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Effect of chicken egg lecithin on gut and liver histology in juvenile Binni fish (*Mesopotamichthys sharpeyi*)

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Abstract
This study was conducted to examine the effects of different levels of chicken egg lecithin (EGL) in diets on growth and feeding parameters, lipoprotein fractions and histological changes in gut and liver of binni juveniles (*Mesopotamichthy Sharpeyi*). The experimental fish with initial mean weight of 3.1 ± 0.17 g were fed to satiation 3 times a day with four experimental diets containing different levels of EGL (0, 2%, 4% and 6%) for 8 weeks. Fish were fed EGL4-6% showed significantly higher final growth (FAW), specific growth rate (SGR), improved feed conversation ratio (FCR), protein efficiency (PE) and survival compared with control group. Fish were fed the diet containing EGL 4-6% showed significantly higher high density lipoprotein (HDL) and low density lipoprotein (LDL) than fish fed EGL 2% and control. Fish were fed the diet containing EGL 4% showed higher goblet cells and lower lipid vacuoles in anterior intestine enterocytes than control group. Also, the livers of fish were fed EGL 4% showed normal structure and hepatocyte with clear central nucleus compared with control group, visually. So, it appears phospholipids (PLs) have a specific role for lipid transport and absorption. Therefore, the use of EGL 4% as PLs source is recommended in diet of juvenile binni fish for improvement growth performance.

Keywords: Binni, Chicken egg lecithin, Enterocyte, Growth, Hepatocyte

INTRODUCTION

In recent decades, the aquaculture industry has fastest growing among other industries around the world (FAO, 2018). So, it has become one of the most important parts of food production and human protein requirements. On the other hand, access to high quality fingerling fish is one of the main aspects in aquaculture production (Cahu et al. 2003). One way to improve the quality of the fish is use of suitable dietary ingredients. Lipids are major source of energy for growth, reproduction and movement (including migration) in the diet of fish (Geurden et al. 2006). Studies have shown that neutral plant or animal oils in diet of larval and juvenile fish, lead accumulation of fat in the intestinal entrocytes (Dabrowski et al. 2007) followed by reduced growth (Morais et al. 2007). Because, juvenile fish have not ability for lipoproteins production due to lack of enzyme at these stages (Tocher et al. 2008). It was reported that PLs affect the growth and survival (Cahu et al. 2009) through decreases accumulation of lipid droplets in the intestine (Wold et al. 2007) and increases the absorption of dietary lipids (Hamza et al. 2008). Therefore, PLs induce increase transport of saturated and mono unsaturated fatty acids as an energy source from the intestinal enterocytes toward the blood (Morais et al. 2007). PLs have four main classes containing phosphatidylcholine (PC), phosphatidylinositole (PI), phosphatidylserine (PS) and phosphatidylethanolamine (PE) which PC has major role in lipoprotein structure for dietary lipid transport (Tocher et al., 2008). Two types of usual sources of lecithin are soybean lecithin with four PL classes (PC, PI, PS, PE) and chicken egg lecithin with two classes (PC, PE) predominately with PC (Mohammadiazarm et al. 2013). Therefore, chicken egg lecithin was selected because of high amount of PC.

Mesopotamichthys sharpeyi (Gunther, 1874) is belongs to Cyprinidae family and the Barbus genus (Coad, 1996). It is one of the important economic freshwater fish in Iran. It has great market demand in south of Iran and Iraq and high price due to its tender flesh and good taste in recent years. Full grown specimens may reach a length of half a meter and weigh 800 gram. But, the commercial culture of this species is limited because of taking some time to grow to such good size. One reason is lack of knowledge about their nutritional needs. Therefore, this study was conducted to investigate the effects of different dietary chicken egg lecithin levels as a lipid source on growth and feeding parameters, lipoprotein fractions, foregut and liver histological changes in binni juveniles.

MATERIALS AND METHODS

Diet preparation

Ingredients and proximate composition of the experimental diets are given in Table1. Basal experimental diet was formulated and used as control without EGL and three other diets were prepared to contain 2%, 4% or 6% EGL by replacing soybean oil. All diets were formulated to isonitrogenic and isolipidic. Dry ingredients were weighed and ground (100 µm particle sizes) and then mixed thoroughly. Fish oil, soybean oil, chicken egg lecithin and water were added to the dry ingredients and mixed again until dough was formed. Then prepared dough was pelleted using a pelleting machine which it was dried at room temperature for 24 h and ground into desirable particle sizes. The diets were broken up and sieved into a proper pellet size, packed and stored at -20 ˚C until used.

Experiment fish and feeding conditions

Juveniles of binni were obtained from a local commercial

Figure 1 shows lipid vacuole accumulation and few goblet cells in the epithelial layer of intestine in control group. Figure 2 shows high goblet cells and few lipid vacuole in the anterior intestine enterocytes in fish were fed EGL 4% (Scale bar =20 μm).

Figure 3

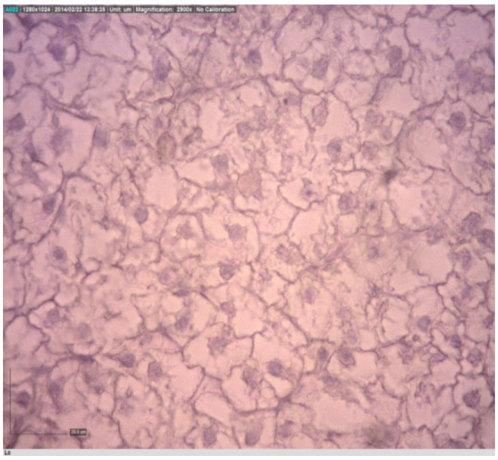

Figure 4

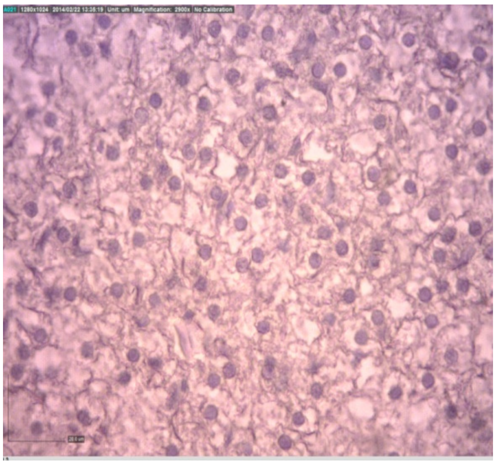

Figure 3 shows the liver of control group with swollen hepatocytes and large number of lipid vacuole and translocation their nuclear of lipid accumulation. Figure 4 shows the liver of fish fed EGL 4% with normal structure and hepatocytes with a clear central nucleus. (Scale bar =20 μm).

DISCUSSION

It was mention that, dietary PLs enhance growth and survival of larval and juvenile stages of marine and fresh water fish species (Tocher et al. 2008). The results of this study showed that PLs have beneficial effect on growth performance of *(M. sharpeyi)*. This is in agreement with result of earlier studies that showed the growth promoting effect of lecithin in a diet of carp larvae (*Cyprinus carpio* L) (Geurden et al. 1995), turbot juvenile (*Scophthalmus maximus* L) (Geurden et al. 1997), ayu (*Plecoglossus altivelus*) (Kanazawa et al. 1981), Caspian brown trout *(Salmo trutta fario)* juvenile (Kenari et al. 2011) and rainbow trout (*Oncorhynchus mykiss*) larvae (Mohammadizarm et al. 2013).

The result of histological morphology of intestine (Figs 1, 2, 3 and4) showed lower lipid accumulation and higher goblet cell in anterior intestine of juveniles were fed EGL 4 % compared to control group. This result is in agreement with result of Olsen et al. (1999) on Arctic charr (*Salvelinus alpines L.*) and Liu et al. (2002) on gilthead sea bream (*Sparus aurata*) that use of lecithin in diets induced lower lipid accumulation in entrocyte of fish and increased lipid transport from intestine to other tissue of fish. Geurden et al. (1998) reported that dietary PLs in diets of turbot (*S. maximus*) induced higher number of goblet cell in intestine of fish that it can be related to higher maturation of intestine. Furthermore, Lu et al. (2008) reported that lower lipid accumulation in entrocyte with higher number of goblet cell in intestine of *Pelteobagrus fulvidraco* can be related to higher maturation of intestine that cause by PLs. On the other hand, liver histology study showed esteatosis hepatica and swollen hepatocytes with the large number of lipid vacuole in liver of fish fed diet without of PLs (Figs 7 and 8). The result is in agreement with earlier studies of Wold et al. (2009) and Salhi et al. (1999) that reported swollen hepatocytes with the large number of lipid vacuole in cod (*Gadus morhua*) and sea bream larvae fed diet without of PLs, respectively. Also, PLs lead secretion of bile acids and modulate fat of liver. Also, it was reported that choline causes prevention of fatty liver in red drum (*Sciaenops ocellatus*) (Craig and Gatlin, 1997).

Furthermore, fish were fed the diet containing EGL 4-6% showed significantly higher HDL and LDL than other groups. In this regards, it was reported dietary PLs contribute to lipoprotein production, thereby it increase the efficiency of lipid transport from the digestive tract to the body' s tissues (Salhi et al. 1999). Pervious study reported that *De vono* synthesis of PLs occurs in fish but it seems that this synthesis is not enough for formation of lipoprotein during the rapid growth of early development (Cottuea et al. 1997). Also, it has been reported that fish larvae have a limited ability to de novo synthesize of PLs (Geurden et al. 1995). Lack of dietary PLs resulting in accumulation of lipid droplets in the intestinal mucosa and reduction of growth performance in fish which PtCho has major role in the synthesis and secretion of them (Gisbert et al., 2005). Therefore, exogenous PLs are required to satisfy the demand for lipoprotein synthesis (Fontagne et al. 2000; Mohammadiazarm et al. 2013).

So, the result of the study confirms the role of PLs about decreasing fat accumulation in liver and intestine through lipoprotein synthesis and improvement growth performance of binni juveniles.

CONCLUSION

EGL promoted the growth of juveniles' binni and prevented lipid accumulation in anterior intestine and liver of fish. Therefore, it can be one of the proper nutritional components to increase growth performance and lipoprotein synthesis of fish. So, due to the cost of making feed, inclusion of 4 % chicken egg lecithin in diet of juvenile binni fish is recommended.

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