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Differences in Nutritional Value of Various Fish Products Expressed by the Amino Acid Profiles of their Water-soluble Fractions

Marina V. Mikhailova, Konstantin V. Zolotarev, Anton N. Mikhailov, Maxim A. Sanzhakov, Tatyana E. Farafonova

***Abstract*: The amino acid profiles of the whole water-soluble fraction of some popular fish products (muscle and caviar) have been studied. The pike (Esox lucius) muscle and caviar contain more branched-chain amino acids than all the products being studied including some valuable sturgeon and salmon fish species, and pike muscle also contains the highest amount of phenylalanine and lysine. Pike caviar is also a leader in threonine content. The pike may be considered as one of the most nutritionally valuable fish species, especially if the full amino acid content from the water-soluble fraction of its edible tissues is compared.**

***Keywords*: amino acids, caviar, muscle, nutritional value.**

I. INTRODUCTION

Consumption of fish products is widespread and helpful throughout all stages of human lifecycle. Fish is a source of nutrients critical for brain development during early years of life [1] so it is widely advised for consuming to the pregnant women [2]. Nowadays, the world's population gets about 25% of its protein from fish on average; as for Asia, this value is about 55%. Besides protein, fish is a good source of some bioactive peptides [3]. Fish protein contains greater amounts of residues of essential amino acids (EAAs) including branched-chain amino acids (BCAAs) then conventional meat products (beef, poultry, pork) [4].

Fish is also a valuable nutrient source used in some severe diseases treatment. In animal studies, more significant hypocholesterolemic activity has been shown for proteins from different fish species, if compared with casein as protein source. Edible tissues of some fish species also contain peptides with antihypertensive and antioxidant activity [5].

According to the abovementioned facts, we considered that it might be helpful to study the amino acid profiles of the whole water-soluble fraction of some popular fish products (muscle and caviar) because it contains rapidly assimilating proteins and also peptides.

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* Correspondence Author

Dr. Marina V. Mikhailova, Laboratory of Environmental Biotechnology, Institute of Biomedical Chemistry, Moscow, Russia. Email: m_mikhailova@mail.ru

Konstantin V. Zolotarev*, Laboratory of Environmental Biotechnology, Institute of Biomedical Chemistry, Moscow, Russia. Email: fireaxe@mail.ru. Phone: +7(916)133-73-82

Anton N. Mikhailov, Laboratory of Environmental Biotechnology, Institute of Biomedical Chemistry, Moscow, Russia. Email: myhas84@mail.ru

Dr. Maxim A. Sanzhakov, Laboratory of Nanomedicines, Institute of Biomedical Chemistry, Moscow, Russia. Email: sanwakov@mail.ru

Dr. Tatyana E. Farafonova, Laboratory of Systems Biology, Institute of Biomedical Chemistry, Moscow, Russia. Email: farafonova.tatiana@gmail.com

II. METHODOLOGY

A. Fish samples obtaining

All the fish samples were obtained by ordinary fishing or aquaculture breeding in various regions of Russia (see Table I). Three samples of each fish tissue were collected for analysis; only adult and healthy-looking fishes were chosen. The caught fishes were dissected *in situ*; the muscle and ovary samples were rinsed, separated from other tissues and frozen immediately.

Table I. Fish tissue samples used in this work

Common name	Latin name	Tissues studied	Region of origin	Source of fish
Pike	*Esox lucius*	Muscle, caviar	Tver region	Fishing
Zander	*Sander lucioperca*	Muscle, caviar	Tver region	Fishing
European perch	*Perca fluviatilis*	Muscle, caviar	Tver region	Fishing
Chum salmon	*Oncorhynchus keta*	Muscle	Sakhalin island	Fishing
Coho salmon	*Oncorhynchus kisutch*	Muscle	Sakhalin island	Fishing
Pink salmon	*Oncorhynchus gorbuscha*	Muscle	Sakhalin island	Fishing
Siberian sturgeon	*Acipenser baerii*	Muscle, caviar	Astrakhan region	Aquaculture
Russian sturgeon	*Acipenser gueldenstaedti i*	Muscle, caviar	Astrakhan region	Aquaculture
Sterlet	*Acipenser ruthenus*	Muscle	Tver region	Aquaculture

B. Sample preparation

60 g of each fish tissue were homogenized with a meat grinder (muscle samples) or a mortar (caviar samples), then 180 ml of distilled water were added and the mixtures were homogenized for 1 min in a blender. After that, the mixtures were left for 30 min for extraction at room temperature with periodic stirring. Then, the mixtures were centrifuged at 6000 G for 15 min, and the supernatants were freeze-dried. The conditions of freeze-drying procedure are shown on Fig. 1. The dried extracts were controlled for residual moisture.

Water content was measured via volumetric Karl Fischer titration using HYDRANAL Solvent and HYDRANAL Titrant 5. If the dried sample contained more than 5% of water by weight the freeze-drying procedure would have to be revised.

C. Amino acid analysis

Amino acid concentrations were measured using a chromatographic analysis of their orthophtalic derivatives according to standard amino acid samples. First, 10 mg of the dried extract of each sample were dissolved in 1 ml of distilled water. The resulting solution was diluted in 25 times and 50 µl of the solution were dried up in an ampoule. Then, 100 µl of 6 M HCl was added to it and the ampule was sealed under vacuum. Acidic hydrolysis was performed over 24 hours and at 110 ^{o}C. After that, the ampoule was opened and the solution was dried up in the Eppendorf Concentrator 5301 vacuum concentrator. Finally, 50 µl of 0.1 M HCl was added to the dried sediment. The chromatographic separation was done using an Agilent 1200 series chromatographic system equipped with fluorescent detector and ZORBAX Eclipse AAA (5µm; 4.6 x 150 mm) column. The mobile phases were 40 mM pH 7.8 phosphate buffer solution (Solution A) and 80% water solution of acetonitrile (Solution B). Borate buffer with pH 10.2 and o-phtalaldehyde were used for amino acid derivatization. The amino acid derivatives were eluted at a flow rate of 1 ml min-1 with a gradient of the Solution B in a three steps: for the first 16 min from 2 to 12% B, the next 18 min from 12 to 36% B at last 2 min from 36 to 63% B. A total run time was 41 min including 3 min flushing with 63% Solution B and 2 min re-equilibration to 2% Solution B. The areas under the fluorescent chromatogram peaks of the analyzed samples and of the amino acid standards (Agilent, USA) were measured.

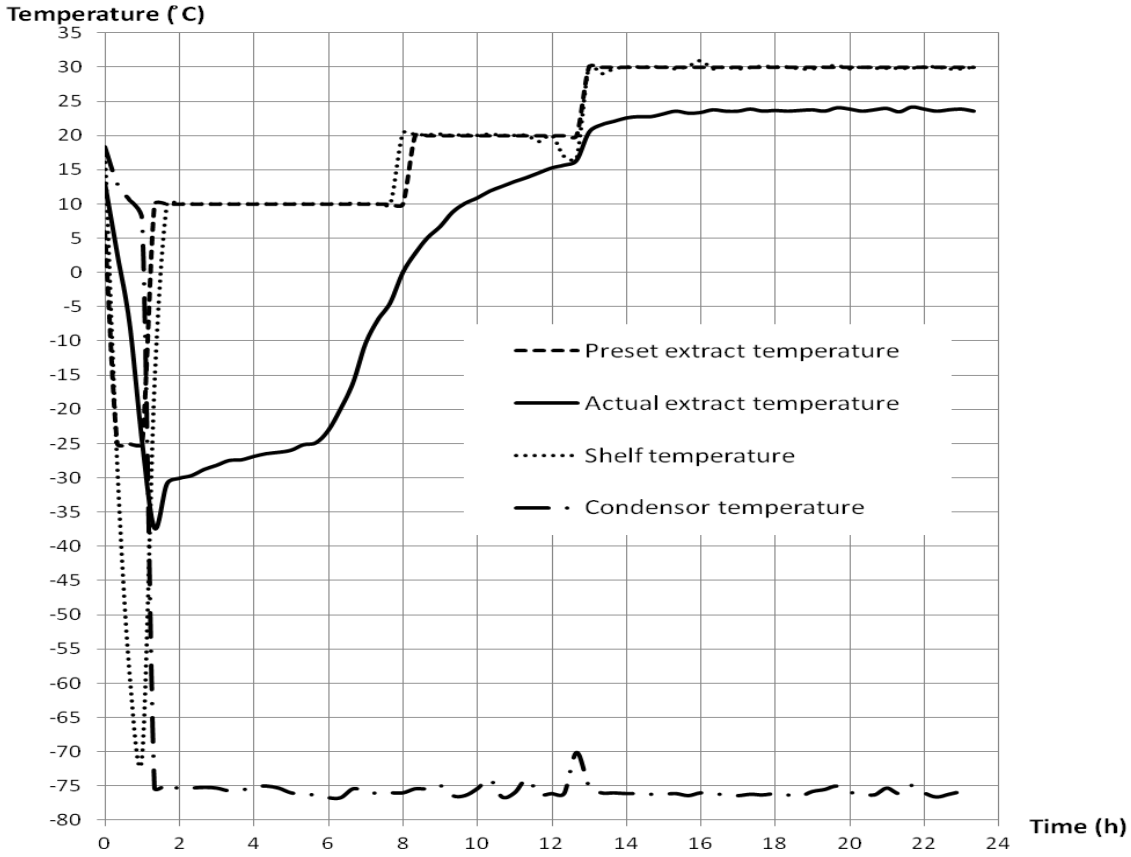

Fig. 1. The conditions of freeze-drying used for sample preparation

III. RESULT AND DISCUSSION

The EAA concentrations in the fish tissue samples are shown on Fig. 2. According to these data, the pike muscle and caviar contain more BCAAs than all the products being studied, and pike muscle also contains the highest amount of phenylalanine and lysine. Pike caviar is also a leader in threonine content. The Russian sturgeon is only the second fish tissue by the nutritional value expressed by the total EAAs content in the water-soluble fraction despite the fact that it is considered to be the one of the most valuable fish products. The amount of essential amino acids has always been one of the key criterions of fish nutritional value. [6]. Thus, the pike (*Esox lucius*) may be considered as one of the most nutritionally valuable fish species, especially if the full amino acid content from the water-soluble fraction of its edible tissues is compared.

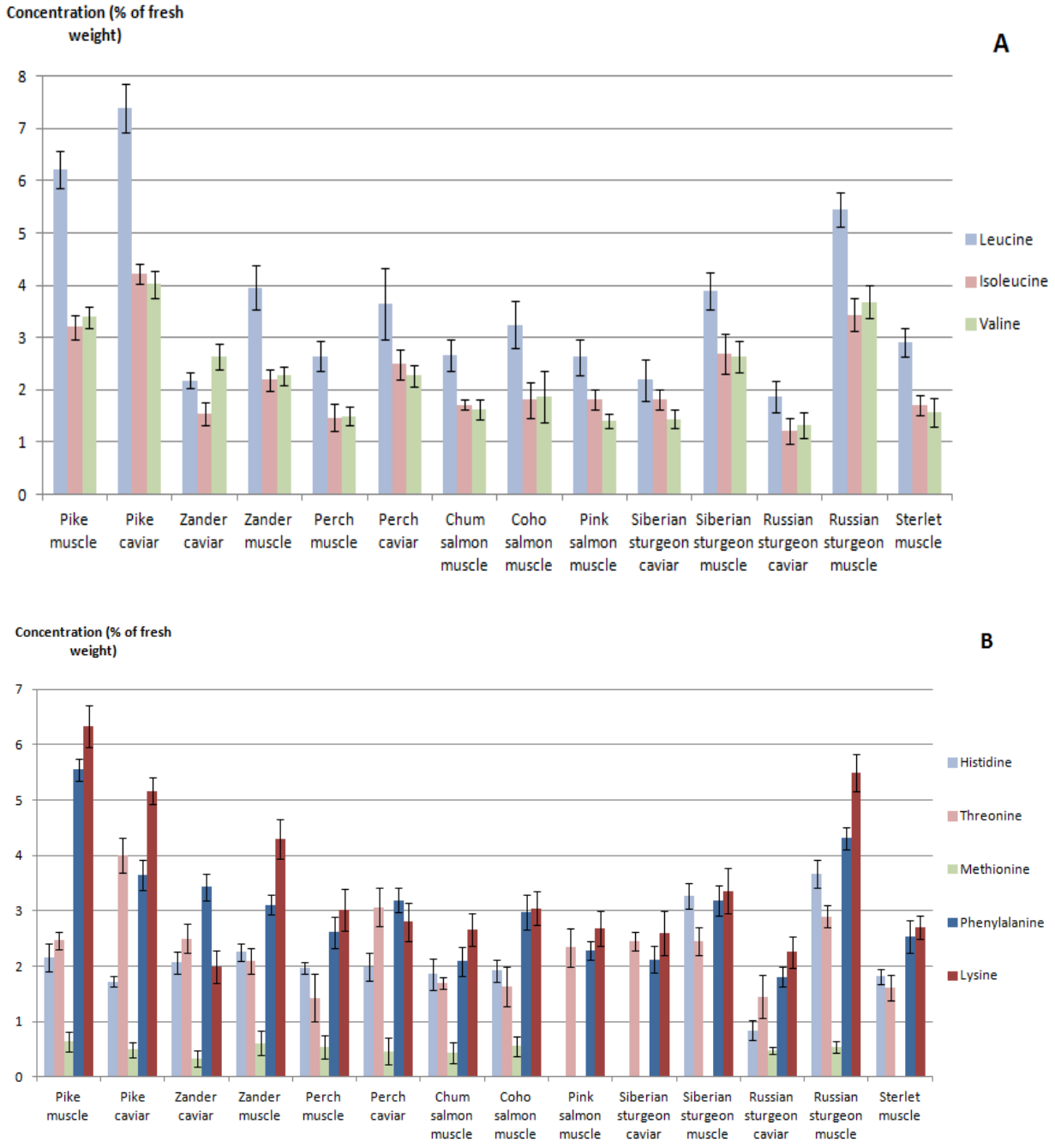

Fig. 2: Essential amino acid concentrations in fish muscle and caviar samples (expressed as mean values ± SD): (A) BCAAs, (B) other EAAs

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AUTHORS PROFILE

Marina V. Mikhailova, PhD, graduated from the Astrakhan State Technical University, Associate Professor, Head and leading researcher at Laboratory of Environmental Biotechnology of Institute of Biomedical Chemistry (IBMC), Full member at the International Academy of Ecology and Life Protection Sciences (MANEB), Head of the Industrial Aquaculture block in the sectoral program of scientific and technical support for Russian fisheries in the Astrakhan, Volgograd regions and the Republics of Dagestan and Kalmykia. Publications:

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Maxim A. Sanzhakov, PhD, graduated from the Moscow State University of Fine Chemical Technologies named after M.V. Lomonosov, researcher at Laboratory of Nanomedicines of Institute of Biomedical Chemistry. Publications:

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Tatyana E. Farafonova, PhD, graduated from the Moscow State University of Fine Chemical Technologies named after M.V. Lomonosov, researcher at Laboratory of Systems Biology of Institute of Biomedical Chemistry. Publications:

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