PERFORMANCE ENHANCING SUBTANCES -2 NUTRITIONAL SUPPLEMENTS IN SPORTS

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WHAT ARE DIETARY SUPPLEMENTS

- Dietary Supplement Health and Education Act(DSHEA) of 1994 established definition :
- Not food, or used as a food item
- Most include at least one of following:

Vitamins

Minerals

Herbs

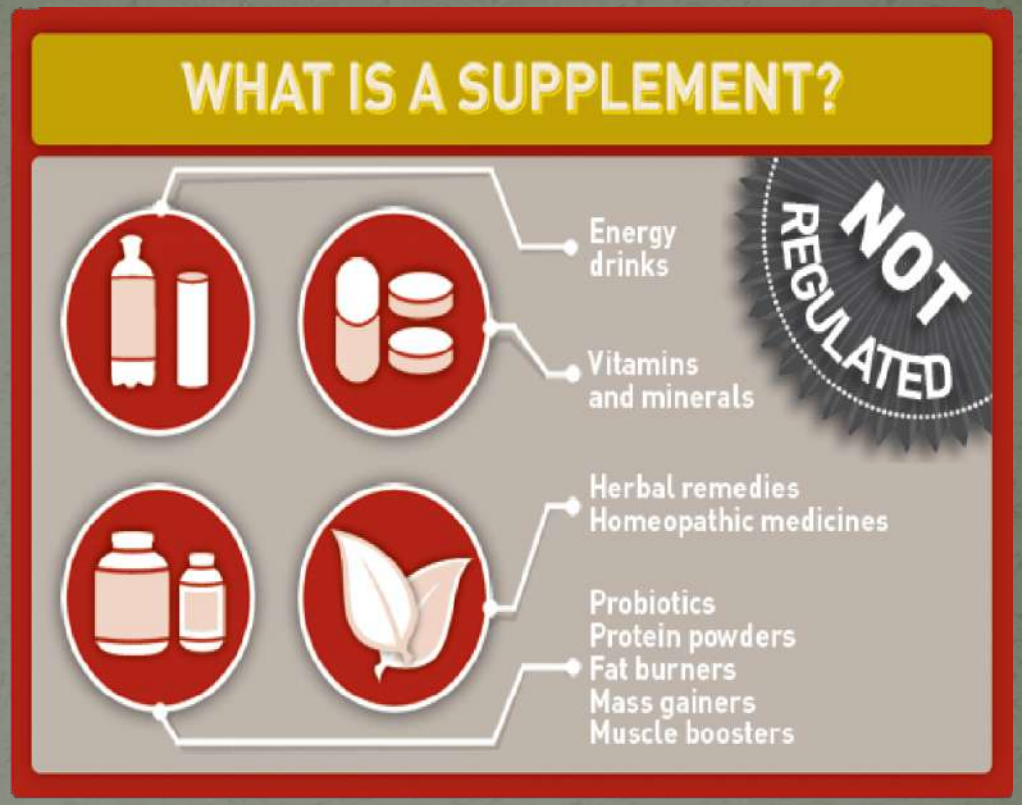
AA

Dietary substance to supplement diet

- Doesn't ensure safety, effectiveness or quality of dietary supplements.

REGULATIONS OF SUPPLEMENTS

- Can be marketed without proof of safety, efficacy and quality.
- Products containing new ingredients must notify FDA, but do not require prior approval.
- Manufacturer responsible for safety but not required to prove safety or efficacy.



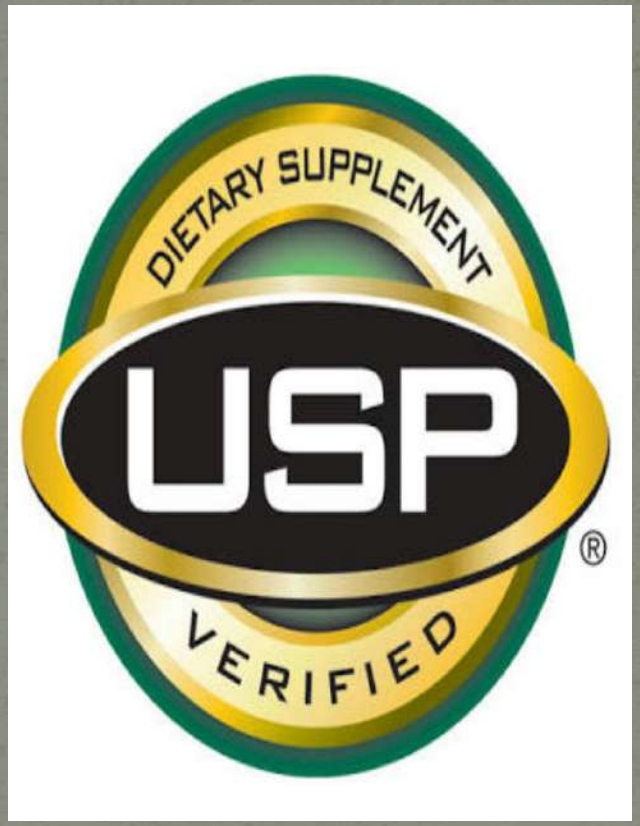
USADA currently recognizes NSF Certified for Sport® as the program best suited for athletes to reduce the risk from supplements.

SAFETY OF SUPPLEMENTS

- Look for USP SEAL

2003 guidelines for quality, purity, ingredients and manufacturing standards.

Buy from well known companies



National Collegiate Athletic Association(NCAA)

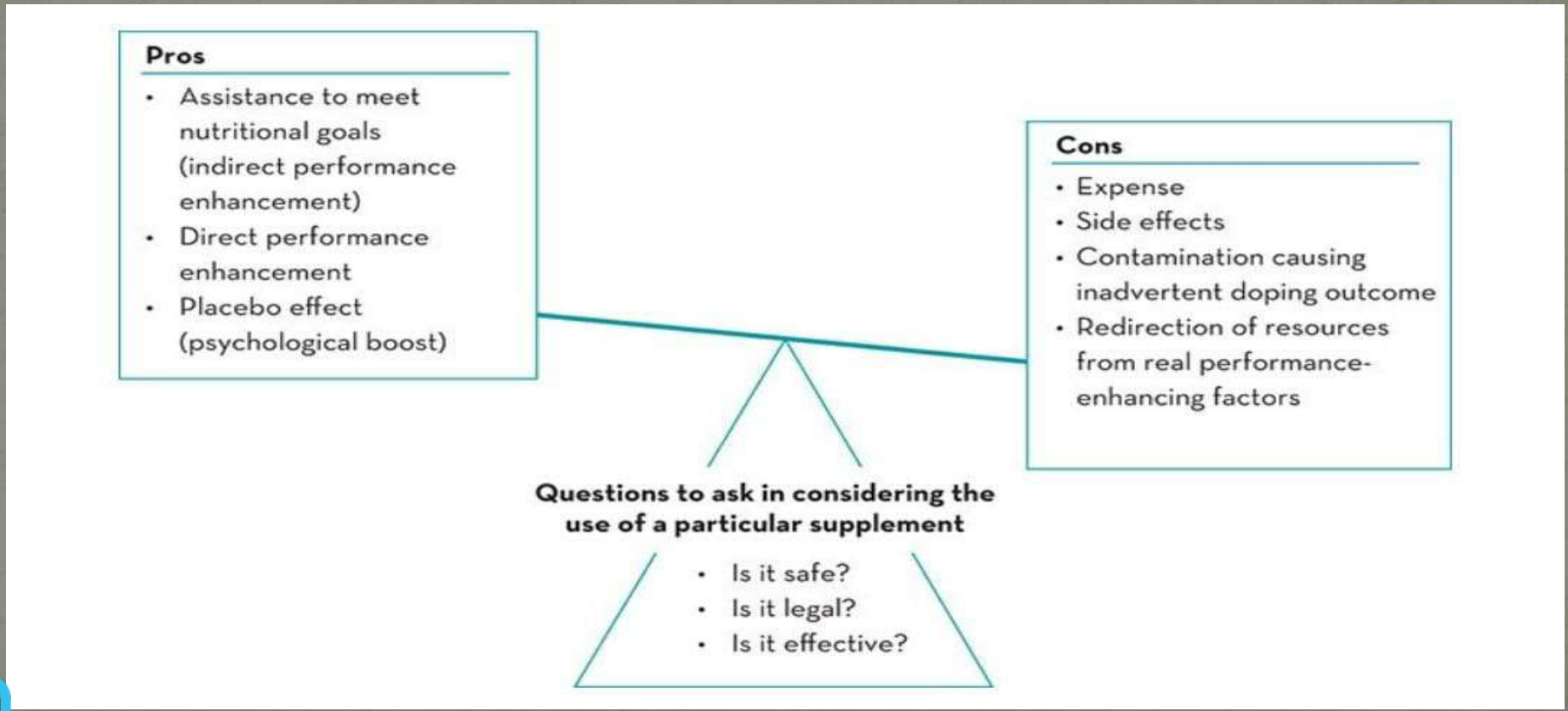
ALLOWED

- Providing NON-ERGOGENIC nutritional supplements
- Essential nutrients
- Food substances and constituents sold as dietary supplements

PROHIBITED

- Providing ERGOGENIC nutritional supplements
- Many SPORTS SUPPLEMENTS(i.e Androstenedione)
- Dietary supplements that contain substances that are PROHIBITED(i.e chinese ephedra)

Issues to consider while making a decision to take supplement???



- Scenarios where a sports food does not produce a true physiological or ergogenic benefit, an athlete might attain some performance benefit because of a PSYCHOLOGICAL BOOST or 'placebo' effect.

- Weightlifters who received saline injections that they believed to be anabolic steroids increased their gains in lean body mass (BM)

Pros: true performance benefits

- Direct performance-enhancing (ergogenic) effect.
- To meet their nutrition goals
- To achieve optimal health, recovery and performance.
- The placebo effect

Cons:

- Expense
- Side effects
- Doping Outcomes
- Displacement of real priorities

Successful sports performance is the product of SUPERIOR GENETICS, LONG-TERM TRAINING, OPTIMAL NUTRITION, ADEQUATE SLEEP AND RECOVERY, STATE-OF-THE-ART EQUIPMENT AND A COMMITTED ATTITUDE. These factors cannot be replaced by the use of supplement

a) Which among the following is best reason for an athlete to take food supplements

b) To aid recovery from training
c) For health
d) To improve performance
e) To prevent or treat an illness
f) To compensate for a poor diet

Ans A

Sports foods and medical/health supplements

Supplement	Form	Typical composition	Sports-related use
Sports drink	Powder or liquid	5–8% CHO 10–35 mmol/L sodium 3–5 mmol/L potassium	Optimum delivery of fluid + CHO during exercise
			Post-exercise rehydration
			Post-exercise refuelling
Sports gel or sports confectionery	Gel 30–40 g sachets or larger tubes or jelly–type confectionary (generally 5–6 g each in pouch of ~40–50 g)	60–70% CHO (~25 g CHO per sachet) or 90% CHO confectionery items (~5 g per piece) Some contain caffeine or electrolytes	Supplement high-CHO training diet
			CHO loading
			Post-exercise CHO recovery
			May be used during exercise when CHO needs exceed fluid requirements
Electrolyte replacement supplements	Powder sachets or tablets	< 2% CHO 50–60 mmol/L sodium 10–20 mmol/L potassium	Rapid and effective rehydration following dehydration undertaken for weight-making
			Replacement of large sodium losses during ultra-endurance activities
			Rapid and effective rehydration following moderate to large fluid and sodium deficits (e.g. post-exercise)
Protein supplement	Powder (mix with water or milk) or liquid protein-rich bar, usually low in CHO	Powder of 70–90% protein content from whey or other animal or vegetable sources of high biological value protein (e.g. milk, pea, soy) May have other ingredients: additional branched chain amino acids Powders or bars with other ingredients from group C are considered non-optimal due to additional cost and increased risk of contamination	Post-exercise recovery following key training sessions or events where adaptation requiring protein synthesis is desired
			Achievement of increase in lean mass such as during growth or response to resistance training
			Portable nutrition for travelling

Liquid meal supplement	Powder (mix with water or milk) or liquid	1–1.5 kcal/mL 15–20% protein 50–70% CHO low to moderate fat vitamins/minerals: 500–1000 mL supplies RDI/RDAs	Supplement high-energy/CHO/nutrient diet (especially during heavy training/competition or weight gain)
			Low-bulk meal replacement (especially pre-event meal)
			Post-exercise recovery—provides CHO and protein to meet goals
			Portable nutrition for travelling athlete
Sports bar	Bar (50–60 g)	40–50 g CHO 5–10 g protein Usually low in fat and fibre Vitamins/minerals: 50–100% of RDA/RDIs May contain creatine, amino acids	CHO source during exercise
			Post-exercise recovery—provides CHO, protein and micronutrients
			Support for high-energy/CHO/nutrient diet
			Portable nutrition (travelling)
Vitamin/mineral supplement	Capsule/tablet	Broad range 1–4 × RDI/RDAs of vitamins and minerals	Micronutrient support for low-energy or weight-loss diet
			Micronutrient support for restricted variety diets (e.g. vegetarian)
			Micronutrient support for unreliable food supply or disrupted eating patterns (e.g. travelling athlete)
Iron supplement	Capsule/tablet	Ferrous sulfate/gluconate/fumarate	Supervised management of iron deficiency (including treatment and prevention)
Calcium supplement	Capsule/tablet	Calcium carbonate/phosphate/lactate	Calcium supplementation in low-energy or low dairy food diet under supervision
			Treatment/prevention of osteopenia
Vitamin D	Capsule/tablet	Vitamin D3	Supervised management of vitamin D deficiency (including treatment and prevention for athletes as risk of deficiency)
Probiotics	Capsule/tablet or liquid	*Bifidobacterium lactis Lactobacillus fermentum Lactobacillus casei*—Shirota strain	Treatment prevention of gastrointestinal upset for athletes in high-risk situations, including travel
			Prevention of upper respiratory tract infection

CAFFIENE

- Caffeine removed from the WADA list of prohibited substances in January 2004.
- Prior to this time, athletes were allowed to consume caffeine, but only to urine levels of 12 µg/ml following competitions. This level coincided with the consumption of ~10 mg caffeine/kg body mass (bm), which is a high dose (~700 mg of caffeine for a 70 kg individual).

- Caffeine is member of the METHYLXANTHINES, a family of naturally occurring stimulants found in the leaves, nuts and seeds of a number of plants.
- Major dietary sources of caffeine—tea, coffee, chocolate, cola and energy drinks—typically provide 30–200 mg of caffeine per serve, whereas some non-prescriptive medications contain 100–200 mg of caffeine per tablet.

ERGOGENIC RESPONSE

INCREASED FREE FATTY ACID (FFA) and glycerol levels)

RELEASE from storage sites in adipose tissue and muscle

INCREASED CATECHOLAMINE

INCREASED MUSCLE FAT OXIDATION

SPARING OF MUSCLE GLYCOGEN

Caffiene is RAPIDLY absorbed by body

Appears in Blood with in 10-20 mins

Peak at 45-90 mins

CROSS BBB to

+ NEURONAL FIRING'

+ Neurotransmitter Activity

+ SPINAL EXCITABILITY

+ VOLUNTARY ACTIVATION

+ MAX FORCE

DEC PAIN AND FORCE SENSATION

SKELETAL MUSCLE **excitation– contraction coupling

(1) increasing the release of Ca2+ from the sarcoplasmic reticulum

(2) enhancing troponin/myosin Ca2+ sensitivity

(3) decreasing the reuptake of Ca2+ by the sarcoplasmic reticulum.

** Stimulate Na+–K+ ATPase activity in inactive skeletal muscle leading to increased rates of **K+ uptake and Na+ efflux. Rise in plasma [K+] with exercise, which may help maintain the membrane potential in contracting muscle and contribute to caffeine's ergogenic effect during exercise.

- Moderate doses of Caffiene during Endurance exercise known to enhance performance benefit due to.

a. Dec release of Ca2+ from SR
b. Inc plasma K+
c. Inc plasma Na+
d. Decreasing Ca2+ sensitivity

Ans: B

CAFFIENE

Adenosine Receptor Antagonism

Inc in serotonin, dopamine, acetylcholine, norepinephrine, and glutamate, andthese neurotransmitters are all inhibited by adenosine

- Consuming ~250 to 300 mg of caffeine has a mild diuretic effect at rest
- ~500 mg (~7 mg/kg bm) leads to dehydration at rest or, importantly, negatively affects exercise hydration status, performance, or the ability to thermoregulate in a cool or hot environment.

Buffering Agents

- Exercise performed at high intensities results in the formation of carboxylic acid groups produced as results of oxidation of glucose or glucosyl (from glycogen) unit metabolized.

increase in dissociated lactic acid

ACCUMULATION OF H+ IN THE CONTRACTING SKELETAL MUSCLE ACCUMULATION OF GLYCEROL-1-PHOSPHATE AND GLUCOSE-6- PHOSPHATE

- Under resting conditions, in healthy individuals, intramuscular pH is around 7.0, with arterial and venous blood pH being slightly higher at 7.4 and 7.3.

- During high-intensity exercise, muscle pH may fall to between 6.5 and 6.0 depending.

Supplements to Increase Intracellular Buffering Creatine/Phosphorylcreatine

- Creatine (Cr) (methylguanidine acetic acid) is a guanidino compound synthesized from arginine and glycine in the liver and kidney named from the Greek word for “fl esh,” is a naturally occurring nutrient first identifi ed in meat in 1835.
- Cr exists in high concentrations in the skeletal muscle with around 95% of the body content stored here.
- High-energy phosphate donor to facilitate ATP resynthesis during exercise. Maintenance of a high ATP to low ADP ratio is facilitated by the high activity of CK in muscle, and high concentrations of Cr and PCr.

Creatine Homeostasis

- Creatine homeostasis in humans is maintained by endogenous creatine synthesis and degradation, dietary creatine intake, and efficient conservation of creatine by the kidney, which collectively maintain a total body content of around 120 g for an average male.

- The store of ATP in human skeletal muscle is relatively small (~24 mmol/kg dry muscle) and the energy required to maintain contraction (as well as ion pumps, etc.) during intense exercise would hypothetically deplete muscle ATP stores within 3 seconds.
- The major contributors to the necessarily rapid resynthesis of ATP are ADP (in which 2 ADP combine to form ATP and AMP) and PCr hydrolysis, and glycolysis.
- PCr is broken down by the enzyme creatine kinase (CK) to produce creatine and Pi, which is then transferred to ADP in order to resynthesize ATP (PCr + ADP + H+ → ATP + Cr).

- PCr + ADP + H ⟷ Cr + ATP CK

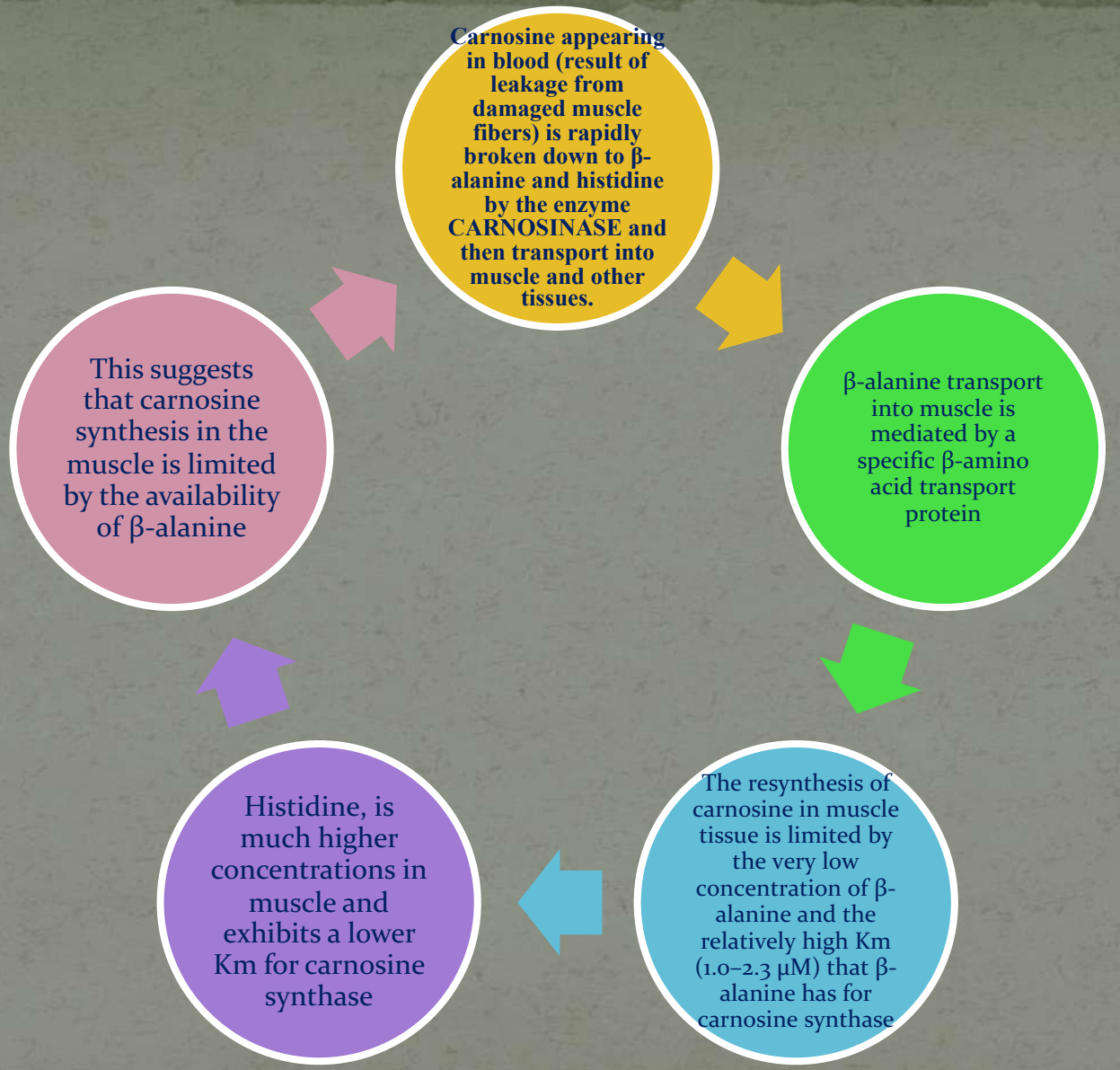
Pi myosinATPas

- Muscle cells do not possess the ability to synthesize creatine, dependent on the availability of creatine from the systemic circulation.
- There is around a 1000-fold concentration gradient between plasma (20–50 μmol/l) and muscle (~35 mmol/l intracellular water), and so creatine is actively transported from the extracellular space into the intracellular space by a saturable highcapacity, high-velocity, Na+-dependent process.
- In order to saturate the creatine transporter, a plasma creatine concentration of greater than 500 μmol/l is required and ingestion of a
- 5 g creatine bolus was capable of rapidly increasing plasma creatine concentration 20- to 30-fold (within 15 minutes) to 600–900 μmol/l.

Thus, the 5 g creatine dose has become the standard single dose prescribed to humans

β-alanine/ CARNOSINE

- Carnosine (β-alanyl-l-histidine) is a cytoplasmic dipeptide and is formed, mainly in muscle tissue, by bonding histidine and β-alanine in a reaction catalyzed by carnosine synthase.
- BRAIN and MUSCLE, particularly type II fibres.
- It also plays a role in increasing the efficiency of calcium handling in the muscle to enhance the efficiency of excitation-contraction coupling, via the process known as the CARNOSINE SHUTTLE.
- Dietary sources of carnosine and β-alanine include MEATS, ESPECIALLY 'WHITE' (FAST TWITCH) MEAT SUCH AS THE BREAST MEAT OF POULTRY AND OF SEA ANIMALS THAT ARE EXPOSED TO HYPOXIA, SUCH AS WHALE.
- Vegetarians have lower resting muscle carnosine concentrations than meat eaters.



- 1.6-6.4 g β-alanine/day
- Supplementation results in equal increases in both types I and II muscle fibers
- Experience of paraesthesia β-alanine-induced multiple action potentials of dorsal root ganglia neurons terminating in the skin when doses of >800 mg or f 10 mg/kg of β-alanine.
- To combat this, a sustained release formulation is now available (CarnoSyn™), which imposes a physical restraint on the rate of release of β-alanine.

- WHY NOT CARNOSINE BUT BETA ALANINE SUPPLEMENTATION??

- Direct supplementation with carnosine offers no advantage over β-alanine, since this is fully hydrolyzed on absorption.

Supplements to Increase Extracellular Buffering

- Anaerobic glycolysis provides the primary fuel source for exercise of near-maximal intensity lasting longer than approximately 20–30 seconds.
- When intracellular buffering capacity is exceeded, lactate and hydrogen ions diffuse into the extracellular space, perhaps aided by a positive pH gradient.
- An increase in extracellular buffering capacity should delay the onset of muscular fatigue during prolonged anaerobic metabolism by increasing the muscle's ability to dispose of excess hydrogen ions.

Sodium Bicarbonate

- To combat Metabolic acidosis

- $H^+ + HCO_3^- \leftrightarrow H_2CO_3 \leftrightarrow H_2O + CO_2$

- Blood bicarbonate buffers H+ by combining with it to form carbonic acid which then quickly dissociates to form carbon dioxide and water.

ACUTE LOADING

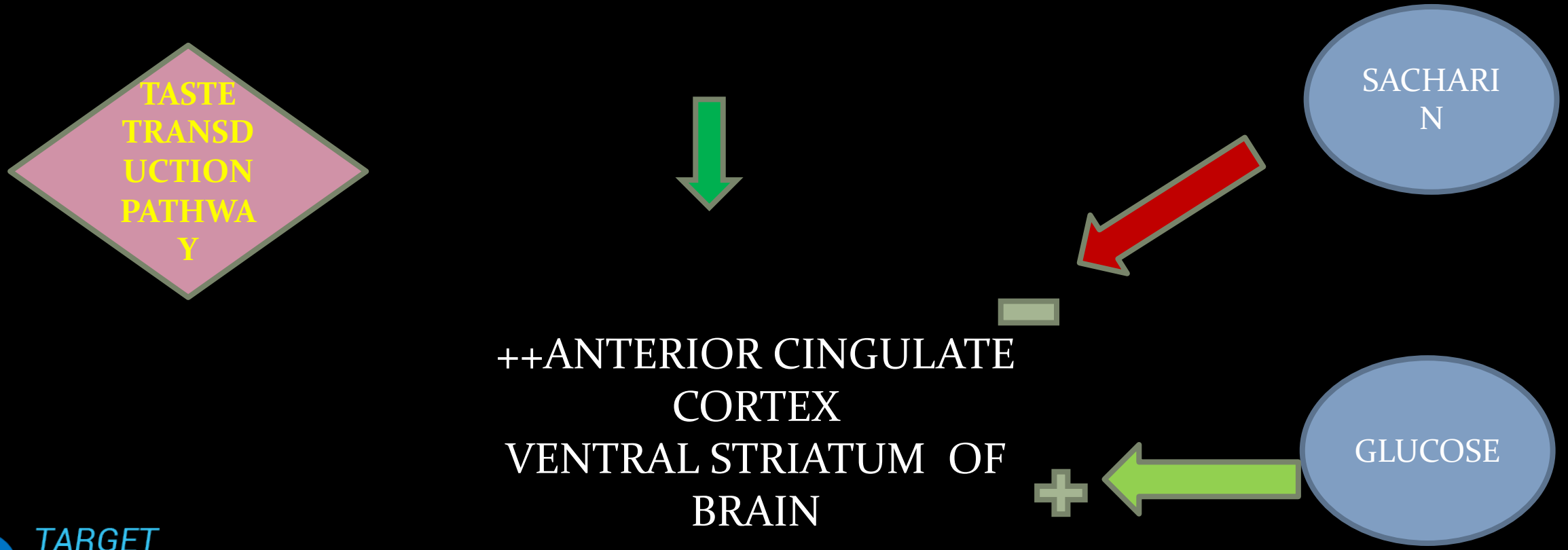
- The general protocol for bicarbonate loading is to ingest 0.3 g of sodium bicarbonate/kg BM 1–2 hours prior to exercise; this equates to 4–5 teaspoons of bicarbonate powder.
- The major side effect of bicarbonate supplementation is gastrointestinal (GI) distress including nausea, stomach pain, diarrhoea and vomiting . HYPEROSMOTIC DIAHROHOEA

‘SERIAL’ LOADING PROTOCOL

- 5–6 days of bicarbonate supplementation with a total of 500 mg/kg/d, spread into four doses over the day.

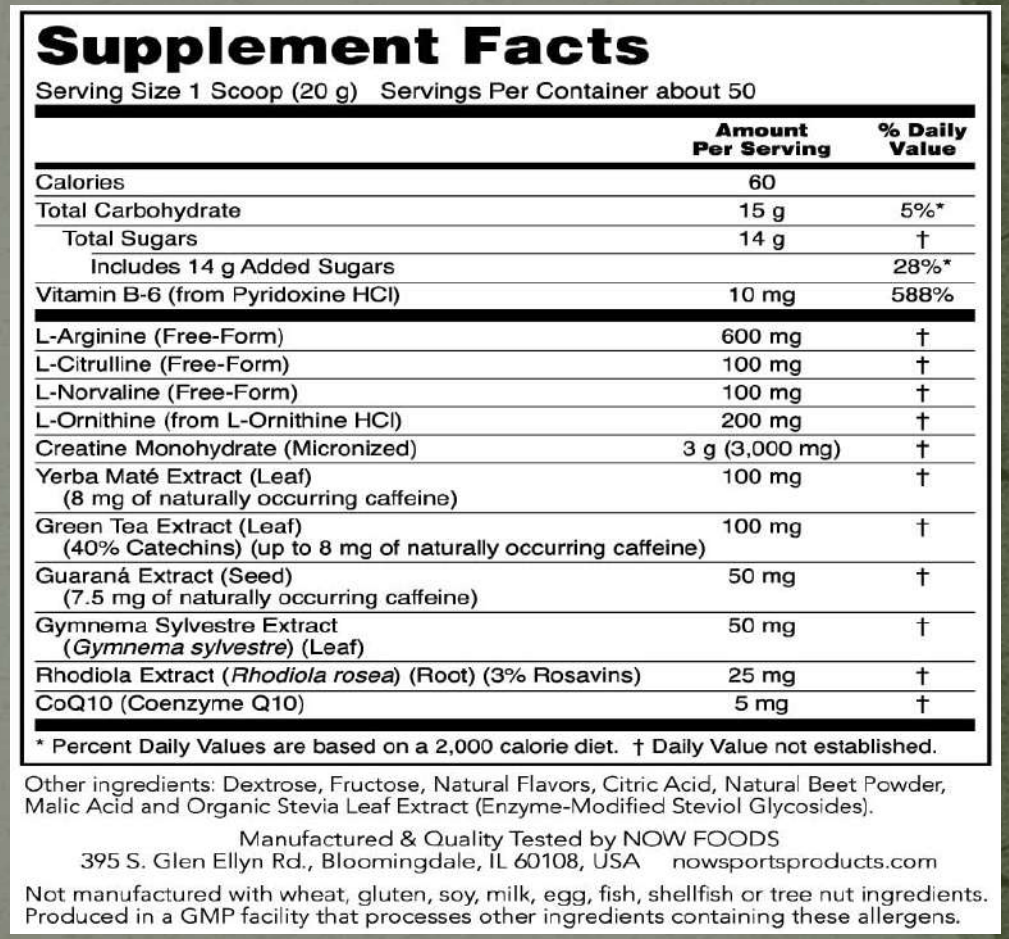
CARBOHYDRATE RINSE

- 5seconds Rinse ..... NO SWALLOWING.... MATRODEXTRIN



ARGININE

- Essential amino acid.
- 3.5 to 5 grams daily
- Detoxification of ammonia formed during the nitrogen catabolism of amino acids via the formation of urea.
- Potential to be converted to glucose (hence its classification as a glycogenic amino acid); and its ability to be catabolized to produce energy.



Supplement Facts

Serving Size 1 Scoop (20 g) Servings Per Container about 50

	Amount Per Serving	% Daily Value
Calories	60	
Total Carbohydrate	15 g	5%*
Total Sugars	14 g	†
Includes 14 g Added Sugars		28%*
Vitamin B-6 (from Pyridoxine HCl)	10 mg	588%
L-Arginine (Free-Form)	600 mg	†
L-Citrulline (Free-Form)	100 mg	†
L-Norvaline (Free-Form)	100 mg	†
L-Ornithine (from L-Ornithine HCl)	200 mg	†
Creatine Monohydrate (Micronized)	3 g (3,000 mg)	†
Yerba Maté Extract (Leaf) (8 mg of naturally occurring caffeine)	100 mg	†
Green Tea Extract (Leaf) (40% Catechins) (up to 8 mg of naturally occurring caffeine)	100 mg	†
Guaraná Extract (Seed) (7.5 mg of naturally occurring caffeine)	50 mg	†
Gymnema Sylvestre Extract (*Gymnema sylvestre*) (Leaf)	50 mg	†
Rhodiola Extract (*Rhodiola rosea*) (Root) (3% Rosavins)	25 mg	†
CoQ10 (Coenzyme Q10)	5 mg	†

* Percent Daily Values are based on a 2,000 calorie diet. † Daily Value not established.

Other ingredients: Dextrose, Fructose, Natural Flavors, Citric Acid, Natural Beet Powder, Malic Acid and Organic Stevia Leaf Extract (Enzyme-Modified Steviol Glycosides).

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Not manufactured with wheat, gluten, soy, milk, egg, fish, shellfish or tree nut ingredients. Produced in a GMP facility that processes other ingredients containing these allergens.

1) its role in the secretion of endogenous GROWTH HORMONE... infusion of arginine stimulated growth hormone secretion from the anterior pituitary by suppression of endogenous somatostatin secretion.... 12 grams to 30 grams.

2) its involvement in the synthesis of CREATINE (Arginine, glycine, and methionine are the three amino acids involved in the synthesis of creatine).

3) its role in augmenting NITRIC OXIDE.

NO is synthesized from arginine under the enzymatic control of nitric oxide synthase (NOS).

There are three NOS isoforms, endothelial cell NOS (eNOS), neuronal NOS (nNOS), and inducible NOS (iNOS). Skeletal muscle expresses all three forms of NOS, with nNOS predominating.

NO

- Muscle functions regulated by NO or related molecules include force production (excitation-contraction coupling), autoregulation of blood flow, myocyte differentiation, respiration, and glucose homeostasis

- Contractile activity greatly increases NO production in the muscle, and this is likely due to elevated intracellular calcium .
- NO on skeletal muscle metabolism is to increase the delivery and uptake of fuel substrates via its vasodilating effects

- **EFFECTIVENESS: STRENGTH AND PEAK POWER**

12g arginine/day for 8 weeks

improved 1RM bench press

improved wingate peak power(peak anaerobic power)

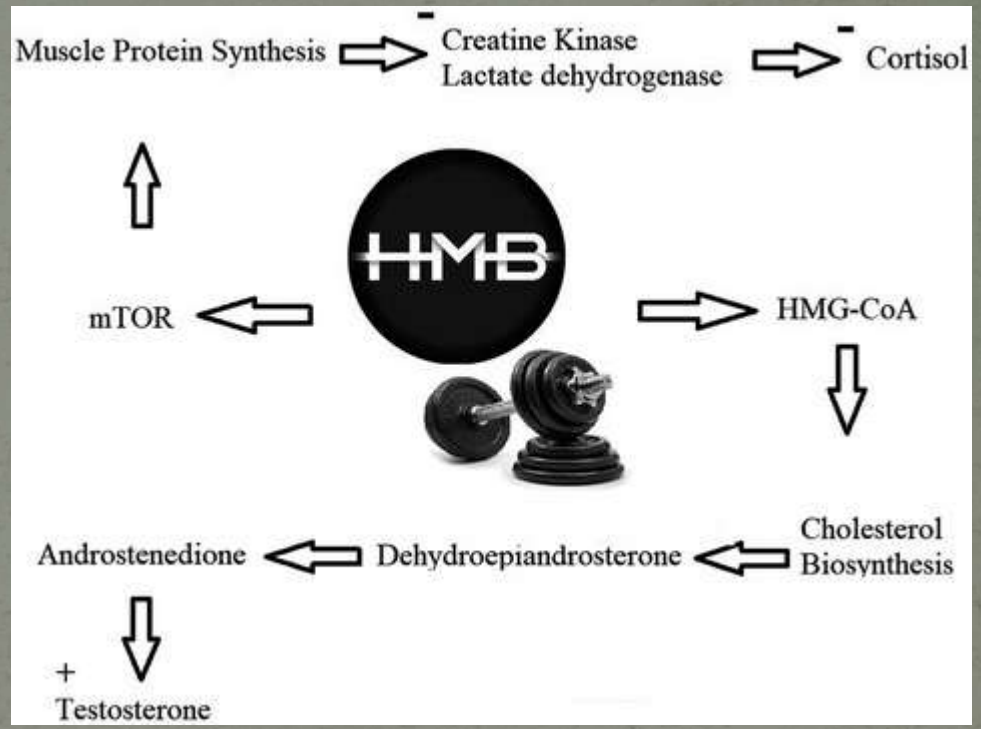
** no effect on body composition

no effect on aerobic capacity

No proof that arginine influences NO levels in muscles

HMB

- Increase exercise-induced gains in muscle size,
- muscle strength,
- lean body mass,
- reduce skeletal muscle damage from exercise,
- improve aerobic exercise performance,
- expedite recovery from exercise.



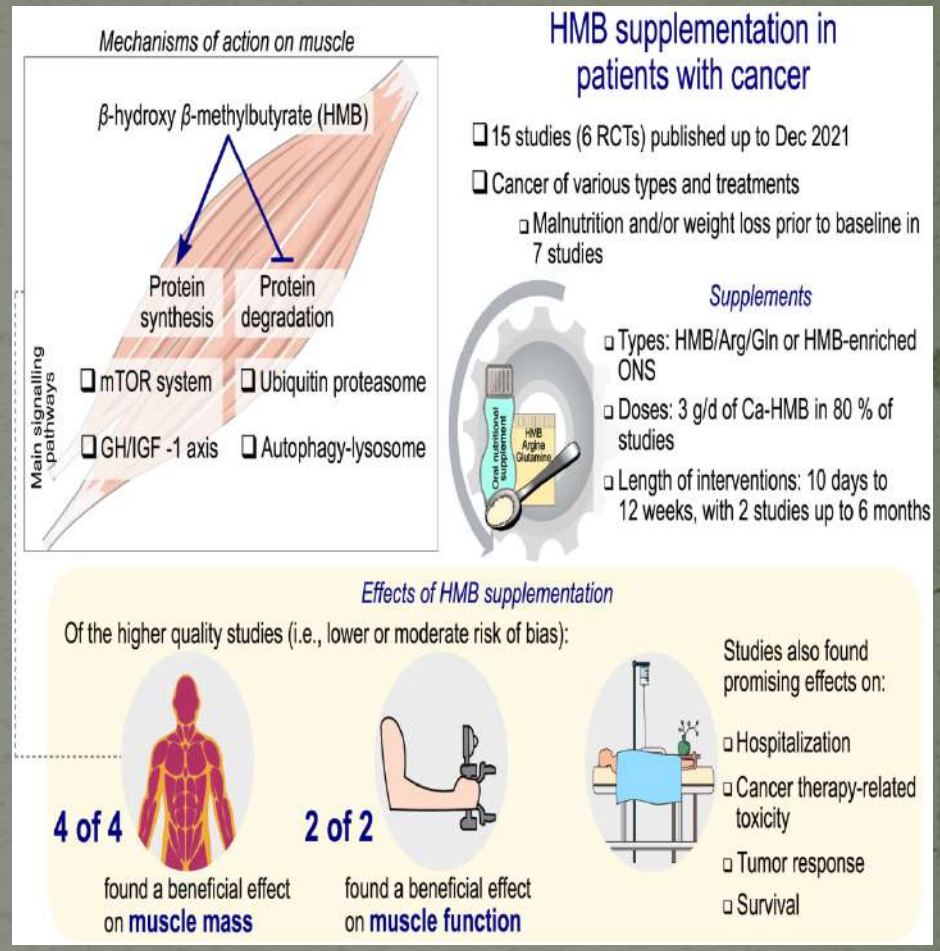
- HMB is also present in insignificant quantities in certain foods
- ALFAALFA
- ASPARAGUS
- AVOCADOS
- CAULIFLOWER
- GRAPEFRUIT
- CATFISH

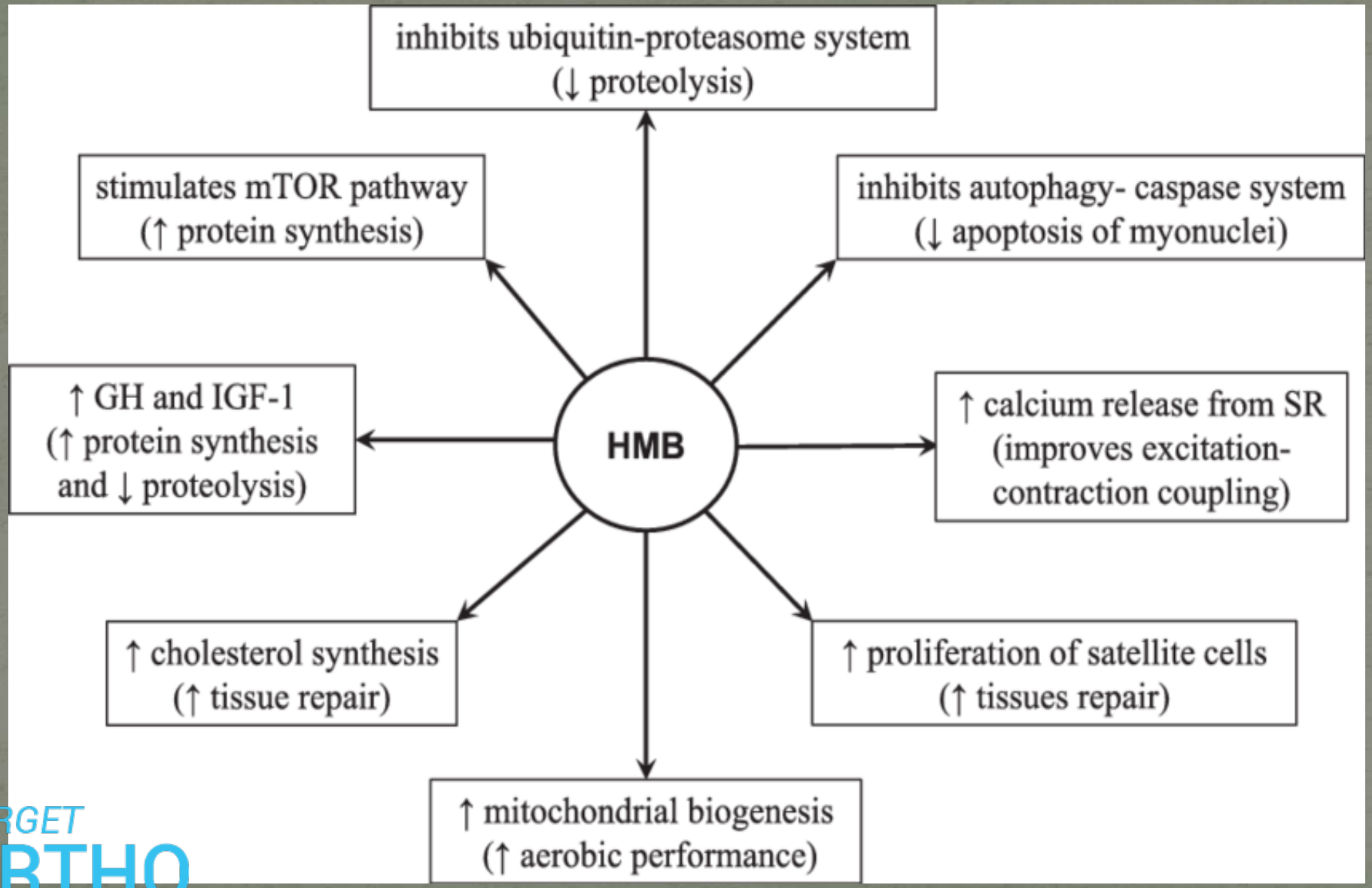
- HMB has not been banned by the **NCAA , WADA.**
- FREE ACID form, *β-hydroxy β-methylbutyric acid* (HMB-FA), and as a monohydrate salt of calcium base *calcium β-hydroxy β-methylbutyrate monohydrate* (HMB -Ca, CaHMB).

HMB and athletes

- It is a metabolite of leucine. (anticatabolic)
- 1.5-3g/day inc fat free mass and strength in a dose dependent manner
- HMB is classified as a dietary supplement and is NOT on the World Anti Doping Agency (WADA)'s list of banned substances

- increase protein synthesis muscle via PHOSPHORYLATIONS of the mechanistic target of rapamycin (mTOR) and activation of mTORC1, which leads to PROTEIN BIOSYNTHESIS in cellular RIBOSOMES via phosphorylation of mTORC1's immediate targets p70S6 Kinase and translation repressor protein 4EBP1).
- HMB attenuates muscle protein breakdown in an INSULIN -independent manner in humans.
- HMB reduce muscle protein breakdown in humans by inhibiting the 19S & 26S subunits of the Ubiquitin-Proteosome system in skeletal muscle and by inhibiting APOPTOSIS of skeletal muscle.





- Impact of HMB on athlete performance :

a) Improve strength when training involves movements like bench press, squats and dead lifts.

b)Improvements in endurance performance when training involves running, cycling and rowing.

c)Increases muscle mass gains when training to increase strength.

d)Reduces blood indicators of muscle cell damage after high training loads.

e) Reduces the recovery time needed between training sessions

WHEY PROTEIN

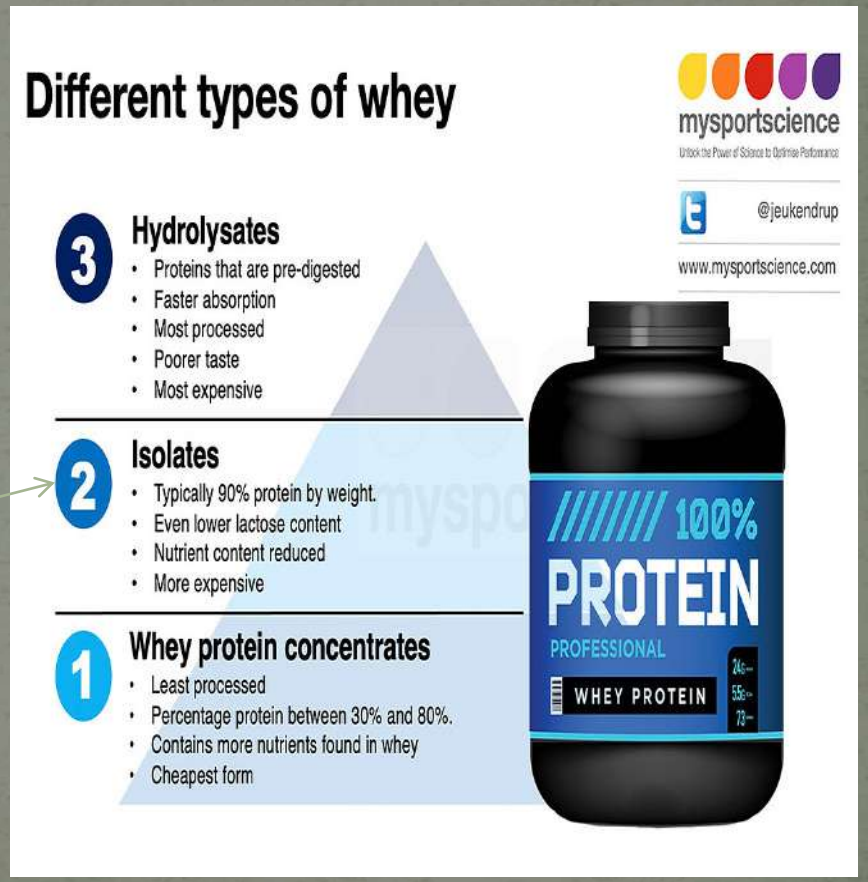
- The current Recommended Dietary Allowance (RDA) for healthy individuals is 0.8 g/kg/day
- Protein intake of at least 1.4–1.6 g/kg/day training INDIVIDUAL

- WP contains β-lactoglobulin, α-lactalbumin, immunoglobulins, bovine serum albumin, lactoferrin, lactoperoxidase, phospholipoprotein, bioactive factors, and enzymes.

WHEY PROTEIN

- The **HIGH LEUCINE CONTENT** in WP ….stimulate muscle protein synthesis by upregulating target of Rapamycin signaling in high concentration.

- Selective elution, also known as ion exchange chromatography,



- Whey protein supplementation with L-tyrosine can lead to an increase in dopamine that in turn may lead to an improvement in mood state.

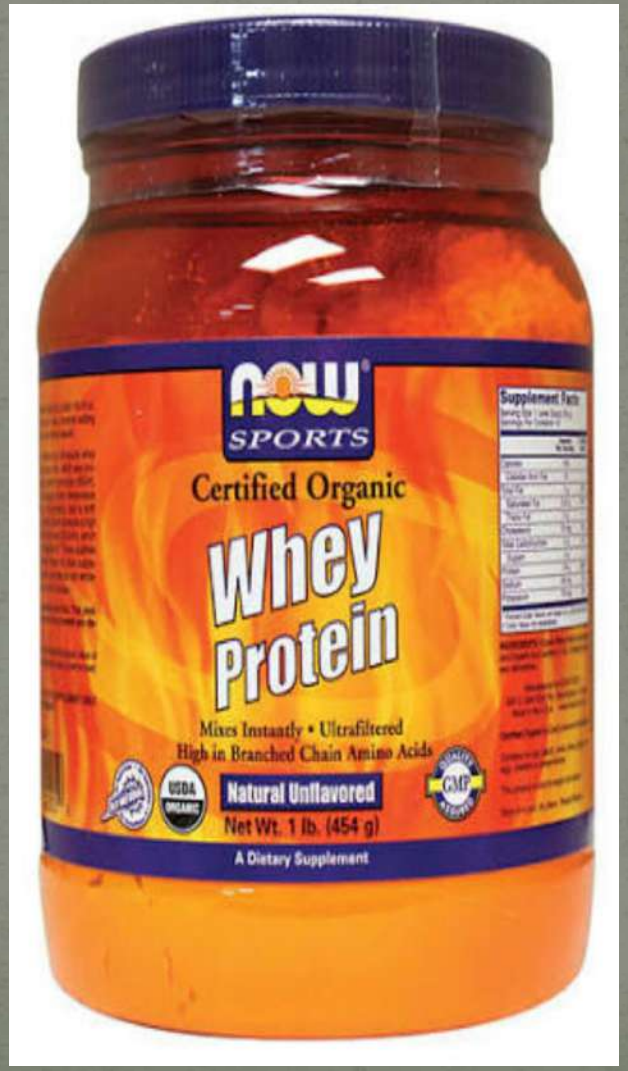
WHEY PROTEIN

- Inc lean body mass and strength
- Enhance immunity
- MOA:

  High biological value and rapid digestion rate

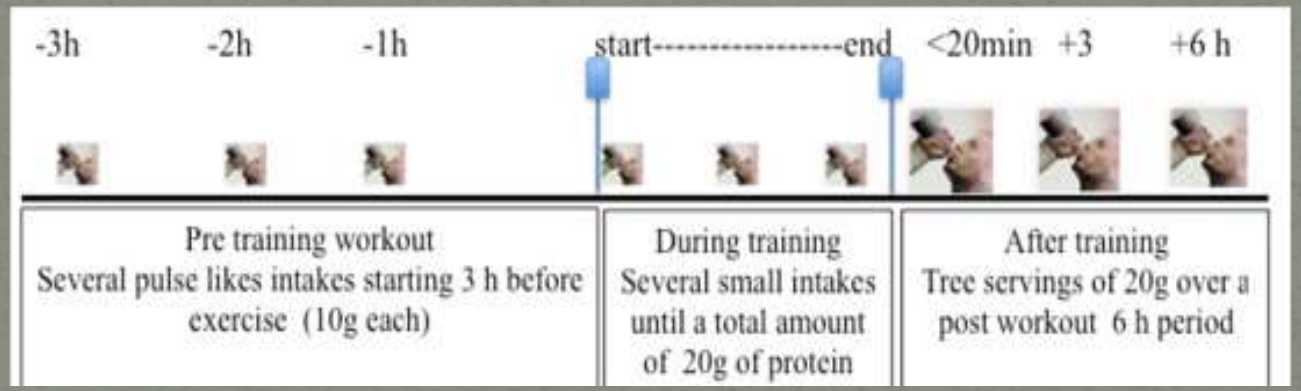
Elevate glutathione level(high cysteine content)-red oxidative stress

20% of milk protein(presume to be safe)



Optimal protocol for administering a supplement---NO SET PRTOCOL

- 2g of Leucine (20 to 25 mg/kg) seems appropriate for eliciting optimal muscular responses.
- Carbohydrate: Whey = 3:1



Effectiveness: Strength

- 20g whey/day for 3 months(no training) inc:

peak power
work capacity
glutathione levels

Supplementation promoted : greater gain in lean mass
greater decrease in fat mass

May enhance performance by reducing oxidative stress and muscle fatigue

EPHEDRA

- It is a shrub(ma huang), traditionally been used i
  weight loss supplements.
- sympathomimetic and a central nervous system stimulant…. Energy Enhancer
- In USA FDA banned supplements containing ephedrine in 2004.
- Studies have shown that normal doses do not produce performance enhancing effects.
- Larger doses have been shown to improve performance in cyclist.

- Improve ENDURANCE via increased fat utilization and glycogen sparing during exercise.
- exerts its THERMOGENIC effects via ….

Catecholamine release---- ----Catecholamine release and actions.

- ✓ adenosine and prostaglandin relea… …otic ju… …ction
- ✓ elevated phosphodiesterase enzyme activity

NEGATIVE FEEDBACK SYSTEMS

[]

degradation of cyclic adenosine monophosphate (cAMP).

EPHEDRINE+ CAFFEINE

EFFECTS ON PERFORMANCE by Dec Apetite

Dec Fat MASS

- **Thermogenesis and Lipolysis**
- increases in both fat oxidation and fat loss

CNS STIMULANT WITH THERMOGENIC AND LIPOLYTIC EFFECTS.

Exercise Performance by Inc resting Vo2

DIRECT SYMPATHOMIMETIC EFFECTS

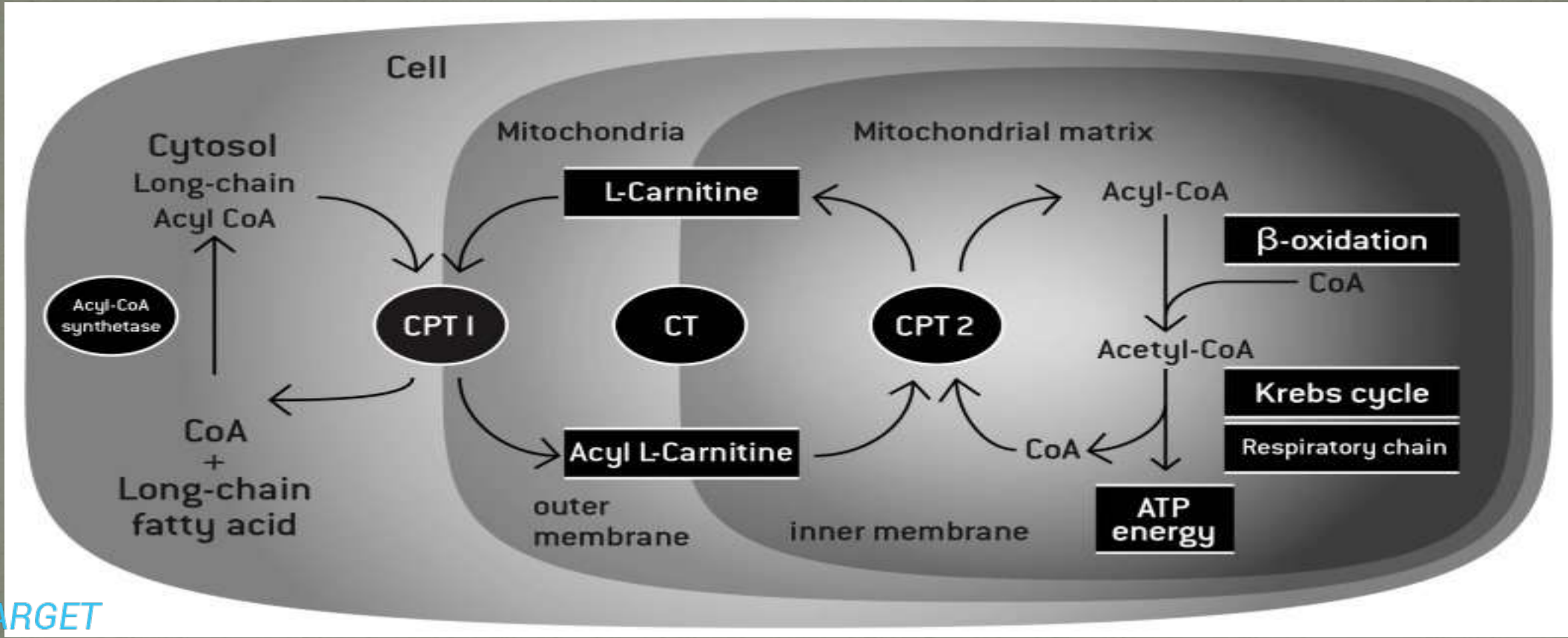
Carnitine

- Naturally occurring, L-carnitine is a quaternary amine (3-hydroxy-4-*N*-trimethylaminobutyrate) found in all mammalian species.

- L-carnitine in FATTY ACID OXIDATION in the liver and the heart.

- As mitochondrial membranes are impermeable to coenzyme A (CoA) esters and long-chain fatty acids, binding of L-carnitine to acetyl groups via carnitine acyltransferase is essential for the shuttle of the acetylated fatty acids into the mitochondria and for their subsequent β-oxidation in the matrix

- The products of the β-oxidation (two carbon molecules) are then used by the Krebs cycle to produce Adenosine triphosphate (ATP) as form of energy. L-carnitine has also been recognized for its crucial biological function in buffering the free CoA/acetyl-CoA ratio.
- Under conditions of stress with excess formation of acyl-CoA, transesterification with L-carnitine potentially promotes the substrate movement in the Krebs cycle.



1. Inc in Power Output
2. Alleviated pain, tenderness and release of creatine kinase—a marker of muscle injury-indicating that the nutrient was effective in reducing tissue disruption and subsequent leakage of cytosolic proteins.
3. facilitated tissue repair by protecting against carnitine deficiency in the endothelial cells, thereby ameliorating blood flow and oxygen supply
4. Effective in mitigating oxidative stress during exercise.[Muscle damage especially during eccentric exercise (active force generating lengthening contractions) is caused by immediate cellular and structural injury and subsequent biochemical responses during tissue repair]
5. Daily Dosage : 1-2g/day

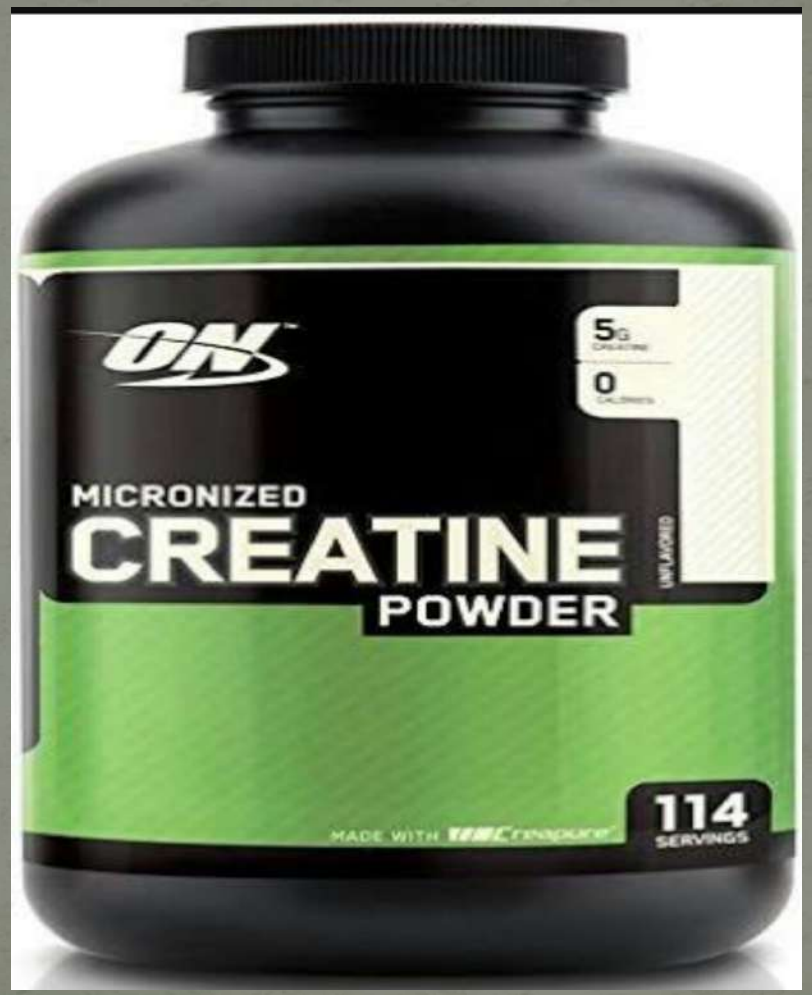
Uptake of L-carnitine by blood cells may induce at least three mechanism

1) stimulation of hematopoiesis
2) a dose-dependent inhibition of collagen-induced platelet aggregation
3) the prevention of programmed cell death in immune cells.

CREATINE

- Most popular nutritional supplement on market @ 300million sales in U.S in 2000.
- First reported supplementation- Barcelona Olympics in 1992
- Creatine is main component of creatine phosphate. Creatine is found in meat and fish (mixed diet provides about 1g/day) but is also synthesized in liver, pancreas an kidney.(95% found in skeletal muscle,5% in brain liver, kidney and testes)

- Dietary supplementation is of at least 15-25g/day for 2-7 days can inc muscle creatine by 20-30%(20% is in CrP)



- Physiological benefits inconsistently reported in research.
- Detrimental effects – inc body water(weight),muscle cramping, possible renal damage from long term intake.

- Not banned, but in US, the NCAA prevents college teams from providing it to players

Creatine Biochemistry

- Creatine function by controlling ATP and ADP ratios when skeletal muscle is intensely contracted.(Crp donates a phosphate to ADP to form ATP).
- CREATINE MONOHYDRATE is supplemented to inc skeletal creatine levels.

- Safety : pose no actual health risk but because of filtration by kidney, may cause kidney damage.
- Leads to muscle cramps due to inc water content in muscle diluting the electrolyte levels which may possible cause death.
- Legal and ethical issues :currently legal for use may be unethical.
- Recommendations: may be an effective sports ergogenic for specific exercise task.

Nutrional Agents/Supplements

- AA Supplementations
- Bee Pollen
- Carbohydrate Loading
- Carnitine
- Caffeine
- Chromium Picolinate
- Eicosanoids
- Ginseng
- Sodium Bicarbonate
- Coenzyme Q-10
- Creatine Phosphate
- Water or Special Beverages
- Hydroxymthyl butyrate(HMB)
- Inosine
- Octacosanol
- Royal jelly
- Spirulina
- Vitamins
- Wheat germ oil

Nutritional Aids

A. Metabolic Fuels

Carbohydrate,protein,pyruvate,lactate,fat,caffiene,branched chain AA,etc.

B. Limiting cellular components

Creatine,carnitine,vitamins,phosphate,sodium bicarbonate

C. Anabolic and stimulatory Substance

protein,chromium,vanadium,ephedrine,HMB,caffeine,androste-nedione,etc.

D. Anti-catabolic

anti-oxidants,HMB,etc.

1)Amino Acids : BCAA(valine,leucine,isoleucine): -
+protein syntheis
+muscle growth over time

2)Bee Pollen: (antioxidant+ergogenic effect+muscle building effect) -endurance enhancer(35-40%)

3)Chromium picolinate :+ Insulin activity=metabolie glucose and fat
DNA and Lipid damage

4)Eicosanoids ; Endogenous FA produce from Arachidonic acid.

5)Ginseng: (panax ginseng): traditionaly used as energy enhancer and sexual stimulant.

-inc strength by inc creatine production

-delays fatigue(by inc enzyme involve in creatine production)

-improve aerobic capacity

6)Inosine(Purine ribonucleoside) : -Inc form of 2,3DPG=inc RBC(inc more O_2)

- Inc ATP(endurance exercise)

S/E:inc uric acid production

7)Octacosanol: Waxy substance found in wheat germ oil
-Improve endurance(Cureton Tik et al,1972)
-1mg/day for 8week improve grip strength
-No effect on endurance(Saint John M et al,1986)

8)Spirulina: Blue Green algae(2012 NASA, 1gm=1000gm fruits and vegetables)
(300% > fe than spinach,>300% calcium,>200% meat protein)

9)Royal Jelly :B complex vitamin(B-5 and B-6)-boost energy stamina and immune system.

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