

Effect of Garlic (*Allium sativum* L.) essential oils on *Oncorhynchus mykiss* fillets during storage

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Summary. Suitable pH, very amounts of rich nutrients and with high A_w aquatic products are often perishable. This situation, it has become an important restriction in aquatic food product industry. Aimed to this study, reported resulting effect of garlic essential oils in terms of microbiological changes, chemical changes and organoleptic changes on *Oncorhynchus mykiss* fillets during storage at $2\pm 2^\circ\text{C}$ for 15 days. In the Quality loss of fillets were evaluated by pH, total volatile basis nitrogen (TVB-N), Thiobarbituric acid (TBA), aerobic bacteria (AB), psychrophilic bacteria (PB), lactic acid bacteria (LAB), yeast-mold and organoleptic characteristics. Findings showed that Trout fillets non treatment with Garlic essential oils exhibited significant quality decline after 6 days of storage. Shelf life of products throughout, in terms of AB, PB, LAB and yeast-mold count was determined that the products with the least growth were in the groups treated with 4% garlic oil. Fillets apply with garlic essential oil (especially 4%) was more effective in controlling quality changes in fillets shelf life with lower TVB-N, TBA and organoleptic scores.

Key words: garlic essential oils, *Oncorhynchus mykiss*, storage, microbiological changes, chemical changes

Introduction

Fish has long been accepted as a valuable source of protein in the human diet (1, 2). Fish rich in terms of good quality protein, A and B group vitamins, calcium and phosphorus (3). It is extremely healthy food due to this feature (4). Garlic has been used as both medicine and food since antiquity. Garlic according to legend used in ancient Egypt to increase workers' resistance to infection and later used it medicinally. Garlic identified to exert both direct and indirect effects against various pathogens. Allicin is believed to be chiefly responsible for garlics antimicrobial activity (5). Allicin is responsible for the unique taste and smell of crushed garlic or freshly cut (6). Essential oils derived from plants have been used as aromatic flavors and natural protective to extent the storage of food through their effect on the bacteria (7, 8). The preferred antimicrobial factor for foods quality are natural components such as essential oils and plants extracts. Oregano, cinnamon, anise essential oils or garlic essen-

tial oils have been reported to show lethal against very much microorganisms in food (9-12). There are many studies about garlic today. Effect of chitosan-gelatin with garlic extracts showed good antioxidant activity and antibacterial activity. Duan et al. (13), investigated bacterial growth in tilapia fillets treatment with Garlic juice and in products, only *Pseudomonas* was remained, which illustrated that garlic extract weakly inhibited *Pseudomonas*. Abdou et al. (14), investigated of effect on shelf life of chicken fillet coated with garlic essential oil at 4°C for 12 days.

This study reports resulting effect of garlic essential oils in terms of microbiological analysis, chemical analysis and sensorial analysis on *Oncorhynchus mykiss* fillets at $2\pm 2^\circ\text{C}$ during storage.

Materials and Methods

The samples trout ($368 \pm 56\text{g}$) were received aquaculture farm located in Keban Dam Lake, and trans-

ported in ice to the laboratory immediately. The fishes were washed in the laboratory, It was made fillet. Then samples fillets were divided randomly into four groups: the essential oil not applied group was set as control group (A), to samples applied with 1% essential oil was group B, to samples applied with 2% essential oil was group C and to samples applied with 4% essential oil was group D. All analyses were performed in triplicate at 0th, 3th, 6th, 9th, 12th and 15th on days. Analyzes were carried out 2 times.

Microbial analyses: 10 g samples were taken into a sterile stomacher bag, containing 90 ml 0.1% peptone water solution. The samples were then homogenized. The resulting solutions were then diluted in the peptone water solution. To determine the total aerob bacteria, plate count agar (LAB149) were incubated at 30 °C for 3 days. To count psychrophile bacteria, Plate count agar (LAB149) incubated at 5±1 °C for 7 days. Lactic acid bacteria was incubated at 30 °C for 2 days medium in ManRogosa Sharpe (LABM093) agar. Potato Dextrose Agar medium (LABM098) was used to count the number of yeast and fungi colonies after the cultivated plaques were incubated at 25±1°C for 4–5 days (15).

Chemical analyses: The pH values of experimental samples were determined was made using a pH meter (Thermo Scientific Orion, UK) (16). The method given by Conell and Shewan (17) was applied. The total volatile basic nitrogen (TVB-N) value was determined at the level of mg/100g. In order to determine of Thio-barbituric acid amount (TBA), the method given by Tarladgis et al. (18) was applied.

Organoleptic analyses: Five experienced panelists were elected from academic staff. The samples treated with garlic essential oil were cooked for 10–15 min at 180°C in a cooking bag and the products were presented to panelists. Panelists' evaluated general acceptability of the samples on a hedonic scale (9-point) ranging from dislike extremely (1) to like extremely (9) (19).

Statistical analysis: The datas detected in the analysis days of fillets were statistically analyzed. For statistical data, the SPSS 22 statistical software package program was used. The statistical significance ($p < 0.05$) of storage days and differences between groups was detected using variance analysis.

Results

The microbiological changes determined during storage of trout fillets treatment with garlic oil in different ratios at $2 \pm 2^\circ\text{C}$ are given in Figure 1, chemical changes are given in Figure 2 and organoleptic changes are given in Figure 3. When the trout fillets with essential oil were examined from the sensory point of view, deterioration occurred on day 15, between the groups were evaluated according to this deterioration.

Discussions

Total aerobe bacteria counts in the experimental control samples were reduced on the initial level ($3.12 \pm 0.13 \log \text{CFU/g}$) to 3–4 log CFU/g when the fillets were treated with garlic essential oil (Figure 1a). Total aerobe bacteria amount (AB) in the all samples treatment with garlic essential oils increased significantly during 15th days of storage at refrigerated temperature (Figure 1a). Compared to all experimental samples, the counts of garlic essential oil treated samples had a significantly ($p < 0.05$) higher increase day 0th and day 6th, on the other hand group A has deteriorated after 6th days. When all days were considered within storage period, significant difference was evident in terms of AB counts ($p < 0.05$). Hassanin and El-Daly (20) reported that AB counts in initial of storage period was determined as $4.59 \pm 0.0139 \log \text{CFU/g}$ in the control groups, $4.58 \pm 0.0139 \log \text{CFU/g}$ in minced garlic groups. These findings coincide with our findings. Teixeira et al. (12) was studied that is of antibacterial effect against microorganisms of garlic essential oil with fish protein films. There was an increase in the end of on days 15th in the all groups for the counts of psychrophilic bacteria (PB) from trout fillets applied with garlic essential oil (Figure 1b). At the beginning of the storage time, the PB counts were determined as $3.08 \pm 0.39 \log \text{CFU/g}$ in the group D into all groups. However, the most levels of PB counts were identified as $7.43 \pm 0.48 \log \text{CFU/g}$ in C groups on day 12th during storage. Moreover, it was determined that PB were significant as statistically differences among groups ($p < 0.05$). Furthermore, it was determined that in terms of the PB population that the storage period had a significantly statistical among days ($p < 0.05$). In the available studies in the literature,

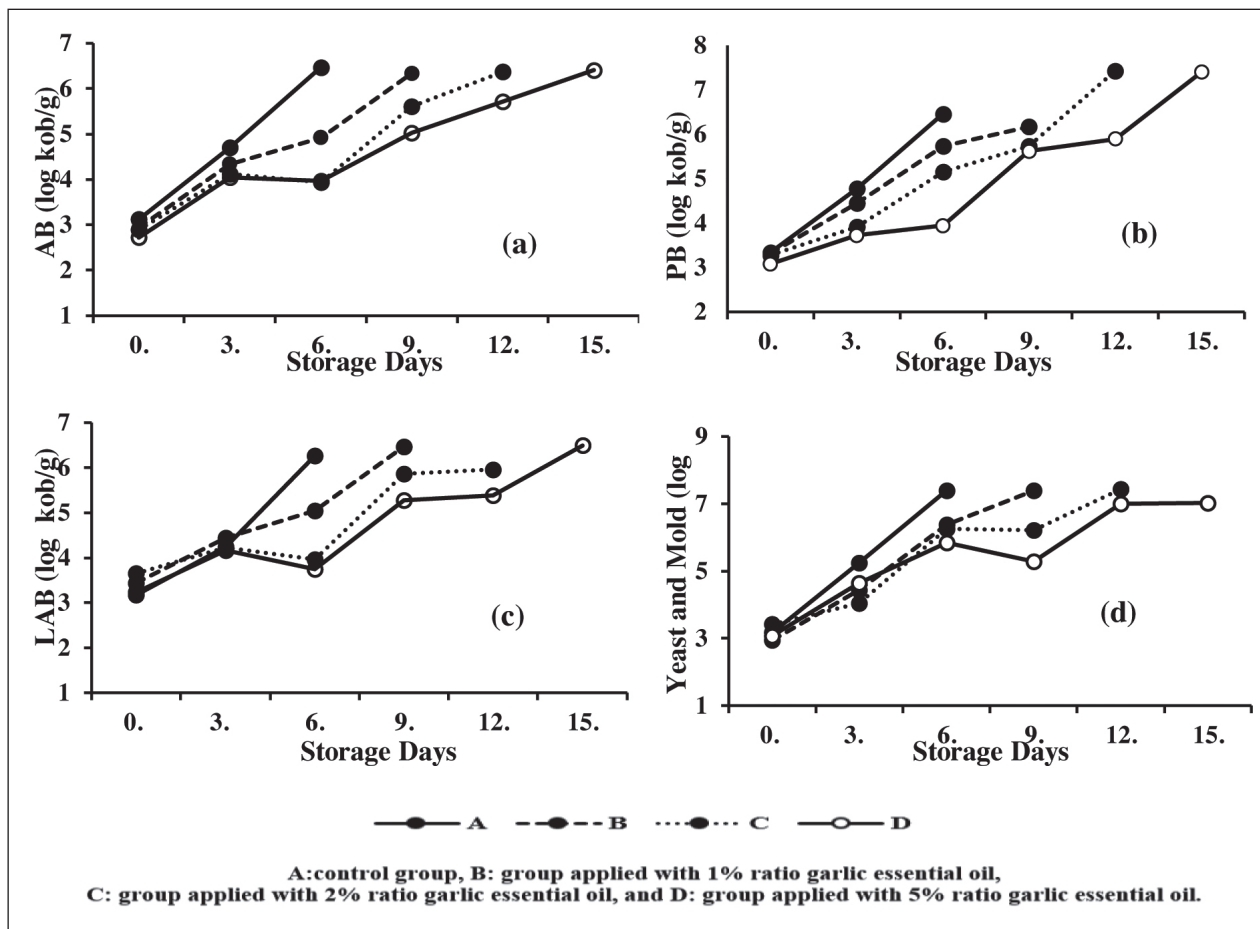


Figure 1. Microbiological changes in the trout fillets of garlic essential oil addition during storage.

it was stated that different essential oils reduced PB activities (21, 22). This finding also confirms to our results. The counts of Lactic acid bacteria (LAB) in trout fillets treated with garlic essential oil during storage period increased significantly ($p < 0.05$) (on the day 6th), compared to control samples (Figure 1c). The highest LAB count during storage period was determined to be in group D (6.49 ± 0.05) on day 15th, while the lowest LAB count was determined in group A (3.17 ± 0.32) on day 0th. When all days were considered during the storage period, significant difference was significant in terms of LAB count ($p < 0.05$). This situation showed that garlic essential oil is effective on LAB. In the light of these data, the LAB of the experimental samples are similar to those found by many researchers (23, 24). At the first day of storage period (Figure 1d.), yeast and mold counts were deter-

mined the highest bacteria count in C groups (7.43 ± 0.05) in control and other treatments groups. Significant difference was determined between days during storage of samples yeast and mold counts ($p < 0.05$) and the differences between the groups were examined, statistical differences were found to be significant ($p < 0.05$). Similar findings have been found by Emir Çoban et al. (24).

The average pH amount in the *O. mykiss* fillets used in this study was detected as 6.55 ± 0.43 (Figure 2a). When pH amount were determined alongside the shelf life, a decrease was observed in all groups in storage period; but the pH decrease rate in the groups to which essential oils had been applied, was limited with respect to other control group. In terms of pH, significant differences weren't detected among the groups during storage ($p > 0.05$). Moreover, significant differ-

ence was detected between days during storage of samples pH values ($p < 0.05$). In the light of these data, the pH values of the experimental samples are similar to those found by many researchers (24, 25). The TVB-N value in control samples was determined as 12.97 ± 2.33 mg/100g on day 0th, as displayed in Figure 2b. After the essential oils coating process, the TVB-N value did change among all groups in the range of 9.79 ± 4.01 mg/100g– 45.01 ± 5.01 mg/100g. with regard to, the TVB-N value, it was detected that the effect of the storage period (6th and 9th day) was statistically significant in all experimental fillets groups ($p < 0.05$). The effect of the storage period on the TVB-N was con-

sidered, significant differences were detected ($p < 0.05$). Gómez-Estaca et al. (26) used chitosan film added with essential oil to salmon during storage period, and the microbial activity was decreased considerably and corresponded with the delay in TVB-N production, as observed in the them study. The changes in TBA amount of *O. mykiss* samples prepared during shelf life are displayed in Figure 2c. In regard to these measurements of samples during storage period, the highest TBA value was determined for group B as 4.62 ± 0.08 mg MA/kg on day 15th; the lowest value was determined group D as 0.51 ± 0.26 mg MA/kg on 0th. The results indicated that TBA amount for significantly increase in all experimental groups according to the storage period ($p < 0.05$). When all days were considered within the storage period, significant difference was evident in terms of TBA value ($p < 0.05$). Karaton Kuzgun and Gürel İnanlı, (22) reported the TBA value as 0.45 ± 0.24 mg MA/kg. This values was close values to our findings.

Organoleptic values of shelf life of trout treated with garlic essential oils are presented in Figure 3. In the values of all samples observed a significant decline with increasing in storage period. The panelists mentioned that the garlic flavor was very befit for the experimental fish product. The control groups (A) showed spoilage after day 6th storage, while other garlic essential oils applied groups (D) resulted in higher general acceptability scores than the control from 15 day. In terms of General acceptability values of experimental fillets sam-

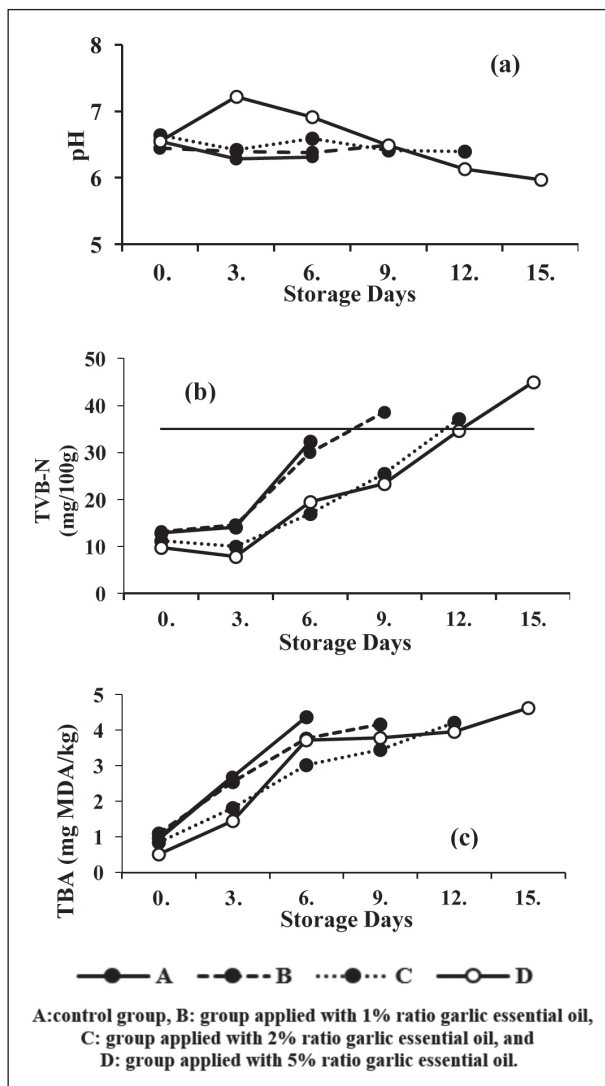


Figure 2. Chemical changes in the trout fillets of garlic essential oil addition during storage.

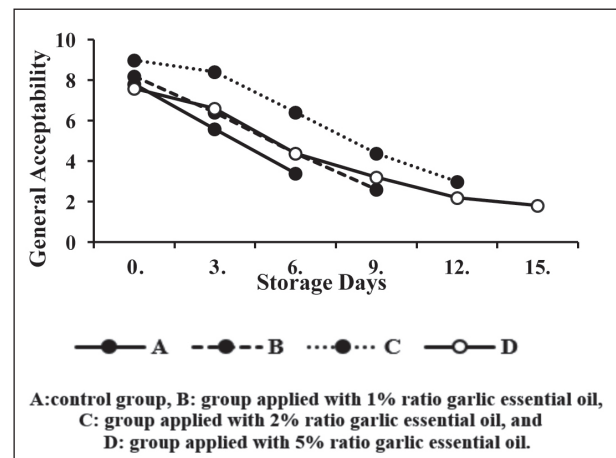


Figure 3. Organoleptic changes in the trout fillets of garlic essential oil addition during storage.

ples showed on days 0th, 6th and 9th differences among all groups ($p < 0.05$). It has been reported by Wang et al. (27) that general acceptability scores of grass carp coated with garlic similar to our value.

Conclusion

Our results proved that garlic essential oil as a natural antimicrobial and antioxidant agent can be used to extend the shelf life of *O. mykiss* fillets and for other food preservation. We hope to relocate to synthesized products with natural products in human nutrition by conducting more research on their preservative effects.

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