JRIFST

https://journals.rifst.ac.ir
ISSN: 2252-0937(print), 2538-2357(online)
Journal of Research and Innovation in Food Science and Technology

Research Institute of Food Science and Technology

Volume 11, Issue 2, September 2022, Pages 169-182
Document Type: Extended Abstract
https://doi.org/10.22101/JRIFST.2022.328783.1331

Extended Abstract

Using Red Grape Seed Essential Oil Nanoemulsion (*Vitis Vinifera*) for Improvement of Chemicals and Bacteria Indices and Increasing the Shelf Life of Fresh Packaged Chicken Fillets at Refrigerated Temperature

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Recieved: 2022.02.27; **Accepted:** 2022.07.09

Abstract

Chicken fillet is one of the most popular food products made from chicken. Microbial growth and oxidation of lipids are the primary factors of spoilage of this product in refrigerated conditions. Chicken fillet samples were prepared in the form of a control sample and a treatment with grape seed essential oil and 4 treatments with concentrations of 1, 2 and 5% grape seed essential oil nanoemulsion and were kept in a refrigerator (4 and 8 °C) for 14 days. During this period, all the samples were evaluated and compared by performing microbial, chemical and sensory tests at different time intervals. Two-way analysis of variance was used to analyze the data, and Duncan's multiple range test was used to compare their averages. The results showed that the samples treated with different concentrations of grape seed nanoemulsion compared to the control sample had lower bacterial counts and lower total volatile nitrogen and proxid value throughout the study period. Samples treated with 5% concentration of grape seed essential oil nanoemulsion were more effective in increasing shelf life compared to concentrations of 1 and 2%. Also, the overall acceptance of the sample with 5% essential oil nanoemulsion up to day 7 had a score of 3.12±0.11. Therefore, it can be concluded that grape seed essential oil nanoemulsion can increase the shelf life of fresh packaged chicken fillet in refrigerated conditions by delaying microbial and chemical spoilage and improving sensory characteristics.

Keywords: Chicken fillet, Nanoemulsion essential oil, Red grape seed, Refrigerated conditions

Introduction

In the current century, maintaining the safety of food and its quality during the shelf life is an issue that has not only been of interest to food industry specialists and health officials of countries but inattention or less attention to this issue can impose irreparable damage to the society (Akbari *et al.*, 2013).

Chicken fillet is one of the most popular food products made from chicken meat. Microbial growth and lipid oxidation are the primary spoilage factors of this product in refrigerated conditions. Chicken fillet is ideal for the growth of pathogenic microbes and is prone to microbial spoilage due to its high moisture, protein content, and high pH. Moreover, the presence of long-chain polyunsaturated fatty acids with several unsaturated bonds improves the nutritional value of this product and, at the same time, increases its sensitivity to oxidative spoilage during cooking and storage (Heydarian *et al.*, 2015), thus compromising its nutritional value and taste. Oxidative spoilage causes an unpleasant odor, an unfavorable

change in taste, a change in the structure of nutrients, and a reduction in the nutritional value of the product. Therefore, the use of suitable materials with antibacterial and antioxidant activity is useful and necessary to improve the quality, increase the shelf life of meat, and thereby prevent economic losses. Accordingly, a conventional method to increase the shelf life of meat products is to use synthetic antioxidant compounds, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), as well as antimicrobial preservatives by spraying on the surface or immersing the meat in an antimicrobial solution. In many countries of the world, there is a rising demand for the use of healthy and environmentally friendly preservatives in food preservation. Given the increasing cases of drug resistance in microorganisms, an appropriate solution to this issue is to replace substances with appropriate and different functions against microbes. Plant essential oils (EOs) fall into these substances with minimal side effects that can be used by humans. Many compounds used as preservatives to increase food shelf life are carcinogenic and therefore threaten the safety of consumers. Thus, this issue further amplifies the importance of using plant EOs and the value of related research. This study aims to investigate the increase in the shelf life of packaged chicken fillets to more than 3 days using grape seed essential oil (GSEO) nanoemulsion.

Results and discussion

Chicken fillet samples were prepared as a control sample and a treatment with GSEO and four treatments with concentrations of 1, 2, and 5% GSEO nanoemulsion and refrigerated (4 and 8 °C) for 14 days. During this period, all the samples were evaluated and compared by microbial, chemical, and sensory tests at different time intervals. Data were analyzed using the two-way analysis of variance (ANOVA), and mean values were compared by Duncan's multiple range test.

The results showed that the control sample without coating and packaging had scores of 2.02±0.12 and 2.96±0.16 on days 3 (8 °C) and 5 (4 °C), respectively. The treatments showed an unpleasant odor at 8 and 4 °C after days 3 and 5 respectively. However, the samples treated with 5% GSEO nanoemulsion could prevent the spread of the bad smell caused by secondary oxidation products up to days 5 (8 °C) and 7 (4 °C). In the evaluation of color, all the samples for 3 days (8 °C), 5 days (4 °C), and the duration received good points from the assessors. However, a good score was recorded in the sample treated with 5% GSEO nanoemulsion after 5 (8 °C) and 7 days (4 °C). Paleness in chicken fillet samples is caused by an oxidation reaction that affects myoglobin (Suman & Joseph, 2013). In the texture evaluation, the presence of the GSEO nanoemulsion coating could maintain the texture hardness to a large extent, resulting in more acceptability. As a result, they received a good score until day 5 (8 °C) and day 7 (4 °C), but the chicken fillet texture did not score well in the sensory evaluation after 14 days. According to the taste evaluation results, the treatments could obtain good scores until days 3 (8 °C) and 5 (4 °C), but the best score belonged to the 5% GSEO nanoemulsion, which was scored 3.02 and 3.12 by days 5 (8 °C) and 7 (4 °C), respectively.

The results showed that the duration of storage, the refrigerated temperature, and the percentage of GSEO nanoemulsion produced significant effects (P<0.05). Based on the results, the temperatures used in this research were 4 and 8 °C, and the effect of the latter on the peroxide value was greater than that of the former. Another factor affecting the peroxide value is the applied treatment divided into four categories in this research (use of GSEO and GSEO nanoemulsion with three different concentrations). Furthermore, the amount of primary oxidation products increased from 12 to 77 mEq at 4 °C and from 14 to 91 mEq at 8 °C in the control sample, indicating that this sample contained large amounts of hydroperoxide compounds after 7 days. The antioxidant potential of GSEO is 25 times higher

than that of vitamins E and C (Shi *et al.*, 2003). The reduction of peroxide value in 5% GSEO nanoemulsion can be attributed to the effect of nanoemulsion form on lipolytic bacteria (e.g., *Pseudomonas*) and the high antioxidant effect of GSEO nanoemulsion. In another study, the use of thyme, sage, clove, and rosemary EOs at a concentration of 600 mg/kg in smoked rainbow trout fillets and vacuum packaging reduced the rate of hydroperoxide formation compared to the control sample, and a significant difference was observed between the examined EOs in terms of reductions in the peroxide value (Çoban *et al.*, 2014).

Conclusions

According to the results, lower bacterial counts and lower total volatile nitrogen and peroxide values were measured in the samples treated with different concentrations of GSEO nanoemulsion than the control sample during the study period. Samples treated with 5% GSEO nanoemulsion were more effective in increasing shelf life than 1 and 2% concentrations. Additionally, the overall acceptance of the sample with 5% GSEO nanoemulsion was scored 3.12±0.11 up to day 7. Therefore, it can be concluded that GSEO nanoemulsion can increase the shelf life of freshly packaged chicken fillets in refrigerated conditions by delaying microbial and chemical spoilage and improving sensory properties.

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