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Omega-3 Fatty Acids and Brainpower: The Role of Seafood Consumption

Ajit Pal Singh[1,*], Rahul Saxena[2], Suyash Saxena[3]

Abstract

The following article talks about the strong link between eating seafood and brain health, focusing on the role of omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), in supporting brain development, function, and longevity. The article uses new research to show how these important polyunsaturated fatty acids help the brain in ways like memory, learning, focus, and attention. It also reduces the chance of developing dementia, Alzheimer's, and other neurological diseases. Better mood control and better sleep, both crucial for overall brain health, are also associated with omega-3s. Some of the best places to get EPA and DHA are from fatty fish, like mackerel, tuna, salmon, and sardines. Concerns about environmental pollutants, particularly mercury, are also prevalent. The article provides evidence-based guidance on selecting low-mercury fish, such as wild Alaskan salmon and sardines. Because environmental worries are growing, it stresses how important it is to choose sustainable seafood and supports responsible sourcing to protect marine ecosystems and human health for future generations. The piece stresses the importance of sustainable seafood in protecting our oceans and our health by encouraging people to eat in a way that is beneficial for the environment.

Keywords: Effects, health, research, memory, fatty acids

INTRODUCTION

Our brain depends on an ongoing flow of nourishment and energy to function as the three-pound command centre that controls everything from intricate thought to muscular contraction. Like how a high-performance car needs premium fuel to run smoothly, our brain's complex network of synapses and neurons needs a balanced diet to perform at its best. Scientific research increasingly reveals a fascinating interplay between what we eat and how well we think, learn, and remember [1, 2]. Studies have shown that a healthy diet rich in essential vitamins, minerals, healthy fats, and antioxidants can significantly impact cognitive function, memory, mood, and even protect against neurodegenerative diseases like Alzheimer's and dementia. Deficiencies in key nutrients, on the other hand, have been linked to cognitive decline, impaired concentration, and an increased risk of mental health issues like depression and anxiety. The creation and maintenance of brain cell membranes relies on omega-3 fatty acids, especially in fish that contain oil, such as salmon, fish, Sardine and mackerel [3, 4]. These fats support the flexibility of Nervous system Which is important to memory and learning Because the fat will be adjusted. The brain will create new connections. Synthesis of neurotransmitters, which are chemicals that help brain cells communicate. Depends on vitamin B Especially vitamin B12 and folate. Vitamin B. can

***Author for Correspondence**
Ajit Pal Singh
E-mail: ajit.singh1@sharda.ac.in

[1]Assistant Professor, Department of Medical Lab Technology, SSAHS, Sharda University, Greater Noida, Uttar Pradesh, India
[2]Professor, Department of Biochemistry, SSAHS, Sharda University, Greater Noida, Uttar Pradesh, India
[3]Assistant Professor, Department of Biochemistry, SSAHS, Sharda University, Greater Noida, Uttar Pradesh, India

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lead to fatigue, mental symptoms and even loss of memory. Fruits, vegetables and cereals, antioxidants, fighting free radicals, which hurt the brain tissue and loss of recognition of eggs, liver and eggs. Which is a substance similar to vitamin B Acetylcholine Is a neurotransmitter that is essential to memory, focus, and operation of general perception. Similarly Transferring oxygen to the brain Which is important to maintain energy levels and promote brain function Need to have iron Which can be found in red meat, beans and green leafy vegetables. Unexpectedly, the large ecosystem of bacteria living in our guts, known as the gut microbiome, had an impact on brain-gut axis functioning, a term used to describe the bidirectional communication between the gut. And the brain is backed by research. Prebiotics – High dietary fiber supports healthy gut flora, can reduce inflammation and promote the synthesis of positive neurotransmitters, both of which are associated with performance. Improved learning and reduced risk of depression [5, 6]. On the other hand, the heavy food of sugar, processed foods and poor fat can cause the plants in the intestines to cause inflammation and may affect the brain. while there is no "brain food" can be confident about the ability to eat foods that contain nutrients. Many types of condensates can greatly increase the efficiency of your work. Choose whole grains over processed carbs for long-term energy. Consider lean protein sources, such as fish, poultry, and nuts for neurotransmitter production. And eat a rainbow of fruits and vegetables to fight free radicals. Remember that healthy fats are important for brain cell health. And it can be found in foods, such as avocados, almonds, and olive oil. This is because the brain is primarily made up of water and needs it to function optimally. It is also important to stay hydrated. The data clearly shows that our nutrition has a significant impact on our ability to think, feel, and act. Although research on diet and brain health is still ongoing [7, 8], we can enhance our lifelong cognitive abilities by recharging our brains and making sure we eat a healthy diet important first. Our human brain, a three-pound marvel of evolution coordinating everything from composing symphonies to coordinating the intricate dance of muscles during a marathon, depends on a constant supply of premium fuel to function at its best. Much like a high-performance engine demanding high-octane gasoline, the intricate network of neurons and synapses in our brain thrives on a balanced diet rich in essential nutrients. Mounting scientific evidence reveals a fascinating connection between what we eat and how well we think, learn, and remember. Studies consistently demonstrate that a diet rich in specific nutrients, like vitamins, minerals, healthy fats, and antioxidants, can significantly impact cognitive function, memory, mood, and even offer protection against neurodegenerative diseases like Alzheimer's and dementia [9, 10]. Conversely, deficiencies in key nutrients have been linked to cognitive decline, impaired concentration, and an increased risk of mental health issues, such as depression and anxiety. In this intricate dance of brain health and nutrition, seafood emerges as a potential star player. Research increasingly highlights the potential benefits of omega-3 fatty acids, particularly those abundant in oily fish like salmon, sardines, and mackerel. These essential fats play a crucial role in building and maintaining the health of brain cell membranes, the delicate structures that govern communication between neurons. Omega-3s also promote neuroplasticity, the brain's remarkable ability to adapt and form new connections throughout life, a process essential for learning and memory. Beyond omega-3s, seafood offers a treasure trove of other brain-boosting nutrients. Synthesis for neurotransmitters, chemicals that allow brain cells to communicate depending on vitamin B, especially B-12 and folate [11, 12]. Fatigue, dizziness, and memory loss can result from vitamin B deficiency. These B vitamins are found in abundance in seafood. especially in shellfish Especially clams, mussels, and oysters. Not a conclusion of storytelling Rich in vegetables, fruits and cereals Antioxidants are necessary to celebrate free radicals. Some seafood, such as natural mackerel There are harmful chemicals that cause brain tissue irritation and cause intellectual defects. There is noisy in selenium. Which is a powerful substance There are antioxidants that are necessary to protect brain cells. Although the source of many plants also has antioxidants. In addition, Acethiloline, which is a neurotransmitter that is necessary for Focus memory and general perception Still from choline Which is a substance similar to B vitamins that are available in eggs and some fish, such as cod fish [13, 14]. In addition to red meat, beans and green leafy vegetables, many seafood, such as sardines and oysters are unexpectedly rich carriers of iron, a mineral important for brain function. The problem of seafood and brain health is more complicated by new intestinal microbiology research. Through two ways of communication, called the intestinal and brain axis. Currently, it is known that the micro Bomo in the intestines. Which is the original ecosystem of bacteria that live in our intestines

Surprisingly affecting the health of the brain. Foods with high prebiotics or dietary fiber that helps the intestines to be healthy. Can reduce inflammation and stimulate the synthesis of positive neurotransmitters Both of these are related to the better and less awareness performance. Also related to risks as well It is interesting to know that Seafood types, such as seaweed and some kind of sea vegetables There is a tendency to be recognized as a pre-biotic source that has potential in the opposite side of food that is full of sugar, processed foods and poor fats, which can cause abnormal digestive systems. Causing inflammation and may affect the work of the brain. While there's no single "magic bullet" food for guaranteeing peak cognitive performance, incorporating a variety of nutrient-rich seafood into your diet can significantly benefit your brainpower [15, 16]. Oily fish, like salmon, sardines, and mackerel, are champions when it comes to brain-boosting omega-3s. Shellfish, like clams, mussels, and oysters, offer a bounty of B vitamins. Certain fish varieties, like tuna and cod, provide valuable antioxidants like selenium. And for those seeking to support a healthy gut microbiome, some types of seaweed and sea vegetables show promise as prebiotics. Remember, staying hydrated is also crucial, as the brain is composed mostly of water and relies on it for optimal functioning. While the research on diet and brain health, particularly the role of seafood, is ongoing, the evidence is compelling: what we eat has a profound impact on how well we think, feel, and function. By prioritizing a balanced diet that includes a variety of seafood options, we can nourish our brains and optimize our cognitive potential throughout our lives [17–20].

THE POWER OF OMEGA-3S

Our brains are the intricate command centres that govern our thoughts, emotions, and actions. Maintaining optimal brain health throughout life is crucial for navigating the complexities of the world and ensuring a high quality of life. Diet plays a significant role in supporting brain function, and omega-3 fatty acids are a class of essential fats that have emerged as key players in this arena. The unique molecular structure of omega-3 fatty acids, a type of polyunsaturated fat. It is characterized by a large number of double bonds between carbon atoms and like other fats, our body cannot synthesize sufficient amounts of omega-3 on its own. Therefore, we depend on food sources to meet our daily needs. There are three main types of omega-3s:alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is found primarily in plant-based sources like flaxseeds, chia seeds, and walnuts. However, the human body's conversion of ALA to EPA and DHA is limited. Fatty fish, such as salmon, tuna, sardines, mackerel, and herring are primary sources of EPA and DHA, which are often called long-chain omega-3s. The body can utilize these long-chain forms more effectively, and they play a crucial role in brain function. Pregnancy and early childhood are periods of remarkable brain development. DHA is especially important as a fundamental component of brain structure, constituting a large part of the cell membranes in brain cells. These membranes serve as the outer layer of brain cells, creating a flexible and dynamic environment necessary for vital functions. Proper communication between brain cells depends on these membranes being fluid and intact, which is something that DHA helps to maintain. Neurotransmitters, which are chemical messengers that connect neurons, and electrical signals are the two ways that brain cells communicate. These neurotransmitters' synthesis and function are influenced by omega-3 fatty acids, which guarantee precise and effective information transfer in the brain. This efficient communication underpins crucial cognitive processes like learning, memory, and problem-solving. Research suggests that adequate DHA intake during pregnancy and breastfeeding can have a lasting positive impact on a child's cognitive development. Studies have shown a correlation between higher maternal DHA levels and improved cognitive function, visual acuity, and even motor skills in their offspring [21–25]. These benefits extend beyond infancy. Children with sufficient omega-3 intake tend to perform better on tests of attention, memory, and emotional regulation. When children enter teenagers and adults, the strong brain is still the foundation of academic success. Social interaction and well-being the benefits of Omega 3 for brain health are extended beyond the beginning of the adult life still needs these essential fats in order to maintain the perception of the perception. As we age, our brains naturally undergo changes that can affect memory, focus, and processing speed. Research shows that a healthy omega-3 diet may help protect against these age-related cognitive deficits. Higher blood levels of omega-3 fatty acids have been linked in studies to improving

cognitive function and reducing the risk of age-related memory problems. Additionally, omega-3 fatty acids in specifying or specifying. These disorders are becoming more prevalent in our aging population. Characterized by progressive loss of cognitive function. Research suggests that chronic inflammation may play a role in the development of many disorders. Although the exact causes are complex and not fully understood [26–30]. Because omega-3 fatty acids have anti -inflammatory properties Research points out that it may help reduce inflammation in the brain. Reduce the occurrence of deteriorating nervous system Omega 3 fatty acids have an impact on mental health, in addition to perception efficiency. Our brain is responsible for controlling emotions. And the study found that omega-3 fatty acids may be important for emotional management. Affecting the synthesis of hormones and chemicals in the brain that are essential to emotional security, such as Dapamine and serotonin. And from the study found that People with low EPA and DHA levels tend to become more anxiety and depression. [31–35]. Conversely, research suggests that supplementation with omega-3s may be beneficial in managing symptoms of depression and may even offer some protection against developing the condition in the first place. Our brains, the intricate command centres for thought, emotion, and action, require a constant supply of essential nutrients to function optimally throughout life. Among these, omega-3 fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) abundantly found in fatty fish, have emerged as crucial players in brain health. These polyunsaturated fats, distinguished by their unique chemical structure with multiple double bonds, are vital because our bodies can't synthesize them in sufficient quantities. EPA and DHA become woven into the very fabric of our brain cells, forming a significant portion of cell membranes. Helps to enhance and smoothness necessary for appropriate communication between brain cells. It also affects the synthesis and efficiency of neurotransmitters. Which is a chemical that is transmitted through the data between nerve cells. This efficient communication underpins crucial cognitive processes like learning, memory, and problem-solving. Research suggests adequate EPA and DHA intake during pregnancy and breastfeeding may positively impact a child's cognitive development and visual acuity later in life. As adults, sufficient omega-3s continue to support brain function by potentially mitigating age-related cognitive decline and even playing a role in preventing or managing neurodegenerative diseases. Omega-3s may also influence mood regulation by impacting the production of hormones and brain chemicals that affect emotions. Studies suggest they might be beneficial in managing symptoms of depression and anxiety. Including a variety of EPA and DHA-rich seafood, like salmon, tuna, sardines, mackerel, and herring in your diet is a great way to ensure you're getting enough of these essential fats for optimal brain health throughout life. It could be wise to speak with a healthcare provider about omega-3 supplements if dietary intake is inadequate. Our brains, the intricate command centres that orchestrate our thoughts, emotions, and actions, require a constant influx of essential nutrients to function optimally throughout life. Omega-3 fatty acids, especially iCozada Enoic acid (EPA) and docos Haxasa Eopic (DHA) and most of the fatty acids that are in fish that are fat in important components in Creating. These polyunsaturated fats, distinguished by their unique chemical structure containing multiple double bonds between carbon atoms, are vital because our bodies cannot synthesize them in sufficient quantities [36–40]. You can get it from foods like walnuts, flaxseeds, chia seeds, and fatty fish. However, the human body's conversion of the plant-based alpha-linolenic acid (ALA) found in these sources to the more readily utilized EPA and DHA is limited. Therefore, fatty fish becomes a particularly important dietary source of these long-chain omega-3s. Once absorbed, EPA and DHA become woven into the very fabric of our brain cells, forming a significant portion of cell membranes. These membranes act as the outer layer of brain cells, providing a flexible and dynamic environment for essential functions. Proper communication between brain cells depends on the fluidity and integrity of these membranes, which are greatly impacted by EPA and DHA. Electrical signals and the production of chemical messengers called neurotransmitters are how this communication takes place bridge the gap between neurons. Omega-3s play a critical role in influencing the production and function of these neurotransmitters, ensuring efficient and accurate information transfer within the brain. This efficient communication underpins crucial cognitive processes like learning, memory, and problem-solving. The significance of omega-3s extends far beyond communication, playing a vital role in brain development, particularly

during the remarkable period of pregnancy and early childhood. DHA, in particular, acts as a critical building block for brain structure, making up a significant portion of the cell membranes in brain cells [41]. These membranes provide a foundation for the proper organization and function of brain circuits. Research suggests that adequate DHA intake during pregnancy and breastfeeding can have a lasting positive impact on a child's cognitive development. Studies have shown a correlation between higher maternal DHA levels and improved cognitive function, visual acuity, and even motor skills in their offspring. These benefits extend beyond infancy. Children with sufficient omega-3 intake tend to perform better on tests of attention, memory, and emotional regulation. The foundation of a thriving society, prosperity, and good living hinges upon the brain which as an organ needs to be healthy for children as they transition into adolescence and adulthood. The crucial role of omega-3s continues throughout adulthood, supporting brain function and potentially mitigating age-related cognitive declines. Our mind restructuring as we grow older could mean an impact on some capabilities, such as memory, attention and processing speed. Diets that are rich in omega 3 may prevent further deterioration according to studies. Studies have shown that higher levels of omega-3s in the blood are associated with better performance on cognitive tests and a reduced risk of age-related memory problems. Neurodegenerative disorders, such as dementia and Alzheimer's, might benefit from omega-3 fatty acid therapies. Their most alarming factor is the acceleration with which society loses the ability to think, remember new information or perform otherwise simple tasks. Chronic inflammation could influence the development of many health problems, and while precise reasons are multifaceted and difficult to understand, research has proposed this to be true. Omega-3 fatty acids are known for their anti-inflammatory effects, and research indicates they might help reduce inflammation in the brain, potentially slowing the development of neurodegenerative diseases. In addition to supporting cognitive function, omega-3s play a key role in mood regulation by influencing the production of hormones and brain chemicals, like serotonin and dopamine, which are essential for maintaining emotional stability. Studies have found that individuals with low levels of EPA and DHA are more prone to experiencing depression and anxiety. On the other hand, supplementing with omega-3s has been shown to help alleviate symptoms of depression and may even provide some protection against developing the condition. EPA and DHA, in particular, are vital for maintaining overall brain health. From building a strong foundation for brain development in children to supporting cognitive function throughout adulthood and potentially mitigating age-related declines, these essential fats are crucial for optimal brain health. Their influence extends beyond cognition, potentially impacting mood regulation and offering some protection against mental health conditions. Including a variety of EPA and DHA-rich seafood, like salmon, tuna, sardines, mackerel, and herring, in your diet is a great way to ensure you're getting enough of these essential fats for optimal brain health throughout life. If your diet lacks sufficient omega-3s, it might be a good idea to talk to a healthcare professional about taking supplements [42–45].

BENEFITS OF SEAFOOD FOR BRAIN HEALTH

Our brains, the intricate command centres of our being, are constantly striving for optimal performance. Fortunately, a delicious solution swims in our oceans and rivers – seafood. Beyond its delightful taste, seafood offers a bounty of brain benefits, empowering cognitive function, memory, learning, and focus. The true benefit comes from omega-3 fatty acids, especially DHA and EPA. DHA acts like a building block for the brain, fostering the very foundation for strong memory, enhanced learning, and razor-sharp focus. It facilitates the growth and formation of new brain cells, improves communication between them, and promotes neuroplasticity – the brain's remarkable ability to adapt and learn. But DHA isn't the only brain-boosting hero in seafood [46]. Its partner, EPA, joins the party by tackling chronic inflammation, a potential culprit in cognitive decline. This anti-inflammatory prowess may offer protection against cognitive decline, ensuring your mental faculties stay sharp for longer. Additionally, EPA appears to play a role in regulating mood and neurotransmitters, potentially contributing to a more positive outlook and emotional well-being, which can indirectly benefit cognitive function. However, the brilliance of seafood extends beyond the realm of omega-3s. Vitamin D, which is essential for overall brain health and neuroprotection, is abundantly found in fatty fish. Research

indicates a potential connection between vitamin D deficiency and cognitive decline, underscoring the significance of including this essential nutrient in your diet. Iodine, another crucial player, is particularly important for foetal brain development and continues to be necessary for optimal cognitive function throughout life. Fortunately, seafood is rich in iodine, providing essential support for brain health. Additionally, B vitamins, especially B12 and B6, are crucial for maintaining healthy nerve function. and cognitive processes. Many seafood varieties are excellent sources of these B vitamins, further enriching the brain-boosting potential of your diet. To reap these remarkable benefits, aim for at least two servings of seafood per week. Explore a delightful variety of fish, from the vibrant salmon and heart-healthy sardines to the rich mackerel and flavourful herring. Venture beyond fish and discover the wonders of shellfish, such as oysters, mussels, and clams, which are also rich in brain-nourishing nutrients. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a harmful toxin that can build up in the body and negatively affect cognitive function. Larger, predatory fish tend to have a higher mercury content. To minimize mercury intake, choose low-mercury options like salmon, sardines, herring, mackerel, and trout. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation. Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources ensures you can safely savour the brain-boosting benefits of seafood [47–50].

By incorporating this brain food into your diet, you're not just treating your taste buds to a delightful experience; you're empowering your cognitive function for a lifetime of sharp thinking, vibrant memory, and a sharper, more focused you. Embrace the world of seafood and tap into its potential to support a lifetime of optimal brain health.! As we navigate the ever-evolving landscape of life, our brains, the tireless command centres orchestrating every thought and action, become a focal point for concern. The potential for age-related cognitive decline and dementia casts a long shadow, raising anxieties about memory, focus, and overall mental sharpness. Fortunately, a delicious solution emerges from the depths of our oceans: seafood. Packed with a symphony of brain-boosting nutrients, particularly omega-3 fatty acids, like DHA and EPA, seafood offers a powerful line of defence against cognitive decline. DHA, a cornerstone nutrient for brain health, acts like a microscopic building block, fostering the growth and communication of brain cells. This translates to a sharper memory, enhanced learning capabilities, and improved cognitive flexibility, allowing your brain to adapt and thrive throughout life. But DHA isn't a lone warrior. Its partner, EPA, tackles chronic inflammation, a potential culprit in cognitive decline. By reducing inflammation, EPA may act as a shield, protecting your brain function from its detrimental effects and potentially slowing cognitive decline [51]. The benefits extend beyond inflammation control, as EPA appears to influence mood and neurotransmitters, potentially leading to a more positive outlook and emotional well-being, which can indirectly contribute to cognitive function. However, the brilliance of seafood extends far beyond the realm of omega-3s. Fatty fish abundantly contains Vitamin D, a crucial player in overall brain health and neuroprotection. Studies suggest a link between vitamin D deficiency and cognitive decline, highlighting the importance of incorporating this vital nutrient into your diet for optimal brain function. Iodine, another essential element, is particularly important for foetal brain development and continues to be necessary for optimal cognitive function throughout life. Thankfully, seafood is rich in iodine, providing your brain with the essential nutrients it needs to stay sharp. B vitamins, particularly B12 and B6, are the unsung heroes, playing a vital role in maintaining healthy nerve function and cognitive processes. Many seafood varieties are excellent sources of these B vitamins, further enriching the brain-boosting potential of your diet. To reap these remarkable benefits, aim for at least two servings of seafood per week. Explore a delightful variety of fish, from the vibrant salmon and heart-healthy sardines to the rich mackerel and flavourful herring. Don't forget to venture beyond fish and explore the wonders of shellfish, like oysters, mussels, and clams, which are also packed with brain-nourishing nutrients. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet

are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body and impair cognitive function. Larger, predatory fish tend to have a higher mercury content. To minimize mercury intake, choose low-mercury options like salmon, sardines, herring, mackerel, and trout. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation. Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Referring to these resources helps you safely enjoy the brain-boosting benefits of seafood. Incorporating seafood into your diet not only delights your taste buds but also supports a lifetime of optimal brain health. With each delicious bite, you're fortifying your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, and empowering your brain to stay sharp, focused, and vibrant for years to come. So, set sail on a culinary adventure and unlock the potential for a lifetime of exceptional brain health with the bounty of the sea! Our minds, the intricate control centres conducting the symphony of our lives, deserve the best possible fuel for optimal performance [52]. Fortunately, a delicious solution swims in our oceans and rivers – seafood. Beyond its delightful taste, seafood offers a bounty of benefits, not just for cognitive function but also for mood and mental health. This brilliance lies primarily in omega-3 fatty acids, particularly DHA and EPA. DHA acts like a building block for the brain, fostering the very foundation for strong emotional well-being. Studies suggest that sufficient DHA levels may be linked to a reduced risk of depression, a debilitating condition characterized by low mood, loss of interest, and decreased energy. The EPA steps in to address chronic inflammation, a factor that has been linked to mood disorders. By reducing inflammation, EPA may act as a shield, potentially protecting your emotional well-being from its detrimental effects. Additionally, EPA appears to play a role in regulating mood and neurotransmitters, the chemical messengers in the brain. Keeping these neurotransmitters in balance is essential for a positive mindset and emotional stability. But seafood's benefits go beyond just omega-3s. Vitamin D, often called the sunshine vitamin, is key to regulating mood and supporting emotional health. Research shows that a lack of vitamin D may be tied to a higher risk of depression. Fatty fish are abundant sources of vitamin D, offering a delicious way to combat deficiency and potentially elevate your mood. Another crucial player is iodine. While primarily known for its role in thyroid function, iodine deficiency has also been linked to mood disorders. Thankfully, seafood is a treasure trove of iodine, ensuring your body has the resources it needs to maintain emotional balance. B vitamins, especially B12 and B6, are crucial for creating neurotransmitters that help control mood and sleep. A lack of these vitamins can lead to symptoms like anxiety, depression, and fatigue. Many seafood varieties are excellent sources of B vitamins, further enriching the mood-boosting potential of your diet. To reap these remarkable benefits, aim for at least two servings of seafood per week. Explore a delightful variety of fish, from the vibrant salmon and heart-healthy sardines to the rich mackerel and flavourful herring. Venture beyond fish and discover the delights of shellfish, such as oysters, mussels, and clams, brimming with nutrients that nourish your mood. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body, impair cognitive function, and potentially contribute to mood disorders. To minimize mercury intake, choose low-mercury options like salmon, sardines, herring, mackerel, and trout. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation. Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources ensures you can safely savour the mood-boosting benefits of seafood [53]. Incorporating seafood into your diet isn't just a treat for your taste buds – it's an investment in your overall health and well-being. With each delicious bite, you're potentially nurturing a more positive mood, reducing the risk of depression and anxiety, and empowering your mind to navigate the complexities of life with emotional resilience. So, set sail on a culinary adventure and unlock the potential for a lifetime of exceptional mental health with the bounty of the sea! Our brains, the tireless conductors of our thoughts and actions, thrive on a foundation of quality sleep. Yet the constant demands of modern life often disrupt this vital restorative process. Fortunately, a delicious solution emerges from the depths of our oceans: seafood. Packed with

a symphony of brain-boosting nutrients, seafood offers not only a direct cognitive advantage but also an indirect benefit through improved sleep quality. Omega-3 fatty acids, especially DHA and EPA, play a key role in orchestrating this harmony. DHA acts like a maestro, fine-tuning the brain for optimal performance. But its influence extends beyond cognitive function. Studies suggest a link between sufficient DHA levels and improved sleep quality. This could be because DHA helps regulate the production of melatonin, the hormone that controls our sleep-wake cycle. Our bodies can naturally produce the melatonin required for a restful night's sleep with adequate DHA, enabling our brains to fully recharge and consolidate memories. EPA contributes to the fight against chronic inflammation, a factor known to disrupt sleep. By reducing inflammation, EPA may act as a shield, potentially protecting our sleep from its disruptive effects. However, the brilliance of seafood extends beyond the realm of omega-3s. Vitamin D, often called the sunshine vitamin, is also essential for regulating sleep. Researchers have linked sleep disorders like insomnia to vitamin D deficiencies. Fatty fish are abundant sources of vitamin D, offering a delicious way to combat deficiency and potentially promote deeper, more restorative sleep. Vitamin B6 is another important contributor. It serves as a coenzyme in the production of melatonin, helping to support the sleep-wake cycle. Many seafood varieties are excellent sources of vitamin B6, ensuring your body has the resources it needs to naturally regulate sleep. To reap these remarkable benefits, aim for at least two servings of seafood per week. Explore a delightful variety of fish, from the vibrant salmon and heart-healthy sardines to the rich mackerel and flavourful herring. Explore the wonders of shellfish, such as oysters, mussels, and clams, which are also rich in nutrients that promote sleep. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body and impair cognitive function, potentially disrupting sleep patterns. To minimize mercury intake, choose low-mercury options like salmon, sardines, herring, mackerel, and trout. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation. Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources ensures you can safely savour the sleep-promoting benefits of seafood. By making seafood a staple in your diet, you're not just treating your taste buds; you're investing in a lifetime of optimal brain health. With each delicious bite, you're not only empowering your cognitive function directly but also indirectly through improved sleep quality. By ensuring your brain gets the restorative sleep it craves, you're setting the stage for a lifetime of sharp thinking, vibrant memory, and emotional resilience. So, set sail on a culinary adventure and unlock the potential for a lifetime of exceptional brain health with the bounty of the sea [54].

CHOOSING THE RIGHT SEAFOOD

A delectable answer for brain health comes from the depths as we explore the enormous ocean of available data: seafood. Full of nutrients that promote brain function, it provides a strong defence against cognitive decline, improved memory, learning, and even better sleep. However, to truly unlock this potential, we must set sail on a course for the richest sources of these brain-nourishing treasures. Here's where the concept of "fatty fish" takes centre stage. These magnificent denizens of the deep, like salmon, tuna, sardines, and mackerel, are veritable swimming vaults of omega-3 fatty acids, particularly DHA and EPA. DHA acts like microscopic building blocks, fostering the growth and communication of brain cells, leading to sharper memory, enhanced learning capabilities, and improved cognitive flexibility. Its partner, EPA, tackles chronic inflammation, a potential culprit in cognitive decline, potentially shielding your brain function from its detrimental effects. Additionally, EPA appears to influence mood and neurotransmitters, potentially leading to a more positive outlook and emotional well-being, which can indirectly contribute to cognitive function. But the brilliance of seafood extends beyond omega-3s. Vitamin D, crucial for overall brain health and neuroprotection, is abundant in fatty fish. Studies suggest a link between vitamin D deficiency and cognitive decline, highlighting the importance of incorporating these fatty varieties into your diet [55]. Iodine, another essential element for foetal brain development and continued cognitive function throughout life, is also plentiful in fatty

fish. B vitamins, particularly B12 and B6, play a vital role in maintaining healthy nerve function and cognitive processes, and many fatty fish varieties are excellent sources of these B vitamins. To reap these remarkable benefits, aim for at least two servings of seafood per week, with a focus on these fatty fish. Explore the vibrant world of salmon, rich in omega-3s, vitamin D, and B vitamins. Savour the heart-healthy sardines, brimming with DHA, EPA, and vitamin D. Delight in the flavourful mackerel, packed with omega-3s and vitamin B12. Don't forget to venture beyond fish and explore the wonders of shellfish, like oysters, mussels, and clams, which can also be good sources of brain-nourishing nutrients. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body and impair cognitive function. Larger, predatory fish tend to have a higher mercury content. To minimize mercury intake, choose low-mercury options like the fatty fish mentioned above. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation. Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources helps you safely enjoy the brain-boosting benefits of seafood. By making these nutrient-packed fatty fish a regular part of your diet, you're not just indulging your taste buds – you're investing in long-term brain health. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a culinary adventure filled with the bounty of the sea. As we dive into the sea of information on brain health, a tasty solution rises from the depths: seafood. Packed with a symphony of brain-boosting nutrients, it offers a powerful defence against cognitive decline, sharper memory, enhanced learning, and even improved sleep. However, to truly unlock this potential, we must set sail on a course for the richest sources of these brain-nourishing treasures. Here's where the concept of "fatty fish" takes centre stage [56]. These magnificent denizens of the deep, like salmon, tuna, sardines, and mackerel, are veritable swimming vaults of omega-3 fatty acids, particularly DHA and EPA. DHA acts like microscopic building blocks, fostering the growth and communication of brain cells, leading to sharper memory, enhanced learning capabilities, and improved cognitive flexibility. Its partner, EPA, tackles chronic inflammation, a potential culprit in cognitive decline, potentially shielding your brain function from its detrimental effects. Additionally, EPA appears to influence mood and neurotransmitters, leading to a more positive outlook and emotional well-being, which can indirectly contribute to cognitive function. But the brilliance of seafood extends beyond omega-3s. Vitamin D, crucial for overall brain health and neuroprotection, is abundant in fatty fish. Studies suggest a link between vitamin D deficiency and cognitive decline, highlighting the importance of incorporating these fatty varieties into your diet. Iodine, another essential element for foetal brain development and continued cognitive function throughout life, is also plentiful in fatty fish. B vitamins, particularly B12 and B6, play a vital role in maintaining healthy nerve function and cognitive processes, and many fatty fish varieties are excellent sources of these B vitamins. To reap these remarkable benefits, aim for at least two servings of seafood per week, with a focus on these fatty fish. Here's the key to maximizing your brain boost: prioritize variety within this category. Explore the vibrant world of salmon, rich in omega-3s, vitamin D, and B vitamins. Savour the heart-healthy sardines, brimming with DHA, EPA, and vitamin D. Delight in the flavourful mackerel, packed with omega-3s and vitamin B12. Don't forget to venture beyond fish and explore the wonders of shellfish, like oysters, mussels, and clams, which can also be good sources of brain-nourishing nutrients. Remember, cooking methods matter! Opt for healthy techniques, like baking, grilling, or broiling, to preserve the precious nutrients within these treasures of the sea. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body and impair cognitive function. Larger, predatory fish tend to have a higher mercury content. To minimize mercury intake, choose low-mercury options like the fatty fish mentioned above. Variety is key! Rotate the types of seafood you consume to further reduce the risk of mercury accumulation.

Additionally, reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources ensures you can safely savour the brain-boosting benefits of seafood. By making these nutrient-rich fatty fish a staple in your diet, with a focus on at least two servings per week and incorporating a variety of options within this category, you're not just treating your taste buds; you're investing in a lifetime of optimal brain health. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a culinary adventure filled with the bounty of the sea! As we navigate the vast ocean of information on brain health, a delicious solution emerges from the depths: seafood. Packed with a symphony of brain-boosting nutrients, it offers a powerful defence against cognitive decline, sharper memory, enhanced learning, and even improved sleep. However, to truly unlock this potential, we must set sail on a course for the richest sources of these brain-nourishing treasures. Here, the concept of "fatty fish" takes centre stage. These magnificent denizens of the deep, like salmon, tuna, sardines, and mackerel, are veritable swimming vaults of omega-3 fatty acids, particularly DHA and EPA. DHA acts like microscopic building blocks, fostering the growth and communication of brain cells, leading to sharper memory, enhanced learning capabilities, and improved cognitive flexibility. Its partner, EPA, tackles chronic inflammation, a potential culprit in cognitive decline, potentially shielding your brain function from its detrimental effects. Additionally, EPA appears to influence mood and neurotransmitters, leading to a more positive outlook and emotional well-being, which can indirectly contribute to cognitive function. But the brilliance of seafood extends beyond the realm of omega-3s. Fatty fish are undoubtedly the heavyweights in the brain-boosting arena, but other treasures from the sea offer valuable contributions [57]. Vitamin D, crucial for overall brain health and neuroprotection, is abundant in fatty fish. Research suggests a connection between vitamin D deficiency and cognitive decline, emphasizing the importance of including these fatty fish in your diet. While not as rich in omega-3s as their fatty cousins, lean fish varieties, like cod, tilapia, and halibut, can still be good sources of vitamin D and other essential nutrients. Iodine, another essential element for fetal brain development and continued cognitive function throughout life, is plentiful in all types of seafood, making it a valuable addition to your brain-healthy diet. B vitamins, particularly B12 and B6, play a vital role in maintaining healthy nerve function and cognitive processes, and many seafood varieties, including shellfish, like oysters, mussels, and clams, are excellent sources of these B vitamins. To enjoy these incredible benefits, try to include at least two servings of seafood in your diet each week. with a focus on fatty fish like salmon, sardines, and mackerel. However, don't hesitate to explore the bounty of the sea beyond these champions. Lean fish and shellfish offer valuable contributions to your brain health as well. Remember, variety is key! Rotate the types of seafood you consume to maximize nutrient intake and minimize mercury risk. While the advantages of incorporating seafood into your diet are significant, a word of caution is necessary regarding mercury levels in certain fish varieties. Mercury is a toxin that can accumulate in the body and impair cognitive function. To minimize mercury intake, choose low-mercury options and consult reliable sources, like the FDA and EPA, for advisories on specific fish varieties. By making these nutrient-packed options a regular part of your diet, you're not just satisfying your taste buds – you're investing in lifelong brain health. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a culinary adventure filled with the bounty of the sea [58].

POTENTIAL CONCERNS AND CONSIDERATIONS

As we navigate the vast ocean of information on brain health, a delicious solution emerges from the depths: seafood. Packed with a symphony of brain-boosting nutrients, it offers a powerful defence against cognitive decline, sharper memory, enhanced learning, and even improved sleep. However, to truly unlock this potential, we must tread cautiously, navigating the waters with an awareness of potential concerns. The beauty of seafood lies in its abundance of omega-3 fatty acids, especially DHA and EPA. These powerhouses act like microscopic building blocks, fostering the growth and communication of brain cells, leading to a sharper mind. But the bounty doesn't stop there. Vitamin D,

crucial for overall brain health and neuroprotection, is abundant in fatty fish. Iodine, another essential element, and B vitamins, particularly B12 and B6, all play vital roles in cognitive function, and many seafood varieties are excellent sources. To reap these remarkable benefits, aim for at least two servings of seafood per week. Here's where the concept of "fatty fish" takes centre stage. Salmon, tuna (canned light), sardines, and mackerel are champions in the brain-boosting arena, brimming with omega-3s, vitamin D, and other essential nutrients. However, it's important to be cautious about mercury levels. Mercury is a toxin that can build up in the body and negatively affect cognitive function. Larger, predatory fish tend to have a higher mercury content. So, how do we navigate these concerns and ensure we're getting the brain benefits without the risk? The key lies in choosing low-mercury options. Here's your guide: prioritize the aforementioned fatty fish like salmon and sardines. Lean fish varieties, like cod, tilapia, and halibut, can also be part of your brain-healthy diet, but they are not as rich in omega-3s. Shellfish, like oysters, mussels, and clams, are generally low in mercury and offer valuable contributions of B vitamins and other nutrients. Remember, variety is key! Rotate the types of seafood you consume to maximize nutrient intake and minimize mercury risk. Reliable sources, like the FDA and EPA, provide advisories on mercury levels in specific fish varieties from different regions. Consulting these resources ensures you can safely savour the brain-boosting benefits of seafood. By incorporating this bounty of the sea into your diet with a focus on low-mercury options and variety, you're not just treating your taste buds; you're investing in a lifetime of optimal brain health. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a culinary adventure filled with the wonders of the ocean! As we explore the sea of information on brain health, a tasty solution rises from the depths: seafood. Packed with a symphony of brain-boosting nutrients, it offers a powerful defence against cognitive decline, sharper memory, enhanced learning, and even improved sleep. However, to truly unlock this potential, we must tread cautiously, navigating the waters with an awareness of potential concerns. The greatness of seafood comes from its wealth of omega-3 fatty acids, especially DHA and EPA. These powerhouses act like microscopic building blocks, fostering the growth and communication of brain cells, leading to a sharper mind. But the bounty doesn't stop there. Vitamin D, crucial for overall brain health and neuroprotection, is abundant in fatty fish. Iodine, another essential element, and B vitamins, particularly B12 and B6, all play vital roles in cognitive function, and many seafood varieties are excellent sources. To reap these remarkable benefits, aim for at least two servings of seafood per week. Here's where the concept of "fatty fish" takes centre stage. Salmon, tuna (canned light), sardines, and mackerel are champions in the brain-boosting arena, brimming with omega-3s, vitamin D, and other essential nutrients. However, it's important to exercise caution not only with mercury levels but also with other potential contaminants. Mercury, a toxin that can accumulate in the body and impair cognitive function, is a concern primarily with larger, predatory fish. To navigate this, prioritize the aforementioned fatty fish, like salmon and sardines. Lean fish varieties, like cod, tilapia, and halibut, can also be part of your brain-healthy diet, but they are not as rich in omega-3s. Shellfish, like oysters, mussels, and clams, are generally low in mercury and offer valuable contributions of B vitamins and other nutrients. Beyond mercury, micro plastics, or tiny plastic fragments, have become a growing concern in our oceans. While research on the health impacts of micro plastics in seafood is ongoing, some studies suggest potential risks. To reduce exposure, choose smaller fish lower on the food chain, as they generally accumulate fewer microplastics. Additionally, choosing fish caught using sustainable methods can help reduce overall micro plastic pollution in the oceans. Remember, variety is key! Rotate the types of seafood you consume to maximize nutrient intake and minimize risks from all potential contaminants. Reliable sources, like the FDA and EPA, provide advisories on mercury levels and potential micro plastic concerns for specific fish varieties from different regions. Consulting these resources ensures you can safely savour the brain-boosting benefits of seafood. By incorporating this bounty of the sea into your diet with a focus on low-mercury options, variety, and sustainable practices, you're not just treating your taste buds; you're investing in a lifetime of optimal brain health. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a

culinary adventure filled with the wonders of the ocean! As we explore the vast sea of information on brain health, a tasty solution rises from the depths: seafood. Packed with a symphony of brain-boosting nutrients, it offers a powerful defence against cognitive decline, sharper memory, enhanced learning, and even improved sleep. However, to fully unlock this potential, we must be responsible guardians of this essential resource. The brilliance of seafood lies in its abundant omega-3 fatty acids, especially DHA and EPA. These powerhouses act like microscopic building blocks, fostering the growth and communication of brain cells, leading to a sharper mind. But the bounty doesn't stop there. Vitamin D, crucial for overall brain health and neuroprotection, is abundant in fatty fish. Iodine, another essential element, and B vitamins, particularly B12 and B6, all play vital roles in cognitive function, and many seafood varieties are excellent sources. To enjoy these remarkable benefits, aim for at least two servings of seafood per week, while being mindful of sustainability. Here's where the concept of "fatty fish" takes centre stage. Salmon, tuna (canned light), sardines, and mackerel are champions in the brain-boosting arena, brimming with omega-3s, vitamin D, and other essential nutrients. However, a word of caution is necessary regarding not just mercury levels and micro plastics but also the long-term health of our oceans. Unsustainable fishing practices can deplete fish populations, disrupting the delicate balance of marine ecosystems. To navigate this concern, prioritize seafood choices that are certified sustainable by reputable organizations like the Marine Stewardship Council (MSC). These certifications ensure that fishing practices are conducted responsibly, minimizing environmental impact and safeguarding fish populations for future generations. Beyond certifications, choosing smaller fish lower on the food chain can also contribute to sustainability. These fish tend to accumulate fewer micro plastics and are less likely to be overfished. Shellfish, like oysters, mussels, and clams, are generally good choices in this regard, offering valuable B vitamins and other brain-nourishing nutrients. Remember, variety is key! Rotate the types of seafood you consume to maximize nutrient intake and minimize risks from all potential contaminants. Reliable sources, like the FDA and EPA, provide advisories on mercury levels, micro plastic concerns, and sustainable fishing practices for specific fish varieties from different regions. Consulting these resources ensures you can safely savour the brain-boosting benefits of seafood while remaining an advocate for healthy oceans. By incorporating this bounty of the sea into your diet with a focus on low-mercury options, variety, sustainable practices, and responsible sourcing, you're not just treating your taste buds and investing in your brain health; you're becoming a guardian of our vital marine ecosystems. With each delicious bite, you're empowering your cognitive function, potentially reducing the risk of age-related cognitive decline and dementia, nurturing a more positive mood, and promoting restful sleep – all while setting sail on a culinary adventure filled with the wonders of a healthy and sustainable ocean [59, 60].

CONCLUSIONS

Consequently, as the challenges of maintaining optimal brain function in an increasingly complex world persist, seafood emerges as a highly effective ally. Seafood, particularly fatty fish, offers a rich array of nutrients, making it a powerful, natural option for enhancing cognitive performance, emotional well-being, and overall brain health. Omega-3 fatty acids, notably DHA and EPA, are central to this brain-boosting potential. DHA is a critical component of brain structure and function, facilitating the growth and communication of brain cells, which leads to improved memory, learning, and cognitive flexibility. Meanwhile, EPA plays a vital role in reducing chronic inflammation, a major contributor to neurodegeneration, while also influencing mood regulation and emotional resilience. In addition to omega-3s, seafood provides a wealth of other essential nutrients that support brain function. Vitamin D, for example, is crucial for neuroprotection and has been linked to cognitive decline when deficient. Studies indicate that adequate vitamin D levels, abundant in fatty fish, may help reduce the risk of neurodegenerative diseases. Moreover, iodine, an essential nutrient for fetal brain development and lifelong cognitive function, is plentiful in most seafood species. B vitamins, particularly B12 and B6, are vital for maintaining healthy nerve function and cognitive processes, and seafood remains one of the best sources of these nutrients. To fully reap the cognitive benefits of seafood, it is recommended to consume at least two servings per week. Fatty fish, such as salmon, sardines, and mackerel are particularly rich in omega-3s, vitamin D, and B vitamins, while shellfish, like oysters, mussels, and

clams, provide additional valuable minerals. However, variety is key to maximizing nutrient intake and minimizing potential risks, such as mercury exposure. Following guidelines from reputable organizations, like the FDA and EPA, can help individuals select seafood that is both nutritious and low in contaminants. Ultimately, incorporating seafood into one's diet is not only a flavorful choice but also an investment in long-term brain health. Each serving provides a unique blend of nutrients that support cognitive function, improve mood, and promote better sleep, all while reducing the risk of age-related cognitive decline and dementia. By choosing sustainable seafood options, individuals can help conserve marine ecosystems while nourishing their minds for years to come. In essence, by embracing the bounty of the ocean, a path to a healthier, more vibrant future is set – one bite at a time.

REFERENCES

1. Darmawan A, Wulandari N, Nurjanah S, Sugiarto AT, Kusumaningrum HD. Optimization of pulsed electric field design for seafood products with salting process. In: IOP Conference Series: Earth and Environmental Science. 2024 Jun;1359(1):012020. IOP Publishing.
2. Russo GL, Langellotti AL, Torrieri E, Masi P. Emerging technologies in seafood processing: An overview of innovations reshaping the aquatic food industry. Compr Rev Food Sci Food Saf. 2024;23(1):e13281.
3. Holm P, Hayes P, Nicholls J. Historical marine footprint for Atlantic Europe, 1500–2019. Ambio. 2024;53(4):624–36.
4. Zhang J, Ahmmed MK, Regenstein JM, Wu H. Recent advances of recycling proteins from seafood by-products: Industrial applications, challenges, and breakthroughs. Trends Food Sci Technol. 2024;104533.
5. Gurel M, Rathod N, Cabrera LY, Voyton S, Yeo M, Ozogul F, Ozbolat IT. A narrative review: 3D bioprinting of cultured muscle meat and seafood products and its potential for the food industry. Trends Food Sci Technol. 2024;104670.
6. Saaoud F, Lu Y, Xu K, Shao Y, Praticò D, Vazquez-Padron RI, et al. Protein-rich foods, sea foods, and gut microbiota amplify immune responses in chronic diseases and cancers–Targeting PERK as a novel therapeutic strategy for chronic inflammatory diseases, neurodegenerative disorders, and cancer. Pharmacol Ther. 2024;108604.
7. Liu WJ, Liu P, Lei W, Jia Z, He X, Shi W, et al. Surveillance of SARS-CoV-2 at the Huanan seafood market. Nature. 2024;631(8020):402–8.
8. Chandrababu A, Puthumana J. CRISPR-edited, cell-based future-proof meat and seafood to enhance global food security and nutrition. Cytotechnology. 2024;1–34.
9. Brauge T, Mougin J, Ells T, Midelet G. Sources and contamination routes of seafood with human pathogenic Vibrio spp.: A Farm-to-Fork approach. Compr Rev Food Sci Food Saf. 2024;23(1):e13283.
10. Tacon AG, Coelho RT, Levy J, Machado TM, Neiva CR, Lemos D. Annotated bibliography of selected papers dealing with the health benefits and risks of fish and seafood consumption. Rev Fish Sci Aquacult. 2024;32(2):211-305.
11. Lorusso L, Shum P, Piredda R, Mottola A, Maiello G, Cartledge EL, et al. Mismanagement and poor transparency in the European processed seafood supply revealed by DNA metabarcoding. Food Res Int. 2024;114901.
12. Varzakas T, Smaoui S. Global food security and sustainability issues: the road to 2030 from nutrition and sustainable healthy diets to food systems change. Foods. 2024;13(2):306.
13. Akhila DS, Ashwath PG, Manjunatha KG, Akshay SD, Surasani VKR, Sofi FR, et al. Seafood processing waste as a source of functional components: Extraction and applications for various food and non-food systems. Trends Food Sci Technol. 2024;104348.
14. Bjørndal T, Dey M, Tusvik A. Economic analysis of the contributions of aquaculture to future food security. Aquaculture. 2024;578:740071.
15. Singh AP, Saxena R, Saxena S, Maurya NK. Unveiling the Ocean's Arsenal: Successful Integration of Marine Metabolites into Disease Management. Uttar Pradesh J Zool. 2024;45(13):170–88.

16. Morales-Nin B, Zimmermann F, Merino G, Antelo LT, Murillas-Maza A, Moksness E. Challenges on blue food provision. Front Ocean Sustain. 2024;2:1271783.
17. Steinhagen S, Stedt K, Trigo JP, Undeland I, Pavia H. A step towards closing the food-waste gap in novel protein sources: Post-harvest protein boost of the seaweed crop Ulva by herring production tub water. Future Foods. 2024;9:100347.
18. Han K, Yeom J, Chung K. Identifying Emerging Issues in the Seafood Industry Based on a Text Mining Approach. Appl Sci. 2024;14(5):1820.
19. Karimidastjerd A, Gulsunoglu-Konuskan Z, Ersoy B, Cetinkaya T, Khan ZS, Okpala COR. Nutritional and sustainability aspects of algae and fungi sources in the seafood analogs. Ann Anim Sci. 2024.
20. Lee YC, Kim HG, Jeong JC, Kang CS. Current Trends and Prospects of High Value-added Seafood Processing Technology Development. J Pract Agric Fish Res. 2024;25(4):148–57.
21. Singh AP, Saxena R, Saxena S, Maurya NK. Artificial Intelligence Revolution in Healthcare: Transforming Diagnosis, Treatment, and Patient Care. Asian J Adv Res. 2024;7(1):241–63.
22. Tacon AG, Shumway SE. Critical need to increase aquatic food production and food supply from aquaculture and capture fisheries: trends and outlook. Rev Fish Sci Aquacult. 2024;32(3):389–95.
23. Desai AK, Desai AK, Rush J, Naveen L, Thaipisuttikul P. Nutrition and nutritional supplements to promote brain health. In: Enhancing Cognitive Fitness in Adults: A Guide to the Use and Development of Community-Based Programs. 2011. p. 249–69.
24. Park J. The role of diet and nutrition in brain health and concentration. Brain. 2023.
25. Ahire ED, Keservani RK, Bharti SK. Role of fruit and food components in brain cognition. In: Nutraceutical Fruits and Foods for Neurodegenerative Disorders. Academic Press; 2024. p. 1–14.
26. Power R, Prado-Cabrero A, Mulcahy R, Howard A, Nolan JM. The role of nutrition for the aging population: implications for cognition and Alzheimer's disease. Annu Rev Food Sci Technol. 2019;10:619–39.
27. Hale J. The Truth About Nootropic Brain Supplements and Brain Power. 2023.
28. Tardner P. Memory Supplements: Best supplements for brain health and memory. 2020.
29. Smarta R. Nutrition needs for lifestyle changes and managing disorders. In: Nutrition Science, Marketing Nutrition, Health Claims, and Public Policy. Academic Press; 2023. p. 45–56.
30. Donahue SM, Rifas-Shiman SL, Gold DR, Jouni ZE, Gillman MW, Oken E. Prenatal fatty acid status and child adiposity at age 3 y: results from a US pregnancy cohort. Am J Clin Nutr. 2011;93(4):780–8.
31. Nurk E, Drevon CA, Refsum H, Solvoll K, Vollset SE, Nygård O, Nygaard HA, Engedal K, Tell GS, Smith AD. Cognitive performance among the elderly and dietary fish intake: the Hordaland Health Study. Am J Clin Nutr. 2007 Nov 1;86(5):1470–8.
32. Morris MC, Brockman J, Schneider JA, Wang Y, Bennett DA, Tangney CC, van de Rest O. Association of seafood consumption, brain mercury level, and APOE ε4 status with brain neuropathology in older adults. Jama. 2016 Feb 2;315(5):489–97.
33. Singh AP, Saxena R, Saxena S, Maurya NK. Mind Unveiled: Cutting-Edge Neuroscience and Precision Brain Mapping. Asian J Curr Res. 2024;9(3):181–95.
34. Kim DH, Grodstein F, Rosner B, Kang JH, Cook NR, Manson JE, Buring JE, Willett WC, Okereke OI. Seafood types and age-related cognitive decline in the Women's Health Study. J Gerontol A Biol Sci Med Sci. 2013 Oct 1;68(10):1255–62.
35. Morris MC, Evans DA, Tangney CC, Bienias JL, Wilson RS. Fish consumption and cognitive decline with age in a large community study. Arch Neurol. 2005 Dec 1;62(12):1849–55.
36. van de Rest O, Wang Y, Barnes LL, Tangney C, Bennett DA, Morris MC. APOE ε4 and the associations of seafood and long-chain omega-3 fatty acids with cognitive decline. 2014.
37. Yoshimura H. Neuroplasticity and Nutrition: The Role of Diet in Brain Resilience and Repair. Nutr. 2016 May 31;86(22):2063–70.
38. Singh AP, Saxena R, Saxena S, Maurya NK. The Future of Protection: Unleashing the Power of Nanotech against Corrosion. Asian J Curr Res. 2024;9(3):23–44.
39. Mao X, Chen C, Xun P, Daviglus M, Steffen LM, Jacobs Jr DR, Van Horn L, Sidney S, Zhu N, He K. Effects of seafood consumption and toenail mercury and selenium levels on cognitive function among American adults: 25 y of follow up. Nutr. 2019 May 1;61:77–83.

40. Nooyens AC, Van Gelder BM, Bueno-de-Mesquita HB, Van Boxtel MP, Verschuren WM. Fish consumption, intake of fats and cognitive decline at middle and older age: the Doetinchem Cohort Study. Eur J Nutr. 2018 Jun;57:1667–75.
41. Avella-Garcia CB, Julvez J. Seafood intake and neurodevelopment: a systematic review. Curr Environ Health Rep. 2014 Mar;1:46–77.
42. Cardoso C, Afonso C, Bandarra NM. Dietary DHA and health: cognitive function ageing. Nutr Res Rev. 2016 Dec;29(2):281–94.
43. Hei A. Mental health benefits of fish consumption. Clin Schizophr Relat Psychoses. 2020;15(5).
44. Bushkin-Bedient S, Carpenter DO. Benefits versus risks associated with consumption of fish and other seafood. Rev Environ Health. 2010 Sep;25(3):161–92.
45. Cohen JF, Gorski MT, Gruber SA, Kurdziel LB, Rimm EB. The effect of healthy dietary consumption on executive cognitive functioning in children and adolescents: a systematic review. Br J Nutr. 2016 Sep;116(6):989–1000.
46. Kalmijn SV, Van Boxtel MP, Ocke M, Verschuren WM, Kromhout D, Launer LJ. Dietary intake of fatty acids and fish in relation to cognitive performance at middle age. Neurology. 2004 Jan 27;62(2):275–80.
47. Mozaffarian D, Rimm EB. Fish intake, contaminants, and human health: evaluating the risks and the benefits. Jama. 2006 Oct 18;296(15):1885–99.
48. Assisi A, Banzi R, Buonocore C, Capasso F, Di Muzio V, Michelacci F, Renzo D, Tafuri G, Trotta F, Vitocolonna M, Garattini S. Fish oil and mental health: the role of n-3 long-chain polyunsaturated fatty acids in cognitive development and neurological disorders. Int Clin Psychopharmacol. 2006 Nov 1;21(6):319–36.
49. Liu C, Ralston NV. Seafood and health: What you need to know?. In: Adv Food Nutr Res. 2021 Jan 1;97:275–318.
50. Oken E, Wright RO, Kleinman KP, Bellinger D, Amarasiriwardena CJ, Hu H, Rich-Edwards JW, Gillman MW. Maternal fish consumption, hair mercury, and infant cognition in a US cohort. Environ Health Perspect. 2005 Oct;113(10):1376–80.
51. Sasaki N, Jones LE, Carpenter DO. Fish consumption and omega-3 polyunsaturated fatty acids from diet are positively associated with cognitive function in older adults even in the presence of exposure to lead, cadmium, selenium, and methylmercury: a cross-sectional study using NHANES 2011–2014 data. Am J Clin Nutr. 2024 Feb 1;119(2):283–93.
52. Qin B, Plassman BL, Edwards LJ, Popkin BM, Adair LS, Mendez MA. Fish intake is associated with slower cognitive decline in Chinese older adults. J Nutr. 2014 Oct 1;144(10):1579–85.
53. Shaffer J. Neuroplasticity and clinical practice: Building brain power for health. Front Psychol. 2016;7:205377.
54. Dougherty P. How Much Omega 3 Per Day for Bodybuilding-Here's How Much You Need!. Omega. 3. 0.
55. Kuempel CD, Arnett E, Klein CJ. Quantifying global redundant fisheries trade to streamline seafood supply chains. PLoS One. 2024;19(7):e0305779.
56. Mahmud N, Valizadeh S, Oyom W, Tahergorabi R. Exploring functional plant-based seafood: Ingredients and health implications. Trends Food Sci Technol. 2024;104346.
57. Lester SE, Gentry RR, Froehlich HE. The role of marine aquaculture in contributing to the diversity and stability of US seafood production. Mar Policy. 2024;160:105994.
58. McClements DJ. Novel animal product substitutes: A new category of plant-based alternatives to meat, seafood, egg, and dairy products. Compr Rev Food Sci Food Saf. 2024;23(3):e313330.
59. Shum P, Cusa M, Prasetyo A, Mariani S. Nanopore sequencing facilitates screening of diversity and provenance of seafood and marine wildlife. Food Control. 2024;161:106908.
60. Lee JH. Proteomic investigation of key proteins involved in the manufacture of plant-based seafood. Food Res Int. 2024;141:109827.

