Marine and freshwater crab meals in diets for the red porgy (*Pagrus pagrus*): growth, colour, and fish composition

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Introduction

Red porgy, *Pagrus pagrus*, is one of the marine fish species for the aquaculture diversification in the Mediterranean and Mid Atlantic coasts. Relevance of its nutrition has been demonstrated not only from growth and body composition, but also because it's important role in fish skin colour and carotenoids deposition (Kalinowski *et al*., 2005; Pavlidis *et al*., 2006). Present study evaluate the influence of two different crab meals by products, marine and freshwater origin, as protein and pigment sources in experimental diets for red porgy and its effects on fish growth and feed utilization parameters, fish skin colour and fish composition.

Material and Methods

Trial description		
Feeding trial and diets	Red porgy (*Pagrus pagrus*), 233g initial body weights, were distributed in 15 tanks of 500L and fed to apparent satiation 6 days per week during 6 month with five experimental diets (50%P-12%L) (**Table 1**)	
Colour parameters	L (lightness), a* and b* (red/green and yellow/blue chromaticity, respectively) were measured in fish skin using a portable colorimeter (Hunter Lab MiniScan TM XE) from which Hue (Hab=arctan(b*/a*)) and Chroma (Cab=(a*2+b*2)1/2) values were calculated (CIE 1976; Hunt, 1977)	
Biochemical analysis	Moisture, crude protein and ash	AOAC (1995)
	Total lipid	Folch *et al*. (1957)
	Fatty acid	Christie (1989); Izquierdo *et al*., 1990
	Carotenoids extraction	Barua *et al.* (1993)
	Thin Layer Chromatography	Kalinowski, 2007

Table 1. Composition (g/Kg wet wt) of the experimental diets used to feed the red porgy

	Control	RC10	RC20	MC10	MC20
Substitution levels of fish meal protein	-	10%	20%	10%	20%
Fish meal (FM)	672	608	543	608	543
River crab meal (RCM)[a]	-	105	215	-	-
Marine crab meal (MCM)[b]	-	-	-	98	213
Gelatinized starch	213	172	127	178	128
Fish oil	70	70	70	71	70
Vitamin, minerals and CMC	45	45	45	45	45

[a] Meal from river crab *Procamburus Clarkii (36.34% Protein; 6% L; 30.69% Ash and 13 % Moisture)*
[b] Meal from marine crab *Chaceon affinis (42.10% Protein; 5.32% L ; 28.48% Ash and 8.17 % Moisture)*

Results

Table 2. Growth and feed utilization parameters at the end of the trial

	Control	RC10	RC20	MC10	MC20
Initial weight (g)	239.49±39.77	234.39±31.75	228.74±35.94	228.65±35.73	233.68±36.70
Final weight (g)	433±56.19 [b]	420.27±59.25 [b]	412.53±52.14 [b]	430.99±58.59 [b]	481.91±59.34 [a]
Growth (%) [a]	80.84±0.32 [b]	79.21±8.93 [b]	80.38±1.70 [b]	88.61±8.74 [b]	106.24±1.43 [a]
Feed intake (g)	3926.84±6.20 [ab]	3758.10±215.90 [b]	3361.09±40.6 [b]	3427.55±122.55 [b]	4153.57±194.98 [a]
SGR [b]	0.38±0.00 [ab]	0.37±0.03 [b]	0.38±0.00 [ab]	0.42±0.04 [ab]	0.46±0.01 [a]
FCR [c]	1.77±0.13	1.80±0.12	1.75±0.18	1.82±0.16	1.71±0.26

Different letters in same row denote significant differences amount groups (P<0.05).

[a] **Growth (%)=** ((final weight-initial weight)/initial weight)x100
[b] **SGR: specific growth rate=** 100x(ln final weight-ln initial weight)/nº days
[c] **FCR: feed conversion ratio=** feed intake (g)/weight gain (g)

Table 3. Muscle, liver and whole fish proximate composition (% wet wt)

		Control	RC10	RC20	MC10	MC20
Muscle	**Protein**	23.00±0.13	22.91±0.13	22.99±0.10	23.08±0.14	22.97±0.20
	Lipid	3.67±0.39	3.96±0.85	3.45±0.14	3.15±0.05	4.09±0.93
	Moisture	73.58±1.16	73.62±1.19	74.24±0.23	74.70±0.22	73.58±1.87
Liver	**Protein**	10.64±0.17	10.66±0.26	10.73±0.27	10.87±0.73	10.71±0.27
	Lipid	12.27±0.74	11.16±0.19	13.12±0.06	12.13±0.67	12.94±0.95
	Moisture	61.94±0.14 [b]	64.27±1.12 [a]	62.90±1.24 [ab]	63.11±0.48 [ab]	61.64±2.10 [ab]
Whole	**Protein**	18.73±0.77 [a]	18.13±0.38 [ab]	18.49±0.51 [ab]	18.50±0.96 [ab]	17.72±0.06 [b]
	Lipid	15.03±0.91 [a]	12.94±0.50 [b]	13.04±0.41 [b]	12.50±1.51 [b]	12.75±0.72 [b]
	Moisture	63.66±0.11 [b]	63.50±0.12 [b]	64.58±2.00 [b]	67.17±1.68 [a]	66.86±1.46 [a]

Different letters in a row denote significant differences amount groups (P<0.05).

River crab *Procamburus Clarkii*.

Marine crab *Chaceon affinis*.

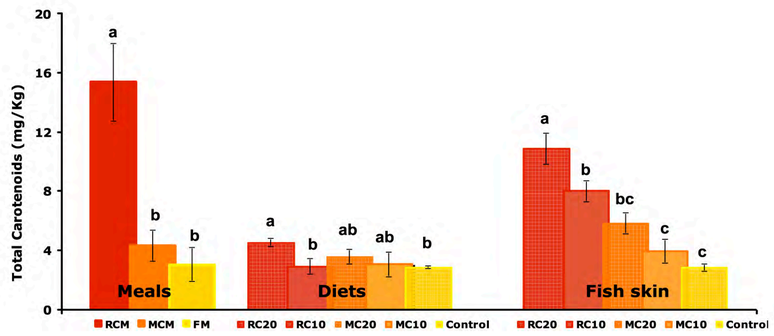

Fig. 2 Total carotenoids content of meals, diets and final fish skin (mg/kg). (Means in same group with common letters denote no significant differences (P<0.05)).

Discussion

Growth responses were similar between control diet and river crabs diets, being higher for the marine crab diets with also higher feed intake. Quality differences between both meals and also differences in palatability should be the related. Increasing levels of crab meal in the diets tend to increase whole fish moisture content being significantly higher for case of MC based diets; some lower protein and significantly lower lipid content in whole fish feed both crab meals groups of diets were also obtained. However, fish liver and fish muscles content where not high affected by the crab meals. Dietary energy and protein digestibility and protein efficiency ratios could be related with observed results and are being studying at the moment.

Respect to the colour parameters, RC and MC groups showed lower and better HUE values than those for the Control group, due to an increase of redness (a*) respect to the yellowness (b*), that in fact it is observed in the same way by TLC analysis, with significantly higher % red fraction and lower % yellow one in RC and MC groups, respectively. By the other hand, the skin colour saturation was higher for RC than MC group, in concordance with the higher total carotenoids content found in RC fish skin groups and in RC diets. This means red porgy fed both crab meals based diets were able to efficiently utilize carotenoids from these crustacean meals, which are known to contain high proportion of the red pigment astaxanthin, mainly in its esterified forms, demonstrating the suitability of this meals to be included as pigment sources for this species, as it was previously shown for other similar ingredients (Chebakki, 2001; Cejas *et al*., 2003; Kalinowski *et al*., 2004; 2005). Moreover, in present study suggest that red porgy seems to modify, along 6 months feeding, the proportions of the red and yellow parameters (a* and b*) to simulate that of their wild counterparts.

Conclusion

Both crab meals used in present study are suitability as partial replacers of fish meal in diets for the red porgy. Dietary inclusion levels of 10% and 20% of the dietary protein from these meals have no detrimental effects on growth and feed utilization parameters respect to a fish meal based diet, with high improvements in fish skin redness and skin colour saturation by increased inclusion levels. Digestibility and retention efficiency parameters are being analyzing at the moment.

Acknowledgements

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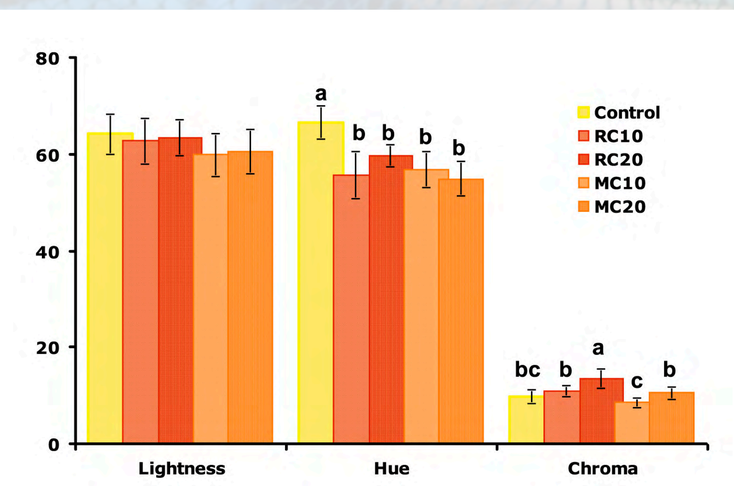

Fig. 1 Lightness, Hue and Chroma values (means ±SD) in fish skin at the end of the trial. (Means with no letter or whit common one denote no significant diferences (P<0.05)).

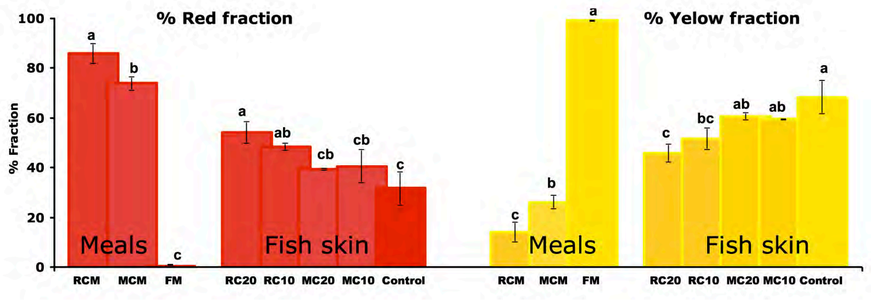

Fig. 3 Percentage of red and yellow pigment fraction, separated on TLC silica gel plates, respect of the total pigment (red+yellow) content from meals and fish skin carotenoids extract. (Means in some group with common letter denote no significant differences (P<0.05)).