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Ontogeny of the digestive enzyme activities in hatchery produced Beluga (*Huso huso*)

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ABSTRACT

The development of digestive enzymes of the stomach (pepsin), pancreas (trypsin, chymotrypsin, amylase, and lipase) and intestine (alkaline phosphatase) were studied in Great sturgeon or Beluga (*Huso huso*) from hatching time to 50th day post hatching. Sampling was carried out immediately after hatching, 111.3, 235.2, 306, 400.2, 490, 612.5, 756 and 906.5 degree days post hatching, ddph (0, 7, 14, 18, 23, 28, 35, 42 and 50 days post hatching, dph, respectively). Beluga larvae had near 70% mortality during rearing procedure. The highest mortality rate was accrued in two stages; firstly, during endogenous feeding (2–9 dph; 30.4–144.9 ddph) and then from a mixed feeding stage (12 dph; 253.5 ddph) until the starting time of weaning (28 dph; 490 ddph), with values ranging from 50 to 40% of total mortality, respectively. Furthermore, the results showed that at the onset of exogenous feeding, gastric glands were already functional as indicated by the steady increase in pepsin specific activity. In contrast, trypsin and chymotrypsin significantly decreased after the onset of exogenous feeding, showing the importance of these types of enzymes in the cleavage of yolk proteins during the endogenous feeding phase. Moreover, amylolytic activity fluctuated considerably over the study period; after onset of exogenous feeding alpha-amylase activity increased ($P < 0.05$), whereas it reached a maximum value at the end of the study ($P < 0.05$). Lipolytic activity was low in the first week ($P < 0.05$), whereas it increased until the onset of exogenous feeding and then, until 490 ddph (28 dph) went down again and reached the same amount in the first week. At the end of the study, lipolytic activity reached 4 times more relative to the activity levels recorded during the first 4 weeks of exogenous feeding. Furthermore, changes in enzyme activities from the stomach and pancreas were coupled with those in the intestine (brush border membrane), whereas the increase in alkaline phosphatase from hatching until 111.3 ddph (7 dph) and reaching a maximum value between 111.3 ddph and onset of exogenous feeding at 235.2 ddph (14 dph), suggested that the Beluga larvae had a developed intestine at the onset of exogenous feeding. The results obtained from this study proposed that, more Beluga weaned earlier, more larvae will live and hence weaning should begin immediately after commencement of exogenous feeding.

1. Introduction

Sturgeon fish are commercially cultured for caviar production, as a result of the sharp decrease in fisheries of this group of fishes. Sturgeons are a group of slow-growing fish that mature very late in life, and consequently, they are particularly vulnerable to overfishing and to other threats, like the loss of their natural habitat, river damming, and deterioration of water quality (May et al., 1997). As a consequence, wild stocks of sturgeons have been decreasing dramatically during these last decades (Billard and Lecointre, 2001) and sturgeons are considered one of the most threatened groups of animals on the IUCN Red List of Threatened Species™ (IUCN, 2013).

The Great sturgeon or Beluga, *Huso huso*, is an important commercial species in the Caspian Sea and a good candidate for aquaculture because of its fast growth and easy propagation in captivity. In addition, this is the most appreciated species in terms of caviar quality. Consequently, this species has been cultured for commercial and restocking purposes in Iran since 1991 (IFO, 2002). Based on fishery data and number of recorded spawning individuals, it has been estimated that the wild native populations of this species have declined over 90% in the past three generations (*ca.* 60 years), and overfishing for meat and caviar will soon cause global extinction of the remaining natural wild populations if conservation measures are not taken in its area of distribution (Gessner et al., 2010). Independently of the final purpose of this activity, conservation and restocking programs or commercial purposes, a reliable larval rearing technique must be developed to ensure consistent production of good quality fry. However, the high mortality rate during beluga larval rearing, up to 80% in some cases, has been identified as one

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