Cocoa

Cocoa (derived from the fruit of the cocoa tree --- Theobromoma cacao) has long been reputed to have health benefits. The health enhancement is seen in many metabolic functions --- including those that relate to diabetes, to liver function, to lung function, and to cardiac and vascular function. There are cognitive function and mood enhancement effects attributed to cocoa. Research shows that there is no one component of cocoa conferring all the physical and mental/emotional benefits. Rather, cocoa is loaded with a broad array of metabolically and mentally active compounds.

Research confirms benefits from cocoa for the following conditions/symptoms:

- alertness; attention and psychoactive performance improves
- mental fatigue decreases
- cognitive performance improves
- memory improves
- "food for mood" = increases dopamine activity
- depressive symptoms decrease
- anxiety symptoms decrease
- calmness increases
- study tasks are more interesting
- improves circulation
- dilates coronary arteries
- lowers systolic blood pressure
- raises heart rate
- antioxidant
- anti-inflammatory; regulates inflammatory prostaglandins & cytokines
- improves gut microbiota
- triglycerides decrease
- c-reactive protein decreases
- beneficial metabolic effects & immune-related effects in .....

    - premature aging
    - oxidative stress
    - atherosclerosis
    - diabetes
    - cancer
    - several central nervous system disorders (Parkinson's & Alzheimer's)

- anti-inflammatory in the lungs = suppresses cough
- bronchodilator in asthma
- visual function = contrast sensitivity & motion detection

- insulin sensitivity improves; improves HDL and triglycerides in Type II Diabetes
- Chronic Fatigue Syndrome = improves fatigue, residual function, anxiety & depression

How many of the physical/mental/emotional benefits of cocoa come from its content of the xanthines, theobromine and caffeine?

What benefits derive from the high percentage of medium-chain triglycerides that constitute the caloric content of cocoa?

What benefits derive from the many other psychoactive substances that have been isolated from cocoa?

And finally, how many of the health benefits can be attributed to the extremely high quantity of flavonoids --- principally Catechins and Procyanidins?

Work done by Plaza et al, and presented in an article entitled "Efficient Extraction Method to Determine Polyphenols in Cocoa" in the publication Food Analytical Methods in 2017, shows the following content of cocoa:

--- Theobromine	=	920mg/100g
--- Caffeine	=	18mg/100g

--- Catechin	=	76mg/100g
--- Epicatechin	=	22mg/100g
--- Procyanidine A	=	44mg/100g
--- Procyanidine B	=	20mg/100g
--- Procyanidine B2	=	13mg/100g
--- Procyanidine C	=	10mg/100g
Total Phenolics	=	215mg/100g

Let us first consider the effects of cocoa's two methylxanthines --- caffeine and theobromine. One analysis shows that dark chocolate contains about 30 mg of caffeine and 250 mg of theobromine per 40g chocolate. Both compounds are present in sufficient concentrations to potentially produce psychoactive effects. We must distinguish between the mood-elevating and physiological effects of caffeine vs theobromine in cocoa.

Individuals vary in their sensitivity to caffeine and theobromine, and some of this variability is genetic in origin. To illustrate, individuals vary in the extent to which they experience anxiety after moderate doses of caffeine, and this response is associated with a polymorphism in the A2A receptor gene.

Whether this same polymorphism contributes to variations in responses to theobromine has not been investigated.

A moderate dose of caffeine increases alertness and improves attention and psychomotor performance. At higher doses, and in some individuals at moderate doses, caffeine also causes anxiety and other unpleasant effects. One study shows that 56 mg caffeine can be distinguished from placebo --- which is similar to the amount contained in 100g of dark chocolate. Thus, it is possible that the psychoactive effects of caffeine (as much or more than theobromine) contribute to the mood-elevating appeal of chocolate.

The contributions of theobromine are less clear, and its psychoactive effects appear more subtle. Some studies show no psychological activity at all, yet one study shows that 5 of 7 participates could discriminate 560 mg theobromine from either placebo or from caffeine --- suggesting that theobromine might be about 1/10th as potent as caffeine.

Studies show a tremendous variability in psychoactive responses to theobromine --- such that at a dose causing no reaction in some individuals, others respond with increased alertness, or headache, or irritability --- suggesting the possibility of individual differences in sensitivity.

One study shows that at high dose of 700 mg, theobromine lowers blood pressure, increases self-reported calmness, and increases subjects' rating of how interesting they found performance of study tasks.

There are drug kinetics differences between caffeine and theobromine. Caffeine is water soluble, peaks in the blood 30 – 40 minutes after ingestion, and has a half-life of 2.5 – 7 hours. Theobromine is fat soluble, obtains peak blood concentration 2 – 3 hours after ingestion, and has an estimated half-life of 7 - 12 hours. Caffeine also penetrates the blood–brain barrier more readily.

Theobromine is a more potent cardiac stimulant than caffeine (and was previously used in humans as a dilator of coronary arteries at daily doses of 300 – 600 mg). One report finds that 979 mg theobromine from cocoa, given daily for 3 weeks, lowers systolic blood pressure and raises heart rate. Both theobromine and caffeine are bronchodilators. Theobromine is a vasodilator, while caffeine may be a vasoconstrictor.

Baggott, et al. Psychopharmacology of Theobromine in Healthy Volunteers. Psychopharmacology, 2013. ----- This study monitored the effects of theobromine in doses of 250, 500 and 1000 mg vs placebo and vs a control dose of 200 mg caffeine on mood, cognitive performance, and associated physiological measures.

This study found that theobromine generally lacked caffeine-like self-reported effects, despite the use of a broad range of theobromine doses. Instead, theobromine showed differential effects depending on dose; at 250 mg it showed limited positive effects on mood that became negative at higher doses. It also dose-dependently increased heart rate. Together, these findings suggest that theobromine at normal intake levels as can be found in a standard 40g bar of dark chocolate, may contribute to the positive effects of chocolate.

200 mg caffeine was used as a positive control. This control allowed distinction between the physiological and mood effects of caffeine vs theobromine, since the caffeine and theobromine were administered such that the timing of the caffeine and theobromine administration assured that both reached their peak effect at the same time.

Caffeine produces its typical mostly pleasurable stimulant-like effects on self-reported measures --- including ratings on the Drug Effects Questionnaire (DEQ). These ratings include “feel effects of treatment” and “feel high from treatment” and “like the effects felt” and “want more of the treatment”. Theobromine noted increased scores on the “want more” item on the DEQ at 250 mg, yet at increased doses of 500 and 1000 mg, theobromine dose-dependently increased ratings of “dislike the treatment”, and at the 1000 mg dose produced a response of “feel effects of treatment”.

On the Addiction Research Center Inventory (ARCI), caffeine produced stimulant-like effects analogous to amphetamines and benzedrine, as well as euphoric effects in the same category as morphine-benzedrine. Caffeine also produced positive responses on the anxiety and arousal scales of the Profile of Mood States (POMS). In contrast, theobromine had very few effects on the ARCI and POMS --- the only significant finding being a dysphoric effect on the ARCI.

On the Attention Network Task (ANT) theobromine showed no effects at lower doses, while the highest dose of theobromine actually decreased alertness and slowed response times on the ANT. Caffeine unexpectedly decreased, rather than increased, the alertness index. And as expected, caffeine improved response times and improved the conflict resolution index in the ANT.

--- In summary, the low (250 mg) dose of theobromine produced modest pleasurable effects, not accompanied by other measures of mood or arousal, and did not resemble the effects of caffeine. This study concluded, as have others, that theobromine does not have caffeine-like stimulating properties, and that it may primarily affect peripheral physiology.

The limited psychoactive effects from theobromine are not likely attributable to inadequate dose. The dose is well above those that would be typically ingested from dietary sources --- as in the U.S., individuals in the 90th percentile of theobromine intake are estimated to consume only about 150 mg theobromine daily. To achieve the highest theobromine dose (1000 mg) in this study from chocolate, an induvial would need to consume 3-5 40g bars of dark chocolate.

Physiological effects of caffeine and theobromine were somewhat surprising. Caffeine had no effect on heart rate as compared to placebo. Theobromine dose-dependently increased heart rate. Caffeine increased both systolic and diastolic blood pressure, while theobromine had no effect on blood pressure at any dose (in contrast to other studies showing theobromine lowers systolic blood pressure).

This study also identified several genotypes that are more sensitive to caffeine or more sensitive to theobromine than the overall human population.

One conclusion we can draw from this comprehensive study by Baggott is that the mood elevation from cocoa is not solely dependent on its theobromine and/or caffeine content.

Tuenter E, et al. Mood Components in cocoa and chocolate: The Mood Pyarimid. Planta Med, 2018. ----- This study attempts to rank which constituents of cocoa have significant psychopharmacological activities. It attempts to rank the mood and cognition-enhancing effects from more general activities associated with flavanols and methylxanthines, to more specific activities related to minor constituents.

This study makes the point that, “Fermentation and processing may lead to important changes in phytochemical composition from fresh beans to chocolate. Naturally occurring polyphenolics are lost, while Maillard Reaction products are formed. Therefore, the polyphenolic content of commercial cocoa products depends not only the raw material, but also on processing factors. ----- In view of the high degree of variation in composition that can be expected for commercial cocoa and chocolate products --- related to differences in genotype, geographical origin, fermentation, and further processing, it is amazing to see how little attention is paid in many studies to proper characterization of test samples. This creates a high degree of uncertainty about which components might be responsible for positive results, and if negative results may be due to poor quality and low levels of biologically active ingredients of the test materials used.”

So Tuenter, in search for verification that cocoa is indeed “food for mood” found very few studies that analyze the constituents of the cocoa used. ----- In one of the few good quality studies, participants were given 1.4g of cocoa extract per day, containing 140 mg theobromine, and 645 mg total polyphenols, specified

as 414 mg flavanols expressed as catechin, 153 mg epicatechin 15 mg, 99 mg procyanidin B2, 13 mg procyanidin B1, and 134 mg oligomeric procyanidins. The subjects were overweight or obese middle-aged and were on an energy-restricted diet to attempt weight loss.

----- Depressive symptoms were evaluated via questionnaire and were found to be reduced in both the cocoa group and in the control (which might be due to the weight loss). --- Anxiety symptoms were not affected. In the cocoa group, HVA levels were significantly higher than in the placebo group, which is positively correlated with central dopaminergic activity --- and brain dopamine is related to mood. The authors of that study claim that "plasma HVA is a more objective parameter for a psychological status than subjective questionnaire such as the BDI …."

In addition, it should be pointed out that HVA is also a metabolite formed from catechin and epicatechin by microbial conversions in the colon and subsequent liver metabolism, which may also account at least in part for the difference in both groups (--- IMMUNO-SYNBIOTIC is essential for everyone).

In another study, participants received 20g of a chocolate drink containing 500, 250, or 0 mg (placebo) polyphenolic compounds, and all treatments contained 240 mg theobromine and 40 mg caffeine. After 30 days, self-rated calmness and contentedness, but not cognitive performance, were improved for the highest dose of polyphenols (500 mg). Apparently the theobromine and caffeine are not involved in this improved mood. (This is important --- the mood enhancement does not come from the theobromine and caffeine, but rather from the polyphenols.)

Tuenter cites another study in which three cocoa drinks containing low, medium, or high (46 mg, 520 mg, or 994 mg) level of total flavanols, but similar levels of caffeine and theobromine, were administered. Both medium and high dose flavanols acutely reduced mental fatigue and at the same time improved performance during demanding cognitive processes. Since the medium dose was more beneficial than the high dose of flavanols, these affects are attributed to the flavanol fraction rather than to the methylxanthines. It was hypothesized by the researchers that this benefit to mental fatigue and cognitive performance might be related to the well-established effects of flavanols on endothelial function, and to blood flow.

Another cited study compared high flavanol (172 mg) and low flavanol (13 mg) cocoa drinks. Based on MRI, the flavanol-rich cocoa increased blood flow to relevant areas of the brain. However, no effects on behavioral responses were evident.

In another cited study, cocoa drinks with high, intermediate, or low (990 mg, 520 mg, and 45 mg) levels of flavanols and containing similar amounts of macronutrients, minerals, theobromine and caffeine, were administered to elderly subjects with mild cognitive impairment. After 8 weeks their cognitive functions were improved. In the second part of this study, it was tested if regular consumption of the same cocoa drinks improved cognitive performance in elderly people with normal cognitive function --- and yes, it was found that regular consumption of flavanols in cocoa can improve some aspects of cognitive dysfunction related to age. ----- A similar study showed the same findings, but additionally showed by MRI that there was enhanced dentate gyrus function in the brain. ----- And yet another similar study concluded that consumption of cocoa flavanols improves regional cerebral diffusion --- hypothesizing that this may be associated with a beneficial effect on cognitive performance.

In pointing out the many good reasons why cocoa and its constituents have cognitive and mood-related effects, Tuenter points to many other studies showing, "flavonoids or their metabolites interact with particular signaling pathways in the brain, and they have beneficial vascular effects, especially with regard to cerebrovascular blood flow. They reduce neurodegenerative processes and neuroinflammation, and stimulate neurogenesis in the hippocampus (one critical memory center of the brain). In addition, cardiovascular health is closely related to cognitive performance. Epicatechin, the most abundant flavanol in cocoa, displays various beneficial effects on the CNS by stimulating perfusion, angiogenesis, and neurogenesis. It induces changes in neuronal morphology, especially in regions involving memory and learning".

As with so many flavanols, the beneficial physiological effects are dependent as much on secondary metabolites produced by colonic microbiota as from the ingested flavanol. (That is why we emphasize over and over again the importance of Immuno-Synbiotic supplementation.) --- Procyanidins are metabolized in the colon to phenolic acids by intestinal microflora and thus are absorbed. The small phenolic compounds can contribute to mood effects. For example, phenylacetic derivatives are demonstrated to reduce anxiety.

Despite the evidence that cocoa flavanols have cognitive and mood enhancing effects, many studies show that it is unlikely that the flavanols are uniquely responsible for these beneficial effects. Some studies try to attribute the mental/emotional benefits to caffeine, and many of those studies show no benefits. Many studies try to demonstrate that it is theobromine responsible

for the mood-elevating or cognitive effects, and most of those studies fail as well. These effects are well described above in the study by Baggot.

But here is what is interesting --- there are many studies showing that neither caffeine nor theobromine alone consistently contribute to the cognitive and mood enhancing effects of cocoa, but when caffeine and theobromine are combined (as they are in cocoa) those beneficial effects are consistently produced. So, there must be interaction between the theobromine and the caffeine that is involved in the unique psychopharmacological properties of cocoa, rather than the individual substances.

Constituents of cocoa that have not received nearly as much study as they deserve as potential mood elevators are the tetrahydroquinoline alkaloids such as salsolinol. A study by Melzig hypothesis that the dopaminergic activity of salsolinol may play an important role in the mood effects of cocoa. Salsolinol can be present in cocoa up to concentration of 20-25 mcg/g. It is an Alkaloid derived from dopamine and binds to the dopamine D3- receptor. The D3-receptor plays a role in the reward system. In addition, salsolinol has an indirect dopaminergic effect by activating micro-opioid receptors on GABAergic neurons. Even though salsoninol only has poor ability to pass the blood-brain barrier, it is observed that bioavailability is improved by co-effectors that influence their solubility and/or transport --- and some of these co-factors are present in cocoa.

There are also studies showing that the orosensory properties of cocoa can at least partly explain the desire to ingest chocolate, and can contribute to the mood effects.

Another minor constituent of cocoa is clovamide, which shows a structural similarity with rosmarinic acid, a well-known anti-inflammatory phenolic compound. Clovamide does exhibit those same anti-inflammatory properties --- which include inhibition of pro-inflammatory cytokines and of NF-kB activation. However, there is no good evidence that there is sufficient clovamide in cocoa to have any clinical benefit.

Antioxidant and Anti-inflammatory: --- The antioxidant benefits of cocoa flavanols are more and more appreciated as their benefits are better and better quantified. Among the myriad of health-promoting effects derived from antioxidants --- anti-inflammatory actions are among the most critical. Cocoa flavanols inhibit lipid peroxidation (catabolic oxidative damage = Dysaerobic and Sympathetic and Prostaglandin Imbalances). It is shown that flavanols affect production of lipid or lipid- derived molecules regulating the immune response (prostaglandins and cytokines). One recent study shows that dietary cocoa ameliorates obesity-related inflammation in high fat-fed mice.

Cocoa flavanols are key players in the increase of beneficial gut microbes, and the decrease of less beneficial microbiota (such as Clostridia). Cocoa ingestion modifies intestinal microbiota in the same way the prebiotics and probiotics do. Some of the health benefits from cocoa may be due to this indirect mechanism of improving intestinal microbiota --- which extends the effects via the gut-immune axis, gut-brain access, gut-liver access, etc.

One study shows that absorption of cocoa flavanols in the small intestine is limited, and the majority of the flavanols reach the large intestine and metabolized by resident microbiota. Daily consumption of a high flavanol cocoa drink for four weeks significantly increased bifido bacteria and lactobacilli populations while significantly reducing clostridia counts. These changes in microbiota were paralleled by significant reductions in plasma triglycerides and c-reactive protein --- showing beneficial metabolic effects and immune-related effects. Cocoa is shown to affect the same disorders that are linked to gut microbiota --- premature aging, oxidative stress, high blood pressure and atherosclerosis, diabetes, cancer, and several central nervous system disorders.

An important observation is that the interaction between the cocoa polyphenols and the gut microbiota is bidirectional. This means that microbes effect the hydrolysis and enhance absorption of the polyphenols, and at the same time the products of this hydrolysis effect the growth of bacterial species that are present in the intestine. Not only is absorption of the intact flavanol improved by favorable microbiota, but the beneficial microbes also metabolize the flavanols into secondary compounds that often have as much or more beneficial effects on metabolism and on the immune system as the ingested flavanol. [Immuno-Synbiotic is essential!]

Another study shows that the alteration in the intestinal ecosystem by ingesting cocoa effects expression of intestinal Toll-like receptors (TLRs) and leads to a lower level of Immunoglobin A secretion in the intestines --- at the same time there is a decrease in Clostridium, Staphylococcus and Bacteroides species on a cocoa diet.

Lung Function: The theobromine in cocoa suppresses cough without the side effects of anti-tussive drugs such as codeine. Theobromine suppresses cough with no adverse effects. The actions of theobromine appear to be peripherally mediated --- effecting sensory nerve depolarization of the vagus nerve --- suggesting an inhibitory effect on afferent nerve activation. At the molecular level, the anti-tussive effect may be due to blockade of adenosine receptors, or to inhibition of phosphodiesterases, or both. Theobromine has been classed as a non-codeine, non-opioid drug for cough that has successfully completed trials and regulatory review in South Korea --- and there is a product sold as “AnyCough” .

Epidemiological evidence suggests that theobromine and caffeine both improve lung function by stimulating bronchodilation in asthma patients. Studies have demonstrated that patients with asthma and bronchitis may effectively self-administer coffee or cocoa to relieve symptoms.

A further beneficial effect of caffeine and cocoa is on apnea of prematurity --- the common problem affecting premature infants. Methylxanthine therapy is a mainstay of treatment for central apnea by stimulating the central nervous system as well as respiratory muscle function. Caffeine, as a non-selective antagonist of adenosine receptors, may improve minute ventilation, carbon dioxide CO2 sensitivity, diaphragmatic contraction, respiratory muscle function, and neural respiratory drive, while decreasing the hypoxic depression of breathing.

Neuro-Degenerative Diseases: Coffee consumption is associated with a decreased incidence of both Parkinson's Disease and Alzheimer's Disease. The active component in coffee appears to almost certainly be caffeine. This hypothesis fits with the main role of methylxanthines, which is adenosine receptor blockade --- that in the brain results in higher neuronal activity, thereby enabling a longer life for brain cells. The higher neuronal activity may be due to a regulation in the perfusion of the brain and/or an increase in cerebral oxygen consumption. Another potential mechanism for neuro-protection may be an increased cerebrospinal fluid production. ------ There may or may not be enough caffeine from consuming cocoa regularly to have this neuro-protective effect. But, the flavonoids in cocoa also have a neuro protective effect --- both directly, and secondary to metabolites of intestinal microbiota via the gut-brain axis.

One other aspect of neural function that improves with cocoa flavanols is visual function. With a single serving of cocoa containing 720 mg of cocoa flavanols, visual contrast sensitivity improves, and the time required to detect motion direction also improves. These acute effects are explained by increased cerebral blood flow caused by cocoa flavanols, although in the case of contrast sensitivity there may be additional contribution from cocoa flavanols inducing retinal blood flow improvement.

One study reports that short-term administration of dark chocolate is followed by a significant increase in insulin sensitivity, as well as a decrease in blood pressure in healthy persons. This effect is postulated to be due to the flavanols in cocoa, although the involvement of adenosine receptor blockade by the caffeine and perhaps the theobromine cannot be ruled out. A cautionary note is offered, however, that the cocoa or chocolate product must be sugar free --- otherwise the benefits on insulin resistance are easily negated by the sugar.

Cocoa flavanols improve cognitive function in subjects with mild cognitive impairment. Ninety elderly individuals with mild cognitive impairment consumed once daily for eight weeks a drink containing cocoa flavanols (990 mg). Improvements were shown in time required to complete a trail-making test (TMT); verbal fluency test score also significantly improved. Insulin resistance, blood pressure, and lipid peroxidation also decreased. Changes of insulin resistance explained about 40% of the variability throughout the study. It is concluded that the regular consumption of cocoa flavanols might be effective in improving cognitive function in elderly subjects, and that this benefit is mediated in part by improvement in insulin sensitivity.

Brickman AM, et al. Enhancing Dentate Gyrus function with dietary flavanols improves cognition in older adults. NAT NEUROSCI, 2014. --- From the abstract: The dentate gyrus (DG) is a region in the hippocampus whose function declines with aging, and is therefore considered to be a possible source of age-related memory decline. Causal evidence is needed, however, to show that DG-associated memory decline in otherwise healthy elders can be improved with interventions that enhance DG function. We address this issue by first using a high-resolution variant of MRI to map the precise site of age-related DG dysfunction and to develop a cognitive task whose function localized to this anatomical site. Then in a controlled randomized trial, we applied these tools to study healthy 50-69- year-old subjects consuming a high cocoa flavanol beverage for three months. A high-flavanol intervention was found to enhance DG function as measured by MRI and cognitive testing. Our findings establish that DG dysfunction is a driver of age-related cognitive decline, suggesting cocoa flavanols as a non-pharmacological means for its amelioration.

Flavanol-rich cocoa acutely improves arterial function and memory performance --- counteracting the effects of sleep deprivation. ----- Sleep deprivation is a risk factor for cardiovascular disease. Cocoa flavonoids exert cardiovascular benefits and neuro-protection. One study finds that sleep deprivation increases both systolic and diastolic blood pressure. Systolic and diastolic blood pressure and pulse pressure are lower in sleep-deprived individuals after cocoa flavonoid treatment. Sleep deprivation impairs flow-mediated vascular dilation, while flavanol-rich cocoa counteracts this failure of vascular dilation. Flavanol-rich cocoa also mitigates the pulse-wave velocity increase associated with sleep deprivation. The flavanol-rich cocoa also preserves working memory accuracy after sleep deprivation, and flow-mediated dilation correlates with working memory performance accuracy --- indicating that the benefits of coca flavonoids on blood pressure and cognitive performance are associated with peripheral and central blood flow.

Vauzour D, et al. The neuro-protective potential of flavonoids: A multiplicity of effects. Genes Nutr, 2008. ----- From the abstract: flavonoids exert a multiplicity of neuro protective actions within the brain, including a potential to protect neurons against injury induced by neuro toxins, and ability to suppress neuro-inflammation, and the potential to promote memory, learning, and cognitive function. These effects appear to be under pinned by two common processes. First, they interact with critical protein and lipid kinase signaling cascades in the brain, leading to inhibition of apoptosis triggered by neuro-toxic species, and to a promotion of neuronal survival and synaptic plasticity. Secondly, they induce beneficial effects on the vascular system, leading to changes in the cerebrovascular blood flow capable of causing angiogenesis, neurogenesis, and changes in neuronal morphology.

Through these mechanisms, the consumption of flavonoid-rich foods throughout life holds the potential to limit neuro-degeneration and to prevent or reverse age-dependent losses in cognitive performance.

Mellor DD, et al. High-cocoa polyphenol-rich chocolate improves HDL cholesterol in Type 2 Diabetes. Diabet Med 2010. ----- Subjects received 45g chocolate with or without high polyphenol content for 8 weeks, then crossed over after a 4 week wash out period. The high polyphenol chocolate increased HDL significantly, decreased total cholesterol, and increased the HDL to total cholesterol ratio significantly. There was no benefit from the low polyphenol chocolate.

Sathyapalan T, et al. High cocoa polyphenol-rich chocolate may reduce the symptoms in Chronic Fatigue Syndrome. Nutr J 2010. ----- High polyphenol chocolate was compared to simulated iso-caloric chocolate (cocoa liquor low in polyphenols) on fatigue and residual function in subjects with Chronic Fatigue Syndrome (CFS). After 8 weeks on the high polyphenol chocolate (a 15g foil-wrapped bar three times daily --- these bars were 75% fat, 20% carbohydrate, and 5% protein ….

- The Chalder Fatigue Scale score improved significantly.

- Residual function, as assessed by the London Handicap Scale improved significantly.

- The Hospital Anxiety and Depression score improved significantly.

All these three improvements deteriorated very quickly when switched to the low polyphenol chocolate --- and actually, the fatigue scale, the anxiety scale, and the depression scale all became worse than at baseline.

It is also interesting to note that even though the high polyphenol chocolate added 245 daily calories to each subject, there was no weight change after 8 weeks. Anecdotally, 2 subjects were able to return to work after having missed work for 2 years due to CFS.

The authors in the study point out that anandamide (a name that comes from the Sanscrit word for "bliss" --- and has a structural similarity to THC and CBD from marijuana), and other related compounds are found in cocoa. There are also compounds in cocoa such as n-acylethanolamines that block the breakdown of anandamide in cocoa.

These and other studies also note that several biological systems have been implicated in CFS, and there is mounting evidence that oxidative stress contributes to the disease process and to some of the symptoms of CFS. Cocoa is extremely high in flavonoids that have a protective effect on cells, including neuronal cells, from oxidative stress. In cocoa, these include epicatechin, catechin, and several procyanidins.

----- Another study --- published in Nature in 1996 by Ditumaso, et al --- was entitled Brain Canabanoids in Chocolate. --- These and other studies show that consumption of high polyphenol cocoa increases brain neurotransmitters phenylethylamine, serotonin, and anandamide.

BROWN COCOA RECIPE

Baking Cocoa	2 rounded Tablespoons (about 1500 mg)
Knox Gelatin	1 package
Cinnamon	3 or 4 “shakes” (or more)
Salt	a pinch (or more; or much more)
Coconut Oil	1 teaspoon
Dextrose	(Optional = zero – 2 Tablespoons)

1. Place all ingredients except the coconut oil in a mug, and stir them together (= helps prevent clumping of the gelatin).

2. Bring 9 ounces of water to a rolling boil and pour over the dry ingredients.

3. Immediately and thoroughly cut and stir.

4. Add the coconut oil and stir again.