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The Role of Food Biochemistry in the Control and Prevention of Nervous System Diseases

Florica Voiţă-Mekereş, Felicia Manole*, Ioan Bogdan Voiţă, Paula Marian

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Abstract

Neurological diseases are one of the most common types of diseases in the world and they follow an increasing trend. The role of nutrition in the occurrence and aggravation of these diseases is an important issue that should be paid more attention to. In this research, the relationship between nutrition and some disorders and diseases of the nervous system was investigated. The obtained results showed that nutritional factors play an important role in depression. On the other hand, those with depression often have poor nutrition and are therefore at risk. New studies show that dietary changes suppress diseases such as MS that involve the activation of the immune system. Also, many studies report a reduction in the risk of Alzheimer's disease and other cognitive disorders following the consumption of marine food compounds. Also, food can play an important role in the management and control of hyperactivity disorder.

Keywords: Nervous system diseases, Food biochemistry, Neurological diseases, Nutrition

Introduction

Today, food and nutrition are one of the most basic and important fundamental needs of human society (Ostadrahimi *et al*., 2006; Polevoy & Sablin, 2022), which causes the well-being and maintenance of the health of society's people during their lifetime from before birth to old age (WHO, 1992; Nix, 2013; Hemdan & Abdulmaguid, 2021; Alqahtani *et al*., 2022). We all need an acceptable level of nutritional information so that we can enjoy a healthy life for ourselves and our families. With the passing of time and turning to a machine life and reducing the time needed to prepare food, man found a need for guidance so that with its help he can keep the quality and type of food he consumes at a high level and by this means he can have good health. Therefore, nutrition science took a new form to provide solutions to maintain the optimal quality of life and also help patients to increase efficiency and reduce disease complications (Walton *et al*., 2014; Kondratenko *et al*., 2021; Al-lbban, 2022).

The human body needs energy to maintain its basic metabolism, which can be provided by consuming food (Walton *et al*., 2014). Neurological diseases are one of the most common types of diseases in the world and they follow an increasing trend. The role of nutrition in the occurrence and aggravation of these diseases is an important issue that should be paid more attention to. Also, chemical compounds of food such as food components, simple carbohydrates and their derivatives, polysaccharides, fats, proteins, minerals, water, vitamins, pigments, bread grains, proteins obtained from leguminous and single plants Cells, milk and dairy products, meat and blood products, eggs, oils, and fats and additives play a very important role in disease control and prevention (Busili, 2021; Helal *et al*., 2021; Rasueva *et al*., 2023). In this review research, the relationship between nutrition and some disorders and diseases of the nervous system was investigated.

Nutrition and Multiple Sclerosis

Multiple sclerosis or MS is the most common neurological disease in adults and the most common autoimmune disease of the nervous system in all ages (Shirazi, 2006; Kanaeva *et al*., 2023). The prevalence of MS in the world varies from 3 to 152 people per 122 thousand people depending on the country or specific population (Small & Cappai, 2006; Salgirieva *et al*., 2022). Areas such as Europe, the United States, Canada, and New Zealand are considered to be areas with a high prevalence of this disease (Tola *et al*., 1994).

Various studies show that nutrition plays a role in the etiology of MS. Although the available studies in this field show conflicting information; in short, the findings of the studies indicate that

Florica Voiţă-Mekereş
Department of Morphological Discipline, Faculty of Medicine and Pharmacy, University of Oradea, 410087 Oradea, Romania.
County Clinical Emergency Hospital of Oradea, 410087 Oradea, Romania.

Felicia Manole*
County Clinical Emergency Hospital of Oradea, 410087 Oradea, Romania.
Surgical Department, University of Oradea, 410073 Oradea, Romania.

Ioan Bogdan Voiţă
Regional Institute of Gastroenterology and Hepatology "Prof. Octavian Fodor", Cluj-Napoca, Romania.

Paula Marian
County Clinical Emergency Hospital of Oradea, 410087 Oradea, Romania.
Department of Medical Discipline, Faculty of Medicine and Pharmacy, University of Oradea, 410087 Oradea, Romania.

***E-mail:** manole.felicia@gmail.com

nutrition can play a role as one of the effective environmental factors in the development of this disease (Antonovsky *et al*., 1965; Malosse *et al*., 1992). New studies show that changes in diet can turn off diseases like MS that involve the activation of the immune system. In a study, researchers from the Van Andel Institute in Michigan investigated the role of diet in MS attacks. In this regard, the role of methionine, a type of amino acid, in the inflammatory reaction of MS was investigated. Methionine is essential for the health of the immune system, but it hurts people with autoimmune diseases. This study shows that in people suffering from inflammatory disorders and autoimmune diseases such as MS, reducing the consumption of methionine can weaken the immune cells involved in the disease and turn off the disease. Some animal products such as meat, eggs, and milk contain methionine. Researchers are trying to develop drugs that target methionine metabolism. Also, various studies have shown the role of factors such as PUFA vitamin D intake, especially omega 3 and omega 6, antioxidants such as vitamins, dietary fiber, vegetable protein, fish, fruit juice, and whole grains in the prevention and control of MS and other factors such as Saturated and animal fats, red meat and high-fat dairy products have been proposed as risk factors in the development of this disease disease (Antonovsky *et al*., 1965; Malosse *et al*., 1992).

Qadirian and his colleagues in a study they conducted in Montreal in 1998 emphasized the positive effects of plant foods in the prevention of MS disease (Ghadirian *et al*., 1998). Also, in a case-control study conducted in France, no relationship was observed between fruit and vegetable consumption and the risk of MS (Berr *et al*., 1989). In this study conducted by Pekmozovic and his colleagues in Serbia in 2009, a significant relationship between the consumption of grapefruit and cherries and a reduction in the risk of MS was seen (Pekmezovic *et al*., 2009). The country of the world was investigated and a significant direct correlation was seen between milk consumption and the prevalence of MS (Malosse *et al*., 1992). Also, in a study in Croatia, which is one of the regions with a high prevalence of MS in Europe, people with MS had a higher consumption of animal fat, whole milk, and nonfat than the healthy group (Tola *et al*., 1994).

Nutrition and Depression

Major unipolar depression is a type of mood disorder including a set of symptoms such as sadness, lack of pleasure and interest, increase or decrease in sleep, increase or decrease in appetite along with weight changes, feeling restless or sluggish, feeling guilty or worthless, lack of Energy, difficulty concentrating, thoughts of death and suicide. To diagnose major depression, the presence of at least five of the mentioned symptoms for 3 weeks is necessary. One of the two symptoms should include feelings of sadness or lack of pleasure and interest in the list of these five symptoms (Payne, 2010).

Depressive disorder is one of the most common psychiatric diagnoses. According to the announcement of the World Health Organization in 2020, depression ranks fourth among diseases in terms of the burden it imposes on society (Nix, 2013; Li *et al*., 2014).

Nutritional factors play an important role in depression. On the other hand, those who suffer from depression often have poor nutrition and are therefore at risk. Improper nutrition can have a significant effect on increasing the prevalence and duration of depression. Many studies have shown a link between a nutrient and depression. For example, vitamin D supplementation with zinc and vitamin B9 is effective for treating depression (Milaneschi *et al*., 2014). A study by Nanri *et al*. (2010) in Japan showed that a healthy Japanese diet characterized by a high intake of fruits and vegetables, mushrooms, and soy products was associated with a reduction in depressive symptoms. Noguchi *et al*. (2013) observed in 2012 that psychological symptoms of depression in men are associated with inadequate intake of vegetable and fish diet and physical symptoms of depression are associated with insufficient meat intake. Sugawara *et al*. (2012) found a direct relationship between a sweet diet and depression, in other words, with a high-carbohydrate diet, the possibility of diabetes and, as a result, the possibility of depression increases. Rashidkhani *et al*. (2013) suggested that a diet containing a high intake of fish, poultry, low-fat and high-fat dairy products, coffee, fruit, fruit juice, vegetables, legumes, olives, and low intake of refined grains, fats, and soft drinks It is significantly related to a lower chance of depression in women.

In a study conducted by Rahe *et al*. (2015), the results of the study showed that people in the healthy control group had a higher intake of fruit and chocolate, cake and pasta, as well as a lower intake of meat and poultry compared to people in the depressed group. Rienks *et al*. (2013) showed that a high intake of foods containing omega-3, including fish, olives, and vegetables, in the Mediterranean dietary pattern is associated with a reduction in depression.

Sánchez-Villegas *et al*. (2009) showed that a high intake of fish and olives along with nuts reduces depression by 20-30%. Nanri *et al*. (2013) showed that the consumption of fruits, vegetables, fish, and olives is related to the reduction of depression and the possibility of suicide. In a cohort study, LePort *et al*. (2012) showed that low-fat diets containing fruits, vegetables, and fish are associated with a reduced risk of depression in men and women.

Nutrition and Alzheimer's

Alzheimer's disease is one of the important causes of morbidity and mortality in the world (Multiple Sclerosis Resource Center). Since the first description of the disease, Alzheimer's has evolved from a rare disorder that was first described to one of the most common debilitating disorders in the elderly, the sixth leading cause of death and the fifth leading cause of death in people over 35 years of age in the United States (Multiple Sclerosis Resource Center). Hereditary Alzheimer's can be related to the mutated amyloid precursor protein gene (Mayeux, 2010). APP gene is located on chromosome 21 (Coppus *et al*., 2012). Mutations in the presenilin 11 gene, which is an important determinant of gamma-secretase activity for beta-amyloid production, can accelerate early Alzheimer's (Issa *et al*., 2006; Nabipour, 2008). APOE4 on chromosome 14 is also indirectly related to Alzheimer's (Liu *et al*., 2004).

Currently, many studies report a reduction in the risk of Alzheimer's disease and other cognitive disorders following the consumption of marine food compounds. In many studies, the effect of omega-3 on reducing the production and effects of beta-amyloid protein has been confirmed. It has also been seen that some marine food compounds have inhibitory effects on acetylcholinesterase enzyme and some of these compounds also have nerve cell growth activating factor effects. In a study that was conducted on a transgenic mouse model to evaluate the nutritional effect of DHA on the production process of the amyloid precursor protein and the amount of amyloid load, it was observed that a diet enriched with omega-3 fatty acids can reduce the amyloid load in these mice (Lim *et al*., 2005).

In a systematic study that was conducted to investigate the correlation between the consumption of fish as a source of long-chain omega-3 acids and the consumption of omega-3 supplements with the risk of Alzheimer's disease or cognitive decline, eleven observational studies and four clinical trials were evaluated. In all 3 observational studies that used the reduction of cognitive level as the main outcome of the study, they reported a significant benefit from the consumption of omega-3 acids (Fotuhi *et al*., 2009).

Nutrition and Hyperactivity

Attention Deficit Hyperactivity Disorder with symptoms such as anxiety, inattention, distress, etc.

A lot of excitement and carelessness is evident. This disorder is mainly associated with aggression and poor academic performance. The required rule for diagnosing attention deficit hyperactivity disorder is that at least six of the nine symptoms mentioned in attention deficit hyperactivity disorder appear in the person in question for at least six months. These symptoms should lead to problems in more than one situation at home and school. It is estimated that 3-12% of school-age children are affected by this disorder and its prevalence is higher in boys than in girls (Schnoll *et al*., 2003).

The subject of the relationship between diet and behavior goes back to the 1920s and became famous in the 1970s with the Feingold diet plan, which focused on eliminating artificial food colors, artificial flavors, preservatives, and salicylates in natural foods. Feingold published his findings that 50% of patients with attention deficit hyperactivity disorder improved by eliminating all food additives and salicylates in natural foods. Feingold's diet eliminated almost all processed foods and a large portion of fruits and vegetables with high salicylates (Feingold, 1975).

In a double-blind, placebo-controlled study, the effect of a combination of artificial food colors and additives on the hyperactive behavior of three- to four-year-old and eight-to-nine-year-old children from the general population was studied.

Researchers reported increased hyperactivity in three- to four-year-olds and eight- to nine-year-olds. However, the author states that more detailed studies are needed to determine whether additives alone or preservatives alone or their combination lead to moderate adverse effects (McCann *et al*., 2007). For the first time, when the fatty acid hypothesis of attention-deficit/hyperactivity disorder was proposed, researchers observed that children with attention-deficit hyperactivity disorder were thirstier than the control group, and this is an indicator that can be a sign of reduced nutritional levels of fatty acids (Colquhoun & Bunday, 1981). This hypothesis was strengthened a few years later with the help of other studies that showed that the blood levels of certain fatty acids are different between people with attention deficit hyperactivity disorder and the control group. Many pieces of evidence show that people with attention deficit hyperactivity disorder may have low levels of essential fatty acids, especially docosahexaenoic acid, and arachidonic acid. Of course, the exact mechanism through which the role of long-chain fatty acids, especially docosahexaenoic acid, can be expressed in behavioral disorders is unclear, but this effect may be due to docosahexaenoic acid for membrane fluidity and neurotransmitter function, especially in the pre- Birth is necessary (Ramakrishnan *et al*., 2009). Several cross-sectional studies reported lower blood levels of docosahexaenoic acid and arachidonic acid in children with attention deficit hyperactivity disorder compared to controls. In several long-term studies, a negative relationship between docosahexaenoic acid status in early life and subsequent behavioral problems in childhood was observed (Hibbeln *et al*., 2007). An extensive review study on the role of zinc in the brain function of people with attention deficit hyperactivity disorder was conducted by Arnold. This study includes reports of 9 studies conducted in different regions of the world, all of which reported low levels of zinc and its relationship with the severity of symptoms in hyperactive children (Arnold & DiSilvestro, 2005).

Low levels of magnesium may also affect brain function through various mechanisms. Low levels of magnesium have been reported in children with attention deficit hyperactivity disorder. Among 116 children with attention deficit hyperactivity disorder, 95% of them had magnesium deficiency and this problem was significantly more common than the control group. In a study on 50 seven-to-twelve-year-old children with attention deficit hyperactivity disorder, supplementing with 200 mg of magnesium per day for six months resulted in a significant reduction in hyperactivity compared to 25 children in the control group (Sinn, 2008).

Conclusion

Today, it has been proven that nutrition has an important effect on human nerves and psyche, and insufficient and wrong nutrition can have adverse effects on human nerves and psyche and cause severe depression and serious neurological disorders. If most nutrients catalyze various biochemical reactions in the body as "coenzymes" or "cofactors". Also, iron or group B vitamins are cofactors of chemical reactions in the body that cause the production of neurotransmitters with chemical mediators.

Since brain chemical mediators are necessary for the transmission of nerve messages and necessary brain functions, therefore, when the coenzymes that catalyze these chemical reactions are low, the necessary reactions are not performed. As a result, the substances that should be made as a result of these reactions are not produced, the balance of these chemical mediators in the brain is disturbed,

the functions related to them are disturbed and finally, it appears in the form of mental disorders.

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