

NATURAL HEALTH PRODUCT

WORKOUT SUPPLEMENTS

This monograph is intended to serve as a guide to industry for the preparation of Product Licence Applications (PLAs) and labels for natural health product market authorization. It is not intended to be a comprehensive review of the medicinal ingredients.

Notes

- ▶ Text in parentheses is additional optional information which can be included on the PLA and product label at the applicant's discretion.
- ▶ The solidus (/) indicates that the terms and/or statements are synonymous. Either term or statement may be selected by the applicant.
- ▶ Sodium is not permitted as a medicinal ingredient on this monograph due to health concerns associated with chronic supplemental use, namely hypertension, which remains the most common and most important risk factor for cardiovascular disease. However, the use of sodium as a counter-ion in medicinal or non-medicinal ingredients (e.g. sodium salts of minerals) is acceptable where warranted.

Date September 29, 2022

Proper name(s), Common name(s), Source information

Table 1. Proper name(s), Common name(s), Source information

Group 1: Proteins

Proper name(s)	Common name(s)	Source information		
		Source ingredient(s)	Source material(s)	Part(s)
<ul style="list-style-type: none"> ▶ Alfalfa protein concentrate ▶ Medicago sativa protein concentrate 	<ul style="list-style-type: none"> ▶ Alfalfa protein concentrate ▶ Medicago sativa protein concentrate 	N/A	<i>Medicago sativa</i>	Herb top
Casein	Casein	<ul style="list-style-type: none"> ▶ Acid casein ▶ Calcium caseinate ▶ Calcium sodium caseinate ▶ Sodium caseinate 	<i>Bos taurus</i>	Milk



Proper name(s)	Common name(s)	Source information		
		Source ingredient(s)	Source material(s)	Part(s)
<ul style="list-style-type: none"> ▶ Casein hydrolysate ▶ Hydrolyzed casein 	<ul style="list-style-type: none"> ▶ Casein hydrolysate ▶ Hydrolyzed casein 	N/A	<i>Bos taurus</i>	Milk
Casein micelles	Micellar casein	N/A	<i>Bos taurus</i>	Milk
Chickpea protein concentrate	Chickpea protein concentrate	N/A	<i>Cicer arietinum</i>	Seed
<i>Cicer arietinum</i>	<ul style="list-style-type: none"> ▶ Chick-pea ▶ Garbanzo 	N/A	<i>Cicer arietinum</i>	Seed
Defatted wheat germ protein	Defatted wheat germ protein	N/A	<i>Triticum aestivum</i>	Seed germ
Fish protein hydrolysate	Fish protein hydrolysate	N/A	<i>Clupea harengus</i>	<ul style="list-style-type: none"> ▶ Egg ▶ Fish semen ▶ Ovary ▶ Testis
			<i>Gadus chalcogrammus</i>	<ul style="list-style-type: none"> ▶ Meat ▶ Muscle
			<i>Gadus morhua</i>	Meat
			<i>Merluccius productus</i>	Meat
			<i>Micromesistius poutassou</i>	<ul style="list-style-type: none"> ▶ Meat ▶ Muscle
			<i>Molva dypterygia</i>	Meat
			<i>Salmo salar</i>	Meat
			<i>Scomber scombrus</i>	Meat
Flaxseed protein	Flaxseed protein	N/A	<i>Linum usitatissimum</i>	Seed
Hemp protein concentrate	Hemp protein concentrate	N/A	<i>Cannabis sativa</i>	Seed
Hemp protein isolate ¹	Hemp protein isolate	N/A	<i>Cannabis sativa</i>	Seed
Hemp seed protein	Hemp seed protein	N/A	<i>Cannabis sativa</i>	Seed

Proper name(s)	Common name(s)	Source information		
		Source ingredient(s)	Source material(s)	Part(s)
Milk protein concentrate	Milk protein concentrate	N/A	<i>Bos taurus</i>	Milk
Milk protein isolate ¹	Milk protein isolate	N/A	<i>Bos taurus</i>	Milk
<i>Oryza sativa</i>	<ul style="list-style-type: none"> ▶ Asian rice ▶ Black rice ▶ Purple rice ▶ Rice 	N/A	<i>Oryza sativa</i>	Seed
Pea protein	Pea protein	N/A	<i>Pisum sativum</i>	Seed
Pea protein concentrate	Pea protein concentrate	N/A	<i>Pisum sativum</i>	Seed
Pea protein isolate ¹	Pea protein isolate	N/A	<i>Pisum sativum</i>	Seed
<i>Pisum sativum</i>	Pea	N/A	<i>Pisum sativum</i>	Seed
<ul style="list-style-type: none"> ▶ Potato protein ▶ Potato tuber protein 	<ul style="list-style-type: none"> ▶ Potato protein ▶ Potato tuber protein 	N/A	<i>Solanum tuberosum</i>	Tuber
Rice protein	Rice protein	N/A	<i>Oryza sativa</i>	Seed
Rice protein concentrate	Rice protein concentrate	N/A	<i>Oryza sativa</i>	Seed
<i>Vicia faba</i>	Fava bean	N/A	<i>Vicia faba</i>	Seed
Wheat protein isolate ¹	Wheat protein isolate	N/A	<i>Triticum aestivum</i>	Seed germ
Whey protein concentrate	Whey protein concentrate	N/A	<ul style="list-style-type: none"> ▶ <i>Bos taurus</i> ▶ <i>Capra hircus</i> 	Milk
Whey protein hydrolysate	Whey protein hydrolysate	N/A	<ul style="list-style-type: none"> ▶ <i>Bos taurus</i> ▶ <i>Capra hircus</i> 	Milk
Whey protein isolate ¹	Whey protein isolate	N/A	<ul style="list-style-type: none"> ▶ <i>Bos taurus</i> ▶ <i>Capra hircus</i> 	Milk

¹For isolate, the potency information should be equivalent to 90% or more protein on a dry weight basis.

Group 2: Amino acids

Group 2a: Essential amino acids

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
▶ (S)-alpha-Amino-1H-imidazole-4-propanoic acid	L-Histidine	▶ L-Histidine

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
▶ L-Histidine		▶ L-Histidine hydrochloride
▶ (2S,3S)-2-Amino-3-methylpentanoic acid ▶ L-Isoleucine	L-Isoleucine	▶ L-Isoleucine ▶ L-Isoleucine ethyl ester ▶ L-Isoleucine ethyl ester hydrochloride ▶ L-Isoleucine hydrochloride ▶ N-Acetyl-L-isoleucine
▶ (S)-2-Amino-4-methylpentanoic acid ▶ L-Leucine	L-Leucine	▶ L-Leucine hydrochloride ▶ L-Leucine ▶ L-Leucine ethyl ester ▶ L-Leucine ethyl ester hydrochloride ▶ L-Leucine methyl ester hydrochloride ▶ N-Acetyl-L-leucine ▶ N-Glycyl-L-leucine
▶ (S)-2,6-Diaminohexanoic acid ▶ L-Lysine	▶ L-Lysine ▶ Lysine	▶ L-Lysine ▶ L-Lysine-L-aspartate ▶ L-Lysine monohydrochloride ▶ L-Lysine acetate ▶ L-Lysine dihydrochloride
▶ (S)-2-Amino-4-(methylthio)butanoic acid ▶ L-Methionine	▶ L-Methionine ▶ Methionine	▶ DL-Methionine ▶ L-Methionine ▶ N-Acetyl-L-methionine
▶ (S)-2-Amino-3-phenylpropanoic acid ▶ L-Phenylalanine	L-Phenylalanine	▶ DL-Phenylalanine ▶ L-Phenylalanine ▶ L-Phenylalanine methyl ester ▶ N-Acetyl-L-phenylalanine
▶ (2S,3R)-2-Amino-3-hydroxybutyric acid ▶ L-Threonine	L-Threonine	▶ DL-Threonine ▶ L-Threonine
▶ (S)-alpha-Amino-1H-indole-3-propanoic acid ▶ L-alpha-Aminoindole-3-propionic acid ▶ L-Tryptophan	▶ L-Tryptophan ▶ Tryptophan	L-Tryptophan
▶ (S)-2-Amino-3-methylbutanoic acid ▶ L-Valine	L-Valine	▶ DL-Valine ▶ L-Valine ▶ L-Valine ethyl ester ▶ L-Valine ethyl ester hydrochloride ▶ L-Valine hydrochloride ▶ N-Acetyl-L-valine



Group 2b: Non-essential amino acids

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
<ul style="list-style-type: none"> ▶ (S)-2-Amino propanoic acid ▶ L-Alanine 	L-Alanine	<ul style="list-style-type: none"> ▶ Alanylglutamine ▶ DL-Alanine ▶ L-Alanine ▶ L-Alanine ethyl ester hydrochloride
<ul style="list-style-type: none"> ▶ 3-Aminopropanoic acid ▶ 3-Aminopropionic acid ▶ beta-Aminopropionic acid 	beta-Alanine	<ul style="list-style-type: none"> ▶ beta-Alanine ▶ beta-Alanine ethyl ester
<ul style="list-style-type: none"> ▶ (S)-2-Amino-5 [(aminoiminomethyl)amino] pentanoic acid ▶ L-Arginine 	L-Arginine	<ul style="list-style-type: none"> ▶ DL-Arginine ▶ L-Arginine ▶ L-Arginine alpha-ketoglutarate ▶ L-Arginine ketoisocaproic acid ▶ L-Arginine monohydrochloride
<ul style="list-style-type: none"> ▶ (S)-2,4-Diamino-4-oxobutanoic acid ▶ L-Asparagine 	L-Asparagine	L-Asparagine
<ul style="list-style-type: none"> ▶ (S)-Aminobutanedioic acid ▶ L-Aspartic acid 	L-Aspartic acid	<ul style="list-style-type: none"> ▶ L-Aspartic acid ▶ Potassium aspartate ▶ Potassium magnesium aspartate
<ul style="list-style-type: none"> ▶ (S)-N5-Carbamoylornithine ▶ L-Citrulline ▶ N5-(Aminocarbonyl)-L-ornithine 	<ul style="list-style-type: none"> ▶ Citrulline ▶ L-Citrulline 	<ul style="list-style-type: none"> ▶ L-Citrulline ethyl ester ▶ L-Citrulline malate ▶ L-Citrulline
<ul style="list-style-type: none"> ▶ (R)-2-Amino-3-mercaptopropanoic acid ▶ L-Cysteine 	L-Cysteine	<ul style="list-style-type: none"> ▶ L-Cysteine hydrochloride ▶ L-Cysteine hydrochloride monohydrate ▶ D-Ribose-L-cysteine ▶ L-Cysteine
<ul style="list-style-type: none"> ▶ (S)-2-Aminopentanedioic acid ▶ L-Glutamic acid 	<ul style="list-style-type: none"> ▶ L-Glutamate ▶ L-Glutamic acid 	<ul style="list-style-type: none"> ▶ L-Glutamic acid hydrochloride ▶ L-Glutamic acid ▶ Monosodium L-glutamate
<ul style="list-style-type: none"> ▶ (S)-2,5-Diamino-5-oxopentanoic acid ▶ L-Glutamine 	<ul style="list-style-type: none"> ▶ Glutamine ▶ L-Glutamine 	<ul style="list-style-type: none"> ▶ L-Glutamine ▶ L-Glutamine ethyl ester
Aminoacetic acid	Glycine	<ul style="list-style-type: none"> ▶ Glycine ▶ Glycine hydrochloride ▶ N-Glycyl-L-leucine
<ul style="list-style-type: none"> ▶ (S)-2-Pyrrolidinecarboxylic acid ▶ L-Proline 	L-Proline	L-Proline

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
<ul style="list-style-type: none"> ▶ (S)-2-Amino-3-hydroxypropanoic acid ▶ L-Serine 	L-Serine	L-Serine
<ul style="list-style-type: none"> ▶ (S)-alpha-Amino-4-hydroxybenzenepropanoic acid ▶ L-Tyrosine 	<ul style="list-style-type: none"> ▶ L-Tyrosine ▶ Tyrosine 	<ul style="list-style-type: none"> ▶ L-Tyrosine ▶ L-Tyrosine ethyl ester ▶ N-Acetyl-L-tyrosine

Group 3: Carbohydrates

Proper name(s)	Common name(s)	Source information		
		Source ingredient(s)	Source material(s)	Part(s)
D-Fructose	D-Fructose	N/A	<i>Malus domestica</i>	Fruit
		D-Fructose	N/A	N/A
D-Galactose	D-Galactose	D-Galactose	N/A	N/A
D-Glucose	<ul style="list-style-type: none"> ▶ Dextrose ▶ D-Glucose ▶ Glucose 	<ul style="list-style-type: none"> ▶ D-Glucose monohydrate ▶ Glucose 	N/A	N/A
4-O-beta-D-Galactopyranosyl-D-glucose	Lactose	Lactose	N/A	N/A
Maltodextrin	Maltodextrin	Maltodextrin	N/A	N/A
D-Mannose	D-Mannose	D-Mannose	N/A	N/A
<i>Solanum tuberosum</i> ¹	<ul style="list-style-type: none"> ▶ Potato starch ▶ Starch - Potato 	N/A	<i>Solanum tuberosum</i>	Tuber
<i>Oryza sativa</i> ¹	<ul style="list-style-type: none"> ▶ Rice starch ▶ Starch - Rice 	N/A	<i>Oryza sativa</i>	Seed
D-Ribose	<ul style="list-style-type: none"> ▶ D-Ribose ▶ Ribose 	<ul style="list-style-type: none"> ▶ D-Ribose L-cysteine ▶ Ribose 	N/A	N/A
<ul style="list-style-type: none"> ▶ alpha-D-Glucopyranosyl-beta-D-fructofuranoside ▶ beta-D-Fructofuranosyl-alpha-D-glucopyranoside 	<ul style="list-style-type: none"> ▶ Cane sugar ▶ Saccharose ▶ Sucrose ▶ Sugar 	N/A	<i>Acer saccharum</i>	Sap
			<i>Beta vulgaris</i>	Root
			<i>Borassus flabellifer</i>	Sap
			<i>Malus domestica</i>	Fruit
			<i>Oryza sativa</i>	Seed

Proper name(s)	Common name(s)	Source information		
		Source ingredient(s)	Source material(s)	Part(s)
			<i>Saccharum officinalis</i>	Leaf stalk
<i>Triticum aestivum</i> ¹	<ul style="list-style-type: none"> ▶ Starch - Wheat ▶ Wheat starch 	N/A	<i>Triticum aestivum</i>	Seed endosperm
<i>Zea mays</i> ¹	<ul style="list-style-type: none"> ▶ Corn starch ▶ Starch – Maize ▶ Zea mays starch 	N/A	<i>Zea mays</i>	Seed
<i>Zea mays</i> ¹	Waxy maize starch	N/A	<i>Zea mays</i>	Seed

¹Starch ingredients should be prepared (e.g., gelatinized) such that carbohydrates are readily absorbable.

Group 4: Ergogenic agents

Group 4a: Non-Caffeinated ergogenic agents

Proper name(s)	Common name(s)	Source information			
		Source ingredient(s)	Source material(s)	Part(s)	Preparation(s)
Calcium beta-hydroxy-beta-methylbutyrate	<ul style="list-style-type: none"> ▶ CaHMB ▶ Calcium beta-hydroxy-beta-methylbutyrate 	Calcium beta-hydroxy-beta-methylbutyrate	N/A	N/A	N/A
<ul style="list-style-type: none"> ▶ (L-3-Carboxy-2-hydroxypropyl) trimethylammonium hydroxide, inner salt ▶ (R)-3-Carboxy-2-hydroxy-N,N,N-trimethyl-1-propanaminium hydroxide, inner salt ▶ L-Carnitine ▶ Levocarnitine 	<ul style="list-style-type: none"> ▶ L-Carnitine ▶ Levocarnitine 	<ul style="list-style-type: none"> ▶ L-Carnitine fumarate ▶ L-Carnitine tartrate 	N/A	N/A	N/A
N-(Aminoiminomethyl)-N-methylglycine monohydrate	Creatine monohydrate	Creatine monohydrate	N/A	N/A	N/A
<i>Eleutherococcus senticosus</i>	<ul style="list-style-type: none"> ▶ Ci wu jia ▶ Eleuthero ▶ Siberian ginseng 	N/A	<i>Eleutherococcus senticosus</i>	Root	Dry
<i>Panax ginseng</i>	<ul style="list-style-type: none"> ▶ Asian ginseng ▶ Chinese ginseng ▶ Hong shen ▶ Korean ginseng ▶ Korean red ginseng 	N/A	<i>Panax ginseng</i>	<ul style="list-style-type: none"> ▶ Root ▶ Rootlet 	Dry

Proper name(s)	Common name(s)	Source information			
		Source ingredient(s)	Source material(s)	Part(s)	Preparation(s)
	<ul style="list-style-type: none"> ▶ Oriental ginseng ▶ Panax ginseng ▶ Red ginseng ▶ Ren shen 				

Group 4b: Caffeine

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
<ul style="list-style-type: none"> ▶ 1,3,7-Trimethylxanthine ▶ 3,7-Dihydro-1,3,7-trimethyl-1H-purine-2,6-dione 	Caffeine	<ul style="list-style-type: none"> ▶ Caffeine ▶ Caffeine citrate

Group 5: Vitamins and Minerals

Proper name(s)	Common name(s)	Source information
		Source ingredient(s)
As per the current NNHPD Multi-Vitamin/Mineral Supplement monograph		

Group 6: Complementary ingredients

Proper name(s)	Common name(s)	Source information			
		Source ingredient(s)	Source material(s)	Part(s)	Preparation(s)
<ul style="list-style-type: none"> ▶ 1-Amino-4-guanidinobutane ▶ 4-(Aminobutyl)guanidine 	Agmatine	Agmatine sulfate	N/A	N/A	N/A
<i>Malpighia glabra</i>	<ul style="list-style-type: none"> ▶ Acerola ▶ Barbados cherry tree ▶ Escobillo 	N/A	<i>Malpighia glabra</i>	Fruit	<ul style="list-style-type: none"> ▶ Dry ▶ Fresh
<i>Piper nigrum</i>	<ul style="list-style-type: none"> ▶ Black pepper ▶ Pepper- black ▶ Pepper- white ▶ White pepper 	N/A	<i>Piper nigrum</i>	Fruit	Dry



Proper name(s)	Common name(s)	Source information			
		Source ingredient(s)	Source material(s)	Part(s)	Preparation(s)
<ul style="list-style-type: none"> ▶ (beta-Hydroxyethyl)trimethylammonium ▶ 2-Hydroxy-N,N,N-trimethylethanaminium ▶ Choline 	Choline	<ul style="list-style-type: none"> ▶ Choline ▶ Choline alfoscerate ▶ Choline bitartrate ▶ Choline chloride ▶ Choline citrate ▶ Choline dihydrogen citrate ▶ Choline orotate 	N/A	N/A	N/A
<i>Capsicum annuum</i>	<ul style="list-style-type: none"> ▶ Cayenne ▶ Cayenne pepper ▶ Chili pepper ▶ Paprika ▶ Red Pepper 	N/A	<i>Capsicum annuum</i>	Fruit	Dry
<i>all-trans</i> -Lycopene	Lycopene	N/A	<i>Solanum lycopersicum</i>	Fruit flesh	N/A
		Lycopene	N/A	N/A	
<ul style="list-style-type: none"> ▶ (S)-2,5-Diaminopentanoic acid ▶ (S)-alpha,delta-Diaminovaleric acid 	L-Ornithine	<ul style="list-style-type: none"> ▶ L-Ornithine ▶ L-Ornithine hydrochloride ▶ L-Ornithine-L-aspartate ▶ Ornicetil 	N/A	N/A	N/A
2-Aminoethanesulfonic acid	Taurine	<ul style="list-style-type: none"> ▶ L-Arginine taurinate ▶ Taurine ▶ Taurine ethyl ester 	N/A	N/A	N/A

References: NHPID 2019.

Route of administration

Oral

Dosage form(s)

This monograph excludes foods or food-like dosage forms as indicated in the Compendium of Monographs Guidance Document.

Acceptable dosage forms for oral use are indicated in the dosage form drop-down list of the web-based Product Licence Application form for Compendial applications.

Note

Liquids and solutions are not permitted for products containing Creatine monohydrate, due to lack of stability of the finished product (Dash and Sawhney 2002).

Use(s) or Purpose(s)

Note

See Ingredient Combination section below.

Products providing at least 2.6 g of protein and/or amino acids from Groups 1, 2a and 2b or containing at least one ingredient from any of Groups 3, 4a or 4b, at or above the relevant minimum doses indicated in the Dose section below

- ▶ Workout supplement
- ▶ Athletic support

Products containing at least one ingredient from Group 1, at or above the minimum dose indicated in the Dose section below

- ▶ Source of protein for the maintenance of good health (CFIA 2019).
- ▶ Source of protein which helps build and repair body tissues (CFIA 2019).
- ▶ Source of amino acids involved in muscle protein synthesis (IOM 2005).
- ▶ Assists in the building of lean muscle tissue/mass when combined with regular weight/resistance training and a healthy balanced diet (NNHPD 2019).

Products containing at least one ingredient from Group 2a, at or above the respective minimum dose indicated in the Dose section below

- ▶ Source of (an) essential amino acid(s) for the maintenance of good health (CNF 2019).
- ▶ Source of (an) (essential) amino acid(s) involved in muscle protein synthesis (IOM 2005).
- ▶ Assists in the building of lean muscle tissue/mass when combined with regular weight/resistance training and a healthy balanced diet (NNHPD 2019).

Products containing all three of L-leucine, L-isoleucine and L-valine, at or above the respective minimum doses indicated in the Dose section below

Source of branched chain amino acids (BCAAs), which are involved in protein synthesis (IOM 2005).



Products containing at least one ingredient from Group 2b, at or above the respective minimum dose indicated in the Dose section below

Source of (an) (non-essential) amino acid(s) involved in muscle protein synthesis (IOM 2005).

Products containing Beta-Alanine, at or above a minimum dose of 800 mg per single dose and 4.8 g, per day

Increases muscle carnosine levels, a factor in delaying neuromuscular fatigue in intermittent high intensity exercises (Hoffman et al. 2008; Hills et al. 2007; Derave et al. 2007; Harris 2006; Stout et al. 2006).

Products containing L-glutamine, at or above a minimum dose of 5 g, per day

- ▶ Helps restore plasma glutamine levels depleted after periods of physical stress (e.g. prolonged exhaustive exercise) (Krzywkowski et al. 2001; Bowtell et al. 1999; Castell and Newsholme 1997).
- ▶ Helps to assist in muscle cell repair after exercise (Newsholme et al. 2003; IOM 2005).

Products containing at least one ingredient from Group 3, at or above the minimum dose indicated in the Dose section below

- ▶ Source of carbohydrates to support energy production (IOM 2005).
- ▶ Source of calories which contributes to weight gain (IOM 2005).
- ▶ Helps to maintain performance/promote endurance in extended (greater than 60 min), high intensity exercise (Kerksick et al. 2008).

Products containing at least one ingredient from Group 4a, at or above the relevant minimum doses indicated in the Dose section below

Helps increase physical performance during intensive exercise (NNHPD 2019).

Additionally, the following recommended uses may be indicated for products containing the corresponding medicinal ingredients, at or above the relevant minimum doses indicated in the Dose section below:

Calcium beta-hydroxy-beta-methylbutyrate (CaHMB)

Enhances muscle strength in previously untrained individuals in combination with intense resistance training exercise (NNHPD 2019).

L-Carnitine sourced from L-Carnitine tartrate

- ▶ Aids in the muscle recovery process by reducing muscle tissue damage associated with a resistance training regimen (Ho et al. 2010; Spiering et al. 2008; Spiering et al. 2007;



- Kraemer et al. 2006; Kramer et al. 2003; Volek et al. 2002).
- ▶ Helps support muscle tissue repair in individuals involved in resistance training (Ho et al. 2010; Spiering et al. 2008; Spiering et al. 2007; Kraemer et al. 2006; Kramer et al. 2003; Volek et al. 2002).
 - ▶ Helps improve physical performance when used in conjunction with a training regimen (Wall et al. 2011; Cha et al. 2001; Arenas et al. 1994; Huertas et al. 1992; Arenas et al. 1991; Vecchiet et al. 1990; Marconi et al. 1985).
 - ▶ Helps delay fatigue during physical activity (Cha et al. 2011; Wall et al. 2011; Karahan et al. 2010).
 - ▶ Helps support fat metabolism (Stephens et al. 2007; Karlic and Lohninger 2004; Müller et al. 2002).
 - ▶ Helps support fat oxidation (Wall et al. 2011; Stephens et al. 2007; Wutzke and Lorenz 2004; Müller et al. 2002).
 - ▶ Helps support fat metabolism and oxidation (Wall et al. 2011; Stephens et al. 2007; Karlic and Lohninger 2004; Wutzke and Lorenz 2004; Müller et al. 2002).
 - ▶ Workout support/supplement that helps improve physical performance when used in conjunction with a training regimen (Wall et al. 2011; Cha et al. 2001; Arenas et al. 1994; Huertas et al. 1992; Arenas et al. 1991; Vecchiet et al. 1990; Marconi et al. 1985).
 - ▶ Workout support/supplement that delays fatigue during physical activity (Wall et al. 2011; Stephens et al. 2007; Karlic and Lohninger 2004; Müller et al. 2002; Cha et al. 2001; Arenas et al. 1994; Huertas et al. 1992; Arenas et al. 1991; Vecchiet et al. 1990; Marconi et al. 1985).

Products containing L-Citrulline at or above a minimum dose of 3 g, per day

L-Citrulline is a precursor of L-Arginine (Ochiai et al. 2012; Waugh et al. 2001).

Products containing L-Citrulline sourced from Citrulline malate at or above a minimum dose of 1.7 g (equivalent to 3 g citrulline malate), per day

Supports an increase in athletic performance in high-intensity anaerobic exercise with short rest period (Perez-Guisado and Jakeman 2010; Bailey et al. 2015; Bendahan et al. 2002).

Creatine monohydrate

- ▶ Increases body/(lean)muscle mass/size when used in conjunction with a resistance training regimen (Brose et al. 2003; Bemben et al. 2001; Volek et al. 1999; Vandenberghe et al. 1997)
- ▶ Improves strength/power/performance in repetitive bouts of brief, highly-intense physical activity (e.g. sprints, jumping, resistance training) (by increasing muscle/intramuscular creatine/phosphocreatine/energy levels) (Okudan and Gökbel 2005; Brose et al. 2003; Preen et al. 2003; Bemben et al. 2001; Volek et al. 1999; Vandenberghe et al. 1997; Hultman et al. 1996)



Eleuthero/Siberian ginseng

Eleuthero/Siberian ginseng is used in Herbal Medicine to help improve physical performance after periods of physical exertion (Bradley 2006; ESCOP 2003; Hoffmann 2003; Mills and Bone 2000).

Panax ginseng

(Chinese/Korean/*Panax*) ginseng is used in Herbal Medicine to help enhance physical capacity/performance (in cases of physical stress) (Kim et al. 2005; ESCOP 2003; Gross et al. 2002; WHO 1999; Gross et al. 1995; Sotaniemi et al. 1995; Schepdael 1993).

Products containing Caffeine (Group 4b), at or above the minimum dose indicated in the Dose section below

- ▶ Helps (temporarily) to relieve fatigue, to promote endurance, and to enhance motor performance (Philip et al. 2006; Doherty and Smith 2005; Smith et al. 2005).
- ▶ Helps (temporarily) to enhance (physical) energy (Philip et al. 2006; Doherty and Smith 2005; Smith et al. 2005).
- ▶ Helps (temporarily) to reduce tiredness and fatigue (Philip et al. 2006; Doherty and Smith 2005; Smith et al. 2005).

Additional claims

Products containing ingredients from Group 5, at or above the minimum doses indicated in the Dose section below

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Note

Claims from the NNHPD Multi-Vitamin/Mineral Supplements Monograph are only acceptable in addition to at least one claim from Groups 1 to 4.

Ingredient Combinations

All ingredients included in this monograph may be combined together, across all Groups, with the following restriction:

Products containing caffeine must indicate the recommended use or purpose for Group 4b, and may not indicate any recommended uses or purposes related to the maintenance/support of good/general health.

Dose(s)

Subpopulation(s)

Adults 18 years and older

Quantity(ies)

Note

The minimum doses indicated below must be met only for medicinal ingredients which are directly supporting any indicated uses or purposes, as per the Use(s) or Purpose(s) section above.

Group 1 (Proteins)

Methods of preparation: Isolate, Standardized extracts (Extract dry)

The potency of protein on an “as is” weight basis is required to be indicated on the Product License Application form and label for each medicinal ingredient from Group 1.

Total amount of protein from Group 1 + amounts of amino acids from Groups 2a and 2b in the product

2.6 - 90 grams, per day (IOM 2005).

Group 2a (Essential amino acids)

Medicinal Ingredients	Doses	
	Minimum/day	Maximum/day ¹
Histidine	49 mg	220 mg
Isoleucine	66.5 mg	3,500 mg
Leucine	147 mg	7,000 mg
Lysine	133 mg	3,000 mg
Methionine	66.5 mg	1,000 mg
Phenylalanine	115.5 mg	339 mg
Threonine	70 mg	301 mg
Tryptophan	17.5 mg	220 mg
Valine	84 mg	3,500 mg

Reference: Doses: Verhoeven et al. 2009; Guttuso et al. 2008; IOM 2005; Coombes and McNaughton 2000; Bassit et al. 2002; Plaitakis et al. 1988; Berry et al. 1982.

¹When combining individual amino acids with protein ingredients, applicants must consider the contribution of the protein ingredient(s) to the total dose of each amino acid, in order to respect the maximum doses indicated above.

Group 2b (Non-essential amino acids)

Medicinal Ingredients	Doses		
	Minimum/day	Maximum/day ¹	Maximum/single dose
Alanine	181.5 mg	363 mg	N/A
Arginine	208.5 mg	9,000 mg	N/A
Asparagine	4.6 mg	93.5 mg	N/A
Aspartic acid	325 mg	1,000 mg	N/A
Beta-Alanine	240 mg	6,400 mg	3,200 mg
Citrulline sourced from L-citrulline ethyl ester or L-citrulline	150 mg	6,000 mg	3,000 mg
Citrulline sourced from L-citrulline malate	150 mg	3,400 mg	1,700 mg
Cysteine	50 mg	1,000 mg	N/A
Glutamic acid	750 mg	1,500 mg	N/A
Glutamine	342.5 mg	9,000 mg	N/A
Glycine	160 mg	1,800 mg	N/A
Proline	259.5 mg	519 mg	N/A
Serine	175.5 mg	351 mg	N/A
Tyrosine	139 mg	3,600 mg	N/A

References: Doses: NNHPD 2019, Lenders et al. 2009, IOM 2005, Derave et al. 2007, Hills et al. 2007

¹When combining individual amino acids with protein ingredients, applicants must consider the contribution of the protein ingredient(s) to the total dose of each amino acid, in order to respect the maximum doses indicated above.

Group 3 (Carbohydrates)

Combined dose for all ingredients from Group 3 in the product

6.5 - 180 grams, per day; Not to exceed 45 grams per single dose (Dietitians of Canada 2013).

Group 4a (Non-caffeinated ergogenic agents)

Medicinal Ingredients	Uses or purposes	Methods of preparation	Doses		
			Minimum /day	Maximum /day	Maximum/ single dose
Calcium beta-hydroxy-beta-methylbutyrate	Enhances muscle strength in previously untrained individuals in combination with intense resistance training exercise	N/A	3 g	6 g	N/A

Medicinal Ingredients	Uses or purposes	Methods of preparation	Doses		
			Minimum /day	Maximum /day	Maximum/ single dose
L-Carnitine	Muscle recovery, Muscle tissue repair, Workout support/supplement	N/A	1 g	4 g	2 g
	Physical performance, Fatigue, Workout support/supplement combined with Physical performance/Fatigue		2 g		
	Fat metabolism, Fat oxidation		3 g		
<i>Eleutherococcus senticosus</i>	Eleuthero/Siberian ginseng is used in Herbal Medicine to help improve physical performance after periods of physical exertion	Dry, Powder, Non-Standardised Extracts (Dry extract, Tincture, Fluid Extract, Decoction, Infusion)	0.91 g of dried root	6 g of dried root	N/A
<i>Panax ginseng</i>	(Chinese/Korean/ <i>Panax</i>) ginseng is used in Herbal Medicine to help enhance physical capacity/performance (in cases of physical stress)	Dry, Powder, Non-Standardised Extracts (Dry extract, Tincture, Fluid extract, Decoction, Infusion)	0.5 g of dried root/rootlets	9 g of dried root/rootlets	N/A
		Standardized Extracts (Dry extract)	200 mg of extract standardized to 4-7% of total ginsenosides; Not to exceed 9 g of dried root/rootlets per day	600 mg of extract standardized to 4-7% of total ginsenosides; Not to exceed 9 g of dried root/rootlets per day	N/A

References: Doses: CaHMB: Rowlands and Thomson 2009, Gallagher et al. 2000a,b. Carnitine: Wall et al. 2011, Ho et al. 2010, Spiering et al. 2008, Spiering et al. 2007, Stephens et al. 2007, Kraemer et al. 2006, Karlic and Lohninger 2004, Wutzke and Lorenz 2004, Kramer et al. 2003, Müller et al. 2002,

Volek et al. 2002, Benvenga et al. 2001, Cha et al. 2001, Ahmet et al. 2000, Arenas et al. 1994, Huertas et al. 1992, Arenas et al. 1991, Vecchiet et al. 1990, Harper et al. 1988, Marconi et al. 1985. Eleuthero : Bradley 2006, ESCOP 2003, Hoffmann 2003, Blumenthal et al. 2000, Mills and Bone 2000. Panax ginseng : Vuksan et al. 2008, Reay et al. 2006, Sievenpiper et al. 2006, Reay et al. 2005, Sünram-Lea et al. 2005, Kennedy et al. 2004, ESCOP 2003, Kennedy et al. 2002, Scholey and Kennedy 2002, Engels et al. 2001, Kennedy et al. 2001, Scaglione et al. 2001, Blumenthal et al. 2000, Tetsutani et al. 2000, McGuffin et al. 1997, Engels et al. 1996, Scaglione et al. 1996, Gross et al. 1995, Scaglione et al. 1994, Scaglione et al. 1990, Petkov and Mosharrof 1987, D'Angelo et al. 1986, Soldati and Sticher 1980.

Dose(s) and duration(s) of use for creatine monohydrate

Medicinal Ingredient	Phases		Doses			Durations of use
			Minimum/day	Maximum/day	Maximum /single dose	
Creatine monohydrate	Loading Phase	Option 1	15 g	20 g	5 g	5-7 days
		Option 2	3 g	5 g	N/A	Use for a minimum of 4 weeks
	Maintenance Phase		2 g	5 g	N/A	N/A

References: Doses: Option 1: Okudan and Gokbel 2005, Preen et al. 2003, Bembem et al. 2001, Vandenberghe et al. 1997, Hultman et al. 1996. Option 2: Hultman et al. 1996. Maintenance phase: Preen et al. 2003, Bembem et al. 2001, Volek et al. 1999, Vandenberghe et al. 1997, Hultman et al. 1996.

Group 4b (Caffeine)

100 - 400 milligrams, per day and 100 - 200 milligrams per single dose (HC 2012).

Note

Maximum daily dose of 1000 milligrams from NNHPD Caffeine monograph does not apply for Workout Supplements as this maximum dose is not acceptable for prolonged use.

Group 5 (Vitamins and Minerals)

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Group 6 (Complementary ingredients)

Medicinal ingredients	Methods of preparation	Doses	
		Minimum/day	Maximum/day
Agmatine	N/A	> 0 mg	2,000 mg
Choline	N/A	> 0 mg	1,000 mg

Medicinal ingredients	Methods of preparation	Doses	
		Minimum/day	Maximum/day
<i>Capsicum annuum</i>	Dry, Powder, Non-Standardised Extracts (Dry extract, Tincture, Fluid Extract, Decoction, Infusion)	> 0 mg dried fruit	650 mg of dried fruit
Lycopene	N/A	> 0 mg	30 mg
L-Ornithine	N/A	> 0 mg	1,500 mg
<i>Malpighia glabra</i>	Dry, Powder, Non-Standardised Extracts (Dry extract, Tincture, Fluid Extract, Decoction, Infusion)	> 0 mg dried or fresh fruit	10 g of dried fruit
			100 g of fresh fruit
<i>Piper nigrum</i>	Dry, powdered	> 0 mg dried fruit	25 mg of dried fruit
Taurine	N/A	> 0 mg	3,000 mg

References: Doses: NNHPD 2019; CNF 2019; Wong et al. 2016; Figueroa et al. 2015; Kenyan et al. 2010.

Direction(s) for use

All products (optional)

Ensure to drink optimal fluid before, during, and after exercise.

Products containing Creatine monohydrate and making Creatine claims

Phase(s)		Direction(s) for use
Loading Phase	Option 1	Step 1 (Loading Phase): Start with a loading phase of 5-7 days (15-20 g/d) and follow with a maintenance phase (2- 5g/d)
	Option 2	Step 1 (Loading Phase): Start with a loading phase of 4 weeks (3-5 g/d) and follow with a maintenance phase (2-5 g/d)
Maintenance Phase		Step 2 (Maintenance Phase): No statement required

Reference: NNHPD 2019.

Products containing L-Carnitine and making Muscle recovery, Muscle tissue repair, Workout support/supplement, Physical performance, or Fatigue claims

Take 2-4 hours prior to exercise (Harper et al. 1988).

Products providing more than 200 mg of caffeine, per day (i.e. to be taken in divided doses)

Wait 3 to 4 hours between each dose



Products containing Whey protein

Take a few hours before or after taking other medications or natural health products (Martindale 2009; Jung et al. 1997).

Products in powder form

Mix product in enough of liquid (water, juice, etc.) to ensure that the powder is drinkable immediately before consumption.

Products for increasing exercise performance (optional)

Consume 45-90 minutes before exercising (Aragon and Schoenfeld 2013).

Products for repairing body tissues/muscles and restoring plasma glutamine levels (optional)

Consume no later than 90 minutes after exercising (Aragon and Schoenfeld 2013).

Products for endurance based on ingredients from Group 3 (Carbohydrates) (optional)

Consume 30-60 grams of carbohydrates, per hour of high intensity exercise (Saunders et al. 2007; Ivy et al. 2003).

Products containing Vitamins and/or Minerals

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Duration(s) of use

Products providing more than 200 mg of Agmatine, per day

Consult a health care practitioner/health care provider/health care professional/doctor/physician for use beyond 3 weeks (Gilad and Gilad 2014; Kenyan et al. 2010).

Products providing 0.42 g and more of L-Arginine, per day

Consult a health care practitioner/health care provider/health care professional/doctor/physician for use beyond 6 weeks if you suffer from a cardiovascular disease (Shao and Hathcock 2008; Sydow et al. 2002; Hambrecht et al. 2000; Clarkson et al. 1996; Rector et al. 1996).

Products providing more than 3 g of L-Citrulline, per day

Consult a health care practitioner/health care provider/health care professional/doctor/physician for use beyond 8 weeks (Behpour et al. 2020; Wong et al. 2016; Figueroa et al. 2015).



Product providing more than 3 g of Beta-Alanine, per day

Consult a health care practitioner/health care provider/health care professional/doctor/ physician for use beyond 10 weeks (Derave et al. 2007; Hills et al. 2007).

Products containing Eleuthero

Consult a health care practitioner/health care provider/health care professional/doctor/physician for use beyond 1 month (ES COP 2003).

Products containing Panax ginseng

Consult a health care practitioner/health care provider/health care professional/doctor/physician for use beyond 3 months (Bradley 2006; Mills and Bone 2005; Blumenthal et al. 2000; McGuffin et al. 1997).

Products containing Vitamins and/or Minerals

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Risk information

Caution(s) and warning(s)

All products

Consult a healthcare practitioner/health care provider/health care professional/doctor/physician prior to use if you are pregnant or breastfeeding.

Products containing milk by-products (such as casein/caseinates, whey and milk proteins)

This product contains milk by-products.

Products providing more than 30 g total protein and/or amino acids (including beta-alanine), per day

Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have liver or kidney disease (Shils et al. 2006).

Products containing Caffeine

- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have high blood pressure, glaucoma, and/or overactive bladder syndrome (detrusor instability) (Cornelis and El-Sohemy 2007, Chandrasekaran et al. 2005,



Noordzij et al. 2005, Avisar et al. 2002, Arya et al. 2000, Jee et al. 1999, Creighton and Stanton 1990).

- ▶ Avoid taking with health products or foods that contain caffeine and/or increase blood pressure (e.g. medications, coffee, tea, colas, cocoa, guarana, mate, bitter orange extract, synephrine, octopamine, ephedra, ephedrine) (Bui et al. 2006; Bouchard et al. 2005; Haller et al. 2005; FDA 2004; Berardi et al. 2002; Vahedi et al. 2000; Zimmerman 1992; FDA 1988).
- ▶ This product is not intended as a substitute for sleep (Berardi et al. 2002, Zimmerman 1992, FDA 1988).

Products providing 200 mg or more of Caffeine, per day and recommended for endurance, motor performance, physical energy or to be taken prior to workout

Caffeine has been shown to reduce blood flow to the heart muscle during exercise which might lead to cardiovascular complications such as chest pain, and irregular heartbeat even in healthy individuals. Stop use and consult a health care practitioner/health care provider/health care professional/doctor/physician if those symptoms occur (Higgins and Babu 2013).

Products providing more than 300 mg of Caffeine, per day

Consult a health care practitioner/health care provider/health care professional/doctor/physician if you are of childbearing age, pregnant or breastfeeding (Nawrot et al. 2003).

Products containing CaHMB

Consult a health care practitioner /health care provider/health care professional/doctor/physician prior to use if you are taking medications for high cholesterol (Nissen et al. 2000).

Products containing Cayenne

- ▶ Keep out of reach of children.
- ▶ Call a Poison Control Center immediately if overdose or accidental ingestion occurs (CPS 2008).
- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have stomach ulcers or inflammation (Brinker 2010; Bradley 2006; Boon and Smith 2004).

Products containing Creatine monohydrate

- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have kidney disease/disorder (Pline and Smith 2005; Pritchard and Kalra 1998).
- ▶ May result in weight gain (Volek and Rawson 2004; Bemben et al. 2001; Mihic et al. 2000)

Products providing more than 200 mg of Agmatine, per day

- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have a mood/affective or psychiatric disorder, diabetes or a cardiovascular disease (Freitas et al. 2016; Nissim et al. 2014; Payandemehr et al. 2013; Piletz et al. 2013; Shopsin 2013; Uzbay et al. 2013; Su et al. 2003).
- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you are taking antidepressant or opioid analgesic medications (Freitas et al. 2016; Payandemehr et al. 2013; Shopsin 2013; Uzbay et al. 2013; Su et al. 2003).

Products providing more than 0.42 g of L-Arginine, per day

- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you suffer from cardiovascular disease and are attempting an increase in physical activity or if your cardiovascular condition worsens (Doutreleau et al. 2010; Doutreleau et al. 2006; Schulman et al. 2006; Nagaya et al. 2001; Bednarz et al. 2000; Ceremuzynski et al. 1997; Rector et al. 1996).
- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you are taking medication for cardiovascular diseases, erectile dysfunction, and/or blood thinners (Huynh et al. 2002; Parker et al. 2002; Siani et al. 2000; Adams et al. 1995).

Products containing L-Carnitine

Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have a seizure disorder (CPS 2008).

Products containing Eleuthero

Consult a health care practitioner/health care provider/health care professional/doctor/physician if you have any type of acute infection (Brinker 2010; Barnes et al. 2007; ESCOP 2003; Mills and Bone 2000).

Products containing Panax ginseng

- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you have diabetes (Brinker 2010; Vuksan et al. 2008; Seely et al. 2008; Sievenpiper et al. 2006; ESCOP 2003; Tetsutani et al. 2000; Sotaniemi et al. 1995; Chin 1991).
- ▶ Consult a health care practitioner/health care provider/health care professional/doctor/physician prior to use if you are taking antidepressant medication, blood thinners or digoxin (Brinker 2010; Lee et al. 2008a; Dasgupta and Reyes 2005; Janetzki and Morreale 1997; Gonzalez-Seijo et al. 1995; Shader and Greenblatt 1988; Jones and Runikis 1987; Shader and Greenblatt 1985).



Products containing Vitamins and/or Minerals

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Contraindication(s)

Products providing more than 0.42 g of L-Arginine, per day

Do not use this product if you have had a heart attack/myocardial infarction (Schulman et al. 2006).

Products containing Eleuthero

Do not use this product if you have high blood pressure (Brinker 2010; Barnes et al. 2007; Blumenthal et al. 2000; Mills and Bone 2000; McGuffin et al. 1997).

Products containing Vitamins and/or Minerals

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Known adverse reaction(s)

Products containing beta-Alanine

Reduce the dose if flushing, tingling and/or prickling sensation of the skin occurs (Harris et al. 2006; Hill et al. 2007; Jordan et al. 2010)

Products containing Caffeine

Stop use if hypersensitivity/allergy occurs (Infante et al. 2003; Hinrichs et al. 2002).

Products providing more than 200 mg of Agmatine, per day or more than 0.42 g of L-Arginine, per day or more than 30 g of protein, per day

Some people may experience gastrointestinal discomfort/disturbance(s) (Keynan et al. 2010; Grimble 2007; Evans et al. 2004; Clarkson et al. 1996).

Products containing Panax ginseng

Stop use if you experience insomnia, anxiety or headaches (Lee et al. 2008b; Vuksan et al 2008; de Andrade et al. 2007; Sievenpiper et al. 2006; Coon and Ernst 2002; Ellis and Reddy 2002; Scaglione et al. 2001; Siegel 1979).

Products containing Vitamins and/or Minerals

As per the current NNHPD Multi-Vitamin/Mineral Supplements Monograph.

Non-medicinal ingredients

Must be chosen from the current Natural Health Products Ingredients Database (NHPID) and must meet the limitations outlined in the database.

Storage conditions

Store in a cool, dry place.

Specifications

- ▶ The finished product specifications must be established in accordance with the requirements described in the Natural and Non-prescription Health Products Directorate (NNHPD) Quality of Natural Health Products Guide.
- ▶ The medicinal ingredient must comply with the requirements outlined in the NHPID.

Hemp protein, Hemp protein isolate and Hemp seed protein

Must not contain more than 10 parts per million delta-9-Tetrahydrocannabinol (THC), or phytocannabinoids that have been isolated or concentrated. The determination of the THC concentration must take into account the potential to convert delta-9-tetrahydrocannabinolic acid (THCA) to THC. These hemp derivatives must also be compliant with the Industrial Hemp Regulations (IHR). All sources of hemp falling under the IHR are expected to be of an approved cultivar, defined in the IHR as any variety of industrial hemp set out in the List of Approved Cultivars, published by the Government of Canada on its website, as amended from time to time. (GC 2018a; GC 2018b; GC 2003; HC 2019; HC 2018)

Creatine monohydrate

The finished product and/or raw material specifications must have limits for the following impurities: not more than 100 ppm creatinine; not more than 50 ppm dicyandiamide; non-detectable dihydrotriazine. The method used to detect dihydrotriazine must have a limit of detection of not more than 5 ppm.



References cited

Adams MR, Forsyth CJ, Jessup W, Robinson J, Celermajer DS. Oral L-arginine inhibits platelet aggregation but does not enhance endothelium-dependent dilation in healthy young men. *Journal of the American College of Cardiology* 1995;26(4):1054-1061.

Ahmet U, Abdurrahman K, Sait B, Ahmet E, Salih D, Mendane S, Ates Y, Fatih B, Necmettin K, Kemal D. L-carnitine therapy in non-alcoholic steatohepatitis. *Turkish Journal of Pediatrics* 2000;11(3):196-201.

Aragon AA, Schoenfeld BJ. Nutrient timing revisited: is there a post-exercise anabolic window? *Journal of the International Society of Sports Nutrition* 2013;10(5).

Arenas J, Huertas R, Campos Y, Diaz AE, Villalon JM, Vilas E. Effect of L-carnitine on the pyruvate dehydrogenase complex and carnitine palmitoyl transferase activities in muscle of endurance athletes. *FEBS Letters* 1994;341:91-93.

Arenas J, Ricoy JR, Encinas AR, Pola P, D'Iddio S, Zeviani M, Didonato S, Corsi M. Carnitine in muscle, serum, and urine of nonprofessional athletes: Effects of physical exercise, training, and L-carnitine administration. *Journal of Muscle & Nerve* 1991;14:598-604.athletes. *FEBS Letters* 1994;341:91-93.

Arya LA, Myers DL, Jackson ND. Dietary caffeine intake and the risk for detrusor instability: a case-control study. *Obstetrics and Gynecology* 2000;96(1):85-89.

Avisar R, Avisar E, Weinberger D. Effect of coffee consumption on intraocular pressure. *The Annals of Pharmacotherapy* 2002;36(6):992-995.

Barnes J, Anderson LA, Philipson JD. *Herbal Medicines*, 3rd edition. London (UK): The Pharmaceutical Press; 2007.

Bassit RA, Sawada LA, Bacurau RFP, Navarro F, Martins Jr E, Santos RVT, Caperuto EC, Rogeri P, Costa Rosa LFBP. Branched-chain amino acid supplementation and the immune response of long-distance athletes. *Nutrition* 2002;18(5):376-379.

Bailey SJ, Blackwell JR, Lord T, Vanhatalo A, Winyard PG, Jones AM. L-Citrulline supplementation improves O₂ uptake kinetics and high-intensity exercise performance in humans. *Journal of Applied Physiology* 2015;119(4):385-395.

Bednarz B, Wolk R, Chamiec T, Herbaczynska-Cedro K, Winek D, Ceremuzynski L. Effects of oral L-arginine supplementation on exercise-induced QT dispersion and exercise tolerance in stable angina pectoris. *International Journal of Cardiology* 2000;75(2-3):205-210.

Bemben MG, Bemben DA, Loftiss DD, Knehans AW. Creatine supplementation during resistance training in college football athletes. *Medicine & Science in Sports & Exercise*



2001;33(10):1667-1673.

Bendahan D, Mattei JP, Ghattas B, Confort-Gouny S, Le Guern ME, Cozzone PJ. Citrulline/malate promotes aerobic energy production in human exercising muscle. *British Journal of Sports Medicine* 2002;36(4):282-289.

Benvenga S, Ruggeri RM, Russo A, Lapa D, Campenni A, Trimarchi F. Usefulness of L-carnitine, a naturally occurring peripheral antagonist of thyroid hormone action, in iatrogenic hyperthyroidism: a randomized, double-blind, placebo-controlled clinical trial. *Journal of Clinical Endocrinology and Metabolism* 2001;86(8):3579-3594.

Behpour N, Moradi F, Tadibi V. The Effect of Resistance Training Program with Citrulline-Malate on Blood Pressure, Nitric Oxide, and Vascular Endothelial Growth Factor in Postmenopausal Women with Prehypertension. *Journal of Fasa University of Medical Sciences* 2020;10(1):1913-1922.

Berardi RR, DeSimone EM, Newton GD, Oszko MA, Popovich NG, Rollins CJ, Shimp LA, Tietze KJ, editors. *Handbook of Nonprescription Drugs: An Interactive Approach to Self-Care*, 13th edition. Washington (DC): American Pharmaceutical Association; 2002.

Berry HK, Bofinger MK, Hunt MM, Phillips PJ, Guilfoile MB. Reduction of Cerebrospinal Fluid Phenylalanine after Oral Administration of Valine, Isoleucine, and Leucine. *Pediatric Research* 1982;16:751-755.

Blumenthal M, Goldberg A, Brinkmann J, editors. *Herbal Medicine: Expanded Commission E Monographs*. Boston (MA): Integrative Medicine Communications; 2000.

Boon H, Smith MJ. *The Complete Natural Medicine Guide to the 50 Most Common Medicinal Herbs*, 2nd edition. Toronto (ON): Robert Rose Inc; 2004.

Bouchard NC, Howland MA, Greller HA, Hoffman RS, Nelson LS. Ischemic stroke associated with use of an ephedra-free dietary supplement containing synephrine. *Mayo Clinic Proceedings* 2005;80(4):541-545.

Bowtell JL, Gelly K, Jackman ML, Patel A, Simeoni M, Rennie MJ. Effect of oral glutamine on whole body carbohydrate storage during recovery from exhaustive exercise. *Journal of Applied Physiology* 1999;86(6):1770-1777.

Bradley PR, editor. *British Herbal Compendium: A Handbook of Scientific Information on Widely Used Plant Drugs, Volume 2*. Bournemouth (UK): British Herbal Medicine Association; 2006.

Brinker F. *Herb Contraindications and Drug Interactions*, 4th edition. Sandy (OR): Eclectic Medical Publications; 2010.

Brose A, Parise G, Tarnopolsky MA. Creatine supplementation enhances isometric strength and body composition improvements following strength exercise training in older adults. *The Journals of Gerontology Series A: Biological Science and Medical Science* 2003;58(1):11-19.

Bui LT, Nguyen DT, Ambrose PJ. Blood pressure and heart rate effects following a single dose of bitter orange. *The Annals of Pharmacotherapy* 2006;40(1):53-57.

Castell LM, Newsholme EA. The effects of oral glutamine supplementation on athletes after prolonged, exhaustive exercise. *Nutrition* 1997;13(7-8):738-42.

Ceremuzynski L, Chamiec T, Herbaczynska-Cedro K. Effect of supplemental oral L- arginine on exercise capacity in patients with stable angina pectoris. *The American Journal of Cardiology* 1997;80(3):331-333.

CFIA 2019: Canadian Food Inspection Agency. Specific nutrient content claim requirements, Ottawa (ON): Canadian Food Inspection Agency and Health Canada. Internet. [Accessed 2019 March 5]. Available from: <http://www.inspection.gc.ca/food/general-food-requirements-and-guidance/labelling/for-industry/eng/1383607266489/1383607344939>

Cha Y-S, Choi S-K, Suh H, Lee S-N, Cho D, Lim K. Effects of carnitine coingested caffeine on carnitine metabolism endurance capacity in athletes. *Journal of Nutritional Science and Vitaminology* 2001;47:378-384.

Chandrasekaran S, Rohtchina E, Mitchell P. Effects of caffeine on intraocular pressure: the Blue Mountains Eye Study. *Journal of Glaucoma* 2005;14(6):504-507.

Chin RKH. Ginseng and common pregnancy disorders. *Asia-Oceania Journal of Obstetrics and Gynaecology* 1991;17(4):379-380.

Clarkson P, Adams MR, Powe AJ, Donald AE, McCredie R, Robinson J, McCarthy SN, Keech A, Celermajer DS, Deanfield JE. 1996. Oral L-arginine endothelium-dependent dilation in hypercholesterolemic young adults. *Journal of Clinical Investigation* 97(8):1989-1994.

CNF 2019: Canadian Nutrient File (CNF). Nutrition & Healthy Eating, Food and Nutrition, Health Canada. [Accessed 2019 March 5]. Available from: <https://food-nutrition.canada.ca/cnf-fce/serving-portion.do?id=1484>

Coombs JS, McNaughton LR. Effects of branched-chain amino acid supplementation on serum creatine kinase and lactate dehydrogenase after prolonged exercise. *The Journal of Sports Medicine and Physical Fitness* 2000;40(3):240-246.

Coon JT, Ernst E. Panax ginseng: a systematic review of adverse effects and drug interactions. *Drug Safety* 2002;25(5):323-344.

Cornelis MC, El-Soheby A. Coffee, caffeine, and coronary heart disease. *Current Opinion in*



Lipidology 2007;18(1):13-19.

CPS 2008: Compendium of Pharmaceuticals and Specialties: The Canadian Drug Reference for Health Professionals. Ottawa (ON): Canadian Pharmacists Association 2008.

Creighton SM, Stanton SL. Caffeine: does it affect your bladder? British Journal of Urology 1990;66(6):613-614.

D'Angelo L, Grimaldi R, Caravaggi M, Marcoli M, Perucca E, Lecchini S, Frigo GM, Crema A. A double-blind, placebo-controlled clinical study on the effect of a standardized ginseng extract on psychomotor performance in healthy volunteers. Journal of Ethnopharmacology 1986;16(1):15-22.

Dasgupta A, Reyes MA. Effect of Brazilian, Indian, Siberian, Asian, and North American ginseng on serum digoxin measurement by immunoassays and binding of digoxin-like immunoreactive components of ginseng with Fab Fragment of antidigoxin antibody (Digiband). American Journal of Clinical Pathology 2005;124(2):229-236.

Dash AK, Sawhney A. A simple LC method with UV detection for the analysis of creatine and creatinine and its application to several creatine formulations. Journal of Pharmaceutical and Biomedical Analysis 2002;29(5):939-945.

de Andrade E, de Masquita AA, de Almeida Claro J, de Andrade PM, Ortiz V, Paranhos M, Srougi M. Study of the efficacy of Korean Red Ginseng in the treatment of erectile dysfunction. Asian Journal of Andrology 2007;9(2):241-244.

Derave W, Ozdemir MS, Harris RC, Pottier A, Rayngoudt H, Koppo K, Wise JA, Achten E. beta-Alanine supplementation augments muscle carnosine content and attenuates fatigue during repeated isokinetic contraction bouts in trained sprinters. Journal of Applied Physiology 2007;103:1736-1743.

Dietitians of Canada 2013. Sports Drinks. [Accessed 2019 June 11]. Available from: <https://www.dietitians.ca/Your-Health/Nutrition-A-Z/Sports-Drinks.aspx>

Doherty M, Smith PM. Effects of caffeine ingestion on rating of perceived exertion during and after exercise: a meta-analysis. Scandinavian Journal of Medicine & Science in Sports 2005;15(2):69-78.

Doutreleau S, Rouyer O, Di Marco P, Lonsdorfer E, Richard R, Piquard F, Geny B. 2010. L-Arginine supplementation improves exercise capacity after a heart transplant. American Journal of Clinical Nutrition. Doi: 10.3945/ajcn.2009.27881.

Doutreleau S, Mettauer B, Piquard F, Rouyer O, Schaefer A, Lonsdorfer J., Beny B. Chronic L-Arginine Supplementation Enhances Endurance Exercise Tolerance in Heart Failure Patients. International Journal of Sports Medicine 2006;27(7):567-572.

Ellis JM, Reddy P. Effects of Panax ginseng on quality of life. *The Annals of Pharmacotherapy* 2002;36(3):375-379.

Engels HJ, Kolokouri I, Cieslak TJ, Wirth JC. Effects of ginseng supplementation on supramaximal exercise performance and short-term recovery. *Journal of Strength and Conditioning Research* 2001;15(3):290-295.

ESCOP 2003: ESCOP Monographs: The Scientific Foundation for Herbal Medicinal Products, 2nd edition. Exeter (UK): European Scientific Cooperative on Phytotherapy and Thieme; 2003.

Evans WR, Fernstrom JD, Thompson J, Morris SM Jr, Kuller LH. 2004. Biochemical responses of healthy subjects during dietary supplementation with L-arginine. *Journal of Nutritional Biochemistry* 15(9):534-539.

FCC 8: Food Chemicals Codex. Eighth edition. Rockville (MD): The United States Pharmacopeial Convention; 2012.

FDA 2004: Food and Drug Administration. Final Rule Declaring Dietary Supplements Containing Ephedrine Alkaloids Adulterated Because They Present an Unreasonable Risk. Washington (DC): Food and Drug Administration, US Department of Health and Human Services; 2004. [Accessed 2018 June 15]. Available from: <https://www.federalregister.gov/documents/2004/02/11/04-2912/final-rule-declaring-dietary-supplements-containing-ephedrine-alkaloids-adulterated-because-they>

FDA 1988: Food and Drug Administration. 21 CFR Part 340. Stimulant drug products for over-the-counter human use; final monograph; final rule. Washington (DC): U.S. Food and Drug Administration, Department of Health and Human Services; 1988. [Accessed 2018 June 15]. Available from: <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPart=340&showFR=1>

Figueroa A, Alvarez-Alvarado S, Ormsbee MJ, Madzima TA, Campbell JC, Wong A. Impact of L-citrulline supplementation and whole-body vibration training on arterial stiffness and leg muscle function in obese postmenopausal women with high blood pressure. *Experimental Gerontology* 2015;63:35-40.

Freitas AE, Neis VB, Rodrigues ALS Agmatine, a potential novel therapeutic strategy for depression. *European Neuropsychopharmacology* 2016;26:1885-1899.

Gallagher PM, Carrithers JA, Godard MP, Schulze KE, Trappe SW. Beta-hydroxy-beta-methylbutyrate ingestion, Part I: effects on strength and fat free mass *Medicine & Science in Sports & Exercise* 2000 Dec;32(12):2109-15a.

Gallagher PM, Carrithers JA, Godard MP, Schulze KE, Trappe SW. Beta-hydroxy-beta-



methylbutyrate ingestion, part II: effects on hematology, hepatic and renal function. *Medicine & Science in Sports and Exercise* 2000 Dec;32(12):2116-9b.

GC 2018a. Government of Canada. *Cannabis Act*. [Accessed 2019 April 4]. Available at: <https://laws-lois.justice.gc.ca/eng/acts/C-24.5/>

GC 2018b. Government of Canada. *Industrial Hemp Regulations*. [Accessed 2019 April 4]. Available at: <https://laws-lois.justice.gc.ca/eng/regulations/SOR-2018-145/>

GC 2003. Government of Canada. *Natural Health Products Regulations*. [Accessed 2019 April 4]. Available at: <https://laws-lois.justice.gc.ca/eng/regulations/SOR-2003-196/?showtoc=&instrumentnumber=SOR-2003-196>

Gilad GM, Gilad VH. Long-term (5 years), high dosage of dietary agmatine – Evidence of safety: A case report. *Journal of Medicinal Food* 2014;17(11):1256-1259.

Gonzalez-Seijo JC, Ramos YM, Lastra I. Manic episode and ginseng: report of a possible case. *Journal of Clinical Psychopharmacology* 1995;15(6):447-448.

Grimble GK. Adverse gastrointestinal effects of arginine and related amino acids. *The Journal of Nutrition* 2007;137(6 Suppl 2):1693S-1701S.

Gross D, Krieger D, Efrat R, Dayan. Ginseng extract G115 for the treatment of chronic respiratory diseases. *Schweiz Zschr Ganzheits Medizin* 1995;1:29-33.

Gross D, Shenkman Z, Bleiberg B, Dayan M, Gittelsohn M, Efrat R. Ginseng improves pulmonary functions and exercise capacity in patients with COPD. *Monaldi Archives for Chest Disease* 2002;57(5-6):242-246.

Guttuso T, McDermott MP, Su H, Kiebertz K Effects of L-isoleucine and L-valine on hot flushes and serum homocysteine. *Obstetrics & Gynecology* 2008;112(1): 109-115.

Haller CA, Benowitz NL, Jacob P. Hemodynamic effects of ephedra-free weight-loss supplements in humans. *The American Journal of Medicine* 2005;118(9):998-1003.

Hambrecht R, Hilbrich L, Erbs S, Gielen S, Fiehn E, Schoene N, Schuler. Correction of endothelial dysfunction in chronic heart failure: additional effects of exercise training and oral L-arginine supplementation. *Journal of the American College of Cardiology* 2000;35(3):706-713.

Harper P, Elwin CE, Cederblad G. Pharmacokinetics of intravenous and oral bolus doses of L-carnitine in healthy subjects. *European Journal of Clinical Pharmacology* 1988;35:555-562.

Harris RC, Tallon MJ, Dunnett M, Boobis L, Coakley J, Kim HJ, Fallowfield JL, Hill CA, Sale C, Wise JA. The absorption of orally supplied beta-alanine and its effect on muscle carnosine synthesis in human vastus lateralis. *Amino Acids*. 2006 May;30(3):279-289.



HC 2019. Health Canada. Prescription Drug List. [Accessed 2019 April 4]. Available at: <https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/prescription-drug-list/list.html>

HC 2018. Health Canada. Health products containing cannabis or for use with cannabis: Guidance for the Cannabis Act, the Food and Drugs Act, and related regulations. [Accessed 2019 April 4]. Available at: <https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/applications-submissions/guidance-documents/guidance-cannabis-act-food-and-drugs-act-related-regulations/document.html>

HC 2012: Health Canada. Caffeine in foods. Health Canada; 2012. [Accessed 2019 March 5]. Available from: <http://www.hc-sc.gc.ca/fn-an/securit/addit/caf/index-eng.php>

Higgins JP, Babu KM, Caffeine reduces myocardial blood flow during exercise. *The American Journal of Medicine* 2013;126(8):730-e 1-8.

Hill CA, Harris RC, Kim HJ, Harris BD, Sale C, Boobis LH, Kim CK, Wise JA. Influence of β -alanine supplementation on skeletal muscle carnosine concentrations and high intensity muscle capacity. *Amino Acids* 2007;32:225-233.

Ho JY, Kraemer WJ, Volek JS, Fragala MS, Thomas GA, Dunn-Lewis C, Coday M, Hakkinen K, Maresh CM. L-carnitine L-tartrate supplementation favorably affects biochemical markers of recovery from physical exertion in middle-aged men and women. *Metabolism Clinical and Experimental Journal* 2010;59:1190-1199.

Hoffman JR, Ratamess NA, Faigenbaum AD, Ross R, Kang J, Stout JR, Wise JA. Short-term duration beta-alanine supplementation increases training volume and reduces subjective feelings of fatigue in college football players. *Nutrition Research* 2008;28(1):31-35.

Hoffmann D. *Medical Herbalism*. Rochester (VT): Healing Arts Press; 2003.

Huertas R, Campos Y, Diaz E, Esteban J, Vechietto L, Montanari G, D'Iddio S, Corsi M, Arenas J. Respiratory chain enzymes in muscle of endurance athletes: Effect of L-carnitine. *Biochemical and biophysical research communications* 1992;188(1):102-107.

Hultman E, Söderlund K, Timmons JA, Cederblad G, Greenhaff PL. Muscle creatine loading in men. *Journal of Applied Physiology* 1996;81(1):232-237.

Huynh NT, Tayek JA. Oral arginine reduces systemic blood pressure in type 2 diabetes: Its potential role in nitric oxide generation. *American College of Nutrition* 2002;21(5):422-427.

IOM 2005: Institute of Medicine of the National Academies. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Food and Nutrition Board, [Accessed 2019 March 5]. Available from:



https://www.nal.usda.gov/sites/default/files/fnic_uploads/energy_full_report.pdf

Ivy JL, Res PT, Sprague RC, Widzer MO. Effect of a Carbohydrate-Protein Supplement on Endurance Performance During Exercise of Varying Intensity. *International Journal of Sport Nutrition and Exercise Metabolism* 2003;13:388-401.

Janetzki K, Morreale AP. Probable interaction between warfarin and ginseng. *American Journal of Health-System Pharmacy* 1997;54(6):692-693.

Jee SH, He J, Whelton PK, Suh II, Klag MJ. The effect of chronic coffee drinking on blood pressure: a meta-analysis of controlled clinical trials. *Hypertension* 1999;33(2):647-652.

Jones BD, Runikis AM. Interaction of ginseng with phenelzine. *Journal of Clinical Pharmacology* 1987;7(3):201-202.

Jordan T, Lukaszuk J, Mistic M, Umoren J. Effect of beta-alanine supplementation on the onset of blood lactate accumulation (OBLA) during treadmill running: Pre/post 2 treatment experimental design. *Journal of the International Society for Sports Nutrition* 2010 May 19;7:20.

Jung H, Peregrina AA, Rodriguez JM, Moreno-Esparza R. The influence of coffee with milk and tea with milk on the bioavailability of tetracycline. *Biopharmaceutics & Drug Disposition* 1997;18(5):459-463.

Karahan M, Coksevim B, Artis S. The effect of L-carnitine supplementation on 1500 m running performance. *Science, Movement and Health Journal* 2010;10(2):504-507.

Karlic H, Lohninger A. 2004. Supplementation of L-carnitine in athletes: Does it make sense? *Journal of Nutrition* 20:709-715.

Kennedy DO, Haskell CF, Wesnes KA, Scholey AB. 2004. Improved cognitive performance in human volunteers following administration of guarana (*Paullinia cupana*) extract: comparison and interaction with *Panax ginseng*. *Pharmacology, Biochemistry and Behavior* 79(3):401-411.

Kennedy DO, Scholey AB, Wesnes KA. Modulation of cognition and mood following administration of single doses of *Ginkgo biloba*, *ginseng*, and a *ginkgo/ginseng* combination to healthy young adults. *Physiology & Behavior* 2002;75(5):739-751.

Kennedy DO, Scholey AB, Wesnes KA. Dose dependent changes in cognitive performance and mood following acute administration of *Ginseng* to healthy young volunteers. *Nutritional Neuroscience* 2001;4(4):295-310.

Kerksick C, Harvey T, Stout J, Campbell B, Wilborn C, Kreider R, Kalman D, Ziegenfuss T, Lopez H, Landis J, Ivy JL, Antonio J. International Society of Sports Nutrition position stand: nutrient timing. *Journal of The International Society of Sports Nutrition* 2008;5:17.



Keynan O, Mirovsky Y, Dekel S, Gilad VH, Gilad GM. Safety and efficacy of dietary agmatine sulfate in lumbar disc-associated radiculopathy. An open-label, dose-escalating study followed by a randomized, double-blind, placebo-controlled trial. *Pain Medicine* 2010;11:356-368.

Kim SH, Park KS, Chang MJ, Sung JH. 2005. Effects of panax ginseng extract on exercise-induced oxidative stress. *Journal of Sports Medicine and Physical Fitness* 45(2):178-182. Kraemer WJ, Spiering BA, Volek JS, Ratamess NA, Sharman MJ, Rubin MR, French DN, Silvestre R, Hatfield DL, Van Heest JC, Vingren JL, Judelson DA, Deschenes MR, Maresh CM. Androgenic responses to resistance exercise: Effects of feeding and L-Carnitine. *Official Journal of the American College of Sports Medicine* 2006;1288-1296.

Kraemer WJ, Volek JS, French DN, Rubin MR, Sharman MJ, Gomez AL, Ratamess NA, Newton RU, Jemolo B, Craig BW, Hakkinen K. The effects of L-carnitine L-tartrate supplementation on hormonal responses to resistance exercise and recovery. *Journal of Strength and Conditioning Research* 2003;17(3):455-462.

Krzywkowski K, Petersen EW, Ostrowski K, Link-Amster H, Boza J, Halkjaer-Kristensen J, Pedersen BK. Effect of glutamine and protein supplementation on exercise-induced decreases in salivary IgA. *Journal of Applied Physiology* 2001;91(2):832-838.

Lee SH, Ahn YM, Ahn SY, Doo HK, Lee BC. Interaction between warfarin and Panax ginseng in ischemic stroke patients. *The Journal of Alternative and Complementary Medicine* 2008a;14(6):715-721.

Lee ST, Chu K, Sim JY, Heo JH, Kim M. Panax ginseng enhances cognitive performance in Alzheimer disease. *Alzheimer Disease and Associated Disorders* 2008b;22(3):222-226.

Lenders CM, Liu S, Wilmore DW, Sampson L, Dougherty LW, Spiegelman D, Willett WC. Evaluation of a novel food composition database that includes glutamine and other amino acids derived from gene sequencing data. *European Journal of Clinical Nutrition* 2009;63(12):1433-1439.

Marconi C, Sassi G, Carpinelli A, Cerretelli P. Effect of L-carnitine loading on the aerobic and anaerobic performance of endurance athletes. *European Journal of Applied Physiology* 1985;54:131-135.

Martindale 2009: Sweetman SC (ed), Martindale: The Complete Drug Reference. [Internet] London (GB): Pharmaceutical Press; Copyright 1933-2010. [Accessed 2019 June 11]. Available from: <http://www.medicinescomplete.com>

McGuffin M, Hobbs C, Upton R, Goldberg A, editors. American Herbal Products Association's Botanical Safety Handbook. Boca Raton (FL): CRC Press; 1997.

Mihic S, MacDonald JR, McKenzie S, Tarnopolsky MA. Acute creatine loading increases fat-free mass, but does not affect blood pressure, plasma creatinine, or CK activity in men and



women. *Medicine & Science in Sports and Exercise* 2000;32(2):291-296.

Mills S, Bone K. 2005. *The Essential Guide to Herbal Safety*. St. Louis (MO): Elsevier Churchill Livingstone.

Mills S, Bone K. 2000. *Principles and Practice of Phytotherapy*. Toronto (ON): Churchill Livingstone.

Müeller DM, Seim H, Kiess W, Löster H, Richter T. Effects of oral L-carnitine supplementation on in vivo long-chain fatty acid oxidation in healthy adults. *Journal of Metabolism* 2002;51(11):1389-1391.

Nagaya N, Uematsu M, Oya H, Sato N, Sakamaki F, Kyotani S, Ueno K, Nakanishi N, Yamagishi M, Miyatake K. Short-term oral administration of L-arginine improves hemodynamics and exercise capacity in patients with precapillary pulmonary hypertension. *American Journal of Respiratory and Critical Care Medicine* 2001;163(4):887-891.

Nawrot P, Jordan S, Eastwood J, Rotstein J, Hugenholz A, Feeley M. Effects of caffeine on human health. *Food Additives and Contaminants* 2003;20(1):1-30.

Newsholme P, Procopio J, Lima MM, Pithon-Curi TC, Curi R. 2003. Glutamine and glutamate—their central role in cell metabolism and function. *Cell Biochemistry and Function* 21(1):1-9.

Nissen S, Sharp RL, Panton L, Vukovich M, Trappe S, Fuller J. 2000. B-Hydroxy-B-Methylbutyrate (HMB) supplementation in humans is safe and may decrease cardiovascular risk factors. *J Nutr* 130:1937-45.

NHPID 2019: Natural Health Products Ingredient Database. Natural and Non-Prescription Health Products Directorate. [Accessed 2019 March 7]. Available from: <http://webprod.hc-sc.gc.ca/nhpid-bdipsn/search-rechercheReq.do>

Nissim I, Horyn O, Daikhin Y, Chen P, Li C, Wehrli SL, Nissim I, Yudkoff M 2014. The molecular and metabolic influence of long term agmatine consumption. *Journal of Biological Chemistry* 289(14): 9710-9729.

NNHPD 2019: Natural and Non-Prescription Health Products Directorate. Internal evidence on NHPs and current NNHPD's monographs.

Noordzij M, Uiterwaal CS, Arends LR, Kok FJ, Grobbee DE, Geleijnse JM. 2005. Blood pressure response to chronic intake of coffee and caffeine: a meta-analysis of randomized controlled trials. *Journal of Hypertension* 23(5):921-928.

Ochiai M, Hayashi T, Morita M, Ina K, Maeda M, Watanebe F, Morishita K. Short-term effects of L-citrulline supplementation on arterial stiffness in middle-aged men. *International Journal of Cardiology* 2012;155(2):257-261.



- Okudan N, Gökbel H. The effects of creatine supplementation on performance during the repeated bouts of supramaximal exercise. *Journal of Sports Medicine and Physical Fitness* 2005;45(4):507-512.
- Parker JO, Parker JD, Caldwell RW, Farrell B, Kaesemeyer WH. The effect of supplemental L-arginine on tolerance development during continuous transdermal nitroglycerin therapy. *Journal of the American College of Cardiology* 2002;39(7):1199-1203.
- Payandemehr B, Rahimian R, Bahremand A, Ebrahimi A, Saadat S, Moghaddas P, Fadakar K, Derakhshaniam H, Dehpour AR. Role of nitric oxide in additive anticonvulsant effects of agmatine and morphine. *Physiology & Behavior* 2013;118:52-57.
- Perez-Guisado J, Jakeman PM. Citrulline malate enhances athletic anaerobic performance and relieves muscle soreness. *The Journal of Strength & Conditioning Research* 2010;24(5):1215-1222.
- Petkov VD, Mosharraf AH.. Effects of standardized ginseng extract on learning, memory and physical capabilities. *American Journal of Chinese Medicine* 1987;15(1-2):19-29.
- Philip P, Taillard J, Moore N, Delord S, Valtat C, Sagaspe P, Bioulac B. 2006. The effects of coffee and napping on night time highway driving: a randomized trial. *Annals of Internal Medicine* 144(11):785-791.
- Piletz JE, Aricioglu F, Cheng J-T, Fairbanks CA, Gilad V, Haenisch G, Halaris A, Hung S, Lee JE, Li J, Liu P, Molderings GJ, Lucia A, Rodrigues S, Satriano J, Seong GJ, Wilcox G, Wu N, Gilad GM. Agmatine: clinical applications after 100 years in translation. *Drug Discovery Today* 2013;18(17):880-893.
- Plaitakis A, Smith J, Mandeli J, Yahr MD. Pilot trial of branched-chain amino acids in amyotrophic lateral sclerosis. *The Lancet* 1988;1(8593):1015-1018.
- Pline KA, Smith CL. The effect of creatine intake on renal function. *The Annals of Pharmacotherapy* 2005;39(6):1093-1096.
- Preen D, Dawson B, Goodman C, Beilby J, Ching S. Creatine supplementation: a comparison of loading and maintenance protocols on creatine uptake by human skeletal muscle. *International Journal of Sport Nutrition and Exercise Metabolism* 2003;13(1):97-111.
- Pritchard NR, Kalra PA. Renal dysfunction accompanying oral creatine supplements. *The Lancet* 1998;351(9111):1252-1253.
- Reay JL, Kennedy DO, Scholey AB. Effects of Panax ginseng, consumed with and without glucose, on blood glucose levels and cognitive performance during sustained 'mentally demanding' tasks. *Journal of Psychopharmacology* 2006;20(6):771-781.



Reay JL, Kennedy DO, Scholey AB. Single doses of *Panax ginseng* (G115) reduce blood glucose levels and improve cognitive performance during sustained mental activity. *Journal of Psychopharmacology* 2005;19(4):357-365.

Rector TS, Bank AJ, Mullen KA, Tschumperlin LK, Sih R, Pillai K, Kubo SH. Randomized, double-blind, placebo-controlled study of supplemental oral L-arginine in patients with heart failure. *Circulation* 1996;93(12):2135-2141.

Rowlands DS, Thomson JS. Effects of beta-hydroxy-beta-methylbutyrate supplementation during resistance training on strength, body composition, and muscle damage in trained and untrained young men: a meta-analysis. *Journal of Strength & Conditioning Research* 2009 May;23(3):836-846.

Saunders MJ. Coingestion of Carbohydrate-Protein during endurance exercise: influence on performance and recovery. *International Journal of Sport Nutrition and Exercise Metabolism* 2007;17:S87-S103.

Scaglione F, Weiser K, Alessandria M. Effects of the standardised ginseng extract G115 in patients with chronic bronchitis. *Clinical Drug Investigation* 2001;21(1):41-45.

Scaglione F, Cattaneo G, Alessandria M, Cogo R. Efficacy and safety of the standardized ginseng extract G115 for potentiating vaccination against common cold and/or influenza syndrome. *Drugs Under Experimental and Clinical Research* 1996;22(2):65-72.

Schepdael PV. Les effets du ginseng G115 sur la capacité physique de sportifs d'endurance. *Acta Therapeutica* 1993;19(4):337-347.

Scholey AB, Kennedy DO. Acute, dose-dependent cognitive effects of *Ginkgo biloba*, *Panax ginseng* and their combination in healthy young volunteers: differential interactions with cognitive demand. *Human Psychopharmacology* 2002;17(1):35-44.

Schulman SP, Becker LC, Kass DA, Champion HC, Terrin ML, Forman S, Ernst KV, Kelemen MD, Townsend SN, Capriotti A, Hare JM, Gerstenblith G. L-Arginine therapy in acute myocardial infarction: the vascular interaction with age in myocardial infarction (VINTAGE MI) randomised clinical trial. *Journal of American Medical Association* 2006;295(1):58-64.

Seely D, Dugoua JJ, Perri D, Mills E, Koren G. Safety and efficacy of *Panax ginseng* during pregnancy and lactation. *The Canadian Journal of Clinical Pharmacology* 2008;15(1):e87-e94.

Shader RI, Greenblatt DJ. Bees, ginseng and MAOIs revisited. *Journal of Clinical Psychopharmacology* 1988;8(4):235.

Shader RI, Greenblatt DJ. Phenelzine and the dream machine – ramblings and reflections. *Journal of Clinical Psychopharmacology* 1985;5(2):65.

Shao A, Hathcock JN. Risk assessment for the amino acids taurine, L-glutamine and L-arginine. *Regulatory Toxicology and Pharmacology* 2008;50:376-399.

Shils ME, Olson JA, Shike M, Ross AC, editors. *Modern Nutrition in Health and Disease*, 10th edition. Philadelphia (PA): Lippincott Williams and Wilkins; 2006.

Siani A, Pagano E, Iacone R, Iacoviello L, Scopacasa F, Strazzullo P. Blood pressure and metabolic changes during dietary L-arginine supplementation in humans. *American Journal of Hypertension* 2000;13(5):547-551.

Siegel RK. Ginseng abuse syndrome. Problems with the panacea. *The Journal of the American Medical Association* 1979;241(15):1614-1615.

Sievenpiper JL, Sung MK, Buono MD, Seung-Lee K, Nam KY, Arnason JT, Leiter LA, Vuksan V. Korean red ginseng rootlets decrease acute postprandial glycemia: results from sequential preparation- and dose-finding studies. *Journal of the American College of Nutrition* 2006;25(2):100-107.

Smith A, Sutherland D, Christopher G. Effects of repeated doses of caffeine on mood and performance of alert and fatigued volunteers. *Journal of Psychopharmacology* 2005;19(6):620-626.

Soldati F, Sticher O. HPLC separation and quantitative determination of ginsenosides from *Panax ginseng*, *Panax quinquefolium* and from ginseng drug preparations. 2^e communication. *Planta Medica* 1980;39(4):348-357.

Sotaniemi EA, Haapakoski E, Rautio A. Ginseng therapy in non-insulin-dependent diabetic patients. *Diabetes Care* 1995;18(10):1373-1375.

Spiering BA, Kraemer WJ, Hatfield DL, Vingren JL, Fragala MS, Ho J-Y, Thomas GA, Hakkinen K, Volek JS. Effects of L-carnitine L-tartrate supplementation on muscle oxygenation responses to resistance exercise. *Journal of Strength and Conditioning Research* 2008;22(4):1130-1135.

Spiering BA, Kraemer WJ, Vingren JL, Hatfield DL, Fragala MS, Ho J-Y, Maresh CM, Anderson JM, Volek JS. Responses of criterion variables to different supplemental doses of L-carnitine L-tartrate. *Journal of Strength and Conditioning Research* 2007;21:259-264.

Stephens FB, Constantin-Teodosiu D, Greenhaff PL. New insights concerning the role of carnitine in the regulation of fuel metabolism in skeletal muscle. *Journal of Physiology* 2007;581(2):431-444.

Stout JR, Cramer JT, Mielke M, O'Kroy J, Torok DJ, Zoeller RF. Effects of twenty-eight days of beta-alanine and creatine monohydrate supplementation on the physical working capacity at



neuromuscular fatigue threshold. *Journal of Strength and Conditioning Research* 2006;20(4):928-931.

Su R-B, Li J, Qin B-Y A biphasic opioid function modulator: agmatine. *Acta Pharmaceutica Sinica* 2003;24(7):631-636.

Sünram-Lea SI, Birchall RJ, Wesnes KA, Petrini O. The effect of acute administration of 400 mg of *Panax ginseng* on cognitive performance and mood in healthy young volunteers. *Current Topics in Nutraceutical Research* 2005;3(1):65-74.

Sydow K, Schwedhelm E, Arakawa N, Bode-Böger SM, Tsikas D, Hornig B, Frölich, Böger RH. ADMA and oxidative stress are responsible for endothelial dysfunction in hyperhomocyst(e)inemia: effects of L-arginine and B vitamins. *Cardiovascular Research* 2003;57(1):244-252.

Tetsutani T, Yamamura M, Yamaguchi T, Onoyama O, Kono M. Can red ginseng control blood glucose in diabetic patients. *The Ginseng Review* 2000;28:44-47.

Uzbay T, Goktalay G, Kayir H, Eker SS, Sarandol A, Oral S, Buyukuysal L, Ulusoy G, Kirli S. Increased plasma agmatine levels in patients with schizophrenia. *Journal of Psychiatric Research* 2013;47:1054-1060.

Vahedi K, Domingo V, Amarenco P, Bousser MG. Ischaemic stroke in a sportsman who consumed MaHuang extract and creatine monohydrate for body building. *Journal of Neurology, Neurosurgery and Psychiatry* 2000;68(1):112-113.

Vandenberghe K, Goris M, Van Hecke P, Van Leemputte M, Vangerven L, Hespel P. Long-term creatine intake is beneficial to muscle performance during resistance training. *Journal of Applied Physiology* 1997;83(6):2055-2063.

Vecchiet L, Di Lisa F, Pieralisi G, Ripari P, Menabo R, Giamberardino MA, Siliprandi N. Influence of L-carnitine administration on maximal physical exercise. *European Journal of Applied Physiology* 1990;61:486-490.

Verhoeven S, Vanschoonbeek K, Verdijk LB, Koopman R Long-term leucine supplementation does not increase muscle mass or strength in healthy elderly men. *American Journal of Clinical Nutrition* 2009;89(5):1468-1475.

Volek JS, Duncan ND, Mazzeti SA, Staron RS, Putukian M, Gomez AL, Pearson DR, Fink WJ, Kraemer WJ. Performance and muscle fiber adaptations to creatine supplementation and heavy resistance training. *Medicine and Science in Sports Exercise* 1999;31(8):1147-1156.

Volek JS, Kraemer WJ, Rubin MR, Gomez AL, Ratamess NA, Gaynor P. L-carnitine L-tartrate supplementation favorably affects markers of recovery from exercise stress. *American Journal of Physiology-Endocrinology and Metabolism* 2002;282:E474-E482.



Vuksan V, Sung MK, Sievenpiper JL, Stavro PM, Jenkins AL, Buono MD, Lee KS, Leiter LA, Nam KY, Arnason JT, Choi M, Naeem A. Korean red ginseng (*Panax ginseng*) improves glucose and insulin regulation in well-controlled, type 2 diabetes: results of a randomized, double-blind, placebo-controlled study of efficacy and safety. *Nutrition, Metabolism & Cardiovascular Diseases* 2008;18(1):46-56.

Wall BT, Stephens FB, Constantin-Teodosiu D, Marimuthu K, Macdonald IA, Greenhaff PL. Chronic oral ingestion of L-carnitine and carbohydrate increases muscle carnitine content and alters muscle fuel metabolism during exercise in humans. *The Journal of Physiology* 2011;589(4):963-973.

Waugh WH, Daeschner III CW, Files BA, McConnell ME, Strandjord SE. Oral Citrulline as arginine precursor may be beneficial in sickle cell disease: early phase two results. *Journal of the National Medical Association* 2001;93(10):362-371.

WHO 1999: World Health Organization (WHO) Monographs on Selected Medicinal Plants: Volume 1. Geneva (CHE): World Health Organization.

Wong A, Alvarez-Alvarado S, Jaime SJ, Kinsey AW, Spicer MT, Madzima TA, Figueroa A. Combined whole-body vibration training and L-citrulline supplementation improves pressure wave reflection in obese postmenopausal women. *Applied Physiology and Nutrition Metabolism* . *Applied Physiology, Nutrition, and Metabolism* 2016;41:292-297.

Wutzke KD, Lorenz H. The effect of L-carnitine on fat oxidation, protein turnover; and body composition in slightly overweight subjects. *Metabolism* 2004;53(8):1002-1006.

Zimmerman DR. *Zimmerman's Complete Guide to Nonprescription Drugs*, 2nd edition. Detroit (MI): Gale Research Inc.; 1992.

References reviewed

Baer DJ, Stote KS, Paul DR, Harris GK, Rumpler WV, Clevidence BA. Whey protein but not soy protein supplementation alters body weight and composition in free-living overweight and obese adults. *The Journal of Nutrition* 2011;141(8):1489-1494.

Cockburn E, Stevenson E, Hayes PR, Robson-Ansley P, Howatson G. Effect of milk-based carbohydrate-protein supplement on the attenuation of exercise-induced muscle damage. *Applied Physiology, Nutrition and Metabolism* 2010; 35(3):270-277.

European Food Safety Authority. Scientific Opinion on the substantiation of health claims related to caffeine and increase in physical performance during short-term high-intensity exercise, increase in endurance performance, increase in endurance capacity and reduction in the rated perceived exertion/effort during exercise pursuant to Article 13(1) of Regulation (EC) No



1924/2006. EFSA Journal 2011;9(4):2053.

Ivy JL, Katz AL, Cutler CL, Sherman WM, Coyle EF. Muscle glycogen synthesis after exercise: effect of time of carbohydrate ingestion. *Journal of Applied Physiology* 1988;64(4):1480-1485.

Millard-Stafford M, Warren GL, Thomas LM, Doyle JA, Snow T, Hitchcock K. Recovery from run training: efficacy of a carbohydrate-protein beverage? *International Journal of Sport Nutrition and Exercise Metabolism* 2005;15(6):610-624.

Saunders MJ, Kand MD, Todd MK. Effects of a Carbohydrate-Protein Beverage on Cycling Endurance and Muscle Damage. *Physical Fitness and Performance* 2004;36(7):1233-1328.

Suzuki A, Charlton MR, Lymp JF, Jorgensen RA, Keach J, Petz J, Angulo P, Lindor K. A Pilot Study: No therapeutic effect of L-Alanine in patients with Nonalcoholic steatohepatitis. *Food and Nutrition Sciences* 2010;1(2):67-73.

Wilson JM, Fitschen PJ, Campbell B, Wilson GJ, Zanchi N, Taylor L, Wilborn C, Kalman DS, Stout JR, Hoffman JR, Ziegenfuss TN, Lopez HL, Kreider RB, Smith-Ryan AE, Antonio J. International Society of Sports Nutrition Position Stand: beta-hydroxy-beta-methylbutyrate (HMB). *Journal of the International Society of Sports Nutrition* 2013; 10:6.