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Nutritional Value of Fish in Human Diet

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ABSTRACT

Fish receives special attention as a food because of its content of first class animal proteins with high nutritive valve and rich in various essential amino acids. Its contribution of fair amounts of water-soluble vitamins and many of the minerals and micronutrients is also well recognized. New knowledge on the role of ω-3 fatty acids in human physiology and high contents of this group has added a new dimension to the importance of fish in health and nutrition. Malnutrition is still a problem in many countries. Micronutrient efficiencies of vitamin A, iron and iodine are also of public health concern in the whole world. Their consequences include nutritional blindness, poor learning capabilities, poor growth and increased morbidity and mortality rates. There is therefore need for development of agricultural programmes including fisheries and aquaculture which mainstream nutrition issues, as these can go a long way in alleviating the problem of malnutrition in the world.

Keywords: Fish, Nutrition, Malnutrition, Agriculture, Omega-3 Fatty acid

INTRODUCTION

In recent times, the application of science in nutrition started during the later parts of the last century. However, fish receives special attention as a food because of its content of first class animal proteins with high nutritive valve and rich in various essential amino acids. Its contribution of fair amounts of water-soluble vitamins and many of the minerals and micronutrients is also well recognized. New knowledge on the role of ω-3 fatty acids in human physiology and high contents of this group has added a new dimension to the importance of fish in health and nutrition. Malnutrition is still a problem in many countries [1]. Micronutrient efficiencies of vitamin A, iron and iodine are also of public health concern in the whole world. Their consequences include nutritional blindness, poor learning capabilities, poor growth and increased morbidity and mortality rates. Development of agricultural programmes including fisheries and aquaculture which mainstream nutrition issues can go a long way in alleviating the problem of malnutrition in the world [2].

Fish and Nutrition

Fish are a rich source of protein, fatty acids, and essential vitamins and minerals such as vitamin A, calcium, iron, zinc, and iodine [3]. The vitamin A, calcium and iron found in small fish species are particularly bioavailable that is, easily absorbed by the body. Rising incomes and high consumer preferences for fish, especially in Asia, have caused global fish consumption to double in the past 30 years to 15kilograms per person per year, according to the Food and Agriculture Organization of the United Nations (FAO). This trend is mainly attributable

to demand from growing urban populations in China and other Asian countries. Studies in rural Bangladesh and Cambodia show that small fish makeup between 50 to 80 percent of all fish eaten during the production season [1]. Although they consumed in small quantities, these small fish, which are consumed whole, are particularly rich in micronutrients. Their bones are an excellent source of calcium, and in some species, vitamin A accumulates in their eyes and intestines. A study of poor, rural households in Bangladesh in 1997 revealed that small fish intake provided about 40 percent of the vitamin A and 32 percent of the calcium recommendations of an average household in the peak fish production season [4]. The long-chained omega-3 polyunsaturated fatty acids (PUFA) found in marine fish has a range of health benefits.

MACRONUTRIENTS

Proteins

Proteins are important for growth and development of the body, maintenance and repairing of worn out tissues and for production of enzymes and hormones required for many body processes [5]. The importance of fish in providing easily digested protein of high biological value is well documented. In the past this has served as a justification for promoting fisheries and aquaculture activities in several countries. On a fresh weight basis, fish contains a good quantity of protein, about 18-20%, and contains all the eight essential amino acids including the sulphur containing lysine, methionine, and cysteine [2].

Fats

The fat content of fish varies depending on the species as well as the season but, in general, fish have less fat than red meats. The fat content ranges from 0.2% to 25%. However, fats from fatty fish species contain the polyunsaturated fatty acids (PUFAs) namely EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) (omega 3 fatty acids) which are essential for proper growth of children and are not associated with the occurrence of cardiovascular diseases such as coronary heart disease[6]. The fat also contributes to energy supplies and assists in the proper absorption of fat soluble vitamins namely A, D, E, and K.

MICRONUTRIENTS

Vitamins

Fish is a rich source of vitamins, particularly vitamins A and D from fatty species, as well as thiamin, riboflavin and niacin (vitamins B1, B2 and B3). Vitamin A from fish is more readily available to the body than from plant foods [7]. Vitamin A is required for normal vision and for bone growth. Fatty fish contains more vitamin A than lean species. Studies have shown that mortality is reduced for children under five with a good vitamin A status. As sun drying destroys most of the available vitamin A better processing methods are required to preserve this vitamin. Vitamin D present in fish liver and oils is crucial for bone growth since it is essential for the absorption and metabolism of calcium. Thiamin, niacin and riboflavin are important for energy metabolism[8]. If eaten fresh, fish also contains a little vitamin C which is important for proper healing of wounds, normal health of body tissues and aids in the absorption of iron in the human body [8].

Minerals

The minerals present in fish include iron, calcium, zinc, iodine (from marine fish), phosphorus, selenium and fluorine [9]. These minerals are highly 'bioavailable' meaning that they are easily absorbed by the body. Iron is important in the synthesis of hemoglobin in red blood cells which is important for transporting oxygen to all parts of the body. Iron deficiency is associated with anemia, impaired brain function and in infants is associated with poor learning ability and poor behavior. Due to its role in the immune system, its deficiency may also be associated with increased risk of infection [4]. Calcium is required for strong bones (formation and mineralization) and for the normal functioning of muscles and the nervous system. It is also important in the blood clotting process. Vitamin D is required for its proper absorption. The intake of calcium, phosphorus and fluorine is higher when small fish are eaten with their bones rather than when the fish bones are discarded. Deficiency of calcium may be associated with rickets in young children and osteomalacia (softening of bones) in adults and older people [10]. Fluorine is also important for strong bones and teeth. Zinc is required for most body processes as it occurs together with proteins in essential enzymes required for

metabolism. Zinc plays an important role in growth and development as well in the proper functioning of the immune system and for a healthy skin. Zinc deficiency is associated with poor growth, skin problems and loss of hair among other problems. Iodine, present in seafood, is important for hormones that regulate body metabolism and in children it is required for growth and normal mental development [11-14]. A deficiency of iodine may lead to goiter (enlarged thyroid gland) and mental retardation in children.

Intake of antioxidants including vitamin C was considered to lower the risk of cancers, while the vitamin K was found to help bones retain calcium to control the onset of osteoporosis[12]. Recognition of these beneficial effects led to the dissemination of dietary guidelines, aimed to reduce the frequency of chronic nutrition related disease such as obesity, cardiovascular disease, hypertension, type II diabetes, osteoporosis and several forms of cancer. It is evident that fish contribute more to people's diets than just the high quality protein they are so well known for. Fish should therefore be an integral component of the diet, preventing malnutrition by making these macro- and micro-nutrients readily available to the body[7].

NUTRITIONAL VALUES OF OMEGA-3 FATTY ACIDS

The benefits of omega-3 fatty acids are widely documented. Increased consumption of finfish reduces the risk of sudden death from heart attacks, improves symptoms of rheumatoid arthritis, decreases the risk of bowel cancer, and reduces insulin resistance in skeletal muscles [13]. DHA supplements promote brain cell and synapse growth, and improve disposition. In pregnant women, the presence of PUFAs in their diets has been associated with proper brain development among unborn babies. In other studies, omega 3 fatty acids have also been associated with reduced risk of preterm delivery and low birth weight. Recent findings showed that consuming two or more servings of fish with high omega-3 fatty acids may lower the risk of age-related macular degeneration, which may cause blindness or vision impairment[2,6].

DHA IN NEURAL DEVELOPMENT

Among PUFA, DHA is conspicuous inn neural and retinal development. During the period of the so-called "growth spurt", the brain can become vulnerable to nutritional insult. A diet unbalanced in ω-3/ ω-6 fatty acids can be quite damaging to the PUFA composition of developing human central nervous system. Special attention is required to ensure the presence of long chain PUFA (mainly DHA) in all formulas devised for infant nutrition[4]. At the same time it would be advisable not to provide excess of precursors, and to include in diet only a moderate balanced amount of long chain PUFA in a proportion not far from that found in normal composition of human tissue.

OBESITY

The prevalence of overweight and obesity has increased over the past few decades. Experimental evidence supports the role of ω-6 fatty acids as being potent promoters of both adipogenesis in vitro and adipose tissue development in vivo during the gestation/ lactation period[3]. It was proposed that unnoticed changes in fatty acid composition of ingested fats over the last decades have been important determinants in the increasing prevalence of childhood overweight and obesity. Eating oily fish regularly could help fight obesity. Small doses of oil containing ω-3fatty acids, combined with moderate exercise, or exercising without taking oils, does not result in weight loss.

DIABETES

Epidemiologic studies have reported a lower prevalence of impaired glucose tolerance and type 2 diabetes in populations consuming large amounts of ω-3 PUFA. Preliminary evidence also suggests that increased consumption of ω-3 PUFAs with reduced intake of saturated fat may reduced the risk of conversion from impaired glucose tolerance to type 2 diabetes in obese persons. Expected health benefits and public health implications of consuming 1-2g ω-3 PUFA per day as part of lifestyle modification in insulin resistance and type 2 diabetes have been reported[7].

Functions of various nutrients available from fish in human nutrition

Nutrients	Functions
Vitamin A	Required for growth and differentiation of epithelial, nervous and bone tissues;11-Cis retinal is a constituent of rhodopsin and other light pigments
Vitamin D	1,25-Dihydroxy-vitamin D3 is a major hormonal regulator of bone mineral (calcium and phosphorous) metabolism
Phosphorus	Constituent of bones, teeth, ATP, phosphorylated metabolic intermediates.
Iron	Heme enzymes (hemoglobin cytochromes)
Iodine	Involved in transport and metabolism of thyroid hormones
Calcium	Constituent of bones teeth; regulation of nerve
Selenium	Plays a major role in enzyme systems (glutathione peroxidase) that control the accumulation of free radicals in the body
Co enzyme Q10	Functions as an antioxidant at the sub-cellular level
Taurine	An amino acid which plays a role in the formation and excretion of bile salts, which are the breakdown products of cholesterol
EPA	Essential for structural integrity of mitochondrial membrane; involved in prostaglandin and leukotriene formation
DHA	Essential nutrient in the brain and retina for optimal neuronal functioning and visual performance

CONCLUSION

Researchers continue to demonstrate the benefits of ω-3 long chain PUFAs. EPA and DHA lower elevated triglyceride levels, afford protection to the cardiovascular system, have anti-inflammatory and immune-modulating properties and are beneficial for the musculoskeletal and gastrointestinal systems. Fish-derived PUFA, particularly DHA are beneficial in infant nutrition and development. Furthermore, beneficial effects of these fatty acids on obesity, kidney and liver function, diabetes, and asthma have been indicated. There is however need for further research to gain a better understanding of the role of fish in decreasing malnutrition and overall health improvement.

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