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Effects of Diets Formulation Based on Digestible Amino Acids and True Metabolism Energy on Egg Characteristics and Reproductive Performance of Broiler Breeder.

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Abstract. A study was conducted to determine the effects of diets formulation based on digestible amino acids of feedstuffs and nitrogen corrected-true metabolizable energy on egg characteristics and reproductive performance of Arian broiler breeder in 50 to 64 wk of age. The numbers of 112 female and 16 male breeders in 4 treatments with 4 replicates (7 females with a male) were used in the form of a completely randomized experimental design 2 × 2 factorial. Four experimental diets were formulated based on two factors, first factor was included, two levels of Apparent and True Metabolizable Energy corrected for Nitrogen (AMEn and TMEn) and the second factor was included, two levels of Total (TAA) and Digestible Amino Acids (DAA) of Feedstuffs. Feeding broiler breeder AMEn diet significantly increased fertility and hatchability. Egg weight was significantly different which was affected by diets formulation based on energy ($P<0.05$). Diet formulated to DAA basis improved significantly egg weight, albumen height, Haugh unit and fertility ($P<0.01$). Treatment 3 (TMEn+TAA) was at the lowest level significantly different in egg weight 65.73 (g), albumen height 7.18 (mm), haugh unit 81.03, fertility 51.06 %, hatchability 46.36 % and chicken weight 45.4 g ($P<0.05$). This experiment suggested that diet formulation based on AMEn+DAA significantly increased egg weight, albumen height, Haugh unit, fertility, hatchability and chicken weight.

Key words: broiler breeders, digestible amino acids, egg, chicken weight.

1. Introduction

Apart from physical factors like temperature, water vapor pressure gradients and turning, bird embryos are entirely dependent upon the contents of the preformed egg for successful growth and development (Whitehead, 1989). The yolk and albumen in the egg supply the developing embryo with nutrients, water and minerals for normal growth. Yolk is an important nutritional component of the avian egg because it contributes 75% of the joules and provides all the lipids, and thus the energy, for the developing embryo (Noble et al., 1996), as well as being an important source of protein (Deeming, 2002). The yolk also provides all or most of the minerals, vitamin A and thiamine, and yolk lipids provide a range of essential components for tissue development and function. The albumen is an important reservoir for water, essential ions and protein, the latter forming 99% of the dry matter of albumen and also having useful anti-microbial properties (Deeming, 2002).

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. The developing embryo and the hatched chick are completely dependent for their growth and development on nutrients deposited in the egg. Current recommendation for diet formulation for broiler breeder hens are expressed as daily nutrient intakes based on Apparent Metabolizable Energy (AME) and Total Amino Acids (TAA) rather than True Metabolism Energy (TME) and Digestible Amino Acids (DAA) of feedstuffs. Energy and amino acids are

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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) in broiler breeder in any age and phase of production and metabolizable energy value of feedstuffs in the diet is essential for their optimal production (NRC, 1994).

Absorption and retention ratio of amino acids depends on two factors. 1-Digestible (protein hydrolysis and absorption) 2- the rate of amino acids Retention. All amino acids are not available in the feedstuffs for maintenance and production. Part of amino acids is indigestible and can vary among different feedstuffs. So to adjust poultry diets with digestible amino acids of feedstuffs is much better and easier meets birds real requirements for maintenance and production (Leeson and Summers, 2000).

The objective of this experiment was to determine the effects of types of broiler breeder formulation diets on reproductive performance and egg characteristics. Diets formulated based on two types of energy (AMEn, TMEn) and two types of amino acids of feedstuffs (total and digestible).

2. Materials and Methods

To determine the effects of diet formulation on the Arian broiler breeder performance, was used the number of 168 hens and 24 males (50 to 64 week). The experimental design was a completely randomized design with a 2×2 factorial treatment structure with 4 replicates per treatment. The first factor included was two types, Apparent and True Metabolizable Energy corrected for nitrogen (AMEn and TMEn) of feedstuffs, the second factor was two levels of Total Amino Acids (TAA) and Digestible Amino Acids of feedstuffs (DAA). At 50 weeks of age, broiler breeders were weighted, and allocated to treatment groups on the basis of mean body weight (g), female (3550 ± 25) and male (4390 ± 30).

Table 1: Composition and calculated contents of the experimental diets.

MEn (Feed)	Apparent		True	
Amino Acid (Feed)	Total	Digestible	Total	Digestible
Item \ Treatment	1	2	3	4
Corn, Grain	54.00	54.00	33.00	33.00
Wheat	12.00	13.00	27.00	27.00
Wheat Bran	13.00	11.20	20.00	20.33
Soybean Meal -48%	12.37	13.00	11.00	10.80
Oyster Shells	7.00	7.00	7.00	7.00
Dical. Phos.	1.00	1.00	1.00	1.00
Common Salt	0.03	0.20	0.20	0.20
Vitamin Premix *	0.25	0.25	0.30	0.30
Mineral Premix *	0.25	0.25	0.30	0.30
DL-Methionine	0.05	0.05	0.15	0.02
L-Lysine HCl	0.05	0.05	0.05	0.05
Total	100	100	100	100
Calculated contents				
Metabolosable Energy (Mcal/Kg)	2.70	2.70	2.70	2.70
Protein (%)	14.00	14.00	14.00	14.00
Ether Extract (%)	2.29	2.29	2.03	2.03
Linoleic Acid (%)	1.05	1.05	1.05	1.05
Calcium (%)	3.00	3.00	3.00	3.00
Avail. Phosphorus (%)	0.40	0.40	0.40	0.40
Potassium (%)	0.60	0.60	0.60	0.60
Chlorine (%)	0.20	0.20	0.20	0.20
Sodium (%)	0.16	0.16	0.16	0.16
LYS (%)	0.65	0.65	0.65	0.65
MET (%)	0.30	0.30	0.30	0.30
CYS (%)	0.27	0.27	0.27	0.27

* This premix supplied the following per kilogram of feed: 12,000 IU of vitamin A, 2,100 IU of vitamin D3, 27.5 IU of vitamin E, 2 mg of vitamin K3, 1 mg of thiamin, 6 mg of riboflavin, 10 mg of pantothenic acid, 20 mg of niacin, 2 mg of pyridoxine, 0.8 mg of folic acid, 0.020 mg of cyanocobalamin, 0.15 mg of biotin, 200 mg of choline, 80 mg of Mn, 40 mg of Zn, 40 mg of Fe, 10 mg of Cu, 1 mg of I, and 0.5 mg of Se.

The pattern of total and digestible amino acids and also nitrogen corrected apparent and true metabolizable energy were determined for feedstuffs (Yaghobfar, 2002 and 2003) Diets were adjusted on the requirements of Arian broiler breeder (Manual, 2002).The composition and calculated contents of the diets are shown in Table 1. Feeds provided were in mash form and were milled with a 3 mm screen to obtain a similar particle size in all diets. Both males and females broiler breeder received the same diets at 8 am. Diets provided 410 Kcal metabolism energy and 21/2 g protein on a daily. Eggs were collected at 52, 56, 60 and 64 week of age. A random sample of eggs production per day from each replicated (16 eggs total/day) for determine in egg characteristics, 112 eggs utilized to measure egg characteristics in week (7 eggs for every replicate). The end of week, eggs (about 30 eggs for each replicate) were set in a Maino, force-draft incubator (Model II, Maino Enrico Co., Italy). On the 18th d of incubation, eggs were transferred to hatching baskets and randomly distributed in the same trolley. All chicks were removed at 21.5 d of incubation. 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 factorial 2×2 (GLM procedure, An ANOVA of SAS Institute, 2001) and where significance occurred, means were compared with the Duncan multiple range tests. Output data were expressed as means with SEM.

3. Results and Discussion

The results indicated that egg weight was significantly heavier on treatment fed diets formulation based on AMEn by 69.69 than TMEn by 67.05 (g) ($P<0.05$). This results agree with Leeson and Summers (2000), showed that increased energy intake had significantly positive effects on egg weight. Metabolizable energy levels in the diet of broiler breeders are very important. A deficiency may lead to a poor performance, as well as an increase of body fat due to an excess in energy levels.

The main effects of diets formulation based on energy (AMEn, TMEn), amino acids of feed (TAAF, DAA) had no effect on yolk (%) and albumen (%). Attia et al., (1995), Bornstein et al., (1979) and Bornstein and Lev (1982) observed the broiler breeder hens (21 to 61 weeks) had a significant positive correlation between energy intake (396, 423 and 450) and fertility and hatchability. In this experiment broiler breeder fed diets formulation based on AMEn was significantly highest in egg weight, fertility and hatchability. No reports describe the effects of diet formulation based on MEn and amino acids of feedstuffs on fertility and hatchability.

Table 2: Main effects of diets formulation based on metabolizable energy, amino acids of feedstuffs on egg characteristics and reproduction traits of broiler breeder (50 to 64 weeks)

	Egg Weight (g)	Yolk (%)	Albumen (%)	Albumen Height (mm)	Haugh unit	Fertility (%)	Hatchability (%)	Chicken Weight (g)
MEn								
Apparent	69.69 [a]	30.99	55.16	7.5	83.28	72.05 [a]	61.76 [a]	49.87
True	67.05 [b]	30.88	55.81	7.54	83.68	57.2 [b]	49.7 [b]	47.4
P-Value	0.04	0.829	0.442	0.882	0.81	0.001	0.001	0.169
Amino Acids (Feed)								
Total	67.03 [b]	30.66	55.8	7.48 [b]	80.88 [b]	56.89 [b]	52.62	47.53
Digestible	69.17 [a]	31.22	55.17	7.93 [a]	86.07 [a]	72.46 [a]	55.53	49.75
P-Value	0.046	0.414	0.626	0.00	0.00	0.028	0.854	0.328
SEM	1.465	0.354	0.698	0.183	1.175	1.053	1.548	1.3

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

Diets formulation based on amino acids of feed (TAAF, DAA) had significantly increased in egg weight, albumen height, Haugh unit and fertility ($P<0.05$). The results of this experiment was the same with the report of Butts and Cunningham, reported that a reduction in albumen is observed when birds receive low-protein diets, suggesting that these diets are lower in essential amino acids (EAA). This diet leads to insufficient protein synthesis to meet the needs for egg formation. Chemical composition of eggs can be influenced by dietary protein level.

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 formulation based on energy and amino acids of feedstuffs (Table 2), Main Effects of energy was significant in fertility (P<0/05). The fertility and hatchability were significantly heavier on treatment fed diets formulation based on AMEn by 72.05 and 61.76% than TMEn by 57.2 and 49.7% respectively (P<0.05). These results are in agreement with the finding of Benton and Brake (1996) noted that the rate of water loss from the egg during incubation was not influenced by albumen quality but suggested that thick albumen may slow vital gas diffusion, limit nutrient availability to the embryo, and subsequently increase the incidence of embryonic death. This conclusion was supported by findings in a report by Benton et al. (1997), which showed that high quality albumen increased incubation time and had a significant negative effect on hatchability of eggs from young broiler breeder flocks (30 to 33 wk of age). Decreased albumen height enhances the flow of water and solutes across the vitelline membrane or into the yolk (Burley and Vadehra, 1989; Stern, 1991). Changes in hatchability in broiler breeder females have been reported to be related to many factors, such as storage time (Kirk et al, 1980), incubation position, incubation conditions (Kirk et al, 1980; Tullett and Burton, 1982), and shell quality (Bennett, 1992). Other researchers have found that bird age (Mather and Laughlin, 1979) and egg size (Morris et al, 1968) also affect hatchability but this experiment showed that Broiler breeders hens fed AMEn diets had a larger egg weight, fertility and hatchability. This difference was significant (P<0.05).

The diets formulation based on AMEn+DAA had best performance in egg weight, 69.17 (g). This difference was significant (p<0/05).

Table 3: The interaction between diets formulation based on Metabolizable Energy and Amino Acids of Feedstuffs on egg characteristics and reproduction traits of broiler breeder (50 to 64 weeks)

MEn	Amino Acids (Feed)	Egg Weight (g)	Yolk (%)	Albumen (%)	Albumen Height (mm)	Haugh unit	Fertility (%)	Hatchability (%)	Chicken Weight (g)
Apparent	Total	68.33 [b]	30.51	55.68	7.03 [c]	80.74 [c]	62.59 [b]	58.84 [ab]	50.1 [ab]
Apparent	Digestible	69.97 [a]	31.47	54.64	7.96 [a]	86.32 [a]	81.51 [a]	64.69 [a]	50.27 [a]
True	Total	65.73 [c]	30.82	55.92	7.18 [c]	81.03 [c]	51.06 [c]	46.36 [c]	45.4 [c]
True	Digestible	68.37 [b]	30.95	55.7	7.89 [b]	85.82 [b]	63.34 [b]	53.04 [bc]	49.4 [b]
P-Value		0.01	0.278	0.46	0.019	0.024	0.001	0.021	0.049
SEM		0.505	0.501	0.845	0.259	1.662	2.904	2.189	1.14

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

4. Conclusion

1-Diet formulation based on AMEn + DAA for broiler breeder significantly increased egg weight, albumen height, Haugh unit fertility, hatchability and chicken weight.

2-Feeding broiler breeder digestible amino acids of feedstuffs significantly increased egg weight by 2.14g more than broiler breeders fed total amino acids of feedstuffs density diets. Formulating broiler diets based on digestible amino acids of feedstuffs gives a better prediction of dietary protein quality and broiler breeder performance than total amino acids.

3-Feeding broiler breeder AMEn diets significantly increased fertility and hatchability.

4-Feeding broiler breeder AMEn diets significantly improved egg weight, fertility and hatchability by 2.64 g, 14.85% and 12.06% more than broiler breeder fed TMEn diets respectively.

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