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Research Article

Effect of Different Dietary Lysine Levels on Egg Composition of Broiler Breeders Kept at Different Temperatures

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Abstract

Poultry is one of the fastest growing and most promising industries with the brightest future in our country. Since 2008, the local broiler breeder industry produces only 35% of the day-old broiler chicks used by the industry and the remaining covered by importing fertile eggs. Experiment has demonstrated clear effect of temperature on broiler breeders' egg composition. The objectives of this experiment were; first to examine effects of four different ambient temperatures 21, 26, 29 and 32oC on the response of the egg composition from laying broiler breeders. Second, to examine their response of four dietary lysine concentrations (35, 50, 65 and 90 g/kg crude protein). Third, to examine whether there were temperature x lysine concentration interactions in the responses of broiler breeders. Two hundred and twenty-four 29-week old hens (308 Ross Broiler Breeder) randomly allocated to 16 identical pens within four environmentally controlled rooms in a facility. Split-plot design was used in which four main plots (rooms) kept at four constant temperatures.

Increasing temperature gave linear decreases in the proportion of shell in the eggs (P=0.049) There were no significant differences (P>0.05) between the different lysine concentration levels in any variable of egg composition. Similarly, there were no consistent (P>0.05) temperature x lysine concentration interactions.

Keywords: Breeders; Lysine; Ambient Temperature; Egg Composition

Introduction

Poultry is an emerging and important sector that has been contributing progressively to our economy from the past decade. Poultry is one of the fastest growing and most promising industries with the brightest future in our country. Since 2008, the local broiler breeder industry produces only 25% of the day-old broiler chicks used by the industry and the remaining covered by importing fertile eggs [1]. Not only are the imported fertile eggs expensive, they also undergo the stress of transportation causing deterioration in their quality. It is therefore important to expand the broiler breeder industry in Kuwait in order to overcome this problem [1]. This, in turn, will lead to a reduction in broiler chick prices, increase profitability and allow local producers to compete very effectively with the imported products in both price and quality.

In Kuwait, rising per capita income to high-income level in the last two decade has led to a concurrent increase in the demand of foods of higher quality, especially poultry products [1]. However, the efficiency of poultry productivity is low in Kuwait because of harsh desert conditions. High environmental temperatures causes heat stress, which reduces feed intake, growth, egg production and egg quality, meat quality and its ability to storage after production. This is especially for broiler breeders. Although Kuwait is still among the leading importers of chicken meat, there has been a recent trend to increase national production. In the past five years, chicken meat production in the region has increased by 35% compared to the overall world chicken meat production increase of 18.5% [2].

Broiler breeder producers need information to be able to predict and understand the effects on the birds of these high temperatures in order to be able to evaluate the economic efficiency of further investments in new sites or in further investment in cooling equipment for existing sites. This experiment was conducted to determine the effects of four different ambient temperatures 21, 26, 29 and 32°C on the response of the breeders' egg composition. Second, was to examine their response of four dietary lysine concentrations (35, 50, 65 and 90 g/kg crude protein). Third, to examine whether there were temperature x lysine concentration interaction in the responses of broiler breeders.

There is a lack of information of laying broiler breeders response to ambient temperature and to a limiting dietary amino acid. In addition, there is a lack of information as to whether these responses are interacting with ambient temperature.

Materials and Methods

Diets and measurements

A single lysine deficient diet that contained 151 g/kg crude protein (Table 1) was formulated based on wheat. The concentration of all amino acids and nutrients met or exceeded the requirements of the broiler breeder hens according to National Research Council [3] and Ross Breeders Limited [4]. Three further dietary levels of lysine concentration were achieved by adding L-lysine-HCl to the deficient diet, to give four concentrations of lysine (35, 50, 65 and 90 g/kg crude protein). All experimental diets were stored at the same environmental conditions. A daily feed restriction programme was followed, 150 g/day bird, then a reduction of 2.5 g feed/bird 28 days period [4].

Ingredients	**Lysine deficient diet (kg)**[†]
Wheat	750.0
Maize gluten meal (600g/kg CP)	50.0
Dehulled soya bean meal	60.0
Full fat soya	10.0
Maize starch	20.8
Limestone	70.0
Dicalcium phosphate	10.0
Sodium bicarbonate	2.0
Salt	2.0
DL-methionine	2.0
L-threonine	1.7
L-tryptophan	1.5
Vitamin-Mineral Supplement[‡]	20.0
Total	1000.0
Nutrient Composition:	
Crude Protein (CP) (g/kg)	151.0
Lysine (g\kg CP)	35.0
Methionine (g\kg CP)	30.0
Tryptophan (g\kg CP)	19.2
Methionine+ Cystine (g\kg CP)	46.5
Threonine (g\kg CP)	41.5
Isoleucine (g\kg CP)	44.0
Arginine (g\kg CP)	65.0
Valine (g\kg CP)	47.0
Histidine (g\kg CP)	24.0
Metabolisable Energy (MJ/kg)	11.8
Calcium (g\kg)	33.6
Phosphorus (g\kg)	5.0
Sodium (g\kg)	1.8
Potassium (g\kg)	4.8
Linoleic acid (g\kg)	12.0
Choline (mg\kg)	1000

[†]The other 3 experimental diets included additional (L-lysine HCl) in replacement for maize starch.

[‡]Supplied per kg of diet: *trans*-retinol(A), 4.8 mg; cholecalciferol(D3), 125μg; α-tocopherol acetate(E), 183.8 mg; thiamine(B1), 3 mg; riboflavin(B2), 10 mg; pyridoxine(B6), 5 mg; vitamin B12, 12 mg; nicotinic acid, 60 mg; pantothenic acid, 15 mg; folic acid, 2.5 mg; biotin, 205 μg; choline chloride, 500 mg; Fe, 20 mg; Co,1 mg; Mn, 100 mg; Cu, 10 mg; Zn, 80 mg; I, 2 mg; Se, 0.2 mg; Mo, 0.5 mg; Ca, 206g/kg; P, 100.5g/kg; Na, 50g/kg; Ash , 882g/kg.

Table 1. Composition of the broiler breeder lysine deficient diet fed (29 to 50 wks. old).

Laboratory analysis

A lysine deficient diet sample was collected for amino acid analysis. The samples were treated with 6M hydrochloric acid in sealed bottles at 110°C for 22 hours in order to hydrolyse the protein chains. For the analysis of cystine and methionine, the samples were oxidised with performic acid at 2-8°C for 16 hours prior to acid hydrolysis. The resulting hydrolysate was diluted and filtered. An aliquot was then adjusted to pH 2.2, and a known quantity of norleucine was added as an internal standard before making up to volume [5].

Birds and housing

224 Ross (308 Broiler Breeder) 29 weeks old hens (Ross Breeder Ltd., Newbridge, Midlothian, Scotland) were placed equally arranged and randomly in 16 identical pens within eight room environmentally control facilities. Two male birds randomly were also placed in each pen.

Each pen was equipped with two galvanized metal nest boxes with an alighting bar. Additionally one cup drinker allowed ad libitum access to water and two single feeders. The daily lighting programme hours was kept at 14 hours of artificial illumination to the end of all the experiment with a mean light intensity of 60 lux. A thermohygrogragh computer programme continuously recorded temperature and humidity. The egg composition of each pen of birds was recorded weekly.

Temperatures

There were four different temperatures used in the experiment (21, 26, 29 and 32°C). Each room was randomized for temperature at the beginning of each period. After the completion of each 28 days period, the whole temperature treatments were immeditaly changed for three days to 21°C and 73% Relative humidity. On the fourth day if necessary, a gradual daily change in temperature was made so that the ambient temperature applied in the next period could be reached.

Statistical analysis

A split-plot design was used in which four main plots (rooms) were kept at four constant temperatures each for a 28 day period. The temperature of the room was then changed to another constant experimental temperature decided upon in a latin-square design. Within each main plot, four sub-plots (pens) were each fed the four different diets each for a 28 day period. Data were compared by analysis of variance of the measured and calculated variables, using a split-plot design that examined the effects of temperature (main-plot) and the effect of diet and the lysine x temperature interactions within the sub-plot [6]. For both the temperature and lysine treatments, the treatment sums of squares was partitioned into their linear and non-linear (quadratic) effects.

Results and Discussion

Throughout the experiment, the 150 g/day bird, of feed always eaten. The mean mortality during the experiment was 2.3% (6 birds in total), which was not associated with particular treatments.

The lysine concentrations in the four experimental feeds were checked and they contained the correct concentrations of lysine. Similarly, the concentrations of all other amino acids were present in the correct amounts.

Average egg composition during the 21 weeks experimental period of 29 to 50 weeks age, on the four temperature and four feeding treatments have summarized in Table 2. Eggshell weight was decreased linearly (P=0.049) by increasing temperature. There were no significant differences (P>0.05) between the different lysine concentration levels in egg composition variables. There were no consistent (P>0.05) temperature x lysine concentration interactions.

Temperatures (°C)	Variables (g)	Lysine concentrations (g/kg Crude Protein)				Mean temperature effects
		35	50	65	90	
21	Egg shell	0.0895	0.0898	0.0957	0.0924	0.0919
	Egg yolk	0.2958	0.3177	0.3112	0.3046	0.3073
	Egg albumen	0.6146	0.5924	0.5931	0.6030	0.6008
26	Egg shell	0.0924	0.0899	0.0897	0.0903	0.0906
	Egg yolk	0.3041	0.3052	0.3064	0.3112	0.3070
	Egg albumen	0.6035	0.6049	0.6039	0.5984	0.6027
29	Egg shell	0.0897	0.0895	0.0904	0.0907	0.0901
	Egg yolk	0.3106	0.3101	0.3047	0.3026	0.3070
	Egg albumen	0.5996	0.6004	0.6049	0.6067	0.6029
32	Egg shell	0.0875	0.0885	0.0885	0.0884	0.0882
	Egg yolk	0.3131	0.3052	0.3067	0.3065	0.3079
	Egg albumen	0.5994	0.6063	0.6048	0.6051	0.6039
	Mean lysine concentration effects					
	Egg shell	0.0898	0.0894	0.0911	0.0905	
	Egg yolk	0.3059	0.3095	0.3073	0.3062	
	Egg albumen	0.6043	0.6010	0.6017	0.6033	

Statistical significance and SEM of treatment means						
	Temperature (n=4)		Lysine (n=16)		Temperature x lysine interaction (n=4)	
	P	SEM	P	SEM	P	SEM
Egg shell	Linear (P=0.049)	0.0020	P>0.10	0.0009	P>0.10	0.0018
Egg yolk	P>0.10	0.0067	P>0.10	0.0023	Linear. Quadratic (P=0.009)	0.0052
Egg albumen	P>0.10	0.0074	P>0.10	0.0027	Linear. Quadratic (P=0.013)	0.0059

Table 2: The effect of lysine and temperature on Effects of four dietary lysine levels on broiler breeders' egg composition (29- 50 weeks of age).

Ambient temperature (heat stress) is one of the most important environmental challenging poultry productions worldwide [7]. The negative effects of heat stress on poultry chickens range from reduced growth and egg production to decreased poultry and egg quality and welfare [8].

There was no significant differences (P>0.05) of a temperature x lysine concentration interaction in any of the egg composition measured variable.

Conclusion

Taken together, heat stress is a significant cause of economic loss in poultry production and is almost inevitable. This study has given clear negative effects of different ambient temperatures on egg composition of broiler breeders' eggs. Therefore, for improving productivity and welfare in heat-stressed poultry, correct ventilation for environmentally controlled poultry house system must selected.

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