Morphometric and proximate traits of three commercial fishes of different grades (*Seriola dumerili, Pagrus pagrus* and *Liza ramada*) in summer and winter, eastern Libya Mediterranean Sea

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Abstract: Fish morphometric traits and proximate composition of flesh were established for *Seriola dumerili* (first class), *Pagrus pagrus* (second class) *Liza ramada* (third class) caught from Al-Hamama coast, eastern Libya Mediterranean Sea, during summer and winter 2015. Morphometric traits and condition factors, were established by species and seasons. Mean total length of *S. dumerili* was 32.31 and 36.26 cm in summer and winter consecutively (corresponding weights: 968.31 and 1180.79g), that of *P. pagrus* was 29.30 and 29.34cm (329.09 and 322.13g), and that of *L. ramada* was 26.12 and 15.75cm (288.17 and 131.27g). Differences between total length in summer and winter were not significant for *S. dumerili* and *P. pagrus* but significant for *L. ramada*. Morphometric traits and condition factors, were established by species and seasons. Most morphometric parameters correlated positively with each other. Some parameters correlated negatively. The length (TL)-weight (TW) relationships in summer and winter were $TW=0.0385\ TL^{2.8552}$, $R^2=0.9638$ and $TW=0.0029\ TL^{3.5575}$, $R^2=0.9181$ consecutively for *S. dumerili*, $TW=0.0532\ TL^{2.5513}$, $R^2=0.9793$ and $TW=0.114\ TL^{2.3304}$, $R^2=0.9729$ for *P. Pagrus*, and $TW=0.3712\ TL^{2.0169}$, $R^2=0.9476$ and $TW=0.2763\ TL^{2.1804}$, $R^2=0.9539$ for *L. Ramada*. Proximate traits of the three species in summer and winter were established. Species effect on all proximate traits (flesh moisture, protein, fats and ash) was significant. The season effect was only significant for moisture. The interaction between the species effect and the season effect on moisture was not significant but was significant for all the other traits. Protein, fats and ash correlated positively with each other and negatively with moisture.

Key words: *Seriola dumerili*, *Pagrus pagrus*, *Liza ramada*, morphometry, Length-weight relationship, condition factor, proximate composition

Introduction

Food quality can be defined as combination of attributes or characteristics of a product that have significance in determining the degree of acceptability of the product to the consumer. Quality evaluation of a product can be achieved through three methods: microbial methods, objective methods and subjective methods such as those used to establish proximate composition [1].

Seriola dumerili (Risso 1810), –*Pagrus pagrus* (Linnaeus 1758) and *Liza ramada* (Risso, 1826) are common fishes in the artisanal catch of Libya [2, 3, 4, 5]. According to the retailers in fish markets of Libya, the greater amberjack *S. dumerili* (Carangidae) is a first-class fish, the sea

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bream *P. pagrus* (Sparidae) is a second-class fish and the thin-lipped grey mullet *L. ramada* (Mugilidae) is a third class-fish. In spite of their commercial importance in Libya, no study has evaluated their proximate composition. The general objective of the present study is, therefore, to assess morphometric and proximate composition of the three fishes in two seasons: summer and winter.

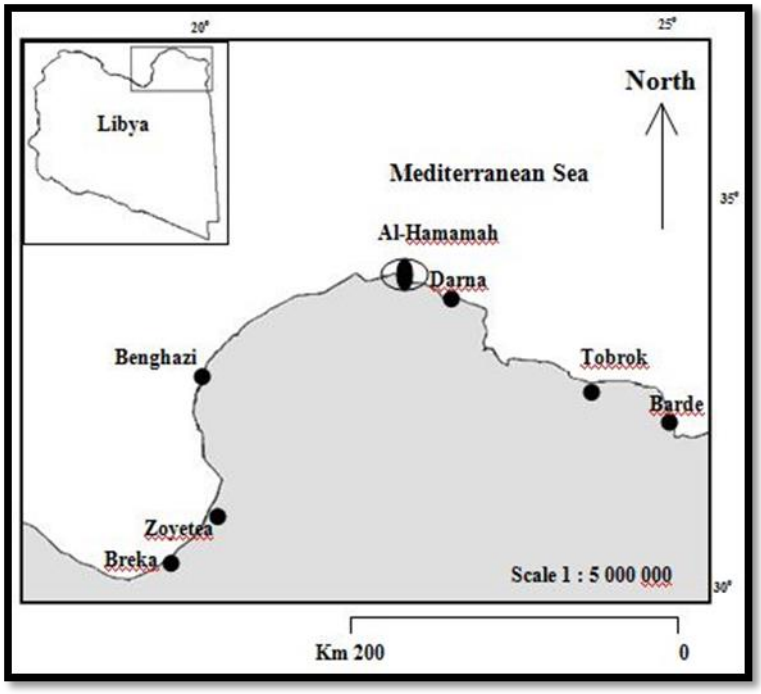
Methods

Collection of fish samples:

Fifteen fresh fish samples of each species vis: *Pagrus pagrus*, *Seriola dumerili* and *Liza ramada* were collected randomly from the artisanal catch of Al-Hamama fishing area (Fig. 1) during summer and equal fish samples were also collected during winter of 2015.

The study area:

Al-Hamama coast (Fig. 1) lies in eastern Libya Mediterranean Sea. It is characterized mainly by a sandy shoreline and a broader coastline plain with intermingled sand beaches and tiny inlets [6]. Estimated average and a maximum depth are about 2 and 50 m [7]. Al-Hamama coast is a principal fishing ground in eastern Libya and feeding ground for several commercial fishes, such as those of the Families Sparidae,



Mugilidae, Serranidae and Carangidae [8].

Fig. 1. Al-Hamama, the site from which the study fishes were collected.

Measuring the morphometric parameters:

Total Length (TL), Head Length (HL), Trunk Length (Tr L), Total Weight (TW) and Gutted Weight (GW) were measured to the nearest 0.1 cm and 0.1 gram for individual fish of the three species.

The Length-weight relationship:

The Length-weight relationship was established according to [9, 10 and 11] as:

- $TW = aTL^b$
- $GW = aTL^b$

The condition factor:

Fulton and Clark condition factors (K_F and K_C) were calculated as follows:

- $K_F = 100 * W / L^3$ [12]
- $K_C = 100 * GW / L^3$ [13]

The proximate analysis:

Fifty-gram samples were taken from the edible muscles of individual fish of the three species and used for establishing moisture and ash contents according to [14], crude protein content according to [1] and soluble fats contents according to [15].

Results

The morphometric traits:

The interaction between the species effect and the season effect was not significant (P>0.05) for total weight, gutted weight and head length, while significantly affected total length and trunk length (Table 1). The differences in fish total length (TL) between summer and winter (Table 1) were not significant for *S. dumerili* and *P. Pagrus* but were significant for *L. Ramada*. TL differences of *P. Pagrus* in summer and winter on one hand and *L. Ramada* in winter on the other hand were significant. Differences in total weight (TW) of *S. dumerili* in summer and winter were not significant. Similar results were observed for *P. Pagrus* and *L. Ramada*. The same thing applied for gutted weight (GW). Summer/winter differences in trunk length (Tr.L) were significant only for *L. Ramada*. Differences in Tr.L of *S. dumerili* and *P. Pagrus* in summer and winter were not significant. Summer/winter differences in head length (H.L) were significant only for *S. dumerili.*

Table 1. Morphometric traits studied for *S. dumerili, P. Pagrus* and *L. Ramada* during summer and winter season.

Species	Season	No	TL cm	TW g	GW g	Tr.L. cm	H.L. cm
S. dumerili	Sum.	15	32.31 ±2.32^{cd}	968.31 ±197.17^{b}	837.98 ±172.41^{b}	25.83 ±1.86^{cd}	6.48 ±0.47^{c}
	Win.	15	36.26 ±1.63^{d}	1180.79 ±199.60^{b}	1063.87 ±180.23^{b}	28.62 ±1.24^{d}	7.64 ±0.43^{d}
P. Pagrus	Sum.	15	29.30 ±1.87bc	329.09 ±49.33a	310.07 ±47.98a	23.45 ±1.49bc	5.86 ±0.37bc
	Win.	15	29.34 ±1.71b	322.13	320.28	23.41 ±1.42b	5.92

			c	±39.91a	±46.42a	c	±0.32bc
L. ramada	Sum.	15	26.12 ±1.75b	288.17 ±37.45a	264.28 ±144.93a	20.90 ±1.40b	5.22 ±0.35ab
	Win.	15	15.75 ±1.59a	131.27 ±28.85a	123.48 ±28.95a	11.14 ±1.34a	4.61 ±0.31a
Sign. Level			*	n.s	n.s	*	n.s

Means within columns carrying different superscripts differed significantly (P<0.5)

*: Significant at the 0.01 level, n.s: not Significant (P>0.05)

The condition factors:

L. Ramada had the highest condition factor (Table 2) in winter (K_F 3.16, K_C 2.79), followed by *S. Dumerili* in summer (K_F 2.37, K_C 2.03) and winter (K_F 2.16, K_C 1.93). *P. Pagrus* had the least condition factor in both seasons (summer: K_F 1.20, K_C 1.10, and winter K_F 1.23, K_C 1.17). Differences between summer and winter K_F and K_C values were not significant for *S. Dumerili* and *P. Pagrus* but were significant for *L. Ramada*. K_F and K_C values were significantly different between the three species except for *P. Pagrus* in winter and *L. Ramada* in summer.

Table 2. Values of Fulton (K_F) and Clark (K_C) condition factors for the three species in summer and winter.

Species	Season	No	K_F	K_C
S. Dumerili	Sum.	15	2.37 ± 0.10^{c}	2.03 ± 0.082^{c}
	Win.	15	2.16 ± 0.12^{c}	1.93 ± 0.097^{c}
P. Pagrus	Sum.	15	1.20 ± 0.05^{a}	1.10 ± 0.031^{a}
	Win.	15	1.23 ± 0.06^{a}	1.17 ± 0.07^{ab}
L. Ramada	Sum.	15	1.63 ± 0.14^{b}	1.43 ± 0.11^{b}
	Win.	15	3.16 ± 0.223^{d}	2.79 ± 0.174^{d}
Level of sign.			*	*

Means within columns carrying different superscripts differed significantly (P<0.5)

*: Significant at the 0.01 level

Effect of species and season on studied morphometric traits:

The species effect:

The species effect on total length, head length and trunk length, was significant (P<0.05) (Table 3). It was also significant for total weight and gutted weight of S. *dumerili* on one hand and *P. pagrus* and *L. ramada* on the other hand, and for head length% and trunk length% of *S. dumerili* and *P. pagrus* on one hand and *L. ramada* on the other hand. The species effect on Fulton and Clark condition factors was significant for *S. dumerili* and *L. ramada* on one hand and *P. pagrus* on the other hand.

Table. 3. Effect of species on morphometric traits

Species effect	TL	TW	GW	HL	HL%	TrL	TrL%	K_F	K_C
S. dumerili	34.29 ±1.44[a]	1074.55 ±139.24[b]	950.93 ±124.32[b]	7.06 ±0.33[c]	20.52 ±0.23[b]	27.23 ±1.13[c]	79.49 ±0.23[b]	2.26 ±0.08[a]	1.98 ±0.06[a]
P. pagrus	29.32 ±1.24[b]	325.61 ±31.18[a]	315.17 ±32.81[a]	5.89 ±0.24[b]	20.18 ±0.24[b]	23.43 ±1.01[b]	79.82 ±0.24[b]	1.21 ±0.04[b]	1.14 ±0.04[b]
L. ramada	20.94 ±1.51[c]	209.72 ±27.42[a]	193.88 ±26.67[a]	4.92 ±0.24[a]	25.23 ±1.20[a]	16.02 ±1.31[a]	74.77 ±1.20[a]	2.40 ±0.19[a]	2.11 ±0.16[a]

Means within columns carrying different superscripts differed significantly (P<0.5)

The season effects:

Winter and summer means of total length, head length, total weight and gutted weight of the three fish summed together were not significantly (P>0.05) different (Table 4) but winter and summer means of the other parameters were significantly (P<0.05) different.

Table 4. Effect of season on morphometric traits.

Season effect	TL	TW	GW	HL	HL%	TrL	TrL%	Kf	Kc
Winter	27.12 ±1.58[a]	544.73 ±96.01[a]	502.54 ±86.54[a]	6.06 ±0.28[a]	23.93 ±0.87[a]	21.06 ±1.34[a]	76.07 ±0.87[a]	2.18 ±0.15[a]	1.96 ±0.12[a]
Summer	29.24 ±1.19[a]	528.52 ±82.06[a]	470.78 ±71.3[a]	5.86 ±0.24[a]	20.02 ±0.01[b]	23.39 ±0.95[b]	79.98 ±0.01[b]	1.73 ±0.09[b]	1.52 ±0.07[b]

Means within columns carrying different superscripts differed significantly (P<0.5)

The interactions:

The interaction between the species effect and the season effect was not significant for total weight, gutted weight and head length but was significant for the rest of the other parameters (Table 5).

Table 5. Interaction between species and season on morphometric traits.

Source of variation	TL	TW	GW	HL	HL%	TrL	TrL %	K_F	K_C
Species*season	**	n.s	n.s	n.s	**	**	**	**	**

** = Significant at the 0.01 level, n.s = not Significant

Correlations between morphometric parameters:

Most morphometric parameters correlated significantly and positively with each other at various magnitudes of the correlation coefficient (Table 6). Some parameters correlated negatively.

Table 6. Pearson's correlations between morphometric traits

Traits	TW	GW	HL	HL%	TrL	TrL%	Kf	Kc
TL	.785**	-.455**	.801**	-.41**	.930**	-.560**	.560**	.997**
TW		.105	.994**	.124	.830**	-.230*	.230*	.761**
GW			.074	.951**	-.255*	.678**	-.678**	-.49**
HL				.113	.851**	-.229*	.229*	.775**
HL%					-.178	.699**	-.699**	-.45**
TrL						-.242*	.242*	.898**
TrL%							-1.00**	-.62**
Kf								.619**

*. Correlation is significant at the 0.05 levels ** Correlation is significant at the 0.01

The length-weight relationship:

The length-weight relationship of *S. dumerili* indicated an almost isometric growth in summer (b = 2.8552) and positive allometr in winter (b = 3.5975) (Table 7). Those of *P. Pagrus* and *L. Ramada* in summer (b = 2.5513, 2.0169) and winter (b = 2.3304, 2.1804) were negatively allometric (Table 7). All relationships were strong, R^2 varied between 0.9181 and 0.9793.

Table 7. Length-weight relationship of the three fish species in summer and winter

Species	Summer	Winter
S. dumerili	$Y = 0.0385X^{2.8552}$, $R^2 = 0.9638$	$Y = 0.0029X^{3.5575}$, $R^2 = 0.918$
P. pagrus	$Y = 0.0532X^{2.5513}$, $R^2 = 0.979$	$Y = 0.114X^{2.3304}$, $R^2 = 0.973$
L. ramada	$Y = 0.3712X^{2.0169}$, $R^2 = 0.9476$	$Y = 0.2763X^{2.1804}$, $R^2 = 0.954$

Proximate traits of *S. dumerili, P. Pagrus* and *L. Ramada*:

Interaction between the species effect and the season effect on moisture was insignificant but was significant on protein, fats and ash (Table 8)**.** Means of moisture of *S. dumerili* and *L. Ramada* flesh in summer and winter were significantly different (Table 8) but those of *P. Pagrus* were not. Means of *S. dumerili* in summer and *P. Pagrus* in summer and winter were not significantly different. Means of *L. Ramada* in summer and winter were significantly different from those of *S. dumerili* and *P. Pagrus* in summer and winter.

Means of protein content of *S. dumerili* and *L. Ramada* flesh in summer and winter were not significantly different (Table 8) but those of *P. Pagrus* were significant. Differences between the three species in both seasons were significant.

Differences of fat content of flesh of the three species in summer and winter were significant (Table 8) but those between *P. pagrus* in winter and *L. ramada* in summer were not significant.

Means of ash of *S. dumerili* and *L. Ramada* flesh in summer and winter were not significantly different (Table 8) but those of *P. Pagrus* were significant. Differences between *S. dumerili* in summer and winter and *P. Pagrus* in winter were not significant. Ash values of *P. pagrus* in winter and summer were significantly different. Ash values of *S. dumerili* in winter and summer were significantly different from those of *L. ramada* in both seasons and those of *P. pagrus* in summer.

Species effect on percentage values of all proximate traits (moisture, protein, fats and ash summed together) were significant between the three species (Table 9). The season effect was significant on moisture (Table 10) but insignificant on protein, fats and ash. Interaction between the species effect and the season effect on moisture was insignificant (Table 11) but was significant on protein, fats and ash.

Table 8. Proximate parameters of *S. Dumerili, P. Pagrus* and *L. Ramada* in summer and winter (means of flesh moisture, protein, fats and ash content by species and by seasons).

Species	Season	No.	Moisture	Protein	Fats	Ash
S. dumerili	Sum.	15	53.27 ± 1.4^{b}	35.13 ± 0.9^{d}	6.13 ± 0.24^{e}	2.15 ± 0.11^{c}
	Win.	15	49.31 ± 1.45^{a}	33.74 ± 0.82^{d}	5.20 ± 0.22^{d}	1.99 ± 0.17^{c}
P. pagrus	Sum.	15	60.47 ± 1.31^{b}	28.63 ± 0.59^{b}	2.94 ± 0.24^{a}	1.51 ± 0.07^{b}
	Win.	15	53.82 ± 1.35^{b}	31.57 ± 1.01^{c}	3.71 ± 0.13^{b}	1.97 ± 0.14^{c}
L. ramada	Sum.	15	72.31 ± 0.62^{e}	19.32 ± 0.39^{a}	3.87 ± 0.23^{b}	0.85 ± 0.07^{a}
	Win.	15	66.22 ± 1.30^{d}	18.48 ± 0.45^{a}	4.57 ± 0.19^{c}	0.90 ± 0.05^{a}
Sign. Level			n.s	*	**	*

Within columns means carrying different superscripts differed significantly ($p<0.5$)

n.s: not Significant, *: Significant at 0.05, **: Significant at the 0.01 level

Table 9. Effect of species on proximate parameters% (means of moisture%, protein%, fats% and ash% of flesh by species).

Species effect	Moisture%	Protein%	Fats%	Ash%
S. dumerili	51.29 ± 1.06^{a}	34.44 ± 0.64^{a}	5.67 ± 0.18^{a}	2.07 ± 0.10^{a}
P. pagrus	57.15 ± 1.11^{b}	30.10 ± 0.67^{b}	3.33 ± 0.15^{b}	1.74 ± 0.09^{b}
L. ramada	69.26 ± 0.91^{c}	18.90 ± 0.30^{c}	4.22 ± 0.16^{c}	0.87 ± 0.04^{c}

Within columns means carrying differed superscript differed significantly ($P<0.5$)

Table 10. Effect of season on proximate parameters (means of moisture%, protein%, fats% and ash% of flesh by seasons).

Season effect	Moisture%	Protein%	Fats%	Ash%
Winter	56.45±1.32a	27.93±1.12a	4.49±0.14a	1.62±0.11a
Summer	62.02±1.35b	27.69±1.06a	4.31±0.24a	1.50±0.09a

Within columns, means carrying differed superscript differed significantly (P<0.5)

Table 11. Proximate parameters species/season interaction.

Source of variation	Moisture%	Protein%	Fats%	Ash%
Species/Season	n.s	*	**	*

n.s = not Significant

*Significant at 0.05

**Significant at the 0.01 level

Correlation between the proximate traits:

All proximate parameters correlated significantly with each other at the *P* = 0.05 or 0.01 levels (Table 12). Protein, fats and ash correlated positively with each other and negatively with moisture.

Table 12. Correlations between proximate traits

Traits	Protein%	Fats%	Ash%
Moisture%	-.747**	-.214*	-.723**
Protein%		.313**	.676**
Fats%			.312**

*: Correlation is significant at the 0.05, **: Correlation is significant at the 0.01 levels

Discussion

In the present study, *S. dumerili* recorded the highest length and weight among the three fishes. Its length ranged from 17.1 to 47.3 cm corresponding to weights of 137.60 to 2713.80 g, seasonal differences were not significant. Retailers in the fish market mentioned that S. *dumerili* is considered first class fish by consumers because it has plenty of flesh and few spines [16] reported that length and weight of S. *dumerili* at Al-Hamama coast, eastern Libya, ranged from 11.5 to 165.4 cm corresponding to 57.7 to 49640.4 g. In the present study *P. pagrus* length was 16.3 to 39.4 cm corresponding to weights of 74.5 to 691.4g. *P. pagrus* is considered second class fish because it is less fleshy and smaller than *S. dumerili* but very tasty. [2] reported lengths of 11.3 to 30.8 cm corresponding to weights of 21.87 to 337.78 g for the same species from Susa, eastern Libya.[3] reported 11.5 to 33.4 cm and 24.5 to 339.6 g for the fish from Ain Al-Ghazala. *L. ramada* parameters obtained in the present study were 11.1 to 29.4 cm corresponding to 47.3 to 391.2 g. This fish is third class fish because it is even smaller than *P. pagrus.* [4], reported

values of 22.9-28.6 cm and 209.8-237.5 g. [17], reported values of 19.2 to 25.43 cm corresponding to 63.66-156.9 g.

The length-weight relationship obtained in the present study for *Seriola dumerili* was $W = 0.0385L^{2.8552}$ and $W = 0.0029L^{3.5575}$ in summer and winter reflecting semi-isometric and allometric growth in order. That obtained for the same species from Al-hamama coast, eastern Libya by [16], was $W = 0.019*L^{2.8726}$. [18], studied the relation between length and weight in south eastern Adriatic Sea. They stated that b = 2.765 and 3.001 for pre-adult and adult *Seriola dumerili*. Similar result (b = 2.933) was reported for *Seriola dumerili* in lagoon of New Caledonia, by [19]. The characteristic high growth rate common to this species was also pointed out as making it suitable for both open sea and inland aquaculture [20, 21]. Fulton and Clark condition factors reflected the healthiness of fish, the higher their value the healthier the fish is. The value of these two factors obtained for *Seriola dumerili* in the present study were 2.37 and 2.03 in summer and 2.16 and 1.93 in winter in order. Mohamed (2015)[16], in a one-year study obtained a range of Fulton and Clark condition factors for pre-adult *Seriola dumerili* as 2.21-3.15 and 1.54-2.76 consecutively, and 1.03-1.44 and 0.89-1.18 for adult *Seriola dumerili*. Variations in condition factors among different studies are often attributed to locality, season and feeding activity [22, 23, 24].

The length-weight relationship of *P. pagrus* of the present study was $W = 0.0532L^{2.5513}$ and $0.114L^{2.3304}$ in summer and winter, reflecting negative allometric growth. The length-weight relationship established for the same species from Susa coast, eastern Libya, by [2], was $W = 0.0228L^{2.7946}$ indicating negative allometric growth. Ibrahim (2013) [3], reported similar relationship of $W = 0.0237L^{2.7718}$ for the same species from Ain El-Ghazala, eastern Libya. Ali (2008) [2] reported that Fulton and Clark condition factors for *P. pagrus* ranged from 0.6 to 3.73 and from 0.57 to 3.64. Ibrahim (2013)[3] reported the following values for the same species: K_F: 0.99-1.44, K_C: 0.89-1.35.

In the present study, the constant b of the length-weight relationship of *L. ramada* was 2.01 in summer and 2.18 in winter reflecting negative allometric growth in both seasons. Khaleefi (2016) [17] obtained b values for the same species from Benghazi coast, eastern Libya Mediterranean Sea, ranging from 2.16 to 3.34 for the same species during December, 2014 to November, 2015. Mohammed *et al*. (2016)[4] reported $W=0.016L^{2.847}$ from Ain El-Ghzala lagoon, eastern Libya Mediterranean Sea. Mehana (2006)[25] mentioned that for *L. ramada* from lake Bardrwil, Egypt, the exponent b was 3.13. It is known that the values of a and b differ between species, through the year, through the spawning season and according to the degree of fullness of the stomach [26]. The K_F obtained in the present study for *L. ramada* were 1.63 and 3.16 in summer and winter, K_c was1.43 and 2.97. Similar results were obtained by [17], who reported that *L. ramada* condition factor was higher during summer (1.1152) and lower during winter (0.9993).

Proximate composition is a way to evaluate food value and quality. It varies greatly depending on species, sexual cycle, age, feed, stage of maturity, environment, season, organs and muscle location [27, 28, 29]. In the present study, the effect of species on proximate composition was significant for the three fishes. The effect of season was significant only for moisture but not for the other proximate traits. Interaction between effects of season and species was significant for all proximates other than moisture. Moisture content of flesh for the three fish species was higher in summer than in winter but the differences were only significant in case of *S. dumerili* and *L. ramada*. Differences in protein contents between the three species were significant. *S. dumerili* had the highest protein followed by *P. pagrus* and then *L. ramada.* S. *dumerili* had relatively

more fats than the other two fishes. Seasonal effect was significant. Proximates of *S. dumerili* of the present study were: Moisture 53.27 and 49.31 %, Protein 35.13 and 33.74%, Fats 6.13 and 5.20% and Ash 2.15 and 1.99 % in summer and winter respectively. Öksüz (2012)[30] reported the following proximates for wild and cultured greater amber jack from turkey: moisture 76.5 and 73.6% in order, Protein 19.6 and 21.8, Lipid 2.0 and 2.90, Ash 1.3 and 1.10, Fillet yield was 60.5 and 61.5. Mastoraki et al. (2015)[31] estimated ranges of moisture, ash, protein and lipids of the fish as 76.10-81.27%, 2.86-3.38%, 11.01-13.70% and 4.85-7.31% respectively. Dawood *et al*. (2015)[32] found that the proximate composition of the fish was: moisture % 71.02±0.09-72.44±0.05, crude protein% 18.38±0.13-20.27±0.41, total lipid% 4.17±0.14-4.49±0.01, crude ash% 3.72±0.17-4.1±0.09.

Proximates of *P. pagrus* of the present study were: moisture 60.47-53.82%, protein 28.63-31.57%, fats 2.94-3.71% and ash 1.51-1.97% in summer and winter. Miniadis-Meimaroglou et al (200)[33], mentioned that moisture, ash, protein and total lipids of *P. pagrus* were 71.7±1.0%, 1.73±0.12%, 21.5±0.8% and 0.81±0.09% of the wet muscle tissue, respectively. Schuchardt *et al*. (2008)[34] reported the following range (gm kg^{-1} dry weight) for the red porgy: moisture 722-749, protein 723–819, lipids 75–94. Romero (2015)[35] recorded whole fish proximate composition (% wet weight) as: moisture 63.50-67.17, protein 17.72-18.73, lipid 12.50-15.03. Manganaro *et al*. (2012)[36] reported dry matter: 27.60-28.94, crude protein: 21.60-23.42, crude fat: 2.20-3.25, ash: 1.53-1.58. Alam *et al*. (2014)[37], estimated proximate composition of the fish as (% dry basis): protein: 61.3-62.2, lipid: 16.1-18.7, ash: 17.6-18.6.

Proximates of *L. ramada* of the present study were: moisture: 72.3-66.22%, protein: 19.32-18.48%, fats: 3.87-4.57% and ash: 0.85-0.90%. El-Sayed (1991)[38] estimated proximate of *L. ramada* from near Alexandria, Egypt, as: crude protein as (% dry weight): 25.86-41.46; crude lipid: 13.41-13.82; ash: 10.16-13.96; and nitrogen free extract: 25.53-42.59. Protein, fat, moisture and ash contents of muscle reported for *L. ramada* from Mersin Gulf, turkey, were 16.02-17.66, 0.25-0.47, 80.70-82.19 and 1.25-1.28 %, respectively [39]. Sayed-Ahmed *et al*. (2009)[40] established that total protein and total lipids of the same species from west of Alexandria, Egypt, ranged from 15.49 to 18.41% and 1.43 to 1.75%. El Shehawy *et al*. (2016)[41] established proximates of the same fish from Makkah Central Fish Market, Saudi Arabia as: was: moisture: 69.72%, ash: 1.20, crude Oil (% from dry weight): 29.13 and crude protein 67.25. Yones *et. al.*, (2016) [42], found that body dry matter %: 25.9-31.4; Protein: 16.5-18.6; Lipid: 5.2-10.2; Ash: 3.2-5.3.

Conclusions

Species effect on all proximate traits (flesh moisture, protein, fats and ash) was significant. The season effect was only significant for moisture. The interaction between the species effect and the season effect on moisture was not significant but was significant for all the other traits. Protein, fats and ash correlated positively with each other and negatively with moisture.

Recommendation

We recommend that proximate traits of other commercial fishes of Libya be conducted.

References:

[1] van Eys, J. E. (2012). Manual of quality analysis (- USSEC) for soybean products in the feed industry. 2nd Edition. Ph.D. GANS Inc., 24 Av. de la Guillemote, 78112.

[2] Ali, Randa Rajab. (2008). biological studies on *Pagrus pagrus* from Sosa (El-Gabal El-Akadar), Libya. M Sc Thesis. Department of Marine Resources Faculty of Natural Resources and Environmental Sciences, University of Omar Al Mukhtar. Albaida, Libya

[3] Ibrahim, S. M. (2013). Characterization and biological study on some species of Family Sparidae in Ain El-Ghazala Gulf of eastern Libya. M. Sc., Faculty of Science, Omar Al-Mukhtar University, Albaida, Libya.

[4] Mohammed, Amena A., Lutfi M. A. Musa, Ramadan A. S. Ali. Abdalla N. Elawad and Sayed M. Ali. (2016). The length weight relationship and condition factors of the thin lip mullet *Liza ramada* and the flathed grey mullet *Mugil cephalus* (Mugilidae) fishes from Ain El-Ghazala lagoon, eastern Libya. International journal information research and review, June, 2016. Vol.03, issu, 06, pp. 2504-2507, June, 2016.

[5] Buzaid, Esam M. K, Sayed Mohamed Ali, Mohamed E. Elmor. (2017). Characteristics of bottom trawling by catch in Benghazi coastal area, eastern Libya Mediterranean Sea. Journal of Gold Scientific Research 2 (2017) 24-34

[6] S.F.S.R. (2010). Scientific field survey report for the development of marine protected areas in Libya Ain El Ghazala and Bomba Bay. 20-27 September 2010

[7] Reynolds, J. E., Haddoud, D. A., Vallet, F., (1995). Prospects for aquaculture development in Libya, Lib. fish field documents N 9. Tripoli / Rome, FAO. FAO. 94p. Fl: DP/LIB/88/009 - Fl: GCP/LIB/021/lsDB, Field Document 9 (En).

[8] Ekwelha, S. A. (2008). Environmental and biological studies on juvenile commercial fishes in EL- Hamamh coast (EL- Gabal EL- Akadar), Libya.

[9] Le-Cren, E. D. (1951). The length – weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatitis*). J. Anim. Ecol. 20:201 – 219.

[10] Ricker, W. E. (1975). Computation and interpretation of biological statistics of fish populations. Bulletin of fisheries research board of Canada 191. 382 pp.

[11] Letourneur, Y.; Kulbicki, M. and Labrosse, P. (1998). Length-weight relationships of fish from coral reefs and lagoons of New Caledonia, southwestern Pacific Ocean: an update. Naga ICLARM Q. 21(4):39-46.

[12] Fulton, F. (1902). Rate of growth of sea fishes. Scient. Invest fish. Div. Scot Rep. 20.

[13] Clark, F. N. (1928). The weight length relationship of the California saerdine (*Sardina coarulea*) at San-Pedro. Division of fish and game of California. Fish bull.no.12-59.

[14] Wassef, Elhama and M. B. Shehata, (1991). Biochemical Composition of Gilthead Bream *Sparus aurata* L. from Lake Bardawil (Egypt). J.K.A.U.: Mar. Sci., Vol. 2, pp. 111-122 (1411 A.H./1991 A.D.

[15] Folch, J., Lees, M., and Sloane Stanley, G.H. (1957). A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226:497-509.

[16] Mohamed, Nesma Idres, (2015). Biological study on *Seriola dumerili* from Al-Hamama coast, Eastern Libya. M.Sc., Faculty of Science, Omar Al-Mukhtar University, Albaida, Libya.

[17] Khaleefi, Manal M., (2016). A study of some population dynamic characteristics of *Liza ramada* (Risso, 1826) in Benghazi coast, Libya. M Sc. Thesis, Omar Al-Mukhtar University, Albaida, Libya.

[18] Kožul, A., Skaramuca, C., Kraljević, K., Dulčić, A. and Glamuzina, (2008). Age, growth and mortality of the Mediterranean amberjack *Seriola dumerili* (Risso 1810) from the south-eastern Adriatic Sea. Journal of Applied Ichthyology. 17, (3): 134-141.

[19] Kulbicki, M., G. Mou Tham, P. Thollot and L. Wantiez, (1993). Length-weight relationships of fish from the lagoon of New Caledonia. Naga ICLARM Q. 16(2-3):26-29.

[20] Cavaliere, A., Crisaf, E., Faranda, F, Greco, G., Manganaro, A. and Mazzola, A. (1989). Collection of fingerlings and rearing of *Seriola dumerili* in tanks. Aquaculture. A biotechnology in progress. De Pauw. Jaspers E. Ackefors H., Wilkins N. (EDS). European Aquaculture Society. I-II:119-123.

[21] Greco, S., Caridi, D., Cammaroto, S. And Genovese, L. (1993). Preliminary studies on artificial feeding of amberjack fingerlings. Production Environment and quality. Bordeaux Aquaculture G. Barnabe and P. Kesemond Eds EAS Special Publ. N. 18:247-254.

[22] Niklosky, G. V. 1963. The ecology of fishes. Academic press London, New York, 352pp.

[23] Roo, F. J. Scorro, M, S. Izquierdo, M. J. Caballero, C. M. Hernandez-Cruz, Fernandez and Palaccios, H. F. (1999). Development of red porgy *Pagrus pagrus* visual system in the diges tive tract and larval feeding habits. Aquaculture 179: 499-512.

[24] Gillanders, B. M., Ferrell, D. J. and Andrew N. L. (2010). Size at maturity and seasonal changes in gonad activity of yellowtail kingfish (*Seriola lalandi*; Carangidae) in New South Wales, Australia. Mar Aqua cult. 22:457-468.

[25] Mehana, F. S. (2006). Fisheries management of the thin lip grey mullet *Liza ramada* and golden grey mullet *L. aurata* from lake Bardail, J. Aquat. Bioi & fish., Voi 10, No.2:33-53 (2006) EGYPT.

[26] Ahemed, A. H. (1987). Fish biology. University of El Basra, El Basra, Iraq: pp. 279.

[27] FAO (2002). Chemical composition. Quality and quality changes in fresh fish. Available fromhttp://www.fao.org/docrep/v7180e/V7180E05.ht m

[28] Noël L, Chafey C., Testu C., Pinte J., Velge P., Guerin T., (2011). Contamination levels of lead, cadmium and mercury in imported and domestic oysters and large crab species consumed in France: differences between white and brown meat. J. Food. Comp. Anal., 24: 368–375.

[29] Roy P. K, Lall S. P., (2006). Mineral nutrition of haddock Melanogrammus aeglefinus (L.): a comparison of wild and cultured stock. J. Fish. Biol., 68: 1460-1472.

[30] Öksüz, A., (2012). Comparison of meat yield, flesh color, fatty acid, and mineral composition of wild and cultured Mediterranean amberjack (*Seriola dumerili*, Risso 1810). Journal of FisheriesSciences.com E-ISSN 1307-234X.

[31] Mastoraki, M., Kotzamanis Y., Ilia V., Antonopoulou E. and Chatzifotis S., (2015). Effect of fish meal replacement by plant proteins supplemented with graded levels of crystalline amino

acids on growth, energy and nutrient retention of greater amberjack (*Seriola dumerili*). Aquaculture Europe 2015Rotterdam, Netherlands.

[32] Dawood, M. A., Koshio S., Ishikawa M., and Yokoyama S., (2015). Effects of Partial Substitution of Fish Meal by Soybean Meal with or without Heat-Killed Lactobacillus plantarum (LP20) on Growth Performance, Digestibility, and Immune Response of Amberjack, Seriola dumerili Juveniles. Hindawi Publishing Corporation BioMed Research International Volume 2015, Article ID 514196, 11 pages. http://dx.doi.org/10.1155/2015/514196

[33] Miniadis-Meimaroglou S, Dimizas C., Loukas V., Moukas A. , Vlachos A. , Thomaidis N., Paraskevopoulou V. , Dasenakis M., (2007). Proximate composition, fatty acids, cholesterol, minerals in frozen red porgy. Chemistry and Physics of Lipids [17 Jan 2007, 146(2):104-110] DOI: 10.1016/j.chemphyslip.2006.12.009.

[34] Schuchardt, D., Vergara, J. M., Fernandez-palacios H., Kalinowski C.T., Hernandez-cruz C. M., Izquierdo M. S., and Robaina L., (2008). Effects of different dietary protein and lipid levels on growth, feed, utilization and body composition of red porgy (*Pagrus pagrus*) fingerlings. Aquaculture Nutrition 2008 14; 1–9 doi: 10.1111/j.1365-2095.2007.00484. x.

[35] Romero, G. J., (2011). Evaluation of alternative ingredients as fish meal replacers in on-growing diets for red porgy (P. pagrus). Thesis for the degree of Doctor of Philosophy University of Las Palmas de Gran Canaria, 2011.

[36] Manganaro, A., Sanfilippo M., Fortino G., Dapra F., Palmegiano G. B., Gai F., Lembo E., Reale A. and Ziino M., (2012). Artificial pigmentation and flesh quality in red porgy (*P. pagrus*). Manganaro *et. al.* International Aquatic Research ,4:15. httb://www.intaquares.com/content/4/1/15

[37] Alam M. S., Watanabe W. O., Myers A. R., Rezek T. C., Carroll P. M., and Seaton P. J., (2014). Replacement of Menhaden Fish Meal Protein by Solvent Extracted Soybean Meal and Soy Protein Concentrate Supplemented with L-Methionine and L-Lysine in the Diet of Juvenile Red Porgy *P. pagrus*. Austin Journal of Aquaculture

[38] El-Sayed, A. M., (1991). Protein requirements for optimum growth of *L. ramada* fry (Mugilidae) at different water salinities. Aquat. Living Resour., 1991, 4, 117-123.

[39] Kalay, M., Sangun M. K., Ayas D., Gocer M., (2008). Chemical Composition and Some Trace Elements Levels of Thinlip Mullet, *L. ramada* Caught from Mersin Gulf. Ekoloji 17, 68, 11-16 (2008).

[40] Sayed-Ahmed, M. A. Mourad, M. H. and Abdel-Halim, A. M. (2009). Physiological Response of Mugil Capito Fingerlings (Liza ramada; Risso, 1826) to Physico-Chemical Characteristics of Wastewaters of Two Hot Spots, West of Alexandria, Egypt. Global Veterinaria 3 (4): 317-328, 2009. ISSN 1992-6197. © IDOSI Publications, 2009.

[41] El Shehawy, S. M., Gab-Alla A. A. and Mutwally H. M. A., (2016). Proximate and Elemental Composition of Important Fish Species in Makkah Central Fish Market, Saudi Arabia. Food and Nutrition Sciences, 2016, 7, 429-439 Published Online May 2016 in SciRes. http://www.scirp.org/journal/fns http://dx.doi.org/10.4236/fns.2016.76044.

[42] Yones, A, M., Metwalli, A. A., and Al-Jilany S. S. A., (2016). Effect of artificial diets on growth performance, body composition and gonad maturation of mullet (*L. ramada*). International Journal of Fisheries and Aquaculture Research Vol.2, No.2, pp.28-49, June 2016.