Developmental transcription of genes putatively associated with growth in two sturgeon species of different growth rate

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A B S T R A C T

In the present study, we surveyed developmental changes in the transcription of growth hormone (gh), insulin-like growth factor-I (igf-I), ghrelin (ghrl) and vascular endothelial growth factor (vegf) genes in the largest freshwater fish, European sturgeon (Beluga, Huso huso) and compared the same parameters to that of its phylogenically close moderate-sized species, Persian sturgeon (Acipenser persicus). The transcripts of gh, igf-I, ghrl and vegf were detected at all developmental time-points of Persian sturgeon and Beluga from embryos to juvenile fish. Changes in normalized gh, igf-I, ghrl and vegf transcription by using the geometric average of genes encoding ribosomal protein L6 (RPL6) and elongation factor (EF1A) over the time of development of Persian sturgeon and Beluga were statistically significant (P < 0.05). Our results showed that the mRNA expression levels of both igf-I and ghrl were low during early larval development and then increased significantly to the late larval time-points when larvae started exogenous feeding. In both Beluga and Persian sturgeon, after a low mRNA expression during the embryonic stage, the transcript levels of vegf displayed an increasing trend during yolk-sac fry, consistent with organogenesis. The vegf level remained constantly high in the time of exogenous feeding. The highest detection of gh transcripts coincided with the end of the embryonic stage (hatching time) in Persian sturgeon and 3 days-post-hatching (dph) in Beluga. In Persian sturgeon, the gh transcript started to decrease to the rest of the developmental time-points, whereas in Beluga gh transcript had a marked second increase from the time of exogenous feeding (20-dph). This Beluga specific increase in gh transcription may be associated with the marked growth rate and extraordinary size of this fish species.

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1. Introduction

Growth and development in fish, as in all vertebrates, are governed through the orderly release of hormones from the neuroendocrine system, which integrates environmental, physiological, and genetic information [46]. In fish, as in mammals, the endocrine control of growth works through the growth hormone (GH)–insulin-like growth factor (IGF) axis [40]. GH plays an essential role in the regulation of growth and development by promoting cell division, differentiation, and enlargement. The importance of the GH as a potential growth-promoting agent has long been recognized, and GH administration has been shown to accelerate growth rate in a number of animals, especially fish [1,9]. The early appearance of GH in larval fish also suggests its important role in growth. In fish, GH also influences osmoregulation and reproduction [27]. It has been known that GH stimulates growth directly by increasing DNA and protein synthesis and lipolysis in muscle and indirectly by inducing the production and release of a mitogen, IGF-I, which is produced both by the liver and by most peripheral tissues [7,46]. In vertebrates, IGF-I is the major regulator of growth and exerts its effects on cells through binding to the IGF-I receptor [43]. IGF-I acts on muscle, liver, adipose tissue, intestine, brain and most tissues to enhance growth [7]. In general, GH regulates IGF-I mRNA expression [7] and both GH and IGF-I are known to play a critical role during early larval development of fish [12].