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The effect of dietary selenium supplementation on meat quality of broiler chickens

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Currently there is a focus on the development of functional poultry products capable of enrichment by selenium, vitamin E, iodine and fatty acids of the third order. Since there is a lack of data about various selenium sources and its synergistic effect on sensory and other properties of vitamin E enriched poultry, the objective of this research was to examine the effect of addition of selenium in broilers diet on meat quality. The amount of Se in the diet was increased from 0.15 $mg \cdot kg^{-1}$ feed (control group) to 0.5 $mg \cdot kg^{-1}$ feed. Addition of Se had no significant effect ($p > 0.05$) on cooking and thawing losses, as well as on the majority of sensory attributes, adhesiveness, cohesiveness of chicken breast samples. Aftertaste ($p < 0.05$), hardness ($p < 0.001$) and resilience ($p < 0.001$) of the texture of the samples increased along with the increased amount of Se in bird diet. Mean values of the sensory attributes of thigh muscles showed no significant differences among the samples in case of intensities of odor and taste attributes; however, firmness and chewiness of the tested samples increased by increasing the amount of Se in the feed ($p > 0.05$). In addition, Se did not have significant influence on meat cooking or thawing losses. The results of this study showed that 0.15 mg and 0.5 mg of selenium in complex with 40 mg of vitamin E could be added to broiler diet without having negative effect on technological or sensory properties of the broiler meat and acceptability.
Keywords. Broilers, breasts, thigh, selenium, technological parameters, sensory attributes, texture, acceptability.

1. INTRODUCTION

The aim of food researchers and producers is to increase the nutritional value of food without decreasing sensory quality or consumers acceptability. Human health may be improved with increasing intake of biologically valuable ingredients. Consumption of poultry meat is constantly increasing and the meat nutrition quality depends largely on the composition of poultry feed. The basic broilers diet consists of cereals (wheat, corn, etc.) in general, but biological active additives are widely used in commercial broiler feed compounds for enrichment of their nutritional value. In this regard, selenium (Se) has been defined as an essential dietary supplement which is important for improving health and performance of the birds and improving meat quality for human consumption (Haug et al., 2007; Yoon et al., 2007). Selenium has important health promoting effect as it is one of the most active natural antioxidants; when combined with vitamin E, it may enhance the immune function and reduce cancer risk as well (Beck, 2001; Lu et al., 2005).

The concentration of Se is low in cereal grown in majority of European countries and Lithuania as well. This is one of the reasons why the low Se intake in human diet is widely observed in these countries.

Recent research suggested synergistic effect of the combinations of Se and vitamin E on diet in comparison to the use of those compounds alone; moreover, results of the joint action of Se with other bioactive ingredients are presented as well. It was established that the addition of 0.3 or 6% of distilled fatty acids to bird diet increased growth of poultry, and this effect would have been higher if diet had been supplemented with vitamin E and Se herewith (Attia et al., 2006).

As noticed in recent years, vitamin E is the most active antioxidant used in animal or bird feeding (Flachowsky et al., 2002). The addition of vitamin E to bird diets improves birds' health and productivity and provides a source of vitamin E useful for human nutrition and health. Vitamin E supplementation in poultry diets results in an increase of vitamin E concentration in the tissue and increases the stability of meat (Grau et al., 2001). The content of vitamin E which is transferred from bird diet to meat depends on consumed amount and birds' type; it was determined that this transfer for hens was higher than for chickens (Flachowsky et al., 2002).

The addition of vitamin E and Se is important when feed is supplemented with fatty acids (Haug et al., 2007). It has been reported that birds' body weight and feed efficiency were not affected by dietary Se levels and no adverse effect on the growth was observed during the experimental period (Ryu et al., 2005). The dietary Se and α-tocopherol levels did not affect surface meat color (Ryu et al., 2005).

Most studies on micronutrient supplementation have been focused on the preventive or beneficial effects on health of the birds or minerals' retention (Surai, 2000; Marković et al., 2008; Shlig, 2009), but not on poultry meat quality.

Meat characteristics such as color, water-holding capacity, texture and sensory properties also have significant effect on consumers. This is the reason why a major attention for use of Se and vitamin E should be taken on the potential negative effect of these bioactive ingredients on the sensory and other characteristics of the products.

Textural characteristics in general and tenderness particularly have been noted as the most important factors determining quality of meat products (Savell et al., 1989). Apart from texture, juiciness, flavor and color are the main quality parameters that could impact the acceptability of the products (Wood et al., 1995).

During technological processes such as freezing, thawing or storage changes in appearance, sensory properties or technological parameters can be observed. Bou et al. (2005) reported that acceptability scores of cooked dark chicken meat (thigh) after 74 days or after 18 months of frozen storage had not been affected by any of the dietary factors (animal fat or linseed oil), Zn (0, 300 or 600 $mg{\cdot}kg^{-1}$) and Se (0 or 1.2 $mg{\cdot}kg^{-1}$ as sodium selenite or 0.2 $mg{\cdot}kg^{-1}$ as Se-enriched yeast).

The objective of the present work was to investigate the effect of different amounts of selenium in diet of broiler chickens on the sensory and technological attributes of chicken meat. Fresh, frozen and stored at -18°C for 3 and 6 months meat samples (breast and thigh) were analyzed.

2. MATERIALS AND METHODS

2.1. Feeding scheme

Four hundred chickens of the strain Cobb 500 were reared from 1 to 35 days old. The birds were fed *ad libitum* with diet formulated to meet nutrient requirements of broiler chickens (NRC, 1994). The birds were allocated to two groups with 4 replications per group at the experimental farm. The broiler chickens of control group were fed diet with 0.15 mg Se [sodium selenite (inorganic Se)] + 40 mg vitamin E and birds of experimental group received diet with 0.5 mg Se [0.15 mg sodium selenite (inorganic Se) + 0.35 mg Se methionine (organic Se Alkosel® R397)] + 40 mg vitamin E.

Alkosel® R397 is a specific inactivated whole cell yeast (*Saccharomyces cerevisiae* NCYC R397) product containing the essential trace element selenium in its natural food form, L(+) selenomethionine. Concentration of selenium is 2,000-2,400 ppm.

The birds were kept on a deep litter and had free access to water from stationary watering containers. The keeping of the broiler chickens and the scientific investigations have been made following the provisions of Law of Republic of Lithuania on Protection, Keeping and Use of Animals and EU Directive 2007/43/EC (www.litlex.lt; www.eur-lex.europa.eu).

At the end of the experiment the 8 broiler chickens of each group were slaughtered according to the given recommendations (Close et al., 1997).

2.2. Cooking and thawing losses

Cooking losses (CL) of the meat samples were determined 20 h after slaughter, according to the methodology proposed (Kouba, 2003). The raw meat samples after weighing and packing in cooking bags were cooked at 100°C for 20 min. After this procedure the samples were cooled at room temperature and weighed again. Cooking losses were calculated as the difference between the initial and the final weight.

The meat samples were weighed before and after freezing so that thawing losses could be determined. They were removed from the freezer, placed on trays and thawed in a commercial refrigerator at 3 to 4°C for 24 h.

2.3. Sensory evaluation

A sensory panel for the descriptive analysis consisted of 7 assessors experienced in sensory evaluation of different food products. The assessors were selected and trained according to the international standards (ISO, 1993). The sensory evaluation was performed according to a standardized sensory descriptive method (ISO, 1985). The sensory attributes of the boiled chicken meat (breast and thigh) were analyzed. A structured numerical scale was used for evaluation of the intensity of each attribute. The left side of scale corresponding to the lowest intensity of attribute was given value of 1, and the right side corresponding to the highest intensity was given value of 7. All sessions were conducted in a climate-controlled sensory analysis laboratory equipped with individual booths.

The samples were prepared by placing them in a boiled water and boiling them for 30 min (breast) or 25 min (thigh) after the water has boiled. The samples were quartered lengthwise and served immediately to panelists along with room temperature water, tea and white bread for neutralization of receptors. The assessors were instructed to clean the palate with water or tea between evaluations of each sample. The following characteristics were assessed: intensity of overall odor, boiled chicken odor, non typical odor, intensity of color, hardness, chewiness, juiciness, fibriness, mouthfeel, boiled chicken taste, non-typical taste and aftertaste. The samples were presented to the assessors monadically. The sample order of presentation to each assessor was randomized.

2.4. Texture measurements

Texture profile analyses (TPA) of boiled chicken breasts were performed using an Universal Testing Machine 3343 (Instron Engineering Group, High Wycombe, UK) equipped with a 1kN load cell and Bluehill software. The samples, measuring 2.0 × 2.0 × 2.0 cm, were compressed perpendicularly using a 50 mm diameter cylindrical probe. The testing conditions were two consecutive cycles at 50% compression, cross-head movement at a constant speed of 1 $mm \cdot s^{-1}$. Texture variables (hardness, gumminess, cohesiveness, chewiness and springiness) were calculated as described by Bourne (1978).

2.5. Color measurement

Instrumental color measurements of both raw and cooked breasts were performed using a spectrometer GBC Cintra 202, calibrated throughout the study using the reference illuminant C. Random readings, each average of 3 measurements, were taken at 3 different locations on the skinless sample. The measurements were averaged and color for each sample was expressed in terms of CIE L*a*b* values for lightness (L*), redness (a*) and yellowness (b*).

2.6. Data analysis

SPSS software, version 15.0 (SPSS, Chicago, IL, USA) was used for statistical analysis. Student's t test was used to evaluate the significance of the differences ($p < 0.05$) in technological and sensory parameters between the samples with the different amount of Se (0.15 mg or 0.5 mg) at the same storage time. The analysis of variance was used to determine if the significant differences existed among means when the impact of storage time had been evaluated. Differences were classified by Duncan multiple comparison test.

3. RESULTS

3.1. Technological properties of the chicken meat samples

Table 1 summarizes mean color values for the raw chicken breast samples (fresh and after 3 months storage) determined by instrumental method. Diet had a significant effect on the color values for the fresh (0 month) samples. Lightness of the samples significantly decreased ($p < 0.001$), but redness ($p < 0.001$) and yellowness ($p < 0.001$) significantly increased along with the increase of content of Se in diet. No significant effect of diet on lightness or yellowness was determined after 3 months storage, but the redness value was higher when amount of Se in diet was higher ($p < 0.01$). Storage was a factor affecting lightness and yellowness of the breasts.

Instrumentally measured color values for the boiled samples (**Table 2**) were significantly affected by diet. Analysis of data showed lower lightness and higher

Table 1. Mean CIE L*a*b* values of raw meat of the chicken breasts[1].

	Diet		*p* value
	0.15 mg Se + 40 mg vitamin E	**0.5 mg Se + 40 mg vitamin E**	
L*			
0 month	73.38 ± 0.1	56.51 ± 0.1	0.000
3 months	60.17 ± 0.1	60.25 ± 0.2	0.917
a*			
0 month	3.05 ± 0.1	6.75 ± 0.1	0.000
3 months	3.75 ± 0.1	8.59 ± 0.0	0.005
b*			
0 month	3.71 ± 0.0	5.20 ± 0.1	0.000
3 months	5.40 ± 0.0	6.35 ± 0.1	0.189

[1] Values are means of 3 replicates; L*: lightness; a*: redness; b*: yellowness.

Table 2. Mean CIE L*a*b* values of boiled meat of the chicken breasts[1].

	Diet		*p* value
	0.15 mg Se+40 mg vitamin E	**0.5 mg Se +40 mg vitamin E**	
L*			
0 month	79.91 ± 0.1^{a}	78.42 ± 0.5^{a}	0.000
3 months	80.70 ± 1.5^{a}	78.72 ± 3.7^{a}	0.372
6 months	81.38 ± 0.7^{a}	83.21 ± 1.1^{b}	0.053
a*			
0 month	2.48 ± 0.1^{a}	2.99 ± 0.2^{a}	0.000
3 months	3.27 ± 0.6^{b}	3.47 ± 1.3^{b}	0.464
6 months	3.17 ± 0.1^{b}	2.81 ± 0.2^{a}	0.096
b*			
0 month	4.22 ± 0.2^{a}	5.67 ± 0.3^{ab}	0.000
3 months	7.23 ± 0.5^{b}	6.96 ± 0.8^{b}	0.639
6 months	6.46 ± 0.1^{b}	4.76 ± 1.2^{a}	0.187

[1] Values are means of 3 replicates; L*: lightness; a*: redness; b*: yellowness. [a, b]: values within each column for each attribute with different superscripts are different at $p < 0.05$.

redness and yellowness values when amount of Se in diet increased for the fresh samples. No differences were observed among the samples color characteristics in dependence from diet after storage.

During storage meat color significantly changed. Storage of the samples for 3 months had no significant effect on boiled meat lightness; however, redness and yellowness values significantly increased ($p < 0.05$). Storage of the samples for 6 months had no significant effect on lightness, but it increased the values of redness and yellowness of meat when the amount of Se in diet was 0.15 mg.

Total cooking losses for the breast or thigh samples were not significantly affected by the chicken diet (**Table 3**). However, a significant difference between cooking losses of fresh and stored for 3 months meat was noticed in comparison with the samples stored for 6 months. When storage period was extended to 6 months, meat (both breast and thigh) cooking losses had become significantly lower than those of fresh and stored for 3 months.

Total thawing losses for the breasts or thigh were not affected by the chicken diet (**Table 4**).

3.2. Sensory evaluation

The sensory data did not indicate significant differences ($p > 0.05$) in the fresh boiled chicken breast odor properties and color intensity due to the different

Table 3. Mean values for cooking losses[1] in %.

	Diet		*p* value
	0.15 mg Se + 40 mg vitamin E	**0.5 mg Se + 40 mg vitamin E**	
Breasts			
0 month	26.96 ± 2.1^{b}	25.93 ± 0.2^{b}	0.832
3 months	26.56 ± 1.0^{b}	27.72 ± 1.2^{b}	0.491
6 months	23.76 ± 0.4^{a}	24.09 ± 0.3^{a}	0.892
Thigh			
0 month	31.87 ± 4.8^{b}	30.27 ± 3.2^{b}	0.521
3 months	32.43 ± 5.1^{b}	33.20 ± 4.7^{b}	0.856
6 months	22.00 ± 2.1^{a}	22.31 ± 4.2^{a}	0.956

[1] Values are means of 3 replicates; [a, b]: values within each column for each sample with different superscripts are different at $p < 0.05$.

Table 4. Mean values for thawing losses[1] in %.

	Diet		*p* value
	0.15 mg Se+40 mg vitamin E	**0.5 mg Se +40 mg vitamin E**	
Breasts	3.26 ± 0.5	3.23 ± 0.6	0.794
Thigh	5.38 ± 0.8	5.36 ± 0.6	0.893

[1] Values are means of 3 replicates.

diet. No significant effect ($p > 0.05$) of increased Se amount in diet was noticed for fresh breast hardness, fibriness, juiciness, chewiness or crunchiness. As shown in **table 5**, the increased amount of Se notably changed intensity of fresh breasts' aftertaste. The chicken breast samples had more intensive aftertaste ($p < 0.05$) with increasing level of Se. It was reported that supplementation of Se and organic acids had no significant effect on the sensory properties of poultry (Haug et al., 2007), but perceived slight or non-typical taste could be caused by small rests of blood on the samples.

Contrarily, no significant differences in appearance, taste or odor of the samples were spotted in the breast samples stored for 3 and 6 months. The increasing amount of Se resulted in higher fibriness ($p < 0.01$), chewiness ($p < 0.05$), juiciness ($p < 0.05$). These changes in texture attributes had no significant negative effect on the samples' acceptability, as shown in **figure 1**.

The sensory data indicated differences due to storage time.

The amount of Se had no significant impact on intensity of taste and odor attributes of the boiled thigh samples ($p > 0.05$). The significant differences in the color attributes, hardness ($p < 0.05$), chewiness ($p < 0.05$) and fibriness values of the thigh samples were identified when the amount of 0.5 mg of Se was added to the chicken diet.

Thigh samples stored for up to 3 months differed significantly only in juiciness. The increasing amount of Se in the chicken diet caused the increase in juiciness of thigh meat, but the same tendency was not ascertained for those samples after 6 months storage. No effects of Se amount in diet on taste, odor and other texture properties of thigh stored for 3 or 6 months were found.

There were no significant differences between the samples (fresh ones and after 3 months storage) in nontypical odor intensities, when the amount of Se in diet was 0.15 mg. However, the samples after 6 months storage differed significantly from the fresh samples ($p < 0.05$). It is important to note that thigh samples' color intensity increased during storage. Storage duration also had significant impact on texture properties. The fresh samples of breasts had higher values of fibriness and crunchiness and the fresh samples of thigh were distinguished for lower values of tenderness in comparison with the stored samples.

When the amount of Se in diet was 0.5 mg during storage of the meat samples, a decrease of odor and color intensity, hardness, juiciness, fibriness, chewiness, crunchiness of the boiled breast samples was observed. Clear impact of storage period on sensory properties for the thigh samples was not determined.

Analysis of the ratings for overall liking showed no significant differences among the breast and thigh samples after 0 and 3 months of storage (**Figure 1**). However, it was determined that storage for 6 months had negative effect on acceptability of the breast and thigh samples. The amount of Se in the chicken diet did not affect acceptability during all storage period.

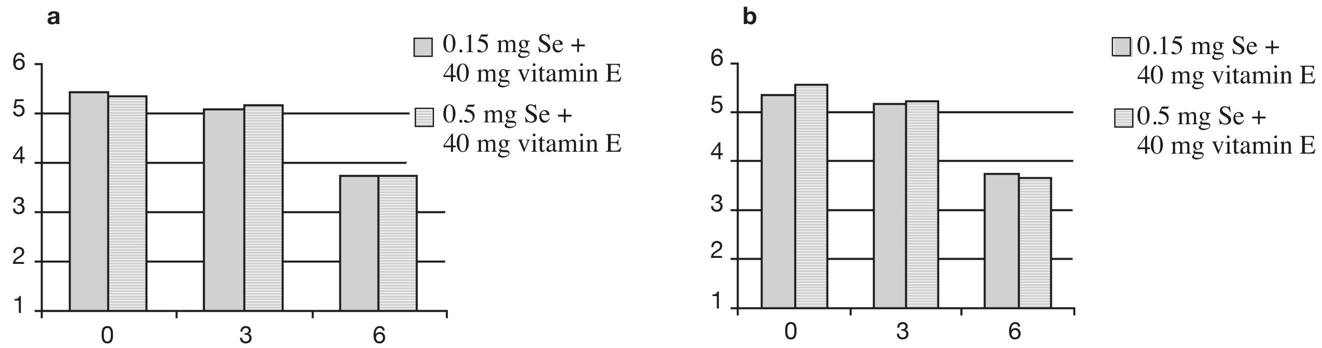

Figure 1. Mean overall liking scores of the chicken meat samples in terms of storage (0, 3, 6 months) and diet for a: breasts, b: thigh meat samples (n = 14).

Table 5. Mean sensory characteristics scores (n = 7 × 3 replicates) for the chicken meat samples (scale from 1 to 7).

Attribute	Diet					
	Breasts			Thigh		
	0.15 mg Se + 40 mg vitamin E	0.5 mg Se + 40 mg vitamin E	*p* value	0.15 mg Se + 40 mg vitamin E	0.5 mg Se + 40 mg vitamin E	*p* value
Boiled chicken odor						
0 month	5.36[a]	5.82[b]	0.208	6.17[b]	5.58[a]	0.134
3 months	5.17[a]	5.60[b]	0.056	5.50[ab]	5.60[a]	0.626
6 months	5.00[a]	4.92[a]	0.807	5.33[a]	5.00[a]	0.410
Non typical odor						
0 month	1.25[a]	1.83[a]	0.166	1.25[a]	1.17[a]	0.633
3 months	1.83[ab]	2.00[a]	0.544	1.83[ab]	1.42[a]	0.155
6 months	2.08[b]	2.08[a]	1.000	2.33[b]	2.67[b]	0.436
Color intensity						
0 month	2.33[ab]	2.67[b]	0.455	3.33[a]	4.08[a]	0.018
3 months	3.92[b]	2.50[ab]	0.058	5.09[b]	4.83[a]	0.540
6 months	2.00[a]	2.00[a]	0.168	4.08[b]	4.25[a]	0.534
Hardness						
0 month	4.17[a]	4.42[b]	0.701	2.75[a]	3.67[a]	0.038
3 months	3.33[a]	3.91[ab]	0.129	3.67[b]	4.18[a]	0.203
6 months	3.83[a]	4.09[a]	0.502	3.42[ab]	3.90[a]	0.376
Fibriness						
0 month	4.42[b]	4.83[c]	0.545	3.00[a]	4.08[b]	0.016
3 months	2.83[a]	3.73[b]	0.007	3.05[a]	3.17[a]	0.320
6 months	2.45[a]	3.09[ab]	0.047	3.25[a]	3.25[ab]	1.00
Juiciness						
0 month	2.80[a]	2.64[a]	0.269	4.42[a]	4.58[a]	0.671
3 months	2.10[a]	2.91[b]	0.020	4.64[a]	5.78[b]	0.001
6 months	2.80[a]	3.00[b]	0.050	4.67[a]	4.42[a]	0.501
Chewiness						
0 month	4.83[a]	5.17[b]	0.501	3.67[a]	4.42[a]	0.028
3 months	4.17[a]	5.08[b]	0.030	4.55[b]	4.64[a]	0.777
6 months	4.83[a]	4.46[a]	0.003	3.40[a]	3.75[a]	0.513
Crunchiness						
0 month	4.55[b]	5.18[c]	0.067	4.25[a]	4.67[a]	0.382
3 months	3.50[a]	3.55[b]	0.916	3.00[a]	3.45[a]	0.240
6 months	3.42[a]	2.00[a]	0.728	3.58[a]	3.42[a]	0.686
Mouthfeel						
0 month	2.00[a]	2.08[a]	0.807	3.00[a]	3.17[a]	0.580
3 months	1.67[a]	1.92[a]	0.237	3.00[a]	3.64[ab]	0.104
6 months	1.80[a]	1.92[a]	0.243	4.25[b]	4.45[b]	0.670

Table 5 (continued). Mean sensory characteristics scores (n = 7 × 3 replicates) for the chicken meat samples.

Attribute	Diet					
	Breasts			Thigh		
	0.15 mg Se + 40 mg vitamin E	0.5 mg Se + 40 mg vitamin E	*p* value	0.15 mg Se + 40 mg vitamin E	0.5 mg Se + 40 mg vitamin E	*p* value
Mouthfeel						
0 month	2.00^{a}	2.08^{a}	0.807	3.00^{a}	3.17^{a}	0.580
3 months	1.67^{a}	1.92^{a}	0.237	3.00^{a}	3.64^{ab}	0.104
6 months	1.80^{a}	1.92^{a}	0.243	4.25^{b}	4.45^{b}	0.670
Non-typical taste						
0 month	1.33^{a}	2.00^{a}	0.167	1.17^{a}	1.00^{a}	0.152
3 months	1.90^{b}	1.72^{a}	0.570	1.18^{a}	1.45^{a}	0.148
6 months	2.20^{b}	2.33^{a}	0.357	2.67^{b}	3.91^{b}	0.031
Aftertaste						
0 month	2.50^{a}	3.54^{a}	0.021	3.67^{a}	3.83^{a}	0.675
3 months	4.00^{b}	4.30^{a}	0.369	4.18^{a}	4.00^{a}	0.684
6 months	3.50^{b}	3.92^{a}	0.980	4.17^{a}	4.25^{a}	0.871

[a, b, c]: values within each column for each attribute with different superscripts are different at $p < 0.05$.

3.3. Texture evaluation

The amount of Se had no significant effect ($p > 0.05$) on cohesiveness and springiness of the fresh and 3-month-stored breast samples. The increased amount of Se resulted in higher hardness ($p < 0.001$), gumminess ($p < 0.01$) and chewiness ($p < 0.01$) of the breast samples (**Table 6**). After 6 months storage the amount of Se had no significant effect on all texture attributes of the samples.

Storage period significantly influenced most of texture properties for the breast sample with 0.15 mg Se in diet. Hardness, gumminess, chewiness of those samples highly increased during storage. In the chicken diet, 0.5 mg Se had no significant effect on variations of its texture properties during storage.

Table 6. Mean values of instrumental texture characteristics of the breast samples[1].

Texture characteristics	Diet		*p* value
	0.15 mg Se + 40 mg vitamin E	0.5 mg Se + 40 mg vitamin E	
Hardness (N)			
0 month	58.26 ± 10.1^{a}	95.27 ± 11.2^{a}	0.000
3 months	81.20 ± 6.5^{b}	110.14 ± 9.2^{a}	0.001
6 months	147.80 ± 22.7^{c}	88.25 ± 19.9^{a}	0.110
Gumminess (N)			
0 month	21.40 ± 3.1^{a}	35.84 ± 6.2^{a}	0.001
3 months	28.12 ± 8.1^{a}	32.96 ± 4.9^{a}	0.006
6 months	49.57 ± 6.9^{b}	33.49 ± 4.2^{a}	0.134
Chewiness			
0 month	114.74 ± 10.2^{a}	210.89 ± 30.1^{a}	0.000
3 months	169.64 ± 16.1^{b}	184.19 ± 14.9^{a}	0.002
6 months	269.60 ± 13.5^{c}	199.98 ± 9.5^{a}	0.285

[1] Values are means of 3 replicates; [a, b, c]: values within each column for each attribute with different superscripts are different at $p < 0.05$.
N: hardness and guminess measured in Newton's.

4. DISCUSSION

The effect of Se in poultry nutrition is associated with its participation in maintaining the antioxidant system of the cells. Results of this study have shown that the increase in amount of Se (from 0.15 mg to 0.5 mg·kg^{-1} feed) had had only minor effects on the chicken meat properties. Freezing raw poultry denatures the myofibrillar proteins and, as a result, some cellular fluids are lost from the muscle tissue during thawing.

Diet with the different amount of Se had no significant effect on the water holding capacity of meat. However, Choct et al. (2004) reported that birds receiving organic Se in their diets had reduced drip loss. This disagreement can be related to different methods used for evaluation of the water holding capacity. Free drip refers to the amount of water that is lost from meat without use of force other than capillary forces (gravity).

Color analysis of the fresh and defrosted breast samples showed significant effect of Se amount in feed on lightness, redness and yellowness. It was established that values of lightness had decreased ($p < 0.001$), values of redness ($p < 0.001$) and yellowness ($p < 0.001$) had increased when amount of Se was raised up to 0.5 mg. Nevertheless, poultry meat color is affected by many different factors like bird gender, age, strain, processing treatments, freezing and other factors (King et al., 2006). Color is an important quality attribute as consumers are often willing to pay more for poultry products having appetizing color. Several factors impact meat color including pH, myoglobin concentration, nitrites, and others (Fletcher, 1999). The degree of meat lightness depends on the amount of light scattered and absorbed; pale meat has an increased amount of scattered light and a decreased absorption.

Addition of Se and vitamin E or their combination on chicken feed had no significant impact on perceived intensities of sensory and texture profiles of the chicken breasts or thigh muscle in general. Juiciness is an important contributor to eating quality of meat (Lyon et al., 2004). The relationship between juiciness and physical and chemical properties of meat had been studied intensively in the past. Se supplementation (0.15 mg or 0.5 mg) in feed had no significant effect on fresh meat (breast and thigh) odor intensities. Thigh meat had more intensive color ($p < 0.05$), higher hardness ($p < 0.05$) and chewiness ($p < 0.05$) when increasing amount of Se, but it had no negative effect on acceptability of meat.

Comparison of texture characteristics of the samples stored for 3 and 6 months evaluated by sensory analysis and instrumental methods resulted in significant differences in hardness during storage. The data are in agreement with the reports of Lee et al. (2008), who had not noticed significant changes in tenderness during first 2 months of frozen storage. However, significant differences in texture properties were found after 2 and 4 months of storage. Instrumental method had revealed significant differences in hardness when texture differences were not determined by sensory assessors. It could be related to juiciness of the samples (Chen, 2009).

The amount of Se in broiler diet had no significant effect on chicken meat acceptability. This is in agreement with the findings of Bou et al. (2005) where it was stated that consumer acceptability values had not showed any significant differences for the samples when the amount of Se was Se 0 mg·kg^{-1}, 1.2 mg·kg^{-1} (selenite) or 0.2 mg·kg^{-1} (Se yeasts) when cooked thighs were evaluated. No significant effect of storage (74 days and 18 months) on meat acceptability was observed in this research. Although, our research results have showed lower acceptability of the samples after 6 months storage, it can be related to technological causes due to freezing process which is similar to that used by consumers at home.

5. CONCLUSION

No significant difference in taste and odor profiles between the chicken groups, fed with 0.15 and 0.5 mg of selenium in diet was observed and the influence of selenium amount did not result in a major effect on meat acceptability. The decreased lightness (L*) and increased redness (a*) values for fresh boiled meat, however, suggest that color changes can be caused by the amount of selenium. No difference was observed for cooking or thawing losses among the tested samples.

Consequently, a different amount of selenium in feed had no significant negative effect on poultry quality with negligible exception for texture properties and acceptability of the samples after 6 months storage.

The results presented in this study showed that 0.15 mg and 0.5 mg of selenium in complex with 40 mg of vitamin E can be added to diet of the broiler chicken without having negative effect on meat technological and sensory properties and acceptability.

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