

# Analysing vitamins and minerals biology essay



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A free radical is reactive and unstable electrically charged atom with an unpaired electron in its outermost shell. To become stable, the free radical has to either give up or gain an electron from another molecule (Tortora et al. 2006, p. 32), thus effecting the body's ability to maintain normal cell function (Rolfes et a. 2009, p. 391). Free radicals have been implicated in the aging process, heart disease, the development of cancer and other chronic diseases (NCNZ 2009, p. 56).

Antioxidants are natural compounds that prevent or neutralise the damaging effects of free radicals, by donating an electron to the unstable molecule without affecting their own stability. Each vitamin and mineral antioxidant functions to protect a particular part of the body (NCNZ 2009, p. 56). For example, selenium functions as a component of proteins that prevent free-radical formation (Rolfes et al. 2009, p. 457) in tissues and cell membranes, and Vitamin C protects body fluids from oxidative stress (Rolfes et al. 2009, p. 351).

Briefly discuss three factors that can affect the assimilation of supplements. Include within your discussion the reasons why supplements may be necessary and why these are sometimes poorly utilised by the body.

Supplement absorption is dependent upon many different factors such as the body's nutritional requirements, digestive function and time, supplement form and method of preparation, the types of foods they are taken with, and the presence of synergists, co-factors or inhibitors.

Most vitamins are well absorbed in the digestive tract. Water soluble vitamins are readily assimilated directly into the blood and are better

absorbed when digested with food. Fat soluble vitamins enter the blood via the lymph and require carriers for transport (NCNZ2 2010, p. 48). Fat soluble vitamins are best taken after meals (Haas 2006, p. 90). A fat deficient diet limits assimilation of fat soluble vitamins (NCNZ2 2010, p. 49).

Minerals have a lower absorption rate than vitamins – they compete with other minerals for absorption, and often require carriers for absorption and transportation (NCNZ2 2010, p. 51).

Low stomach acidity also impacts the absorption of vitamins and minerals such as Vitamin B12 (NCNZ1 2010, p. 26). Calcium also, requires adequate stomach acidity dissolve prior to assimilation (NCNZ2 2010, p. 52).

Supplement form and method of preparation result in differing levels of bioavailability. Naturally derived vitamins and minerals are believed to be assimilated better by the body. Natural supplements may be absorbed up to 85% more than their synthetic counterparts (NCNZ1 2010, p. 8).

Naturally occurring forms of the same vitamin or mineral may also differ in absorption. For example, alpha tocopherol is the most active of the eight different naturally occurring forms of Vitamin E (NCNZ1 2010, p. 17).

Some minerals are bound or chelated to different compounds that enable the mineral to be better absorbed by the body. Ionic minerals are fully dissolved in water particles, and appear to have superior absorption rates (NCNZ1 2010, p. 11).

A varied balance of nutrients are required to work effectively together as synergists and cofactors to promote the absorption and function of vitamins

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and minerals in the body (NCNZ1 2010, p. 10). Vitamins and minerals can interact as synergists. Cofactors can include enzymes and coenzymes, amino acids, antioxidants, and activators (NCNZ1 2010, p. 9).

For example, Vitamin C absorption is increased when taken with bioflavonoids (NCNZ1 2010, p. 28). And Vitamin C, an antioxidant, is a synergist for Vitamins A, D, E, K, B1, B2, B3, B5, B6, B9, calcium, magnesium, iodine, iron, manganese, selenium.

List four points detailing when supplementation may be necessary for someone?

Declining mineral levels in foods:

As the human body does not manufacture minerals, we need to obtain our daily requirements through our diet. However, intensive farming and agricultural practices since WWII have resulted in minerally deficient foods grown in nutrient depleted soils. If our fresh produce is deficient in nutrients, we may require additional supplementation as well as a healthy diet (NCNZ1 2010, p. 6).

Pregnancy:

Women who are planning pregnancy, are pregnant, or who are breastfeeding benefit from a balanced diet and supplementation of certain nutrients such as iron, folic acid and zinc to ensure an adequate supply of micronutrients to minimise the risk of maternal problems and birth defects (Haas 2006, p. 569).

Life stages:

Haas (2006, p. 89) recommends taking additional supplements to support the best possible health during life transition periods, such as adolescence or menopause. Supplementation is particularly beneficial in the elderly as they eat less, and are less efficient at assimilating nutrients from food.

High consumption of stimulants:

High consumption of refined foods, caffeine, alcohol and regular smoking can deplete nutrients in our body (Haas 2006, p. 154). Nutritional deficiencies create a variety of symptoms and increase our susceptibility to disease. Supplementation can be used as a primary treatment for specific problems, for detoxification, or to restore nutritional imbalances (Haas 2006, p. 88-89).

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## Question 5

What is the best absorbed form of vitamin E? List three female health complaints where evidence has shown that vitamin E can help.

The most bioavailable form of vitamin E is alpha-tocopherol. Naturally occurring vitamin E (d- $\alpha$ -tocopherol) is more biologically active and potent than its synthetic equivalent dl- $\alpha$ -tocopherol (Zimmerman 2001, p. 29).

Fibrocystic breast disease

Clinical studies have shown vitamin E supplementation as an effective treatment for fibrocystic breast disease (Murray 1998, p. 456; Haas 2006, p. 104; Zimmerman 2001, p. 32).

### Menopause

Vitamin E supplementation of 400-800IU daily has been shown to reduce symptoms associated with menopause, particularly hot flushes and atrophic vaginitis (Stengler 2001, p 479; Murray 1998, p. 637, Haas 2006, p. 104)

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### Premenstrual syndrome (PMS)

Symptoms of breast tenderness, depression, nervous tension, headaches, fatigue, insomnia and cravings are reduced in women with PMS following vitamin E supplementation (Murray et al. 1998, p. 747; Stengler 2001, p. 480; Zimmerman 2001, p. 32).

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## Question 6

Name at least five whole food sources that are high in vitamin K.

Whole food sources high in vitamin K include leafy greens such as cabbage, kale, lettuce and spinach, alfalfa, kelp, eggs, fish and wholegrain oats (Haas 2006, p. 107; NCNZ 2010, p. 17).

Apart from food sources, how else is this vitamin provided?

Vitamin K is produced in the human body by intestinal bacteria (NCNZ 2010, p. 17).

List three important functions of vitamin K.

The synthesis of coagulation proteins in the liver - Factors II, VII, IX and X in the coagulation cascade, all necessary for blood clotting

Required for bone formation, Vitamin K participates in the synthesis of the bone protein osteocalcin which regulates calcium metabolism.

Assists in glycogenesis - the conversion of glucose to glycogen for storage in the liver.

(Balch 2006, p. 27)

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## **Question 7**

List four unrefined sources that are high in vitamin A and four good sources of beta carotene.

Unrefined sources high in retinol include liver, fish liver oil, egg yolks and whole milk. Sources of beta carotene include carrots, apricots, rockmelon and kumara (Haas 2006, p. 93).

Describe the pathway of conversion between beta carotene and vitamin A.

Provitamin A beta-carotene is converted to retinal during absorption in the upper intestine and by the liver, and further converted by the body to Vitamin A retinol (Haas 2006, p. 92).

Why may large doses of vitamin A be toxic to the body as opposed to high doses of beta carotene?

Retinols are absorbed faster and processed more efficiently than beta-carotenes. Conversion of beta-carotene to retinol is regulated in the body and stored in adipose tissue until required (Rolfes et al. 2\*\*\*, p. 374).

Diets that are low in fat may contribute to decreased absorption of which group of nutrients?

The fat soluble vitamins - A, E, D and K. Also absorption of carotenoids, such as beta-carotene is enhanced by consuming fat with a meal (NCNZ1 2010, p. 14).

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## Question 8

Many of the B vitamins have corresponding tongue and mouth deficiency signs.

On the tongue diagrams provided, draw the various signs of B vitamin deficiency that might be seen and write underneath any mouth signs.

B1: Lines down the side of tongue and furrows on tongue.



B2: Angular stomatitis; cracked lips; cold sores; a sore, bright red or purple tongue that may be mapped.

B3: Mouth sores; cracks in the tongue, often in the middle; a red tip; scalloping; raised papillae; possible small tongue.

B5: Big, red, beefy tongue with cracks and furrows.

B6: Angular stomatitis; enlarged red tongue; redness on the edge of the tongue

B12: Tongue may be smooth, with a strawberry tip and edge.

(NCNZ 2010, p. 20-27)

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## **Question 9**

Name five unrefined foods that are especially high in B vitamins, at least two of them should be from vegetarian sources.

Liver, brewer's yeast, whole grains, wheat germ, legumes.

Describe how a deficiency of vitamin B3 leads to symptoms of anxiety or depression, poor sleeping, and carbohydrate cravings?

Tryptophan is a precursor of serotonin and vitamin B3 (Haas 2006, p. 47).

Vitamin B3 is converted from tryptophan if vitamin B3 levels are low, which depletes serotonin levels. Low levels of serotonin can lead to symptoms of

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anxiety, depression, carbohydrate cravings and insomnia (NCNZ 2010, p. 22).

List seven other vitamins or minerals that are important for stress response?

Vitamin A, C, E & Selenium are potent antioxidants that reduce free radical damage caused by stress. Vitamin C also supports adrenal function. All the B vitamins are required for the proper functioning of the nervous system, particularly Vitamin B5, considered the anti-stress vitamin essential for healthy adrenal function (NCNZ 2010). Calcium and Magnesium are both deficient when stressed. Calcium is important for nerve transmission and aids relaxation and Magnesium, a natural tranquilizer, helps to balance the nervous system (Haas 2006, p. 602).

What is the full name of vitamin B7? List three therapeutic uses for this vitamin.

Biotin can be used therapeutically to control blood glucose in diabetes, for fat metabolism and utilisation in weight management, to prevent hair loss when related to biotin deficiency, and for dermatological conditions such as dermatitis and eczema (Haas 2006, p. 128).

A deficiency of which digestive juices can contribute to B12 deficiency?

Hydrochloric acid aids in the absorption of vitamin B12 (Haas 2006, p. 125).

What dietary factors can contribute to a B12 deficiency?

B12 deficiency can occur in people with strict vegetarian diets (Haas 2006, p. 126). Dairy and wheat intolerances interfere with Vitamin B12 absorption,

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and excessive consumption of alcohol and coffee can reduce B12 levels (NCNZ 2010, p. 26).

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## **Question 10**

What vitamins and minerals are affected by oral contraceptive pill (O. C. P) use?

Discuss whether their absorption is increased or decreased by the O. C. P.

The OCP interferes with the metabolism of most of the B vitamins. In particular, reduced levels of B6, B9 and B12 are related to inadequate absorption (Haas 2006, p. 718). The OCP may also decrease absorption of Vitamin C in the body (Balch 2006, p. 24; Haas 2006, p. 718).

Copper absorption is increased with OCP use (NCNZ 2010, p. 34). Zinc absorption is decreased due to high copper levels, therefore zinc levels drop also (NCNZ 2010, p. 44; Haas 2006, p. 718).

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## **Question 11**

Which four main nutrients and cofactors are necessary for the prevention of anaemia?

Iron, vitamin B12, Folic acid and Vitamin C (NCNZ1 2010; Balch 2006, p. 201).

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## **Question 12**

List five factors that increase, and five factors that decrease, the absorption of calcium

### **Increase calcium absorption**

### **Decrease calcium absorption**

Moderate exercise

Lack of exercise

Vitamin D

Excess dietary fat

Lactose

Oxalic acid foods (e. g. almonds, cocoa, rhubarb, spinach)

Amino acid lysine

Phytates (found in whole grain foods)

Gastric hydrochloric acid

Stress

(NCNZ 2010, p. 30; Balch 2006, p. 31; Haas 2001, p. 155)

Research and describe with reasoning how magnesium can benefit three specific health conditions: Cardiovascular disease, PMS, depression, hypertension

### **Cardiovascular disease:**

According to Haas (2006, p. 666), “ Magnesium may be the single most important nutrient in CVD protection, especially when it is deficient”.

Magnesium (Mg) deficiency is associated with fatal cardiac arrhythmia, hypertension, heart disease and sudden cardiac arrest (Balch 2006, p. 36; Haas 2006, p. 162).

Mg is involved in many enzyme actions controlling glucose, protein and fats (Balch 2006, p. 301) which contribute to energy production and cardiovascular function. Mg assists in maintaining proper heart rhythm and blood pressure (Balch 2006, p. 467). Magnesium is required for the electrical stability of the myocardium, is used to produce energy for heart contractions and regular rhythm, and also relaxes the blood vessel walls, improving circulation and reducing blood pressure. (Haas 2006, p. 666; Al-Delaimy et al. 2004). Mg also keeps calcium in circulation, minimizing increased muscle contractility and nerve conduction of the heart (Al-Delaimy et al. 2004).

A randomized clinical trial showed that intravenous magnesium administered in acute myocardial infarction was associated with a 49% reduction in ventricular tachycardia and fibrillation, a 58% reduction in the incidence of cardiac arrest, and a 54% reduction in mortality (Horner, 1992). Research has shown that increased dietary and supplemental magnesium intake was

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possibly associated with a modestly lower risk of CVD among men (Al-Delaimy et al. 2004). In a cohort study of women, higher plasma concentrations and dietary magnesium intakes were associated with lower risks of sudden cardiac death (Chiuve et al. 2011). Other research have demonstrated that higher magnesium intake was associated with lower blood pressure and lower risk of type 2 diabetes, both of which are risk factors for CVD (Al-Delaimy et al. 2004).

Al-Delaimy W. Rimm E. Willet W. Stampfer M. Hu F. (2004), Magnesium Intake and Risk of CHYPERLINK “ [http://www. jacn. org/cgi/content/full/23/1/63](http://www.jacn.org/cgi/content/full/23/1/63)”oronary Heart Disease among Men, Journal of the American College of Nutrition, Vol. 23 (1), p. 63-70

Chiuve S, Januzzi J. Gantzer M. Albert C. (2011) Plasma and dietary magnesium and risk of sudden cardiac death in women, American Journal of Clinical Nutrition, Vol. 93 (2), p. 253-260

Horner S. (1992), Efficacy of Intravenous Magnesium in Acute Myocardial Infarction in Reducing Arrhythmias and Mortality: Meta-analysis of Magnesium in Acute Myocardial Infarction, Circulation, Vol. 86, p. 774-779

## **PMS:**

Magnesium (Mg) is known fluctuate across the menstrual cycle and is often at its lowest level during menstruation (Haas 2006, p. 164). Mg is involved in various cellular pathways and neuromuscular actions which affect PMS, and deficiency may be related (Balch 2006, p. 646). Haas (2006, p. 721) suggests that Mg may assist with PMS symptoms such as anxiety, mood swings, fatigue, irritability, dysmenorrhoea, pre-menstrual depression and bloating.

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Mg has been noted to reduce negative mood and water retention, and is more effective than placebo in some studies. One study demonstrated the synergistic effect of Mg + vitamin B6 on reducing anxiety-related premenstrual symptoms such as nervous tension, mood swings and irritability (De Souza, 2000). However, a double blinded placebo controlled study of intravenous magnesium infusion in women with premenstrual dysphoric disorder found no significant difference in mood symptoms and no evidence of magnesium deficiency when compared to the control group (Braverman, 2007).

Limited evidence suggests that Mg supplements might be useful in treating premenstrual symptoms and warrants further investigation.

Braverman P. (2007), Mini-Review: Premenstrual syndrome and premenstrual dysphoric disorder, *Journal of Paediatric and Adolescent Gynaecology*, Vol. 20, p. 3-12

De Souza M. Walker A. Robinson P. Bolland K. (2000), A Synergistic Effect of a Daily Supplement for 1 Month of 200 mg Magnesium plus 50 mg Vitamin B6 for the Relief of Anxiety-Related Premenstrual Symptoms: A Randomized, Double-Blind, Crossover Study, *Journal of Women's Health & Gender-Based Medicine*, Vol. 9 (2), p. 131-139

## **Depression:**

It has been suggested that magnesium deficiency causes most major depression episodes and related mental health illnesses. Treatment using magnesium glycinate or taurinate is important for restoring balance (Eby, 2010), and for relaxation and dealing with stress (Haas 2006, p. 737).

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Magnesium chloride (*Magnesia muriatica*) has been used successfully as a homeopathic treatment of emotional problems such as anxiety, apathy, aversions, despair, depression, discontent, headaches, fear, insecurity, irritability, moodiness and uncertainty (Eby, 2006).

Magnesium is necessary in the actions of over 300 enzymes, many of which have a wide role in brain biochemistry, implicating magnesium deficiency in a variety of neuroses (Eby, 2006). It plays a vital role in all the major metabolisms in oxidation-reduction and in ionic regulation (Eby, 2010).

Magnesium ions regulate calcium ion flow in neuronal calcium channels, regulating neuronal nitric oxide production. Magnesium deficiency may cause N-methyl-d-aspartate (NMDA)-coupled calcium channels to be biased towards opening, causing neuronal damage and neurological dysfunction, exhibited as major depression (Eby, 2006).

Cerebral spinal fluid (CSF) magnesium has been found low in patients with treatment-resistant suicidal depression, and brain magnesium has been found low in treatment-resistant depression. However, low blood magnesium levels is not associated with major depression. Insufficient brain magnesium is proposed to reduce serotonin levels (Eby, 2010). Hypothyroidism (symptoms include depression), is associated with low magnesium whereby circulating T4 levels interrelate with magnesium serum levels (Eby, 2006).

Oral magnesium treatment has been found to be effective in treating major depression (Eby, 2010). Case histories have shown that patients taking 125-300 mg of magnesium glycinate and taurinate taken with meals and before bed show a speedy recovery from major depression (Eby, 2006).



Eby (2010) recommends that magnesium be prescribed for treatment-resistant depression, with continued research required to further confirm current findings.

Eby G. Eby K. (2006), Rapid Recovery from Major HYPERLINK “

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Selenium

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you need to go over most of the nutrients and sort out which relate to which type of cancer. There is a very good section in Prescription for Nutritional Healing (Balch & Balch) on different cancers and treatments including nutritional ones. If you dig through Haas also you will find plenty of references to cancer and nutrients. There are also references in the study notes, as you have mentioned.

NCr