studies reported body weight (McDaniel *et al.* 1981) and diet as factors affecting egg weight (Ingram and Wilson 1987, Wilson and Harms 1986, Pearson and Herron 1981 and 1982, Spratt and Leeson 1987). This experiment showed lys and met density had significantly positive effect on egg weight.

Average body weight was unaffected by treatments (P>0.05). Body weight was highest for birds consuming the L and H diet (P>0.05). Feed conversion was highest for broiler breeders fed L diet when compared to the other lys and meth levels (P<0.05). Furthermore, several studies have shown an increase in performance when dietary lys during the laying phase is higher than recommended levels

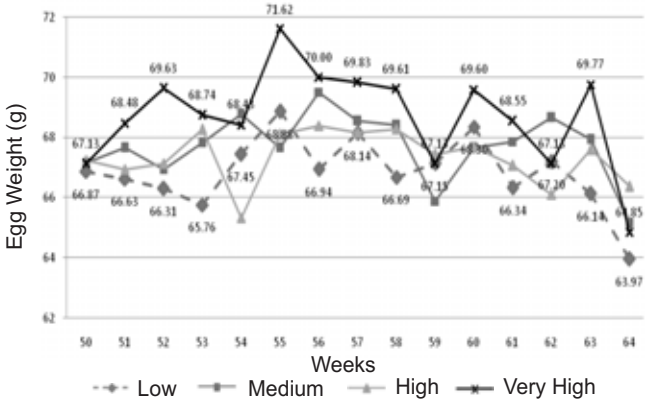

Fig. 1. Effects of different lysine and methionine density diets on mean egg weight from 50 to 64 weeks.

(Bowmaker and Gous 1991, Harms and Wilson 1980, Bornstein *et al.* 1979).

The met+cys requirement for the older breeder weighing 3.5 kg and producing 43.1 g egg mass would only be 953 mg/day with this data. A lower requirement of 750 mg of TSAA for 45 to 60 week old breeders producing an average of 43.6 g egg mass/day, weighing 3.0 kg at 45 weeks, and gaining 17g/7 day period has been reported by Kuana *et al.* (1988).

Wilson and Harms (1984) suggested the met requirement for breeders was 400 mg/day compared to previous recommendations of methionine intake between 400 - 478 mg/day (1980). Wilson and Harms (1984) suggested breeders only needed 20.6 g protein/day instead of 23.4 g in the earlier recommendations. Although this report showed that lys and met requirements for maximized performance were 975 mg/day and 527 mg/day, respectively and suggested breeders hens needed 21 g protein/day from 50 to 64 week of age. Cave *et al.* (1990) reported that breeders between the ages of 33–44 wk consuming 24.8 g of dietary protein per day that weighed 3.5 kg and was producing a maximum egg mass of 50.3 g/day needed 528 mg dietary met/day. The breeders consuming the higher intake of lys and met (VH) produced an average of 3.26% or 2.18 g larger egg weights for the 50–64 week period (P<0.01).

Cave *et al.* (1990) suggested the high met and TSAA requirements determined from their research is justified because the egg mass output is 6 to 8% above previous reported met and TSAA studies. However this study showed 30% increasing lys and met density improved 11.59% egg production and 9.36% egg mass from 50 to 64 weeks.

The methionine and lysine requirement of breeders reported by Bowmaker and Gous (1991) can be predicted with response coefficients for the reading model of (for lysine) 16.88 ME and 11.2 W, and for met, 7.03 E and 1.52 W, where EM = egg mass, g/bird/d, and W = body mass, kg/bird. The simulated requirement for met and lys using the response coefficients of Bowmaker and Gous (1991) for a 3.5 kg older breeder producing (VH density diet) 43.1 g egg mass per day is 303 mg met/day and 727.5 mg lys/day.

Soares *et al.* (1988) reported 45 to 60 week-old broiler breeders required 915 mg lys/day when consuming 18.5 g protein/day, producing an average 48 g egg mass/day, with a body weight of 3.5 kg at 60 weeks. This study suggested broiler breeder required 975 mg lys/day when consumed 21 g protein/day, producing an average 43.1 (g) egg mass/day, with a average body weight of 3.531 kg from 50 to 64 wk. Harms and Ivey (1992) reported the requirement of breeders for dietary lysine as determined from empirical data ranges from 823.6 mg for egg production, 806.1 mg for egg weight, and 818.7 mg/day for egg mass when the daily protein intake was at least 18.6 g. The researchers determined the requirement of lysine while feeding 167.8 g feed/day with diets kept isocaloric (3115 kcal/kg) containing protein levels ranging from 9.6–12.18%. The researchers reported the amount of protein and lys consumption was the controlling factor for body weight gain instead of dietary energy.

These results confirmed the previous studies (Bowmaker and Gous 1991, Harms and Wilson 1980, Bornstein *et al.* 1979) which demonstrated that lys requirement for broiler breeders is higher than that of NRC (1994) recommendations which was supplemented on the diet for maximal performance. It is also confirmed that increasing dietary lys and met level increases egg weight, egg production and egg mass.

The egg size and internal quality of eggs are important for hatching eggs. Fertility and hatchability are the major economical traits in broiler breeder reproductive performance.

Hatchability was significant in diet formulations based on lys and met levels (Table 3), treatment was significant in fertility (P<0/05). The fertility and hatchability were significantly greater on treatment fed H and M diet to 90.87% and 78.37%, respectively (P<0.05). Increasing lys and met density improved fertility and hatchability. In particular, it has been shown that excess protein reduces fertility. Furthermore, consideration must be given to protein quality and the nutritionist must ensure that a balance of amino acids is supplied from good quality protein sources. The yolk supplies 90% of the caloric needs of the developing embryo (Freeman and Vince 1974). Egg weight is a direct proportion of albumen, yolk and shell. The proportion of yolk tends to be greater in larger eggs and the proportion of albumen was measured as smaller in light eggs.

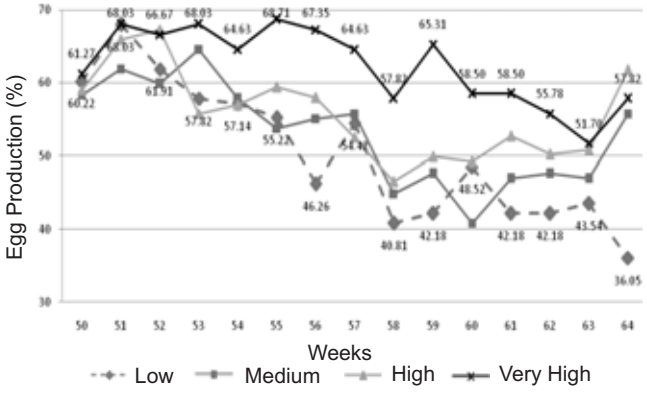

Fig. 2. Effects of different lys and met density diets on egg production from 50 to 64 wks.

Changes in hatchability in broiler breeder females have been reported to be related to many factors, such as storage time (Mather and Laughlin 1979, Kirk *et al.* 1980), incubation position, incubation conditions (Kirk *et al.* 1980,Tullett and Burton 1982), and shell quality (McDaniel *et al.* 1979, 1981, Bell and Brack 1985, Bennett 1992). Other researchers have found that bird age (Mather and Laughlin 1979) and egg size (Morris *et al.* 1968) also affect hatchability. Although this experiment showed that broiler breeders hens fed VH diet had a larger egg weight but lower fertility and hatchability.

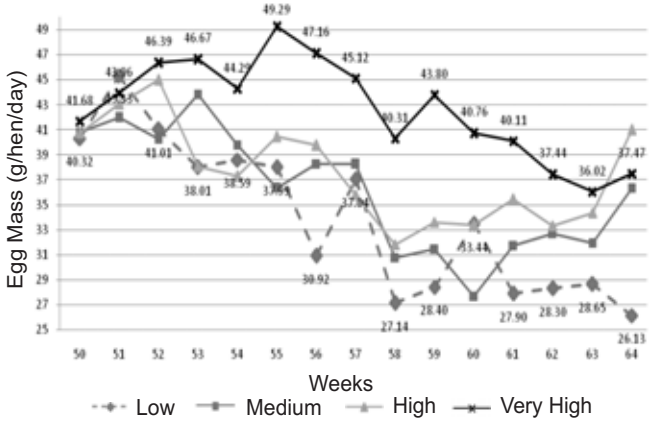

Fig. 3. Effects of different lysine and methionine density diets on egg mass from 50 to 64 weeks.

The fertility was highest on treatment fed H diet and hatchability was highest on treatment fed M diet. This difference was significant (P<0.01). Also, results indicated that the different lys and met intake had significant effects on egg weight (P<0.05).

This experiment showed that Arian broiler breeder hens had highest performance with consuming 21g protein/day, 975 mg lys/day, 527 mg met/day and 953 mg met+cys/day from 50 to 64 weeks of age.

The use of supplemental met and lys will increase daily lys and met intake without effect on hen's body weight.

This study of Arian boiler breeders showed that higher egg weight, egg production and egg mass can be achieved by feeding very high diet. The increases were 2.18 g, 11.95% and 9.36% more than broilers fed low diet, respectively.

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