

Mental Health Benefits of Fish Consumption

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Abstract: Fish is good for both mental and physical health. Fish contains high quality protein, good lipids consisting of essential fatty acids, important minerals, vitamins etc. The grey matter of the brain consists of about 60 % lipids consisting of essential fatty acids DHA, ARA, EPA etc. DHA is the building blocks of brain tissues. Essential fatty acids are important in prevention and amelioration of many civilization and age related diseases such as heart diseases, dementia, mental decline etc. Fish protein as complete protein contains functional amino acids that are rich in brain, hearts, and eyes that are associated with their functions. Fish also contains important minerals, vitamins that are also good for brain. Factors of mental health are many but how to use the faculty is very important. The important functional components of fish are essential and help in overall well-being and quality of human life boosting performance ability. So the objective of the paper is to discuss the important roles of functional components of fish leading to overall well being, better mental health and mood.

1. Introduction

We are what we eat.

Further we are what we think.

In a sound body there is a sound mind.

When health is lost every hope is lost

Both physical and mental health is important factors for success and happiness

To be our best self, you must have a brain that works at its best.

Quality of brain chemistry is equal to quality of life

Our brain is a complex organ whose functioning largely depends on a great number of vital macro and micronutrients. Fish is a good source of vital nutrients such as high quality protein, carbohydrates, lipid with essential omega-3 fatty acids, vitamins and minerals. The food chain and ecological relationship between human beings and fish will be easily understood by studying the roles of functional food components of the fish required in growth, development, better IQ, and well-being with the prevention of diseases. Even a deficiency of an element or vitamin causes small or great pains to the body and disturbs the mental balance.

Fishes as a aquatic food are easier to eat, easier to cook, easier to digest than the terrestrial animals foods. Fish protein is high quality protein with high biological value and it contains all the essential amino acids and lots of other functional amino acids without which life is not possible. Functional amino acids play great the structural and physiological roles which are good for body and brain with the prevention of diseases. Further fish is said to be a brain food as fish lipid

is a rich source of essential polyunsaturated fatty acid docoexahexanoic acids (EPA), arachidonic acid (ARA) and eicosapentanoic acids (EPA), which are abundant in brain tissues and associated with better brain development, function and better IQ. Wholesome consumption of small fish gives more calcium, phosphorus, other mineral elements and vitamin A than the large fishes. Presence of mineral elements and vitamins in addition to the high quality protein and lipids makes fish an important functional food.

Functional food are foods that gives health benefits reducing the risks of disease beyond basic nutrition. So health conscious people have a growing interest and demand for functional foods that give good health and wellbeing reducing the risks of many civilized related diseases. The protein in salmon produces hundreds of neurotransmitters needed for regular maintenance of the brain and need protein to do so. Protein in our diet affects brain performance they provide the amino acids that make up our neurotransmitters. It might also act through its effects on metabolism, as DHA stimulates glucose metabolism and mitochondrial function, reducing oxidation stress.

Researchers say, "eat fish and live longer."

2. Health aspects of food science

It is important in the study of nutrition and food science to consider the aspects of better early development and growth, health maintenance, reduced risk of obesity, reduced risk of chronic diet related diseases.

3. Fish as a functional food

Aquatic systems of the earth are a good suppliers of fish as a functional food so as to improve health status of consumers promoting performance ability and well-being. Before 2500 years ago Hippocrates taught the mankind with the tenet – "Let food be your medicine and medicine be your food". Key to health is right nutrition and physical activities. So food habit and life style plus our environment interaction affect our mental health. Fish are also known for preventing many civilized related diseases like heart diseases, cancers, kidney disorders, osteoporosis etc. and for importance in health, growth, development and maintenance of human body.

With emergence of the idea of functional foods from 1980s the relationship of food and health has been renewed [1]. "Functional food is food that provides health benefits beyond basic nutrition". With governmental and other communities, bringing functional foods to markets will help billions of suffering from chronic illness and general health problems. A sound mind needs a sound body.

Though fish lipid consisting of essential fatty acids is the main agenda and focus as food for brain, other components affecting brain, health and diseases are also to be discussed as overall soundness of body is related to mental health and performance. However the main aim of this short review will be to cover the important areas concerning the

aspects of functional fish components contributing to mental health.

4. Fish as a good source of high quality protein and peptides

The importance of protein and peptides is central in cell biology. Protein is the major functional and structural component of all the cells of the body. Moreover, the constituent amino acids of protein act as precursors of many coenzymes, hormones, nucleic acids RNA, DNA, and other molecules essential for life. Thus, an adequate supply of dietary protein is essential to maintain cellular integrity and function, and for health and reproduction. Unless amino acids are present in the diet in the right balance, protein utilization will be affected. Obviously, protein deficiency has adverse effects on all organs [4]. In infants and young children, it has been shown to have harmful effects on the brain and may have longer-term effects on brain function. Adverse effects on the immune system, resulting in a higher risk of infections and kidney function have been shown by protein deficiency. Adverse kidney effects are on both glomerular and tubular function. Eating good sources of protein helps us boost our level of serotonin and dopamines and this is really important as these helps to boost energy, mental clarity, basically makes us feel happier as well as regulate pains, reduces anxiety, initiate deep sleep.

The nutritional value or quality of structurally different proteins varies and is governed by amino acid composition, ratio of essential amino acid, susceptibility to hydrolysis during digestion, source, and the effects of processing[8]. Functional amino acids (AA) participate in and regulate key metabolic pathways to improve health, survival, growth, development, lactation, and reproduction of the organisms. Functional AAs play great roles in prevention and treatment of metabolic diseases, maintaining health and performance ability.

Fish proteins are highly digestible compared with other terrestrial animal and plant proteins and is called high quality protein as it contains all the essential amino acid. The protein in oily and white fish break down on digestion into polypeptides, peptides and amino acids. Many of these compounds have bioactive properties.

5. Adequate supply of amino acids for optimum brain function

The next consideration for optimum brain function is to have adequate supplies of the right amino acids from protein to provide raw materials for making neurotransmitters and neuropeptides. Amino acids such as tryptophan, tyrosine, histidine, and arginine are used by the brain for the synthesis of various neurotransmitters and neuromodulators[9]. Foods rich in certain amino acids, especially tyrosine and tryptophan, can affect brain chemistry and impact mood. One excellent source of amino acids like tyrosine is fish. Unlike most other organs, the brain is isolated from the general circulation by the blood-brain barrier (BBB). Amino acids that are able to cross the blood-brain barrier stimulate the synthesis of most neurotransmitters, which affects brain chemistry and impacts mood [10]. The aromatic amino acids (tryptophan, tyrosine, phenylalanine) are the biosynthetic precursors for the neurotransmitters serotonin, dopamine, and norepinephrine. The acidic amino acids glutamate and aspartate are themselves brain neurotransmitters. However, they do not have ready access to the brain from the circulation or the diet [11].

Tyrosine has also beneficial effects on the ability of animals to cope with acute stress and can improve performance on tasks requiring attention and learning. For example, if we want to heighten alertness and attention, increase your sense of well-being, and help ward off the effects of stress we would do well to increase your levels of the amino acid Tyrosine. Tyrosine converts into the alerting neurotransmitters

dopamine and noradrenalin, and then into the hormone adrenalin. Increased dopaminergic and noradrenergic activity in the brain has been associated with feelings of motivation, arousal and reward and decreased fatigue, and this has been linked to enhanced performance[10,11].

Tryptophan is the rarest of the essential amino acids found in food and, as noted above, is the precursor of serotonin. The availability of tryptophan to the brain can alter behavioral factors such as alertness, level of depression, aggression, and pain sensitivity. Another well-established effect of tryptophan relates to the role of serotonin in the regulation of mood, in particular, level of depression [10,11].

6. Carbohydrates For Brain

Consumption of fish gives us some amount of carbohydrates. Human brain essentially depends on glucose for its energy [12]. The National Academy of Sciences recommends consuming at least 130 gm of carbohydrates per day. This is the minimum amount of carbohydrates need to produce enough glucose for the brain to function. Evidence from a number of studies suggests strongly that changes in the protein: carbohydrate ratio of food consumed can alter brain serotonin. Keeping blood sugar levels at an optimum level appears to be helpful for maintaining good cognitive functions particularly for nerve mentally demanding tasks.

7. Vitamins for brain

Fish is also a good source of many vitamins, i.e., A, D, B etc. Particularly vitamin B12, vitamin B6, vitamin B3, folate (B9) are on top of the list. This is because they literally "make things happen" in the brain. These vitamins play a crucial role in overall brain function, from regulating energy release in brain cells, to their main function, which is to facilitate the action of neurotransmitters, the chemical messengers that transfer information between over 100 billion neurons. Given their tremendous power, vitamin B deficiencies can lead to numerous degenerative diseases[13,14]. Severe deficiencies in B vitamins have been shown to have profound effects on the brain. These effects include impaired memory, higher levels of anxiety, confusion, irritability, depression, and inhibited mental performance. Insufficient levels of vitamins B6 and B12 were found to lead to dementia, as they contribute to the myelin sheath around nerve cells, which speeds signals through the brain[13,14]. Deficiencies of vitamin B9 are known to cause neural tube defects of the foetus, leading to cognitive dysfunctions later in life. Folic acid also helps maintain normal levels of serotonin, and so deficiencies may contribute to depression, dementia, and schizophrenia. Vitamin B1 deficiencies are known to limit the brain's ability to use glucose, the brain's fuel, therefore decreasing energy available for mental activity. Thiamine (Vitamin B1) is one of the many B vitamins that is found abundantly in the brain and nerve tissue. It plays a role in the conduction of nerve impulses[13,14]. Folic acid (B9) plays an important role in the synthesis of amino acids and the formation of nerve tissue[14]. Choline is another type of B vitamin, is particularly key for manufacturing the neurotransmitter acetylcholine, as well for the production of cell membranes. Acetylcholine is one of the brain's main neurotransmitters. It is crucial for memory and learning. Alzheimer's is typically closely related to memory loss caused by a shortage of acetylcholine. First sign of a B-vitamin deficiency is disruptions in the nervous system, including fatigue, insomnia, nervous twitches, restless limbs, etc. Vitamin A, E and D have important roles in the brain [15,16].

8. Fish as a source of minerals required for brain

Fishes are good sources of magnesium, zinc, copper, iron, iodine, selenium, molybdenum, boron, manganese, and potassium etc. Alongside B vitamins, these nearly 13 minerals represent another set of brain savers. Calcium is the number one essential mineral for healthy brain functioning. It plays a central role as a nerve cell messenger. It also regulates neurotransmission and controls nerve excitability[13,17]. Magnesium is essential brain nutrient because it protects the brain from neurotoxins and required for a well-functioning nervous system. It supports memory and learning[13,17]. Potassium helps regulate muscle contractions, maintain healthy nerve function, and regulate fluid balance. Copper is key to the health of our immune system, blood vessels, nerves, and bones. Selenium influences compounds with hormonal activity, and neurotransmitters, and can affect mood in humans and behaviour in animals. Zinc plays important roles in growth and development, the immune response, neurological function and reproduction[17]. Iodine is an integral component of the thyroid hormone and mediates its effects on brain development. Selenium influences compounds with hormonal activity, and neurotransmitters, and can affect mood in humans and behaviour in animals. Manganese is key to normal cell function and metabolism[17]. Too little of any of these minerals would slow your brain down.

9. Lipid and Essential Fatty Acids from fish

Ackman [2000] reports that the folklore about fish being a brain food is true [18]. About 60 % of the brain composition consists of lipids. Lipid is made up of constituent fatty acids of which essential fatty acids are important in brain and other physical aspects of development.. DHA is essential for the proper development of the brain and retina in the fetus and infant [19]. Tropical fresh water fish are more similar to the composition of brain than any other food. Arachidonic and docosahexaenoic acids are important fatty acids in the brain. According to Dr. L Barbara, a key element in the nutrition for all age, DHA is the building block of human brain tissues and the primary structural fatty acids in the grey matter of the brain and retina. Low level of DHA has been associated with depression, memory loss, dementia and visual problems [20].

Although it is important for everyone to have an optimum level of DHA, it is especially important for the development of human brain, which grows at a rapid pace during the late stage of fetal development. The DHA contents of the fetal brain decrease three to five times during the final trimester of pregnancy and triple during the first 12 weeks of life. The brain 's grey matter is composed of approximately 14 billion cells and adequate amount of DHA ensure optimal composition in the membranes of these nerve cells.

Dr. Simopoulos points out that omega-3 polyunsaturated fatty acids (PUFAs) are essential for human health, but that their intake has gradually declined over the years. It is believed that man evolved on a diet with a ratio of omega-6 to omega-3 PUFAs of about 1:1. Today this ratio is more like 10:1 and in some societies is approaching 25:1. A relative over-abundance of omega-6 PUFAs has been implicated in excessive blood clotting, allergic and inflammatory disorders, and certain cancers. An adequate intake of omega-3 PUFAs, on the other hand, has been linked to improved cardiovascular health[21]. Diet with high content of trans and saturated fats affects cognition.

10.WHY ARE OMEGA-3 FATTY ACIDS OF FISH IMPORTANT ?

Alpha linoleic acids (ALA) which is present in plant foods convert into

long chain fatty acids docosahexaenoic acid(DHA) and eicosapentaenoic acid(EPA) which are found in fish abundantly and cannot meet the needs of the long chain polyunsaturated fatty acids which is essential for human growth and development. Beneficial health outcomes are more likely to result from supplementation with docosahexaenoic acids itself than its precursor alpha-linolenic acid [22].

Recent studies have shown that an adequate maternal intake of seafood, especially oily fish, or fish oil supplements improves verbal communication skills at 6 and 18 months of age, reduces the risk of pre-term birth (low birth weight), improves an infant's problem-solving capacity and eye and hand coordination, and results in a higher intelligence quotient (IQ) in children at 4 years of age [23]. The researchers conclude that fish oil supplementation in women with PPD is well tolerated and effective in reducing symptoms of depression [24]. Dr. Joseph Hibbeln of the US National Institutes of Health reports that the incidence of post-partum depression (PPD) is clearly linked to DHA status and seafood consumption [25]. The milk of 29 lactating women living in Doromoni near lake Katangiri (Tanzania) had high contents of AA, DHA, and EPA, and low AA / DHA ratio. In lactating women could be traced to lifelong consumption of DHA and AA rich fish from the nearby fresh water lake[26].

Alzheimer and dementia: Low levels of long-chain polyunsaturated fatty acids, notably DHA (docosahexaenoic acid) are in people suffering from AD and dementia. An increased intake of fish or omega-3 fatty acids, especially DHA, can substantially reduce the risk of developing Alzheimer' disease. Epidemiological studies have also shown that regular fish consumption is associated with a substantially reduced risk of developing Alzheimer's disease (AD) and dementia[27,28].

Schizophrenia : Schizophrenia is a serious mental illness characterized by such symptoms as delusions, hallucinations, emotional blunting, and social withdrawal. There is growing evidence that abnormalities in cell membrane fatty acid composition is involved in the disease. Taking fish oil supplements significantly decreased symptoms of schizophrenia [29].

Autism: Autism is a developmental disorder primarily affecting communication ability and social, cognitive, and imaginative development. French researchers report that a low level of DHA (docosahexaenoic acid) is characteristic for blood plasma drawn from autistic children and conclude that supplementation with DHA could represent an additional approach to the treatment of autism. Autistic children more often reported symptoms of fatty acid deficiency [30].

Depression : Several large-scale studies have found a clear association between low blood levels of EPA and DHA and an increased risk of depression, violence and suicide[31].

Attention deficit hyperactivity disorder(ADHD) : Dr. Jacqueline Sturdy of the University of Surrey believes that dyslexia, dyspraxia, and attention-deficit hyperactivity disorder have one common denominator – a deficiency of long-chain fatty acids. She concludes that long-chain polyunsaturated fatty acid supplements may benefit children with dyslexia, dyspraxia, and attention-deficit hyperactivity disorders[32].

Mental decline: Fish and fish oil help prevent age related mental and cognitive decline[33].

Agressiveness: DHA supplementation, often through fish oil capsules, prevents an increase in aggressive behaviour during times of mental stress specially among the adolescents [34].

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Anxiety and mood improvement: Deficits in omega-3 fatty acids have been identified as a contributing factor to mood disorders and offer a potential rational treatment approach [35].

Vision: Consuming fish oils may protect against age-related vision loss [36].

Quality of skin and fairness: Fish oil protects skin diseases like psoriasis. Fish and fish oil increase the quality of skin and fairness [37].

11. Conclusion

The above review and discussion show that fish is a super and important functional food that can enhance performance ability and reduces the risks of mental diseases. It is known that fish is good for both mental and physical health. Brain in human beings can be compared to hardware in a computer while mind in humans can be compared to software in a computer. Mind is the medium through which the civilization was developed. It is the medium through which any success can be achieved for happiness and well-being. We hope that this short review paper will enlighten the knowledge of consumers' choice of fish as important functional food for our mental health, growth, better IQ, performance ability, development, and well-being saving us from degenerative diseases and the burden of health care cost.

However the quality of fish is influenced by various factors, such as species, age, feeding, habitats, storage, processing and cooking style. Care should be taken enough in preparing, processing and storage. So sustainable development of the resource is also required.

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