

## The fifth culture generation of Black Sea Trout (*Salmo trutta labrax*): Culture characteristics, meat yield and proximate composition

### Beşinci nesil Karadeniz Alabalığı (*Salmo trutta labrax*): Kültür özellikleri, et verimi ve besin bileşimi

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**Abstract:** In this research, the culture characteristics of the fifth generation of Black Sea trout (*Salmo trutta labrax* PALLAS, 1814) were evaluated. First of all, trout were cultured in recirculating aquaculture system (RAS) and they kept in RAS until smoltification. After that, they were transported to marine cages till market size. Thus, the ratios of specific growth rate (SGR), feed conversion (FCR), mortality and condition factor (CF) were specified from hatching to 16<sup>th</sup> month and the results were evaluated as pre-smoltification and after-smoltification individually. Moreover, the meat yield and proximate composition of Black Sea trout's fifth generation was specified in market size. Samplings were carried out monthly between February 2014 and May 2015. Fish were started to feed in 0.105±0.007g until they reached to 335.50±44.39g in May 2015. According to results; SGR, CF, FCR and mortality were determined as between 0.98-2.70, 0.86-1.15, 1.02-1.30 and 7.67-7.78% until smoltification stage, respectively. However, they were detected between 0.68-2.36, 1.04-1.20, 0.98-1.35 and 0.01-5.82% after smoltification. Also, the meat yield, viserosomatic index (VSI) and hepatosomatic index (HSI) were found to be 60.30%, 9.28% and 1.65% in market-size respectively. According to chemical analyses, trout meat contains crude protein as 15.22%, fat as 7.21%, ash as 1.51% and water (moisture) as 75.17%. In the view of the results, culture characteristics, proximate composition and meat yield were found similar to other cultured trout species. With these features, the fifth generation can be recommended to aquaculture sector considering the economic value of the Black Sea trout in Turkey.

**Keywords:** Black Sea Trout, feed conversion ratio, proximate composition, condition factor, *Salmo labrax*, endemic

**Öz:** Bu çalışmada, Karadeniz alabalığı (*Salmo trutta labrax* PALLAS, 1814)'ın beşinci neslinin kültür karakteristikleri belirlenmiştir. Öncelikle alabalıklar kapalı devre yetiştiricilik ünitesi (RAS)'nde üretilmiş ve smolt boya gelene dek burada tutulmuşlardır. Sonrasında, alabalıklar deniz kafeslerine transfer edilmişler ve porsiyonluk boya gelene kadar orada tutulmuşlardır. Bu nedenle; spesifik büyüme oranı (SGR), yem dönüşüm oranı (FCR), ölüm oranı ve kondüsyon faktörü (CF) parametreleri yumurtadan çıkıştan 16. aya kadar belirlenerek sonuçlar smolt öncesi ve smolt sonrası olarak verilmiştir. Ayrıca, beşinci nesil Karadeniz alabalığının porsiyonluk boydaki et verimi de hesaplanmıştır. Örneklemeler, Şubat 2014 ile Mayıs 2015 arasında aylık olarak yapılmıştır. Balıklar 0,105±0,007g iken beslenmeye başlanmış ve Mayıs 2015'e kadar 335,50±44,39g'a ulaşmışlardır. Sonuçlara göre; smoltifikasyon öncesi SGR, CF, FCR ve ölüm oranı sırasıyla 0,98-2,70, 0,86-1,15, 1,02-1,30 ve %7,67-7,78 aralıklarında belirlenmiştir. Ancak bu parametreler smoltifikasyon sonrası 0,68-2,36, 1,04-1,20, 0,98-1,35 ve %0,01-5,82 olarak belirlenmiştir. Ayrıca; pazar boydaki et verimi, viserosomatik indeks (VSI) ve hepatosomatik indeks (HSI) değerleri sırasıyla %60,30, %9,28 ve %1,65 bulunmuştur. Kimyasal analizlere göre, alabalık eti %15,22 ham protein, %7,21 ham yağ, %1,51 ham kül ve %75,17 su (nem) içermektedir. Sonuçlar açısından, kültür özellikleri, besin bileşimi ve et verimi diğer kültüre alınan alabalık türlerine benzer bulunmuştur. Bu özellikleri ile, Karadeniz alabalığının ekonomik değeri de göz önünde bulundurulurken, beşinci nesil yetiştiricilik sektörüne önerilebilir.

**Anahtar kelimeler:** Karadeniz alabalığı, yem dönüşüm oranı, besin bileşimi, kondüsyon faktörü, *Salmo labrax*, endemik

## INTRODUCTION

The aquaculture has increasing all over the World and culturing of new species are achieved day by day (FAO, 2017). Salmonidae species are integral part of the aquaculture sector (Emre and Kurum, 1998; Herrmann et al., 1993; Katz, 2016) with their extensive economic value (Yeakley and Hughes, 2013) and they adapted to many countries having various environmental conditions since 1970 (Knapp et al., 2007). In Europe, Atlantic salmon (*Salmo salar*) and rainbow trout

(*Oncorhynchus mykiss*) which have great importance for aquaculture sector (Alexandre and Palstra, 2017; Janssen et al., 2015; Liu et al., 2016) are cultured extensively for a long time (Elliot, 1975; Taranger et al., 2015) consisting almost 60% of total finfish production (European Commission, 2015). Economic profitability of aquaculture and the rising importance of product variety made Salmonids as significant (Bagliniere and Maisse, 1991). For this reason, there are lots of Salmonidae

species around the world which are cultured (Okumus, 2000).

Black Sea trout (*Salmo trutta labrax*) is also belongs to Salmonidae family and endemic species for eastern Black Sea (Geldiay and Balik, 1996; Innal and Erk'akan, 2006). Black Sea trout reproduce in up of the rivers where the same river they were hatched from the egg usually and they migrated to sea after smoltification for feeding parallel with growing (Geldiay and Balik, 1996; Slastenenko, 1956; Solomon, 2000; Svetovidov, 1984). This species has three ecotypes such as river, sea and lake and all of them found in Black Sea region of Turkey (Tabak et al., 2001). However, Black Sea trout is listed within important and vulnerable species by Black Sea Biodiversity and Landscape Conservation Protocol (2003). Despite the IUCN Red list (2016) state that *Salmo trutta labrax* not yet been assessed for their database, this species endangered according to several domestic lists (GRID, 1999; Peev et al., 2011) in Black Sea countries such as Bulgaria, Georgia and Russia. For this reason, the culture adaptation studies of this species were started by the Central Fisheries Research Institute (CFRI) from Turkey with the aim of conservation of Black Sea trout since 1998. After the success of the Black Sea trout culture, the culturing of this species has become prevalent especially in Eastern Black Sea region. Nowadays, nineteen fish farm which are registered to Republic of Turkey, Ministry of Food, Agriculture and Livestock are culture Black Sea trout legitimately and their culture reached 1440 ton per year in 2015 (TSI, 2016). Ultimately, the fifth culture line (F5) was achieved today with the works carried out such years. In this study; culture characteristics, meat yield and proximate composition of the latest culture line (fifth) of Black Sea trout were evaluated.

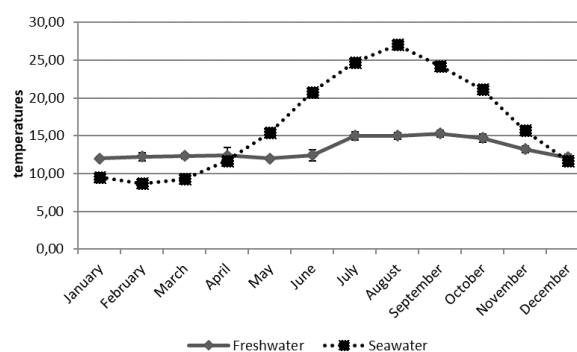
## MATERIALS AND METHODS

### Fish material

Broadstocks caught from their natural habitats which they are rivers of Firtina, Caglayan and Kapistre in northern Black Sea region in 1999 and they were adapted to culture conditions. In this study, fourth generation (F4) of Black Sea trout used as broadstocks and fifth generation (F5) which is latest culture line produced by Central Fisheries Research Institute in 2014-2015 breeding season were used in main study. The fertilised eggs of Black Sea trout are develop till 28th day, hatch in 41th day (Firdin et al., 2012) and larvae are consumes their yolk sac completely until 30th day after the hatching (Cankiriligil et al. 2016). In January, obtained larvae were started to feed and growing was started to monitoring in February 2014. Approximately 4000 larvae were used in this study. All experiments were carried out in accordance with ethical conduct amendments of ARRIVE guidelines (Kilkenny et al., 2010) and European Union Directive as 2010/63/EU (European Commission, 2010).

### Tank material and rearing conditions

Main study was carried out in both recirculation aquaculture system (RAS) at around 10°C and marine cages within the range of 6.5 °C - 29 °C sea temperature and %0.17 salinity between February 2014 and May 2015. After that, the growing of larvae till smoltification were carried out in recirculating system having 1x1x05m fiber tanks with 6.9 lt/min flow rate and 10 % water exchange per day. Stock density was set as 10 kg/m<sup>3</sup> for fish until smoltification (Çakmak et al., 2010). After smoltification, fish were transported and stocked as 20 kg/m<sup>3</sup> to marine cage unit having 4x4x3m net cages (operated in 40°57'35.07"N, 39°51'21.17"E) in December in order to complete their life-cycle. Water temperatures were measured three times a day with thermometer in both RAS and marine cage units and were shown in Figure 1.



**Figure 1.** Yearly temperature records of freshwater re-circulating aquaculture system and marine cages. The lowest sea temperatures were recorded as 6.5°C in marine cages and 11.97°C in RAS unit. The highest temperatures were recorded as 29°C in marine cages and 15.28°C in RAS unit.

### Feeding

In the study, commercial rainbow trout feed which they are different size were used for feeding fish (Table 1). Firstly, fish were fed with daily equal to 3 percent of live fish weight and in time, this ratio was decreased to 1.5 percent parallel with fish growing. In feeding, 300-500µ granule feed was used as pre-growing feed and in time, different sized granule feed in range of 500-800µ and 6mm were used respectively. Feeding was carried out 5 times per day in starting and 3 times per day in growing.

**Table 1.** Commercial rainbow trout feed ratio

Composition	Pre-growing	Growing
Protein (min %)	50.0	49.0
Fat (min %)	15.0	15.0
Ash (max %)	12.0	12.0
Cellulose (max %)	2.0	3.0
Moisture (max %)	12.0	10.0
Phosphor (min %)	1.5	1.5
Metabolizable energy (kcal/kg)	4150.0	4000.0

### Determination of growth characteristics

In this study, Fulton's condition factor (CF), weight gain (WG), specific growth rate (SGR), feed conserving ratio (FCR), survival rate (SR), meat yield, hepatosomatic index (HSI) and viserosomatic index (VSI) were determined in order to determinate growth characteristics of Black Sea trout' fifth generation. The measurements were carried out monthly. Fish length measured with Von-Bayer scale and the weight was determined by using digital balance with an accuracy of 0.01g (Holden and Reitt, 1974).

The equations given below were used in order to calculate these characteristics.

Fulton's condition factor (CF) (Ricker, 1975);

$$CF = (W / L^3) \times 100 \quad W: \text{Weight (g)}, L: \text{Length (cm)}.$$

Weight gain (Ji *et al.*, 2011);

$$GR \% = [(W_2 - W_1) / W_1] \times 100 \quad W_1: \text{Starting weight (g)}, W_2: \text{Final weight}$$

The specific growth (Bagenal and Tesch, 1978; Houde and Scheckter, 1981);

$$SGR \% = [(\ln W_2 - \ln W_1) / t] \times 100 \quad W_1: \text{Starting weight (g)}, W_2: \text{final weight (g)}, t: \text{duration}.$$

Feed conversion ratio (Ebrahimi and Ouraji, 2012);

$$FCR = F_o / W_g \quad F_o: \text{Consumed feed amount (g)}, W_g: \text{Weight gain}.$$

Survival rate (Kritsanapuntu *et al.*, 2013);

$$SR: 100 \times (n_1/n_0) \quad n_1: \text{Final living fish quantity}, n_0: \text{starting living fish quantity}.$$

The meat yield was calculated with edible meat after the fish filleted and separated all organs such as gonad, digestive tract, gill and others. An equation was used to estimation of meat yield given below (Özcan, 2005). Also, viserosomatic index and hepatosomatic index were calculated according to this equation.

$$\text{Meat yield} = [\text{Meat weight (g)} / \text{Total weight (g)}] \times 100$$

$$VSI = [\text{Viscera weight (g)} / \text{Total weight (g)}] \times 100$$

$$HSI = [\text{Liver weight (g)} / \text{Total weight (g)}] \times 100$$

### Proximate composition analysis

Total moisture, crude protein, fat and ash contents were determined to identify proximate composition. In the analyses, 30 market-sized fish was used. Trout fillettes were used as whole and sectioned from three different body parts. First of all proximate composition of whole fillettes were determined. Subsequently, fillettes were cut into two pieces throughout from anus to dorsal, vertically. The meat tissue from anus to caudal fin named as caudal section. Second part of the fillet were also

divided two pieces throughout to linea lateralis and upper part was named as dorsal, lower part was named as abdomen sections. Ultimately, Moisture content was analysed by Horwitz (2000). Samples dehydrated in drying oven at 110°C for 6 hours in each sample (Horwitz, 2000). Crude protein was determined by Kjeldahl (AOAC, 2000) method. In this method, the samples were digested with sulphuric acid and Kjeldahl catalyst containing selenium. Afterwards, the samples were distilled with sodium hydroxide. Further, the samples were titrated with HCl and obtained data were calculated by using 6.25 nitrogen conversion factor for fish and fishery products. The crude fat was specified by Folch *et al.* (1957). According to this method, fat content of fish meat was extracted from 5 gram of fish meat with 10 milliliter chloroform:methanol mixture (2:1) for 12 hours. The extracted samples were evaporated with a rotary evaporator at 55°C until the mixture was concentrated. Afterwards, Total crude ash was determined by Horwitz (2000) method. According to the method, the samples were at 600°C for 6 hours in burned by muffle. Ultimately, the obtained data of total fat and ash were estimated as percentages.

### Statistical analyses

Differences between groups means were determined by one-way analysis of variance ANOVA using Tukey's multiple comparison tests. The level of significance was set as 0.05 (Zar, 1999). All statistics analyses were calculated using IBM SPSS Statistics package programme version 21.0.

### RESULTS AND DISCUSSION

The results were evaluated as pre-smolt and after-smolt along with their culture environment. In the beginning, fish mean weight determined as 0.105±0.007g and they reached to smolt length with 12.67±0.69cm length and 19.84±3.16g weight in 10<sup>th</sup> month. Cakmak *et al.* (2007) stated that, smoltification of Black Sea trout occurs between 11.25–11.50 cm and after smoltification they can adapt to marine conditions quickly same as Atlantic salmon (*Salmo salar*) (Davidson and Good, 2016). After smoltification, trouts were transferred to marine cages and they reached to 335.50±44.39g in feeding trial ends (Table 2). The SGR were determined as highest in 4<sup>th</sup> month with 2.70 and in 12<sup>th</sup> month with 2.36, lowest in 2<sup>nd</sup> month with 1.18 and in 15<sup>th</sup> month with 0.68, in pre-smolt and fillet-size respectively. In smolt size, SGR was determined as 0.98. The condition factor was calculated lowest in pre-smolt with 0.86±0.09 and highest in after smolt with 1.20±0.10. In smolt size, CF was calculated as 0.97±0.08. The decrease of condition factor occurring in smolt size related to fish transporting to marine cages as well as stress caused by saltiness of Black Sea. The mean of feed conversion ratio was determined as 1.10±0.12 in pre-smolt, 1.18±0.12 in after smolt respectively. The survival rate was determined as 93.89±3.75% in fresh water and 99.44±0.96% in marine cages. Finally, the mean weight of trout individuals calculated as 335.50gr as well as maximum as 347.85gr and minimum as 257.95gr. Growing parameters of Black Sea trout were shown in Table 2.

**Table 2.** Growing parameters of Black Sea trout alevin from hatching to 16th month between February 2014 and May 2015. CF: Condition factor, GR: Growth rate, SG: Specific growth, SGR: Specific growth rate, FI: Feed intake (biomass day %).

n:50	Length	Weight	CF	GR	SG	SGR	FI
Feb	2.30±0.10 <sup>n</sup>	0.11±0.01 <sup>i</sup>	0.86±0.09 <sup>g</sup>	-	-	-	-
Mar	2.60±0.14 <sup>n</sup>	0.15±0.02 <sup>i</sup>	0.88±0.06 <sup>g</sup>	32.38	0.11	1.18	%3
Apr	3.00±0.25 <sup>n</sup>	0.24±0.06 <sup>i</sup>	0.88±0.09 <sup>g</sup>	52.52	0.24	1.85	%3
May	3.80±0.34 <sup>m</sup>	0.50±0.13 <sup>j</sup>	0.88±0.06 <sup>g</sup>	124.53	0.88	2.70	%3
Jun	4.70±0.30 <sup>l</sup>	1.09±0.22 <sup>j</sup>	1.00±0.06 <sup>f</sup>	120.38	1.91	2.17	%2.5
July	6.50±0.59 <sup>k</sup>	3.16±0.79 <sup>hi</sup>	1.13±0.08 <sup>ef</sup>	274.64	9.60	2.21	%2.5
Aug	8.10±0.69 <sup>j</sup>	6.03±1.54 <sup>hi</sup>	1.11±0.07 <sup>e</sup>	28.24	3.70	2.16	%2
Sep	9.48±0.81 <sup>i</sup>	10.04±2.70 <sup>gh</sup>	1.15±0.08 <sup>d</sup>	99.80	16.77	1.70	%2
Oct	10.80±0.75 <sup>h</sup>	14.78±3.22 <sup>gh</sup>	1.14±0.07 <sup>cd</sup>	33.76	11.33	1.29	%2
Nov	12.67±0.69 <sup>g</sup>	19.84±3.16 <sup>fg</sup>	0.97±0.08 <sup>bcd</sup>	28.66	12.87	0.98	%2
Dec*	14.10±1.13 <sup>f</sup>	32.1±6.22 <sup>f</sup>	1.04±0.09 <sup>bc</sup>	73.86	42.67	1.61	%1.5
Jan	17.72±1.17 <sup>e</sup>	65.33±11.05 <sup>e</sup>	1.17±0.07 <sup>bc</sup>	119.62	120.13	2.36	%1.5
Feb	21.91±1.23 <sup>d</sup>	124.19±23.72 <sup>d</sup>	1.17±0.08 <sup>bc</sup>	69.99	154.37	2.14	%1.5
Mar	25.49±1.12 <sup>c</sup>	196.63±24.71 <sup>c</sup>	1.18±0.06 <sup>bc</sup>	57.51	215.63	1.53	%1.5
Apr	27.20±1.34 <sup>b</sup>	241.15±31.20 <sup>b</sup>	1.20±0.09 <sup>ab</sup>	25.95	153.27	0.68	%1.5
May	30.30±1.63 <sup>a</sup>	335.50±44.39 <sup>a</sup>	1.20±0.10 <sup>ab</sup>	41.46	308.40	1.10	%1.5

\* Values are expressed as mean ±SD (n = 3), mean values in column with different superscripts were significantly different (P < 0.05).

The first generations of Black Sea trouts (F1) which they have 2.47±0.017 cm length and 0.093±0.0018g weight in starting were bred for year in freshwater. According to results; trouts reached to 11.6±0.337 cm and 17.12±1.645 in one year. Afterwards they transported to marine cages and they showed quick growth rates in that environment as 20.1±0.589 cm and 101.77±8.957 g within three months. Their condition factor risen from 0.63± 0.016 to 1.04± 0.010 in end of the feeding trial. Moreover; their FCR were stated as 2.52±1.41 and 2.83±0.70, survival rate were stated as 90.14±12.52% and 91.85±14.30% in pre-smolt and after-smolt era, respectively (Tabak et al., 2001). Along with these, Black Sea trouts (F1) cultured in Abkhazia, Georgia reached to 20.9 cm length and 90.3 weight within 20 months (Solomon, 2000). In this study, the quick smoltification until 10<sup>th</sup> month and reaching fillet-size in 15<sup>th</sup> month are achieved with selected breeding studies carried out since 1999 as well as decreases of mortality and feed conversion ratios in both pre-smolt and after smolt stages. According to results, condition factor was found higher to other studies carried out with first generations of Black Sea trout. The increase of condition factor in fifth generations also means to high meat yield and this condition were supported meat yield calculations. According to calculations, the meat yield of Black Sea trout's fifth generation was calculated as 60.30±1.91% in fillet size. Atasaral Sahin et al. (2011) found meat yields ratios as 65.39% for *Salmo trutta labrax*, 67.28% for *Salvelinus fontinalis* and 69.83% for their hybrid. Also, Akhan et al. (2010) stated that meat yield of Rainbow trout that reared in Black Sea is varied between 66.06±3.03% and 70.96±2.55%. After the trouts cleaned their bones, skin and whole viscera, they lose approximately %40 lose their total weight. Some cases, the meat yield can be observed lowly by reasons of gonadal growing caused by reproduction season as well as high VSI and HSI rates caused by over-feeding of some illnesses. Thus, viserosomatic index and hepatosomatic index were found as 9.27±1.12%, 1.65±0.86%, respectively. In the Black Sea trout's

reproduction season, the size of gonads become larger until spawning and this situation meat yield are observe lowly (Çakmak et al., 2007). The reproduction season starts in November and continue to mid-january, in culture conditions (Çakmak et al., 2007). In our study, fillet-sized fish which they are not reached reproduction stage yet were used and this caused to low viserosomatic index rate as 9.27±1.12%.

Uysal and Albaz (2002) states that, wild Abant trout (*Salmo trutta abanticus*) and rainbow trout (*Oncorhynchus mykiss*) reached from 0.088±0.01g, 0.093±0.01g to 5.250±0.34g, 133.96±9.24g within 350days, respectively. Besides that, their condition factor as 0.90±0.01, 1.15±0.03 and mortality rate as 71%, 35% were determined. According to another research, brook trout (*Salvelinus fontinalis*) which they have 6.02±1.69 g weight in feeding trial was started is growth to 230.28±75.73g in saltwater, 318.50±99.39 g in freshwater. Also, feed conversion ratio and mortality rate were determined as 1.71 and 58.5% in saltwater as well as 1.73 and 49.2% in freshwater (Okumus et al., 1998). Also, Ustaoglu and Bircan (1998) stated that rainbow trout (*Oncorhynchus mykiss*) bred in marine cages has 1.92±0.11 FCR, %17.92 mortality and 1.38±0.04 condition factor and they reached from 139.7g to 513.5±14.93g in the end of the 109 days of feeding trial. In our results, condition factor, survival rate and growth rate were found higher than the Abant trout (*Salmo trutta abanticus*) which is endemic species for Turkey and being cultured for the purpose of relasing to the rivers. Furthermore, while growth and mortality rates of rainbow trout cultured in freshwater which are one of the most cultured species in both fresh water and seas in Turkey (TSI, 2016) were found more than this study, condition factors were found statistically same. Our results also show that, Black Sea trout has lower growth rate and condition factor than rainbow trouts cultured in saltwater. When we compared to our results to data of other trout species cultured in Turkey, it is obvious fact that, the fifth generation of Black

Sea trout is promising species for aquaculture sector in terms of culture characteristics.

The lifelong alterations in the growth parameters of Atlantic salmon have been determined and listed below; mean smolt length as 14.8 cm (10.5–21.5 cm), mean smolt age as 2.91 years (1.04–5.85), mean survival rate from egg to smolt as %1.5 (%0.2–3.2), comeback length as 56.8 cm (48.5–70.0 cm), maturing in sea as 1.6 year (1.00–2.64) and rate of smolt to grilse as %7.4 (%1.3–17.5) (Hutchings and Jones, 1998). The mortality rate, specific growth rate and feed conversion rate belonging to Atlantic salmon which fed by nourishments included different levels of phospholipid, have been determined and listed as %3.57±0.90-%5.50±0.67; (SGR) 1.34±0.14-1.45±0.08; (FCR) 0.76±0.09-0.89±0.14, respectively (Taylor *et al.*, 2015). The individuals of Atlantic salmon have been weighted as 5.5 g on the average in the beginning of the experiment which nourished with products included different amounts of fish flour, wheat gluten flour and soya protein. At the end of an eighteen-week experimental period, final weight, total feed consumption and FCR values were detected and the values ranges between 19.23-27.29 g; 35.44-40.18 g; 1.85-2.63, respectively (Burr *et al.*, 2012). Other individuals of the species which were of 31.5 g on the average weight in the beginning have been observed for twelve-week period in the same study. Feeding products contained fish oil, chicken flour, corn and soya proteins were used during the experiment. At the end of the period; the final weight, total feed consumption, FCR and survival rate values were measured and the values range between; 101.7-109.9, 70.0-75.9g, 0.86-0.95 and 92.4-96.3, respectively. It is highly possible to accept the potential efficiency of the Black Sea trout in the aquaculture sector due to the approximate values of breeding performance of the Rainbow trout which cultured for more than a hundred year and of the brown trout cultured worldwide. It is recommended for the administrations to separate the broodfish from the broodstock after the age of 6 in which a decreasing performance in breeding is seen, in the applications of brood management. While rainbow trout adapted itself into sea water in the month of November which has the most proper sea water temperature, Black Sea trout until the 5th generation could be grown to the size that it can hardly be adapted to sea water in the late period. To grow the F5 Black Sea trouts, which were produced in 2014 – 2015 producing period by CFRI, into smolt

size will increase the profit by providing usage in advantages of sea water in producing.

According to proximate composition analysis; fifth generation of Black Sea trout meat has 75.17±1.21% moisture, 15.22±0.48% crude protein, 7.21±0.20% crude fat and 1.51±0.12% crude ash in fillet sized individuals. However, some chemical differences were observed by body parts. The meat obtained from dorsal section has highest crude protein as 16.71±0.44% and ash as 1.71±0.11%, the tail section has highest ratio of water as 76.20±1.02%. In abdomen, ratio of fat was determined as 10.38±0.51% and this amount is approximately two times higher than the meats sectioned from dorsal and tail sections. Proximate composition of Black Sea trout was shown in Table 3. The meat of Black Sea trout has high amount of protein, fat and ash. However, proximate composition of body parts shows differences. Abdomen section has highest fat ratio, lowest protein and moisture ratio. Contrary to this, dorsal section has highest protein and lowest fat ratios. Fish use dorsal muscles and tail for swimming and navigation. For this reason, these sections have more muscles and protein than the abdomen as might be expected (Videler, 1993; Wardle *et al.*, 1995). The abdominal part of the muscle tissues are major fat storage sites in Salmonids (Nanton *et al.*, 2007). Likewise, Black Sea trout is rich in terms of fatty acids (Sahin *et al.*, 2011) and moisture and fat are exist inversely correlated in food according to Dean (1990). Also, muscles need to carbohydrates which are mostly stored in muscles in the form of glycogen (Torgersen *et al.*, 2014) in order to compensate energy requirement for swimming (Palstra and Planas, 2011). For this reason, carbohydrate ratios were found more in dorsal and tail sections than the abdomen. Other studies that aim to evaluate proximate composition of Salmonid species in Turkey found similar results to ours. *Salmo trutta macrostigma* has 78.90±1.001%, 16.22±0.012%, 2.55±0.157%, 1.33±0.020% , *Salmo trutta abanticus* has 78.02±0.10, 18.91±0.18%, 1.44±0.03, 1.20±0.19 (Uysal *et al.*, 2002), *Salmo trutta forma fario* has 78.30±0.36, 17.36±0.13, 2.71±0.21, 1.16±0.03 (Kaya *et al.*, 2014), *Salvelinus fontinalis* has 23.46±0.15%, 69.51±0.37%, 9.92±0.07%, 8.05±0.18 (dry weight basis) (Sahin *et al.*, 2011), *Oncorhynchus mykiss* has 77.78±1.10%, 15.47±0.21%, 4.11±0.55, 1.94±0.04% (Çankırılıgil & Berik, 2017) moisture, crude protein, fat and ash, respectively.

**Table 3.** Proximate composition of Black Sea trout's fifth generation

%	Dorsal	Abdomen	Caudal	Whole meat
Moisture	75.43±1.21 <sup>b</sup>	72.87±0.89 <sup>c</sup>	76.20±0.41 <sup>a</sup>	75.17±1.42
Protein	16.71±0.44 <sup>a</sup>	14.49±0.24 <sup>c</sup>	15.21±0.51 <sup>b</sup>	15.22±0.48
Fat	4.71±0.52 <sup>c</sup>	10.38±0.51 <sup>a</sup>	6.03±0.47 <sup>b</sup>	7.21±0.20
Ash	1.71±0.11 <sup>a</sup>	1.54±0.22 <sup>b</sup>	1.45±0.31 <sup>c</sup>	1.51±0.12
Carbohydrate	1.44±0.03 <sup>a</sup>	0.72±0.01 <sup>c</sup>	1.11±0.01 <sup>b</sup>	0.89±0.02

\* Values are expressed as mean ±SD (n = 3), mean values in row with different superscripts were significantly different (P < 0.05).

Values of whole meat were not used in statistical analyses. It is fact that, best way of supplying fish source regularly and

constantly to food sector is aquaculture in terms of sustainability (Anderson, 2007; Broitman *et al.*, 2017).

According to Teletchea and Fontaine (2014) aquaculture industry can focus on domestication of native fish species in future. Besides, 60% of European consumers like to try new fish products and species (European Commission, 2017). Thus, Black sea trout culture is becoming prevalent to aquaculture and seafood sector with all these developments. In sum, the growth performance and culture characteristics of individuals belongs to fifth culture line were evaluated in this study considering the profitable economic production models that use to culturing of Black Sea trout in Turkey. Moreover, the meat yield and proximate composition of F5 culture line were determined with the purpose of reveal that Black Sea trout as a valuable and nutritious fish species same as other prominent Salmonids. It is expected that the study will submit further data to science community as well as becoming a source for Black Sea Trout culturing sector having a great importance for the food sector and the consumer.

## CONCLUSION

Black Sea trout same as Rainbow trout are bred to a certain length in fresh water facilities and transplanted to cages in the

Black Sea, when the temperature of seawater is convenient. In this manner, an aquaculture model has been used which took the advantages of salt water on the trout growth in this study. Besides, Black Sea trout has high potential for aquaculture sector. In this research, culture characteristics, meat yield and proximate composition of the Black Sea Trout's (*Salmo trutta labrax*) fifth generation (F5) were evaluated. In a conclusion, the fifth generation can be suggested to aquaculture sector as a new culture line with their similarities other cultured Salmonid species in terms of both culture conditions and consumer interests.

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