The effect of different selenium levels on production performance and biochemical parameters of broilers

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Abstract

Selenium (Se) is an essential trace element for animal and human. Supplementation of Se usually in livestock diet has been proved as effective element. This study was conducted to investigate the effect of adding different levels of selenium yeast on growth performance, slaughter performance, immune trait, oxidation resistance, meat quality and selenium content in tissue of broilers to comprehensively evaluate the effect of selenium. A total of 540 day-old Arbor Acres (AA) broilers were selected and randomly divided into 5 treatments were 0.0, 0.3, 0.5, 1.0 and 2.0 mg/kg organic selenium respectively. The trial period was 42 days and divided into two periods. Our results showed that effect of different levels of selenium on growth performance, slaughter performance, the immune status, drip loss and meat had not significant difference (P>0.05). The activities of serum glutathione peroxidase (GSH-Px), total superoxide dismutase (T-SOD), the abilities to inhibit hydroxyl radical (OH•), total antioxidant capacity (T-AOC) and superoxide dismutase (SOD), the abilities to inhibit hydroxyl radical (GSH-Px), total superoxide dismutase (T-SOD), the abilities to inhibit hydroxyl radical (SOD), and catalase (CAT) (Newberne and Suphakarn, 1983; Thompson and Scott, 1969). Supplementation of Se usually in livestock diet has been proved as effective element (Quesnel et al., 2008; Yoon et al., 2007; Fairris et al., 1989) Inclusion of selenium in animal production systems has been a common practice (Bourne et al., 2008; Weiss et al., 1997), and Se-yeast were approved by the FDA in 2000 to be used in food.

Introduction

Selenium (Se) is an essential trace element for animal and human. A very important metabolic role of selenium in animals is its function in the active site of glutathione peroxidase (GSH-Px), which protects cells against damage caused by free radicals and lipoperoxides together with superoxide dismutase (SOD) and catalase (CAT) (Newberne and Suphakarn, 1983; Thompson and Scott, 1969). Supplementation of Se usually in livestock diet has been proved as effective element (Quesnel et al., 2008; Yoon et al., 2007; Fairris et al., 1989) Inclusion of selenium in animal production systems has been a common practice (Bourne et al., 2008; Weiss et al., 1997), and Se-yeast were approved by the FDA in 2000 to be used in food.

Materials and methods

Experimental materials

The selenium (2000 mg/kg) was added in Jiaotianle® as powdery produced by brewer's yeast fermentation method by Gansu Biological Technology Co. Ltd., Baiyin, China.

Experimental animals

A total of 540 1-day-old male broilers (Arbor Acres, average initial weight: 42.35 g) were selected and randomly divided into 5 treatments, 6 replicates per treatment, with 18 broilers each treatment. The trial period was divided into two phases, 0-21 days and 22-42 days, respectively. The treatments diets were supplemented with 0, 150, 250, 500 and 1000 mg/kg Jiaotianle®, respectively. Organic selenium content of Jiaotianle® was 2000 mg/kg, thus diets organic selenium additive amount of treatments were 0.0, 0.3, 0.5, 1.0 and 2.0 mg/kg, respectively.

Experimental diets

The nutrient level of basal diet was prepared according to NRC (1994). The compositions and nutrient level of basal diet were shown in Table 1. Organic selenium were serially diluted with limestone when prepared diets, then mixed with other raw materials.

Feeding and management

This study was conducted at Ministry of Agriculture Feed Industry Center of China Agricultural University from June 13 to July 25,
2011. The management of broilers were based on the Administration Regulation on Laboratory Animals of Beijing Municipality (Granted by Standing Committee of Beijing Municipal People’s Congress: the Administrative Department of Beijing Municipal Science and Technology, 2002). The broilers were fed with dry powdery feed in the three-tiered cages for 42 days. Feed and water were provided ad libitum. The room temperature was controlled at 34-35°C for the first week, and decreased 2°C every week to reach the final temperature of 20-26°C. Relative humidity was retained at 45%-55%. Routine immunization and observation were performed every day for broilers health.

Determination of indexes and methods

Growth performance and mortality

The initial weights of broilers were measured before feeding. The fasting weight and feed consumption were recorded on day 21 and day 42 at mornings. The average daily gains (ADG), daily feed intakes (ADFI), feed to gain ratios (F/G) and mortalities from 0-21 d, 22-42 d and 0-42 d were calculated.

Slaughter performance and meat quality

Ninety broilers (18 broilers of each treatment, 3 broiler of each replicates) were randomly selected and slaughtered at day 42. The carcass yield, the weights of bursa of Fabricius, thymus and spleen were determined according to standard methods. The carcass yield and indexes of three immune organs were calculated as following formulas:

\[ \text{Carcass yield, %} = \frac{\text{carcass weight} \times \text{live weight}}{100} \]

\[ \text{Immune organ index} = \frac{\text{immune organ weight}}{\text{live weight (g/kg)}} \]

In brief, the middle part of the left Pectoralis major was weighed and trimmed to be 30 mm×15mm×5mm (length×width×thickness). The muscle chips were hooked with iron wire to keep the muscle fibres vertically upward, and then suspended into plastic bag with air inside to avoid direct contact between meat samples and bag wall; then, bag was tied and hung in the refrigerator at 4°C for 24 h. The meat samples were dried with filter paper, weighed, and the drip loss was calculated. Within 2 h after slaughtered, the L value (brightness), a* value (redness) and b* value (yellowness) of the right side of chest muscles were determined by colourimeter of Japan Minolta CR-410 to evaluate the flesh colour.

Immune indexes

The same 90 broilers were used to collect blood from heart at day 21 and day 42, then the blood sample was centrifugated at 3000 rpm for 15 min. The contents of immunoglobulin G (IgG), immunoglobulin A (IgA) and immunoglobulin M (IgM) in serum were determined using radioimmunoassay (RIA) by immune globulin reagent (3V bioengineering Company, Wei Fang, China), according to the manufacturer’s instruction.

Anti-oxidative ability

Serum antioxidative indexes

The same 90 broilers were used to collect blood from heart at day 21 and day 42, then the blood samples were used to determine the activities of glutathione peroxidase (GSH-Px) and total superoxide dismutase (T-SOD), the contents of glutathione (GSH) and malondialdehyde (MDA), the total antioxidant capacity (T-AOC); and the ability to inhibit the hydroxyl radical (OH•) were determined with UV-visible spectrophotometer (TU-1901, Purkinje General Instrument, Beijing, China).

Tissue antioxidative indexes

The same ninety broilers were used to collect liver and chest muscle at 42d. The activities of GSH-Px T-SOD and T-AOC, the contents of GSH and MDA, and the ability to inhibit the OH• were determined according to standard methods.

Selenium content in tissue

The selenium contents in the chest muscle and liver were determined by inductively coupled plasma emission spectrometer (SN/T 2208-2008, Agilent).

Tissue slice

Thirty broilers (6 broilers of each treatment, 1 broiler of each replicates) were randomly selected to collect liver and kidney at day 21 and day 42. Prepared paraffin sections of liver and kidney, dyed with HE and observed the histopathological changes according to standard methods.

Statistical analysis

One-way ANOVA and Duncan’s Multiple comparison of data were conducted using SAS 8.0. Different small letter is considered as significant (P<0.05). Differences among mortality rates were assayed by χ²-test.

Results

Growth performance and mortality

To investigate the effect of different levels of organic selenium on growth performance and mortality of broilers, the average daily gain (ADG), average daily feed intake (ADFI) and mortality were measured (Table 2); there are no significant difference of ADG, ADFI, and mortality among groups from 0-21 d, 22-42 d and 0-42 d (P>0.05).

Slaughter performance and meat quality

The effects of different levels of Se on slaughter performance and meat quality of 42-day-old broilers are shown in Table 3. Carcass yield, drip loss and flesh colour had no significant difference among different groups at day 42 (P>0.05). The results showed that the slaughter performance and meat quality of broilers had not improved when supplemented with 0.00-2.00 mg/kg organic Se.

Immune performance

The effects of different levels of Se on serum immune performance at day 21 and day 42 and

Table 1. Composition and nutrient levels of basal diet.

| Ingredient | 0-21 d | 22-42 d |
|------------|--------|---------|
| Corn       | 59.63  | 61.55   |
| Soybean meal | 32.50  | 31.70   |
| Fish meal  | 2.00   | 0.00    |
| Soybean oil | 2.00   | 3.00    |
| DCP        | 1.50   | 1.70    |
| Calcium carbonate | 1.34   | 1.13    |
| 98% DL-methionine | 0.23   | 0.12    |
| Salt       | 0.50   | 0.50    |
| 0.5% premix | 100.00 | 100.00  |
| Total      | 100.00 | 100.00  |
| Nutrient levels  |       |
| Metabolizable energy, kcal/kg | 2960   | 3020    |
| Crude protein, %       | 21.54  | 20.02   |
| Calcium, %             | 1.02   | 0.91    |
| True protein, %        | 0.68   | 0.66    |
| Methionine, %          | 0.57   | 0.43    |
| Lysine, %              | 1.21   | 1.09    |
| Selenium, mg/kg        | 0.11   | 0.13    |

DPC, dicalcium phosphate. *Premix per kg compound feed: Vit. A, 9000 U; Vit. D3, 3000 U; Vit. E, 24 mg; Vit. K3, 1.8 mg; Vit. B1, 2.0 mg; Vit. B2, 5.0 mg; Vit. B6, 10 mg; Vit. B12, 0.01 mg; nicotinic acid, 40 mg; pantothenic acid, 15 mg; folic acid, 1.0 mg; biotin, 0.05 mg; choline chloride, 500 mg; Fe; 80 mg; Cu, 20 mg; Zn, 90 mg; Mn, 80 mg, 1, 0.35 mg. *Metabolizable energy, calculated value; other data, determined values.

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immune organ index at day 42 are shown in Table 4. The content of immunoglobulin and immune organ index had no significant differences among five groups (P>0.05).

**Oxidation resistance**

**Serum antioxidative property**

The effects of different levels of Se on serum antioxidative properties of broilers are shown in Table 5. The content of GSH, the activities of T-AOC and the abilities to inhibit hydroxyl radical (OH•) were significantly increased with the Se level on day 21 (P<0.05); the group supplemented with 2.0 mg/kg Se was the highest. The activities of GSH-Px, T-SOD and the content of MDA had no significant difference among groups (P>0.05).

At day 42, the activities of serum GSH-Px, T-AOC and the content of GSH were significantly increased along with the Se level, and the content of MDA was significantly decreased accompanying the Se level increase (P<0.05). The activities of T-SOD and the abilities to inhibit OH• had no significant differences among groups (P>0.05).

**Tissue antioxidative property**

The effects of different levels of Se on antioxidative properties of liver and chest muscle of broilers are shown in Table 6. The activities of GSH-Px, T-SOD and the content of MDA in liver and chest muscle tissue had no significant difference among different groups at day 42 (P>0.05). The ability to inhibit OH• of liver tissue was significantly increased along with the Se supplemented level and the group supplemented with 0.2 mg/kg achieved the highest value (P<0.05).

**Selenium content in tissue**

The effects of different selenium sources on selenium contents in liver and chest muscle of broilers are shown in Table 7; the selenium contents in liver and chest muscle increased along with additive amounts of Se. The content of selenium in liver and chest muscle were 0.28-1.43 mg/kg and 0.07-1.42 mg/kg, respectively when supplemented 0.00-2.00 mg/kg Se. The content of selenium in liver tissue of 0.5 mg/kg, 1.0 mg/kg and 2.0 mg/kg groups were significantly higher than that of 0.0 mg/kg group, but there was no significant difference among them. The content of selenium in chest muscle of 0.3 mg/kg, 0.5 mg/kg, 1.0 mg/kg and 2.0 mg/kg groups were significantly higher than that of 0.0 mg/kg group; the 1.0 mg/kg and 2.0 mg/kg groups were significantly higher than that of 0.3 mg/kg and 0.5 mg/kg group, while the 2.0 mg/kg group was significantly higher than that of 1.0 mg/kg group.

**Discussion**

Numerous reports have demonstrated that selenium was the cofactor and activator of 5’deiodinase that was a key enzyme of Triiodothyronine (T₃) synthesis, and T₃ was the growth control components of animals particularly poultry by controlling the body’s energy and protein assimilation, and thus could regulate animal growth (Ozbal et al., 2008; Kuchan and Milner, 1992). Previous report demonstrated that increased Se levels from 0.10 to 0.25 mg/kg markedly increased broiler weight and reduced feed efficiency ratio, where diet premixes were prepared without Se and vitamin E (Singh et al., 2006). In the pres-

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Table 2. Effects of different levels of selenium on growth performance and mortality of broilers (n=18).

|                | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA     | P          |
|----------------|--------------------------------------|-----|-----------|------------|
|                | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 | Linear | Quadratic |
| ADG, g/d       |      |      |      |      |      |        |           |
| 0-21 d         | 28.15 | 28.96 | 27.19 | 26.59 | 26.86 | 0.99 | 0.45 | 0.25 | 0.19 |
| 22-42 d        | 59.62 | 61.32 | 60.32 | 62.53 | 61.00 | 1.92 | 0.53 | 0.12 | 0.24 |
| 1-42 d         | 43.89 | 44.98 | 44.20 | 44.56 | 44.53 | 0.98 | 0.83 | 0.37 | 0.65 |
| ADFI, g/d      |      |      |      |      |      |        |           |
| 0-21 d         | 34.90 | 35.12 | 34.65 | 34.33 | 33.66 | 1.53 | 0.43 | 0.08 | 0.17 |
| 22-42 d        | 116.86 | 118.21 | 117.90 | 118.10 | 118.70 | 2.45 | 0.95 | 0.40 | 0.70 |
| 1-42 d         | 75.68 | 76.38 | 76.17 | 76.18 | 76.18 | 1.61 | 1.00 | 0.85 | 0.95 |
| F/G            |      |      |      |      |      |        |           |
| 0-21 d         | 1.24 | 1.21 | 1.27 | 1.29 | 1.20 | 0.04 | 0.36 | 0.27 | 0.49 |
| 22-42 d        | 1.97 | 1.93 | 1.95 | 1.90 | 1.95 | 0.05 | 0.62 | 0.23 | 0.33 |
| 1-42 d         | 1.73 | 1.70 | 1.67 | 1.72 | 1.71 | 0.03 | 0.37 | 0.24 | 0.18 |
| Mortality, %   |      |      |      |      |      |        |           |
| 0-21 d         | 1.85 | 0.87 | 1.85 | 0.00 | 0.93 | 1.29 | 0.82 | 0.37 | 0.68 |
| 22-42 d        | 0.98 | 0.34 | 0.00 | 0.00 | 0.00 | 0.61 | 0.57 | 0.13 | 0.29 |
| 1-42 d         | 2.78 | 1.85 | 1.85 | 0.00 | 0.93 | 1.35 | 0.55 | 0.13 | 0.32 |

ADG, average daily gains; ADFI, daily feed intakes; F/G, feed to gain ratios.

Table 3. Effects of different levels of selenium on slaughter performance and meat quality of broilers at day 42 (n=18).

|                | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA     | P          |
|----------------|--------------------------------------|-----|-----------|------------|
|                | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 | Linear | Quadratic |
| Carcass yield, % |      |      |      |      |      |        |           |
| 75.28 | 73.46 | 73.55 | 75.24 | 75.22 | 0.73 | 0.41 | 0.92 | 0.57 |
| Drip loss, %    | 3.57 | 3.40 | 3.17 | 3.26 | 3.26 | 0.20 | 0.69 | 0.24 | 0.34 |
| Flesh colour    |      |      |      |      |      |        |           |
| L (brightness)  | 43.68 | 43.26 | 43.48 | 44.28 | 43.45 | 0.61 | 0.79 | 0.74 | 0.95 |
| a* (redness)    | 8.88  | 8.87 | 9.24 | 9.41 | 9.38 | 0.21 | 0.17 | 0.02 | 0.06 |
| B* (yellowness) | 17.32 | 17.50 | 17.65 | 17.75 | 17.32 | 0.35 | 0.96 | 0.97 | 0.72 |
Table 4. Effects of different levels of selenium on the immune performance of broilers (n=18).

| Day | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA | P |
|-----|-------------------------------------|-----|-------|---|
|     | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 |     |
| Day 21 | IgG, g/L | 3.60 | 3.80 | 3.57 | 3.49 | 3.65 | 0.21 | 0.88 | 0.74 | 0.94 |
|       | IgM, g/L | 1.81 | 1.81 | 1.83 | 1.80 | 1.80 | 0.06 | 1.00 | 0.78 | 0.85 |
|       | IgA, g/L | 1.68 | 1.78 | 1.71 | 1.67 | 1.75 | 0.05 | 0.46 | 0.89 | 0.99 |
| Day 42 | IgG, g/L | 3.94 | 4.13 | 3.88 | 3.75 | 3.54 | 0.19 | 0.26 | 0.05 | 0.08 |
|       | IgM, g/L | 1.38 | 1.53 | 1.26 | 1.22 | 1.27 | 0.09 | 0.19 | 0.10 | 0.27 |
|       | IgA, g/L | 1.12 | 1.13 | 1.17 | 1.20 | 1.13 | 0.06 | 0.65 | 0.59 | 0.66 |
| Bursa index, g/kg | 1.69 | 1.86 | 1.77 | 1.76 | 1.78 | 0.24 | 0.99 | 0.90 | 0.97 |
| Thymus index, g/kg | 2.07 | 2.10 | 2.15 | 2.09 | 2.18 | 0.09 | 0.92 | 0.47 | 0.77 |
| Spleen index, g/kg | 1.01 | 1.00 | 1.04 | 1.02 | 1.10 | 0.06 | 0.73 | 0.24 | 0.44 |

Table 5. Effects of different levels of selenium on serum anti-oxidative property of broilers (n=18).

| Day | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA | P |
|-----|-------------------------------------|-----|-------|---|
|     | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 |     |
| Day 21 | GSH-Px, U/mL | 960.08 | 966.52 | 964.85 | 962.68 | 967.91 | 5.76 | 0.90 | 0.48 | 0.76 |
|       | GSH, mg/L | 6.23a | 6.44ab | 6.72bc | 6.85cd | 7.13de | 0.16 | <0.01 | <0.01 | <0.01 |
|       | T-SOD, U/mL | 156.50 | 157.50 | 158.48 | 156.59 | 158.24 | 1.85 | 0.94 | 0.73 | 0.94 |
|       | T-AOC, U/mL | 7.53a | 7.69ab | 8.09ab | 9.12c | 9.25c | 0.52 | 0.04 | <0.01 | <0.01 |
|       | OH•, U/mL | 552.88a | 573.62ab | 591.78ab | 614.75c | 625.87d | 19.04 | 0.03 | <0.01 | <0.01 |
|       | MDA, nmol/mL | 12.34 | 12.33 | 11.90 | 12.32 | 11.77 | 0.52 | 0.91 | 0.51 | 0.79 |
| Day 42 | GSH-Px, U/mL | 869.60 | 883.82ab | 907.88a | 935.9b | 946.75c | 18.38 | <0.01 | <0.01 | <0.01 |
|       | GSH, mg/L | 5.94a | 6.53ab | 6.78bc | 7.00c | 7.31d | 0.21 | <0.01 | <0.01 | <0.01 |
|       | T-SOD, U/mL | 171.48 | 172.96 | 175.38 | 173.92 | 171.81 | 3.48 | 0.94 | 0.81 | 0.75 |
|       | T-AOC, U/mL | 8.42a | 8.74ab | 9.03bc | 9.52cd | 9.79ef | 0.27 | <0.01 | <0.01 | <0.01 |
|       | OH•, U/mL | 492.65 | 515.82 | 514.58 | 504.00 | 482.54 | 15.42 | 0.51 | 0.71 | 0.18 |
|       | MDA, nmol/mL | 3.44a | 3.28ab | 3.17bc | 3.15d | 3.06e | 0.10 | 0.05 | <0.01 | <0.01 |

Table 6. Effects of different levels of selenium on oxidation resistances of liver and chest muscle of broilers at day 42 (n=18).

| Liver | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA | P |
|-------|-------------------------------------|-----|-------|---|
|       | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 |     |
| GSH-Px, U/mgProt | 22.38 | 23.97 | 25.19 | 22.75 | 23.45 | 0.93 | 0.23 | 0.57 | 0.24 |
| T-SOD, U/mgProt | 299.09 | 301.44 | 295.37 | 296.51 | 300.29 | 12.66 | 1.00 | 0.95 | 0.89 |
| OH•, U/mgProt | 246.31a | 274.62ab | 281.74ab | 303.00bc | 323.58b | 16.26 | <0.01 | <0.01 | <0.01 |
| MDA, nmol/mgProt | 5.15 | 5.06 | 5.28 | 5.29 | 5.18 | 0.18 | 0.90 | 0.64 | 0.89 |

Table 7. Effects of different levels of Se on the selenium content in liver and chest muscle of broilers at day 42 (n=18).

| Liver | Additive amount of Jiaotianle®, mg/kg | SEM | ANOVA | P |
|-------|-------------------------------------|-----|-------|---|
|       | 0.00 | 0.30 | 0.50 | 1.00 | 2.00 |     |
| GSH-Px, U/mgProt | 22.38 | 23.97 | 25.19 | 22.75 | 23.45 | 0.93 | 0.23 | 0.57 | 0.24 |
| T-SOD, U/mgProt | 299.09 | 301.44 | 295.37 | 296.51 | 300.29 | 12.66 | 1.00 | 0.95 | 0.89 |
| OH•, U/mgProt | 246.31a | 274.62ab | 281.74ab | 303.00bc | 323.58b | 16.26 | <0.01 | <0.01 | <0.01 |
| MDA, nmol/mgProt | 5.15 | 5.06 | 5.28 | 5.29 | 5.18 | 0.18 | 0.90 | 0.64 | 0.89 |

Se increased broiler oxidation resistance
ent study, the broiler production performance were not significantly improved when supplemented with 0.3, 0.5, 1.0 or 2.0 mg/kg organic selenium, which was in agreement with other reports (Swain et al., 2000; Yoon et al., 2007). On the other hand, the deposition of selenium in broiler liver and pectoral muscle tissue were getting higher along with Se levels increase, which showed that selenium was absorbed easily by broilers. According to NRC data, the Se requirement for broilers throughout the growth period is 0.15 mg/kg. In this study, selenium content of basis diets were supplemented with 0.11 mg/kg to 0.13 mg/kg, which may already meet the nutrition requirement of the broiler resulting in no improvement of production performance.

Flesh and drip loss were two important indicators that reflect the meat quality. Some studies have shown that selenium could significantly improve animal serum GSH-Px activity, enhance oxidation resistance, effectively prevent the myoglobin or oxymyoglobin been oxidized to metmyoglobin, deepen the muscle chroma, increase flesh colour score, improve meat quality and the water retention properties of the muscle (Tessier et al., 1995; Vignola et al., 2009; Tsopelas et al., 2011; Cai et al., 2012). However, Payne et al. (2005) provided a reverse evidence that carcass yield, breast weight, and moisture loss from the breast were not affected by Se level (Payne and Southern, 2005; Payne et al., 2005). Our results showed that carcass yield, drip loss and fleshcolour had no significant difference among different groups till day 42, which indicated that the redundant selenium yeast did not improve the slaughter performance and meat quality.

The oxidation resistance effect of selenium were generally realized by GSH-Px. selenium was also the composition of its active center elements, GSH-Px activity depends on the selenium content. About 30%-40% of selenium exist in the form of GSH-Px in animal body tissue, and lot of animal diseases and dysfunction are caused by GSH-Px activity change aroused by selenium deficiency (Schisler and Singh, 1988; Pilarczyk et al., 2012). In this study, the content of GSH, the activities of T-AOC and the abilities to inhibit OH• were significantly increased with the selenium level. Moreover, the content of MDA was significantly decreased on day 42. Furthermore, the ability to inhibit OH• of liver tissue was significantly increased with the selenium supplement level. Our results provide a strong evidence that broiler oxidation resistance was significantly increased with selenium additive level.

In summary, our studies demonstrated that organic selenium supplemented with 0.3, 0.5, 1.0 and 2.0 mg/kg of diets with 0.11 mg/kg to 0.13 mg/kg selenium had no obvious effect on production performance of broilers, but significantly influenced the broiler oxidation resistance.

Conclusions

The present study demonstrated that supplementation of different levels of selenium on growth performance, slaughter performance, the immune status, drip loss and flesh had not significant difference, but significantly influenced the broiler oxidation resistance, but not growth performance. In other words, the nutritional quality of broiler body has been enhanced.

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