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Optimal dietary carbohydrate-to-lipid ratios for silvery-black porgy (*Sparidentex hasta*) juveniles

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Abstract

Four isonitrogenous diets containing different carbohydrate:lipid (CHO:L) ratios (0.3, 0.6, 1.1 and 1.8) were tested in triplicate groups (16 fish per replicate) of silvery-black porgy juveniles for 8 weeks. Growth performance was not affected by different dietary CHO:L ratios ($P > 0.05$); however, the viscerosomatic index, the intraperitoneal fat, whole-body lipid, energy and n-3 long chain polyunsaturated fatty acids levels increased with decreasing dietary CHO:L ratios ($P < 0.05$). Fish fed with 1.8 CHO:L diet had the lowest apparent digestibility coefficients of protein and lipid, as well as the lowest plasma haemolytic and lysozyme activities ($P < 0.05$). Red blood cell counts and plasma glucose levels were higher in fish fed with 1.1 and 1.8 CHO:L ratio diets than in the other groups ($P < 0.05$). Plasma alkaline phosphatase and alanine aminotransferase, as well as the level of lipid peroxidation and total antioxidant capacity in the liver and plasma increased as dietary CHO:L ratios decreased ($P < 0.05$). The results of the current study indicated that the diets with CHO:L ratios between 0.6 and 1.1 are optimal for silvery-black porgy, whereas higher ratios may result in hyperglycaemia and immune suppression, and lower CHO:L ratios may lead to oxidative stress and liver dysfunction.

KEY WORDS: carbohydrate:lipid ratios, haemato-immunological parameters, oxidative status, plasma biochemical parameters, sparidae

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Introduction

Silvery-black porgy (*Sparidentex hasta* Valenciennes, 1830) is a demersal carnivorous fish species distributed in the Western Indian Ocean, Oman Sea and the Persian Gulf. Several characteristics, such as its readiness to spawn in captivity, rapid growth, and tolerance to a relatively wide range of culture conditions, make this species as a desirable candidate for aquaculture diversification in its area of distribution (Pavlidis & Mylonas 2011). Consequently, efforts are being focused on establishing the nutritional requirements of the species and optimizing diet formulation. Optimum protein and n-3 long chain polyunsaturated fatty acid (LC-PUFA) levels for the growth of juvenile silvery-black porgy were reported to be 48.8% and 0.8% of diet, respectively (Hossain *et al.* 2014; Mozanzadeh *et al.* 2015a). However, as a means of further informing the successful culture of this species, determining the effects of other nutrients on the physiological responses and health status of this species is of need.

Inclusion of non-protein energy sources, namely lipids (L) and carbohydrates (CHO), maximizes the utilization of dietary protein in fish (Nankervis *et al.* 2000; NRC 2011). It has also been reported that sparidae species have the ability to utilize the non-protein energy and effectively spare protein for growth purposes (Pavlidis & Mylonas 2011). The non-protein energy sources also have been shown to modulate growth performance (Rueda-Jasso *et al.* 2004; Han *et al.* 2014; Sáez-Royuela *et al.* 2015), voluntary feed intake (Saravanan *et al.* 2012), feed utilization (Han *et al.* 2014; Wang *et al.* 2014), lipid metabolism (Kamalam *et al.* 2013), oxidative enzymes activity (Rueda-Jasso *et al.* 2004; Wang *et al.* 2014) and immune responses (Li *et al.* 2012; Wang *et al.* 2014) in different fish species. Carbohydrates are valued ingredients in aquafeeds because