“Energy” Drinks

The other 6 pack

Notice of Copyright and Limitations on Use and Liability

- "Copyright 2007, State of Minnesota, Department of Human Services"
- "This curriculum was written by the Minnesota Department of Human Services for use in its training regarding effects of stimulant beverages. The curriculum was designed for the specific purposes that may or may not apply to other locations, and may require modifications of content and/or form before it can be used in other jurisdictions. The Minnesota Department of Human Services makes no representations and accepts no liability on its use or results. This curriculum is made available free as part of training provided by the Minnesota Department of Human Services and is available for personal use by a single requestor for a nominal fee, which covers the cost of making, certifying, compiling and copying the materials. Any use of this curriculum for other than personal use requires a licensing agreement with the department. This curriculum may not be sold, used, or reproduced for profit or financial gain. Those accessing or copying this document agree to be bound by the aforementioned limitations on its use."

Presented by Rick Moldenhauer, MS, LADC, ICADC, LPC
Treatment Services Consultant/State Methadone Authority
P: (651) 431 2474
F: (651) 431 7449
Chemical Health Division, DHS
444 Lafayette Road
St Paul, Minnesota 55164-0977
richard.moldenhauer@state.mn.us
High Fructose Corn Syrup

- Developed in the 1970s, enzymatic action with corn starch
- Cheaper to make, easier to blend (liquid), ship and longer shelf life (J Am Diet Assoc 2002; 102:351)

- Sucrose = fructose + glucose
- Unlike sucrose, HFCS consists of a mixture of glucose and fructose, which doesn't require an enzymatic step (sucrase) to break it down before absorption in the intestine.

Disaccharide

- **Sucrose** (table sugar)
  - C12H22O12
  - Broken down by sucrase to form fructose and glucose in the intestine and absorbed

- **Lactose** (milk sugar)
  - C12H22O11
  - Broken down by lactase to form galactose and glucose in the intestine and absorbed

Monosaccharide

- **Fructose** (Fruit Sugar)
  - C6H12O6
- **Glucose** (Dextrose) (blood sugar)
  - C6H12O6
- **Galactose** (brain sugar)
  - C6H12O6
Fructose is predominantly metabolized in the liver.
Unlike glucose, does not require insulin to be used by the body.
Discourages adipose generation of leptin.

Because it does not generate insulin or leptin: “this suggests that dietary fructose may contribute to increased energy intake and weight gain.”-Am J Clin Nutr 2004 79:537-43

High blood glucose levels or repeated glycemic “spikes” following a meal may promote type 2 diabetes and coronary heart disease by increasing oxidative damage to the vasculature and also by the direct increase in insulin levels. [1] In the past, post-meal hyperglycemia has been a risk factor mainly associated with diabetes, however more recent evidence shows that postprandial hyperglycemia presents an increased risk for atherosclerosis in the non-diabetic population. [2]

1) Temelkova-Kurktschiev et al (2000). “Postchallenge plasma glucose and glycemic spikes are more strongly associated with atherosclerosis than fasting glucose or HbA1c level.” Diabetes Care 2000 Dec;23(12):1830-4

• Stearoyl-CoA desaturase 1 (SCD1) gene;
• SCD-1 makes an enzyme that inserts a double bond into an unsaturated fatty acid. The result is a saturated fat, which can be stored in the rodent equivalent of spare-tire bulge.

• Removal of SCD1 inhibits storage of carbo/sugar as adipose tissue
• “These findings are telling us that the liver is a key tissue in mediating weight gain induced by excess carbohydrates.” Cell Met 2007; 6:484-96

• “Excessive fructose consumption has been shown to induce insulin resistance and impaired glucose tolerance in animal models: both of which are linked to type 2 diabetes.”


Human study

• 21 men and 9 women
• Drank four, 10 oz glasses of HFCS sweetened soft drinks/day for three weeks. (total 840 oz or 24.8 Liters, given 1 L is 33.8 ounces)
• Both male and female showed significant increase in their caloric intake and body weight

• Am J Clin Nutr 1990;51:963-9
Increase in adipose (fat)

- Postmeal glycemia and insulin levels were significantly higher and plasma triglycerides were threefold greater in the high GI fed rats.
- Pancreatic islet cells suffered "severely disorganised architecture and extensive fibrosis". The evidence in this study showed that continued consumption of high glycemic index carbohydrates would likely have led to the development of severe metabolic abnormalities.


http://www.glycemicindex.com/

- Tofu-based frozen dessert, chocolate with high-fructose (24%) corn syrup (USA) USA
  - GI: 115 +/- 14

Dangers

- Tooth decay
- Mood swings
- Hypertension
- Hyperacidity (?)
- Hyperactivity

No Sugar?

- Saccharin “Sweet’N’Low”
- Aspartame “Equal or NutraSweet”
- Sucralose “Splenda”
- Stevia “PureVia and Truvia”
- Sorbitol
- Maltitol
- Xylitol
- Erythritol
CAFFEINE

- Caffiene is a xanthine alkaloid, a stimulant in humans.
- Caffeine is called guaranine when found in guarana, mateine when found in mate, and theine when found in tea.
- It is found in the leaves and beans of the coffee plant, in tea, yerba mate, and guarana berries, and in small quantities in cocoa, the kola nut and the Yaupon Holly.
- Overall, caffeine is found in the beans, leaves, and fruit of over 60 plants, where it acts as a natural pesticide that paralyzes and kills insects feeding upon them.

- Caffeine is the world's most widely consumed psychoactive substance. In North America, 90% of adults consume caffeine daily.

<table>
<thead>
<tr>
<th>Milk Chocolate (6 oz. bar)</th>
<th>25mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expresso, 1 oz shot</td>
<td>40mg</td>
</tr>
<tr>
<td>Brewed tea, 8 oz</td>
<td>50mg</td>
</tr>
<tr>
<td>Coca-cola, 20 oz bottle</td>
<td>57mg</td>
</tr>
<tr>
<td>Red Bull, 8.3 oz can</td>
<td>80mg</td>
</tr>
<tr>
<td>Brewed coffee, 12 oz cup</td>
<td>200mg</td>
</tr>
<tr>
<td>Mountain dew 64 oz “Big Gulp”</td>
<td>294mg</td>
</tr>
</tbody>
</table>

The caffeine in these drinks either originates from the ingredients used or is an additive.

Guarana, a prime ingredient of energy drinks, contains large amounts of caffeine with small amounts of theobromine and theophylline in a naturally occurring slow-release excipient.

- The amount of caffeine necessary to produce effects varies from person to person depending on body size and degree of tolerance to caffeine.
- It takes about 45’ for caffeine to begin affecting the body and a mild dose wears off in three to four hours.
• Caffeine is an ergogenic: increasing the capacity for mental or physical labor.
• Studies have showed a 7% increase in distance cycled over a period of two hours in subjects.
• Trained runners showed a 44% increase in "race-pace" endurance, a 51% increase in cycling endurance, after a dosage of 9 milligrams of caffeine per kilogram of body weight.
• Another study found 5.5 milligrams of caffeine per kilogram of body mass resulted in subjects cycling 29% longer during high intensity circuits.

• Caffeine is sometimes administered in combination with medicines; Caffeine makes pain relievers 40% more effective in relieving headaches and helps the body absorb headache medications more quickly.
• It is also used with ergotamine in the treatment of migraine and cluster headaches as well as to overcome the drowsiness caused by antihistamines.

• Caffeine in large amounts, especially over an extended period of time, can lead to caffeine abuse or dependency; combining physical addiction and mental conditions.
• Because caffeine increases the production of stomach acid, high usage over time can lead to peptic ulcers, erosive esophagitis, and gastroesophageal reflux disease.

Caffeine intoxication

• An acute overdose of caffeine, usually in excess of 250 milligrams, can result in a state of central nervous system overstimulation called caffeine intoxication: restlessness, nervousness, excitement, insomnia, flushing of the face, increased urination, gastrointestinal disturbance, muscle twitching, a rambling flow of thought and speech, irregular or rapid heart beat, hyperreflexia and psychomotor agitation.
• The LD50 of caffeine is dependent on weight and individual sensitivity and estimated to be about 150 to 200 milligrams per kilogram of body mass, roughly 140 to 180 cups of coffee for an average adult taken within a limited timeframe that is dependent on half-life.

T 1/2

• In healthy adults, caffeine’s half-life is approximately 3-4 hours.
• In women taking oral contraceptives, 5-10 hours
• Pregnant women, roughly 9-11 hours.
• Individuals with severe liver disease, 96 hours.
• In infants and young children, longer than in adults;
• Half-life in a newborn baby may be as long as 30 hours.
• Other factors such as smoking can shorten caffeine’s half-life.

• Caffeine is metabolized in the liver into three metabolic dimethylxanthines, which each have their own effects on the body:
  • Paraxanthine (84%) – Has the effect of increasing lipolysis, leading to elevated glycerol and free fatty acid levels in the blood plasma.
  • Theobromine (12%) – Dilates blood vessels and increases urine volume. Theobromine is also the principal alkaloid in cocoa, and therefore chocolate.
  • Theophylline (4%) – Relaxes smooth muscles of the bronchi, and is used to treat asthma. The therapeutic dose of theophylline, however, is many times greater than the levels attained from caffeine metabolism.

• The principal mode of action of caffeine is as an antagonist of adenosine receptors in the brain, called “Competitive Inhibition”.
• The reduction in adenosine activity results in increased activity of the neurotransmitter dopamine, largely accounting for the stimulatory effects of caffeine.
• Caffeine can also increase levels of epinephrine/adrenaline and serotonin, causing positive changes in mood.
**Vitamins**

- Lipid soluble
  - A
  - D
  - E
  - K
- Water soluble
  - B1 (thiamine)
  - B2 (riboflavin)
  - B3 (niacin)
  - B6 (pyridoxine)
  - B9 (folic acid)
  - B12 (cobalamin)
  - Pantothenic acid
  - biotin
  - C (ascorbic acid)

**FDA Threatens Ban on Alcoholic Energy Drinks**

November 13, 2009

- Alcoholic drinks that contain caffeine are facing an imminent ban by the U.S. Food and Drug Administration (FDA) unless manufacturers can clearly show that the products are safe for consumers.
- The New York Times reported Nov. 13 that the FDA, responding to a request from 19 state attorneys general, told 30 makers of caffeinated alcohol drinks that the agency would move to “ensure that the products are removed from the marketplace” unless the manufacturers produce evidence of their safety within the next 30 days. An FDA official said that consumption of alcoholic energy drinks has been associated with high risk for injury, drunk driving, and sexual assaults, especially among college students.
- The agency noted that the use of caffeine in alcoholic beverages has never been approved by the FDA.
- “For many years, federal regulators have stood mute by as these potentially dangerous products, which resemble nonalcoholic energy drinks in many ways, gained in popularity among young people,” said the Center for Science in the Public Interest (CSPI), an activist industry watchdog group.
- “Energy drinks and caffeinated alcoholic beverages are more likely to be the perpetuator or victim of sexual aggression, to ride with an intoxicated driver or to become otherwise injured.”

B1 (Thiamine)

- Plays an important role in helping the body convert carbohydrates and fat into energy.
- It is essential for normal growth and development, maintains proper functioning of the heart and the nervous and digestive systems.
- The only known cases of thiamine overdose occurred with thiamine injections. Thiamine injection may result in anaphylactic reactions.
- The RDA in most countries is set at about 1.4 mg. However, tests on volunteers at daily doses of about 50 mg have shown an increase in mental acuity.

B2 Riboflavin

- Like the other B vitamins, it supports energy production by aiding in the metabolizing of fats, carbohydrates, and proteins.
- Vitamin B2 is also required for red blood cell formation, respiration, antibody production, regulating human growth, reproduction, healthy skin, nails, hair growth, including regulating thyroid activity.
- Any excess is excreted in the urine, frequently imparting a bright yellow color. As the human body does not store riboflavin it is thought deficiency is common.
B3 Niacin

- Also known as nicotinic acid or vitamin B3, is a water-soluble vitamin whose derivatives such as NADH, NAD, NAD+, and NADP play essential roles in energy metabolism in the living cell and DNA repair.
- Large intake increases cold tolerance.

B5 Pantothenic acid

- Also called vitamin B5, is a water-soluble vitamin required to sustain life.
- Pantothenic acid is needed to form coenzyme-A (CoA), and is critical in the metabolism and synthesis of carbohydrates, proteins, and fats.

B6 Pyridoxine

- Pyridoxine is also called vitamin B6, Pyridoxal, Pyridoxamine or ‘Pyridoxine hydrochloride’.
- Pyridoxine assists in the balancing of sodium and potassium as well as promoting red blood cell production. It has been suggested that Pyridoxine might help children with learning difficulties, and may also prevent dandruff, eczema, and psoriasis.

B7 (Vit H) Biotin

- Catalysis of essential metabolic reactions to synthesize fatty acids, in gluconeogenesis, and to metabolize leucine.
- Biotin is used in cell growth, the production of fatty acids, metabolism of fats, and amino acids. It plays a role in the Krebs Cycle, which is the process in which energy is released from food and assists with the transfer of carbon dioxide.
- Biotin is also helpful in maintaining a steady blood sugar level.
### B9 Folic Acid

- Folate is necessary for the production and maintenance of new cells. This is especially important during periods of rapid cell division and growth such as infancy and pregnancy. Both adults and children need folate to make normal red blood cells and prevent anemia.

### B12 Cyanocobalamin

- **Gastrointestinal:** Diarrhea has been reported.
- **Hematologic:** Peripheral vascular thrombosis has been reported. The correction of megaloblastic anemia with vitamin B12 can result in fatal hypokalaemia and gout in susceptible individuals.
- **Leber's disease:** Vitamin B12 is contraindicated in early Leber's disease, which is hereditary optic nerve atrophy. Vitamin B12 can cause severe and swift optic atrophy.

---

- People with type 2 diabetes often have low levels of biotin. Biotin may be involved in the synthesis and release of insulin. Preliminary studies in both animals and people suggest that biotin may help improve blood sugar control in those with diabetes, particularly type 2 diabetes.

- The risk of toxicity from folic acid is low. The Institute of Medicine has established a tolerable upper intake level (UL) for folate of 1,000 µg for adult men and women, and a UL of 800 µg for pregnant and lactating women less than 18 years of age. Supplemental folic acid should not exceed the UL to prevent folic acid from masking symptoms of vitamin B12 deficiency.
• Dermatologic: Itching, rash, transitory exanthema, and urticaria have been reported. Vitamin B12 (20 micrograms/day) and pyridoxine (80mg/day) has been associated with cases of rosacea fulminans, characterized by intense erythema with nodules, papules, and pustules. Symptoms may persist for up to 4 months after the supplement is stopped, and may require treatment with systemic corticosteroids and topical therapy.

• Alcohol (ethanol): Excessive alcohol intake lasting longer than two weeks can decrease vitamin B12 absorption from the gastrointestinal tract.

• Birth control pills: The data regarding the effects of oral contraceptives on vitamin B12 serum levels are conflicting. Some studies have found reduced serum levels in oral contraceptive users, but others have found no effect despite use of oral contraceptives for up to 6 months. When oral contraceptive use is stopped, normalization of vitamin B12 levels usually occurs.

• Nicotine: Nicotine can reduce serum vitamin B12 levels.

• Folic acid: Folic acid, particularly in large doses, can mask vitamin B12 deficiency. In vitamin B12 deficiency, folic acid can produce hematologic improvement in megaloblastic anemia, while allowing potentially irreversible neurological damage to progress.

• Vitamin C is a water-soluble nutrient and human vitamin essential for life and for maintaining optimal health, used by the body for many purposes. It is also known by the chemical name of its principal form, L-ascorbic acid.

• For a similar reaction, vitamin C is required for synthesis of dopamine, noradrenaline and adrenaline in the nervous system or in the adrenal glands.
• Vitamin C causes diarrhea in everyone if taken in quantities beyond a certain limit, which is variable to the individual. This is called the Bowel Tolerance Limit and it is higher in people with serious illness than those in good health. It ranges from 5 to 25 grams per day in healthy individuals to 300 grams per day in the seriously ill persons.
• Large doses of vitamin C may cause acid indigestion (stomach upset), particularly when taken on an empty stomach.

Inositol
• Inositol, is a cyclic polyalcohol that plays an important role as a second messenger in a cell, in the form of inositol phosphates.
• It is classified as a member of the vitamin B complex, though it is not considered a vitamin itself because it can be synthesized by the human body.

Taurine
• Taurine is a derivative of amino acid, cysteine.
• Taurine has also been implicated in a wide array of other physiological phenomena including inhibitory neurotransmission, long-term potentiation in the striatum/hippocampus, membrane stabilization, feedback inhibition of neutrophil/macrophage respiratory bursts, adipose tissue regulation, calcium homeostasis, bile acid synthesis and osmoregulation.
• There is also evidence that taurine in adult humans reduces blood pressure.

glucuronolactone
• Glucuronolactone is a naturally occurring chemical compound produced by the metabolization of glucose in the human liver.
• Glucuronolactone has been shown to improve memory retention and concentration as well as acting as an antidepressant and stimulant. It is present in some energy drinks such as Red Rooster, Red Bull, Rockstar and Pollen Burst. While these drinks contain caffeine, glucuronolactone is included because it is purported to fight fatigue and provide a sense of well-being.
L-Carnitine

- Assists consumption and disposal of fat in the body via the transport of fatty acids from the cytosol into the mitochondria.
- It is often sold as a nutritional supplement.
- Carnitine is biosynthesized in the body from the amino acids lysine or methionine primarily in the liver and kidneys. Vitamin C is essential to this process.
- Carnitine transports long-chain acyl groups from fatty acids into the mitochondrial matrix, so that they can be broken down through beta-oxidation to acetate to obtain energy via the citric acid cycle.
- L-Carnitine improved glucose disposal among 15 patients with type II diabetes and 20 healthy volunteers. [*] Glucose storage increased between both groups, but glucose oxidation increased only in the diabetic group. Finally, glucose uptake increased about 8% for both.


Panax ginseng

- Panax is a genus of about five or six species of slow-growing perennial plants with fleshy roots, in the family Araliaceae.
- Ginseng is promoted as an adaptogen (a product that increases the body’s resistance to stress), a anticarcinogenic and antioxidant, although animal experiments to determine whether longevity and health were increased in the presence of stress gave negative results.
- Panax ginseng's most common side effects are nervousness and excitability. The ability to concentrate may be decreased, and blood sugar may decrease to abnormally low levels (hypoglycemia).
- Because ginseng has an estrogen-like effect, women who are pregnant or breastfeeding should not take it, nor should children. Occasionally, there have been reports of more serious side effects, such as asthma attacks, increased blood pressure, palpitations, and, in postmenopausal women, uterine bleeding. To many people, ginseng tastes unpleasant.
- Ginseng may cause an increased sensitivity to pain.
- Ginseng has been shown to be a stimulus to the body and has been forbidden in some athletic competitions.
Eleutherococcus senticosus

• Eleutherococcus senticosus is a species of small, woody shrub in the family Araliaceae native to Northeastern Asia. It is also called eleuthero, Devil's Shrub and Siberian ginseng, this last name because its herbal properties are similar to those of Panax ginseng.

Eleutherococcus is a powerful tonic Sherb.

• Stimulates resistance to stress and so it is now widely used as a tonic in times of stress and pressure.

• In an alarming situation, the adrenal glands release corticosteroids and adrenaline which prepare the organism for the fight or flight reaction. When these hormones are depleted, the organism reaches an exhaustive phase. Eleutherococcus delays the exhaustive phase and allows a more economical and efficient release of these hormones.

People with high blood pressure should consult their doctor before taking Eleutherococcus.

• Eleutherococcus may cause light sleep in some people. Users are recommended not to take it in the evening.

Mixes with

• Alcohol
• DXM
• Nicoderm patches
Ethyl Alcohol

- Found in alcohol containing beverages. It is metabolized in the liver by alcohol dehydrogenase to make acetaldehyde, then by acetaldehyde dehydrogenase to make acetic acid.
- At higher dosages (BAC > 0.10), ethanol acts as a central nervous system depressant, producing at progressively higher dosages, impaired sensory and motor function, slowed cognition, stupefaction, unconsciousness, and possible death.

Dextromethorphan

- **Dextromethorphan** (DM or DXM) is an antitussive drug that is found in many over-the-counter cold and cough preparations, usually in the form of dextromethorphan hydrobromide. It is also used as a recreational drug.
- Dextromethorphan is well absorbed from the gastrointestinal tract with maximum serum level occurring at 2.5 hour. Peak concentration of the major metabolite dextrorphan was 1.6 to 1.7 hours. Onset of effect is rapid, often beginning 15 to 30 minutes after oral ingestion. Peak levels for sustained release products generally occur about 6 hours after ingestion although absorption may be erratic.
- The half life of the parent compound is approximately 2 to 4 hours in people with normal metabolism.

- At therapeutic doses, the drug acts centrally to elevate the threshold for coughing, without inhibiting ciliary activity. Dextromethorphan is rapidly absorbed from the gastrointestinal tract. Because administration of DXM can be accompanied by histamine release, its use in atopic children is very limited.
- The average dosage necessary for effective antitussive therapy is between 10mg and 30mg every four to six hours.
- Does not produce physical addiction but can generate psychological dependence in some users.
• Dextromethorphan has little to no psychological effect in the doses used medically, however alteration of consciousness generally occurs following ingestion of approximately 7 to 50 times the therapeutic dose over a relatively short period of time.

• Classified as a dissociative drug, a major subclass of hallucinogenic drugs, along with Ketamine and Phencyclidine. It generally does not produce withdrawal symptoms characteristic of physically addictive substances, but psychological addiction has been reported by some users.

• DXM, when consumed in low recreational doses (usually under 200mg), is often described as having a buoyant, vaguely psychedelic effect similar to a mixture of alcohol, opiates, and marijuana.

• With higher doses, intense euphoria and vivid imagination may occur as bizarre feelings of dissociation increase.

• With very high doses, profound alterations in consciousness have been noted, and users often report out of body experiences or temporary psychosis.

• One of the unique features of a high dose DXM trip is the ability to relive past memories. Most users find such high doses to be extremely uncomfortable and most are unwilling to repeat it. Flanging (speeding up or slowing down) of sensory input also occurs, which is another unique feature of high dose DXM trips. The estimated lethal dose of DXM is between 50 and 500 mg/kg.

• Physical side effects that can occur after ingestion of recreational doses of DXM include a blotchy skin rash, itching (sometimes referred to as "robo itch," short for "Robitussin itch"), and sweating. Many people vomit from recreational doses or feel ill for the first part of the “trip”. When taken in higher doses, physical side effects can include dilated pupils, difficulty urinating, increased urination frequency, fever, tachycardia, loss of appetite, shakiness, seizures, and possible coma and death (however, in pure DXM, this has only been reported when doses exceed 2,000 mg).

• Dextromethorphan should not be used while taking selective serotonin reuptake inhibitors (e.g. fluoxetine, paroxetine) and monoamine oxidase inhibitors. This may produce a life threatening serotonergic syndrome which consists of: restlessness, sweating, hypertension, hyperthermia, tremor, myoclonus and seizures.
nicotine

- A nicotine patch is a transdermal patch that releases nicotine into the body through the skin. It is usually used as a method to quit smoking.
- Nicotine patches come in several steps so that users can phase out nicotine use; e.g. 21, 14, and 7 mg. A cigarette delivers roughly 1 mg of nicotine, so someone who used to smoke a pack (20 cigarettes) per day or more could start with the "step 1" 21mg patch, while someone who smoked less could start with "step 2." After several weeks (6 is recommended) at step 1, new non-smokers move on to step 2 (usually 2 weeks) and step 3 (2 weeks).

- The mean lethal dose has been estimated to be 30 to 60 mg (0.5-1.0 mg/kg)
- A plant alkaloid from tobacco, blocks transmission at nicotinic acetylcholine receptor sites in the parasympathetic nervous system.

- The elimination half-life of nicotine averages 2 hours. The half-life of a drug is useful in predicting the rate of accumulation of that drug in the body with repetitive dosing and the time course of decline after cessation of dosing. Consistent with a half-life of 2 hours, accumulation of nicotine over 6 to 8 hours during regular smoking and persistence of significant levels of nicotine in the blood for 6 to 8 hours after cessation of smoking, i.e. overnight, has been observed. Thus, cigarette smoking represents a situation where the smoker is exposed to significant concentrations and possibly pharmacological effects of nicotine for 24 hours a day.

- The patches take between 2 and 4 hours to achieve peak concentration in the body.
- The nicotine and the adhesive can cause swelling, itching and discomfort in the area covered by the patch. Instructions for using the patch indicate it should be placed at a different location every day. Usually the feeling of itching and mild burning subsides in 30-60 minutes.