

# You Are What You Eat: How Food Affects Your Mood

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For thousands of years, people have believed that food could influence their health and well-being. Hippocrates, the father of modern medicine, once said: "Let your food be your medicine, and your medicine be your food" (1). In medieval times, people started to take great interest in how certain foods affected their mood and temperament. Many medical culinary textbooks of the time described the relationship between food and mood. For example, quince, dates and elderberries were used as mood enhancers, lettuce and chicory as tranquilizers, and apples, pomegranates, beef and eggs as erotic stimulants (1). The past 80 years have seen immense progress in research, primarily short-term human trials and animal studies, showing how certain foods change brain structure, chemistry, and physiology thus affecting mood and performance. These studies suggest that foods directly influencing brain neurotransmitter systems have the greatest effects on mood, at least temporarily. In turn, mood can also influence our food choices and expectations on the effects of certain foods can influence our perception.



Figure Chocolate is a powerful mood enhancer.

## Complex Mood-Food Relationships

The relationship between food and mood in individuals is complex and depends "on the time of day, the type and macronutrient composition of food, the amount of food consumed, and the age and dietary history of the subject" (2). In one study by Spring et al. (1983), 184 adults either consumed a protein-rich or carbohydrate-rich meal. After two hours, their mood and performance were assessed (3). The effects of the meal differed for female and male subjects and for younger and older participants. For example, females reported greater sleepiness after a carbohydrate meal whereas males reported greater calmness. In addition, participants aged 40 years or older showed impairments on a test of sustained selective attention after a carbohydrate lunch. Furthermore, circadian rhythms influence our energy levels and performance throughout the day. "Early birds" feel most productive the first part of the day and their food choices become particularly important during lunch and throughout the afternoon. "Night Owls" feel most energetic later in the day and should pay attention to their breakfast choices as they can increase or decrease energy levels and influence cognitive functioning. For example, according to Michaud et al. (1991), if you are an evening person and you skip breakfast, your cognitive performance might be impaired. A large breakfast rich in protein, however, could improve your recall performance but might impair your concentration (4). This illustrates the complexity of relationships between food and mood and the need to find a healthy balance of food choices.

## **The Serotonin Theory: the effects of carbohydrates and protein**

Serotonin is an important neurotransmitter that the brain produces from tryptophan contained in foods such as “clams, oysters, escargots, octopus, squids, banana, pineapple, plum, nuts, milk, turkey”, spinach, and eggs (1). Functions of serotonin include the regulation of sleep, appetite, and impulse control. Increased serotonin levels are related to mood elevation. Wurtman and Wurtman (1989) developed a theory suggesting that a diet rich in carbohydrates can relieve depression and elevate mood in disorders such as carbohydrate craving obesity, pre-menstrual syndrome, and seasonal affective disorder (SAD) (5). They theorized that increased patients’ carbohydrate intake associated with these disorders represented self-medicating attempts and that carbohydrates increased serotonin synthesis. A protein rich diet, in contrary, decreases brain serotonin levels.

The synthesis of serotonin in the brain is limited by the availability of its precursor tryptophan. The large amino acids such as tryptophan, valine, tyrosine, and leucine share the same transport carrier across the blood-brain barrier (1). The transport of tryptophan into the brain is “proportional to the ratio of its concentration to that of the sum total” of the other large amino acids since they compete for available transporters (1). Eating foods high in protein increases the amount of many amino acids in the blood but not of tryptophan, which is only found in low doses in dietary protein. Therefore, many large amino acids compete with a small amount of tryptophan for transport into the brain, meaning that less tryptophan is available for serotonin synthesis. Consuming foods high in carbohydrates can also change amino acid levels in the blood. As blood glucose levels rise, insulin is released and enables

muscle tissues to take up most amino acids except for tryptophan, which is bound to albumin in the blood. As a result, the ratio of tryptophan relative to other amino acids in the blood increases, which enables tryptophan to bind to transporters, enter the brain in large amounts, and stimulate serotonin synthesis (5).

The potential of increased carbohydrate intake to treat depression, pre-menstrual syndrome and SAD remains small, however. Benton and Donohoe (1999) found that only a protein content of less than 2 percent of a meal favored the rise in serotonin levels. Foods high in carbohydrates such as bread and potatoes contain 15 percent and 10 percent of calories, respectively, that come from protein thereby undermining the effects of carbohydrates on serotonin levels (5).

In addition, “carbohydrate craving” is not an accurate description to describe the craving for foods such as chocolate, ice cream, and other sweets. Although people might think that these foods are high in carbohydrates because of their sweet taste, most of the calories come from fat and contain enough protein to undermine any effect of carbohydrates on serotonin levels (6). Rather, taste preferences for sweets seem already present at birth. For example, the facial expressions of newborns indicate a positive response to sweet stimuli and a negative response to bitter stimuli (7). The innate preference for sweet-tasting foods might have adaptive value since bitter tastes could indicate the presence of toxins and sweetness signals a source of energy in the form of carbohydrates.

### **The effects of chocolate**

Chocolate has a strong effect on mood, generally increasing pleasant feelings and reducing tension.

Nevertheless, some women, especially those trying to lose weight, experience guilt after eating chocolate (8).

Many people consume chocolate when they are in negative moods such as boredom, anger, depression and tiredness, experience stress, or are in a particularly happy mood. Furthermore, many women label themselves as “chocoholics,” which led researchers to examine the effects of psychoactive substances in chocolate that potentially could create a drug-like addiction (6). Chocolate contains a number of potentially psychoactive chemicals such as anandamines which stimulate the brain in the same way as cannabis does, tyramine and phenylethylamine which have similar effects as amphetamine, and theobromine and caffeine which act as stimulants (6). Nevertheless, these substances are present in chocolate in very low concentrations. For example, 2 to 3g of phenylethylamine are needed to induce an antidepressant effect, but a 50g chocolate bar only contains a third of a milligram (6). In 1994, Michener and Rozin conducted an important experiment, which showed that the sensory factors associated with the consumption of chocolate produce the chocolate cravings rather than psychoactive substances. Participants were supplied with boxes that contained either milk chocolate, white chocolate, cocoa powder capsules or white chocolate with cocoa and instructed to eat the contents of one box when they experienced a craving for chocolate. If the chemicals in chocolate produced the craving, the intake of pure cocoa would satisfy it. Interestingly, only milk chocolate could alleviate the desire for chocolate. White chocolate was not as effective and adding cocoa to white chocolate did not alter the results. Cocoa powder could not satisfy the craving at all. The unique taste and feel of chocolate in the mouth is responsible for the chocolate

craving (8). Therefore, chocolate can serve as a powerful mood enhancer.

### **Caffeine: a psychoactive drug**

Caffeine, mostly consumed in the form of coffee and tea, has stimulant effects enhancing alertness, vigilance, and reaction time but also increases anxiety in susceptible individuals. It is the most commonly used psychoactive substance in the world with an estimated global consumption of 120,000 tonnes per year (7). Caffeine blocks adenosine receptors in the brain and can relieve headaches, drowsiness and fatigue. Short-term caffeine deprivation in regular users can lead to withdrawal symptoms (7).

Personality might determine caffeine use. For example, evening people who have difficulty getting up in the morning can improve their alertness and energy levels through caffeine. Contrarily, caffeine can cause unpleasant effects in people who have high levels of anxiety.

### **Omega-3 fatty acids**



*Fish oil pills are sold as Omega-3 fatty acid supplements*

Omega-3 fatty acids can influence mood, behavior and personality. Low blood levels of polyunsaturated omega-3 fatty acids are associated with depression, pessimism and impulsivity, according to a study by the

University of Pittsburgh Medical Center (9). In addition, they can play a role in major depressive disorder, bipolar disorder, schizophrenia, substance abuse and attention deficit disorder. In recent decades, people in developed countries have consumed greater amounts of omega-6 polyunsaturated fatty acids, contained in foods such as eggs, poultry, baked goods, whole-grain bread, nuts, and many oils, that outcompete omega-3 polyunsaturated fatty acids. Especially docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), both members of the omega-3 fatty acid family, contribute to the fluidity of the cell membrane thereby playing an important role in brain development and functioning (10). Omega-3 fatty acids are found in fish, other seafood including algae and krill, some plants, meat, and nut oils. Many foods such as bread, yogurt, orange juice, milk, and eggs are oftentimes fortified with omega-3 fatty acids as well.

## **Micronutrients**

### *Thiamine*

According to one study by Benton and Donohoe (1999), insufficient amounts of thiamine or Vitamin B1 caused “introversion, inactivity, fatigue, decreased self-confidence and generally poorer mood” in participants (5). Improved thiamine status increased well-being, sociability, and overall energy levels. Thiamine is contained in foods such as cereal grains, pork, yeast, potatoes, cauliflower, oranges, and eggs and can influence mood states. Thiamine deficiency is very rare in the United States, however.

### *Iron status*

Iron deficiency represents one of the most common nutritional problems in both developing and developed countries affecting over 2 billion people worldwide. Iron deficiency anemia can result in depressed mood, lethargy and problems with attention (5). A low iron

status is most common among women, children, vegetarians, and people who follow a diet. Iron deficiency also results in a decreased ability to exercise. Foods rich in iron include liver, vegetables such as broccoli, asparagus, and parsley, seafood, iron-fortified grains, greens, nuts, meat, and dried fruits.

### *Folic acid*

Besides helping in the prevention of neural tube defects, folic acid also plays an important role in the brain. Folic acid deficiency, which is rare in the general population, is associated with depressed mood. Psychiatric patients are particularly at risk for developing folic acid deficiency because of possible disordered eating habits caused by a loss of appetite and anticonvulsant drugs, which inhibit folic acid absorption (6). Foods rich in folic acid include dark, leafy green vegetables, liver and other organ meats, poultry, oranges and grapefruits, nuts, sprouts, and whole wheat breads.

## **Food effects on emotions**

Studies have found that diets low in carbohydrates increased feelings of anger, depression, and tension and diets high in protein and low in carbohydrates increased anger (6). Diets high in carbohydrates have a generally uplifting effect on mood.

### *Mood effects on food choice*

As much as food can affect our mood, our mood can also affect our food choices. In a study by Macht (1999), female and male participants were asked to report how their eating patterns changed with emotions of anger, fear, sadness, and joy. When experiencing anger and joy, participants experienced increased hunger as compared to feelings of fear and sadness. Anger increased comfort and impulsive eating, and joy increased eating for pleasure (6). Another study found

that people eat more less-healthy comfort foods when they are sad (11). Participants either watched a happy or a sad movie and were provided with buttered popcorn or seedless grapes throughout the movie. The group watching the upbeat movie consumed significantly more grapes and less popcorn than the group watching the sad movie. In addition, when participants were provided with nutritional information, the sad people consumed less popcorn than the happy people and the happy people did not alter their consumption (11).

#### *Psychological effects of food consumption*

Cognitive factors are often more powerful than physiological factors (6). For example, if a group of dieting individuals is asked to eat foods high in calories, they might experience anxiety and other negative emotions because they are afraid of gaining weight. These effects have nothing to do with the ingredients of the foods themselves.

In addition, learned appetites can also influence our experience of foods. For example, our favorite foods usually trigger positive emotions. Even the smell of food can evoke a strong emotional experience. Furthermore, the situation in which food is consumed

and our past experience with particular foods also affects our emotional response (6, 7). For example, a person who thinks that drinking a cup of coffee will increase alertness might feel more alert even after drinking decaffeinated coffee.

#### *How to maximize the benefits of food on mood*

The perfect diet to enhance mood and optimize performance and health remains unknown. Although abundant research exists on food-mood relationships, the findings of these studies are often generalized and subjective. For example, the ability of carbohydrates to positively influence mood remains controversial. Therefore, it seems best to follow a well-balanced diet rich in protein, moderate in carbohydrates and low in fat since this could generally improve mood and energy levels. This should also ensure the adequate supply of micronutrients such as omega-3 fatty acids, iron, folic acid and thiamine. Furthermore, to avoid the sense of guilt evoked from overindulging in craved foods such as chocolate, the best way is to manage their intake such as including them in small amounts with meals and avoiding them when hungry. In addition, reading the labels before consuming these comfort foods can also deter from overconsumption.

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