



## Proximate Composition of Red Band Fish (*Cepola macrophthalma*, Linnaeus, 1758) and its Quality Changes during Refrigerated Storage ( $4\pm 2^\circ\text{C}$ )

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### Abstract

The aim of this research was to determine the quality of red band fish (*Cepola macrophthalma* Linnaeus, 1758) to estimate the potential usage of this species as a human food source. For this purpose, proximate composition, chemical, microbiological, sensorial, color and texture analyses were done. Moisture, crude fat, crude protein, ash and carbohydrate values were found as  $76.5\pm 0.03$ ,  $0.98\pm 0.12$ ,  $18.96\pm 0.05$ ,  $0.32\pm 0.03$  and  $1.24\pm 0.02$  % respectively. To determine the refrigerated shelf life, chemical quality analyses based on TVB-N (mg TVB-N/100 g), TMA (mg TMA/100 g) TBA (mg malonaldehyde/kg) and pH were used. Color values and textural parameters were also monitored. In addition, sensorial analyses were used to decide if the species is suitable for human consumption and to determine the shelf life. Results showed that it is possible to use red band fish as human food until 6<sup>th</sup> day at refrigerator ( $4\pm 2^\circ\text{C}$ ).

**Keywords:** Red band fish, quality, sensory analysis, color measurement, shelf life.

### Kurdela Balığının (*Cepola macrophthalma*, Linnaeus, 1758) Yaklaşık Kompozisyonu ve Buzdolabında Muhafaza ( $4\pm 2^\circ\text{C}$ ) Sırasındaki Kalite Değişimleri

### Özet

Bu çalışmanın amacı kurdela balığının (*Cepola macrophthalma* Linnaeus, 1758) kalite tespiti ve gıda kaynağı olarak tüketim potansiyelini tespit etmektir. Bu doğrultuda yaklaşık kompozisyon, kimyasal, mikrobiyal, duyuşsal, renk ve doku analizleri yapılmıştır. Nem, ham yağ, ham protein, kül ve karbonhidrat değerleri sırasıyla (%)  $76,5\pm 0,03$ ,  $0,98\pm 0,12$ ,  $18,96\pm 0,05$ ,  $0,32\pm 0,03$  ve  $1,24\pm 0,02$  olarak tespit edilmiştir. Buzdolabı raf ömrünün tespiti için, kimyasal analizlerden TVB-N (mg TVB-N/100 g), TMA (mg TMA/100 g) TBA (mg malonaldehyde/kg) ve pH kullanılmıştır. Renk değerleri ve doku parametreleri de aynı zamanda gözlemlenmiştir. Ek olarak duyuşsal analizler kullanılarak türün insan tüketimi için uygunluğu ve raf ömrü tespiti yapılmıştır. Sonuçlar, kurdela balığının uygun bir gıda kaynağı olduğunu ve buzdolabında ( $4\pm 2^\circ\text{C}$ ) depolandığında 6. güne kadar tüketilebileceğini göstermiştir.

**Anahtar Kelimeler:** Kurdela balığı, kalite, duyuşsal analiz, renk ölçümleri, raf ömrü.

### Introduction

The red band fish, *Cepola macrophthalma* (Linnaeus, 1758) (synonymous to *Cepola rubescens*, Linnaeus, 1766), is a zooplanktophagous benthic species found singly or in small groups at depths between 60 and 120 m (Stergiou, 1993a). It inhabits temperate and subtropical waters, ranging in the eastern Atlantic from the British Isles to north of Senegal (Fischer *et al.*, 1987). It is also common in the Mediterranean Sea but not in the Black Sea (Tortonese, 1986). Age, growth, mortality and abundance of red band fish have been studied from

experimental trawl samples collected from 1986 to 1988, separately in two adjacent marine regions of the western Aegean Sea (Stergiou, 1992a, 1992b; Stergiou 1993a, 1993b; Stergiou *et al.*, 1992; Stergiou and Papaconstantinou, 1993). Kaya, Ozaydın and Benli (2001) studied the age and growth parameters of red band fish (*Cepola rubescens* L., 1766) in Izmir Bay (Aegean Sea).

In the literature, it is also possible to find some studies about its systematic (Atkinson *et al.*, 1977), population (Martin and Sebates, 1991), catch (Isola and Relini, 1984) and behaviors. The present study provides information on the proximate chemical

composition and the shelf life of the red band fish obtained from the Aegean Sea at refrigerated storage.

## Materials and Methods

### Raw Material

Samples were caught from outer part of Izmir bay by using trawl net. They were put in to a polystyrene box with ice. The transportation of the samples took one hour from the site of catch (Urla) to laboratory. 180 individual specimens were used and the total weight of the specimen was 6 kg. For each analysis period, homogenization of the edible part of 40 specimens was used for chemical analysis. The rest were used for textural, sensorial and microbiological analysis. Samples were gutted and after removing heads and skins, they were stored in refrigerator ( $4\pm 2^{\circ}\text{C}$ ). Before gutted, biometrical measurements of the samples were; net weight  $41.65\pm 1.57$  g, total length  $46.00\pm 1.51$  (cm), wide  $0.82\pm 0.16$  cm, height  $2.30\pm 0.43$  cm and head weight  $8.42\pm 1.37$  g. The ratio of edible part was about 30%. It was calculated after removal of the bones, head and skin. The analyses were performed during the storage period (T0, T3, T6) and all carried out in triplicate.

### Proximate Composition

Dry matter was determined by drying the samples at  $105^{\circ}\text{C}$  to a constant weight (AOAC, 1990). Crude protein content was calculated by converting the nitrogen content determined by the Kjeldahl method ( $6.25\times\text{N}$ ) (AOAC, 1990). Fat was determined using the method described by Bligh and Dyer (1959). Ash was determined by using the method of Ludorff and Meyer (1973). Carbohydrate content of each sample was calculated by difference.

### Chemical Quality Characteristics

Total volatile basic nitrogen, TVB-N (according to the method of Vyncke, 1996), thiobarbituric acid, TBA (according to the method proposed by Tarladgis *et al.*, 1960) and trimethylamine, TMA (according to the method proposed by AOAC, 1990) were carried out. The pH value was recorded using a Hanna 211 model pH meter (Cluj-Napoca, Romania), the glass electrode being applied directly to the homogenate (5g of fish/5ml distilled water), prepared by using an Ultraturax homogenizer (Yellow line, DI 25 Basic, Staufen, Germany). The Ultraturax was dipped into the solution and used for 1 minute.

### Color Measurement Characteristics

The colorimeter operates on the spectral method described in DIN 5033 (Deutsches Institut Für Normung, CIE, 1995) using the  $45/0^{\circ}$  circular

viewing geometry. The sample is illuminated with polychromatic light encircling it at an angle of  $45^{\circ}$ , with the optical unit observing the reflected light from a horizontal angle ( $0^{\circ}$ ) towards the sample surface. The Spectro-pen<sup>®</sup> is a genuine grating colorimeter measuring the visible spectral range (400 to 700 nm) at intervals of 10 nm. A  $10^{\circ}$  standard observers and a D65 illuminant were used. The PC-software "Spectral-QC" for Windows (Spectral-QC Operating Instructions Version 3.6, Dr. Bruno Lange GmbH & Co. KG, 4/2002, Dusseldorf, Germany) was used for data processing. Before measuring each lot, the colorimeter was calibrated against a white standard (LZM 229). The color was measured from homogenates (according to the method proposed by Schubring, 2003). For each batch, 3 samples were taken. To measure the flesh color, samples were minced separately in a Kitchen Aid KPMS Professional meat grinder (St. Joseph, Michigan, USA), equipped with 2 cm grinding blades and a metallic screen with 4 mm diameter circular holes. The pooled mince was placed in a plastic Petri dish. The surface was required to be smooth and the mince was required to be nearly uniform in color. The color measurement was repeated ten times using different parts of the mince surface.

### Microbiological Quality Characteristics

Total Aerobic Mesophilic Bacteria count was determined according to Harrigan and Mccance (1976).

### Textural Analysis

TPA (Texture Profile Analysis) was performed by using TA-XT Plus texture analyzer (Schubring, 2002). Cylindrical samples were compressed two times between plates. From the resulting force-time curve, hardness, cohesiveness, springiness, gumminess, resilience and chewiness were determined.

### Sensorial Analysis

From each fish sampled, epaxial parts of the fillets were cut. The parts close to the head and to the tail were removed to obtain portions of approximately  $12\times 3$  cm, that was divided in four portions of approximately  $3\times 3$  cm. Similar portions were obtained from the other samples. Samples were wrapped in aluminium foil without any seasoning added and baked in a preheated conventional household oven, as described by Conrad *et al.* (1994), Parrish *et al.* (1995) and Orban *et al.* (1997). Preheating took 30 min at  $200^{\circ}\text{C}$  and cooking time was 10 min for each  $3\times 3$  cm portions. Ten panellists were used for sensory analysis. Each assessor received two portions of approximately  $3\times 3$  cm of

each sample. Sensorial parameters were investigated for determining the preferred size for consumers. 11 sensory attributes selected (2 for odor, 2 for appearance, 3 for flavor and 5 for texture). The scores were ranked for each description for all the parameters, between 0-10 with less importance were given lower scores. The limit of the acceptability was 4 for each parameter.

### Statistical Analysis

The SPSS (SPSS, 1999, Version 9.0. Chicago, IL, USA) program was used to look for significant differences between mean values of the different analysed parameters. The data were analysed by a one-way analysis of variance (ANOVA) followed by either the Tukey or Duncan multiple comparison test. Fixed factor was the storage conditions when a significant difference was detected between the groups ( $P < 0.05$ ) stored for different duration. The results were presented as means  $\pm$  SD in the tables.

## Results and Discussion

### Chemical Quality Characteristics Results

The proximate composition values of the red band fish samples were determined as follows: moisture  $76.5 \pm 0.03\%$ , crude fat  $0.98 \pm 0.12\%$ , crude protein  $18.96 \pm 0.05\%$ , ash  $0.32 \pm 0.03\%$  and carbohydrate  $1.24 \pm 0.02\%$ .

The results of the chemical quality analyses (TMA, TVB-N, TBA) during the refrigerated storage can be seen in Table 1.

TMAO is an osmoregulating agent in salt water fish muscle. Despite its limited amounts, TMA also can be used as a secondary parameter of spoilage for fish. In fresh fish, trimethylamine (TMA-N) values should be close to 1 mg N/100 g and in spoiled samples it is more than 8 mg N/100 g (FAO, 1986). TMA-N values were determined on the first day of refrigeration as  $1.78 \pm 0.17$  mg N/100 g. However, during the period of 6 days the TMA-N values of the samples increased and on the 6<sup>th</sup> day of storage samples were considered spoiled based on TMA-N value (Table 1). Almost all volatile amines can be separated and total volatile basic nitrogen (TVB-N) includes all volatile amines. TVB-N is a spoilage

index for fish and seafood (FAO, 1986). The FAO has indicated that samples with less than 25 mg N/100 g TVB-N value are 'perfect quality', samples with up to 30 mg N/100 g TVB-N are 'good quality', samples with up to 35 mg N/100 g TVB-N are 'marketable quality' and the samples with more than 35 mg N/100 g TVB-N value are indicated as 'spoiled' (Schormuller, 1968; Ludorff and Meyer, 1973). The concentration of TVB-N in freshly caught fish is typically between 5 and 20 mg N/100 g, whereas levels of 30–35 mg N/100 g fresh are generally regarded as the limit of acceptability for ice-stored cold water fish (Connell, 1995). At the beginning of the storage period the TVB-N values of the samples were  $22.46 \pm 0.51$  mg N/100 g. These values improved that the fish were fresh in the beginning of the storage. However, during the storage the increase was fast, from 22 mg N/100 g tissue to 31 mg N/100 g tissue after 3 days of ice. Civera *et al.* (1995) have also observed a fast and regular increase of TVB-N of a similar pattern as the one presently found, in three *Sparidae* species during refrigerated storage. After 6 days storage, TVB-N values of the samples were found over the limits ( $41.18 \pm 0.89$ ). According to volatile compounds TMA and TVB-N, the shelf life of red band fish in refrigerator storage was lower than 6 days. Similar results have been reported by other authors in different Aegean Sea species (Huidobro, Mendes and Nunes, 2001; Kyrana *et al.*, 1997).

The TBA index is a widely used indicator for the assessment of the degree of lipid oxidation (Nishimoto *et al.*, 1985). The TBA values of the samples can be seen in Table 1. At the beginning of the storage period, TBA value was found as  $2.00 \pm 0.19$  mg malonaldehyde/kg. At the end of the storage, while the samples could be considered spoiled according to the TMA and TVB-N values, no spoilage was detected according to the TBA determination. Changes of TBA values were negligible during the 6 days period. Similar results can be seen in the study of Caklı *et al.* (2008) where TBA values of the samples were determined between  $0.95 \pm 0.11$  and  $1.48 \pm 0.31$  mg malonaldehyde/kg. No oxidation spoilage occurred at the end of the storage period as they were both under the limits. Similar results were found in *Sparidae* species by Connell (1995).

**Table 1.** The results of TMA, TVB-N and TBA during refrigerated storage at  $4 \pm 2^\circ\text{C}$

Storage Days	TMA (mg/100 g)	TVB-N (mg /100 g)	TBA (mg malonaldehyde/ kg)
0	$1.78 \pm 0.17^a$	$22.46 \pm 0.51^a$	$2.00 \pm 0.19^a$
3	$2.09 \pm 0.01^b$	$31.33 \pm 0.51^b$	$2.70 \pm 0.20^b$
6	$20.24 \pm 0.14^c$	$41.18 \pm 0.89^c$	$3.79 \pm 0.15^c$

Different superscript letters within each column represent significant differences ( $p < 0.05$ )  $n=10$ . Each data represents mean value  $\pm$  standard deviation.

### Microbiological Quality Control Results

The initial total aerobic bacteria count of the samples (Table 2) was 3.50 log cfu/g. The microbial load increased during the storage period, showing a value of 4.07 log cfu/g at 3 days of storage, exceeding at day 6 the maximum limit (7 log cfu/g) for microbiological criteria, given by ICMSF (1978) for fresh fish.

In the study of Caklı *et al.* (2008) on a new culture species (*Diplodus puntazzo*), the psychrophilic bacteria count increased from 3.34 to 7.11 log cfu/g for 10 days of refrigerated storage. In another study, psychrophilic bacteria counts for sharp snout sea bream exceeded 7.0 log cfu/g, which is considered the maximum level of acceptability for freshwater and marine fish (Mol *et al.*, 2007) after 8 days. Initial bacterial load is very important for the shelf life since these bacteria grow very quickly and accelerate the spoilage of fish. Bacteria decompose mainly non-protein nitrogen compounds that cause the development of off-odors and off-flavors related to spoilage (Ozogul *et al.*, 2005).

### Color and Texture Characteristics Results

The color values of the samples can be seen in Table 3. L\* values of sample were 40.64±1.14 at the beginning, and 51.61±1.10 at the end of the storage periods. The values increased significantly from the beginning to the 3<sup>rd</sup> day of refrigerated storage.

Positive a\* has known as red and negative represent green color, thus explain that all groups and raw material results brought green values. Statistically no differences were observed in the measured values during the storage. Similar results were also obtained for b\* values (known as yellow when positive and blue when negative) in the samples analysed at different times during the storage.

In relation to the textural analyses results, no significant differences were determined during the storage, with the exception of hardness and chewiness parameters (Table 4). Results showed that the initial values for the hardness, chewiness and springiness parameters of the samples were higher than those registered at the other times. Significant decrease (p<0.05) in the values can be seen in hardness and chewiness values during storage. The results of Alasalvar *et al.* (2001) supported our findings for their study relating to the shelf life of gilt head sea bream. Sigurgisladdottir *et al.* (1999) studied the textural properties of raw salmon fillets and also found similar results.

The sensory panel analysed the samples for the following attributes: odor intensity, fresh odor, color, flakiness, flavor intensity fresh flavor, firmness, chewiness, fibrousness, juiciness and fatness (Figure 1). In the initial day, the panelists found the fish acceptable for consuming with high scores. On the day 3<sup>rd</sup>, the results of sensorial analysis showed the fish were still consumable because the results of all the investigated parameters were within accepted

**Table 2.** Total Aerobic Mesophilic Bacteria Counts (log cfu/g) during refrigerated storage at 4±2°C

0.day	3. day	6.day
3.50±0.12 <sup>a</sup>	4.07±0.06 <sup>b</sup>	7.51±0.03 <sup>c</sup>

Different superscript letters represent significant differences (P<0.05) n=3. Each data represents mean value ± standard deviation

**Table 3.** Color values of the fish during refrigerated storage at 4±2°C

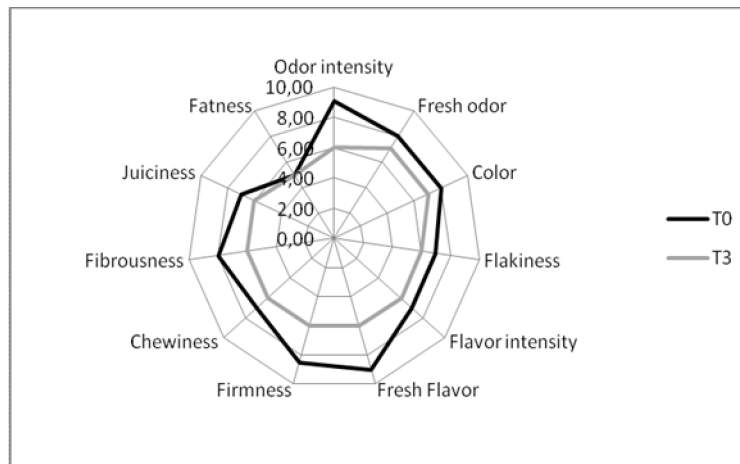
Storage Days	L*	a*	b*
0	40.64±1.14 <sup>a</sup>	-0.60±0.27 <sup>a</sup>	13.12±0.62 <sup>a</sup>
3	51.78±2.47 <sup>b</sup>	-0.58±0.66 <sup>a</sup>	13.70±0.98 <sup>a</sup>
6	51.61±1.10 <sup>b</sup>	-0.78±0.34 <sup>a</sup>	14.08±0.76 <sup>a</sup>

Different superscript letters within each column represent significant differences (P<0.05) n=10. Each data represents mean value ± standard deviation.

**Table 4.** TPA values of the samples during refrigerated storage at 4±2°C

Storage Days	Hardness (g)	Springiness	Chewiness	Cohesiveness	Resilience	Adhesiveness
0	1369.80±1004.84 <sup>a</sup>	0.15±0.04 <sup>a</sup>	127.11±137.7 <sup>a</sup>	0.54±0.02 <sup>a</sup>	0.22±0.04 <sup>a</sup>	-9.80±5.60 <sup>a</sup>
3	300.65±254.35 <sup>b</sup>	0.13±0.02 <sup>a</sup>	24.44±23.41 <sup>b</sup>	0.54±0.07 <sup>a</sup>	0.19±0.03 <sup>a</sup>	-11.55±6.70 <sup>a</sup>
6	288.15±123.60 <sup>b</sup>	0.12±0.02 <sup>a</sup>	22.84±9.95 <sup>b</sup>	0.54±0.06 <sup>a</sup>	0.20±0.04 <sup>a</sup>	11.47±6.70 <sup>a</sup>

Different superscript letters within each column represent significant differences (P<0.05) n=10. Each data represents mean value ± standard deviation.



**Figure 1.** Results of the sensorial analysis performed at the beginning (T0) and on the 3<sup>rd</sup> (T3) day of refrigerated storage at 4±2°C.

limits. According to the chemical and microbiological quality results, the samples were found spoiled on the day 6<sup>th</sup>, therefore, the sensory analysis was not carried out for this day. Fatness attribute was the only value below the desired limits showing that the red band fish is a fatless species.

## Conclusion

The red band fish (*Cepola macrophthalma* Linnaeus, 1758) is not a target species in trawl net operations in Aegean Sea. High amounts of catch can be seen in each trawl net operations. Current study showed that it may be consumed and can be used in bait processing factories. Future studies which will be focus on these hypothesis, may increase the commercial value of red band fish.

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