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Original article

Preservative effect of coriander essential oil applied in different proportions on the storage of rainbow trout (*Oncorhynchus mykiss*) fillets

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Abstract. Aim of this study, the sensorial, microbiological, and chemical features during shelf life at 2 ± 2 °C of rainbow trout fillets samples treatment with coriander essential oils were examined of protective effect of oils. According to the findings of the research, the storage during of fillets ended on day 9th, that of control on day 12th, that of samples applied with coriander oils 0.1% on day 15th, which of fillets applied with coriander oils 0.25% and applied with coriander oils 0.5% on day 18th. The minimum number of bacteria, values of TVB-N and TBA were founded in trout fillets treatment with 0.5% coriander essential oil. In terms of the sensory quality of the fillets, as assessed by panelists participating in the panel, it was detected that highest point was given to the fillets groups to which coriander essential oil of 0.5% had been enforced, and as a result, with this application, it was underlined that was obtained in a positive direction of a flavor very different other than ordinary fish flavor by panelists.

Keywords: Coriander essential oil; rainbow trout; storage; microbiological quality; chemical quality

Introduction

Of the freshwater fish species with commercial value, Rainbow trout is a popular fish species appurtenant to the Salmonidae family and quite appreciated by consumers in European (1). Additionally, trout fillets packaged in various forms are being exported to different countries and also, consumed without further heat process (2).

The essential oils are acceptable the most natural preservatives at replace of chemical protecting and their use preservation of food meets of demands of consumers for fresh products or lightly processed. Essential oils are aromatic plants obtained from plant. Essential oils from sage, mint, rosemary, thyme and clove are some of the essential oils that have been used to improve sensorial features and lengthen the storage periods of foods (3-5).

Coriander (*Coriandrum sativum* L.) belonging to the Apiaceae family is a plant, herbaceous, aromatic, which has with a long history as a kitchen herb being a different odor and the source of aroma compounds (6). Coriander is a well-known herb widely used in food industries and in the drugstore and in folk medicine. Coriander oil is one from mainly 20 type extract in all markets around the world (7, 8) and it is known to have antimicrobial and antioxidant activity as a result of the work done (8-10). In the research done by Burdock and Carabin (8) suggested the possibility of using materials such as coriander essentials oils as a food ingredient.

The essential oil have been shown to possess anti-diabetic, anti-cancerous, anti-mutagenic, (11, 12). Additionally, it is usually used in ailments such as diarrhea, dyspepsia, anorexia, vomiting, and griping pain. Fruit of coriander is also reputed as tonic, diuretic,

refrigerant, while, coriander oil is considered useful in rheumatism, neuralgia, flatulent colic. Coriander is also used as anti-diabetic, anti-septic, anti-hypertensive, and possess nerve-soothing property (13). There are many studies in literature on the effects antioxidant and antimicrobial with regards coriander oils. But, there are no studies on the extension of shelf life under refrigerator conditions of fish filets.

It is a very desirable situation that materials and methods used for lengthen the storage of food are safe, easy and free charge. Therefore, herbal oils like coriander essential oil have been highly preferred. The purpose of in this research was to investigate the sensory microbiological and chemical changes of *Oncorhynchus mykiss* fillets coated with coriander essential oils during storage period.

Materials and Methods

Raw material of research

In the study, rainbow trout obtained from an aquaculture farm located on Keban Dam Lake were brought to the Firat University Biology laboratory with Styrofoam boxes in ice. The fishes were made into fillets in the same day. Coriander oil was brought from the Kalsec company (33 – 03, 864286). The study was conducted in two parallel studies and in three replicates.

Preparation of Fish Fillets and Packaging

The filleted fishes were divided into different four groups; control samples without application coriander oil and samples coated with at ratio of 0.1%, 0.25% and 0.5% coriander oil. Coriander oil was applied to surface of fillets in appropriate amounts with a micropipette, followed by slightly massaging the oil on all fillets (except control group) with gloved. The prepared fillets were aerobically packed in a low density polyethylene pouches and stored at 2 ° C to undergo quality assessment and analysis on days 1th, 3th, 6th, 9th, 12th, 15th and 18th.

Microbiological analysis

Fish fillet 10 g was mixed with of 90 ml Peptone Water solution (sterile) and then stomached (3 min). Moreover, dilution was made at a ratio of 1:10 and then 0.1 ml of every dilution was pipetted with micro pipette over the surface of PCA (plate count agar) (LAB149, 125801/093) plates for examined of aerobic bacteria (AB – 3 days at 30±1 ° C) and psychrophilic bacteria (PB – 7 days at 5±1 ° C). For lactic acid bacteria (LAB), 0.1 ml of each dilution was pipetted over the surface of MRS (Man Rogosa Shape agar) (LABM093, 123839/254). Potato Dextrose Agar medium (PDA – LABM098, 123328/229) was used to count of yeast – fungi colonies (4 – 5 days at 25±1 ° C) (14).

Chemical analysis

The pH ratio of experimental samples were measured by using a pH meter (Hanna) (15). TVB – N (The total volatile basic nitrogen, mg $100g^{-1}$) was measured according to the method of Conell and Shewan (16). TBAR (Thiobarbituric acid reactive, MA kg^{-1}) values was detected with distillation method of Tarladgis et al. (17).

Sensory analysis

Ten experienced panelists were academic staff. The experimental products were cooked for 15 min at 170 ° C in a cooking bag, and the products were served to panelists. Panelists evaluated appearance, flavor, general acceptability of the fillets samples on a scale (9 – point) ranging from dislike extremely (1) to like extremely (9) (18).

Statistical analysis

The values of all analysis detected during shelf life of the samples were statistically analyzed. For the determination of statistical analyzes, the IBM SPSS-22 (USA) statistical software package program was used. The statistical significance (p<0.05) of the differences

among experimental groups was detected by means of variance analysis (One-Way ANOVA), using Duncan's (Duncan,1955) multiple range test.

Results and Discussion

Microbiological changes

AB (The aerobic bacteria) detected during the shelf life period of fillets groups investigated in of study is presented in Figure 1a. As the count of aerobic bacteria in the experimental groups used in the research was detected to be in the range of 3.56±0.09 log cfu g^{-1} – 7.26±0.03 log cfu g^{-1} in four groups. Furthermore, it was detected that the all groups was statistically meaningful in during storage period (p<0.05). The total aerobic bacteria quantity detected in the current study exceeded the acceptable limits on the 9th day in the Control groups, on the 12th day in the 0.1% groups, on the 15th day in the 0.25% groups and on the 18th day in the 0.5% groups. Similar studies show related to essential oils such as coriander applied to mean samples to inhibiting microorganism development, determination the antioxidant effect, storage and therefore increasing shelf life of the food product (19). Our results for AB are similar with findings shelf life of various fish species with other different essential oils (20, 21, 22, 23). Hussein et al. (22) reported, which had been examined to be in the range 3.98 ±0.22 - 9.87 ±0.76 log cfu g^{-1} in all groups of *Luciopercia s*. fillets of AB amount. This value is different from our values. This situation, we can attribute to different of the percentage of essential oil applied to the fish.

The psychrophilic bacteria (PB) of all groups were viewed during storage (Figure 1b). Initial numbers of psychotropic bacteria of control group (A), 3.49±0.22 log cfu g^{-1} and other samples were 3.60±0.22 log cfu g^{-1}, 3.24±0.07 log cfu g^{-1} and 3.44±0.08 log cfu g^{-1}, respectively. PB of group A, 6.15±0.65 and other groups were 6.20±0.39, 5.68±0.08 and 7.29±0.40 log cfu g^{-1} at the end of the shelf life, respectively. As a result of the statistical analysis, coriander essential oils treated groups was determined to be meaningful of statistical significant when compared to control groups during storage (p<0.05). Our findings for PB are contacted with findings of fish samples treatment with different essential oils research (5).

As seen in Figure 1c, The lactic acid bacteria (LAB) was determined as 2.19±0.18 – 4.88±0.10 log cfu g^{-1} in all groups during shelf life. It was determined significant of different between experimental groups (p<0.05). Özpolat and Duman (23) reported, which has determined as 3-7 log cfu g^{-1} in the all groups of lactic acid bacteria counts during storage periods. This find is similar to our findings.

The yeast-mold amount of experimental samples detected during shelf life are presented in Figure 1d. Whereas the count of yeast-mold detected in A groups was at the end of the shelf life periods as 6.38±0.23 log cfu g^{-1}, it was detected for the, the other groups (B, C and D) at the end of the shelf life as 6.38±0.24 log cfu g^{-1}; 6.39±0.25 log cfu g^{-1} and 6.51±0.24 log cfu g^{-1}, respectively. There wasn't found a significant difference during storage period among the groups with regard to yeast-mold count (p>0.05). Inhibited effect of essential oils on the count of yeast-mold has been pointed out by some researchers (5, 24).

Chemical changes

The value of pH in all groups ranged from 6.53±0.03 to – 6.95±0.05 mg 100g^{-1} (Figure 2a). The end of period of storage pH value in A, B, C and D groups was 6.61±0.01, 6.63±0.03, 6.53±0.3 and 6.58±0.03 mg 100g^{-1}, respectively. Karaton Kuzgun and Gürel İnanlı (5) reported, which has ranged from 6.22 ± 0.24 - 6.63 ± 0.14 mg 100g-1 of the pH value in all groups. This value is different from our values. This situation, we can attribute to be different essential oil applied, to be chitosan edible films and to be different fish species. The pH value for significantly decrease in each groups during shelf life (p<0.05). These decreases in pH values could be related to the increase in the number of lactic acid bacteria during shelf life period.

The TBA values were determined in the samples (Figure 2b) and The initial TBA values were 0.58±0.25 mg MA kg^{-1}, 4.41±0.15 mg MA kg^{-1}, 0.20±0.25 mg MA kg^{-1} and 0.20±0.09 mg MA kg^{-1} for A, B, C and D treated groups, respectively Fig. (2b). The TBA values

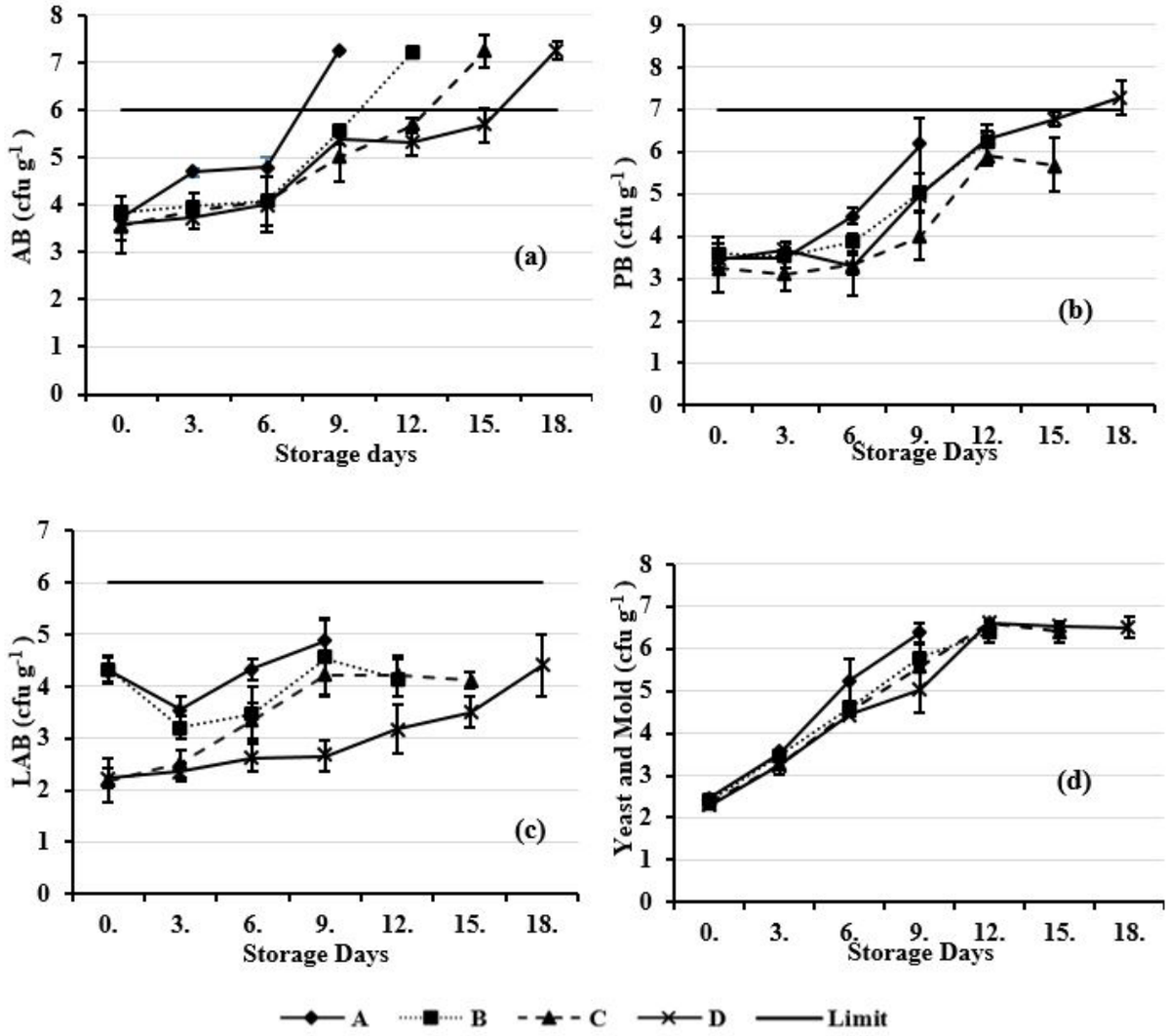


Figure 1. Microbiological Changes of trout fillets treatment with coriander essential oils during storage(a) (b) (c) (d)

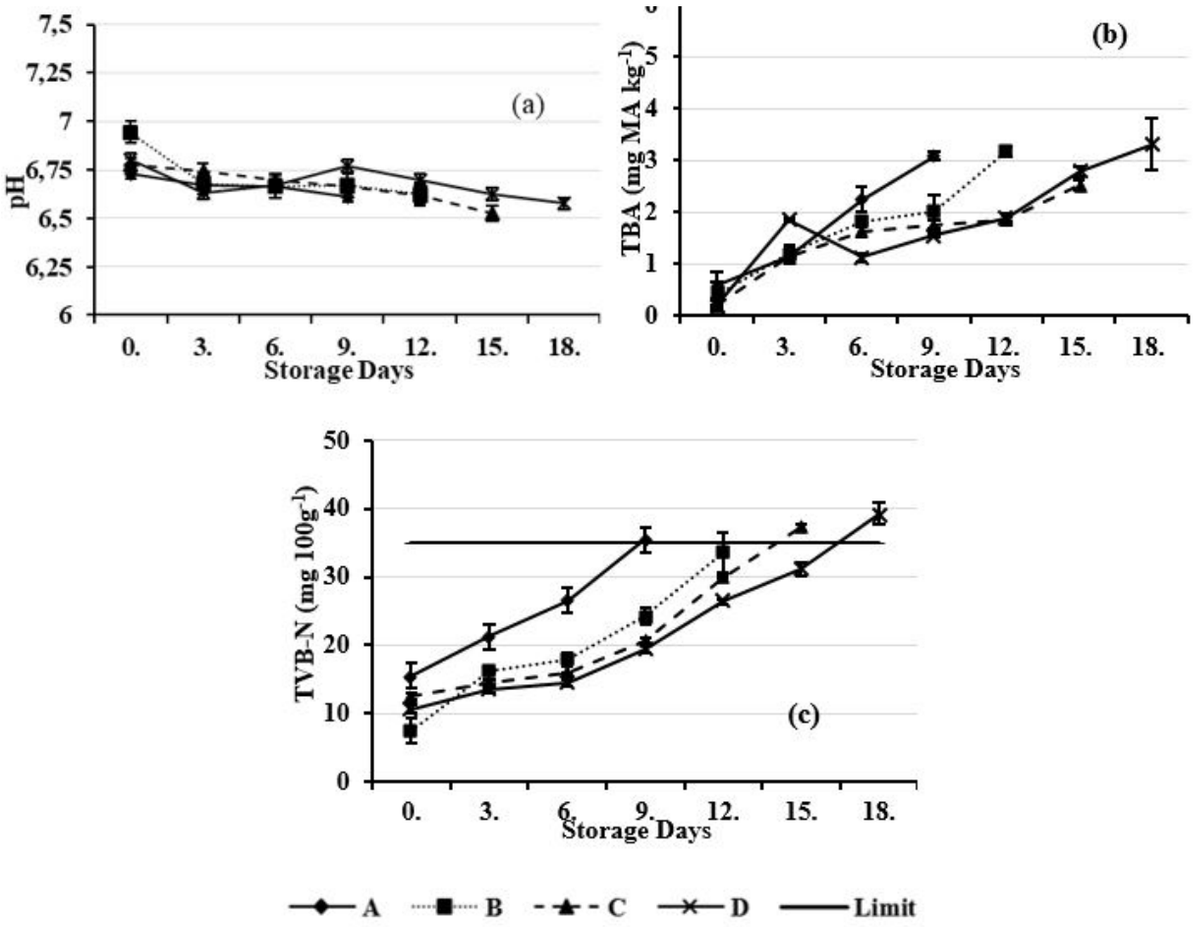
of control samples were increased reaching 3.03±0.09 mg MA kg^{-1} after 9th on days of storage. Gradual increases in TBA were noticed at 9th day where TBA became 6.84±0.12 mg MA kg^{-1}, 6.72±0.11 mg MA kg^{-1} and 6.85 ± 0.15 mg MA kg^{-1} in B, C and D groups respectively. All treated fillets groups were significant on control group (p<0.05) during storage time. The coriander sativum essential oils as a natural prohibitive against oxidative rancidity; This hypothesis is supported by the results determined by Viuda–Martos et al. (25), Sriti et al. (26), Hussein et al. (22) and Turan et al. (27).

The TVB-n values of *O. mykiss* fillets prepared during storage period are seen in Figure 2c. In terms of these values of samples, the lowest value was determined in the group B as 7.45±1.85 mg $100g^{-1}$ on 0th day; the highest TVB-n value was measured for group B as 39.20±1.60 mg $100g^{-1}$ on 3th day. The results indicated that TVB-n value for significantly increase in each groups during storage period (p<0.05). Hussein

et al. (22) reported that in *Luciopercia sandra* fillets, which had been imposed to different essential oils, the coriander essential oil received the lowest value of the last day of the conservation. This value is different from our values. This situation, we can attribute to different of the percentage of essential oil applied to the fish.

Sensorial Changes

The sensorial changes of experimental samples treatment with Coriander essential oils are presented in Table 1. This indicates that all experimental samples at start (0th and 3th day) were in excellent quality. By the 9th day, there was a significant loss in the fillets quality for all samples, which were rejected by the panelists after 12th, 15th, and 18th on days for control, 0.1% coriander, 0.25% coriander and 0.5% coriander treated groups, respectively. The results of the sensory quality indicated that storage of fish meat was affected by coriander oil addition. (Table 1). Similar results were seen in different studies in which positive effects of different products on foods (such as, coriander oils in cake, *Lucioperca l.* Fillets) (10, 22) and plant extracts on food (such as, rosemary, clove, garlic, wheat germ and black cumin oil) (23, 5, 28, 29).



A:Control, **B:** 0.1% coriander essential oil, **C:**0.25% coriander essential oil, **D:** 0.5% coriander essential oil

Figure 2. Chemical Changes of trout fillets treatment with coriander essential oils during storage (a) (b) (c)

Table 1. Sensory quality changes of trout fillets treatment with coriander essential oils during storage

	Groups	Appearance	Flavour	General acceptability	Groups	Appearance	Flavour	General acceptability
0. day	A	6.80±1.47	7.00±1.09	7.00±0.63^{a}	*12. day*	NA	NA	NA
	B	7.50±0.50	7.50±0.50	7.50±0.50^{ab}		5.66±0.00	5.66±0.00	5.66±0.00
	C	7.00±1.09	7.20±1.16	7.00±1.09^{a}		7.00±0.00	7.00±0.82	7.00±0.00
	D	8.00±1.59	8.20±1.16	8.40±0.80^{a}		7.00±0.82	6.66±0.47	7.00±0.82
3. day	A	7.60±0.91	6.70±0.78^{a}	6.90±070^{a}	*15. day*	NA	NA	NA
	B	7.60±0.49	7.70±0.64^{b}	7.70±0.64^{b}		NA	NA	NA
	C	8.18±0.57	8.27±0.75^{b}	8.27±0.61^{b}		6.37±0.86	6.37±0.86	6.62±0.86
	D	7.75±0.66	7.87±0.78^{b}	7.75±0.82^{b}		6.12±1.26	6.25±1.19	6.12±0.92
6.day	A	4.60±1.20^{a}	4.00±1.26^{a}	4.20±0.98^{a}	*18.day*	NA	NA	NA
	B	5.80±0.75^{ab}	5.60±1.50^{ab}	5.40±1.02^{a}		NA	NA	NA
	C	7.20±0.36^{bc}	7.00±0.58^{b}	7.20±0.36^{b}		NA	NA	NA
	D	7.20±0.75^{c}	7.00±0.89^{b}	7.00±0.89^{b}		3.28±1.03	3.00±1.41	3.71±0.88
9. day	A	3.75±0.83^{a}	3.50±1.12^{a}	3.25±0.83^{a}	*21.day*	NA	NA	NA
	B	7.50±0.86^{b}	6.75±1.78^{b}	7.00±0.00^{b}		NA	NA	NA
	C	7.00±1.22^{b}	7.25±0.82^{b}	7.25±0.82^{b}		NA	NA	NA
	D	7.75±0.43^{b}	7.50±0.50^{b}	7.75±0.43^{b}		NA	NA	NA

Conclusion

As a result of the analysis of data regarding the this research shows that adding coriander essential oils on trout fillets causes of delay oxidative and microbial deterioration and it increases the storage by 9 days over the control groups samples. In addition, it was come to the conclusion that coriander essential oil enhances the aroma of the fish and positively affects its consumability.

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Conflict of Interest

The authors have declared no conflicts of interest for this article.

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