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Effect of tarragon addition on volatile compound profile and some quality paramaters of sucuk

Tarhun ilavesinin sucuğun uçucu bileşen profiline ve bazı kalite parametrelerine etkisi

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Abstract

The goal of the present study was to investigate the effect of tarragon and ripening period on certain quality parameters and the volatile profile of sucuk (Turkish dry fermented sausage). Tarragon was used in sucuk samples at three distinct levels (0.25%, 0.50% and 0.75%), and tarragon-free samples were used as control. Analyses were performed on the 0., 3., 5., 7., 9. and 13. days of ripening time. Although the presence of tarragon did not affect L and b* values, the pH, a* (P<0.01), aw (P<0.05), and TBARS values of the sucuk samples were statistically affected. Tarragon demonstrated antioxidant activity in sucuk in accordance with 90 % ± 0.3 DPPH scavenging activity. When the volatile profile was evaluated, the key component affected by the addition of tarragon was determined as Anisole, p-allyl-. As a result, while an antioxidative effect was detected during ripening in the presence of tarragon in sausage, undesirable changes were not observed on some quality characteristics such as pH and a_w.*

Keywords: Tarragon, TBARS, Volatile compound, Sucuk, Fermentation.

Öz

Bu çalışmada tarhun ve olgunlaştırma süresinin sucuğun bazı kalite parametreleri ve uçucu profili üzerindeki etkisinin araştırılması amaçlanmıştır. Sucuk örneklerinde 3 farklı seviyede (%0.25, %0.50 ve %0.75) tarhun ve kontrol olarak tarhun içermeyen örnek kullanılmıştır. Analizler olgunlaşma süresinin 0., 3., 5., 7., 9. ve 13. günlerinde yapılmıştır. Tarhun varlığı, L, b* değerlerini etkilemezken sucuk örneklerinin pH, a* (P<0.01), a_w (P<0.05) ve TBARS değerlerini istatistiksel olarak etkilemiştir. Tarhun, göstermiş olduğu %90±0.3 DPPH süpürme aktivitesi ile uyumlu olarak sucukta antioksidan aktivite göstermiştir. Uçucu profili değerlendirildiğinde, tarhun ilavesinin etki ettiği major bileşenin Anisole, p-allyl- olduğu belirlenmiştir. Sonuç olarak kullanılan konsantrasyonlardaki tarhun varlığında, sucukta olgunlaştırma sırasında antioksidatif etki tespit edilirken, pH ve a_w gibi bazı kalite özellikleri üzerinde arzu edilmeyen değişimler gözlenmemiştir.*

Anahtar kelimeler: Tarhun, TBARS, Uçucu bileşen, Sucuk, Fermantasyon

1 Introduction

Sucuk, is a dry fermented meat product, widely consumed in Turkey. Conventionally, it is produced using beef or buffalo meat, sheep's tail fat, salt, nitrite and various spices [1],[2] Oxidation is a change affecting the properties of foods as well as meat products [3]. Synthetic antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), tert-butylhydroquinone (TBHQ), propyl gallate (PG) are used in meat products to prevent oxidation [4]. Recently, conscious consumers have been interested in naturally sourced content. The use of natural antioxidants has gained importance in response to consumer demand. Spices and herbs are one of the most important natural sources of antioxidants [5],[6]. These sources may contain bioactive substances, phenolic mixtures and flavonoids with antioxidative effect [7].

Tarragon (*Artemisia dracunculus*) is a plant belonging to the Asteraceae family. It is known that different plants in this family have antimicrobial and antioxidative effects [8],[9]. Tarragon is a spice widely used in various cuisines around the world. This spice, which has a very important place in the French cuisine, has also been studied medicinally [10]-[12]. Studies on the effect of tarragon on meat and meat products are very insufficient in the literature [13]-[15]. Therefore, the purpose of this study is to determine the effects of *A. dracunculus* on sausage quality and oxidative properties during the ripening period.

2 Material and methods

2.1 Determination of Antioxidative Activity of Tarragon

1, 1-diphenyl-2-picrylhydrazyl (DPPH) method was used for this purpose. Tarragon sample (1/10, w/v) was diluted with ethanol and 2 ml of 0.06 mM DPPH solution volume was transferred to ensure mixing. The resulting mixture was kept in a dark place for 30 min. at room temperature. After 30 min. the absorbance analysis was carried out at 517 nm. The values obtained were determined using the following formula as the percent free radical inhibition [14].

$$\% \text{ free radical inhibition} = (A0 - As) \,/\, A0 \ * \ 100$$

Where A_0 = absorbance of blank and A_s = absorbance of sample.

2.2 Sucuk manufacturing

For sucuk production, meat and fat were supplied from the producers in Bayburt and tarragon grown in Bayburt region was used. 20 g of NaCl, 10 g of garlic, 9 g of cumin, 7 g of red

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pepper, 4 g of sucrose, 5 g of black pepper, 2.5 g of pimento and 150 ppm of $NaNO_2$ are contained in 1 kg of meat-fat mixture (80% of beef meat and 20% of beef meat fat). Sucuk batter was prepared with meat mincer. After mincing, powdered tarragon in various amounts (0.25, 0.50 and 0.75%) was added to the sucuk batters and the control group was prepared without tarragon. Sucuk batters were inoculated with autochthonous *Lactobacillus plantarum* S91+ *Stahphylococcus xylosus* GM92 [16] at 7 and 6 log CFU/g, respectively. The sausage batter was portioned using casings to weigh 200±5 g. Ripening conditions were preferred as; 1 day, (92±2 % relative humidity (RH), 24±1 ◦C), 2 day (90±2% RH,20±1◦C), 4 day (88±2% RH, 18±1 ◦C), 2 day (88±2% RH,16±1 ◦C), 7. day (80 ±2% RH, 16±1 ◦C) [17].

2.3 Physicochemical analysis

For pH determination 100 ml of distilled water was applied to the sample of 10 grams, then homogenized with Ultraturrax (IKA Werk T 25. Germany) for 1 min. A pH-meter was used to assess the pH values after homogenization (Jenco Electronics. 6173) [18]. Also, moisture content of sucuk samples were determined according to Gökalp et al. [18].

2.4 Color evaluation

The color of the samples was determined by a colorimeter (Model CR 300. Chromometer, Minolta, Japan). The results were recorded as L* (brightness: 100. darkness: 0), a* (red: +, green: -), b* (yellow: +, blue: -). From every sample slice, four measurements were obtained.

2.5 Determination of thiobarbituric acid reactive substances (TBARS) value

2 g of the samples and 12 ml of trichloroacetic acid (TCA) solution (7.5% TCA, 0.1% ethylenediaminetetraacetic acid (EDTA), 0.1% Propylgalate (dissolved in 3 ml ethanol) were homogenized with Ultraturrax for 15-20 secs. For filtering the homogenate, Whatman 1 filter paper was used. 3 ml of filtrate and 3 ml of thiobarbituric (TBA) solution (0.02 M) was mixed. In a water bath, the mixture was held on at 100 °C for 40 min., after which it was cooled under cold water. The absorbance values were read by a spectrophotometer (Spectrophotometer. Shimadzu. UV-1800) at 530 nm after centrifugation at 2000 g for 5 min. TEP (1.1.3.3. tetra ethoxy propane) was used in the preparation of the standard and the k value was calculated. Results were obtained for mg malonaldehyde (MDA)/kg [19].

2.6 2.6 Determination of volatile compounds

For analyzing volatile compounds, the method presented by Kaban [16] was used. Volatile compounds of samples were determined at the last day of ripening period. The samples were shredded and moved (Supelco, Bellefonte PA, USA) to sample containers. By putting the CAR/PDMS fiber (Supelco 75 µm, USA) for the adsorption of free compounds, samples that were held on at a temperature of 30°C for 60 min. to accumulate volatile compounds in the head space were stored for 2 hours. To classify the volatile compounds by injection into the fiber gas chromatograph (GC, Agilent Technologies 6890N), mass spectrometry (MS, Agilent Technologies 5973) was used. BD-624 was used as the column (J&W Science, 30 m, 0.25 mm i.d., 1.4 µm film). Initially, the oven temperature of the gas chromatograph was 5 min. at 40 °C, then progressively increased to 110 °C at 3 °C/min, 150 °C at 4 °C/min, 210 °C at 10 °C/min. and was held for 12 min. at the final temperature. Helium was used at a 1 ml/min flow rate as a carrier gas. Compared with the mass spectrometry library (NIST, WILEY, FLAVOR), the data obtained was evaluated. The Kovats index was calculated by regular mixes (Supelco 44585-U and 5-02251, Bellefonte PA USA).

2.7 Statistical analysis

Statistical analysis was conducted using the SPSS 16.0 package program. As a total randomized design with two replications, the experiment was planned. Tarragon (at the rate of 0, 0.25. 0.50 and 0.75%) and the ripening period (0., 3., 5., 7., 9. and 13. days) were included in the model as the primary impacts. The data was evaluated by variance analysis (significance $p<0.05$ and $p<0.01$) and the multiple range test of Duncan (significance $p<0.05$) was then performed to test the mean differences. The results were expressed as data ± standard deviation.

3 Results and discussion

The pH values of sucuk samples ($p<0.01$) were very significantly influenced by using tarragon and the ripening duration. A lower pH value in the presence of tarragon relative to the control group was determined, as shown in Table 1. It can be said that, during the fermentation phase, the presence of tarragon encourages acid formation. After the third day of fermentation, the pH levels fell below 5. A rise in the pH value was calculated during the subsequent days of ripening. It can be said that ammonia and buffering components formed in the fermentation environment and decreased electrolyte dissociation caused this rise [20].

Table 1. Effect of tarragon and ripening period on the pH.

			T	
R	Control	0.25%	0.50%	0.75%
0	5.76±0.01$^{a, A}$	5.75±0.01$^{ab, A}$	5.75±0$^{ab, A}$	5.73±0^{b,A}
3	4.37±0.01$^{a, E}$	4.36±0.01$^{a, E}$	4.33±0.01$^{b, D}$	4.31±0$^{b, DE}$
5	4.46±0.01$^{a, D}$	4.39±0.01$^{b, D}$	4.38±0.01$^{b, C}$	4.29±0.01$^{c, E}$
7	4.47±0.01$^{a, D}$	4.42±0.01^{b,C}	4.40±0.01$^{b, BC}$	4.32±0 ^{c,D}
9	4.59±0.01$^{a, B}$	4.52±0 ^{b,B}	4.44±0.02$^{b, B}$	4.41±0.01$^{c, B}$
13	4.52±0.01$^{a, C}$	4.41±0.07 ^{b,CD}	4.41±0.01$^{b, BC}$	4.37±0.01$^{c, C}$
Significance				
R		**		
T		**		
R*T		**		

a-c: Any two means in the same raw having the same letters in the same section are not significantly different ($p<0.05$).
A-E: Any two means in the same column having the same letters in the same section are not significantly different (*$p<0.05$. **$p<0.01$), NS: not significant.
SD: Standard deviation.
T: Treatment.
R: Ripening period(day).

a_w values varied significantly during the ripening period ($p<0.01$) (Table 2). The addition of tarragon had a statistically significant effect on the aw values ($p<0.01$). On the 13th day of ripening, it was observed that the a_w value decreased below 0.90 in all sucuk groups.

In cured fermented meat products, color is an important parameter. Table 3 presents a* values of sucuk samples. Although it was found that the influence of the tarragon content on the a* value was significant ($p<0.01$), it was found to have no effect on the L* and b* values ($p>0.05$) (data not given). In the control group, although the a* value was maximum at after 13 day ripening, it was found to be lower in the tarragon-containing groups. The increase in quantity of tarragon contributes to a decrease in the a* value. The lowest value in the sucuk batter and on the last day of ripening was determined when the shift in the a* value was discussed during ripening. Although the color in the sucuk batter was not stable, the desired cured meat color was achieved in the coming days by the development of the nitrosomyoglobin complex. It can be said that the decrease in the a* value at the end of ripening was due to the prevention of the oxygen interaction of sucuk samples and the denaturation of nitrosomyglobin during ripening [21],[22]. In general, discoloration of meat products coincides with lipid oxidation [23],[24]. The brown metabolites resulting from browning reactions and/or oxidation that have occurred over time may cause this decrease [25].

To determine the lipid oxidation level in meat and meat products, the TBARS value is an important parameter [26]. Table 4 presents changes in the TBARS values during the ripening phase. The tarragon content and ripening period ($p<0.01$) significantly influenced TBARS values. TBARS values ranged from 0.6 to 0.72 mg/kg in sucuk samples after ripening ($P<0.05$). In the control group, the highest mean TBARS value was obtained. It was determined that there was a decrease in the TBARS value with the increase in tarragon content. The lowest TBARS mean values were determined in samples with tarragon (Table 4). The DPPH scavenging activity of tarragon extract was determined in this analysis to be 90 %± 0.30. There are several reports in the literature demonstrating the existence of the antioxidant effect of the tarragon plant [27]-[29]. In this study, it was found that the quantity of tarragon contributed to a reduction in the TBARS value ($p<0.05$). Sharafati Chaleshtori et al. [15] stated that the addition of essential oil from tarragon had no significant impact on the degree of lipid oxidation of raw hamburger meatballs stored for 12 days at +4 °C. Wu and Rule [30] stated that the sensory sensitivity of lipid oxidation was above 1 mg/kg TBARS in fermented meat products. The TBARS values of the sucuk samples were estimated to be below 1 mg/kg at the end of ripening.

It was determined that, along with the increase in tarragon content, the presence of Anisole, p-allyl-, one of the allyl phenol derivatives, increased. Phenol derivative monoterpenes were reported to exhibit antioxidant activity [28]. This information explains the decrease in the TBARS mean value with the increase in anisole content in sucuk samples.

The volatile profile of fermented sucuk samples was determined to be composed of 40 compounds in total, including 3 sulphured compounds, 21 terpenes, 3 ketones, 1 ester, 1 ether, 4 aromatic hydrocarbons, 1 aliphatic hydrocarbon, 3 aldehydes, 1 alcohol, and 2 acids. Many volatile compounds may emerge during lipid oxidation. The most prominent examples of them include aldehydes, ketones, alcohols and acids [31]. The results of volatile compounds of fermented sucuk samples are presented in Table 5. When the total volatile compound content was considered, it was determined that tarragon content had no significant effect on the volatile profile ($p>0.01$). But, it was determined that tarragon content had a significant effect on Benzene, 1-methoxy-4-(1-propenyl)-, Phenol, 2-methoxy-4-(2-propenyl)-, Anisole, p-allyl-, 2,3-Butanedione, propanoic acid and β- myrcene compounds ($p<0.05$). Among these compounds, Phenol, 2-methoxy-4-(2-propenyl)-, Anisole, p-allyl- and Benzene, 1-methoxy-4-(1-propenyl)-content increased with the increase in tarragon content.

While Rabe and Krings [32] reported that lipids had a significant effect on aroma compounds, in this study, it was determined that the most important compounds affecting the sucuk aroma were terpenes and aromatic compounds. The aromatic compound content increased with the increase in tarragon content ($p>0.01$). The major compound in aromatic compounds was determined to be 1-allyl-4-methoxybenzene(p-allyl-anisole) or estragole. Estragole, a phenylpropanoid compound, is characterized by tarragon in many studies [33]-[35].

Table 2. Effect of tarragon and ripening period on the a_w.

	T			
R	Control	0.25%	0.50%	0.75%
0	0.949±0.001^{a,A}	0.947±0.001 ^{b,A}	0.949±0^{a,A}	0.948±0.001^{ab,A}
3	0.938±0.001^{a,B}	0.939±0.001^{a,B}	0.939±0^{a,B}	0.939±0.001^{a,B}
5	0.929±0.001^{a,B}	0.938±0.001^{a,B}	0.937±0.001^{a,B}	0.935±0^{a,BC}
7	0.914±0.003^{a,D}	0.930±0.001^{a,C}	0.928±0.001^{a,C}	0.931±0.001^{a,C}
9	0.910±0^{c,E}	0.923±0.001^{a,D}	0.920±0.002^{ab,D}	0.916±0.001^{bc,D}
13	0.863±0.01 ^{b,F}	0.878±0.0 ^{a,E}	0.864±0.001 ^{b,E}	0.879±0.004 ^{a,E}
Significance				
R		**		
T		**		
R*T		**		

a-c: Any two means in the same raw having the same letters in the same section are not significantly different ($p<0.05$).

A-F: Any two means in the same column having the same letters in the same section are not significantly different (*$p<0.05$. **$p<0.01$).

NS: Not significant.

SD: Standard deviation. T: Treatment. R: Ripening period (day).

Table 3. Effect of tarragon and ripening period on a* value.

	T			
R	Control	0.25%	0.50%	0.75%
0	12.89±2.45^{a}	9.50±1.44^{ab}	8.30±0.28^{ab,B}	7.36±2.28^{b}
3	13.00±0.95^{a}	12.49±0.06^{a}	12.71±1.94$^{a, A}$	9.21±0.80^{b}
5	13.37±1.43^{a}	11.93±1.53^{ab}	10.02±1.45^{ab,AB}	8.33±0.28^{b}
7	14.18±0.10^{a}	11.62±1.74^{ab}	10.23±0.40$^{b, AB}$	8.48±1.69^{b}
9	13.41±1.41^{a}	13.15±2.58^{ab}	10.10±1.48a$^{b, AB}$	8.01±1.61^{c}
13	13.77±0.57 ^{a}	9.92±2.73 ^{ab}	9.33±2.66 $^{ab, AB}$	6.50±2.41^{b}
Significance				
R		NS		
T		**		
R*T		NS		

*a-c: Any two means in the same row having the same letters in the same section are not significantly different (p<0.05).
*A-B: Any two means in the same column having the same letters in the same section are not significantly different (p<0.05), (*p<0.05.**p<0.01).
NS: Not significant.
SD: Standard deviation.
T: Treatment.
R: Ripening period (day).

Table 4. Effect of tarragon and ripening period on TBARS values(mg/kg).

	T			
R	Control	0.25%	0.50%	0.75%
0	0.38±0$^{C, a}$	0.39±0.19 $^{AB, a}$	0.38±0.^{2B,a}	0.38±0.21 $^{A, a}$
3	0.49±0.01^{B,a}	0.28±0.03 ^{AB,b}	0.33±0.08 $^{B, bb}$	0.36±0.08 $^{A, bb}$
5	0.55±0.04^{B,a}	0.4±0.06 ^{AB,bc}	0.29±0$^{B, c}$	0.43±0.06$^{A, ab}$
7	0.67±0.04$^{A, a}$	0.43±0.03$^{AB, b}$	0.44±0.02$^{B, b}$	0.40±0.01^{A,b}
9	0.50±0.02$^{B, ab}$	0.60±0.08 ^{A,a}	0.37±0 $^{B, b}$	0.45±0.12$^{A, ab}$
13	0.72±0.12$^{A, a}$	0.60±0.06^{A,b}	0.68±0.01 $^{A, ab}$	0.63±0.04 $^{A, ab}$
M	0.55±0.12^{a}	0.45±0.14^{b}	0.41±0.15^{b}	0.44±0.12^{b}
Significance				
R		**		
T		**		
R*T		NS		

*a-c: Any two means in the same row having the same letters in the same section are not significantly different(p<0.05).

*A-C: Any two means in the same column having the same letters in the same section are not significantly different (p<0.05), (**p<0.01).

NS: Not significant; SD: Standard deviation.

T: Treatment.

R: Ripening period (day).

M: Mean.

Table 5. Volatile compounds of sucuk samples.

	KI	Volatile Compounds	Control	0.25%	0.50%	0.75%	Significance Level
Acids	717	Acetic acid	18.10	12.22±0.58	15.60±1.90	20.96±1.10	NS
	886	Propanoic acid	2.35±0.06b	3.70±0.82a	2.42±0.16b	1.25±0.01b	*
Alcohols	539	Ethanol	5.77	6.48±1.00	3.37±1.14	3.85±0.62	NS
Aldehydes	<500	Propanal	0.66	0.29	0.14	0.64	NS
	849	Hexanal	0.33±0.16	0.59±0.06	0.71±0.37	0.46±0.19	NS
	1334	Propanal, 2-methyl-3-phenyl-	2.82±0.27	2.50±0.21	3.31±0.81	4.68±0.69	NS
Aliphatic hydrocarbons	500	Hexane	5.16±0.90	3.09±3.37	3.85±4.72	2.71±0.32	NS
Aromatic hydrocarbons	1133	Benzene, 1-methyl-4-(1-methylethenly)	1.39±0.09	1.68	1.45±0.34	1.61±0.56	NS
	1230	Benzene, 1-methoxy-4-(1-propenyl)-	2.96±0.56c	3.89±0.78bc	5.04±1.00ab	7.07±0.94a	*
	1450	Phenol, 2-methoxy-4-(2-propenyl)-	1.35±0.01b	1.46±0.11b	1.70±0.25ab	2.38±0.40a	*
	1482	Benzene, 1,2-dimethoxy-4-(2-propenyl)-	8.27±0.62	8.32±0.82	9.28±0.25	79.23±1.80	NS
Ester	648	Ethyl acetate	0.51±0.06	0.44	0.55	0.59	NS
Ether	1460	Anisole, p-allyl-	4.25±1.01d	32.25±2.62c	38.90±7.07b	125.00±14.14a	**
Ketones	657	2,3-Butanedione	4.43±0.18a	3.97±0.14a	3.08±0.36b	3.21±0.16b	*
	779	2-Butanone, 3-hydroxy-	5.05±3.86	4.43±2.09	2.23±0.49	6.13±1.27	NS
	1025	2,3-Octanedione	0.26±0.01	0.47±0.34	0.27±0.07	0.31±0.05	NS
Sulphured compounds	1038	Diallyl disulphide	2.58±0.52	3.99±1.56	2.35±0.22	2.46±0.45	NS
	<500						
	730	Sulfide, allyl methyl	1.92	2.69±0.40	2.17	2.62	NS
	574	Thiirane, methyl-	21.54±0.09	32.48±4.62	25.09±4.26	21.94±0.7	NS

Table 5. Continued.

	KI	Volatile Compounds	Control	0.25%	0.50%	0.75%	Significance Level
Terpenes	944	alpha.-Thujene	1.25	0.64	0.55±0.03	0.91	NS
	950	alpha.-Pinene	3.58±0.34	3.30±0.04	3.50±0.07	3.77±0.30	NS
	970	Camphene	1.45	0.44	0.62	0.45	NS
	1006	Sabinene	0.86±0.05	0.56	0.85	1.03±0.06	NS
	1005	beta.-Myrcene	29.87±0.34a	27.46±3.60ab	22.33±2.46b	11.48±0.78c	**
	1019	alpha.-Phellandrene	5.31±0.01	5.38±0.83	4.70±0.43	5.28±0.49	NS
	1026	3-Carene	14.01±0.12	13.28±1.03	11.83±1.41	12.84±0.97	NS
	1030	alpha terpinene	1.25±0.09	1.34±0.37	1.41±0.57	1.27±0.32	NS
	1054	D-Limonene	21.28±0.27	22.62±2.74	21.78±2.33	24.49±1.74	NS
	1065	beta.-Phellandrene	1.64±0.01	1.72±0.38	1.55±0.39	1.65±0.28	NS
	1059	O-cimene	43.56±0.03	47.69±6.14	44.50±4.02	44.75±1.73	NS
	1100	γ-Terpinen	28.99±0.86	26.77±2.34	23.69±3.08	26.8±3.32	NS
	1240	Terpinolene	1.69±0.27	1.40±0.36	1.26±0.39	1.54±0.43	NS
	1161	linalool	13.63±0.78	14.45±1.54	15.20±2.19	16.68±6.17	NS
	1167	allo-Ocimene	0.46±0.13	1.28±0.52	1.54±0.25	10.49±11.47	NS
	1367	Gama elemene	2.66±0.54	2.63±0.23	2.19±0.28	2.89±0.79	NS
	1433	Copaene	3.59±0.12	3.68±0.40	3.61±0.23	3.79±0.28	NS
	1473	*trans*-caryophyllene	1.15±0.16	1.48±0.07	1.39±0.16	1.49±0.13	NS
	1490	Caryophyllene	13.10±1.25	14.73±2.32	13.76±0.35	15.20±1.20	NS
	1504	alpha.-Caryophyllene	1.43±0.26	1.21±0.28	1.06±0.09	1.26±0.27	NS
	1233	Camphor	1.36±0.33	1.59±0.73	-	1.85	NS
		Total Volatile Compounds	294.32±43.93	381.1±18.80	388.26±61.80	445.81±20.25	NS

a-c: Any two means in the same row having the same letters in the same section are not significantly different (*p<0.05. **p<0.01), Results are expressed in Arbitrary area units (AU) × 10^{-6}). NS: not significant. SD: Standard deviation. KI: Kovats index calculated for DB-624 capillary column (J & W scientific: 30 m, 0.25 mm id, 1.4 lm film thickness) installed on a gas chromatograph equipped with a mass selective detector.

There are studies reporting that aldehyde content is an important compound in the detection of lipid oxidation in fermented meat products [35]-[39]. On the contrary, when the volatile profile of sucuk samples was evaluated, it was determined that it had no determining effect on aldehyde content. However, the propanoic acid (acid) and 2,3-butanedione (ketone) content of the control group samples were found to be higher than the samples containing 0.50% and 0.75% tarragon. It can be said that this situation is caused by lipid oxidation [31].

4 Conclusion

In the study, it was determined that the addition of tarragon had a significant effect on the TBARS, a_w and pH value of the fermented sucuk. Furthermore, the fact that the presence of tarragon has no effect on Hunter L* and b* values of the sucuk. As expected, tarragon, which is a herb with antioxidant properties, showed antioxidant activity in fermentation conditions. While tarragon had effect on the volatile profile of the product only by increasing the aromatic compounds due to the volatile compounds it contains, no significant effect on the total amount of volatile compounds was found. In conclusion, it can be said that this herb, which is included in people's consumption habits and is known to be rich in bioactive compounds, can be used for delaying lipid oxidation of the fermented sucuk at the concentrations studied. Further studies are needed to explain the mechanism of antioxidative action of tarragon in sucuk.

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6 Author contribution statements

In the scope of this study, the Aybike KAMILOĞLU, in the formation of the idea, the design, the literature review, Tuğba ELBIR, in the assessment of obtained results, the literature review and examining the results; the Kübra ÇINAR TOPÇU, the assessment of obtained results, examining results and the spelling and checking the article, contributed. All authors contributed to conducting experiments and obtaining data, writing original draft.

7 Ethics committee approval and conflict of interest statement

There is no need to obtain permission from the ethics committee for the article prepared. There is no conflict of interest with any person/institution in the article prepared.

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