Engineering Sciences
ISSN: 1308 7231 (NWSAENS)
ID: 2017.12.4.1A0394

Status : Original Study
Received: May 2017
Accepted: October 2017

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DOI	**http://dx.doi.org/10.12739/NWSA.2017.12.4.1A0394**
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SERUM BIOCHEMISTRY OF FARMED BLUEFIN (*Thunnus thynnus* L.) IN THE AEGEAN SEA

ABSTRACT

Values of blood biochemistry are important for all animals in terms of health and welfare, providing knowledge of evidence in diseases. One of the most economically important fish species bluefin tuna-BFT (*Thunnus thynnus* L.) in aquaculture considering high prices in the related business. Accordingly, farmers care about fattening fishes and some analyses provide significant knowledge, especially blood analyses for them. In the study, blood samples were recovered from fishes (10 male and 12 female) in fattening farms at Ildır, Çeşme, İzmir province, East of Aegean Sea. Fork length and weight values were 140-180cm, and 40-80kg, respectively. Water quality parameters such as temperature, salinity, dissolved oxygen, pH and turbidity were indicated as 16-20°C, ‰ 35.7-38.2g L^{-1}, % 6.9-7.8mgL^{-1}, 36.8-38.2m. The research measured uric acid 4.32mg/100mL^{-1}, creatinine 1.12mg/100mL^{-1}, serum urea concentration 15.04mg/100mL^{-1}), albumin 2.30g/100mL^{-1}, globulin 2.56g/100mL^{-1}, total protein 6.15g/100mL^{-1}, serum glutamic oxaloacetic transaminase 178.24UL^{-1}, serum glutamate pyruvate transaminase 141.52UL^{-1}, alkaline phosphatase 54.26UL^{-1}, g-glutamyl transferase 220.14UL^{-1}, total cholesterol 272.04mg/100mL^{-1}, triglycerides 320.75mg/100mL^{-1}, high-density lipoprotein 88.68mg/100mL^{-1} and low-density lipoprotein 180.18mg/100mL^{-1}. Results during the fattened period in growing cages indicates that BFTs were under pressure and stress attacks because of unnatural habitats such as feeding, narrow area etc. in farm area. Also, males were more sensitive and undergo more stress than females.

Keywords: Bluefin tuna, *Thunnus thynnus*, Serum Biochemistry, Fattened Fish, Farm Areas

How to Cite:
Perçin, F., Konyalıoğlu, S., Fırat, K., Saka, Ş., and Özden, O., (2017). Serum Biochemistry of Farmed Bluefin (*Thunnus Thynnus* L.) in The Aegean Sea, **Engineering Sciences (NWSAENS)**, 12(4):271-276, DOI: 10.12739/NWSA.2017.12.4.1A0394.

1. INTRODUCTION

Bluefin tuna fish (*Thunnus thynnus* L. 1758) is one of the fish species of greatest economic value in Turkey as well as across the world the fact that its meat has been consumed to produce traditional sushi and sashimi in Far East Counties especially in Japanese Fisheries Market (Tokyo Fish Market) further increases its importance. Popularly known as diamonds of oceans, tuna fish gradually decreases in number. Therefore, it is included in the list of endangered fish species [1, 2, 3 and 4]. However, institutions have been established which monitor universal tuna fish catching and quota amount of catches in order that the species should survive and reproduce in terms of sustainability. Of such Institutions called International Commissions and Conservations of Bluefin Tunas (ICCBFT), the one in Mediterranean basin is named International Commissions and Conservations of Atlantic Bluefin Tunas (ICCAT) [3, 4, 5 and 6].

Those commissions reregulate catching quotas in oceans and regions where they have been established and determined given amount of fish catching quotas in nations with permission of tuna fisheries. Accordingly, catching pressure over tuna species all over the world is minimized with quotas for minimum fishing [2, 4, 5 and 6]. Tuna fish have been recently captured live in nature and dragged in cages to be extensively fed (*ad libitum*) for about 6-8 months at minimum, harvested and sent to Japan. Following catching and dragging in cages from April, May, June through July reduces catching pressure on tuna species and prevents poaching thanks to minimal catching quotas, captives are fed by mackerel, sardine, ringa, twait shad and squids with high protein content. They are finally harvested and exported in winter. The reason for harvesting them in winter is because its meat quality and world market value is high in this season [3, 5, 6 and 7]. Blood biochemical parameters in humans and many other animals' exhibit knowledge of feeding metabolism, growth and digestive system as well as health and disease parameters. Levels of liver enzymes in particular show such values above and cannot be easily affected by variations in external factors [8 and 9]. In addition, they provide us with many physiological parameters such as health of heart, kidneys and renal systems and circulatory systems as well. Such data obtained in early periods of time give us knowledge of health of live organism, catching diseases and immune system. Therefore, dangers (cirrhosis …,) can be easily determined early and harvesting can be made prior to diseases due to timely precautions [3, 8, 9 and 10]. The present study exhibits cholesterol profiles to indicate vascular health and hepatic fattening levels in addition to serum glutamic oxaloacetic transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), and alkaline phosphatase (ALT), g-glutamyl transferase (GGT) to clarify liver health. Moreover, parameters to explain renal (kidney) functions as well as liver processes mechanisms of protein metabolism such as, albumin, creatinine and uric acid etc in live bluefin tunas.

2. RESEARCH SIGNIFICANCE

Tunas are including seven migratory fish species and the giant and commercial group is bluefin tuna (*Thunnus sp.*, L). The genus *Thunnus sp.* consist of three sub group and the giant and most expensive fish of them is Atlantic Bluefin Tuna (*Thunnus thynnus* L.) otherwise it is konwn as "Diamond of the Sea" in the Mediterranean. In Turkey, bluefin tuna is one of the significant fish species export to Japan, such as sea bass, sea bream, and rainbow trout. Thus, meat quality and health of bluefin tuna during the fattening period in farm cages are significantly important for fish producer and manufacturer.

On the other hand, blood biochemistry values are important for all animal health mainly farmed animals. Because it gives significant knowledge for health, welfare and disease impacts before illness of commercial farm animals such as farmed fishes or poultries. Thus, the values of blood biochemical parameters give important data to understand bluefin physiology and fattening in farm conditions such as stress attacks. Also, in the literature few references on blood biochemistry are detect on fish especially bluefin. Hence, the study gives some valuable knowledge on blood structure of bluefin tuna and gives important knowledge to researchers, producers and manufacturers.

3. MATERIAL AND METHOD

3.1. Study Area

The study was conducted in feeding farms at Ildır, Çeşme, İzmir province in Aegean Sea in west of Turkey. Water Quality: Quality values of water that is temperature, salinity, dissolved oxygen, turbidity and pH data were determined with Oxyguard Handy Gamma (Oxyguard Int. A/S Denmark) and pH meter (Hanna Inst. RI, USA) from the cages of bluefin tuna. Sampling: Fork length and weight of BFT were measured with ±0.1cm with fish size bar and ±0.1kg weighing instrument. Also genders were detected after harvesting with visual inspection. Feeding: Tuna fish were fed by mackerel, sardine, ringa, twite shad, and squids with *ad libitum* once a day in the morning. Divers check out fishes in cages twice a day. Blood Sampling: Blood samples were recovered from 10 male and 12 female tuna fish in harvesting process.

3.2. Method

Immediately after blood samples were taken from pectoral veins with vacutainer during harvesting, they were centrifuged at 4000g for 4–5 minutes to separate serums which where separately taken into another tube and brought in CO_2 ice storage at -78°C to laboratory where they were preserved at -80°C until analyses. Blood samples were taken out of cold storage during analysis and thawed out. They were later fed into automatic blood chemistry analyser (Mindray BS 300 Medical Instrumentation chemistry analyser) to be analysed using its mindray reagent kits. The parameters were measured of uric acid, serum urea concentration (SUC), albumin, globulin, total protein, serum glutamic oxaloacetic transaminase (SGOT), and serum glutamate pyruvate transaminase (SGPT), alkaline phosphatase (ALT), g-glutamyl transferase (GGT), total cholesterol (T CHOL), triglycerides (TRIG), high-density lipoprotein (HDL) and low-density lipoprotein (LDL). All the analyses were repeated three times for each.

3.3. Statistics

Analyses were repeated three times. Results were data analyzed using SPSS stat program on PC. One Way-ANOVA analyses were made using the data above. Later, Mann Whitney U test was employed in comparison between males and females to finally determine statistical significance values.

4. RESULT AND DISCUSSION

First of all, water quality parameters such as temperature, salinity, dissolved oxygen, pH and turbidity values were found indicated as 16–20°C, %35.7–38. 2g L^{-1}, %6.9-7.8mgL^{-1} and 36.8–38.2m. These parameters were suitable range for fish farming production and no pollutants in the sampling areas [1, 2, 3, 5 and 6].

The average mean of fork length and weight of bluefin tuna were 140-180cm, and 40-80kg respectively. In addition, mean values of fork length in male and female ones were measured as 138-185cm and 141-181cm. Also, data of weights were found as 39-84kg and 42-86kg respectively in both ones. In addition, levels of food conversion ratio in bluefin tuna were detected as 10:1-15:1 in the cage area. According to the obtained results, liver function tests and enzyme values in fish were shown in table 1. Fishes fed *ad libitum* under cage area and stress conditions present acute short term and long-term variations. Such values were shown those blood levels which indicate long-term liver functions. Furthermore, values of uric acid, creatinine, albumin, serum urea concentration, globulin, total protein, imply kidney and renal functions and protein metabolism, as well as definition of liver functions in fishes [3, 8, 9 and 10].

The fact that fishes remain in cages for a long time where they are fed and affected by environmental physical and chemical conditions influences their physiological functions [1, 2, 4 and 6]. In addition, rapid fattening fishes for a short time naturally change their digestive metabolism of ingested food as well. For this reason, the data obtained enlightens us on structure and health excretory system such as kidneys as well as those of digestive system [3, 8 and 9]. Cholesterol profiles provide us with data of important metabolic system this orders such as distention of liver, hepatic fattening and fat storage in addition to liver's functions. Values of Triglyceride, HDL cholesterol and LDL cholesterol show data of function and health of cardio vascular system and veins. Increases in the above parameters particularly suggest internal venous and arterial lipoproteins which indicate risks of acute cardiac crisis and increase sensitivity in fishes as well as in many animals and human beings [3, 8, 9 and 10]. Such fishes are exposed to acute cardiac crisis under any stress situations or sudden stress levels (thunderbolt and sudden lightning). Fattening farms experience such sudden mass mortalities. As a result, fishes die prior to being harvested with significant losses in terms of economy [3, 6, 9, and 11].

Table 1. Blood serum biochemistry values of bluefin tuna

Parameters	Average Values (+/-)
Uric Acid	4.32 ($mg/100mL^{-1}$)
Creatinine	1.12 ($mg/100mL^{-1}$),
SUC	15.04 ($mg/100mL^{-1}$)
Albumin	2.30 ($g/100mL^{-1}$)
Globulin	2.56 ($g/100mL^{-1}$)
Total Protein	6.15 ($g/100mL^{-1}$)
SGOT	178.24 (UL^{-1})
SGPT	141.52 (UL^{-1})
ALT	54.26 (UL^{-1})
GGT	220.14 (UL^{-1})
T Chol	272.04 ($mg/100mL^{-1}$)
TRIG	320,75 ($mg/100mL^{-1}$)
HDL-Chol	88.68 ($mg/100mL^{-1}$)
LDL-Chol	180.18 ($mg/100mL^{-1}$)

Comparison between male and female fishes shows that females seem more resistant to stress levels than males (Table 2). Female hormones and related protective factors make females more strong and resistant to stress factors and external influences, which could cause liver function tests to appear lover in females. Albumin, urea, uric

acid and creatinine values did not show any significant variations between males and females, which shows that physiological structure of female and male metabolisms are similarly affected [3, 8, 9 and 10].

Table 2. Blood serum biochemistry values of male and female Bluefin tuna

Parameters	Average Male Values(+/-)	Average Female Values(+/-)
Uric Acid	4.52 ($mg/100mL^{-1}$)	4.12 ($mg/100mL^{-1}$)
Creatinine *	0.08 ($mg/100mL^{-1}$)	1.17 ($mg/100mL^{-1}$)
SUC	15.48 ($mg/100mL^{-1}$)	14.60 ($mg/100mL^{-1}$)
Albumin	1.89 ($g/100mL^{-1}$)	2.72 ($g/100mL^{-1}$)
Globulin	2.45 ($g/100mL^{-1}$)	2.66 ($g/100mL^{-1}$)
Total Protein	5.70 ($g/100mL^{-1}$)	6.55 ($g/100mL^{-1}$)
SGOT*	216.25 (UL^{-1})	140.28 (UL^{-1})
SGPT*	161.33 (UL^{-1})	121.71 (UL^{-1})
ALT	59.50 (UL^{-1})	50.02 (UL^{-1})
GGT	216.77 (UL^{-1})	223.51 (UL^{-1})
T Chol*	301.27 ($mg/100mL^{-1}$)	242.81 ($mg/100mL^{-1}$)
TRIG*	361.20 ($mg/100mL^{-1}$)	280.30 ($mg/100mL^{-1}$)
HDL-Chol*	51.15 ($mg/100mL^{-1}$)	126.21 ($mg/100mL^{-1}$)
LDL-Chol	201.16 ($mg/100mL^{-1}$)	159.20 ($mg/100mL^{-1}$)

Significance values were given as * for $p<0.05$

It follows from cholesterol profile that there were differences between males and females. Particularly healthy cholesterol was high in females. Also known as malignant cholesterol, Ldl cholesterol was almost the same in both sexes in values without any statistically significant variations ($p<0.05$) between them. Triglyceride values were low in females but high in males, from which it is clear that female tunas are affected less than males by stress factors and narrow area stress caused by cages, which also affects health of fishes and plays protective roles in catching diseases. Influence of testosterone in males and its related stress increases make males more aggressive than females, which causes males to be more sensitive and weaken in their immune system [6, 8, 9 and 10]. As a result, examination of the obtained data showed that such related studies made in this field should be further conducted in wider areas and a more comprehensive perspective. Studies on bluefin tuna metabolism will be of great use in progressing fattening technology and thus obtaining high yielding quality in meat.

NOTE

This work is presented at 5-8 September 2017, 2nd International Science Symposium (ISS2017) in Tbilisi-Georgia.

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