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Effects of Dietary Addition of Wormwood (*Artemisia* sp.) on the Growth Performance, Nutrients Utilization, and Abdominal Fat Deposition of Broiler Chickens

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사료내 쑥 첨가가 육계의 성장률, 영양소 이용률, 복강내 지방에 미치는 영향

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This study was carried out to investigate the effects of wormwood (*Artemisia* sp.) addition on the growth performance, nutrients utilization and abdominal fat deposition of broiler chickens. Two hundred twenty five and two-day old Arboracre strain male commercial broiler chicks were distributed to 5 treatments with wormwood supplementation levels; C(0%), T_1 (1%), T_2 (3%), T_3 (5%), and T_4 (10%) and with 3 replications each with 5 birds for five weeks. Body weight gain during the experiment was improved in T_1 (1723.0g) compared with that of T_3 (1557.7g) and T_4 (1450.7g) ($P<0.05$). Feed intake was significantly ($P<0.05$) increased as the levels of wormwood addition increased (C: 2653.8g, T1: 2852.0, T_2: 2900.3, T_3: 2900.7g, T4: 2954.7g). Feed conversion rate (feed/gain) was significantly ($P<0.05$) increased as the levels of wormwood addition increased (C: 1.55, T_1: 1.66, T_2: 1.70, T_3: 1.86, T_4: 2.04). The days reaching to 2.0kg of body weight were expected to be 43.2 days in control, whereas those of group T1 were reduced to 42.6 days by 0.6 day from control. Nutrient utilization and abdominal fat deposition in the experiment were significantly decreased ($P<0.05$) and small intestine contents in the broilers was significantly increased ($P<0.05$) as the levels of wormwood addition increased. Therefore, although there was no significant

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improvement for the performance of broiler chickens with the dietary supplementation of wormwood meal, less than 1% addition of wormwood to broiler diets might have beneficial for human health by reducing the abdominal fat deposition of the broiler chickens.

Key words : *broiler, wormwood, body weight, feed intake, feed conversion rate, nutrient utilization*

Ⅰ. Introduction

Antibiotics have been widely used to promote growth and improve feed efficiency as well as to prevent infectious diseases. However, increased occur of resistance bacteria, decline in efficacy and residual in the body by prolonged usage of antibiotics have been pointed causing human health problem (Lee et al., 2001). Therefore, it is required the development of additives for growth with less side effects and safe.

Wormwood (*Artemisia*) species belongs to the family Compositae consisting of about 500 species. Most wormwood herbs are perennials widespread in Korea and are used for various purposes, such as medicine, food, spices, food and ornamentation. The compounds isolated from wormwood species such as terpenoids, flavonoids, coumarins, acetylenes, caffeoulquinic acids and sterols were shown to be anti-malarial, anti-viral, anti-tumor, anti-pyretic, anti-hemorrhagic, anti-coagulant, anti-anginal, anti-oxidant, anti-hepatitis, anti-ulcerogenic, anti-spasmodic and anti-complementary activities (Tan et al., 1998).

The previous studies have been conducted to examine the effect of the medicinal herb for medicine and animal performance. Allen et al. (1997) reported that when fed over a period of 3 week at a level of 5%, a dried leaf supplement of *Artemisia* provided significant protection against coccidia infected lesions due to *Eimeria tenella*. The herb *Artemisia annua* has been used for many centuries in Chinese traditional medicine as a treatment for fever and malaria. The antimalarial activity in wormwood leaves was found to be associated with artemisinin, a sesquiterpene lactone possessing an endoperoxide functional group (reviewed by Klayman, 1985). It also reported that *Artemisia Montana* silage improved feed intake, digestibility, rumen function in sheep (Kim et al., 2006).

Among *Artemisia* herbs, *A. princeps*, *A. argyi*, *A. capillaris*, and *A. iwayomogi* are important medicinal materials in traditional medicine in Asia. *A. argyi* is called ‘Aeyup’ in Korea and is a medicinal plant widespread or cultivated commercially in Korea and China. *A. argyi* has been used in traditional Korean medicine for the treatment of colic pain, vomiting and diarrhea, and irregular bleeding from the uterus (Zhao, et al., 1994). However, little is known about the nutritional value of wormwood (*Artemisia* sp.) for chickens and the influence of feeding the Artemisia herb on the performance of chickens has also not been reported.

Therefore, the study regarding to the effect of wormwood (*Artemisia* sp.) feed additives on the metabolism comprising the improvement of growth rate, feed efficiency, and abdominal fat deposition is required. This study was conducted to evaluate the effects of wormwood meal addition on growth performance of broiler chickens.

Ⅱ. Materials and Methods

1. Animals and Housing

Two hundred twenty five broiler chickens (Arboracer broiler) were obtained from a commercial hatchery. The chickens (44.95±0.3g BW) were individually weighted at the beginning of the experiment. The chickens were allocated randomly to five treatments with 3 replicates each and housed in electrically heated batteries. Temperature was being maintained at 34±1℃ with gradual decrease by every week 3℃ to 22℃, this temperature was maintained until the end of feeding trials. Standard recommendations were followed in maintaining the houses and broiler chickens (Institute of Laboratory Animal Resources Commission on Life Science, 1996).

2. Experimental Design, Diets and Feeding

Five experimental groups, control group (C) which was fed a diet based on NRC (1984), four experimental groups depending on the amount of wormwood meal additives, T_1 (1%), T_2 (3%), T_3 (5%) and T_4 (10%) were randomly allocated (Tables 1 and 2). Each group was consisted of 3 replicates with 5 chickens. Wormwood was harvested in the fields around the experimental farm and then sun-dried for 2 days prior to grinding it. The wormwood meal was chemically composed of 87.03% dry mater (DM), 12.85% crude protein (CP), 3.47% ether extract (EE), 20.69% crude fiber (CF) and 42.25% nitrogen-free extract (NFE). Feeding trial was performed with 2 days-old broiler chicks for 5 weeks and metabolism tests were conducted for 5 days after feeding test following 3 days preliminary test. Feed and water were provided *ad libidium*. Feed intake was measured every week and body weight was measured at 3 weeks after initiation of feed trial as well as the end of experiment.

Table 1. Ingredients and chemical composition of experimental starter diets (0-3 weeks, as-fed basis)

Item	C*	T1*	T2	T3	T4
Ingredients (%)					
Wormwood meal	0	1.0	3.0	5.0	10.0
Corn grain	53.2	52.7	51.6	50.6	47.9
Soybean meal	17.7	17.5	17.2	16.8	15.9
Corn gluten meal (60%)	7.0	6.9	6.8	6.7	6.3
Fish meal (60%)	10.0	9.9	9.7	9.5	9.0
Yellow grease	4.5	4.2	4.1	4.1	3.8
Tapioca	3.0	3.0	2.9	2.9	2.7
Rapeseed meal (35.5%)	2.0	2.0	1.9	1.9	1.8
Cotton seed meal	1.0	1.0	1.0	1.0	0.9
Tricalcium phosphate	0.2	0.2	0.2	0.2	0.2
Limestone	0.6	0.6	0.6	0.6	0.6
Salt	0.3	0.3	0.2	0.2	0.2
Methoinine	0.2	0.2	0.2	0.2	0.2
Lysine	0.1	0.1	0.1	0.1	0.1
Vitamin mixture**	0.5	0.5	0.4	0.4	0.4
Chemical composition (%)					
Crude protein	23.0	22.9	22.7	22.4	21.8
EE fat	7.9	7.9	7.8	7.7	7.4
Crude fiber	3.5	3.7	3.9	4.2	5.0
Crude ash	5.4	5.4	5.4	5.5	5.6
ME (kcal/kg, calculated)	3200	3199.5	3195.2	3194.0	3191.1
Calcium (calculated)	0.9	0.9	0.8	0.8	0.8
Phosphate (calculated)	0.6	0.6	0.6	0.6	0.6

* C*, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

** Vitamin mixture contained vit. A 120,000 IU, vit. D 24,000 IU, vit. E 211 IU, vit. B_1 1.43mg, vit. B_2 7.86mg, vit. B_6 1.43mg, vit. B_{12} 10.0mg, calcium pantothenate 17.14mg, folic acid 0.5mg, HCl-choline 1300mg, niacin 31.43mg, vit. K_3 1.43mg, xanthophyl 32.6mg, sodium 0.94mg, chlorine 0.25mg, potassium 0.69mg, magnesium 0.15mg, sulfur 0.22mg, manganese 114.78mg, iron 91.43mg, copper 9.14mg, cobalt 0.34mg, zinc 91.43mg and iodine 0.91mg.

Table 2. Ingredients and chemical composition of experimental finisher diets (4-5 weeks, as-fed basis)

Item	C*	T1	T2	T3	T4
Ingredients(%)					
Wormwood meal	0	1.0	3.0	5.0	10.0
Corn grain	63.6	63.0	61.7	60.4	57.2
Soybean meal	9.1	9.0	8.8	8.6	8.2
Corn gluten meal (60%)	7.0	6.9	6.8	6.7	6.3
Fish meal (60%)	10.0	9.9	9.7	9.5	9
Yellow grease	2.6	2.5	2.5	2.4	2.3
Tapioca	3.0	3.0	2.9	2.9	2.7
Rapeseed meal (35.5%)	2.0	2.0	1.9	1.9	1.8
Cotton seed meal	1.0	1.0	1.0	1.0	0.9
Tricalcium phosphate	0.4	0.4	0.4	0.3	0.3
Limestone	0.6	0.5	0.5	0.5	0.5
Salt	0.3	0.3	0.2	0.2	0.2
Methoinine	-	-	-	-	-
Lysine	0.1	0.1	0.1	0.1	0.1
Vitamin mixture**	0.5	0.5	0.5	0.5	0.5
Chemical composition					
Crude protein	20.0	19.9	19.7	19.6	19.1
EE fat	6.5	6.5	6.4	6.4	6.2
Crude fiber	3.3	3.4	3.7	4.0	4.7
Crude ash	5.1	5.1	5.1	5.2	5.3
ME (kcal/kg, calculated)	3200	3199.5	3195.2	3194.0	3191.1
Calcium (calculated)	0.9	0.9	0.8	0.8	0.8
Phosphate (calculated)	0.6	0.6	0.6	0.6	0.6

* C, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

** Vitamin mixture contained vit. A 120,000 IU, vit. D 24,000 IU, vit. E 211 IU, vit. B_1 1.43 mg, vit. B_2 7.86mg, vit. B_6 1.43mg, vit. B_{12} 10.0mg, calcium pantothenate 17.14mg, folic acid 0.5mg, HCl-choline 1300mg, niacin 31.43mg, vit. K_3 1.43mg, xanthophyl 32.6mg, sodium 0.94mg, chlorine 0.25mg, potassium 0.69mg, magnesium 0.15mg, sulfur 0.22mg, manganese 114.78mg, iron 91.43mg, copper 9.14mg, cobalt 0.34mg, zinc 91.43mg and iodine 0.9mg.

3. Metabolic Trial

Metabolic trial to determine apparent nutrient digestibility was performed after the feeding trial with total 20 chickens; 4 chickens with similar body weight from each group. The broiler chicks were housed individually in metabolic cages and fed the same 4 corresponding experimental diets added with chromic oxide at 5g/kg as a digestibility marker. The test period was consisted of 8 days (i.e. 3 day adaptation and 5 days sample collection). The proximate components in feed and excreta were quantified, and the apparent digestibility of nutrients was calculated on a percentage of DM basis and expressed as percentage of nutrient absorbed.

4. Data and Sample Collection

Representative samples of the experimental diets were collected every week and stored (-25 ℃). At the end of the feeding trial, four chickens with similar body weight were weighed and intestine and abdominal fat were taken out and weight of liver, length of the small intestine, carcass weight and abdominal fat were measured.

5. Chemical Analysis

Feed and fecal samples were thawed at room temperature, dried in a forced draught oven at 65℃ for 48h and ground to pass a 1mm screen with a Wiley mill. Chemical analysis of feed and feces was performed by standard procedures (AOAC, 1990).

6. Statistical Analysis

The data were analyzed as a completely randomized design using the General Linear Models procedure of SAS (1990) and differences among treatment means were tested by Duncan's multiple range test and then a P value of <0.05 was considered significant.

Ⅲ. Results

1. Body Weight, Feed Intake and Feed Conversion Rate of Broiler Chickens

Effects of wormwood meal addition on body weight gain, feed intake, and feed conversion rate (FCR, feed intake/gain) of broiler are shown in Table 3. Between 0 and 3 weeks experimental period, body weight was 750.8g in control (C) and in T_1 with 1% addition of wormwood meal was 757.3g showing only slight increase. Addition of wormwood meal above 1% in broiler diet found to reduce the body weight. Feed intake was 1043.5g in control and was increased by addition of wormwood meal. T_1 and T_2 treatments showed highest feed intake as much as 1145.0 and 1174g respectively ($P<0.05$). Control group showed the best feed efficiency (1.39) among the treatments and the FCR was decreased as the increased addition of wormwood meal.

Table 3. Effect of dietary wormwood meal addition levels on the performance of broiler chickens for the experimental period

Treatment*	Body weight (g)			Feed intake(g)			Feed/gain		
	0~3 weeks	4~5 weeks	Total	0~3 weeks	4~5 weeks	Total	0~3 weeks	4~5 weeks	Total
C	751.8^a ±18.7**	964.5^b ±28.5	1715.3^a ±18.2	1043.5^{bc} ±10.4	1610.3^c ±18.2	2653.8^d ±23.5	1.39^c ±0.12	1.68^d ±0.07	1.55^d ±0.02
T_1	757.3^a ±2.4	965.6^b ±5.9	1723.0^a ±3.5	1143.0^a ±9.2	1727.0^b ±20.4	2852.0^c ±12.4	1.52^{bc} ±0.01	1.79^c ±0.02	1.66^c ±0.01
T_2	708.0^b ±2.3	980.3^a ±6.9	1708.3^a ±23.6	1174.3^a ±29.4	1876.0^a ±21.5	2900.3^b ±12.6	1.63^b ±0.02	1.91^{bc} ±0.05	1.70^c ±0.03
T_3	639.7^c ±1.5	918.0^b ±4.2	1557.7^b ±4.6	1065.0^b ±7.5	1835.7^a ±6.2	2900.7^b ±6.4	1.67^b ±0.02	2.00^b ±0.01	1.86^b ±0.01
T_4	605.0^c ±2.7	845.7^c ±8.7	1450.7^c ±10.5	1089.3^b ±9.7	1865.3^a ±26.3	2954.7^a ±35.2	1.80^a ±0.03	2.19^a ±0.02	2.04^a ±0.01

[a,b,c,d] Values in the same column with different superscripts differ significantly ($p<0.05$).

* C, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

** Mean ± S.E.

Between 4 and 5 weeks experimental period, T_2 showed the highest body weight gain (980.3g) and the lowest body weight gain was observed in T_4 (845.7g). Feed intake in control was 1610.3g and the effect of addition of more than 3% wormwood meal on the feed intake was increased significantly, especially manifested in T_2 of which feed intake was highest (1876.0g). Feed conversion rate in control was 1.68 and was observed to decrease while increasing the amount of wormwood meal in diet T_4 which received 10% wormwood meal showed lowest feed efficiency (2.19).

During the whole experimental period, T_1 showed the highest body weight (1723.0g) and increasing the amount of wormwood meal resulted in reduced body weight, especially manifested in T_4 group of which body weight was lowest among the groups. Feed intake in control was 2653.8g and the addition treatments of more than 1% addition of wormwood meal on the feed intake were increased significantly ($P<0.05$). Feed conversion rate in control was 1.55 and as the increase of addition levels of wormwood meal, FCR was decreased, as observed the lowest rate in T_4 (2.04).

2. Relationship Between Age and Body Weight of Broiler Chickens

The relationship between age and body weight of broiler chickens by regression equation is presented in Table 4, based on the result of feeding trial over experimental period.

Table 4. The relationship between age (Y) and body weight (X) of broiler chickens by regression equation

Treatments*	Linear regression equation	R^2	Days of body weight 2.0kg
C	$Y = 0.0213 X + 0.5945$	0.9642	43.2
T_1	$Y = 0.0211 X + 0.4321$	0.7233	42.6
T_2	$Y = 0.0224 X + 0.7635$	0.7224	45.6
T_3	$Y = 0.0280 X + 0.7669$	0.7222	56.8
T_4	$Y = 0.0291 X + 0.5142$	0.7210	58.7

* C, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

Regression coefficient of independent variants was increased as the level of supplemented wormwood meal increase, showing that of group T_4 was 0.029 whereas group T_1 was the lowest

(0.021). Coefficient determination (R^2) was also highly correlated in control as 0.96 and treatments supplemented with wormwood meal were less correlated as 0.72. The days reaching to 2.0kg of body weight were expected to 43.2 days in control, whereas in group T_1 it was reduced to 42.6 days by 0.6 day from control. But they were prolonged in T_2 (45.6 days), T_3 (56.8 days) and T_4 (58.7 days) which had increased amount of wormwood meal.

3. Digestibility of Nutrients in Broiler Chickens

Apparent nutrient digestibility of broilers with the different supplementation levels of wormwood meal during the feeding trial is summarized in Table 5. Dry matter and CP digestibilities in control were highest ($P<0.05$) as 82.4 and 54.5 respectively compared with all wormwood meal additions except for those in group T_1. Digestibilities of EE and crude fiber of control and 1% wormwood supplementation were significantly higher ($P<0.05$) than the other treatments. Ether extract and crude fiber digestibilities were linearly decreased by increased supplementation levels of wormwood meal. Digestibility of NFE in control was significantly higher ($P<0.05$) than all supplementation treatments of wormwood meal.

Table 5. Effect of dietary wormwood meal addition levels on apparent nutrient digestibility (% DM) of broiler chickens for the experimental period

Treatments*	Dry matter	Crude protein	Ether extract	Crude fiber	NFE
C	$82.4\pm1.7^{a**}$	54.5 ± 2.2^{a}	76.2 ± 0.3^{a}	39.1 ± 0.9^{a}	87.9 ± 1.2^{a}
T1	81.5 ± 0.5^{ab}	51.9 ± 0.5^{ab}	72.7 ± 0.4^{a}	37.4 ± 0.1^{a}	83.8 ± 0.2^{b}
T2	79.7 ± 0.0^{b}	50.1 ± 0.2^{b}	65.8 ± 2.4^{b}	33.0 ± 0.1^{b}	81.1 ± 0.9^{b}
T3	79.7 ± 0.6^{b}	49.0 ± 0.1^{b}	66.9 ± 0.1^{b}	28.6 ± 0.5^{c}	82.5 ± 0.5^{b}
T4	79.2 ± 0.2^{b}	48.1 ± 0.2^{b}	65.8 ± 0.2^{b}	26.6 ± 0.1^{d}	83.8 ± 0.3^{b}

^{a,b,c,d,e} Values in the same column with different superscripts differ significantly ($p<0.05$).

* C, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

** Mean ± S.E.

4. Weights of Abdominal Fat of Broiler Chickens

The amounts of abdominal fat of broilers fed diets containing the different supplementation levels of wormwood meal during the feeding trial is summarized in Table 6. The proportion of abdominal fat in broilers' body was significantly higher in control (2.44%) and 1% supplementation group (2.29%) compared with the higher supplementation groups (P<0.05). The proportions of liver and gizzard in the broiler body weights among all treatments were not significantly different, although the liver content in broilers in T_4 was higher. The small intestine contents were higher in T_3 (9.90%) and T_4 (9.54) than those in control, T_1, and T_2 (P<0.05).

Table 6. Effect of dietary wormwood meal addition levels on the abdominal fat and the size of internal organs of broiler chickens

Treatments*	Body weight (g)	Dressed carcass weight (g)	Abdominal fat		The internal organs (% body weight)		
			Weight (g)	% of body weight	Liver	Gizzard	Small intestine
C	1720.0^{a} ±10.1**	1396.8^{a} ±40.0	42.0^{a} ±3.3	2.44^{a} ±0.19	2.14 ±0.07	1.91 ±0.09	8.06^{b} ±0.11
T_1	1720.4^{a} ±50.0	1387.0^{a} ±23.0	39.4^{a} ±2.0	2.29^{a} ±0.05	2.14 ±0.06	1.73 ±0.07	8.05^{b} ±0.10
T_2	1695.3^{ab} ±25.0	1218.1^{b} ±10.0	28.4^{b} ±0.8	1.68^{b} ±0.03	2.12 ±0.18	1.90 ±0.08	8.70^{ab} ±0.09
T_3	1565.06^{ab} ±34.9	1111.3^{b} ±36.6	25.3^{b} ±0.9	1.62^{b} ±0.09	1.99 ±0.04	1.74 ±0.05	9.90^{a} ±0.04
T_4	1504.8^{b} ±74.8	1070.1^{b} ±74.3	22.7^{b} ±1.0	1.51^{b} ±0.02	2.48 ±0.57	1.95 ±0.31	9.54^{a} ±0.07

[a,b] Values in the same column with different superscripts differ significantly (p<0.05).

* C, T_1, T_2, T_3, T_4 represent addition levels of 0, 1, 3, 5 and 10% of wormwood meal in the experimental diets.

** Mean ± S.E.

Ⅳ. Discussion

Wormwood is a perennial plant that grows and multiplies well, and contains various bio-active substances such as alkaloid, essential oils, vitamins and essential minerals. Since the ancient times in Korea, wormwood has been used as an edible vegetable and as a medicinal component of folk remedies and medical practices.

In the feeding trial, more than 5% addition of wormwood meal reduced the body weight gain of broiler chickens. Control group had the lowest feed intake and feed intake of broiler chickens was increased significantly as addition of increase amount of wormwood meal, resulted in group T4 with 10% wormwood meal showed highest feed intake. It is suggested that the bitter taste of wormwood improves the appetite of broiler chickens and some components of wormwood inhibits the digestion and absorption of broiler chickens.

α-Glucosidases located in the brush-border surface membrane of intestinal cells are the key enzymes for carbohydrate digestion (Caspary, 1978). α-Glucosidase inhibitors delay the digestion of oligosaccharide and disaccharide to monosaccharide by inhibiting α-glucosidase on the small intestinal brush-border, and reduce the rate of glucose absorption. The intestinal α-glucosidases are divided into four hydrolase types, namely, maltase (EC 3.2.0.20), glucoamylase (EC 3.2.1.3), sucrase (EC 3.2.1.48), and isomaltase (EC 3.2.1.10). Among them, maltase is the major enzyme which is responsible for the digestion and absorption of dietary starch, whereas sucrase can only hydrolyze sucrose. We reported that the n-butanol and ethyl acetate fractions from *Artemisia capillaris* were shown to have inhibitory effects on membrane-bound intestinal α-glucosidase and pancreatic α-amylase enzymes in vitro as well as on blood glucose elevation in mice loaded with maltose *in vivo* (Lee and Kim, 2007). Therefore, although *Artemisia capillaries* is a different species in the genus of wormwood, dietary treatment of wormwood meal may influence body weight gain, feed intake, and FCR of broiler chickens by delaying the digestion of carbohydrate through inhibition of α-glucosidase. Again, other enzymes involved in other nutrients were likely responsible for lower digestibility of broilers consumed wormwood.

Glycosidases including glucosidases are essential not only to carbohydrate digestion but also the processing of glycoproteins and glycolipids in virus. It is reported that glucosidase inhibitor are potent inhibitor on HIV replication and HIV-mediated syncytium formation in vitro (Walker et al., 1987), and secretion of HBV particles (Block et al., 1994). Wormwood showed inhibitory effect on interstinal α-glucosidase, therefore Wormwood may be useful for the development of feed additive to avoid infection of avian influenza.

The day reaching 2.0kg of body weight of broilers was little bit improved by supplementing 1% of wormwood meal to the feed compared to control, whereas when the supplemented was 3% or more, the effect was reduced. According to the oriental medicine prescription, herbs should be supplied 67.5g/average body weight 60kg/day on the base of dry matter, and about 2% of medical herbs or prebiotics per total feed needed to be fed to adult broilers with average body weight 2.0kg and 110g of feed intake a day (Han et al., 1984). Therefore, supplementation of more than 3% wormwood meal had diminished the effect of wormwood as medicinal herb on broiler production.

Genetic improvement of growth performance traits, such as body weight, growth rate and FCR of broiler chickens and advance of feed technology had contributed reducing the time required for market consignment, but also resulted in increase of production of fat chicken. This fat chicken production has been causing of waste of energy, reduction of taste and economic problem, in addition to human health. The content of abdominal fat of broiler chickens was highest in control group and significantly decreased as wormwood addition level increased. The content of CP, CF, and metabolic energy in wormwood meal is 13.1%, 20.69% and 2310 kcal/kg, respectively and the content of crude protein and metabolic energy tend to be decreased as the increase of wormwood meal content because of low energy and relative high fiber level of wormwood. Therefore, the content of abdominal fat tends to be decreased as the supplemented energy level decreased in agreement with previous reports (Sonaiy and Benyi, 1983; Deaton et al., 1983; Deaton and Lott, 1985; Jones and Wiseman, 1985).

The proportions of liver and gizzard in the broiler body weights among all treatments were not significantly different but the small intestine contents were significantly higher in T_3 and T_4 than those in control, T_1, and T_2.

It is reported that fiber inclusion increased the relative weight of digestive tract in young broiler chickens (Gonzalez-Alvarado et al., 2007). Jørgensen et al. (1996) reported that the length of the intestine increased with the fiber level and the digestibility of all nutrients also decreased with increasing fiber level in broiler chickens.

In conclusion, although there was no significant improvement for the performance of broiler chickens with the dietary supplementation of wormwood meal, less than 1% addition of wormwood to broiler diets might have beneficial for human health by reducing the abdominal fat deposition of the broiler chickens.

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Ⅵ. 적 요

본 연구는 국내에서 약용으로 많이 사용되고 있는 쑥을 건조시켜 사료에 첨가할 경우 육계의 성장률, 영양소 이용률, 복강내 지방함량에 미치는 영향을 구명하기 위하여 2일령의 Arbroracre 계통의 육계 숫병아리 225수를 공시하여 쑥 분말의 첨가를 0%(대조군, C), 1%(T_1), 3%(T_2), 5%(T_3), 10%(T_4) 등 모두 5개 군으로 나누어 5주간 3반복 사양실험하였다. 육계의 최종체중 1% 처리군(T_1: 1723.0g)이 대조군(1715.3g), T_2(1708.3g), T_3(1557.7g, $P<0.05$), 그리고 T_4(1450.7g) 보다 효과가 좋았다. 그러나 사료 섭취량은 쑥 분말 첨가량이 많아질수록 증가하였다(C: 2653.8g, T_1: 2852.0, T_2: 2900.3, T_3: 2900.7g, T_4: 2954.7g). 또한 쑥 분말 1% 첨가군(T_1)에서 2kg 도달일령이 가장 우수하여 대조군 보다 0.6일 빠른 42.6일이었으나 쑥 분말을 3% 이상 처리시에는 오히려 늦어지는 것으로 나타났다. 사료요구량은 쑥분말 첨가가 증가함에 따라 유의적으로 증가하졌지만, 복강내 지방함량은 유의적으로 감소하였다. 비록 체중, 사료요구량, 사료 섭취량 등은 대조구와 비교하여 효과가 없었지만, 복강내 지방함량을 고려할 때, 쑥 분말 첨가 1% 이하로 급여할 경우 인간의 건강에는 효과적일 것으로 판단되었다.

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