

The Levels of Serum Thyroid Hormone in Sturgeon Populations

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Abstract. Thyroid hormone (TH) play an important role in the growth and development of animals, and regulate the protein metabolism, structure and function of the growth and development of the central nervous system. It also has a direct impact on the quantity and quality of animal population. Sturgeon is rich in nutritional value, and the thyroid hormone function is crucial to the fish growth. However, there is less information about the thyroid hormone concentrations in sturgeon bodies. The aims of this study were to evaluate the serum levels of thyroid-stimulating hormone (TSH), triiodothyronine (T₃), thyroxine (T₄), Free triiodothyronine (FT₃) and Free thyroxine (FT₄) in three sturgeon populations that were reared in cages. Our results showed that there are differences among the sturgeon populations. The serum T₃ levels of Amur sturgeon was significantly lower than both populations of Siberian sturgeon and Russian sturgeon. The serum levels of FT₃, FT₄ and T₄ were significantly different between Siberian sturgeon and Amur sturgeon, but no obvious different with Russian sturgeon. Correlation analysis showed that the serum T₃ and FT₃, T₄ and FT₄ had a positive correlation in sturgeon populations, but did not find the serum hormone levels associated with growth traits data. Our results also found that serum T₃ and FT₄, FT₄ and FT₃ exist highly relevant in both Russian sturgeon and Amur sturgeon. It is suggested that the sturgeon thyroid endocrine system is relatively complex.

Keywords: sturgeon populations, thyroid hormone, content.

1. Introduction

Fish growth and development are affected by environmental factors, physiological structure, and genetic mechanism, through the neuroendocrine system release hormones to regulate the body. Like other vertebrates, the endocrine gland of fish is made up of the scattered neurosecretory cells. Fish is lower vertebrates, which endocrine gland is also in a relatively primitive stage. The shape of Elasmobranch thyroid is like crescent or irregular lump and located in the tongue ventral cartilage. But the teleosts thyroid tissue is scattered diffusely and mainly distributed in the ventral aorta and cheek area, even diffusion to the gills, eye, kidney, head kidney and spleen etc...Fish thyroid hormone has two forms, one is 3, 3, 5-triiodo-L-tyronine (triiodothyronine, T₃), and the other is L-thyroxine (T₄). They are both stored in the follicular. The synthesis and secretion of thyroid hormones are regulated and controlled by thyroid stimulating hormone (TSH) [1]. The fish thyroid tissue release T₃ is rarely. Although most of T₃ in blood circulation of fish body was transformed from T₄, its biological activity is stronger than T₄ [2], [3].

Thyroid hormone plays an important role in the growth and development of animals. Previous studies indicated that thyroid hormones play an important role in the egg development and improve the survival rate of juvenile fish [4], [5]. In addition, thyroid hormones may also have important effects on the development of fish embryos and some types of metamorphosis [6]-[9]. Sturgeon is rich in nutritional value, and the thyroid hormone function is crucial to the fish growth. However, there is less information about the thyroid hormone concentrations in sturgeon bodies. Thus, we investigate the levels of serum thyroid hormone in sturgeon populations in this study.

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2. Materials and Methods

2.1. Blood Sampling

The Siberian sturgeon (*Acipenser baerii* Brandt), Russian sturgeon (*Acipenser gueldenstaedti* Brandt) and Amur sturgeon (*Acipenser schrenkii* Brandt) serum were collected from sturgeon breeding farm. The basic growth trait of sturgeon populations were list in Table 1.

Table 1: The basic growth trait of sturgeon populations in this study

Variety	N	weight (g)
Siberian sturgeon (S)	31	737.9 ± 110.1
Russian sturgeon (R)	30	991.5 ± 480.6
Amur sturgeon (A)	31	907.2 ± 129.4

2.2. Hormone Assay

The contents of thyroid hormone TSH, T₃, T₄, FT₃ and FT₄ were measured by chemical luminescent immunoassay (CLIA) (Simense, IMMULITE1000, USA).

2.3. Data Statistics

The One-way variance analysis, Duncan's multiple comparisons and Pearson's correlation analysis were analysed by SPSS 11.5.

3. Results

3.1. Hormone Determination

Multi-comparison on levels of serum thyroid hormones of deferent sturgeon populations were list in Table 2. In addition to the TSH, thyroid hormone levels were significant difference in the three sturgeon population. The average content of T₃ in Amur sturgeon group was 14.98 ± 2.690 ng/dL and its content significantly lower than both the Siberian sturgeon and the Russian sturgeon. Serum levels of FT₃, FT₄ and T₄ did significantly different between Siberian sturgeon and Amur sturgeon, but no obvious different with Russian sturgeon. This may indicate the Siberian sturgeon is more similar with Russian sturgeon endocrine gland activity mechanism.

Table 2: Multi-comparison on levels of serum thyroid hormones of deferent sturgeon populations

Group	N	TSH μIU/mL	T ₃ ng/dL	FT ₃ pmol/L	FT ₄ pmol/L	T ₄ μg/dL
S	31	0.0022±0.0022 ^a	49.25±22.09 ^a	2.094±0.589 ^a	4.774±1.598 ^a	0.554±0.245 ^a
R	30	0.0019±0.0021 ^a	51.09±0.625 ^{ac}	2.188±0.906 ^{ab}	4.087±1.584 ^{ab}	0.481±0.1755 ^{ab}
A	31	0.0011±0.0018 ^a	14.98±2.690 ^b	1.175±0.660 ^b	3.563±1.449 ^b	0.395±0.1565 ^b

Note: Different letters within the same column differ significantly, P<0.05

3.2. Hormone Assay

As shown in Table 3 ~ Table 5, the levels of serum T₃ and FT₃, FT₄ and T₄ are showed extremely significant positive correlation in three sturgeon groups. Correlation analysis showed that serum T₃ and FT₃, T₄ and FT₄ had a positive correlation in sturgeon populations, but did not find the serum hormone levels associated with growth traits data. Our results also found that serum T₃ and FT₄, FT₄ and FT₃ exist highly relevant in both Russian sturgeon and Amur sturgeon. It may indicated that thyroid hormone levels mainly affected by the external environment factors, physical structure, and has no relationship with growth traits.

Table 3: Pearson's Correlation coefficient of serum thyroid hormones of the Siberian sturgeon

	TSH	T ₃	FT ₃	FT ₄	T ₄
TSH	1				
T ₃	/	1			
FT ₃	/	0.822**	1		
FT ₄	/	/	/	1	
T ₄	/	/	/	0.708**	1

Table 4: Pearson's Correlation coefficient of serum thyroid hormones of the Russian sturgeon

	TSH	T ₃	FT ₃	FT ₄	T ₄
TSH	1				
T ₃	/	1			
FT ₃	/	0.785**	1		
FT ₄	/	0.435*	0.585**	1	
T ₄	/	/	/	0.557**	1

Table 5: Pearson's Correlation coefficient of serum thyroid hormone of the Amur sturgeon

	TSH	T ₃	FT ₃	FT ₄	T ₄
TSH	1				
T ₃	/	1			
FT ₃	/	0.722**	1		
FT ₄	/	0.469**	0.515**	1	
T ₄	/	/	/	0.646**	1

Note: * indicates significant differences at $p < 0.05$; ** indicates significant differences at $p < 0.01$; / indicates no significant differences

4. Discussion

The previous researchers mainly focus on the thyroid morphology and the effects of thyroid hormones on the metamorphosis and behaviour of fish, especially in fish hatching, larval growth, and development and survival rate at the early stage of fish growth [10], [11]. However, the investigation on thyroid hormone concentration of different fish species is still very little. In this paper, the contents of thyroid hormones in three groups of sturgeons were determined by chemical luminescent immunoassay. Our results showed that thyroid hormone content of Russia sturgeon and Siberia sturgeon is more similar, and is quite different from the Amur sturgeon. The T₄ is a kind of original hormones in fish, and its half-life is 7 days. Although the T₃ half-life is only 1 day, its activity is stronger than T₄. The contents of T₃ and FT₃, T₄ and FT₄ showed extremely significant positive correlation in this study. The result is similar to that reported by Eales and Shostak about rainbow trout [12]. It is indicated that there is a coordination mechanism in serum T₃ and FT₃ or T₄ and FT₄, which have mutual feedback on hypothalamic pituitary thyroid axis.

Our results also showed that the content of TSH among the three groups was not significant. Thyroid stimulating hormone, which is secreted by the pituitary gland, has the function of regulating thyroid function and maintaining the stability of thyroid hormone in the body. Their activity has been found in many teleost fishes [13]-[19]. TSH is a kind of heterologous dimers glycoprotein hormones, which is composed of two noncovalently associated subunits, α and β . The TSH α subunits is common to the other dimers glycoprotein hormones, such as luteinizing hormone (LH), promoting follicular hormone (FSH) and chorionic promote gonadal hormone (CG), which function is to activate the adenosine cyclise. The TSH β gene is specific to the pituitary gland and is significantly higher in immature fish than in mature fish [17], [20]. Although there is no any index can comprehensively measure thyroid function, but TSH is a sensitive index to reflect the hypothalamus - pituitary - thyroid axis function [3]. Therefore, the clinical detection of serum TSH level is mainly used to evaluate the function of hypothalamic pituitary thyroid axis [18]. TSH secretion is regulated by the hypothalamic pituitary thyroid axis, and there is a self regulation of the thyroid gland. But serum T₃ and T₄ have negative feedback regulating effect on TSH.

Sturgeon has plenty of nutrients, and many organs have medicinal, cosmetology, health care function [21]. In present study, the levels of serum thyroid hormone in sturgeon populations have been investigated, and it is better for us to understand the major mechanism for adjusting sturgeon thyroidal status.

5. Conclusion

Cultured fish often respond to environmental stresses. Environment stress factors have a main effect on the growth of fish. Fish body physiological and biochemical will changes for a long time in environment stress, resulting in neuroendocrine will change. In the present study, our result suggested that the sturgeon thyroid endocrine system is relatively complex. It means that environment factors could interfere with the

normal physiological function of the thyroid, and have direct or indirect influence on the regulation of growth, development, reproduction of fish. The content of thyroid hormone related farmed sturgeon have not been reported previously, our results showed that the juvenile fish can more sensitive to thyroid disruption. It is better for us to understand the major mechanism for adjusting sturgeon thyroidal status.

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