Emir. J. Food Agric. 2014. 26 (9): 822-827
doi: 10.9755/ejfa.v26i9.17535
http://www.ejfa.info/

Animal Science

REGULAR ARTICLE

Effects of the soy isoflavones on the growth and the exterior development of the ISA Brown pullets

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Abstract

The soy isoflavones are phytoestrogens with the same structure as the estrogen hormones of the animals, but with weaker activity. According to some authors, they influenced the growth and the body weight of small chicken. Because of this we conducted a study to establish the effect of isoflavones on the growth performances and the body weight of the light strain chicken, from hatching to 20 weeks of age. To get an answer to this aim, investigation has been made in a rearing farm. The feed in different periods was enriched with 40.88% isoflavone additive in the amount of 300, 600, 1200 and 1800 mg /kg feed. From the obtained results of the investigation it is concluded that soy isoflavones offered in different concentrations in the feed mixtures decreased the body weight of the pullets at all different ages during the experiment. The results of this investigation suggested that isoflavones supplemented to the diets did not influence the skeletal exterior indexes (Long-leggedness, Stockiness and Massiveness) of the ISA brown pullets.

Key words: Chicken, Exterior, Isoflavones, Pullets

Introduction

The amount of the soybean inclusion in the poultry feed rapidly increased in recent years. Soybean contains isoflavones which are potential dietary supplement that may affect the growth and the productive performance. Isoflavones are diphenolic compounds in aglycone (unconjugated) and conjugated forms (Kudou et al., 1991). The aglycone forms of isoflavones are daidzein, genistein and glycitein. The positive effect on the growth performance and carcass muscle was reported by Cook et al. (1998) in pigs, and the negative effect on the growth performance in broilers was reported by Payne et al. (2001a). Some studies demonstrated that the long-term intake of daidzein and other isoflavones could interact with the animal reproduction and cause estrous disorders and regular ovary and genital development (Kaladas, 1989; Nwannenna et al., 1995; Odum et al., 2001; Mitchell, 2001).

Other studies suggested its stimulatory effects on the growth performance in the broiler, the beef, the sheep and the pig (Wang and Han, 1994; Zhengkang, 1999; Payne et al., 2001b). Jiang et al. (2007) reported that isoflavones affected and increased the growth, the meat quality and the antioxidative effect at male broilers treated with 0, 10, 20, 40 и 80 mg soybean isoflavones/kg feed during the 3 wks experimental period.

Therefore, the purpose of this experiment was to evaluate the effect of isoflavones on the growth and exterior development of egg laying strain of chicken from hatching till 20 weeks old pullets of the ISA Brown poultry.

Material and methods

Experimental animals and rearing systems

The experiment was performed with ISA Brown chicken from hatching through 20 wks.

Received 03 December 2013; Revised 28 May 2014; Accepted 03 June 2014; Published Online 01 July 2014

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The treated chicken were randomly assigned to 5 groups (1st to 6th week 50 chicken; 7th to 20th week 20 chicken per group). The chicks were housed in a standard rearing poultry house and fed with basal diet and with isoflavones supplemented diets according to the experiment. The equipment was three stages "Salmet" with a capacity of 25 chicks per cage (to 5th week of age) and 7 chicks (from 6th to 15th week). After 16 week they were removed in laying house (5 per cage). Water was offered for ad libitum consumption throughout the experiment. The experiment was conducted under permitted ethical regulations and rules. Chicken were randomly assigned to receive basal feed, and 300, 600, 1200 and 1800 mg supplemented isoflavones per kg feed. The experimental feed was enriched with concentrated product produced by the North China Pharmaceutical Corporation. The composition of the product consisted of genistin (7.30%), genistein (1.26%), daidzin (22.12%), daidzein (1.74%), glycitin (8.01%) and glycitein (0.45%), and the total amount of isoflavones was 40.88%.

The composition and nutritive value of the basal diet is presented in Table 1.

The morphological changes of the chicken body were measured as the body weight of the control and experimental groups using digital balance. The body length, the breast circumference and the length of the legs were measured using the clot tape. The exterior was measured on the 13th, 16th and 20th week of age and the body weight was measured on the first day, 6th, 13th, 16th and 20th week.

The body indexes (in %) were calculated using the following formulas: 1. Long-leggedness (the ratio of leg length, cm and body length, cm x 100); 2. Stockiness (the ratio of breast circumference, cm and body length, cm x 100) and 3. Massiveness (the ratio of body weight, kg and body length, cm x 100) (Oblakova, 2007).

Table 1. Composition and nutritive value of the basal feed (BF).

Ingredient, g/kg	Period from hatch to 6 weeks	From 6 weeks to 13 weeks	From 13 weeks to 16 weeks	Before the first egg laid (16 to 20 weeks)
Maize	562.3	603.9	607.2	552.5
Soybean meal 44%	188.4	187.8	74.1	168.9
Sunflower meal 33%	153.4	65.0	146.8	150.0
Fish meal	50.0	25.7	–	–
Wheat bran	–	73.4	127.8	50.0
Soybean oil	3.5	–	–	7.0
Methionine 99%	0.7	0.2	0.3	0.7
L-lysine	1.0	0.7	0.8	0.6
Calcium carbonate	16.4	19.8	18.2	43.9
Mono calcium phosphate	14.2	13.2	13.8	14.5
$NaHCO_3$	–	–	1.0	1.6
Minezyl (Zeolites)	3.0	3.0	3.0	3.0
Salt	2.2	2.2	2.1	2.4
Mineral premix	5.0	5.0	5.0	5.0
Total	1000	1000	1000	1000
Chemical composition, calculated				
Dry matter, g/kg	89.24	89.04	88.95	89.42
Metabolic energy, Kcal/kg	2900	2800	2750	2750
Crude protein, g/kg	21.44	18.20	14.81	17.50
Crude fat, g/kg	3.14	2.86	2.89	3.13
Calcium, g/kg	1.05	1.10	1.00	2.00
Phosphorus (available), g/kg	0.78	0.74	0.81	0.78
Lysine, g/kg	1.20	1.00	0.65	0.85
DL Methonine, g/kg	0.53	0.39	0.33	0.41
Methionine + cystine., g/kg	0.83	0.67	0.57	0.68
Soybean meal isoflavones, mg/kg[1]	43.33	43.19	17.04	38.85

[1] Native isoflavones in soybean meal

Statistical analysis

The obtained data were tested for significance using the analysis of variance, the F-test according to Snedecor and Cochran (1989).

Results and Discussion

Effect of the soy isoflavones on the mortality and growth

Table 2 presents the mortality, livability and growth performances of the birds after hatching to 20th week of age.

The survival of the chicken was better in the period after 13th week of age in comparison with the first and second rearing period. Total mortality rate was higher in group fed with 1200 mg AI/kg feed. Livability in group fed with 600 mg AI/kg feed was 100% (the highest), but in group fed with 1200 mg AI/kg feed was 85.74% as a result of the physical damages.

The body weight of a day old chicken was from 39 g to 40 g. On the 6th wks of age the average body weight was between 349 g (group 4) and 438 g (Control group). The significant differences were found between the experimental groups and the control group ($P<0.05$). The biggest body weight of chicken at 13 wks of age was observed in the control group (1342 g). The average body weight of chicken aged 13 wks was from 1216 g (group 4) to 1222 g (group 1 and 2). Statistical significant differences ($P<0.01$) in the body weight of 13 wks old chicken between all experimental groups and the control group were found.

At 16 wks of age the pullets from the experimental groups 3 and 4 were for 127 and 132 g smaller in comparison with the control group ($P<0.01$). This decreasing expressed in relative numbers was between 8.6 and 8.3% (groups 4 and 3). The body weight of the 20 wks old pullets had a similar trend in all experimental groups ($P<0.05$).

Several authors worldwide investigate the influence of isoflavones on the body weight of the chicken. James et al. (1994) and Payne et al. (2001b) reported that these phytoestrogens have effect on the increase of the body weight of the broilers and the meat quality. In our experiment the body weight of the chicken fed with isoflavones supplemented feed during the period of growing and their development was smaller in comparison with the control group, fed with basal diet.

There are some reported pieces of information (Payne et al., 2001b; Jiang et al., 2007) which indicate that phytohormones added to a large amount to the feed of chicken cause changes in the body weight, appearance that have influence on some other exterior characteristics and the whole body conformation.

Table 2. Mortality, livability and growth performances of the ISA Brown birds.

	Control Group Basal feed (BF)	Group 1 BF + 300 mg AI/kg	Group 2 BF + 600 mg AI/kg	Group 3 BF + 1200 mg AI/kg	Group 4 BF + 1800 mg AI/kg
I Mortality-Livebility					
1st day	2	2	0	4	2
6th week	5	5	0	5	0
13th week	0	0	0	5.26	0
16th week	-	-	-	-	-
20th week	7	7	0	14.26	2
Total livebility, %	93	93	100	85.74	98
II Body weight, g					
1st day	39±0.54	40±1.09	40±2.18	39±0.54	40±0.54
6th week	438^{a}±46.35	425^{b}±65.51	400^{b}±56.28	392^{b}±67.60	349^{b}±46.72
13th week	1342^{A}±113.90	1222^{B}±112.00	1222^{B}±126.97	1218^{B}±96.44	1216^{B}±100.34
16th week	1526^{A}±92.81	1409^{B}±91.25	1464^{B}±122.66	1399^{B}±87.32	1394^{B}±111.53
20th week	1877^{a}±166.56	1793^{b}±110.88	1748^{b}±160.41	1732^{b}±138.43	1756^{b}±148.77
III Weight gain, g					
6th week	399±46.35	385±65.51	360±56.28	353±67.60	309±46.72
13th week	904±113.90	797±112.00	822±126.97	826±96.44	867±100.34
16th week	184±92.81	187±91.25	242±122.66	181±87.32	178±111.53
20th week	351±166.56	384±110.88	284±160.41	333±138.43	362±148.77
Total weight gain, g	1838	1753	1708	1693	1716

AI- additional isoflavones Values are means ± S.D

A,B – Values in the same row with no common superscript differ significantly ($P<0.01$)

a,b – Values in the same row with no common superscript differ significantly ($P<0.05$)

In our experiment soya isoflavones supplemented in different concentration to the ISA Brown pullets diet caused depression of the body weight on the 6th week of age (P<0.05), the 13th week of age (P<0,01), on the 16th week of age (P<0.01) and on the 20th week of age (P<0.05).

Effect of the soy isoflavones on the feed intake

The results for the feed consumption and conversion are presented in Table 3. Feed consumption of the chicken in control group was higher in comparison to the other experimental groups, because the average consumption per bird was 8.14 kg. In the other groups the feed consumption differs from 7.83 to 7.95 kg. Feed conversion was also better in control group (4.43 kg/kg weight gain). In the other groups the conversion differs from 4.47 to 4.66 kg per kg weight gain. The differences were significant. The largest amount of feed spent per kg weight/gain was 8.39 kg in average noticed in the period of 92nd to 112th day (13th to 16th week of age). This situation was a result of special nutritional management of feeding the chicken with lower quality mixture to improve the development (enlargement) of digestive system.

Effect of the soy isoflavones on the exterior development

The obtained results for the exterior development and the indexes are presented in Table 4.

The body length is characteristic which indicates the evaluation of the development of the reproductive organs and the digestive system. There are no significant differences between the experimental groups in different periods during the investigation. The values of the breast circumference and the length of the legs have a similar trend during the investigation. The index of the Long-leggedness calculated on the basis of the body length indicates that 13 wks old the index was similar and observed some increase in the treated groups with a higher level of isoflavones.

The index called Stockiness, which is calculated on the basis of the breast circumference and the length of the body, indicates the highest level on the 13th week of age and reached 133 to 137%, but significant differences are not noticed as a result of the isoflavone treatment. The index decreased on the 16th week of age (117 to 121%), and significant differences are not noticed. The Massiveness pullets have the highest value and reached 162 to 166%. The values of the index of Long-leggedness decreased from 138 to 144% in 16 wks old pullets, and on the 20th week of age Index which is calculated on the basis of the body weight and the body length has a similar trend as other calculated indexes.

Table 3. Feed spenditure of the rearing ISA Brown birds treated with additional isoflavones.

Age of the birds	Control Group Basal feed (BF)	Group 1 BF + 300 mg AI/kg	Group 2 BF + 600 mg AI/kg	Group 3 BF + 1200 mg AI/kg	Group 4 BF + 1800 mg AI/kg
I Feed consumption, kg					
- 1 to 42 day	1.13	1.17	1.10	1.09	1.11
- 43 to 91 day	2.98	2.65	2.66	2.79	2.89
- 92 to 112 day	1.62	1.64	1.63	1.60	1.57
- 113 to 140 day	2.41	2.40	2.44	2.41	2.38
Total feed consumption	8.14	7.86	7.83	7.89	7.95
II Feed conversion, kg					
- 1 to 42 day	2.93	3.04	3.06	3.09	3.59
- 43 to 91 day	3.30	3.33	3.24	3.38	3.33
- 92 to 112 day	8.80	8.77	6.74	8.84	8.82
- 113 to 140 day	6.87	6.25	8.59	7.24	6.58
Average feed conversion	4.43	4.47	4.58	4.66	4.63

Table 4. Exterior development of the ISA Brown pullets.

Group	Age	Body lenght, cm	Breast circumference, cm	Length of the legs (femur + tibia + metatarsus), cm	Long-leggedness Index	Stockiness Index	Massiveness Index
Control	13. wks	17.97±1.42 ^{A}	24.63±1.54 ^{A}	29.76±1.26 ^{A}	166±19.36 ^{A}	137±16.44 ^{A}	7.46±1.10 ^{A}
Group	16 wks	20.18±0.75 ^{B}	24.44±1.21 ^{B}	28.73±1.29 ^{B}	142±8.69 ^{B}	121±7.10 ^{B}	7.43±0.47 ^{B}
Basal feed (BF)	20 wks	20.78±1.09 ^{B}	27.59±1.25 ^{B}	28.35±1.23 ^{B}	136±8.35 ^{B}	133±9.48 ^{B}	8.90±0.93 ^{B}
Group 1	13. wks	17.27±0.72 ^{A}	23.45±1.04 ^{A}	28.54±1.39 ^{A}	165±7.36 ^{A}	135±5.50 ^{A}	7.06±0.49 ^{A}
BF +	16 wks	20.03±1.04 ^{B}	24.44±1.33 ^{B}	28.88±1.09 ^{B}	144±6.21 ^{B}	122±6.20 ^{B}	7.04±0.49 ^{B}
300 mg	20 wks	20.67±1.06 ^{B}	27.23±0.80 ^{B}	27.23±1.02 ^{B}	132±8.23 ^{B}	132±7.76 ^{B}	8.66±0.66 ^{B}
AI/kg							
Group 2	13. wks	17.05±0.69 ^{A}	23.32±1.73 ^{A}	28.14±1.45 ^{A}	165±5.99 ^{A}	137±8.21 ^{A}	7.15±0.59 ^{A}
BF +	16 wks	20.25±1.21 ^{B}	24.50±1.14 ^{B}	28.20±1.47 ^{B}	139±8.41 ^{B}	121±5.97 ^{B}	7.21±0.74 ^{B}
600 mg	20 wks	20.17±0.89 ^{B}	26.97±1.04 ^{B}	26.86±1.60 ^{B}	133±10.07 ^{B}	134±7.58 ^{B}	8.68±0.82 ^{B}
AI/kg							
Group 3	13. wks	17.00±0.63 ^{A}	23.37±1.18 ^{A}	27.60±1.28 ^{A}	162±5.70 ^{A}	137±4.69 ^{A}	7.18±0.39 ^{A}
BF +	16 wks	20.24±0.84 ^{B}	23.79±1.36 ^{B}	28.07±1.27 ^{B}	139±8.99 ^{B}	117±6.80 ^{B}	6.67±0.37 ^{B}
1200 mg	20 wks	19.950.83 ^{B}	26.65±1.00 ^{B}	26.89±1.20 ^{B}	135±8.52 ^{B}	134±6.46 ^{B}	8.42±0.66 ^{B}
AI/kg							
Group 4	13. wks	17.67±0.57 ^{A}	23.55±0.83 ^{A}	28.55±1.20 ^{A}	162±5.30 ^{A}	133±4.66 ^{A}	7.30±0.43 ^{A}
BF +	16 wks	20.40±1.05 ^{B}	24.45±0.87 ^{B}	28.12±1.62 ^{B}	138±7.58 ^{B}	120±7.68 ^{B}	6.76±0.60 ^{B}
1800 mg	20 wks	19.81±0.89 ^{B}	26.47±0.70 ^{B}	27.25±1.53 ^{B}	137±9.32 ^{B}	134±5.10 ^{B}	8.83±0.81 ^{B}
AI/kg							

AI- additional isoflavones Values are means ± S.D

A,B – Values in the same column with no common superscript differ significantly (P<0.01)

There is not enough relevant data on the influence of isoflavones on the body configuration of growing chicken from light egg strain varieties. From the data of our results it can be clearly seen that the length of the legs is longer in 13 wks old chicken and shorter in 20 wks old pullets. The average length in 13 wks old chicken is 28.52 cm and in 20 wks old pullets 27.32 cm. The same trend is observed with the long-leggedness index. The pullets (20 wks) have shorter legs and opposite, the younger pullets (13 wks) have longer legs (P<0.01).

An opposite conclusion is found on the breast circumference which is longer in older pullets. The average in 13, 16 and 20 wks old pullets is 23.66, 24.32 and 26.98 cm, respectively. This trend is in a positive correlation with the age of pullets (r=0.7). The body length in 13 wks old pullets is in average 17.48 cm, but at 16th and 20th week the growth is completed because the length is 20.4 cm (16th week) and 20.28 cm (20th week). The difference is significant between all experimental groups at 13th and 16th week of age, and between 13th and 20th week of age (P<0.01).

The skeletal exterior in the experimental groups depends on the age. The index of Long-leggedness has the highest value on 13th week of age, but the index of the Stockiness has the smallest value on the 16th week of age.

Conclusions

The results of this investigation suggested that isoflavones supplemented diets did not influence the skeletal exterior indexes (Long-leggedness, Stockiness and Massiveness) of the ISA brown pullets. The large amount of additional isoflavones in the feed influenced the body weight and feed conversion because it cause tendency of depression in female chicken.

Further experiments are required to investigate the influence of isoflavones on some other skeletal exterior characteristics of the ISA brown pullets.

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