The Science of Nutritional Supplementation

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  Methionine
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  Phenylalanine
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Tyrosine
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Micronutrients

Functions

Terminology

Vitamins
Vitamin A
Beta-carotene
Vitamin B complex
Thiamin (Vitamin B1)
Riboflavin (Vitamin B2)
Niacin (Vitamin B3)
Pantothenic acid (Vitamin B5)
Pyridoxine (Vitamin B6)
Vitamin B12 (Cobalamin)
Biotin
Folic acid
Vitamin C
Vitamin D
Vitamin E
Vitamin K

Vitamin-like substances
Choline
Inositol
PABA

Minerals
Boron
Calcium
Chromium
Copper
Iodine
Iron
Magnesium
Manganese
Molybdenum
Phosphorus
Potassium
Selenium
Silicon
Vanadium
Zinc
Other popular supplements
Activated charcoal
Alpha-lipoic acid
Anthocyanins
Antioxidants
Bee products
Beta-sitosterol
Bilberry
Bromelain
Caprylic acid
Carnitine
Carotenoids
Catechins
Chitosan
Condroithin sulphate
Coenzyme Q10
Creatine
DHEA
Digestive enzymes
Flavonoids
Gamma-oryzanol
Glucosamine
Glutathione
Grapeseed extract
Grapefruit extract
Green tea
Gugulipid
Ipriflavone
Lecithin
Lycopene
Melatonin
MSM
Naringin
Natural progesterone
Oregano oil
Policosanol
Probiotics
Quercetin
The Science of Nutritional Supplementation

“When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it - this is knowledge.”

~ Confucius~

We are exposed today to a vast array of nutritional supplementations, in various chemical combinations and each of them claiming ownership over quality! Which one should we choose? But more importantly, why?

The material presented in this section will attempt to answer some of these questions. As the name suggest, “Nutritional Supplementation” attempts “to supplement”, to improve, and to support. Nutritional supplementation has not been designed to replace food intake and/or normal body physiology processes; it has been designed to enhance effects of macronutrients, or to add to their effect, if the health status, or a particular health condition require so.

In order to accomplish its goals, nutritional supplementation, in any form, needs to be mastered as in: what is it, what forms does it take, how it works, effects on the body in basic, maintenance amounts, what does it do for the body in therapeutic dosages, what does it interact with…and the list could go on.
It is our view that CAM practitioners need to be informed on all types of prescriptions and recommendations available to the public (medication, supplements, herbs, others), and understand the intricate relationship/interactions between the above mentioned.

**DIETARY/NUTRITIONAL SUPPLEMENT:** a product that contains substances like vitamins, minerals, foods, botanicals, amino acids and is intended to supplement the usual intake of these substances.

**MAINTENANCE DOSE:** the amount (of nutrients, herbs, etc) necessary to maintain the state of health or to maintain what has been achieved after a therapeutic protocol;

**THERAPEUTIC DOSE:** the amount (of nutrients, herbs, etc) necessary to achieve a therapeutic effect (a change in the initial status);

**Forms of supplements administration**
*(For the following, the term ‘substance’ refers to any nutrient, herb, food component or other nutraceutical)*

**Tablets** are a mixture of substance(s) and diluents, lubricants and stabilizers; the mixture is granulated and compressed into a tablet; the type and amount of additives and the degree of compression affect how quickly the tablet disintegrates and the substance is absorbed; a tablet can compress a substantial amount of the given substance, thus the daily dosage can be given in fewer doses; also, tablets have a longer shelf-life than other forms;

**Capsules** consist of substance(s) and additives within a gelatin shell that swells and releases its contents in the presence of humidity, eroding quickly. The size of the substance particles and the properties of the additives affect how quickly the substance(s) dissolves and is absorbed; generally, capsules have increased absorbability potential, but the daily dosage requires an increased number of capsules/day; shorter shelf-life than tablets;

**Powder and liquid forms:** substance(s) are either dried up and turned into powder or mixed with various liquid excipients in order to create a liquid form; great absorbability potential; short shelf-life; daily dosages requirements of substance(s) may result into increased number of dosages/day;
**Enteric-coated:** supplemental forms (tablet or capsule coated with a protective substance) designed to bypass the acidic environment of the stomach and allow their content to be released at intestinal level;

**Time-release:** some substance(s) products are specially formulated to release their active ingredients slowly or in repeated small amounts over time—usually for a period of 12 hours or more.

**Topical applications:** ointment, cream, lotion, a solution, or a gel; this form will deliver the active dose transdermally (on the surface of the skin), based on absorption by skin blood vessels;

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### Comments on administration of supplements

When you recommend/advise on nutrients/supplements intake, always take into consideration the following factors:

- Assess the health status of your client’s liver and kidneys, as they are detoxification organs;
- Always start with the lower possible dose (on the low end of a dosage range) and increase accordingly, based on improvement/plateau; if no change occurs, slowly increase the dosage; if improvement occurs, consider the given dosage the maintenance dosage and proceed from that moment on, based on clinical status; also, if no change occurs, consider the applicability of the particular supplement;
- As manufacturers’ metrics are different from one company to another, use nutraceuticals “as prescribed” or “as directed” when you do not have a clear dosage range; when in doubt, call the manufacturer for details;
- Always read the insert of a nutraceutical, if available; check for inactive components; check for interactions with other nutraceuticals or drugs, before making your recommendation.

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[FRUCTO-OLIGOSACCHARIDES (FOS)]
General information:
○ Non-digestible dietary fibers that help keep the digestive tract healthy by nourishing and promoting the naturally present, "friendly" bacteria (Bifidobacteria and Lactobacilli in particular); because of these properties FOS are considered "prebiotics."
○ Natural food sources of FOS include onions, garlic, and asparagus. FOS capsules, however, provide high concentrations of a purified form of this dietary fiber;
○ Frequently added to fiber supplements;

Recommendations:
○ FOS may benefit people who suffer from irritable bowel syndrome, by exerting a regulatory action on bowel movements;
○ Dysbiosis, candidiasis; by promoting health of “good flora”;

Facts and Caution:
FOS supplements appear to be safe; occasionally, stomach cramps, gas, or bloating may occur for first time users; generally, associated in supplementation forms with probiotics.

EPO (Evening Primrose Oil)

General information:
Evening primrose oil is extracted from the evening primrose plant (Oenothera biennis). The therapeutic agent contained in EPO is gamma-linolenic acid (GLA).

Recommendations:
○ PMS (Premenstrual Syndrome), endometriosis, fibrocystic breast disease: acts by interfering with the production of inflammatory prostaglandins;
○ Rheumatoid arthritis; beneficial effects due to anti-inflammatory action;
○ Skin disorders, such as eczema, acne rosacea, acne; by exhibiting anti-inflammatory effects;
○ Beneficial effects in Multiple Sclerosis (GLA incorporates easily into brain lipids);

Recommended dosages: vary; usually take “as prescribed”; commonly, 1000-1300mg once or twice a day;
**Facts and Cautions:**
- Evening primrose oil supplementation should be taken with meals, as to avoid any side effects;
- Conversion of evening primrose oil into gamma linolenic acid partially depends on presence of vitamin C, vitamin B-complex, magnesium and zinc;
- Vitamin E supplementation may be recommended when taking EFA’s, as it protects against lipid oxidation;

**Interactions:**
- EPO may interfere with medication prescribed for schizophrenia;
- When taken along with anticonvulsants, EPO may decrease drug’s effectiveness;
- Evening primrose oil may increase the risk of temporal lobe epilepsy; when taken concomitantly with Phenothiazine or other epileptogenic drugs.

**METHIONINE**

**General information:**
- Sulfur-containing amino-acid very important for liver detoxification;
- Assists in fat break-down;
- Synthesis of cysteine and taurine depend on presence of methionine;
- Helps reduce excessive histamine levels;
- Helps lower cholesterol levels by increasing the liver's production of lecithin;
- Regulates formation of ammonia;

<table>
<thead>
<tr>
<th>Facts</th>
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</thead>
<tbody>
<tr>
<td>The body can convert methionine into cysteine, a precursor of glutathione (very powerful antioxidant);</td>
</tr>
<tr>
<td>Liver-detoxifying products called lipotropic combinations increase bile flow; they are commonly combined with the B vitamins choline and inositol in addition to methionine;</td>
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*Commonly recommended form: SAMe (S-adenosylmethionine); body manufactures SAMe from methionine and adenosine triphosphate (ATP);*
Recommendations:
○ Depression; as SAMe may contribute to formation of dopamine and serotonin;
○ Arthritis; (due to the fact that methionine’s break down in the body creates substances that benefit the health of joint structures);
○ Fibromyalgia; chronic fatigue syndrome;
○ Some liver disorders, such as alcohol-induced cirrhosis, drug toxicity, hepatitis, and cholestasis (*reduction or stoppage of bile flow*);

Recommended dosages: generally, 400 mg of SAMe twice a day; when symptoms improve, reduce the dosage by half;

SAMe Facts and cautions:
○ Methionine converts into homocysteine (its presence has been associated with increased risk for cardio-vascular conditions) in the absence of folic acid and vitamins B6 and B12; ensure proper levels of these supplements/foods;
○ Avoid in pregnancy in supplemental form;
○ Use enteric-coated SAMe, if possible;
○ SAMe is best absorbed on an empty stomach;
○ To prevent insomnia, avoid taking SAMe late, as it may increase energy levels;
○ It is considered that SAMe can be safely combined with other natural antidepressants and/or most prescribed antidepressants; do not reduce/discontinue prescribed antidepressants while taking SAMe without medical supervision;
○ SAMe could trigger or exacerbate mania; use with caution, upon medical supervision;

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NIACIN (VITAMIN B3)

General information:
○ Important in the process of releasing energy from carbohydrates; helpful in controlling blood-sugar levels;
○ The body also synthesizes niacin from tryptophan in the presence of vitamins B1, B2 and B6; (niacin is not a ‘real’ vitamin, as it can be synthesized in the body);
○ Lime makes the type of niacin found in corn more absorbable;
○ Niacin may increase uric acid levels;
**Recommendations:**
- Cholesterol-level control: it seems that vitamin B₃ helps decrease LDL levels and promotes increase of HDL levels;
- Protection of cardio-vascular system;
- May help Raynaud’s disease and tinnitus cases, by exerting vasodilator effects;
- May have a role in treatment of depression, as niacin is very important for normal nervous system function;
- Arthritis; especially rheumatoid arthritis (due to niacinamide’s anti-inflammatory properties);
- May protect against development of diabetic neuropathy and other complications;
- May play a role in Alzheimer disease prevention;

**Forms:**
- Niacin (nicotinic acid or nicotinate); generally useful for its blood lipid lowering properties;
- Niacinamide (nicotinamide); generally useful for arthritis and diabetes;
- Inositol hexaniacinate (does not create the characteristic B₃ ‘skin flushing’);

RDA: 6-12mg/day, in children, according to age; 19 mg/day for adult males; 15 mg/day for adult females;

**Recommended dosages:**
- For high cholesterol (hypercholesterolemia), Raynaud's disease, intermittent claudication* or tinnitus: 500 mg of inositol hexaniacinate three times a day;
- For anxiety or depression: 50-100mg niacin/day;
- For arthritis: 1,000 mg of niacinamide three times a day.

*Intermittent claudication is a symptom of arterial insufficiency, a form of vascular disease; predictable pattern of lower leg pain caused by inadequate blood flow to leg muscles; cramping pain in the calves brought on by exertion that is relieved by rest.

**Facts and caution:**
- Generally, niacin in the form of inositol hexaniacinate and niacinamide tends to cause fewer side effects than nicotinic acid;
○ It is recommended to take niacin with food, to avoid gastro-intestinal discomfort;
○ The “sustained-release”, time-release and slow-released forms seem to have increased liver-damaging effect; avoid, if possible;
○ Niacin can impair glucose tolerance, thus use it with caution and under supervision for diabetes cases;

Side effects:
○ “Flushing effect”- due to intense vasodilation, at high doses;
○ Possible gastric irritation and nausea;
○ Possible liver damage;
○ Possible ocular damage.
Note: these side effects may manifest at doses higher than prescribed dosages.

NOTE: if taking any niacin form, have your liver enzymes and liver status checked periodically (every 3 months);

Interactions:
○ Niacin may interfere with action of cholesterol-lowering medication, such as statin drugs;
○ May increase toxicity of drugs with liver clearance;

Niacin deficiency
Causes: | lack of intake; | malabsorption; | high corn intake; | alcoholism.

Consequences of deficiency: The 4 D’s (Pellagra)
○ Dermatitis: exacerbated by sun exposure;
○ Diarrhea: caused by inflammation of the gastro-intestinal tract;
○ Dementia: irritability, headaches, followed by mental confusion and depression;
○ Death.

Niacin toxicity
○ Flushing, itching, liver damage;
○ Nausea is the first sign of toxicity with both niacin and niacinamide

GLUCOSAMINE
General information:
Produced by the body, vital in maintaining cartilage structure; glucosamine stimulates the production of glycosaminoglycans (structural components of cartilage) and the incorporation of sulfur into cartilage (sulfur is necessary for cartilage repair).

Recommendations: arthritis, osteoarthritis, sprains and strains;

Forms: glucosamine sulfate (most absorbable form), glucosamine hydrochloride and N-acetyl-glucosamine (NAG). Glucosamine is often sold in combination formulas for arthritis with chondroitin sulfate;

Recommended dosages: generally, 500 mg two or three times/day, or “as directed”;

Facts and caution:
○ Occasionally, glucosamine supplementation may cause abdominal discomfort; in such cases, it is recommended to take the supplementation with food;
○ It is recommended to take glucosamine supplementation with food, in the presence of PUD (peptic ulcer disease);
○ Some forms of glucosamine may be made from crab, shrimp or oyster shells; avoid taking them in the presence of shellfish allergies;
○ Allow treatment to progress for two to eight weeks for appropriate results;

Interactions:
○ Some glucosamine supplements may contain sodium and/or potassium; caution is recommended in cases on a restricted sodium diet or cases taking potassium-sparing diuretics;
○ Caution is recommended for diabetes cases, as glucosamine may decrease effectiveness of insulin;
○ NSAIDs (non steroidal anti-inflammatory drugs): glucosamine may potentate effects;

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APPENDIX A: Adverse reactions of some nutraceuticals
<table>
<thead>
<tr>
<th>Nutraceutical</th>
<th>Adverse Reaction</th>
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<tbody>
<tr>
<td>Activated charcoal</td>
<td>When taken in large doses, activated charcoal can cause black stools, diarrhea, constipation, nausea, and vomiting;</td>
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<tr>
<td>Alpha-lipoic acid</td>
<td>It may cause mild stomach upset and rarely an allergic skin rash;</td>
</tr>
<tr>
<td>Arginine</td>
<td>Avoid taking arginine supplementation if you are prone to develop <em>Herpes simplex</em> infections, as arginine may promote virus’s multiplication;</td>
</tr>
<tr>
<td>Beta glucans</td>
<td>Use with caution in supplemental form for cases with allergic terrains and/or autoimmunity, as it seems to exert immune stimulating properties;</td>
</tr>
<tr>
<td>Borage oil</td>
<td>Borage oil may cause loose stools and abdominal upset in some individuals;</td>
</tr>
<tr>
<td>Calcium</td>
<td>Calcium carbonate may cause gas and constipation in some cases;</td>
</tr>
<tr>
<td>Chondroitin</td>
<td>Mild abdominal discomfort; possible allergic reactions, when supplement developed from cartilage;</td>
</tr>
<tr>
<td>VITAMIN</td>
<td>DEFICIENCY</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>VITAMIN C</td>
<td>Scurvy, delayed wound healing, reduced resistance to infections;</td>
</tr>
<tr>
<td>THIAMIN(B1)</td>
<td>Beriberi</td>
</tr>
<tr>
<td>RIBOFLAVIN (B2)</td>
<td>Associated with red and burning eyes and decreased neurotransmitters function;</td>
</tr>
</tbody>
</table>

**NUTRACEUTICALS-DRUGS INTERACTIONS**

<table>
<thead>
<tr>
<th>Nutraceutical</th>
<th>Interaction</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Antibiotics, such as tetracycline or doxycycline;</td>
<td>Calcium may decrease the absorption of the drug;</td>
</tr>
<tr>
<td></td>
<td>Thiazide diuretics</td>
<td>May cause increase in calcium levels</td>
</tr>
<tr>
<td>Chondroitin</td>
<td>Anticoagulants</td>
<td>Chondroitin may increase the medication’s effect;</td>
</tr>
</tbody>
</table>
Chromium may alter insulin requirements or the dosage needed for various diabetes medications;

APPENDIX F: NUTRACEUTICALS-NUTRACEUTICALS INTERACTIONS

<table>
<thead>
<tr>
<th>Nutraceutical</th>
<th>Nutraceutical</th>
<th>Effect</th>
</tr>
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<tbody>
<tr>
<td>Beta carotenes</td>
<td>Vitamin E</td>
<td>Lowers vitamin’s absorption;</td>
</tr>
<tr>
<td>Calcium</td>
<td>Vitamin D</td>
<td>Vitamin D increases mineral’s absorption;</td>
</tr>
<tr>
<td>Carnitine (L)</td>
<td>Vitamin C</td>
<td>Decreases vitamin’s absorption;</td>
</tr>
<tr>
<td>Coenzyme Q_{10}</td>
<td>Vitamin E</td>
<td>Increases vitamin’s effects;</td>
</tr>
<tr>
<td>Copper</td>
<td>Vitamin C</td>
<td>Interfere with each other’s bioavailability;</td>
</tr>
</tbody>
</table>

Macrophages: tissue cells originating from monocytes (a type of white blood cells); very important in immunity;  
Malabsorption: improper absorption;  
Malaise: a feeling of deep discomfort;  
Maldigestion: improper digestion;  
Malignant: cancerous;  
MCHC: Microcrystalline hydroxyapatite; form of calcium supplementation;  
Melena: lower gastro-intestinal bleeding, black stools;
**Menorrhagia**: heavy menstrual bleeding;
**Metabolism**: all chemical reactions in the body;
**Metastasis**: spread of cancer;
**Metrorrhagia**: inter-period uterine bleeding;
**Microorganism**: microscopic organism, such as viruses, bacteria, fungi, protozoa;
**Micturition**: urination;
**Monocites**: type of white blood cells;
**MOA**: monoamine oxidase; enzyme catalysing breakdown of several biogenic amines, such as serotonin, adrenaline, noradrenaline, dopamine;
**MOAI**: monoamine oxidase inhibitors; group of antidepressant drugs that prevent the activity of the enzyme monoamine oxidase in the central nervous system thus affecting mood;
**MS**: multiple sclerosis;
**MSK**: musculo-skeletal;
**MSM**: sulfur compound (short for methylsulfonylmethane); MSM appears to inhibit pain impulses that travel along nerve fibers, acting as an analgesic; it also exhibits anti-inflammatory properties;
**Mucolytic**: mucus breaking;
**MUFA**: monounsaturated fatty acids;
**MVP**: Mitral valves prolapse;
**Myocardium**: the heart muscle;
**Myometrium**: the uterus muscle;
**Myopia**: nearsightedness;