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Original Article

Influence of Feed Additives in Quality of Broiler Carcasses

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ABSTRACT

This study was carried out to assess the effect of some feed additives on quality of broiler carcasses. A total of one hundred and eighty of one day old broiler chicks were reared and divided into six groups. Five groups were fed on treated rations (20 g of freshly minced of each of garlic and onion to 1 Kg of ration, 400mg of vitamin E in one liter of drinking water, B.subtilis 4 $\times 10^8$ c.f.u was added in amount 1.5 g to 1 Kg ration, 10 g hot pepper to one Kg of ration and 50g zinc bacitracin added to the ration in amount 1.5 g to 1 Kg ration), and the sixth group used as control group. Broilers were slaughtered at age of 45 days to evaluate pH, moisture content, cooking loss, shear force and instrumental color. The feed additives (onion and garlic, Vit.E, hot pepper, B.subtilis and zinc bacitracin) were decreased pH in broiler meat. Moisture did not influence by dietary supplementation. Cooking loss was decreased with storage of broiler meat. Vit.E, B.subtilis and hot Pepper groups increased tenderness in broiler meat. Onion and garlic and Vit.E increased lightness and yellowness of broiler meat. Zinc bacitracin and hot pepper decreased redness of broiler meat.

Keywords: Feed additives, onion & garlic, vitamin E, hot pepper, B.subtilis, zinc bacitracin, meat quality and Broiler carcasses.

INTRODUCTION

Broiler quality improvement may be depending on the selected feed ingredient. Appearance is the major criterion for purchase, selection and initial evaluation of meat quality. Other quality attributes, such as tenderness, color, cooking- loss and shelf-life are important to the consumer after purchasing the product (Jeremiah, 1982). The variations in color of broiler breast meat fillets were significant correlated with muscle pH and extremes in color variations .Breast meat may appear dark due to high muscle pH. The use of nutritional strategies to improve the quality of meat is a relatively new approach that has emerged at the interface of animal science and food science. It often represents the only technology available to alter the quality of intact muscle, where utilization of exogenous compounds is difficult if not impossible. Nutritional approaches are often more effective than direct addition of the additive to meat since the compound is preferably deposited where it is most needed (Govaris et al., 2004). To ensure optimum quality, it is necessary to consider the entire production chain from farm to fork. Many studies focused on the impact of many dietary supplemental components such as vitamin E on post-mortem meat quality (Jensen *et al*., 1998 and Govaris *et al.*, 2007). Garlic (Allium sativum), have been widely used as herbal supplement to maintain and improve health of humans (Freeman and Kodera 1995). Broiler chicken have been recognized for its strong stimulating effect on the immune system and the very rich aromatic oils enhance digestion of birds (Gardzielewska *et al*., 2003). A world trend to reduce the usage of antibiotics in animal feed due to residues problems in the final products was evident. Most of broilers industry practioners have been given a growth promoter as additive in ration (Menten et al.). The objective of this study is to evaluate the effect of using feed additives (onion and garlic, vitamin E, hot pepper, zinc bacitracin and Bacillus subtilis) as well as their effect on keeping quality and extension of shelf life.

MATERIALS AND METHODS

1- Management:

1.1-Chicks: A total hundred and eighty of one day old chicks were purchased from a poultry company at El Mansoura Governorate. Broiler chicks were reared and divided into six groups. Each group contained thirty broiler chicks. The broiler chicks were randomly distributed into six pens. Each pen was one meter in length and two meter in width .The broiler chicks were 30 birds /pen for a final density per meter (fifteen birds in square meter). Broiler chicks were reared under good hygienic conditions. The rations were formulated to meet or exceed the nutrient requirement. Five groups received treated rations and the sixth group used as control group (received ration without treatment) .The

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infra-red lamps was used to provide the initial heating and light (nine hours was dark). All birds were vaccinated against new- castle disease at age of fifth day with (hitchner strain) and twice with lasota strain at age of Eighteenth and thirty five days. The birds received ration and water ad libitum. At the end of the experiment, all groups of broilers were separately slaughtered in poultry slaughter plant at Beni-Suef City. Birds were slaughter at age of 45 days for evaluation some quality parameters.

Broiler carcasses were transferred to the National Center for Radiation Research and Technology (NCRRT) in ice boxes. The thighs and the breasts were separately dissected from each carcass, placed in sealable polyethylene bags relative to each treatments and then stored either in the refrigerator (5± 1^{o}C) and examined at regular intervals under chilling conditions until spoilage (every 3 days).

1.2-Additives material: 1- Group one: Ration plus 2% of each onion and garlic. 2- Group two: Ration plus addition of 200000 mg of vitamin E in drinking water. 3- Group three: ration plus Bacillus subtilis; 4 x 10^{8}colony forming units CFU/g product)**.** 4- Group four: ration plus 1% hot pepper. 5- Group five: ration plus 50g zinc bacitracin.

2- Experimental techniques

2.1-PH measurement: The pH was measured by directly inserting the electrodes in the breast muscle using a pH meter (Mettler Toledo/ MB 220, UK) in each sample group (Olivo *et al*., 2001). Analyses were performed in triplicate on refrigerated and frozen samples. The pH meter was daily calibrated with standard buffers of pH 4.0 and 7.0 at 25^{o}C.

2.2-Moisture content: Moisture content of chicken thighs were determined according to the Association Official Analytical Chemists (AOAC, 1990), by drying about 10 g of the sample at 105 ^{o}C until a constant weight was recorded.

2.3-Cooking loss and Shear force

The breast samples of each treated group were oven cooked at 180^{o}C for 20 minutes to attain an internal temperature of 70^{o}C. Samples were left to cool at room temperature then used for the determination of cooking loss and tenderness. Cooking loss of the examined samples were determined, each sample was weighed prior to cooking. Upon completion of cooking, a final weight was obtained and cooking loss % was determined as the differences between the fresh and cooked weight divided by the fresh weight %.

The shear force was then determined using Instron 1195 (England) with a blade (68 mm wide× 72 mm long× 3 mm thick) (Yoon, 2003). The blade advanced 10mm/ min and the pick-up strength of the measuring head was 50 kg with the muscle fibers parallel to the direction of the blade. The results were expressed as kilogram force (kg f) to shear.

2.4-Instrumental color measurements: Instrumental color determinations were made on the surfaces of skinless breast samples using a micro color unit attached to a data station (Brano Lange -Germany) using the standard CIE LAB color system as follows: a-value (redness/green), b-value (yellowness/blue) and L-value (lightness/darkness,). Color measurements were determined in triplicate on each treatment group. All samples were measured in polyethylene bags. Six readings were taken at various points on each breast in an area free of obvious color defects (over scald, bruises and blood accumulation) (CIE, 1978).

3-Statistical Analysis:

The results are presented as mean of three replicates with standard division. Analytical test used f-test for comparing means of each treated group with each other and with control group

RESULTS AND DISCUSSION

Table (1), it was showed that the mean value of pH of meat of broiler fed on treated ration with onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin rations, each constituting 5.72, 5.79, 5.63, 5.76 and 5.67 at Zero time; respectively, while it was 5.91, 5.87, 5.81, 5.85 and 5.8 after three days of chilling at 5°C and 6.25, 6.23, 6.1, 6.23 and 6.17 after six days of chilling at 5°C for each; respectively.

There was significantly decreased in mean pH value at ($P<0.05$) of two groups (B.subtilis and zinc bacitracin) than other groups. Referring to the decrease of pH in broiler meat , it was a result of used each of B.subtilis and zinc bacitracin at both zero time and after 6 days of chilling storage . This may be due to the preventive effect of probiotics against micro-organisms. This in contact of that mentioned by Pascual et al. (1999). In this respect, Ali (2010) stated that probiotics decrease pH in broiler meat.

The obtained data in table (2), it showed that the mean value of moisture % in broiler fed on treated ration with onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin was 73. 9, 74.7, 73.2, 76.1 and 74.9 at Zero time while it was 73.5, 74.0, 72.6, 75.5 and 74.5 after three days of chilling as well as ,it was constituting 72, 71.4, 74.8, 73.9 and 73.9 after six days of chilling; respectively. Similar results were recorded by Onibi et al. (2009) and Ali and Zahran (2010). Moisture content of meat did not follow any trend in relation to treatment groups. This held view of Onibi et al (2009*)* and Ali and Zhran (2010). However, Bolianne (1995) stated that no differences in moisture content from pale and dark broiler breast meat. Moreover Qiao (2001) reported there is no correlation between broiler meat pH and moisture content.

The data in table (3) revealed that the mean values of cooking loss% in broiler fed on treated ration with each of onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin was 20.8, 18.57, 19.59, 20.66 and 17.41 at Zero time while it was 20.37, 18.36, 19.42, 19.77 and 16.19 after three days of chilling as well as 20.09, 16.31, 17.36, 12.88 and 15.23 after six days of chilling; respectively. Similar results were showed in broiler fed on each of control and rations treated with onion and garlic and vitamin E by Chuaynukool et al (2007)**,** Kim and Jin (2009) and Ali and Zahran (2010). High results were showed in broiler

fed on each of control and rations treated with B.subtilis and zinc bacitracin by Pelicano et al. (2003) and Ali (2010). The present data recorded in table (3) revealed that there was no significant differences of mean value at of cooking loss at (P <0.05). Cooking loss % was decreased with storage as compared with control may be due to the linear decrease of cooking loss accompanied with increase of pH. This in-agreement with Bouton et al. (1971). On contrary, Allen (1998) reported that there is no correlation between pH of cooked meat and cooking loss.

The obtained data in table (4),it showed that the mean value of shear force in meat of broiler fed on treated ration with each of onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin , control ration was 8.63, 9.05, 9.68, 10.1 and 10.38 at zero time ; respectively; while it was 7.6, 8.87, 8.4, 2.08 and 9.72 kgf/g after three days of chilling. It was constituted 7.6, 4.83, 5.39, 9.08 and 6.36 kgf/g after six days of chilling; respectively. Low figures in pH values were detected in broiler fed on each onion and garlic, B.subtilis and control by Pelicano et al (2003), Chuaynukool et al (2007). Kim and Jin (2009) Ali and Zahran(2010). Similar results in pH values were detected in broiler fed on vitamin E were recorded by Kim and Jin (2009) and Ali and Zahran(2010). After six days of chilling storage, there was a significant decrease in shear force values in broiler meat for vit.E., B.subtilis, hot pepper groups. This decrease in shear force values could be attributed to the tenderizing effects of vit.E. B.subtilis, hot pepper when supplemented to broiler. This held the view of Harris et al., (2001), Kim et al.,(2009) and Li et al., (2009) .

Shear force values were decreased by storage, thus improving tenderness was detected. This in-agreement with Ali and Zhran (2010). However, Miller (1994) stated that shear force values can be used to determine if meat products vary in texture by measuring the variability in total cutting force. Shear force values were highly correlated with overall tenderness of muscle. Moreover, Destefanis et al. (2008) reported that a highly variable characteristic shear-force values depending on many intrinsic and extrinsic factors of the meat and on their interactions. On contrary, Simpson and Goodwin (1974) proposed values up to 8kgf/g, while Lyon and Lyon (1988) considered that values up to 7.5 kgf/g might be consider as tender.

The present data in table (5) showed that the mean value of instrumental color at zero time for broiler fed on treated ration with onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin was 65. 49, 64.68, 61.67, 46.72 and 61.12 at L-*(lightness) 4.08, 3.7, 4.02, 2.96 and 3.05 at a* (redness) and 3.82, 2.66, 2.85, -1.1 and 2.37 at b-*(yellowness). Similar results in broiler fed on treated ration with each of onion and garlic, vitamin E and B.subtilis were recorded by Ali (2010) and Ali and Zahran(2010). High results were detected in broiler fed on ration treated with vitamin E by Pelicano ERL et al (2003). The data obtained at zero time, showed that mean value of L-*(lightness) were significantly at p (<0.05) increased in carcasses of broiler fed on onion and garlic group than carcasses of broiler fed on hot pepper, zinc bacitracin and control. Carcasses of broiler from hot pepper group have significantly decreased in mean value of L-*(lightness) at p (<0.05) as compared with other five treated groups. Hot pepper and zinc bacitracin were significantly decreased in mean value of a* (redness) at (P <0.05) than onion and garlic and B.subtilis groups. Carcasses of broiler from hot pepper group had significantly decreased in mean value of b-*(yellowness) at (P <0.05) as compared with other five treated groups. On contrary, Carcasses of broiler fed on onion and garlic group showed significantly increase in mean value of b-*(yellowness) at (P <0.05) than Carcasses of broiler were fed on Vit.E, hot pepper and zinc bacitracin.

The obtained results in table (6) revealed that the mean value of instrumental color after 3 days of chilling storage was 63.6, 62.9, 61.2, 44.48 and 60.8 at L-*(lightness) 4.1, 4.02, 4.3, 3.3 and 3.1 a*(redness) and 3.09, 1.89, 1.9, -1.36 and 1.84 at b-* (yellowness) for broiler fed on ration treated with onion and garlic, vitamin E, B.subtilis, hot pepper and zinc bacitracin; respectively. The recorded results in table (7) showed that the mean value of instrumental color after 6 days of chilling storage was 60.3, 59.6, 56.9, 41.18 and 57.5 at L-*(lightness) 4.7, 4.62, 4.9, 3.9 and 3.7 a*(redness) and 2.49, 1.29, 1.3, -1.96 and 1.84 at b-* (yellowness) for broiler fed on ration treated with onion and garlic, vitamin E, B.subtilis, hot Pepper and zinc bacitracin; respectively. After 3 and 6 days of storage at 5°C, hot pepper group showed significantly decreased in mean value of L-*(lightness) at (P <0.05) as compared with other five treated groups. Hot pepper and zinc bacitracin had significantly decreased in mean value of a* (redness) at (P <0.05) than onion garlic, Vit.E and B.subtilis. A decreased in mean value of b-*(yellowness) at (P <0.05) was in hot pepper group as compared with other five treated groups. Onion and garlic and Vit.E group were increased in lightness and yellowness. In addition, the decreased redness in muscles of broilers fed on treated rations with each of hot pepper and zinc bacitracin may be attributed to significant correlation existed between pH and color as well as odor. This held the view of Allen et al. (1997). A decreased yellowness and lightness of broiler meat of group fed on hot pepper ration may be due to the effectiveness of the met myoglobin reducing system and oxygen consumption. This in-agreement with O'Keefe and Hood (1982) . However, Greene et al., (1971) and Ledward (1991) stated that the rate of discoloration in fresh meat is related to the rate of pigment oxidation. Moreover, the effect of endogenous vitamin E on color quality was more evident in species having high levels of myoglobin and positive relationship between vitamin E and improved color stability has been clearly demonstrated by Chan et al. (1996) and Guidera et al. (1997). On other hand, Phillips et al. (2001) and Zouari et al. (2010) reported that vitamin E supplementation did not improve the color stability of thigh meat. However, Zouari et al. (2010) found that vitamin E supplementation increases the endogenous vitamin E level in post-mortem muscles. Moreover Ali (2010) reported that the darker broiler breast meat has a shorter shelf-life than lighter breast meat. The shorter shelf-life may be due to differences in pH.

Table 1 - Statistical analytical results of pH values in examined broiler samples at chilling storage.

Feed additives	Zero time				Three-days				Six-days			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	5.78	5.86	5.82[a]	0.02	6.01	6.27	6.13[b]	0.07	6.29	6.42	6.36[b]	0.03
Onion and garlic	5.68	5.76	5.72[a]	0.024	5.86	5.95	5.91[a]	0.027	6.15	6.32	6.25[ab]	0.05
Vit E	5.77	5.82	5.79[a]	0.015	5.83	5.9	5.87[a]	0.02	6.11	6.38	6.23[ab]	0.07
B.subtilis	5.57	5.71	5.63[b]	0.04	5.68	5.92	5.81[a]	0.071	6.05	6.18	6.1[a]	0.03
Hot pepper	5.67	5.88	5.76[a]	0.06	5.81	5.92	5.85[a]	0.03	6.16	6.38	6.23[ab]	0.07
Zinc bacitracin	5.62	5.77	5.67[b]	0.047	5.75	5.94	5.8[a]	0.05	6.1	6.26	6.17[a]	0.04

a and b superscripts indicate significant difference of mean value at p (<0.05) within column.

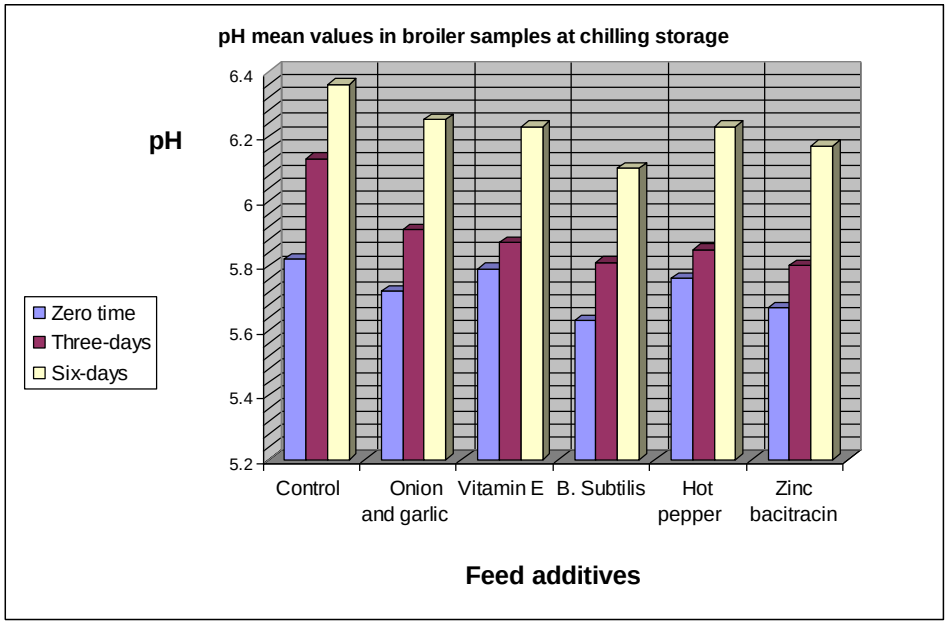

Table 2 - Statistical analytical results of moisture % values in examined broiler samples at chilling storage.

Feed additives	Zero time				Three-days				Six-days			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	75.76	75.86	75.8[a]	0.02	72.5	73.33	72.9[a]	0.24	69.69	73.89	71.8[a]	1.21
Onion and garlic	71.7	76.27	73.9[a]	1.3	71.93	75	73.5[a]	0.88	67.35	77.24	72[a]	2.88
Vit E	72.73	76.74	74.7[a]	1.15	70.97	77.78	74[a]	1.9	70.97	71.88	71.4[a]	0.26
B.subtilis	71.05	75.61	73.2[a]	1.3	70.85	74.36	72.6[a]	1.01	70.85	74.36	74.8[a]	1.4
Hot pepper	75	77.78	76.1[a]	0.84	72.92	77.42	75.5[a]	1.34	70.16	77.59	73.9[a]	2.14
Zinc bacitracin	71.67	78.79	74.9[a]	2.07	70.79	78.41	74.5[a]	2.19	70.27	77.27	73.8[a]	2

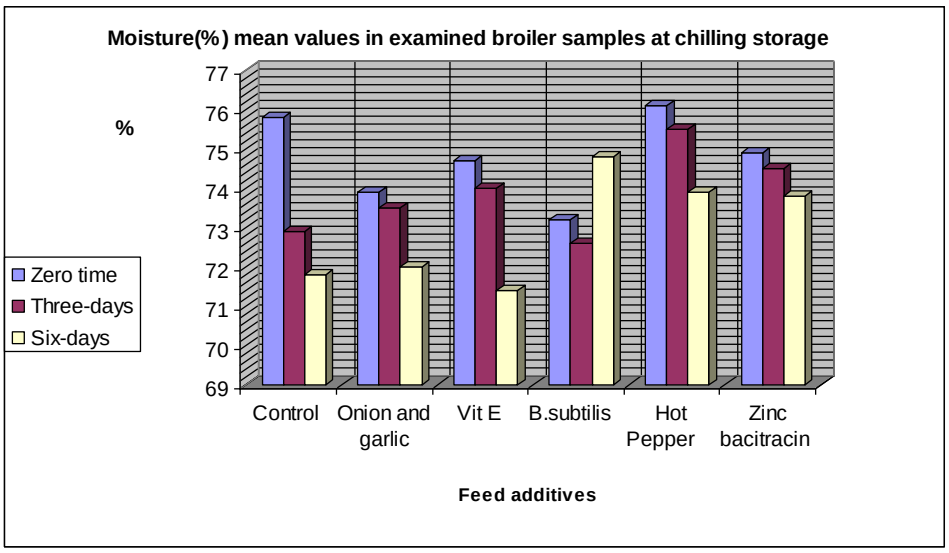

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Table 3 - Statistical analytical results of cooking loss values in examined broiler samples at chilling storage.

Feed additives	Zero time				Three-days				Six-days			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	21.1	29.8	25.71^{b}	2.52	20.3	21.9	20.91^{a}	0.51	13.35	21.2	17.35^{a}	2.26
Onion and garlic	20.15	21.38	20.8^{a}	0.35	18.28	22.24	20.37^{a}	1.14	19.5	21.04	20.09^{a}	0.47
Vit E	17.12	21.24	18.57^{a}	1.3	17.9	18.83	18.36^{ab}	0.26	14.61	18.04	16.31^{a}	0.99
B.subtilis	19.27	20.18	19.59^{a}	.295	18.36	20.48	19.42^{a}	0.61	12.01	23.86	17.36^{a}	3.46
Hot pepper	19.63	26.7	20.66^{a}	2.04	18.54	21.67	19.77^{a}	0.96	9.64	16.62	12.88^{a}	2.03
Zinc bacitracin	16.45	18.38	17.41^{a}	0.55	13.49	18.1	16.19^{b}	1.39	8.52	19.17	15.23^{a}	3.37

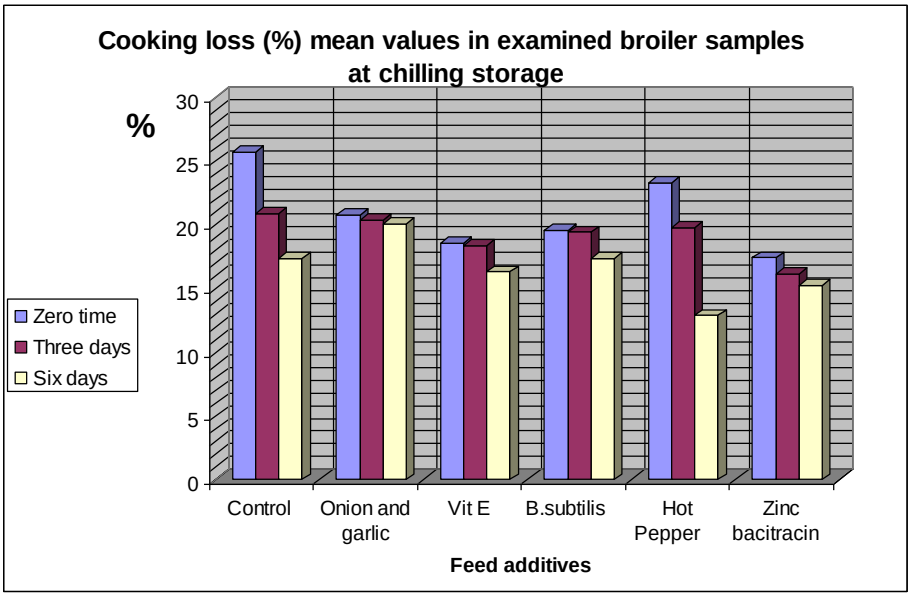

Table 4 - Statistical analytical results of Shear force (kgf/g) values in examined broiler samples at chilling storage.

Feed additives	Zero time				Three-days				Six-days			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	2.26	30.25	13.1^{a}	8.6	9.54	10.25	9.89^{a}	0.2	5.5	5.85	5.7^{a}	0.1
Onion and garlic	7.61	9.91	8.63^{a}	0.67	3.16	9.98	7.6^{a}	2.2	6.47	8.56	7.6^{a}	0.62
Vit E	8.36	9.99	9.05^{a}	0. 48	8.43	9.39	8.87^{a}	0.28	3.36	6.06	4.8b^{c}	0.69
B.subtilis	9.04	10.52	9.68^{a}	0.43	7.65	9.23	8.4^{a}	0.45	3.1	7.18	5.3^{b}	1.2
Hot pepper	8.48	12.41	10.1^{a}	1.12	7.6	11.07	9.08^{a}	1.03	1.93	4.22	2.9^{c}	0.68
Zinc bacitracin	8.33	12.81	10.3^{a}	1.3	8.36	10.81	9.72^{a}	0.72	5.45	7.54	6.3^{a}	0.61

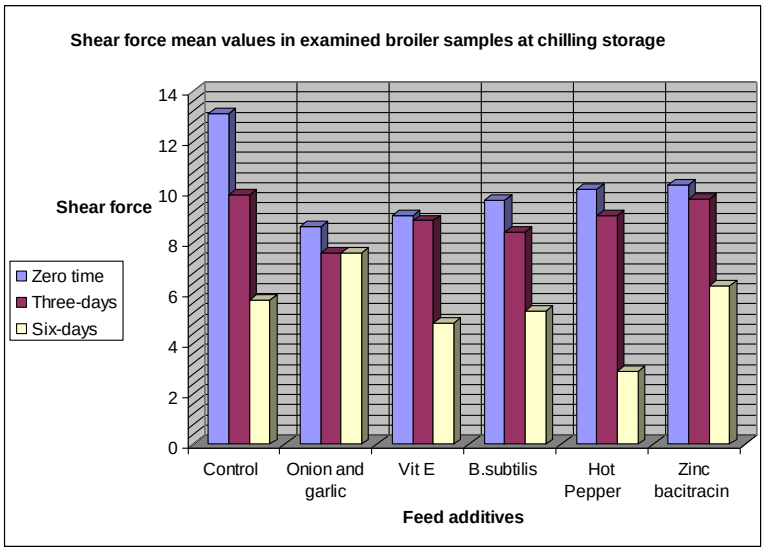

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Table 5 - Statistical analytical results of Instrumental color values in examined broiler muscles at zero time.

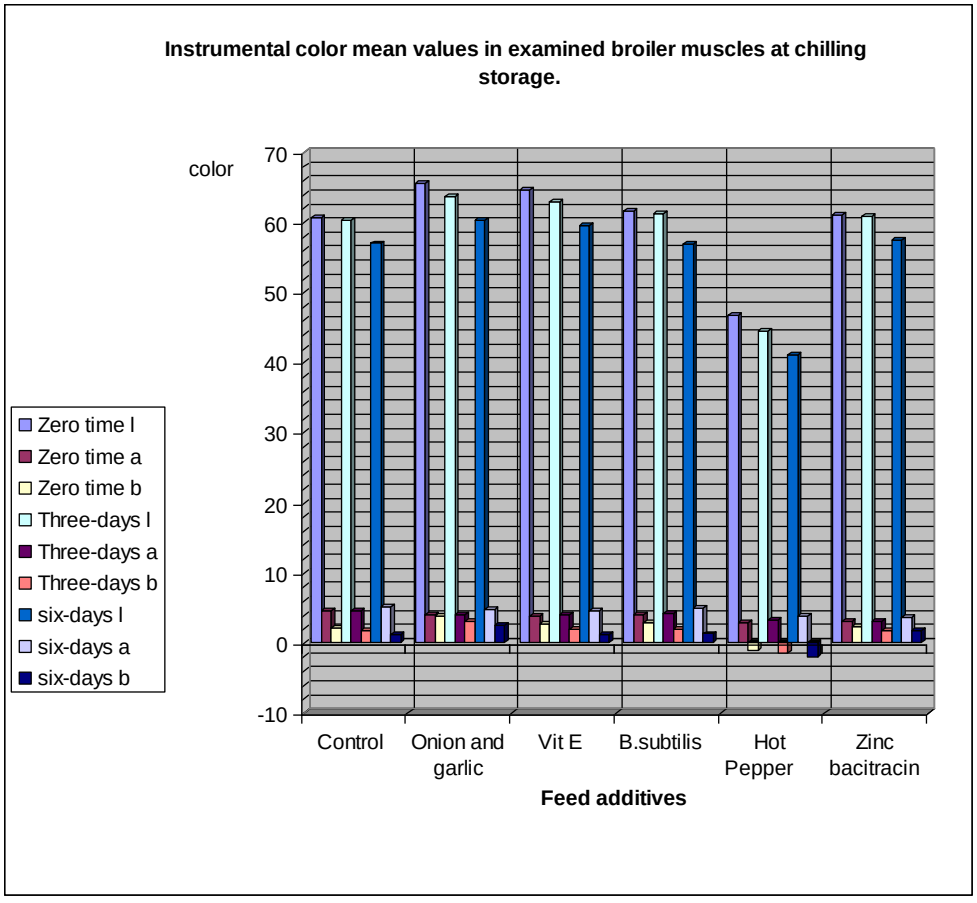
Feed additives	L				a				b			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	56.68	64.54	60.61^{c}	2.2	4.29	4.89	4.52^{a}	0.18	2.11	2.11	2.11^{c}	0
Onion and garlic	64.23	66.75	65.49^{b}	0.7	3.83	4.33	4.08^{a}	0.14	2.93	4.73	3.83^{a}	0.51
Vit E	64.67	64.69	64.68^{bc}	0.005	3.2	4.87	3.77^{ab}	0.55	2.09	3.23	2.66^{c}	0.32
B.subtilis	59.5	65.71	61.67^{bc}	2	3.33	4.51	4.02^{a}	0.35	2.77	2.93	2.85^{ac}	0.04
Hot pepper	45.69	47.49	46.72^{a}	0.53	2.93	2.99	2.96^{b}	0.01	-2.08	-0.6	-1.1^{b}	0.5
Zinc bacitracin	59.26	62.99	61.12^{c}	1	2.54	3.34	3.05^{b}	0.25	1.9	2.84	2.37^{c}	0.27

Table 6 - Statistical analytical results of Instrumental color values in examined broiler muscles at three days of chilling storage.

Feed additives	L				a				b			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	55.84	69.66	60.3^{b}	2.5	4.03	5.44	4.6^{a}	0.41	1.63	4.96	1.73^{b}	0.05
Onion and garlic	61.7	61.71	63.6^{b}	1	3.8	4.43	4.1^{a}	0.15	1.82	4.36	3.09^{b}	0.73
Vit E	62.02	63.8	62.9^{b}	0.51	3.56	4.48	4.02^{a}	0.26	1.12	2.66	1.89^{b}	0.44
B.subtilis	60.07	62.3	61.2^{b}	0.64	4.1	4.52	4.3^{a}	0.09	1.65	2.15	1.9^{b}	0.14
Hot pepper	43.55	45.42	44.48^{a}	0.53	2.97	3.8	3.3^{b}	0.23	-2.52	-0.78	-1.36^{a}	0.58
Zinc bacitracin	59.98	60.64	60.8^{b}	0.47	2.9	3.33	3.1^{b}	0.12	0.34	1.833	1.84^{b}	0.86

Table 7 - Statistical analytical results of Instrumental color values in examined broiler muscles at six days of chilling storage.

Feed additives	L				a				b			
	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.	Min.	Max.	Mean	S.E.
Control	52.54	66.36	57.0^{b}	2.5	4.63	6.04	5.2^{a}	0.41	1.03	4.36	1.13^{b}	0.05
Onion and garlic	58.4	58.41	60.3^{b}	1	4.4	5.03	4.7^{a}	0.15	1.22	3.76	2.49^{b}	0.73
Vit E	58.72	60.85	59.6^{b}	0.51	4.16	5.08	4.62^{a}	0.26	0.52	2.06	1.29^{b}	0.44
B.subtilis	56.77	59.0	56.9^{b}	0.64	4.7	5.12	4.9^{a}	0.09	1.05	1.55	1.3^{b}	0.14
Hot pepper	40.25	42.12	41.18^{a}	0.53	3.57	4.6	3.9^{b}	0.23	-3.12	-1.38	-1.96^{a}	0.58
Zinc bacitracin	56.68	57.34	57.5^{b}	0.47	3.5	3.93	3.7^{b}	0.10	0.32	1.823	1.84^{b}	0.86



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CONCLUSION

From the present data it could be concluded that:

- Onion and garlic and Vit.E were increased lightness and yellowness of broiler meat.
- Zinc bacitracin and hot pepper were decreased redness of broiler meat.
- The feed additives (onion and garlic, Vit.E, hot pepper, B.subtilis and zinc bacitracin) were decreased pH in broiler meat.
- Moisture did not influence by both pH and dietary supplementation.
- Hot Pepper and zinc bacitracin were decreased W.H.C, which increased with storage of broiler meat.
- B.subtilis and Vit.E group were decreased cooking loss in broiler meat. Cooking loss was decreased with storage of broiler meat.
- Vit.E, B.subtilis and hot pepper groups were increased tenderness in broiler meat.
- Vitamin E, B.subtilis, zinc bacitracin protected chicken meat from lipid oxidation. The tendency of lipid oxidation was increased by storage of broiler meat.
- Vit.E increased total unsaturated fatty acids (TUF) in broiler meat**.**

From pervious data pH appear to be accompanied by increase in water holding capacity and decrease in cooking loss. As well as darker meat than normal and tender meat, the extension of shelf-life time during preservation of treated groups leads to decrease of tenderness of meat.

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