2. ROLE AND IMPORTANCE OF TROUT MEAT IN THE HUMAN DIET

The development of science in the 20th century has shed a new light on the role of fish consumption in supporting human health. Currently, the theory on the impact of marine-origin food on the evolution of a species is accepted. Archaeological studies have confirmed that Homo sapiens evolved from the primates in the coastal regions of Africa and Anatolia. The unique composition of diet, particularly a high content of polyunsaturated fatty acids, has enabled an expansion of brain volume and intellectual development of our ancestors in a relatively short period of time. These acids are now still used by human organism to construct cell membranes, especially the neurons and the brain, which is composed in app. 60% of lipid components.

Since lipids are not only a source of energy, but also a substrate for the construction of many components of the body, they should be supplied with food throughout life. Their supply is particularly important during growth, i.e. during pregnancy and the intensive development of a child. It has been shown that intellectual development of children is strongly and positively correlated with the volume of fish consumed by their mother during pregnancy. The authors strongly recommend listening to a very interesting lecture on these issues delivered by Prof. Michael Cawford, Institute of Brain Chemistry and Human Nutrition in London, which can be found at http://www.seafood.net.au/printerfriendly/?pid=1003&nid=403#4.

2.1. Characteristics of trout fat

It is generally accepted that lipids are natural, substances that are insoluble in water and mainly composed of glycerin and fatty acid esters. These glycerols may be bound to other compounds/substances to form complex lipids, such as glycolipids (with sugars) or phospholipids (with residues of phosphoric acid). They have a variety of different functions in the body and are a source of concentrated and readily-available energy as well as being substrates for many important structures in the body.

Fatty acids with different structures are the components of cell membranes. Saturated acids form simple and rigid chains, ensuring proper cell shape, whereas unsaturated acids loosen the structure, allowing for exchange through the cell membrane and for changes in its shape. Lack of an appropriate volume of fatty acids forces the body to use another acid to construct the cell, usually with the same number of carbon atoms, although this compromises its functions. This knowledge confirms the importance of supplying food with an adequate ratio of fatty acids.

Fatty acids are the components of many other biologically-active compounds, such as tissue hormones (prostaglandins), neurotransmitters (serotonin and dopamine) and eicosanoids with anti-inflammatory and
anti-thrombotic activity. Fatty acids constitute the structure of cholesterol and it is well-known that, depending on the type of acid (saturated or unsaturated), "good" HDL or "bad" LHL cholesterol is formed. It is clearly a mistake to eliminate lipids from the human diet. Instead, the level and composition of fat should be adjusted to individual physical activity level to ensure a supply of all essential fatty acids, particularly those found in fish.

The international scientific literature constantly (practically each month) provides further evidence on the beneficial impact of fish consumption on the physical and mental state of the human body; this effect may sometimes be termed therapeutic. The first reports concerned the prophylactic and therapy-supporting impact of ω-3 fish fatty acids on the condition of the cardiovascular system. This discovery has resulted in a wide variety of available preparations based on fish liver oil. Currently, there is growing evidence confirming the role of ω-3 fatty acids in decreasing the frequency of deaths due to cardiac failure by preventing arrhythmia related to acute cardiac ischemia that leads to heart attacks.

There are numerous clinical publications that have documented the role of polyunsaturated fatty acids in reducing hypertension. This metabolic disease affects a significant fraction of the adult population in well-developed countries. Furthermore, this condition is being more commonly seen even in children. The possible reasons include decreased physical activity and inadequate diet composition: excessive salt and fat with an inadequate ratio of fatty acids (a high proportion of saturated acids, an excess of monounsaturated and diunsaturated acids, together with a deficiency in polyunsaturated fatty acids). Population studies have confirmed a significantly lower incidence of hypertension in groups of people frequently consuming fish and seafood despite a high incidence of other risk factors, such as severe stress or smoking.

Arteriosclerotic vascular disease (ASVD) is another metabolic disease with increasing incidence which can be prevented with systematic consumption of fish. Polyunsaturated fatty acids alleviate the inflammatory reaction of the endothelium by reducing the volume of free radicals, increasing the concentration of HDL cholesterol and significantly decreasing the concentration of triglycerides in the blood. The occurrence of ASVD lesions is mainly associated with the presence of "bad" cholesterol, whereas most recent studies have indicated that free radicals and pro-inflammatory factors, as well as an excess of triglycerides are the predominant cause. A diet rich in fish provides a source of polyunsaturated fatty acids which counteract these unfavourable factors.

There are several publications which have confirmed the beneficial impact of ω-3 fatty acids on patients with mental and neurological diseases (schizophrenia, depression, Alzheimer’s disease and Parkinson’s disease), rheumatic diseases or skin conditions (e.g. psoriasis). Administration of ω-3 preparations is commonly used to enhance general immunity. However, it would be more beneficial to introduce more fish into the daily Polish diet instead of occasional supplementation with such preparations.

2.2. Characteristics of trout protein

While discussing the importance of "trout meat", the role of protein cannot be omitted. It is one of the essential nutrients in the human diet. The most recent Polish standards indicate a dose of 0.8g/kg BW/day for an adult, which corresponds to app. 50g of (pure) protein per day. It is emphasized that not only the quantity, but also the quality of protein is fundamental to the proper functioning of the body. Fish protein is much higher quality than standard protein, i.e. chicken egg protein. Despite the well-known nutritional values of fish protein, there are a limited number of publications on its composition.

The nutritional value of protein in a food product, including fish protein, is determined by its amino acid composition. The main attention is focused on the amino acids that cannot be synthesized by
the human body; these are called “essential” amino acids and include histidine (essential for children),
treonine, lysine, leucine, isoleucine, phenylalanine, methonine, tryptophan and valine.

The total content of essential and semi-essential amino acids in fish usually exceeds the content
in the standard protein, i.e. 26.5 g in 100 g of protein. Fish protein has a high concentration of lysine,
leucine, aromatic amino acids (phenylalanine and tyrosine), sulphur amino acids (methionine and
cysteine) and histidine.

The basic parameter used for evaluation of the nutritional value of protein in food products is the
chemical score (CS) which describes the lowest content of a given essential amino acid in relation to its
content in the standard protein. Such amino acid is termed as “limiting the nutritional value of a given
protein”. In the case of fish, valine is a limiting amino acid although the CS values for this amino acid are
very high. It is important since a valine deficiency may cause motor incoordination, loss of body mass
and inappetance, whereas an adequate amount of this amino acid exerts a beneficial impact on the
functioning of the dendritic cells, especially in persons with hepatic cirrhosis. The calculated CS values
indicate that almost 100% of essential amino acids from fish protein may be used to synthesise the pro-
teins of the body.

From the perspective of using fish protein in human nutrition, it seems beneficial because of the
high content of lysine that is found in small amounts in cereal proteins. It should be emphasized that
cereals and cereal food products are the basis of all food-guide pyramids which have been developed
to date. Since it is recommended to frequently consume cereals, lysine should be supplied in daily ra-
tions with other food products. This is important because a lysine deficiency in diets may lead to muscle
atrophy and bone decalcification and putrescine and cadaverine synthesis (due to decay processes in
the large bowel). The lysine supply in diets should not be too high, although it helps to reduce the risk
of heart diseases and neoplastic conditions which result from aberrated metabolism.

It has been found that an optimal level of leucine in the human body prevents neurological disor-
ders. Moreover, leucine helps to maintain optimal body weight since it reduces body fat mass by 25%
and improves the indices of glucose and cholesterol metabolism. A high content of aromatic amino
acids (phenylalanine and tyrosine) in the protein of trout should not pose any risk in the individuals
who do not show any abnormalities in the process of oxidation of phenylalanine to tyrosine. It has been
shown that a diet deficient in, or without tyrosine, results in an increased demand for phenylalanine
above the current nutritional recommendations.

The consumption of sulphur amino acids and its volume has attracted interest in the context of the
prevalence of chronic diseases, such as cardiovascular conditions, Alzheimer’s disease and diabetes. In the
body, methionine is transformed into homocysteine, which elevates blood levels and leads to hyperho-
mocysteinaemia, a risk factor of development of sclerotic and thrombotic changes in blood vessels, infarct
and stroke. Furthermore, a high consumption of proteins containing methionine and cysteine increase
calcium losses, leading to a significant reduction in bone mineral density and bone mass. Methionine de-
fi ciencies may lead to degeneration of the liver and impaired immunity. This does not present a problem
because of the volume of fish consumption in the world and in the countries of Eastern Europe.

2.3. Other advantages of trout meat

The content of undesirable substances in fish and seafood is a major obstacle to increasing the con-
sumption of these products. For instance, in countries with a high consumption of fish and seafood, the
allowed levels of daily mercury intake are exceeded. The average Polish diet has only a small percent-
age of the allowed amount of this very dangerous element. This is explained by the low consumption
of sea fish. Moreover, fish are an important source of contamination with dioxins. These compounds are
carcinogenic, teratogenic and have estrogenic properties, even in microdoses. Their wide prevalence
leads not only to increased incidence of neoplastic diseases and congenital disorders in children, but it
is also associated with problems with maintaining pregnancy, a reduction in the number of live sperm
cells and even with an increase in the severity of osteoporosis.

Fish from aquaculture, particularly from farms operating in Poland, are a counterbalance for fish and
seafood. The strict environmental laws and the knowledge of fish producers and diligence in their daily
work contribute to the fact that Polish trout are a high quality source of food (in terms of the level of
environmental contamination). The attention paid to the quality of feed generates a product with many
healthy properties as well as good economic effects.

2.4. Summary

Trout consumption in Poland should be increased since it contains highly valuable, easily digestible
protein and lipids with unique compositions and beneficial properties for the human body. An increase
in fish consumption, including trout, would support the activities of public health and hygiene cam-
paigns aimed at preventing obesity and metabolic diseases. Fish consumption should be promoted,
particularly among pregnant women and children, since epidemiological studies clearly indicate a bet-
ter development of the nervous system and higher intellectual level in children, who may benefit from
fish fatty acids starting from the foetus. The health qualities of trout and the possibility to direct it for
consumption shortly after catching are additional arguments for increasing the consumption of this
fish in Poland.