

EATING ON PURPOSE:
CREATING RECIPES FROM THE SCIENTIFIC EFFECTS OF FOOD
ON THE MIND AND BODY

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Abstract

The industrial revolution introduced significant advances in the healthcare system, extending average life expectancy through the elimination or control of acute diseases. However, our food system was industrialized as well, replacing fresh foods with processed food products and omega-3 with omega-6 fatty acids in the diet, aggravating chronic disease. As interest in the relationship between nutrition and health has risen among scientific study and in the public, the benefits of eating particular foods has become a hot topic in the media. However, media claims tend to be suggestive and lacking in hard evidence, so my project became an investigation of these suggestions for efficacy in peer-reviewed journal articles. I then compiled the scientific evidence for the effects of food on the mind and body and created purposeful recipes for the conscious eater.

Eating on Purpose

Nutritional neuroscience is the scientific examination of the relationships between human behavior and nutrition (Lieberman 2005). Investigation in the area of nutritional neuroscience has been prompted by the increasingly epidemic nature of psychological and depressive disorders in the present day. It has been predicted by The World Health Organization that by the year 2020 clinical depression will be the number two disabling disease worldwide, following cardiovascular disease (Pauwels 2008). Stress responses as well as anxiety and depression deteriorate sexual desire, resulting in a lack in libido (especially in women) (Arnett 1986). Stress also disrupts sleep, causing insomnia, for which 30% of adults reported at least one symptom, and 10% reported daytime impairment in a 2007 study (Roth 2007). The number of children taking medication for

attention deficit-hyperactivity disorder doubled every 4 years between 1971 and the mid-1980s and more than doubled between 1990 and 1995 (LeFever 1999). Modern technology has evolved to encourage multitasking and coddle the ever shortening attention spans of persons in the twenty-first century. Since the speedy decline in psychological health has accompanied our rapidly changing lifestyle, it is plausible that the cause is rooted in environmental, rather than genetic, factors, inspiring research on the role of diet in psychological health. Measured effects of diet on the brain and behavior include both acute effects, which are manifested directly upon absorption, and chronic effects, which are the cumulative result of long-term dietary patterns. This analysis will concentrate on the more immediate effects of foods in the diet, focusing on acute, rather than long term dietary and behavioral relations. Bioactive food components can acutely alter the regulation of appetite, mood, and sleep, as well as affect cognitive performance and memory via the nervous system. This examination of the function of whole foods in the diet contrasts with supplementation and psychopharmacology in that it regards the therapeutic effects of a consciously composed diet. Instead of replacing the diagnostic administration of pills, diet is best utilized as a complimentary supplementation to treatment with the advantage of proven scientific evidence without the side-effects that come with drugs.

The Underlying Science: Sending Messages in the Nervous System

The nervous system is composed of a network of nerve cells called neurons. These neurons transmit electrical signals produced by chemical or charge interactions at the synapse: where the axon end of the pre-synaptic cell meets the dendrite

end of the post-synaptic cell (Purves 2008). As the axon sends signals, it synapses onto the dendrite which is branched for the reception of signals (See **Figure 1**). Signals transmitted by neurons can be electrical or chemical.

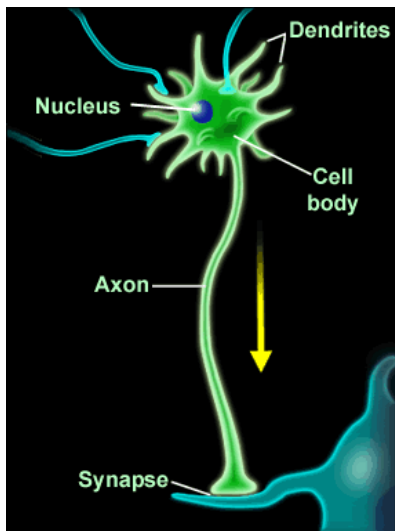


Figure 1. Components of a neuron

Neurotransmitters

The most common type of signal in the nervous system is sent via chemical synapses (Purves 2008). In chemical synapsing, neurotransmitter molecules containing synaptic vesicles are transmitted. These neurotransmitters found in the transported vesicles are the chemical signals which act as messengers between the communicating neurons (Purves 2008). In order for a message to be relayed between neurons, neurotransmitters must be present within the presynaptic neuron and released in response to the presence of calcium ions. Additionally, specific receptors for the neurotransmitters must be present in the post synaptic cell in order to receive the signal.

Neurotransmitter subgroups

There are two classes of neurotransmitters: small molecule neurotransmitters and neuropeptides. The first group consists of diverse molecules typically synthesized in the synaptic bouton, while neurotransmitters of the second group are synthesized in the nerve cell body. Because of their size (3-36 amino acids long), peptide neurotransmitters rarely cross the blood brain barrier to affect behavior. Small-molecule transmitters are more diverse and have versatile functions, and many are able to cross the blood brain barrier and ultimately affect behavior. **Table 1.** organizes some of prevalent small-molecule neurotransmitters.

Table 1. Small molecule neurotransmitters

Neurotransmitter	Subcategory (if applicable)	Postsynaptic effect	Precursor
Acetylcholine		Excitatory	Choline + acetyl CoA
Glutamate	Amino acids	Excitatory	Glutamine
GABA	Amino acids	Inhibitory	Glutamate
Catecholamines (epinephrine, norepinephrine, dopamine)	Biogenic amines	Excitatory	Tyrosine
Serotonin (5-HT)	Biogenic amines	Excitatory	Tryptophan

(Purves 2008)

In addition to the neurological chemicals that are produced in the body, neurotransmission and brain function can be influenced by diet. Some neurotransmitters, or their precursors, which are present in different foods, can be absorbed into the blood during digestion, cross the blood brain barrier, and influence neurotransmitter

function. For example, the neurotransmitter melatonin can be directly found in certain foods (Hattori 1995), and the amino acid tryptophan is a precursor found in multiple food sources. The content levels of tryptophan in various foods can be seen in **Table 2**. Once ingested, your body then converts the tryptophan into serotonin: a multi-functional small-molecule neurotransmitter whose projections to the forebrain regulate sleep and wakefulness. Receptors for these food-supplied neurotransmitters at the blood brain barrier allow for their uptake and resulting influence on behavior.

Table 2. Tryptophan containing foods

Food with tryptophan:	Tryptophan content level per standard serving:
wheat germ	0.4 g/1 cup
granola	0.2 g/1 cup
cottage cheese	0.4 g/1 cup
egg	0.1 g/1 egg
duck	0.4 g/1 cup (1 cup=quarter lb)
turkey	0.37 g/1 cup (1 cup=quarter lb)
chicken	0.28 g/1 cup (1 cup=quarter lb)

(The Healing Nutrients Within by Dr. Eric R. Braverman)

Cherries have efficacy as a sleep aid. In a scientific study, melatonin was proven as a sleep aid at the dose of .1 mg (Dollins 1994) and cherries were shown to contain melatonin (Huang 2011). In addition, ingestion of cherries was shown to increase plasma melatonin concentrations and bind successfully to melatonin receptors at the brain (Hattori 1995). It would then be suggested that sufficient ingestion of cherries would influence physiological processes. This was confirmed in a study which administered 200 g of cherries to adults twice a day and measured parameters of sleep duration and quality (Garrido 2010).

Of course, there are various factors which affect the regulation of brain activity. Complex carbohydrates are a favorable food source in the evening because they

contain an abundance of the amino acid L-tryptophan, which produces serotonin and leads to a sense of satiety and relaxation. Alternatively, protein contains the amino acid L-tyrosine, which produces norepinephrine and dopamine, leading to a state of elevated alertness (Pierce 2000). Thus, in respect to decreasing brain activity and promoting relaxation favorable for sleep, one would want to consume pure carbohydrates or another source high in tryptophan, but low in protein for dinner. This means one would want to avoid eating meat sources of tryptophan, as the effects would be negated by the opposing amino acid, L-tyrosine, which is found alongside tryptophan in meats.

Evaluating Nutritional Neuroscience

Since the acute effects of food influence aspects of cognitive performance and mood, including memory, mental energy, stress relief, depression, and anxiety, they are quantified using behavioral end points. One method of behavior research involving mood evaluation in nutritional neuroscience utilizes the questionnaire Profile of Mood States (POMS) (Lieberman 2005). Scales measured on the self-report style POMS questionnaire include vigor, fatigue, tension, depression, anxiety, anger, and overall mood state. The Cognitive Performance Assessment uses tests similar to those used in psychopharmacology (Lieberman 2005). Testers perform tasks to assess a specific behavioral parameter measuring either memory, vigilance, or learning.

The Venture: Separating Food Science from Food Hype

Since the suggestion of potential health benefits in certain foods can all too easily become the sensation story of the week, my project became a creative investigation of the allegations which reach the public through secondary and tertiary sources. From age-old stories of alleged aphrodisiacs to present daytime television shows suggesting a link between peppers and pain modulation, the hearsay on the potential functionality of food in the media is endless. As a habitual reader of current health articles and information via online articles, magazines, books, and the occasional television show, I am continually presented with wonderful suggestions about the potential of food with no hard evidence to back it up. Thus came the development of the investigation: taking leads from media claims and perusing databases for peer-reviewed journal articles for scientific support.

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I expected some functionalities of food, such as the cognitive benefits of omega-3 fatty acids, since I had come across the suggestion of such a correlation in so many sources. However, I was surprised to find broader correlations, such as that between cognitive performance and mood, linked by the underlying anti-inflammatory effect of these foods.

An inclusive summary of the effects of studied foods on behavior from which I constructed recipes is displayed in the following table.

Table 3. Overview of ingredients and their functionalities.

Source	Active Compound	Amount**	Effects	Reference
Maca root (<i>Lepidium meyenii</i>)	unknown	3.5g/day (1tsp=4g)	decreased anxiety, antidepressant	Brooks et al., 2008
	unknown	2.4g/day (1tsp=4g)	aphrodisiac properties concerning psychological and social performance improvements in male sexual behavior	Zenico et al., 2009
	unknown	3.5g/day (1tsp=4g)	increased sexual desire, antidepressant, anti-stress, decreased anxiety, improved energy, improved memory (due to decrease in acetylcholinesterase)	Gonzales et al., 2009
Citrus Fragrance	volatile terpenes (ie., citral, limonene),		antidepressant (more effective than antidepressant pills without side effects and drug-induced mood swings)	Komori et al., 1995
Citrus	quercetin; apigenin		anti-inflammatory*; antidepressant	Szic et al., 2010;
Honey	for memory: acetylcholine & choline ester like compounds	3Tbsp/day (10% caloric diet)	decreased anxiety, anti-inflammatory* (favorable for mood and cognition), improved memory	Chepulis et al., 2009
Fava bean	L-dopa	250g/day (1.5 cups)	improved mood	Rabey et al., 1992
Salmon, Walnut, Flax	omega-3 fatty acids EPA & DHA	(1.3 oz walnuts)	Anti-depressant; Anti-stress, improved cognition; improved neurotransmission (due to increased fluidity)	Parker et al., 2006; Bourre et al., 2005; Pauwels et al., 2008
Cinnamon scent	unknown		increased sexual desire	Krychman et al., 2007
Ginger	unknown		anti-inflammatory*	Butt et al., 2011
Turmeric	Curcumin		Anti-inflammatory*; improved memory, antidepressant	Szic et al., 2010; Xu et al. 2009
Apples	epicatechin, quercetin		anti-inflammatory*; antidepressant	Szic et al., 2010; Kawabata et al., 2010
Berries	quercetin		anti-inflammatory*; antidepressant	Szic et al., 2010; Kawabata et al., 2010

Spinach	folic acid, folate		anti-inflammatory*	Szic et al., 2010
Garlic	diallyl disulfide		anti-inflammatory*	Szic et al., 2010
Onion	quercetin		anti-inflammatory*, antidepressant	Kawabata et al., 2010
Cherry	Melatonin	400g/day (2.5 cups)	decreased sleep latency, increased sleep duration, decreased awakenings, decreased nocturnal activity, increased immobility, and elevation in assumed sleep	Garrido et al., 2010

*At the biochemical level, depression, anxiety, and deterioration of cognitive performance result from inflammation (Chepulis 2009, Pauwels 2008)

**left blank if association was confirmed but specific amount was irrelevant or unspecified

Recipes

Rise and Shine Citrus Smoothie

2 Tbsp lemon juice
1 cup fresh orange juice or whole orange
2 Tbsp honey
2 Tbsp ground flax
½ cup plain yogurt
1 frozen banana
½ cup ice cubes
1 tsp maca powder

Blend ingredients until smooth for 1 large smoothie and begin your day calm, focused, and in good spirits thanks to the flax, citrus, maca, and honey in this refreshing concoction.

Apple Walnut Salad

2 cups spinach leaves
¼ cup diced onion
¼ cup walnuts
¼ cup diced green apple
½ cup blackberries
2 Tbsp raisins

dressing:

1 Tbsp mustard
1 Tbsp honey
1 Tbsp olive oil
½ tsp lemon juice

Place spinach leaves in a bowl and sprinkle with onion, walnuts, apple, blackberries and raisins. Mix dressing in a separately and then pour over salad as desired.

Compound the mood boosting omega-3 and anti-inflammatories in this recipe with a spritz of citrus in the dressing and quercetin in the apple, berries, and onion.

Sharp Ginger Salmon

2 tsp olive oil
1 Tbsp honey
1 Tbsp Dijon mustard
2 tsp grated fresh ginger
1 lb salmon fillets

Preheat oven to 350 degrees F. In a small bowl, blend olive oil, honey, Dijon mustard and ginger. Brush salmon fillets evenly with the olive oil mixture and place in a medium baking dish. Bake 15-20 minutes in the preheated oven. The fish should flake easily when it is finished.

Looking for an afternoon mood and brain boost? Choose this entrée for lunch and let the omega-3 and anti-inflammatory components go to work.

Carb-up Calm-down Movie Mix

2 cups Wheat Chex cereal
3 cups Corn Chex cereal
2 cups Whole Wheat Pretzels
1 bag fat free popcorn

Mix ingredients of this pure carbohydrate snack mix for an evening hit of calming serotonin.

Beans, the Magical Fruit

3 cups cooked fava beans
2 cups cooked rice
½ onion, diced
1 Tbsp olive oil
1 Tbsp honey
1 Tbsp turmeric
2 tsp minced garlic
1 tsp sea salt

Heat the olive oil and brown onions in a skillet on medium heat. Add the fava beans, turmeric, garlic, honey, and salt. Once the mixture is warm, stir in the rice and cook until thoroughly heated.

The more you eat the better you feel, so eat fava beans at every meal.

Cherry Oatmeal Spell

½ cup quick oats
1 cup cherries
1 cup water
1 tsp cinnamon
Pinch of sea salt

Stir together water, oatmeal, and cinnamon, and microwave on high one minute and 30 seconds. Stir in cherries and microwave another 30 seconds.

To ensure you fall into bed easily, have two bowls for a sweeping dose melatonin and serotonin.

My Honey Brownies

1 cup butter
2 cups dark chocolate chips
3 eggs
1 ½ Tbsp instant espresso granules
1 Tbsp vanilla extract
1 cup honey
½ cup all purpose flour,
3 Tbsp maca powder
½ Tbsp baking powder
1 ½ Tbsp ground cinnamon
1 tsp sea salt

Preheat the oven to 350 degrees and grease a 6 x 9 inch pan. Melt the butter and 1 cup of the chocolate chips in a double broiler. When melted, remove from heat. In a separate bowl, mix eggs, espresso granules, vanilla, and honey. Add the melted chocolate and butter to the mix. In a separate bowl, combine flour, maca powder, baking powder, cinnamon, and salt. Gently stir the dry mixture into the wet ingredients. Pour the batter into the pan and sprinkle with remaining chocolate chips. Bake for 35-40 minutes and then enjoy it hot.

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