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A biological and biochemical study of two species of sea bream Acanthopagrus arabicus (Iwatsuki, 2013) and Sparidentex hasta (Valenciennes, 1830) fromShatt Al-Arab River – Southern Iraq

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ABSTRACT--*Due to the importance of sea bream, Acanthopagrus arabicus (Iwatsuki, 2013) and Sparidentex hasta (**Valenciennes**, 1830),the current study aimed to identify some of the biology aspects and biochemical contents of these two species for both fisheries and aquaculture industry.During the time from January 2018 to June 2018, samples of both species were obtained. In which the relationship between fish lengths and weights was studied, a simple regression between lengths and weights and their mathematical expression was analyzed.The absolute condition factor (K)and the relative condition factor (Kn) of both species were also determined.The study found that the sizes of S hasta fish are larger than that of the sizes of A arabicus, as their lengths ranged between 9 to 25 cm (average length of 17 cm) while they were in the A. arabicus fish 9-19 cm (average length of 14 cm).and the weights of S. hasta fish ranged between 19.64 g to 87.32 g, with an average weight of 52.24 g, whereas in the A. arabicus, it was 18.10 to 43.70 g, with average weight of 37.92 (g).The equation of the length-to-weight relationship for the A.rabicus fish was W= 1.541 + 2.639 L, and W= 0.39 + 2.800L for S. hastafish. The absolute (K) were* 44311*and* 44013*of the two species respectively, relative condition (Kn) were* 04910 *for A. arabicus and* 04999 *for S. hasta.Fish muscles were taken to measure the chemical composition. The results indicated that S.hasta fish have the highest percentage of meat (yield %), high protein and fat content, as the yield % reached 48.97 ± 2.54 %, protein content 19.5 ± 1.89, and fat content 8.1 ± 0.53 compared to yield % , protein and fat content of A.arabicusfish meat45.63±2.08%, 18.79 ± 0.50 and 3.31 ± 1.01%respectively. Based on these results, the two species are good source of protein, fat and minerals, and provide useful data for both fisheries management, and aquaculture industry.*

Key words-- *Acanthopagrus, Sparidentex, Sea bream, chemical composition, length weight relationship*

I. INTRODUCTION

The Sparidae family, known as sea breams or porgis, is found in tropical and temperate waters (Froese and Pauly, 2013). Sparid fish are distributed widely and commercially important for the world's fisheries sector and industries (Pavlidis and Constantinos, 2011). *Acanthpagrus arabicus* and *Sparidentex hasta* are categorized in the same order as Perciformes and the Sparidae family, but separate subfamilies; Sparinae and Denticinae, respectively. (Kuronuma and Abe, 1986). Since the species are commercially important, their biology and taxonomy have been well studied. Age growth and reproductive biology including almost all sparide species have

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been conducted by various researchers in several countries (El-Agamy, 1989; Kailola *et al*., 1993; Kraljevic *et al*., 1996; Radebe *et al*., 2002; Willis *et al*., 2003; Hughes *et al*., 2008; Al-Mamry *et al*., 2009).The family Sparidae is among the larger commercial fish families in the Arab Gulf, with approximately eight genera, but the most abundant in the Iraqi coasts and estuaries are *A.arabicus* and *S.hasta*. (Al-Daham,1979; Kuronuma and Abe 1986).*A. arabicus* locally known as Shank reproduces in the northern Arabian Gulf and its juveniles join the Shatt Al-Arab, Shatt Al-Basra and Hor Al-Hmmar Marsh (Hussain *et al*., 1987; Al-Daham *et al*., 1993; Mohamed and Mutlak, 2007) for feeding. Studies also covered *A.arabicus'* age and development in the coastal waters of the Northwest Arabian Gulf of Iraq (Al-Areki, 2001).FAO-FishStatPlus (2008) has identified Sea Bream, *S. hasta* locally known as Sobaity as the only species in the genus Sparidentex, *S. hasta* is a native species of Bahraini, Kuwaiti, Saudi Arabia, Omani, Qatari and Iraqi waters in the Arabian Gulf. It is also widely found throughout the West Indian Ocean and the Indian coast (Bauchot and Smith, 1984).There are several attempts to cultivate it in estuaries, salt lagoons, salt marshes and coastline in different regions of Iraqi water as potential candidates for aquaculture, taking full advantage of their easy adaptation to captivity and the use of available production technologies.Al-Faiz*et al*., (2016),and Hussein *et al*. (2016) investigated the potential of cultivating these two species using different farming systems in Iraqi waters in the Al-Faw region. The present research has been intended to study certain biological aspects of the relationship between length-weight, absolute and relative condition factorof *A. Arabicus* and *S.hasta*, as well as chemical composition and nutritional value, which will provide useful data for both fisheries and aquaculture management in southern Iraq.

II. MATERIAL AND METHODS

A sample of 415 *A.arabicus*fish and 847 *S. hasta* fish were collected from River of Shatt Al-Arab at Al-FAWSouthern Iraq, representative the relative abundance of capture sizes for the period January 2018 to June 2018 of both species.The length (cm)and weight (g) of fish was measured.Length-weight relationship (LWR) was calculated using the formula:

W= a+ b L (Ricker, 1973). Where, (W)is Body Weight (g), (a) is the regression intercept (constant), (L) istotal length (cm), and (b) is regression slope (constant).

Absolute condition factor (K) calculatedby:

$K = 100\ W/L^3$., Where, (W)is weight (g), (L) is total body length (cm).

Relative condition factor (kn) calculatedby:

Kn = W/w (Le Cren, 1951). Where,(W) is Observedbody weight (g), (w)is calculated body weight resulting from LWR.

The muscles were removed from the fish and the percentage offish meat was calculated as follow:

Meat weight (yield %) = weight fish meat (g) / total weight of fish (g) x 100.

The chemical composition of the fish meat according to A.O.A.C. (2005) has been estimated. The nutritional value of fish (kcal/100 g) was estimated by multiplying 5.56 of the protein contents and 9.45 of fat content (Winberg,1971).

III. RESULTS AND DISCUSSION

The research analyzed the length-weight relationship of the *A.arabicus* and *S.hasta* fish species collected from Shatt Al-Arab River. Table (1) shows length, weight and absolute and relative condition factors of studied fish. A total of 140 of *A. arabicus* and 847 of *S. hasta* were used. The length of *S. hasta* fish are larger than the length of the *A. arabicus*, as their lengths ranged between 9 to 25 cm and an average length of 17 cm while they were 9-19 cm in the *A. arabicus* fish and an average length of 14 cm. Resean *et al*., (2008) estimated the total length of *A. arabicus*varied from 13 to 34 cm in Iraqi marine waters Northwestern Arabian Gulf , Awan *et al*. ,(2017) recorded the mean length of *A. Arabicus* (14.7 cm) and *S.hasta* (36.29 cm) in Pakistan. Randall (1995) recorded a maximum total length of *S.hasta* 50 cm, but Karam (2011) indicated that *S. Hasta* as well as other sparid fish could increase up to 75 cm in length. Figure (1) indicates the length frequency distribution of both *A.arabicus* and *S.hasta*, where the majority of the fish fall into length groups of 16-19 in, *A.arabicus* and the length group of 15-25 cm of *S.hasta* fish, the cause is due to the similarities of the fishing methods of both species and the mesh size used, and the rise in the number of *S.hasta* can be due to their abundance in Shatt al-Arab River. Resean *et al*. (2008) stated that the 23 cm in length group of *A.arabicus* was the dominant group in the Marine Iraqi waters Northwestern Arabian Gulf. The weights of *S. hasta* fish range is greater than the weight of *A. Arabicus*, when their weight varied from 19.64 g to 87.32 g and their average weight was 52.24 g since they were in *A. Arabicus* fish from 18.10 to 43.70 g, with an average weight of 37.92 g (Table, 1).The length- weight relationship constants(a), (b)and the regression coefficient(r^2) are shown in Table (2).The simple linear regression slope (b) of *A.arabicus* was 2.402, while that of *S.hasta* was 2.747.The growth coefficient (b) suggested that both species had negative allometric growth. This finding is consistent with the analysis by Pauly (1983) who reported a (b) range of 2.5 to 4.0 for several species of fish. The values of (b) for *A.arabicus* and *S.hasta* in this study were within the limitations defined by Froese (2006)and Pervin and Mortuza (2008). It has been stated that if (b) value is equal to 3.0, the fish will develop isometric contraction, resulting in an optimal fish shape.(Olurin and Aderibigbe, 2006). If the value of (b) is less than 3.0, the fish will undergo adverse allometric development. (Sandon, 1950). However, when the value of (b) is greater than 3.0, the fish grows according to the positive morphometric growth rate. The length-weight relationship regression coefficient (r^2) for *S.hasta* was high, indicating that the length increased with an increase in the fish's weight.Many researchers have previously pointed out that length-weight relationships can differ wildly even in the same species as some of those influenced by different factors like sex, spatial variations, growth stage, stomach content, and gonadal development. (Kawamura 1972; Bagenal and Tesch 1978; Hossain *et al* 2006; Leunda *et al* 2006; Gaspar *et a*l 2012).Hussian *et al*. (2010) described the length-weight relationship between two species of the same family from the Karachi coastline, and the study found isometric expansion for *A.arabicus* (b) is 3.015 and *A.berda* (b) is 3.092. In comparison, Hameed *et al*.(2013) and Riaz *et al*.(2017) found negative morphometric growth rates in *A.berda* and *A.arabicus* from the Karachi coast lines.According to the present study, negative morphometric growth rates in *A.arabicus* and *S.hasta* from the Shatt Al-Arab River have also been shown, which can be attributed to environmental stress or fish body size. Spatial change in the value of (b) and negative morphometric growth detected for another region (Ahmed *et al*., 2013; Safi *et al*., 2014). The condition factor is an indicator supposed to reflect arelationship between abiotic and biotic factors in fish biological circumstances (Le Cren, 1951**)**. As a consequence, the condition factor can vary between species of fish in different locations.(Blackwell *et al.,* 2000). It can also be a good measure to observe the feed activity, growth and survival rate of fish(Ujjania *et al*., 2012;Bagenal 1978). It was found that the absolute condition coefficient (K) was 1.369

in the *A.arabicus* while it was 440.0 in the *S. hasta*(Table 1).From a nutritional perspective, therefore, the increase in K-values specifically indicates the accumulation of fat and infrequently gonadal growth (Maguire and Mace, 1993). However, from a reproductive perspective, Angelescu *et al.* (1958) confirmed that the highest K values can be obtained in which the fish are sexually active and have a relatively high reproduction rate.The relative condition factor (Kn) was lower than the absolute condition factor (K) and reached 1.0006 and 1.010 for *A.arabicus* and *S hasta*fish. The current study shows the appropriateness and fertility of the Shatt Al Arab River water for such two species and has been accomplishing good returns.

Table (1)Length, weight, absolute and relative condition factor of *A.arabicus and S.hasta* from Shatt Al-ArabRiver

species	N	Length(cm)			Weight (g)			Absolute Condition factor (K)	Relative condition factor (Kn)
		Range	mean	±SD	Range	mean	±SD		
Acantopagrus arabicus	415	9-19	14	0.89	18.10 - 43.70	37.92	2.376	1.369	1.0006
Sparidentex hasta	847	9-25	17	1.47	19.64 - 87.32	52.24	4.273	1.075	1.010

Table (2)Length-weight relationship of *A.arabicus* and *S.hasta* from Shatt Al-ArabRiver

species	a	b	r^2	Growth pattern
Acantopagrus arabicus	1.637	2.402	0.987	NA
Sparidentex hasta	0.0001	2.747	0.999	NA

(a)is intercept of regression, (b)is slope of regression, (r^2)is regression coefficient, (NA)is negative allometric

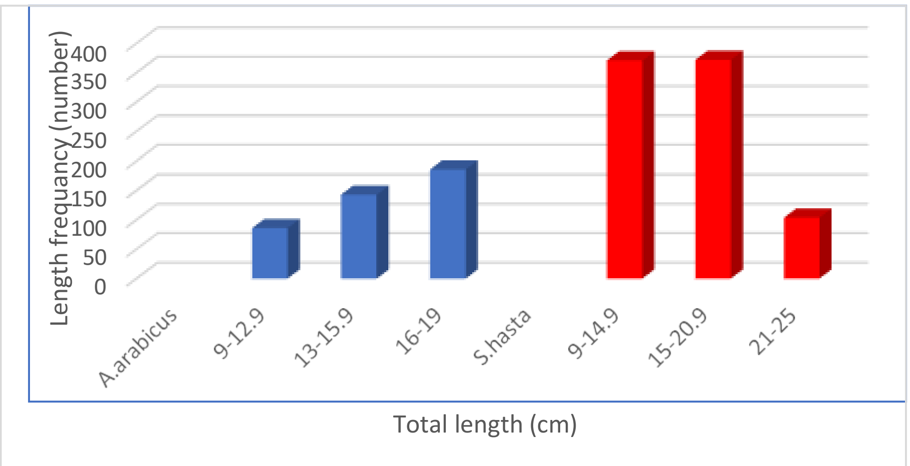

Fig (1) Length frequency distribution of *A.arabicus* and *S.hasta* collected from Shatt Al-ArabRiver

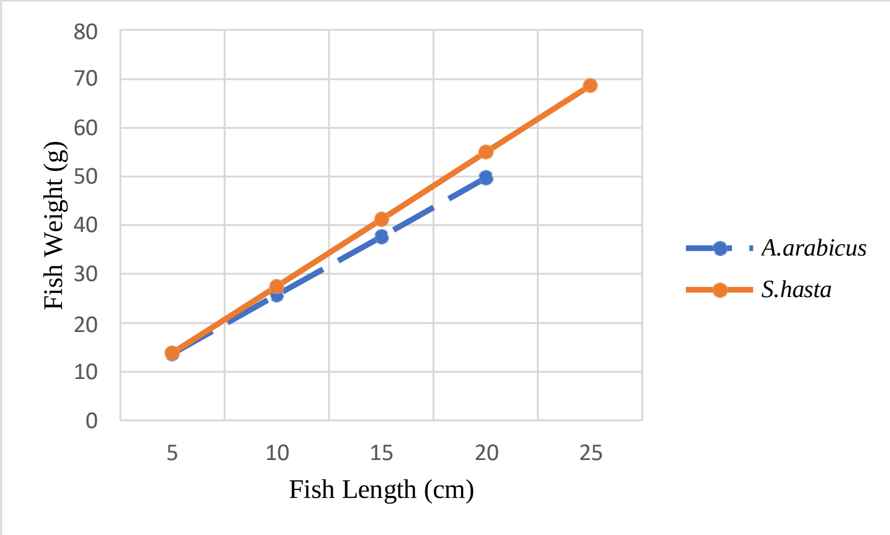

Fig (2) Length weight relationship *A.arabicus* and *S.hasta* collected from Shatt Al-ArabRiver

IV. PERCENTAGE OF MEAT FROM FISH(YIELD):

The weight composition is defined as the percentage of weight of each portion or organ reflected as a percentage of the overall body weight. It is important to know the percentage of edible fish parts for assessment as food (Zatiev *et al*.,1969).The percentage of a meat to the overall weight of the fish is of economic importance for evaluations of the fish, the understanding of the composition of the fish's weight is an important determinant since some parts of it are not eaten(Yesser 1995).Even though *A.arabicus* and *S. hasta* fish are small compared to fish of other commercial significance in the waters of the Shatt al-Arab River, they are of commercial benefit related to high quality of their meat and market competition.Table (3) shows that the weight of the meat ranged between 11,96-33,48 g and an average of 22,70 g in *A.arabicus* fish and ranged between 14,7 and 39,22 g and an average of 26,96 g in *S.hasta* fish. The percentage of edible meat (yield percent) in *A.arabicus* and *S.hasta*. Was 45.63 and 48.97 percent, respectivelySaleh *et al*., (2014) found that the proportion of meat in common carp fish (47 per cent), and was (49.60 per cent) in *Tilapia zill*. The edible portion of fish varies by sex, and time of fishing (Zatiev *et al*. 1969).

Table 3. The proportion of fish meat of *A.arabicus* and *S.hasta* collected from Shatt Al-ArabRiver

Fish species	Range of fish meat Weight (g)	Mean fish meat weight (g)	Fish meat / 100 gm fish weight (yield %)
Acantopagrus arabicus	11.93-33.48	22.70	45.63±2.08
Sparidentex hasta	14.7-39.22	26.96	48.97 ± 2.54

V. CHEMICAL COMPOSITION:

The composition of fish meat and its nutritional value are shown in Table (4).Considerable differences ($P<0.05$) were observed in the moisture, fat, ash and nutritional value of the fish. The highest percentage of moisture 75.47 ± 1.24 was observed in*A.arabicus*, whereas it was 70.31 ± 1.57% in *S.hasta* fish,Protein, fat , ash and nutritional value based on wet weight in the *S.hasta* fish muscles (19.53 per cent, 8.12 per cent, 1.68 per cent and 185.72 kcal/100 g) were highest compared to *A.arabicus* (18.79 per cent, 3.31 per cent, 1.07 per cent and 135.80 kcal/100 g).These results are in agreement with those stated by (Mahdi *et al*. 2006; Hantoush *et al*. 2014) For other commercially important fish from Shatt Al-Arab River and Iraqi water Northwest Arab Gulf, and Younis *et al*. (2011) from Saudi Arabia's Arab Gulf Coast.It is well known that seasonal change and food availability, as well as the physiological of fish, influence the chemical composition of fishes (Egan *et al*., 1981). Both species provide a good source of protein, fat and minerals. From these results it is concluded that these species make a significant contribution to a food safety and nutritious for human consumption.

Table (4) Chemical composition of *A. arabicus* and *S. hasta* fish, caught from the Shatt alArab in the Al-Faw region southern Iraq

Chemical content (%)	*A. arabicus*	*S. hasta*	Significance *
Moisture	75.47±1.24	70.31± 1.57	*
Protein	18.79± 0.50	19.53± 0.66	-
Lipid	3.31± 1.01	8.12± 1.07	*
Ash	1.07± 0.13	1.68± 0.27	*
Nutritive value (kcal/100g)	135.80±12.55	185.72±13.83	*

* The mean difference is significance at the (P < 0.05).

REFERENCES

1. A.O.A.C. (2005). Official methods of analysis, association of official analytical chemists. 18th edition Gaithersburg; AOAC press.
2. Ahmed Q., Tabbassum S., Younus F., Türkman M. (2013). Length weight relationship and seasonal distribution of Megalaspis cordylla(Linnaeus 1758) fish size frequencyvariation, Karachi Coast. Fen Bilimeiri Desgisi. TheBlack Sea Journal of Sciences. 31(9):115-123.
3. Al-Areki, M. K. (2001). The biology of Acanthopagrus latus (Houttuyu, 1782) in Iraqi marine waters. Msc thesis, Agri. Coll., Basrah Univ., 70p. (In Arabic).
4. Al-Daham, N. K. (1979). Fishes of Iraq and Arabian Gulf. Part 2. Basrah Univ., 406p. (In Arabic).
5. Al-Daham, N. K., Mohamed A. R.,Al–Dobeykel A. Y. (1993). Estuarine life of yellow fin seabream Acanthopagrus latus in Southern Iraq. Marina Mesopotamica, 8(1): 137–152.
6. Al-Faiz N.A., Yesser A. K. T., Hussein S. A. (2016).A Preliminary Study on Cultivation of Sobaity Seabream Sparidentex hasta (Valenciennes, 1830).At Basrah Province, Southern Iraq.BJAS.29(1):275-285.Basrah J. Agric. Sci.
7. Al-Mamry, J.M., McCarthy, I.D., Richardson, C.A. and Meriem, S.B. (2009). Biology of the kingsoldier bream (Argyrops spinifer, Forsskal 1775; Sparidae), from the Arabian Sea, Oman. Journal of Applied Ichthyology, 25, 559–564.
8. Angelescu V., Gneri F.S., Nani A. (1958). Argentine sea hake (biology and taxonomy) Secr. Mar. Serv. Hydrogenation. Nav. Public, H1004: 1-224.
9. Awan K.P., Qamar N., Farooq N, Panhwar S.K. (2017). Sex Ratio, Length Weight Relationships and Condition of Eight Fish Species Collected From Narreri Lagoon, Badin, Sindh, Pakistan. J Aquac Mar Biol 5(4): 00130.
10. Bagenal T. B., (1978). Aspects of fish fecundity. In: Ecology of freshwater fish production. Gerking S. D. (ed), pp. 75-101, Blackwell Scientific Publications, Oxford.

11. Bagenal T. B., Tesch F. W., (1978). Age and growth. In: Methods for assessment of fish production in fresh waters. 3rd edition, Bagenal T. (ed), pp. 101–136, IBP Handbook No 3. Blackwell Scientific Publications, Oxford.
12. Bauchot, M.L., Smith M.M. (1984). Sparidae. In: Fisher, W., Bianchi,G. (Eds.). FAO Species Identification Sheets for Fishery Purposes.Western Indian Ocean (Fishing area 51), vol. four, FAO, ROME.Accessed through Fish-base (2014), web page: www.fishbase.us/summary/4499
13. Blackwell BG., Brown M .L., Willis DW. (2000) Relative Weight (rw) Status and Current Use in Fisheries Assessment and Management. Reviews in Fisheries Science 8: 1-44.
14. El-Agamy, A.E. (1989). Biology of Sparus sarba Forsskal from the Qatari water, Arabian Gulf. Journal of the Marine Biological Association of India, 31 (1/2), 129–137.
15. Egan H., Kirk S., Sawyer, R. (1981). Pearson's chemical analysis of food, 8th ed., Churchill Livingstone, London.
16. FAO-FishStatPlus. (2008). Food and Agriculture Organisation of theUnited Nation. FAO Fisheries and Aquaculture Department.Statistical Collections. Capture production and aquacultureproduction database 1950–2006 (Release date 2008).
17. Froese R. (2006). Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. Journal of Applied Ichthyology 22(4):241-253.
18. Froese R., Pauly D. (Eds.) (2013) FishBase. Version 12/2013. Available from: http://www.fishbase.org (accessed 17 December 2013)
19. Gaspar S., Tobes I., Miranda R., Leunda P. M., Peláez M. (2012). Length–weight relationships of sixteen freshwater fishes from the Hacha River and its tributaries (Amazon Basin, Caquetá, Colombia). Journal of Applied Ichthyology 28(4):667–670.
20. Hameed L., Habib-ul-Hasan, Khan MZ., Asim M. (2013). Length weight relationship in common Sea bream Acanthopagrus berda (Forsskål 1775) from Karachi coast, Pakistan. International Journal of Biology and Biotechnology. 10(4):593-596.
21. Hantoush A.A., Al-Hamadany Q.H., Al-Hasson., A.S. and. Al-Ibadi H.J. (2014).Nutritional value of important commercial fish from Iraqi waters.Mesopot. J. Mar. Sci., 29(1): 13 –22
22. Hossain M. Y., Ahmed Z. F., Leunda P. M., Jasmine S., Oscoz J., Miranda R., Ohtomi J.,(2006). Condition, length–weight and length–length relationships of the Asian striped catfish, Mystus vittatus (Bloch, 1794) (Siluriformes: Bagridae) in theMathabhanga River, Southwestern Bangladesh. Journal of Applied Ichthyology22:304–307.
23. Hughes, J.M., Stewart, J., Kendall, B.W. (2008) Growth and reproductive biology of tarwhine Rhabdosargus sarba (Sparidae) in eastern Australia. Marine and Freshwater Research, 59, 1111–1123.
24. Hussain, N. A., Hamza H. A., Soud K. D. (1987). Some biological aspect of the freshwater population of Acanthopagrus latus in the Shatt Al–Arab River, Iraq. Marina Mesopotamica, 2 (1): 29–40.
25. Hussein, S. A., Al-Faiz N. A., Yesser A. K. T. (2016). The effect of various stocking densities on growth performance of Arabian yellowfin seabream (Acanthopagrus arabicus) cultivated in cages at Basrah province.Iraqi J. Aquacult. Vol. (11) No. (3): 13-22.
26. Hussian S.M., Paperno R., Khatoon Z. (2010). Length–weight relationships of fishes collected from the Korangi-Phitti Creek area (Indus delta, northern Arabian Sea). Journal of Applied Ichthyology.; 26:477-480.

27. Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A., Grieve, C. (1993). Australian Fisheries Resources. Bureau of Resource Sciences and Fisheries ResearchDevelopment Corporation, Canberra, Australia, 422 pp.
28. Karam, Q.E., (2011). Toxicity of Kuwait crude oil and dispersed oil onselected marine fish species of Kuwait (Ph.D. thesis). The School ofMarine Science and Technology, Newcastle University, NewcastleUpon Tyne, pp. 237.
29. Kawamura G. (1972). Gill-net mesh selectivity curve developed from length–girth relationship. Bulletin of the Japanese Society for the Science of Fish 38:1119–1127.
30. Kraljevic, M., Dulčić, J., Cetinić, P., Pallaoro, A. (1996) Age, growth and mortality of the striped sea bream, Lithognathusmormyrus L., in the northern Adriatic. Fisheries Research, 28, 361-370.
31. Kuronuma K., Abe Y. (1986). Fishes of the Arabian Gulf. KuwaitInstitute for Scientific Research, Kuwait, 356 p.
32. Le Cren E. D. (1951). The length weight relationship and seasonal cycle in gonad weight and condition in the perch (Perca fluviatilis). Journal of Animal Ecology 20:201-219.
33. Leunda P. M., Oscoz J., Miranda R., (2006). Length–weight relationships of fishes from tributaries of the Ebro River, Spain. Journal of Applied Ichthyology 22:299–300.
34. Maguire J.J, Mace P.M. (1993). Biological reference points for Canadian Atlantic Gadoid stocks. In: Smith S.J., Hunt J.J. and Rivard D. (eds.), Risk Evaluation and Biological Reference Points forFisheries Management. Can. Spec. Publ. Fish. Aquat. Sci., 120, 67-82.
35. Mahdi A.A., Al-Selemi, A.H.K., Al-Saraji A.Y.J. (2006). Nutritional value of some Iraqi fishes. Marina Mesopotamica, 22(2): 239-253.
36. Mohamed, A. R. M., Mutlak F. M. (2007). Composition, abundanceand diversity of small fish assemblage in the Shatt Al-Arab estuary,Northwest Arabian Gulf. 1st Scientific Conference of Agriculture College,26-27 November, 2007, Basrah University.
37. Olurin K.B.,Aderibigbe O.A. (2006). Length-weight relationship and condition factor of pond reared Oreochromis niloticus. World Journal of Zoology, 1 (2), 82-85.
38. Pauly D. (1983). Some simple methods for the assessment of tropical fish stocks. FAO Fisheries,Tech. Pap., FAO Rome, 234, 52.
39. Pavlidis M., Constantinos M. (2011). Sparidae: Biology andaquaculture of Gilthead Sea bream, Blackwell.
40. Pervin M. R., Mortuza M. G. (2008). Length-weight relationship and condition factor of fresh water fish, L. boga (Hamilton) (Cypriniformes: Cyprinidae). UniversityJournal of Zoology (Rajshahi University) 27:97-98.
41. Radebe P.V., Mann, B.Q., Beckley, L.E.,Govender, A. (2002). Age and growth of Rhabdosargus sarba (Pisces: Sparidae),from KwaZulu-Natal, South Africa. Fisheries Research, 58, 193–201.
42. Randall, J.E. (1995). Coastal fishes of Oman. University of Hawaii Press, Honolulu, Hawaii,439P.
43. Resean A. K., Mohamed A.R M., Hashim A. A. (2008). The stock assessment of yellow fin bream Acanthopagrus latus in north-west Arabian Gulf. Basrah J. Agric.Sci., 21(Special issue)
44. Riaz S.,Khan M. A.,Ahmed F.,Karim A. (2017). Condition factor and seasonal variation in Length weight relationship of Acanthopagrus arabicus from Karachi Coast, Pakistan.Journal of Entomology and Zoology Studies 2017; 5(3): 448-454.

45. Ricker W. E. (1973). Linear regressions in fishery research. Journal of the FisheriesResearch Board of Canada 30(3):409-434.
46. Safi A., Khan A., Hashmi MUA., Khan ZM. (2014). Lengthweight relationship and condition factor of stripped piggy fish, Pomadasys stridens (Forsskäl, 1775) from Karachi coast, Pakistan. Journal of Entomology and Zoology Studies. 2(5):25-30.
47. Saleh J.H., Al-HamadanyQ.H.; Matlak F.M. (2014). Chemical composition and yield of edible part of Tilapia zilli (Gerv, 1848) intruder to Iraqi water. Basrah J. Agric.Sci. 27(1):12-20.
48. Sandon H. (1950). An illustrated guide to the freshwater fishes of the Sudan. Sudan Notes and Rec., 25-61
49. Ujjania N.C., Kohli M.P.S., Sharma L.L. (2012). Length-weight relationship and condition factors of Indian major carps (C. catla, L. rohita and C. mrigala) in Mahi Bajaj Sagar, India. Research Journal of Biology, 2 (1), 30-36
50. Willis, T.J., Millar, R.B., Babcock, R.C. (2003) Protection of exploited fish in temperate regions: high density and biomass ofsnapper Pagrus auratus (Sparidae) in northern New Zealand marine reserves. Journal of Applied Ecology, 40, 214–227.
51. Winberg, G.G.(1971).Symbols, units and conversion factors in studies of fresh water Productivity, pp. 134-178.
52. Yesser, A.K.T. (1995). Studied of some aspects of chemical composition of two fish species Anchovy, Thryssa hamiltoni and sea catfish Arius thalassimus. Marina Mesopotamica, 10 (2): 351-358.
53. Younis EM., Abdel-WarithAA., Ali A., Al-Asgah NA, El-Shayia AS. (2011). Chemical Composition and Minerals Contents of Six Commercial Fish Species from Arabian Gulf Coast of Saudi Arabia. J Animal Vet Adv 10: 3053-3059.
54. Zatiev V., Kizevetter I., Lagunova L., MakarovaT., MinderL., PodsevalovV. (1969). Fish Curing and Processing. Translated to English from Russian by Demerindd, A. Mir publishers Moscow, 722 pp. Translated to Arabic from English by Hindi, M.J. (1986), 853 pp.