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Research Article

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The Involvement of Hormones in Fish: Basic and Applied Aspects of Russian Sturgeon (Acipenser Gueldenstaedtii)

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Abstract

Fish are a very large group, containing a huge variety of over 33,000 species.Scientific knowledge about the interaction between hormones of the somatic axis (SA) and the gonadotropic axis (GA), both of which function in the brain, and the pituitary gonad axis (BPG) that controls growth and reproduction, is vital for the domestication of fish in aquaculture.The Acipenserida family comprises 27 species, some of which have a very high economic value, among them Russian sturgeon (Acipenser gueldenstaedtii) that adapted to growth in aquaculture conditions. Many aspects aimed at improving the adaptation and production of Russian sturgeon (Acipenser gueldenstaedtii) have been studied for quite a long time. Models based on the results of our and others' studies describing the interaction between GA and SA during oogenesis in Russian sturgeon have been suggested. The mRNA relative level of FSH during vitellogenesis (VTL) was higher in females than in males, affecting VTL secretion of vitellogenin (Vg); however, it was lower in the pre-vitellogenic stage than in VTL. No difference was found in mRNA levels of the luteinizing hormone (LH) in Russian sturgeon during the first four years of growth. During its first five years of growth, the level of GH mRNA was higher in females than in males, but due to the high standard deviation of the mean, the difference was not significant. IGF-I mRNA expression differed between the various tissues.

Introduction

The Russian sturgeon (Acipenser gueldenstaedtii) primitive fish belong to the Acipenseridae family comprised of 27 species whose eggs are a source of caviar. The distribution of Russian sturgeon habitats include the Azov Sea, the Black Sea and the Caspian Sea [1]. Parallel to over-fishing, the destruction of habitats is causing the development of fish farms for growing Russian sturgeon for caviar production. Many aspects of life cycle reproduction and growth are under investigation [2-8].

Oogenesis, the main process of caviar production in Russian sturgeon,is controlled by the brain pituitary gonad axis (BPG), different parts of which are described in numerous papers that include the somatotropic and gonad tropic axes and the interaction between them [4,5,7].

The aim of the present study is to build a quality model to describe the somatotropic and gonadotropic axes controlling oogenesis (caviar production).

Materials and Methods

Fish and Sampling

Fish samples were taken from the ovaries of female Russian sturgeon during the growth ages (1, 2, 3 4, 5, 6 and 7 years old) in the Dan Fish Farms (Upper Galilee, Israel; 31°30'N, 34°45'E) using endoscopy, as previously described [5,9].

Measurement and Analysis of Different Parameters

Different gene cloning and transcription that were encoded to hormones have been described in detail in various papers, and only a few examples are given here: Kisspeptine receptor (GPR54), Kisspeptine 1 (Kiss1) FSH, FSHR, LH and LHR; VTL, Vg gonadotropin-releasing hormone (GnRH) Estradiol-17β (E); and GH, IGF-I [1,4,7-11].

Results

GPR54 was detected in the brain of Russian sturgeon, and the nucleotide sequence of the isolated stGPR54 cDNA included an open reading frame of 2190 bp encoding a predicted 357 amino acid peptide, a 539 bp 5′UTR and 1.2 kb 3′UT. The transcription of stGPR54 in the ovary was significantly higher in black oocytes compared to previous stages of oogenesis in the ovary of Russian sturgeon (pre-vitellogenic, white, yellow and gray oocytes) [10]. These results support the suggested model where by Kiss1 secreted into the brain affected GnRH, which affected FSH secretion (Fig. 1). From the pituitary gland secretion, two hormones are involved in vitellogenesis – FSH and GH. FSH affects endocrine secretion, which causes the synthesis of Vg secreted to the blood and reaches the oocytes,which affects the creation of black caviar (Fig. 1) [1,4,7,9].

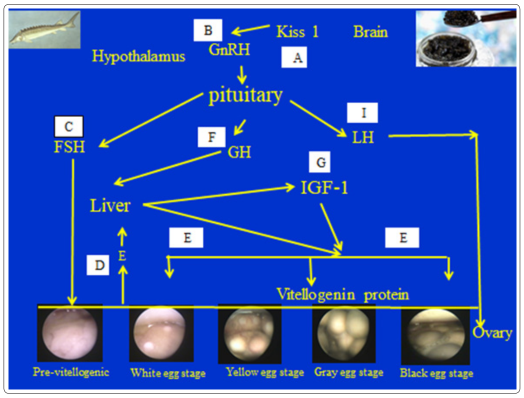

Figure1: Proposed quality model of BPG control by the somatotropic and gonadotropic axes of vitellogenesis in Russian sturgeon [1,5,7-11].

Discussion

Oogenesis in fish is controlled by the BPG axis. Most of the genes encode the hormones that control oogenesis and are condensed on the endocrine's BPG-axis mechanism [6,7]. The genes involved in paracrine and autocrine secretion have been studied less [10,12,13]. The genes described in Russian sturgeon that encoded to the genes of hormones controlling vitellogenesis are very limited. Many more genes are involved in vitellogenesis (caviar creation). In order to understand the mechanism of controlling sex or oogenesis, which is very important in further aims and the economy of creating caviar, the transcriptomes of various sturgeon species have been studied in various genes regarding sex [14,15]. Based on these studies, some genes having greater expression were found to be significantly higher on the BPG axis, which helped us build the proposed model of hormones controlling oogenesis (Fig.1). The aim of the current paper is to add knowledge and summarize the information of previous studies on genes having a higher transcription in the BPG-axis ovary. Two different endocrine secretions LH and GH and autocrine/paracrine are directed [2,4,8]. The proposed quality model concentrated on endocrine secretion, which is used more in the aquaculture of Russian sturgeon [1,7].

In the future, I suggest studying the genome and transcriptome of Russian sturgeon in all organs of the BPG axis in order to better understand the effect of genes on oogenesis and the interaction between the somatotropic and gonadotropic axes.

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