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Effect of Organic Selenium and Vitamin E Supplementation on Physico-chemical Characteristics of Broiler Meat

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ABSTRACT

Present study was conducted to investigate the effect of organic selenium and vitamin E on physico-chemical characteristics of broiler meat. This study was a 3 x 2 factorial arrangement of three levels of organic selenium (0, 0.1, and 0.2 ppm) and two levels of vitamin-E (0 and 300mg/kg). Day-old Vencobb broiler chicks (n=180), were randomly assigned in 6 treatment groups. The experiment lasted for 35 days. The six different dietary treatments were: T_1- Control diet without organic selenium and vitamin E; T_2- 300mg/kg vitamin E; T_3- 0.1ppm organic selenium; T_4- 0.1ppm organic selenium and 300mg/kg vitamin E; T_5- 0.2ppm organic selenium and T_6- 0.2ppm organic selenium and 300mg/kg vitamin E. Supplementation of organic selenium and vitamin E had no significant effect on pH of broiler meat. Extract release volume (ERV) and water holding capacity (WHC) were significantly ($P<0.01$) increased in organic selenium and vitamin-E supplemented groups as compared to control and was recorded highest in birds fed 0.1ppm organic selenium with 300mg/kg vitamin-E. Significantly ($P<0.01$) decreased level of thiobarbituric acid (TBA) and tyrosine value (TV) were observed in birds fed organic selenium and vitamin-E as compared to control and was least in birds fed 0.1ppm organic selenium with 300mg/kg vitamin-E. There was marked interaction between organic selenium and vitamin E for ERV, WHC, TBA and TV ($P<0.01$) however it was non-significant for pH. Supplementation of organic selenium and vitamin E reduces the lipid peroxidation and autolysis, thus improves the shelf life of broiler meat.

Keywords: Broiler meat, Organic selenium, Physico-chemical characteristics, Vitamin E

Poultry meat is very perceptive to oxidative damage due to a high content of polyunsaturated fatty acids if sufficient antioxidants are not added in the diet. Selenium is an essential trace mineral which is necessary for normal growth, maintenance and production in poultry. The maximum permissible level of selenium supplementation is 0.30 ppm (AAFCO, 2010). It is an essential component of glutathione peroxidase (GSH-Px), an enzyme which is involved in cellular antioxidant mechanism. In poultry feed primarily the inorganic form of selenium, sodium selenite (SS) has been used (Tayeb and Qader, 2012) whereas, Boiago *et al*. (2014) reported that organic source (selenomethionine) of selenium is more effective than inorganic one (sodium selenite) for broiler meat preservation. In addition, the antioxidant effect of selenium and vitamin E on the meat quality of chickens has also been reported (Kim *et al*., 2010) Therefore, study was conducted to assess the effect of organic selenium and vitamin E on physico-chemical characteristics of broiler meat.

MATERIALS AND METHODS

The experiment was conducted in the Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh, India.

Experimental design and housing

This study was a 3 x 2 factorial arrangement of three levels of organic selenium (0, 0.1, and 0.2 ppm) and two levels of vitamin E (0 and 300mg/kg). 180 day old Vencobb broiler chicks belonging to a single hatch were wing banded, weighed and randomly distributed into six dietary treatments (three replicates of 10 birds/treatment). Feed and water given *ad lib*. The experiment was carried out for 5 week duration. Birds were raised under deep liter system. Birds were vaccinated against Ranikhet disease (F strain) and Infectious Bursal disease on day 7 and day 14, respectively. A booster dose for Ranikhet disease was given on day 28.

Treatments and additives

The diets were formulated according to BIS (1992). Ingredient composition of broiler's diet was shown in table 1. The six different dietary treatments were: T_1- Control diet without organic selenium and vitamin E; T_2- 300mg/kg vitamin E; T_3- 0.1ppm organic selenium; T_4- 0.1ppm organic selenium and 300mg/kg vitamin E; T_5- 0.2ppm organic selenium and T_6- 0.2ppm organic selenium and 300mg/kg vitamin E.

Sample analysis

pH: Soon after slaughter pH of the finely minced meat sample was determined by the method of Gillespie (1960). 10 g of meat sample were homogenized with 50 ml of distilled water using mortar and pestle for 30-60 seconds. Then the slurry is taken into a beaker and the electrode is dipped into the slurry and the pH of the suspension was recorded using digital pH meter.

Extract release volume (ERV): It is the volume of extract released by a homogenate of meat when allowed to pass through the filter paper for a given period of time. It is inversely proportional to the extent of spoilage and was determined as per the procedure outlined by Pearson (1968).

Water holding capacity (WHC)

It is described as the ability of the post-mortem muscle to retain water even though external pressures are applied to it. The method used for determining the WHC was a modification of the high speed centrifugation method (Harris and Shorthose, 1988).

Thio barbituric acid (TBA) value

The TBA value is the measure of oxidative rancidity in food and is expressed as a value or number. It measures the carbonyl residues resulting from lipid peroxidation. The rate of this change depends on initial bacterial load, physical and bio chemical change, availability of oxygen, temperature of storage and muscle composition and was determined as per Strange *et al.* (1977) with slight modification.

Tyrosine value (TV)

Value effectively monitors the meat quality to indicate proteolysis and to measure the amino acid tyrosine and tryptophan present in a non polar extract of meat. In the presence of tyrosine, folin ciocalteu phenol reagent produces blue colour, the intensity of which is a measure of protein cleavage. Tyrosine value (TV) of meat samples was determined as per Strange *et al.* (1977) with slight modification.

Statistical analysis

The data obtained were subjected to 3x2 factorial scheme for analysis two factor and their interaction as per the Snedecor and Cochran, 1994. The significance difference is analysed by Duncan (1955).

RESULTS AND DISCUSSION

pH: Result revealed that organic selenium and vitamin-E had no significant effect on pH of chicken meat. The mean pH of fresh meat sample ranged from 5.56 to 5.83 (Table 2).

Extract release volume (ERV)

The ERV ranged from 19.00 to 29.27 ml. Significant ($P<0.01$) differences were observed in extract release volume (ERV) of chicken meat in organic selenium and vitamin E supplemented group as compared to control. ERV obtained highest in birds fed 0.1ppm organic selenium with 300mg/kg vitamin-E and the level was found to increase more than 35% as compared to control group.

Table 1. Ingredient composition of broiler starter and finisher diet

Feed ingredients	Broiler starter (%)	Broiler finisher (%)
Yellow maize	58.5	63.38
Soya DOC	35.74	31
Maize gluten	-	0.3
Deoiled rice bran	0.12	-
Soyabean oil	1	3
Dicalcium phosphate	2.18	1.05
Limestone powder	0.94	0.21
DL-methionine	0.34	0.22
Lysine	0.08	0.11
Soda-bi-carb	0.11	0.05
Choline chloride	0.07	0.03
Salt	0.33	0.26
Premix1	0.49	0.39

[1] Trace mineral premix mg/kg diet: Mg 300, Mn 55, Fe 56, Zn 30, Cu 4; vitamin premix per kg diet: vit. A 8250IU, vit. K 1mg, vit. E 26.84 mg, vit. B_1 2 mg, vit. B_2 4 mg, vit. B_{12} 100µg, Niacin 60 mg, pantothenic acid 10 mg; choline 500 mg and 30 ppm salinomycin (Coxistac 12%), 55 ppm bacitracin methylene di salicyclate (BMD110,)

Water holding capacity (WHC)

WHC of the chicken samples ranged from 69 to 72.50%. WHC obtained highest in birds fed 0.1ppm organic selenium with 300mg/kg vitamin E and the level was found to increase 4.83% as compared to control group.

Thiobarbituric acid (TBA) value

It varies from 0.17-0.35 mg malonaldehyde/kg meat. Significant ($P<0.01$) differences were observed in birds fed organic selenium and vitamin E as compared to control. TBA obtained least in birds fed 0.1ppm organic selenium with 300mg/kg vitamin E and was found to be almost 50% less as compared to control.

Tyrosine value (TV)

It ranges between 6.00-10.55 mg/100g. Meat with combination of 0.1ppm organic selenium and vitamin E showing the lowest value and was 42.13% less than control group.

There was marked interaction between organic selenium and vitamin E for ERV, WHC, TBA and TV ($P<0.01$) however it was non-significant for pH.

Trace elements can drastically affect the animal performance and immunity. A discussion of selenium would be curtailed without mentioning the interrelationship between selenium and vitamin E. Vitamin E, a fat-soluble vitamin which is present in cellular membranes, is considered as the first line of defense against cellular oxidative damage. Selenium, as a component of GSH-Px, acts as a second line of defense. Supplementation of highly bio-available sources of dietary selenium can reduce the requirement of vitamin E in the diet (Zduńczyk *et al*., 2013).

In current experiment no significant effect was found in pH due to dietary supplementation of organic selenium and vitamin E whereas ERV and WHC were significantly increased in selenium and vitamin E supplemented group. Similar findings on pH of poultry breast meat were also reported by Allen *et al.* (1997). Pearson (1968) reported that meat could be acceptable, when the ERV is at least 17 ml. The physical properties such as colour, texture, juiciness and tenderness of meat partly depend on the WHC of the muscle tissue. When tissue has deprived WHC, loss of moisture and consequently loss of weight during storage is enormous.

The TBA value is anticipated as a measure of lipid oxidation in muscle tissue (Santosh *et al.*, 2012). In current research work TBA concentration was significantly decreased in selenium and vitamin E supplemented groups. Supplementation of organic selenium in turkey diet decreased the levels of TBA reactive substances in the yolk (Jankowski *et al*., 2011). Current findings also corroborated with Naik *et al*. (2014). Adebiyi *et al*. (2014) also reported that combination of selenium and vitamin E significantly reduces the TBA reactive substances in breast meat of turkey. Deficiency of selenium and vitamin E increased the level of TBA which might be due to increased lipid peroxidation of the meat.

Table 2. Effect of organic selenium and vitamin-E in physico-chemical properties of meat (Mean± SE)

	Particulars		**Physico-chemical characteristics of meat**				
	Organic selenium (ppm)	**Vitamin E (mg/kg)**	**pH**	**ERV(ml)**	**WHC (%)**	**TBA (mg malondialdehyde /kg meat)**	**TV (mg/100gm meat)**
T_1	0	0	5.76±0.04	19.00±0.14^{a}	69.00±0.20^{a}	0.35±0.01^{d}	10.55±0.15^{c}
T_2	0	300	5.56±0.14	26.17±0.14^{c}	72.33±0.17^{c}	0.22±0.01^{b}	6.27±0.07^{a}
T_3	0.1	0	5.70±0.03	22.30±0.08^{b}	71.74±0.13^{bc}	0.25±0.004^{c}	8.23±0.09^{b}
T_4	0.1	300	5.79±0.01	29.27±0.74^{e}	72.50±0.14^{c}	0.17±0.002^{a}	6.00±0.06^{a}
T_5	0.2	0	5.80±0.03	22.50±0.03^{b}	71.08±0.04^{b}	0.24±0.002^{c}	8.27±0.06^{b}
T_6	0.2	300	5.83±0.02	27.70±0.24^{d}	71.72±0.07^{bc}	0.21±0.006^{b}	6.50±0.09^{a}
Selenium effects							
	0 ppm		5.66±0.08^{a}	22.58±0.87^{a}	70.67±0.42^{a}	0.28±0.02^{c}	8.41±0.53^{c}
	0.1 ppm		5.75±0.02^{ab}	25.78±0.92^{c}	72.12±0.13^{c}	0.21±0.01^{a}	7.11±0.28^{a}
	0.2 ppm		5.82±0.02^{c}	25.10±0.64^{b}	71.40±0.09^{b}	0.22±0.00^{b}	7.38±0.22^{b}
Vitamin-E effects							
	0 mg/kg		5.75±0.02	21.27±0.32^{a}	70.61±0.24^{a}	0.28±0.01^{b}	9.01±0.22^{b}
	300 mg/kg		5.73±0.05	27.71±0.35^{b}	72.18±0.10^{b}	0.20±0.00^{a}	6.26±0.06^{a}
Source of variations (Probabilities)							
	Selenium		NS	P<0.01	P<0.01	P<0.01	P<0.01
	Vitamin-E		NS	P<0.01	P<0.01	P<0.01	P<0.01
	Selenium x Vitamin-E Interaction		NS	P<0.01	P<0.01	P<0.01	P<0.01

Superscripts are read column wise for comparison of means.

Means in the same column with different superscript a, b, c are significantly different, NS= Non significant.

Similarly supplementation of selenium and vitamin E reduce the level of TV. The increase in TV attributed primarily due to autolytic changes in meat and bacterial action (Strange *et al.*, 1977) In addition selenium in complex with vitamin E could be added to broiler diet without having any adverse effect on sensory properties of the meat and their acceptability (Miezeliene *et al.*, 2011). Therefore supplementation of antioxidants in the diet of chicken was necessary to improve the shelf life of meat.

It may be concluded that dietary supplementation of organic selenium and vitamin E in the diets upto 5 week of age has significantly improved the physico-chemical characteristics of meat by reducing the lipid peroxidation and proteolysis.

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