



Building Better Brain Power: Fruits for Cognition

Fruit Intake Enhances Mental Acuity

The old adage, “eat, drink and be merry” never applied so much to any one category as it does to fruits, according to one recent study. While fruits have always projected a healthy halo, a growing body of research indicates the daily consumption of fruits and vegetables can improve our mental well-being or aid with cognition.

One group of researchers from the University of Leeds, U.K., recently published a study linking the relationship between fruits and vegetables and well-being.¹ Since most people do not consume the recommended daily amount of fruits and vegetables, “adding one portion per day could significantly improve psychological health,” said lead researcher Neel Ocean, Ph.D., research fellow at University of Leeds. Due to this fact, he added, “it probably wouldn’t be a bad thing if there was an increase in the availability of convenience foods that had significant fruit or vegetable content.”

In recent years, the importance of fruit intake has been propelled by the ongoing wellness trend, and consumers are more determined than ever to make healthier lifestyle choices. Fruit has a positive role to play in convenience foods, as mentioned above, but is also a viable, functional ingredient in multiple, application categories. Researchers constantly report on new reasons to believe in fruits' beneficial aspects, particularly the link between fruit consumption and improved cognitive function.

An Age-Old Issue

The health benefits of fruits and vegetables may be more important than ever before considering the aging population in the United States. And the fact that most adults in modern societies can count on a longer lifespan. How well we age can be influenced by personal choices such as diet and exercise. Consumers who follow a healthy diet can help ensure that mental faculties remain sharp.

Consumers are aware of this link between food and better health. According to a Nielsen Global Health and Ingredient Sentiment survey,² 70 percent of consumers around the globe or 60 percent of Americans, say they actively make dietary choices to help prevent adverse health conditions, one of which they named as cognitive health. *See fig. 1*

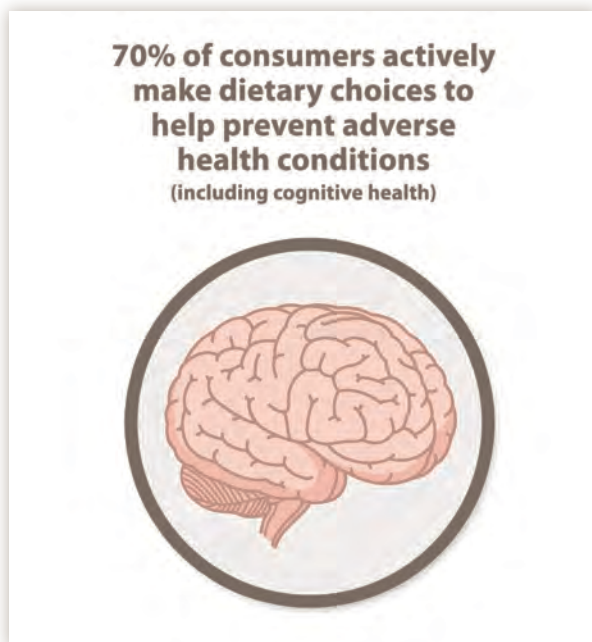


fig. 1

Synergistic Formulating

Fortunately for formulators many of the foods or nutrients that benefit brain health also provide benefits to help stave off other health issues. One study for example, indicates that berry phenolics, while potent "in vitro antioxidants" exert *in vivo* biological activities beyond antioxidation and can have "complementary and overlapping mechanisms of action" that can positively impact human health as it relates to certain types of cancers, heart and neurodegenerative diseases.⁴

The Emory University Goizueta Alzheimer's Disease Research Center lists recommendations to help stave off or compensate for age-related changes. One primary tactic is to maintain good health. Within their recommendation for medical visits, etc., it specifically said, "a diet rich in fruits and vegetables containing antioxidants, such as blueberries, strawberries and broccoli...may be neuroprotective."⁵

As of 2015, 48 million Americans were above the age of 65, accounting for 15 percent of the total U.S. population. According to the Population Reference Bureau, the number of Americans ages 65 and older is projected to double by the year 2060 to 98 million individuals, representing nearly 24 percent of the population. And according to AARP data, by the year 2040, one in five Americans will be over age 65.

AARP released a consumer insight survey on nutrition and brain health, one key finding said, "Significantly more adults, age 40 plus, who ate the recommended daily amount of fruits and vegetables reported better brain health than (77%) those that didn't (39%)."³ Sadly, most adults aren't getting the daily recommended servings from all five food groups and one-third of those responding didn't consume the recommended amount in any food group. Increased education might help with this issue as the survey said nearly nine in 10 adults were likely to eat more healthfully if they knew it would lower the risks of cognitive decline (87%) or other diseases. And cognitive decline is a valid concern among older populations. In Mintel's 2019 report,

“Formulating for Cognitive Health,” adults above the age of 55 from three major countries, the U.K., China and the U.S., cited concerns about weakening memory or the possibility of developing dementia.

Berries—The Brain’s New Best Friend?

Brightly colored berries are bursting with a diverse array of phytochemicals known as phenolics. This includes flavonoids such as anthocyanins and flavonols. These same anthocyanins that provide berries with their brilliant hues also positively impact the human body in more ways than one, specifically the brain. The research community is investigating links between anthocyanins and cognition, adding ‘brain health’ to the list of benefits that fruits and berries can supply for better health. Compounds like anthocyanins can cross the blood-brain barrier to exert their antioxidant and anti-inflammatory properties.

Oxidative stress and inflammatory mediators in the blood can damage brain cells. The flavonoids within berries possess both antioxidant and anti-inflammatory effects that can help counteract and reduce this damage.

Studies from around the globe link berry consumption with brain health. In one of the more notable studies, “Berry Fruit Enhances Beneficial Signaling in the Brain,” authors Marshall G. Miller and Barbara Shukitt-Hale⁶ reported meaningful results linking berry consumption to improved brain function in aged rodents. Their experiments showed that aged rats fed just a two percent blueberry or two percent strawberry diet for two months (2/2/2) displayed improved spatial working memory. Additionally, rats fed blackberry and purple grape juice performed better on cognitive tests than control animals not

consuming fruit products. According to the research, this effect was due to the berry fruits’ neuroactive phytochemicals that offer antioxidant, anti-inflammatory benefits. Shukitt says that blueberries and strawberries have been shown to increase the number of new neurons made in the brain, in addition to the number of branches neurons have.

Another study, “Enhanced Neuronal Activation with Blueberry Supplementation in Mild Cognitive Impairment,” published in *Nutrition Neuroscience*⁷ provided data demonstrating, for the first time, enhanced neuronal response during working memory challenge in blueberry-treated older adults with cognitive decline. It reports that it aimed to investigate the effect of blueberry supplementation on regional brain activation in older adults at risk for dementia. Previous studies have identified “associations between anthocyanins and such benefits as...improved cognitive performance and neuronal function in aged animals.”

It isn’t just older adults who benefit from fruit intake related to cognition. Researchers studied cognitive development in infants whose mothers consumed extra fruit juice supplementation compared to a normal diet during gestation. The researchers report that, “Our study supports increased fruit consumption during pregnancy with significant increases in infant cognitive performance.”⁸

Another study published in the *Annals of Neurology* shows that women who consumed two or more

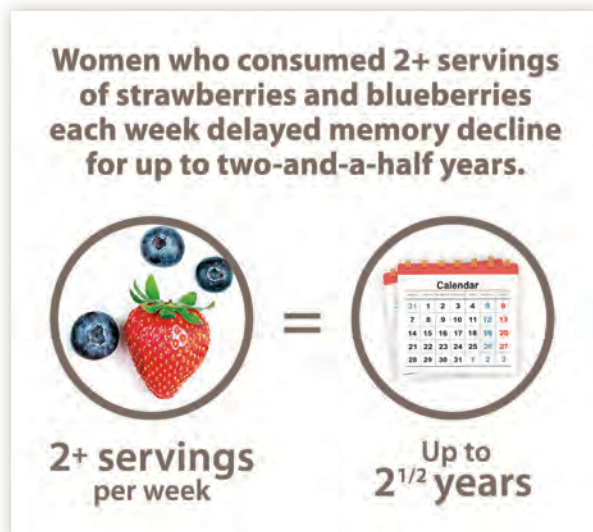


fig. 2

servings of strawberries and blueberries each week delayed memory decline for up to two-and-a-half years. The study conducted by researchers at Harvard's Brigham and Women's Hospital attributed this effect to the berry's flavonoids.⁹ *See fig. 2*

Tree Top specialists can help formulators incorporate berry fruit ingredients into almost any type of application. We offer a variety of ingredients from the berry family of fruits. This includes single strength purées, concentrated purées, dried fruit powders and fruit juice concentrate from blueberries, blackberries, cranberries, raspberries and strawberries.

Apples Add A-Peel to Healthy Brains

Remember the adage about an apple a day keeping the doctor away? Apples might help chase away age-related health issues too. Researchers from the University of Massachusetts in Lowell¹⁰ found a link between consumption of apple juice and the prevention of the decline of a neurotransmitter known as acetylcholine. Acetylcholine is documented to show a positive impact on memory and brain health. In fact, in patients with Alzheimer's, their mental decline can be slowed when acetylcholine levels in the brain increase. The lead researcher said, "These findings suggest that regular consumption of apple juice can not only help to keep one's mind functioning at its best but may also be able to delay key aspects of Alzheimer's disease and augment therapeutic approaches."

This reinforces an earlier study, conducted in 2006, that also showed a link between apple juice and a reduction in the risk of Alzheimer's. In that study, participants who drank as little as 4 ounces of apple juice even three times per week could reduce the risk of Alzheimer's by 75 percent.¹¹

When it comes to apples, our experts have no equal. Tree Top's cooperative was formed in 1960, in the heart of Washington's apple country in Selah, where we still process 800 million pounds of apples on an annual basis. Since our dried apples have much of the moisture removed, a half-cup fruit serving equivalent requires significantly less weight. *See fig. 3*

**7 grams of dried apples
at 18% moisture
=
1/2 cup fruit serving equivalent**



fig. 3

Taking a Bite out of Brain Disorders

Prebiotics are a class of fibers that can be metabolized by human gut bacteria. These fibers not only help to feed beneficial bacteria and promote benefits of probiotic organisms, they also have been shown to significantly reduce the amount of cortisol, the stress hormone, found in the human body. The connection between our gut and brain are starting to be better understood by doctors, nutritionists and neuroscientists. Several recent studies show there is a bi-directional communication between our brain and the gut microbiota, citing "strong effects of *Bifidobacterium* and *Lactobacillus* on the brain-gut axis."¹²

Several different neurophysiological characteristics, such as resistance to anxiety and depression have been linked to the proper sustenance of prebiotics within the intestine. Soluble and insoluble fibers can be found in dried fruits and vegetables as well as nuts, seeds, beans, bran and other whole grains. Men should consume 30 to 38 grams of fiber daily, while women need 21 to 25 grams.

Apples in particular are rich in pectin, which accounts for approximately 50 percent of an apple's total fiber content. Soluble fruit fibers offer prebiotic benefits. These fibers increase butyrate, a short-chain fatty acid that helps promote the growth of beneficial gut bacteria and thereby decreases the population of harmful bacteria. Pectin is a soluble fiber.

A study in Japan showed that participants who ate two apples per day for two weeks significantly increased their count of *Bifidobacteria* and *Lactobacillus*. Researchers concluding their findings indicated that “apple consumption is related to an improved intestinal environment, and apple pectin is one of the effective apple components” involved in this process.¹³

It is important to note that the Dietary Guidelines for Americans (DGAC) believes that gut microflora do play a role in health, but insufficient evidence was available for the DGAC committee to make dietary recommendations for Americans regarding prebiotics or probiotics. This is an emerging area of research.

In the U.S., products that contain at least 10 percent of the daily value or 2.5 grams of fiber per serving can claim they are a “good source of fiber,” and those containing at least 20 percent of the daily value of fiber or 5 grams or more of fiber per serving can label the product with a high fiber claim. Many of Tree Top’s fruit ingredients are a good or high source of fiber.

- Tree Top’s drum-dried apple powder contains 13 to 15 grams of fiber per 100 grams of product.
- Tree Top’s concentrated blueberry purée contains 5 to 6 grams of total fiber per 100 grams, including soluble and insoluble fibers.
- Tree Top’s single-strength purées contain one to two grams of fiber per 100 grams for most fruits, including soluble and insoluble fibers.

A Vitamin C Story

Readily available in most fruits and vegetables, vitamin C plays a critical role in brain function. This micronutrient is used to repair oxidative damage caused by free radicals. It also is used to generate the neurotransmitter norepinephrine. The general function of norepinephrine is to mobilize the brain and body for action. In the brain, norepinephrine will increase alertness and vigilance.¹⁴ It assists the forming and recall of memory and focuses attention. In the rest of the body, norepinephrine increases blood pressure, triggers the release of glucose from stored forms and increases blood flow to our muscles.

Since our human metabolic systems cannot generate vitamin C, we are dependent on a constant supply of dietary sources to maintain all of these critical activities. Men should consume 75 to 90 mg per day, while women need between 65 and 120 mg per day.

Although most fruits contain some vitamin C, guavas, strawberries, blackberries and citrus fruits have the highest concentration of this crucial vitamin. Tree Top is primarily involved with berry fruits grown in the U.S. Northwest Naturals, a wholly-owned subsidiary, offers more of the tropical fruit varieties like guava.

B for Better Health

The B-complex vitamins play critical roles in building strong neural networks, maintaining white brain matter, and balancing the chemicals that make up the communication system for our nervous systems. Cognitive decline and dementia have been associated through multiple studies with low and suboptimal levels of B-vitamins.¹⁵ The B vitamins found in fruits are B1, B2, B6 and folic acid. For example, fruits with higher levels of B6 include bananas, guavas, mangos, tangerines, pineapples and pomegranates. *See fig. 4*

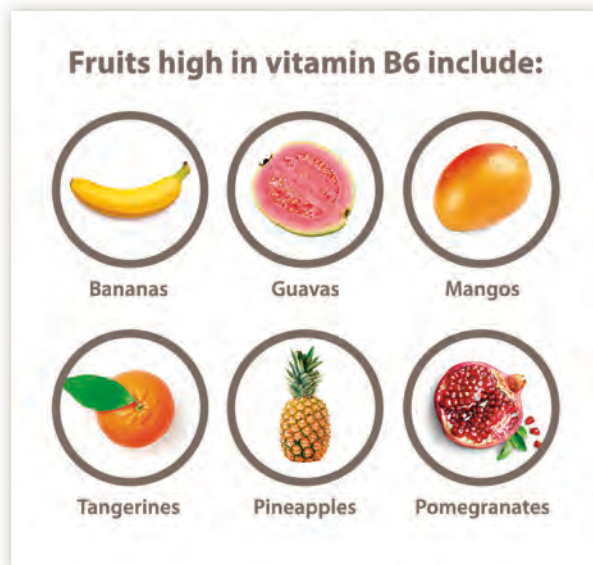


fig. 4

- Thiamine — Vitamin B1 is important because it assists in metabolism of carbohydrates, lipids and amino acids. Decreased levels of thiamine can lead

- to nerve degeneration in the arms and legs.
- Riboflavin — Vitamin B2 is essential for the production of red blood cells. Although the best sources of this vitamin are found in leafy green vegetables, nuts, eggs and other food categories, a few fruits supply small amounts as well.
 - Pyridoxine — Vitamin B6 is concentrated in the brain at levels 100 times the rest of the body. It is required for the generation of many of the neurotransmitters, including serotonin, dopamine, GABA and norepinephrine. Deficiency can lead to brain fog, irritability and depression.
 - Folic acid — Studies with older women have shown that eating diets high in folate, containing fruits and vegetables has slowed the generation of beta-amyloid plaques in the brain which reduce the transmission of signals between brain cells and eventually kills them off. Keeping folate levels high every day will provide the maximum benefit to slowing the decline of attention, decision making and reasoning.

Tree Top's product development team is often tasked with creating blends of fruits to meet a specific customer need whether that be for color

or flavor enhancement, or for their nutritional properties. Cognitive health is a newer category for the company, but one that is growing steadily.

There's always been a "healthy halo" around the benefits of fruit consumption, and now adding to its repertoire of goodness is the possibility of formulating products that target brain health. Look to the category of berry fruits for phytochemicals that aid with cognition. Bananas, pomegranates, pineapples, apricots, blueberries and strawberries all contain varying amounts of vitamin B. Fruits high in vitamin C include guava, strawberries, blackberries and citrus fruits. And many fruits can contribute a good source of fiber including raspberries, blackberries, pears and apples.

Whether developing products to assist with brain health or any other type of application, Tree Top's research and development team can help you achieve your product goals. We specialize in all forms of fruit and can offer decades of experience working with customers to aid with product development for a wide variety of applications.

Bios

Becky Douglas, Senior Food Scientist

Becky Douglas joined the Tree Top team in 2017. Prior to her transition to her current role, Becky spent the past 10 years specialized in food manufacturing process and package systems. She holds a bachelor's degree in Chemical Engineering from Oregon State University. More recently, her career has focused on the science of fruit, and the processes used to convert it into delicious ingredients. Becky is serving our industry with innovative solutions by tapping into her diverse processing expertise and scientific approach to all fruit matters. When Becky isn't pondering the next fruit solution, she enjoys gardening with her husband.

Doug Webster, Director of Research and Development

Doug Webster has been with Tree Top, Inc. since 2000 and is currently Director of Product Development. In this role, he leads a research and development team, creating custom fruit solutions for customers of Tree Top. Doug earned a bachelor's degree in biology at Western Washington University and a Master of Science in food science from Washington State University. After completing his masters, he moved to the Yakima Valley, focusing his endeavors in the hop, wine and fruit industries. Doug is a winemaker, and until recently, owned his own winery. He now only makes wine for family and friends.

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