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Effect of adding different concentrations of tarragon on chemical, cooking, and microbial properties of refrigerated beef patties

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Abstract

Objective

Tarragon (*Artemisia dracunculus* L.) is a perennial aromatic herb widely used both fresh (leaves) and dried as a culinary and medicinal herb. Its essential oil contains bioactive compounds with estragole identified as the major component in the oil profile. It also contains flavonoids, phenolic compound and carotenoids. Tarragon exhibits considerable medicinal potential, with essential oils and extracts showing strong antibacterial effects and a wide range of bioactivities. The current study aimed to know the effect of adding different concentrations of tarragon powder on some microbial and chemical properties of minced meat patties stored at 4°C. The study also evaluated the effect of tarragon powder on some physical properties, including cooking loss and cooking yield of beef patties.

Materials and methods

During this study, different percentages of tarragon powder (1, 2, and 3%,) were added to the minced beef patties and stored at a temperature of 4°C. Control treatment was minced beef patties without any addition. Microbiological tests were conducted for ground meat patties after passing

0, 3, 6 and 9 days from cold storage at 4° C. Statistical analysis was performed using GenStat version 12.

Results

The results of the study indicated that tarragon powder significantly reduces microbial growth and lipid oxidation in refrigerated beef patties during storage. After 9 days of storage, total bacterial counts decreased from 296 × 10^6 CFU/g in the control to 75 × 10^6 CFU/g in patties containing 3% tarragon powder. Similarly, TBA values decreased from 2.77 mg malondialdehyde/kg in the control treatment to 1.55 mg malondialdehyde/kg in the 3% tarragon treatment. Moreover, the results of the study indicated a significant increase in TBA values during storage, indicating increased lipid oxidation. In addition, increasing tarragon concentration significantly reduced cooking loss from 38.0% in the control to 17.93% in the 3% tarragon treatment, while cooking yield increased from 61.88% to 82.07%.

Conclusion

The findings suggest that tarragon powder can be used as a natural antioxidant and antimicrobial agent to improve the quality and extend the shelf life of beef patties during refrigerated storage.

Keywords: tarragon herb, minced meat patties, microbial load, TBA, pH

Paper type: Research paper.

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Introduction

Plants are considered one of the important natural resources in increasing people's health and quality of life. Herbal medicine contained natural ingredients which can promote healthy lifestyles and relieve diseases (Alhasoon et al., 2026; Mohammadabadi et al., 2025). In recent years, consumer concerns about artificial preservatives have increased, so they have become increasingly interested in using natural plant-derived additives in meat products

(Mohammadabadi et al., 2022; Vahabzadeh et al., 2020). Natural plants are rich in phenolic compounds and essential oils. This makes them have strong antioxidant and antimicrobial activities (Roudbar et al., 2015; Vahabzadeh et al., 2021). Therefore, they have become promising alternatives to improve meat quality and extend shelf life (Tuasha et al., 2023). Artemisia dracunculus L. (*Tarragon or Estragon*), belongs to the genus *Artemisia* (Zhmurko & Vashchenko, 2025). It is a species perennial herb (Harris et al., 2025). Tarragon (*Artemisia dracunculus* L.) is a perennial aromatic herb widely used both fresh (leaves) and dried as a culinary and medicinal herb. Its essential oil contains bioactive compounds with estragole identified as the major component in the oil profile (Attar, 2025). It also contains flavonoids, phenolic compound and carotenoids (Khadim et al., 2024). Tarragon exhibits considerable medicinal potential, with essential oils and extracts showing strong antibacterial effects and a wide range of bioactivities that contribute to its traditional therapeutic uses (Qadir et al., 2025). It also considers as antioxidants (Khadim et al., 2024). In recent years, researchers looking for replaced sources of antibacterial and chemical preservatives against bacteria and lipid oxidation in foods (Sweet et al., 2024). Meat and its products are widely consumed all over the world (Eghtedari et al., 2025). The problems are with the short storage period. This is because of lipid oxidation and degradation of organoleptic agents change the flavor, color and texture of meat and meat products. Zhang et al. (2024) mentioned that food spoilage and pathogenic bacteria could contaminate meat products and result to health hazard and economic losses. On the other hand, using artificial antioxidants with high activity such as TBHQ (tertiary butyl hydroquinone), can affect human health (Esazadeh et al., 2024). Although several studies have investigated the antimicrobial and antioxidant properties of medicinal herbs in meat products, limited information is available regarding the effects of tarragon powder on the physicochemical, microbial, and cooking properties of refrigerated beef patties. In particular, few studies have evaluated the influence of different concentrations of tarragon powder on lipid oxidation, microbial stability, cooking loss, and cooking yield during refrigerated storage. Due to the antioxidants and antibacterial properties of tarragon, the current study aimed to evaluate the effects of different concentrations of tarragon powder on the microbial, physicochemical, and cooking properties of beef patties stored under refrigerated conditions.

Materials and methods

Beef was bought from a market in the holy city of Najaf. As for Tarragon, it was purchased from the city of Mashhad - Iran. All the media used in the research was prepared by Hodeida - India. The oil used in the cooking was sunflower oil.

Preparation of tarragon powder: The purchased herb was taken dry and the grinding process was done with an electric grinder and made into a fine powder. After grinding the fine powder was stored at -18 °C until use.

Preparation of ground beef patties: Beef (thigh area) was obtained from a market in the city of Najaf. Beef was chopped using sterile chopping machine. The ground beef quantity was divided into four treatments represented as following: T1 represent as control (no tarragon added), T2 (1% tarragon powder), T3 (2% tarragon powder) and T4 (3% tarragon powder). Then the ground beef patties with different treatments were formulated at 100g per treatment. The samples were placed in polyethylene bags and kept in the refrigerator at a temperature of 4 ° C and for periods of 0, 3, 6 and 9 days. All beef samples were obtained from the same cut (thigh region) and prepared under identical conditions to minimize variations in fat content among treatments.

Microbiological tests: Microbiological tests were conducted for ground meat patties after passing 0, 3, 6 and 9 days from cold storage at 4°C.

Samples preparation: Weigh 10 g of ground meat and mix well with 90 mL of peptone water. Buffered peptone water was prepared according to standard microbiological procedures. Serial decimal dilutions were prepared using sterile peptone water before plating. Spread plate method was used for counting microorganisms (ASM, 2005).

Total count bacteria: Total bacterial count was counted according to the methods described by Downes & Ito (2001). Plates were incubated at 34°C for 24-48 h before colony counting.

Coliform bacteria: Coliform bacteria count was counted according to the methods mentioned by Downes & Ito (2001). Coliform bacteria were enumerated using Violet Red Bile Agar (VRBA) and incubated at 34°C for 24 h. Typical colonies were counted and confirmed according to Downes & Ito (2001).

pH Determination: The pH was determined according to the method published by ASTM (2016) using pH meter by taking 5g from ground beef patties and adding 10 mL of distilling water, mixed well using a blander for 2 minutes, and then filtration through cotton and pH measured for the filtrate.

Weight loss during cooking: The percentage of weight loss during cooking was calculated by cooking. Beef patties were cooked on a preheated hot plate at approximately 180°C for 8 min with regular turning until the internal temperature reached 72°C (Vu et al., 2022). Cooking loss (%) was calculated according to the following equation:

$$\text{Cooking loss (\%)} = [(\text{Weight before cooking (g)} - \text{Weight after cooking (g)}) \div \text{Weight before cooking (g)}] \times 100$$

Cooking yield (%) was calculated using the following equation:

$$\text{Cooking yield (\%)} = [\text{Weight after cooking (g)} \div \text{Weight before cooking (g)}] \times 100$$

Lipid oxidation analysis: Lipid oxidation was determined using the TBARS method according to Colle et al. (2016). Briefly, samples were homogenized with trichloroacetic acid (TCA) solution and reacted with thiobarbituric acid (TBA) reagent. The absorbance was measured at 532 nm using a spectrophotometer. Results were expressed as mg malondialdehyde (MDA)/kg sample using a standard curve prepared with malondialdehyde standards (Colle et al., 2016). Approximately 0.5 g of each patty selected for oxidation analysis was cut on day 0, 3, 6 and 9 evaluated using the thiobarbituric acid reactive substances (TBARS). Three independent replicates were prepared for each treatment, and all analyses were performed in triplicate. Samples were homogenized for 2 min using a laboratory homogenizer at room temperature (25 ± 2°C). Serial decimal dilutions were prepared using sterile peptone water before plating.

Statistical analysis: The pH and thiobarbituric acid (TBA) values, as well as the results of microbial assays, were analyzed as a factorial experiment using a completely randomized design (CRD). The cooking yield and weight loss percentage data were analyzed as a simple experiment using the same design. Comparisons between means were performed using the least significant difference (LSD) test and Duncan's multiple range test at a significance level of $p \leq 0.05$. Statistical analysis was performed using GenStat version 12 (Payne, 2009).

Results and discussion

Total bacteria count for beef patties: Table 1 shows the average total bacterial counts for beef patty samples. No significant differences were observed among treatments at day 0. The table shows no significant differences in bacterial counts after processing, which is expected given that the samples were cultured immediately after the mincing, mixing, and addition process, in addition to the good quality of the meat. However, bacterial counts increased significantly after three days of refrigerated storage at 4°C. While, the increase decreased significantly with increasing percentage of tarragon powder added. On the sixth and ninth day of refrigerated storage at 4°C, the number of bacteria also increased significantly for all treatments. But this increase was significantly reduced with increasing percentage of tarragon powder added. Jaworska et al. (2021) indicated that the addition of herbs such as thyme and oregano at a concentration of 0.5% improved the microbial stability of minced meat by inhibiting the growth of Psychrotrophic bacteria. The herbs also contributed to maintaining product quality for up to 10 days. In another study, Macari et al. (2021) indicated that adding tarragon extract at a concentration of 0.1-0.2% to sausage effectively contributed to reducing the total number of bacteria during refrigerated storage.

Table 1. Effect of different concentrations of tarragon powder on total bacterial counts (×10⁶ CFU/g) of beef patties during refrigerated storage at 4°C

Treatment	Day 0	Day 3	Day 6	Day 9	Treatment Mean
Control	4.00 ± 0.30a	85.00 ± 6.30a	118.00 ± 8.85a	296.00 ± 22.20a	125.88
1% Tarragon	1.50 ± 0.01a	32.00 ± 0.21b	68.50 ± 0.46b	140.50 ± 0.94b	60.75
2% Tarragon	3.50 ± 0.21a	15.50 ± 0.93c	46.50 ± 2.79c	117.50 ± 7.05c	45.75
3% Tarragon	1.50 ± 0.02a	7.00 ± 0.09d	18.50 ± 0.25d	75.00 ± 1.01d	25.50
Day Mean	2.62	35.00	63.00	157.25	—

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the same column indicate significant differences among treatments at $p \leq 0.05$ according to Duncan's multiple range test. LSD for treatment = 4.509; LSD for storage days = 4.509; LSD for treatment × storage period interaction = 9.017.

Total coliform bacteria for beef patties: Table 2 shows the average bacterial counts of coliform bacteria in beef patty samples. The table indicates the absence of coliform growth after processing, which is expected given that the samples were cultured immediately after mincing, mixing, and adding, in addition to the good quality of the meat. However, the coliform count increased significantly after three days of refrigerated storage at 4°C. However, this increase decreased significantly as the percentage of tarragon powder added increased. On the sixth day of refrigerated storage at 4°C, a significant increase in the total number of coliform bacteria was observed for all treatments. But this increase was significantly reduced with increasing percentage of tarragon powder addition. On the ninth day of refrigerated storage at 4°C, the increase in the total number of coliform bacteria continued significantly for all treatments. This increase was significantly reduced with increasing percentage of tarragon powder addition. Demirhan (2020) indicated that adding turmeric to meatballs significantly reduced coliform bacteria at a concentration of 4% compared to the control treatment.

Table 2. Effect of different concentrations of tarragon powder on total coliform bacteria count (×10⁶ CFU/g) in beef patties during refrigerated storage at 4°C

Treatment	Day 0	Day 3	Day 6	Day 9	Treatment Mean
Control	ND	32.50 ± 2.44a	45.00 ± 3.375a	90.00 ± 6.75a	41.88
1% Tarragon	ND	10.50 ± 0.01b	16.50 ± 0.02b	60.00 ± 0.06b	21.75
2% Tarragon	ND	6.50 ± 0.01c	12.50 ± 0.01c	47.00 ± 0.05c	16.50
3% Tarragon	ND	2.00 ± 0.01d	9.00 ± 0.02d	30.50 ± 0.02d	10.38
Day Mean	0	12.88	20.75	56.88	—

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the same column indicate significant differences among treatments at $p \leq 0.05$ according to Duncan's multiple range test. ND: Not detected.

Chemical test for beef patties

pH value in beef patties: The results in the table 3 shows the effect of adding different concentrations of tarragon herb on the pH of beef patties during refrigerated storage at 4°C. The results showed that the pH of the beef patties was closed to each other after processing, ranging from 6.64 to 6.67. However, the pH of both the treated and untreated patties increased significantly after refrigerated storage at 4°C with increasing storage time. The reason for the increase in pH with longer storage times in meats preserved at low temperatures is that refrigeration encourages the growth of bacteria that break down protein and form amino acids. This process then leads to the production of amino bases and amino groups (NH3), which raise the pH of the preserved materials. The table also shows that this increase in pH decreased significantly with increasing proportion of tarragon added compared to the control sample. The decrease in pH values may be attributed to the inhibitory effect of tarragon added to beef patties against food-degrading and spoilage microorganisms, due to its content of active compounds that prevent microorganisms from carrying out their food-degrading and spoilage activity (Akarca & Ceran, 2023). Although tarragon-treated samples exhibited slightly lower pH values compared to the control, the differences were not statistically significant. This suggests that while tarragon may suppress microbial growth to some extent, its effect on pH changes is limited under refrigerated conditions.

Table 3. Effect of different concentrations of tarragon powder on pH values of beef patties during refrigerated storage at 4°C

Treatment	Day 0	Day 3	Day 6	Day 9	Mean
Control	5.67 ± 0.01a	5.77 ± 0.02a	6.01 ± 0.02a	6.40 ± 0.01a	—
1% Tarragon	5.66 ± 0.01a	5.74 ± 0.01a	5.97 ± 0.02a	6.25 ± 0.02a	—
2% Tarragon	5.66 ± 0.01a	5.71 ± 0.01a	5.90 ± 0.02a	6.19 ± 0.02a	—
3% Tarragon	5.64 ± 0.01a	5.69 ± 0.01a	5.86 ± 0.01a	6.14 ± 0.01a	—

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the same column indicate significant differences among treatments at $p \leq 0.05$ according to Duncan's multiple range test. Treatment and storage time interaction was not significant (NS).

TBA in beef patties: Table 4 shows the effect of adding different concentrations of tarragon herb to minced beef patties on thiobarbituric acid values during refrigerated storage. The results in the table showed that the TBA values immediately after manufacturing reached 0.29 mg malondialdehyde/kg for all treatments. While, after three days of refrigerated storage at 4°C, a significant increase in TBA values was observed for all treatments. However, this increase decreased significantly with increasing proportions of tarragon added to the beef patties. This may be attributed to the herb's natural antioxidants, which reduced oxidative damage to the fats during storage. This significant increase persisted with increasing refrigerated storage durations of 6 and 9 days. The value for the control treatment and treatments T1, T2, and T3 were 2.77, 1.93, 1.79, and 1.55 mg malonaldehyde/kg, respectively. It is noted that the increase in TBA values decreased significantly with increasing proportion of herb added. The study results showed that the control sample had exceeded the permissible limits for TBA values from the ninth day of storage which indicated that the limit is 2 mg malonaldehyde/kg according to acceptable limits reported in previous studies. This type of meat is then considered invalid for consumption, while samples containing varying concentrations of tarragon did not exceed permissible limits. This may be due to tarragon containing active compounds that can contribute to reducing oxidative damage and preserving the meat from spoilage (Ekiert et al., 2021). The reduction in TBA values observed in tarragon-treated samples may be attributed to the presence of phenolic compounds and flavonoids that act as free radical scavengers and inhibit lipid peroxidation. Similar findings were reported by previous studies using herbal antioxidants in meat products, where natural plant extracts effectively delayed oxidative deterioration during refrigerated storage.

Table 4. Effect of different concentrations of tarragon powder on thiobarbituric acid (TBA) values (mg malondialdehyde/kg) of beef patties during refrigerated storage at 4°C

Treatment	Day 0	Day 3	Day 6	Day 9	Mean
Control	0.29 ± 0.00a	0.75 ± 0.00a	1.80 ± 0.00a	2.77 ± 0.00a	—
1% Tarragon	0.29 ± 0.00a	0.63 ± 0.00b	1.22 ± 0.00b	1.93 ± 0.00b	—
2% Tarragon	0.29 ± 0.00a	0.60 ± 0.00c	1.08 ± 0.00c	1.79 ± 0.00c	—
3% Tarragon	0.29 ± 0.00a	0.54 ± 0.00d	0.96 ± 0.00d	1.55 ± 0.00d	—

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the same column indicate significant differences among treatments at $p \leq 0.05$ according to Duncan's multiple range test.

Weight loss during cooking for beef patties: Table 5 shows the results of adding tarragon herb powder to minced beef patties on the percentage of weight loss during cooking of the beef patties. The results showed a significant decrease in the percentage of weight loss during cooking for meat patties treated with tarragon powder compared to the control sample. The percentage of weight loss during cooking for the control sample was 38.0%. While, for meat patties treated with 1% tarragon powder, the percentage of loss decreased significantly to 28.16%. When 2% of tarragon powder was added, the percentage of loss reached 24.27%, and the percentage decreased to 17.93% when 3% of tarragon powder was added. Alam et al. (2025) found that treating minced beef with green tea extract resulted in a significant decrease in the percentage of weight loss during cooking compared to the control sample. Dzudie et al. (2004) demonstrated that adding essential oils of herbs such as rosemary and basil to beef patties had a significant effect on cooking weight loss. In addition, the results showed that samples containing the herbal additives exhibited a change in water-holding capacity (WHC), a key factor determining the amount of weight loss during cooking. A decrease in WHC was observed to lead to increased weight loss. While, some of the herbal additives contributed to reducing weight loss by improving water binding within the protein structure of the meat.

Table 5. Effect of different concentrations of tarragon powder on cooking loss (%) of beef patties

Treatment	Cooking loss (%)
Control	38.00 ± 2.85^{d}
1% Tarragon	28.16 ± 2.01^{c}
2% Tarragon	24.27 ± 1.85^{b}
3% Tarragon	17.93 ± 0.98^{a}

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the column indicate significant differences at p ≤ 0.05 according to Duncan's multiple range test.

Cooking yield for meat patties: Table 6 shows the results of the effect of adding tarragon powder on the percentage of cooking yield in beef patties. The results showed a significant increase in the percentage of cooking yield in the minced meat patties treated with tarragon powder compared to the control sample, as the cooking yield in the control sample reached 61.88%. It is less than in the meat patties treated with tarragon powder, as the percentage of cooking yield increased significantly with the increase in the percentage of tarragon added. The sample to which 1% of tarragon powder was added gave a cooking yield of 71.84%. While, the cooking yield in the sample to which 2% of tarragon powder was added increased significantly to 75.73%. Then the cooking yield increased significantly to 82.07% when 3% of tarragon powder was added. The decrease in cooking yield in the control sample may be due to the loss of moisture and fat during the cooking process.

Table 6. Effect of different concentrations of tarragon powder on cooking yield (%) of beef patties

Treatment	Cooking yield (%)
Control	61.88 ± 4.01^{a}
1% Tarragon	71.84 ± 4.11^{b}
2% Tarragon	75.73 ± 4.23^{c}
3% Tarragon	82.07 ± 5.02^{d}

Values are expressed as mean ± standard deviation (n = 3). Different superscript letters within the column indicate significant differences at p ≤ 0.05 according to Duncan's multiple range test.

This decrease in cooking yield was less pronounced in the meat patties treated with tarragon powder. These results are consistent with those of Asghar et al. (2023). They found a significant increase in cooking yield when poppy seeds were added to beef meat patties. Yu et al. (2024) demonstrated that adding herbs such as rosemary, turmeric, and bay leaves to beef patties significantly reduced cooking loss and increased water retention, resulting in improved cooking yield. These herbs also contributed to better texture and reduced fat oxidation, likely due to their high content of phenolic compounds that enhance the meat's ability to retain water during heat treatment.

Conclusion: According to the results of this study, it can be concluded that the addition of tarragon powder can improve the microbial stability, oxidative stability and cooking properties of beef cutlets during refrigerated storage at 4 °C. The antioxidant activity of tarragon is probably due to the presence of phenolic compounds and its volatile components. These compounds effectively reduce lipid oxidation and inhibit the growth of spoilage microorganisms in a concentration-dependent manner. The results show that higher levels of tarragon (3%) have the greatest effects in reducing microbial load, reducing lipid peroxidation, reducing cooking waste and increasing cooking efficiency. It can be concluded that tarragon powder can be considered as a promising natural ingredient for improving the quality and stability of beef cutlets. It may have potential applications as a natural preservative in meat products. It is better to conduct more research on sensory quality and consumer acceptance to confirm its industrial application so that conclusions can be drawn with greater certainty.

Author contributions

L. F. H. A. contributed to the study methodology and experimental design and performed data collection, S. A. M. A. assisted with data analysis and contributed to writing the initial draft and statistical analysis, and M. H. A. K. drafted the original manuscript and reviewed, A. S. A. discussed, and approved the final version of the manuscript.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Ethical Considerations

Not applicable.

Conflict of Interest

The authors declare that they have no competing interests or financial conflicts of interest related to this study.

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تأثیر افزودن غلظت‌های مختلف ترخون بر ویژگی‌های شیمیایی، پخت و میکروبی برگرهای گوشت گاو نگهداری‌شده در یخچال

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چکیده

هدف: ترخون (*Artemisia dracunculus L.*) یک گیاه معطر چندساله است که هم به‌صورت تازه و هم خشک به‌عنوان ادویه و گیاه دارویی استفاده می‌شود. اسانس آن حاوی ترکیبات زیست‌فعال بوده و استراگول به‌عنوان ترکیب اصلی شناخته می‌شود. همچنین حاوی فلاونوئیدها، ترکیبات فنلی و کاروتنوئیدها است. ترخون دارای پتانسیل دارویی قابل توجهی بوده و اسانس و عصاره آن اثرات ضدباکتریایی قوی و فعالیت‌های زیستی متنوعی نشان می‌دهد. هدف این مطالعه بررسی تأثیر افزودن مقادیر مختلف پودر ترخون بر برخی ویژگی‌های میکروبی و شیمیایی برگرهای گوشت چرخ‌کرده در دمای ۴ درجه سانتی‌گراد بود. همچنین اثر آن بر ویژگی‌های فیزیکی شامل کاهش افت پخت و بازده پخت نیز ارزیابی شد.

مواد و روش‌ها: در این مطالعه، درصدهای مختلف پودر ترخون (۱، ۲ و ۳ درصد) به برگرهای گوشت گاو چرخ‌کرده افزوده شد و در دمای ۴ درجه سانتی‌گراد نگهداری گردید. تیمار شاهد بدون هیچ افزودنی بود. آزمون‌های میکروبی در روزهای ۰، ۳، ۶ و ۹ نگهداری انجام شد. تحلیل آماری با استفاده از نرم‌افزار GenStat نسخه ۱۲ انجام گرفت.

نتایج: یافته‌ها نشان داد که پودر ترخون به‌طور معنی‌داری رشد میکروبی و اکسیداسیون چربی را در برگرهای نگهداری‌شده کاهش می‌دهد. پس از ۹ روز نگهداری، تعداد کل باکتری‌ها از 296×10^6 CFU/g در نمونه شاهد به 75×10^6 CFU/g در تیمار ۳ درصد ترخون کاهش یافت. همچنین مقدار TBA از ۲/۷۷ میلی‌گرم مالون‌دی‌آلدئید/کیلوگرم در شاهد به ۱/۵۵ در تیمار ۳ درصد کاهش یافت. با این حال، مقدار TBA در طول زمان نگهداری افزایش یافت که نشان‌دهنده افزایش اکسیداسیون چربی بود. علاوه بر این، افزایش غلظت ترخون موجب کاهش افت پخت از ۳۸٪ در شاهد به ۱۷/۹۳٪ در تیمار ۳ درصد و افزایش بازده پخت از ۶۱/۸۸٪ به ۸۲/۰۷٪ شد.

نتیجه‌گیری: یافته‌ها نشان می‌دهد که پودر ترخون می‌تواند به‌عنوان یک عامل طبیعی آنتی‌اکسیدان و ضدباکتریایی برای بهبود کیفیت و افزایش ماندگاری برگرهای گوشت گاو در شرایط نگهداری سرد مورد استفاده قرار گیرد.

کلمات کلیدی: بار میکروبی، برگر گوشت چرخ‌کرده، ترخون، pH، TBA

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