JFBE 1(1): 26-29,2025

Journal of Nutraceutical Foods and Bioactive Extracts

https://sanad.iau.ir/journal/nutfood

Original research

The Effect of Shirazi Thyme Extract on Extending the Shelf Life of Chicken Meat Stored at Refrigerator Temperature

Maryam Moghaddas[1], Kosar Shirzadi Mokhles[2], Mohaddese Shirzadi Mokhles[3]

[1]*Department of Chemistry, Safadasht Branch, Islamic Azad University, Tehran, Iran*
[2]*Department of Chemistry, Pharmaceutical Sciences Branch, Islamic Azad University, Tehran, Iran*
[3]*Department of Chemistry, Pharmaceutical Sciences Branch, Islamic Azad University, Tehran, Iran*

ABSTRACT

Fresh chicken meat is highly perishable due to microbial growth and physicochemical changes, even when stored under refrigerated conditions. *Zataria multiflora*, with its high content of bioactive compounds such as polyphenolic compounds, can be used as a natural preservative in meat products. Therefore, this study aimed to investigate the antibacterial activity of Shirazi thyme extract to improve the shelf life of chicken meat stored at refrigerator temperature. For this purpose, Shirazi thyme extract was prepared at four concentration levels (0%, 1%, 2%, and 3%) and added to chicken samples. A sample without extract was considered as the control. All samples were stored at 4 °C for nine days. Total bacterial count, pH, peroxide value, and sensory evaluation were tested on the first, third, sixth, and ninth days. The results showed that Shirazi thyme extract significantly reduced the total microbial load compared to the control sample (p<0.05). The peroxide value and pH level were also significantly reduced in the treated samples compared to the control. The three percent extract concentration was identified as the optimal treatment. According to the results, Shirazi thyme extract has a high potential to increase the shelf life of chicken meat stored at refrigerator temperature.

Keywords: Antimicrobial compounds, shelf life, Shirazi thyme, chicken fillet.

Received 30 May 2024; Accepted 30 Oct 2024

1. Introduction

Chicken meat is popular among consumers worldwide due to its desirable nutritional qualities, such as high protein content, low fat, relatively high concentration of polyunsaturated fatty acids, affordability, easy and quick cooking, easy digestion, higher production capacity, and softer texture compared to red meat (Tong et al., 2022). Chicken breast meat is widely consumed globally. Global chicken meat production is growing, projected to reach 139.19 million tons annually by 2025 (Uzundumlu et al., 2023). Fresh meat products are typically marketed under refrigerated conditions (2 to 5 degrees Celsius). Lipid oxidation and microbial growth may occur during refrigeration storage. The spoilage of fresh poultry meat poses a financial burden on producers, necessitating the development of new methods to increase shelf life and overall meat safety/quality, which is a major challenge for the poultry processing industry (Uzundumlu et al., 2023). Oxidative spoilage leads to unpleasant odors, undesirable changes in flavor, alterations in the structure of nutrients, and reduced nutritional value of the product. Additionally, poultry meat and products are often contaminated with microorganisms during slaughtering and production processes. These microorganisms cause undesirable qualitative changes in the meat, particularly concerning lactic acid bacteria, a major group associated with meat spoilage. There is increasing interest and attention towards using fewer synthetic preservatives, leading to research on finding and using natural derivatives with antimicrobial properties (Jebelli Javan et al., 2012). One example of natural additives to food products is the essential oil or extract of Shirazi thyme, which has been shown in several studies to have anti-Listeria

and anti-Vibrio parahaemolyticus effects in salted fish (Ekhtiarzadeh et al., 2011), anti-Escherichia coli O157:H7 effects in minced beef (Noori et al., 2012), and anti-Bacillus cereus effects in commercial soup (Mashak et al., 2012).

The Shirazi thyme plant, with bushes reaching heights of 40 to 80 centimeters, is greenish-white and aromatic, with multiple, firm, and resilient stems and grayish-white or slightly brownish bark. Shirazi thyme leaves are small with short petioles. The Shirazi thyme plant has relatively widespread distribution in Iran. The most important active ingredient in the thyme extract is thymol. Additionally, other phenolic compounds such as carvacrol and eugenol have been isolated from Shirazi thyme leaves (Lahooji et al., 2010).

Studies on minced beef have shown that Shirazi thyme essential oil significantly reduces the population of Escherichia coli O157:H7 in treated minced beef stored at 4 degrees Celsius compared to samples stored at 10 degrees Celsius (suboptimal refrigeration) (Noori et al., 2012). Furthermore, as far as we know, the antioxidant and antimicrobial effects of thyme extract, alone or in combination, on fresh chicken breast meat have not been examined. Therefore, the present study aimed to determine the effects of Shirazi thyme on pH, microbiological analysis, peroxide value, and sensory analysis during storage at 4 degrees Celsius.

2. Material and Methods

2-1.Extraction Preparation

Thyme plants were collected from the medicinal plant farm at the Agricultural Jihad Applied Science Center in Karaj in May 2023. The leaves were dried in a dark place at room temperature. After grinding, the aqueous extract was prepared by boiling the plant powder in a distillation device with water in the laboratory at a ratio of 1 to 10 for one hour. The resulting extract was then dried under vacuum using a rotary evaporator and concentrated to the desired percentage. The extract was stored in a sterile glass container covered with aluminum foil at 4°C until the time of the experiment (Asgari et al., 2012).

2.2. Chicken Sample Preparation

Chicken breast samples were obtained from the Golchin Poultry slaughterhouse in Karaj and transported to the food industry laboratory at the Karaj Research Center in insulated containers with sufficient ice. The chickens were immediately filleted into pieces of 4 × 10 × 1 cm under sterile conditions. The fillets were thoroughly washed with sterile cold water to remove blood and other residues. The chicken samples were then completely immersed in 0%, 1%, 2% and 3% aqueous extracts of thyme and distilled water for 2 hours. Each sample was placed in sterile stomacher plastic bags and stored at 4°C for 9 days. The chicken samples were randomly selected for microbial and chemical evaluation on days 1, 3, 6, and 9 (Behnanm and Akbarlu, 2013).

2.3. Peroxide Value

Initially, 9.8 ml of chloroform-methanol solution (chloroform to methanol ratio of 7 to 3) was added to 0.01 grams of the sample. It was mixed with a vortex for a few seconds. Then, 50 microliters of ammonium thiocyanate solution were added to the mixture and vortexed again for a few minutes. Next, 50 microliters of ferrous chloride solution were added and mixed with a vortex. After standing at room temperature for five minutes, its absorbance was recorded using a spectrophotometer (LKB, Sweden) at a wavelength of 500 nanometers. The peroxide value was calculated using the following formula (84.55: molecular weight of iron) (IDF, 1991):

(2 × sample weight × 84/55) / (52/41 × (absorption of iron solution in nanometers - sample absorption in nanometers)) = peroxide value

2.4. pH *Measurement*

To determine the pH, 10 grams of chicken fillet was homogenized with 100 ml of distilled water using a blender. The homogenized liquid was filtered and poured into a beaker. After calibrating the digital pH meter, the pH of the homogenized solution was measured (Wenjiao et al., 2009).

2.5. Total Microbial Count

One gram of chicken fillet was placed in 90 ml of 0.85% sterile physiological serum and homogenized for 60 seconds in a stomacher. Required dilutions were prepared, and one milliliter of each dilution was plated using the pour plate method on Plate Count Agar (Merck). The inoculated plates were incubated at 37°C for 48 hours and then counted (Sallam, 2007).

Sensory Evaluation

The sensory quality of the cooked chicken samples (oven-cooked at 180°C for 45 minutes) was evaluated by a trained panel consisting of 10 laboratory staff members (Alais & Linden, 1991). The panelists rated the color, odor, texture, taste, and overall acceptance on a scale from 1 to 4 (1 = very bad, 4 = very good). The scores for each attribute were compiled, and the overall opinion for each characteristic was calculated.

3. Results and Discussion

3.1. pH

The results of comparing the means showed that the pH level in the treatments significantly increased over time ($P<0.05$). The highest pH was observed in the control group on the ninth day, and the lowest pH was observed in the 3% thyme extract treatment on the first day. Significant differences in pH levels were observed between all treatments and the control sample during the storage period. Manat et al. (2005) attributed the increase in pH over the experimental period to the effect of internal and microbial enzymes on proteins and the release of amine compounds resulting from their decomposition. As seen, the 3% samples had a lower pH compared to the control, which could be due to the antimicrobial effect of the thyme extract on proteolytic spoilage bacteria.

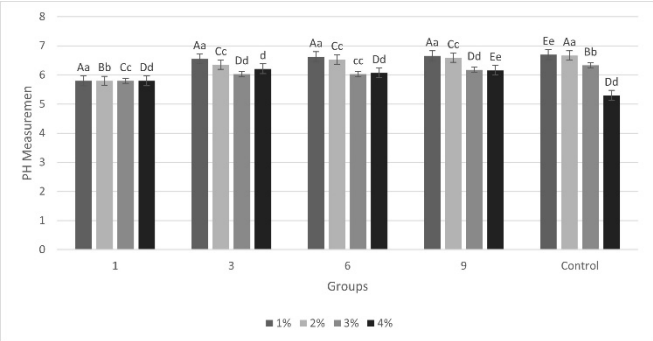

Figure 1 - Changes in pH levels in chicken samples during the storage period. (Different letters indicate statistically significant differences($p<0.05$)).

3.2.*Peroxide Value*

The peroxide value in the treatments significantly increased over time (P<0.05). The highest peroxide value was observed in the control group on the ninth day, while the lowest value was found in the 3% thyme extract treatment on the ninth day. Jebelli Javan et al. (2012) stated that the permissible limit for the peroxide value in chicken meat is 10 milliequivalents. In the present study, the peroxide value in the 1% treatment remained normal until the third day, in the control only on the first day, and in the 2% and 3% extracts until the sixth day of the experiment.

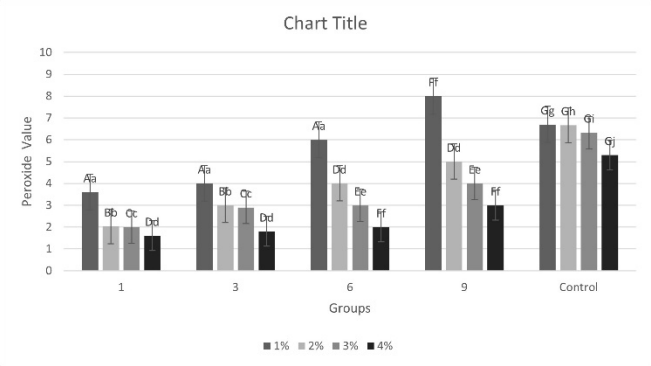

Figure 2 - Changes in peroxide value in chicken samples during the storage period. (Different letters indicate statistically significant differences (p<0.05)).

3.3. *Total Microorganism Count*

The total microorganism count in the treatments significantly increased over time (P<0.05). The highest total microorganism count was observed in the control group on the ninth day, and the lowest count was in the 3% treatment on the first day. The microbial load results showed that the thyme extract has a high ability to control the growth of microorganisms. Although no study was found on the effect of thyme extract on chicken fillet, similar studies have been conducted on the effect of thyme essential oil on the shelf life of fish fillets. The results of this study are consistent with the findings of Mahmoud et al. (2006) on the effect of thyme essential oil in reducing the microbial load of carp fillet and Caulier et al. (2004) on refrigerated barracuda. The main antimicrobial compounds of these plants are phenolic compounds, which have phenolic groups and a molecular weight of 150 to 160 (Shelef, 1983). These compounds in thyme mainly include the terpenes carvacrol, thymol, and p-cymene (Holley and Patel, 2005). These compounds exert their antimicrobial activity by disrupting the phospholipid bilayer of cell membranes, increasing cell permeability, and causing the loss of cellular components. They also destroy the cell's enzymatic system, which plays a role in energy production and synthesis of structural components, and they damage the cell's genetic material (Kim et al., 1995).

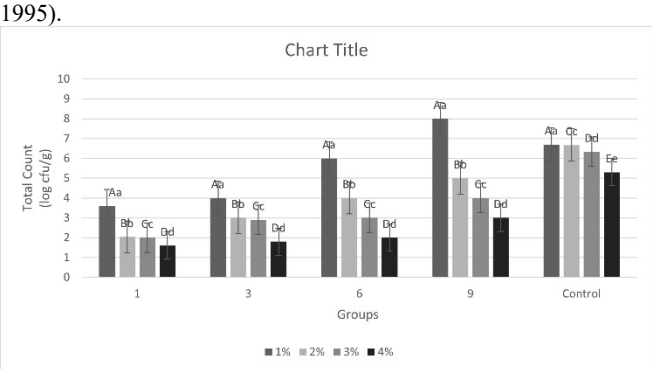

Figure 3 - Changes in total microbial load in chicken samples during the storage period. (Different letters indicate statistically significant differences (p<0.05)).

3.4. *Sensory Evaluation*

The results of the sensory evaluation are shown in Figure 4. The results indicate that with the increase in storage duration, a significant decrease in sensory scores was observed. The 3% treatment received the highest sensory scores compared to the control and the 1% and 2% treatments during the experiment. According to Hansen et al. (2009), chicken samples that scored up to 2.5 out of 4 were considered suitable for human consumption. In this study, the 1% and 2% treatments were acceptable until the third day, and the 3% treatment was acceptable until the ninth day. Consistent with the present study, Formanek et al. (2003) demonstrated that the use of plant extracts not only prevents lipid oxidation and microbial spoilage but also prevents color changes in meat during the storage period, improving meat quality in terms of sensory factors. This can be attributed to the structural compounds of the plants, their antioxidant and antimicrobial properties, and their prevention of oxidative spoilage, which was confirmed by the microbial tests conducted in this research

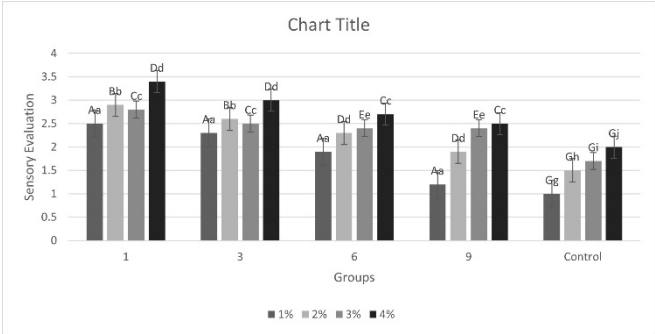

Figure 4 - Sensory evaluation results of chicken samples during the storage period. (Different letters indicate statistically significant differences (p<0.05)).

4. Conclusion

The results of this study indicated that adding Shirazi thyme extract to chicken significantly reduced oxidation and microbial spoilage in chicken fillets compared to the control. Additionally, the results showed that adding this extract could effectively improve the quality and shelf life of refrigerated chicken meat. Based on the findings, the 3% concentration could extend the shelf life of chicken by at least 2 days compared to the control. Considering that the results obtained with a concentration of 3% have a favorable effect, higher concentrations were not investigated. It is concluded that this concentration can be used to increase the shelf life of chicken meat.

References

Alais, C. and Linden, G. 1991. Food Biochemistry. English Edition. Ellis Horwood. Chapter 17. Pp. 212.

Asgari, S. Ansari Samani, R. Deris, F. Shahinfard Salimi, M. Mortazaei, S. Asgharzadeh, S. Hedayatollah, S. and Rafieian-Kopaei, M. 2012. Antioxidant Activity and the Lowering Effect of Hydroalcoholic Extract of Allium hirtifolium Boisson on Some Haemostatic Factors in Hypercholesterolemic Rabbits. Journal of Mazandaran University of Medical Sciences. 22(91): 40-48.

Behnam, B. and Aliakbarlou, J. 2013. Antioxidant effects of Zataria multiflora and Mentha longifolia essential oils on chicken meat stored at 4°C. Journal of Food Research. 23(4): 533-543.

Chouliara, I. Savvaidis, I.N. Panagiotakis, N. and Kontominas, M.G. 2004. Preservation of salted, vacuum-packaged, refrigerated sea bream (Sparus aurata) fillets by irradiation: microbiological, chemical, and sensory attributes. Journal of Food Microbiology. 21: 351–359.

Formanek, Z. Lynch, A. Galvin, K. Farkas, J. and Kerry, J.P. 2003. Combined effects of irradiation and the use of natural antioxidants on the shelf life stability of overwrapped minced beef. Meat Science. 63(4): 433-440.

Holley, R.A. and Patel, D. 2005. Improvement in shelf-life and safety of perishable foods by plant essential oils and smoke antimicrobials. Food Microbiology. 22: 273-292.

Jebelli Javan, A. Ghazvinian, K.h. Mahdavi, A. Javaheri Vayeghan, A. Steji, H. and Ghaffari Khaligh, S. 2012. The effect of dietary Zataria multiflora Boiss. Essential oil supplementation on microbial growth and lipid peroxidation of broiler breast fillets during refrigerated storage. Journal of Food Processing and Preservation, 37(3): 45-53.

Kim, J. Marshall, M.R. and Wei, C. 1995. Antimicrobial activity of some essential oil components against five foodborne pathogens. Journal of Agricultural and Food Chemistry. 43: 2839–2845.

Lahooji, A. Mirabolfathy, M. and Karami Osboo, R. 2010. Effect of Zataria multiflora and Satureja hortensis essential oils, Thymol, and carvacrol on growth of Fusarium graminearum isolates and deoxynivalenol production. Iranian Journal of Plant Pathology. 46(1): 37-50.

Mahmoud, B.S.M. Yamazaki, K. Miyashita, K. Shin, L.L. and Suzuki, Y. 2006. A new technology for fish preservation by combined treatment with electrolyzed NaCl solutions and essential oil compounds. Food Chemistry. 99: 656-662.

Mashak, Z. Moradi, B. and Moradi, B. 2012. The combined effect of Zataria multiflora Boiss and Cinnamomum zeylanicum Nees essential oil on the growth of Bacillus cereus in a food model system. Journal of Medicinal Plants. 11(42): 62-73.

Noori, N. Rokni, N. Akhondzade Basti, A. Misaghi, A. Dabbagh Moghaddam, A. Yahyaraeyat, R. and Ghanbari Sagharlou, N. 2012. The antimicrobial effect of Zataria multiflora Boiss essential oil against E. coli O157: H7 in minced beef during refrigerated storage as a replacement for chemical preservatives in order to maintain consumers' health. Journal of Army University of Medical Sciences. 10(3): 192-197.

Sallam, K.I. 2007. Antimicrobial and antioxidant effects of sodium acetate, sodium lactate, and sodium citrate in refrigerated sliced salmon. Journal of Food Control. 18: 566–575.

Shelef, L.A. 1983. Antimicrobial effects of spices. Journal of Food Safety. 6: 29–44.

Tong, H. Cao, C. Du, Y. Liu, Y. and Huang, W. 2022. Ultrasonic-Assisted Phosphate Curing: A Novel Approach to Improve Curing Rate and Chicken Meat Quality. International Journal of Food Science and Technology. 57: 2906–2917.

Uzundumlu, A.S. and Dilli, M. 2023. Estimating Chicken Meat Productions of Leader Countries for 2019–2025 Years. Ciencia Rural. 53:2.