What is an Ergogenic Aid?

• *Ergo* = “work”
• *Genic* = “to generate”
• Substances, products or techniques that enhance physical performance
  – Many and varied
  – Ergogenic aids extend beyond supplements and medications and can take many forms
• Examples?
## Types of Ergogenic Aids

<table>
<thead>
<tr>
<th>Type of Ergogenic Aid</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutritional</td>
<td>Any supplement, food product, or dietary manipulation that enhances work capacity or athletic performance</td>
<td>Carbohydrate loading; creatine phosphate; amino acid supplementation; vitamin supplementation; glucose polymer drinks; sports gels; carbohydrate-loading drinks; liquid meals</td>
</tr>
<tr>
<td>Physiological</td>
<td>Any practice or substance that enhances the functioning of the body’s various systems (e.g., cardiovascular, muscular) and thus improves athletic performance</td>
<td>Bicarbonate buffering; any type of physical training (e.g., endurance, strength, plyometric); blood doping via transfusions; the practice of warming up</td>
</tr>
<tr>
<td>Psychological</td>
<td>Any practice or treatment that changes mental state and thereby enhances sport performance</td>
<td>Visualization; sessions with a sport psychologist; hypnosis; pep talks; relaxation techniques</td>
</tr>
<tr>
<td>Biomechanical</td>
<td>Any device, piece of equipment, or external product that can be used to improve athletic performance during practice or competition</td>
<td>Weight belts; knee wraps; oversize tennis rackets and golf clubs; clap skates; body suits (swimming/track); corked bats</td>
</tr>
<tr>
<td>Pharmacological</td>
<td>Any substance or compound classified as a drug or hormonal agent that is used to improve work output and/or sport performance</td>
<td>Hormones (e.g., growth hormone, erythropoietin, anabolic androgenic steroids); amphetamines; caffeine; beta-blockers; ephedrine</td>
</tr>
</tbody>
</table>
Example of Physiologic Ergogenic Aid: Glucosamine

- Glucosamine is naturally produced by the human body to maintain cartilage in the joints
  - Not a nutrient per se
  - Not obtained directly from foods

- Claim
  - Decrease pain and delay osteoarthritis progression
Glucosamine

• GAIT (Glucosamine/chondroitin Arthritis Intervention Trial) by NIH – 2010
  – 1583 patients (majority with mild disease)
  – Glucosamine 1500mg/chondroitin 1200mg
  – 2 years
  – Overall not better than placebo
  – Trend toward significance in small subgroup with moderate to severe knee pain
Glucosamine

- Studying effect of therapeutic interventions is complicated by many factors
  - Slow progression of the disease
  - Increased placebo effect in larger trials
  - Limited standardized outcome measures
Example of Pharmacologic Ergogenic Aid: Human Growth Hormone

• Human growth hormone (HGH) is produced by the body to trigger tissue synthesis
  – Not a nutrient

• HGH increases protein synthesis and muscle mass accretion
  – May also spare glycogen

• Side effects of growth hormone include heart disease, impotence, osteoporosis, and death
Regulation of Nutritional Ergogenic Aids in Canada

• Conventional sport products are typically regulated as “foods” not “drugs,”
  – Fluid replacement beverages, sport gels, protein powders, and meal replacement drinks
  – Should have a Nutrition Facts Panel or nutrient information on the label
  – Burdon of proof of efficacy is lower than that required for pharmaceutical products
Regulation of Nutritional Ergogenic Aids in Canada

• Supplement tablets and capsules, amino acids preparations, energy drinks and vitamin-mineral enhanced waters:
  – Regulated as dietary supplements or licensed natural health products
  – Will have a Natural Health Product Number (NPN) or a Drug Identification Number (DIN) on the label if they are legally approved for sale in Canada
Regulation of Nutritional Ergogenic Aids in Canada

• Products with a NPN or DIN have been assessed by Health Canada and found to be safe, effective and of high quality under their recommended conditions of use.

This is the condition of use. Based on this info an athlete should not expect this products to promote endurance.

Keep in mind that the conditions of use and what the athlete wants or has heard the product will do are not always the same thing.
Regulation of Nutritional Ergogenic Aids in Canada

• Be aware that regulation of nutritional ergogenic aids and supplements in Canada is very loose

• **Unapproved, ineffective products can still be sold**

• Even approved products are not risk free:
  – Can be toxic if taken in excess
  – Can interact with other supplements, medications and foods
Off Label Use

• Off Label Use:
  – When a drug or NHP is used for a purpose that has either not been approved by Health Canada (drugs) OR is not the stated condition of use (NHP)
    • E.g. HGH being taken to promote muscle gain in an otherwise healthy adult
  – There can be no guarantees of safety or efficacy when a drug or NHP is used “off label”
Undeclared Ingredients and Contamination

• The addition of undeclared ingredients to seemingly harmless sport supplements is relatively common
  – E.g. anabolic steroids added to “muscle gain” products

• This is a concern for elite athletes because undeclared ingredients in a supplement may lead to a positive doping test
Contamination is Common

• 2001 IOC international study;
  – 634 non-hormonal supplements,
  – 15% contained undeclared steroids

• 2007 study of 58 USA supplements
  – 25% contaminated with prohibited steroids
  – 11% contained undeclared or prohibited stimulants

• 2008 UK study of 152 supplements
  – 10% contaminated with steroids and/or stimulants

Undeclared Ingredients are Not Unusual

• U.S. FDA Media Release (2009):

“As part of its ongoing cooperation with the Food and Drug Administration (FDA), Bodybuilding.com, announced today that it is conducting a voluntary nationwide and international recall of all lots and expiration dates of 65 dietary supplement products that were sold through the Company's website, www.bodybuilding.com”
Why Add Undeclared Ingredients?

APS Nutrition Ultra Mass Stack 90 Capsules

“APS Nutrition have formulated Ultra Mass Stack to **build slabs of lean hard muscle** with the help of this powerful anabolic blend.”

“Increase lean muscle mass, strength and jump start your sex drive with the help of the Ultra Mass Stack from APS. “

Without the addition of an anabolic steroid there is no nutritional supplement that could achieve these outcomes! If the product doesn’t work, no one will buy it.

**The undeclared ingredient (Trenbolone – a veterinary steroid) is added so the product will actually do something!**
Possible Consequences

• **Strict Liability**
  – Ultimately, athletes are responsible for any prohibited substance that may be found in their sample

• If athletes who use supplements test positive for a prohibited substance, this can result in a violation being declared, regardless of how the prohibited substance got into their body

• Serious sanctions may be imposed
What is doping?

• Practice of enhancing performance using banned foreign substances or other artificial means
  – Intentional or inadvertent

• Doping is a problem of epidemic proportions in sport

• Oversight agencies
  – World Anti-Doping Agency (WADA)
  – Canadian Centre for Ethics in Sport (CCES)
World Anti-Doping Agency Code: Definition of Doping

As defined by the WADA Code (WADA 2003), doping encompasses one or more of the following:

- Presence of a prohibited substance or its metabolites or markers in an athlete’s bodily specimen
- Use or attempted use of a prohibited substance or a prohibited method
- Refusing, or failing without compelling justification, to submit to sample collection after notification as authorized in applicable anti-doping rules or otherwise evading sample collection
- Violation of applicable requirements regarding athlete availability for out-of-competition testing including failure to provide required whereabouts information and missed tests which are declared based on reasonable rules
- Tampering or attempting to tamper with any part of doping control
- Possession of prohibited substances and methods
- Trafficking in any prohibited substance or prohibited method
- Administration or attempted administration of a prohibited substance or prohibited method to any athlete, or assisting, encouraging, aiding, abetting, covering up, or any other type of complicity involving an anti-doping rule violation or any attempted violation

Note: The code specifies strict liability, meaning that an athlete is responsible regardless of whether a violation was committed unknowingly or intentionally.

A complete explanation of the code can be found on the WADA Web site: www.wada-ama.org/en.

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Table 16.1  Drugs Banned by the World Anti-Doping Agency (WADA) or National Collegiate Athletic Association (NCAA) or Both

<table>
<thead>
<tr>
<th>Substance</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulants</td>
<td>Caffeine(^2), ephedrine(^2) (ephedra, ma huang), synephrine (Citrus aurantium, or bitter orange),(^4) cocaine</td>
</tr>
<tr>
<td>Street drugs</td>
<td>Codeine, morphine, heroin, marijuana</td>
</tr>
<tr>
<td>Anabolic agents</td>
<td>Testosterone(^5), stanozolol, androstendione (Andro), dehydroepiandrosterone (DHEA), clenbuterol</td>
</tr>
<tr>
<td>Beta-2 agonists</td>
<td>Atenolol, metaprolol, propranolol</td>
</tr>
<tr>
<td>Diuretics and other masking agents</td>
<td>Furosemide, triamterene, acetazolamide</td>
</tr>
<tr>
<td>Peptide hormones and analogs</td>
<td>Growth hormone (HGH), insulin-like growth factor (IGF-1), erythropoietin (EPO)</td>
</tr>
</tbody>
</table>

\(^1\)Complete lists of banned substances can be found at www.wada-ama.org/en/ and www.ncaa.org/wps/ncaa?ContentID=282

\(^2\)Urinary concentrations must exceed 15 μg/mL for NCAA. As of 2005, caffeine has not been banned by WADA.

\(^3\)Urinary concentrations must exceed 10 μg/mL for WADA.

\(^4\)Not banned by WADA. Note: Phenylephrine and pseudoephedrine, found commonly in cold medications, are no longer banned by either organization.

\(^5\)Ratio of total urinary concentration of testosterone to epitestosterone must exceed 6.

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Inadvertent Doping

- Ingestion of substances that unbeknownst to the athlete can cause a positive test for doping.
  - E.g. creatine supplement containing undeclared anabolic steroids

- Causes
  - Ignorance of what substances are banned.
  - Names in ingredients list are not recognized.
  - Manufacturer may not list all ingredients.
  - Product could be contaminated in production.
    - Undeclared ingredients
SOCHI -- Sweden center Nicklas Backstrom missed the gold-medal game at the 2014 Sochi Olympics on Sunday against Canada because of a failed doping-control test, Swedish hockey officials said.

The positive test was for excess levels of pseudoephedrine, which was the result of an over-the-counter allergy medicine being taken by the player. Swedish team doctor Bjorn Waldeback said during a press conference Sunday. Waldeback said the medicine was Zyrtec-D, which Backstrom has taken intermittently during the past seven years, according to his NHL club, the Washington Capitals.

According to Swedish hockey general manager Tommy Boustedt, the suspension was levied Sunday by the International Olympic committee, the governing body for all Olympic competition. It came less than two hours before the game, after a hearing with the IOC disciplinary committee.

Backstrom said he last was tested Wednesday after Sweden defeated Slovenia in the quarterfinals.

Sweden lost the gold-medal game to Canada 3-0 at the Bolshoy Ice Dome.

"I want to say I have absolutely nothing to hide; I have allergy problems," Backstrom said at a press conference after the game. "I've taken Zyrtec-D for many years. It was a little shocking to me, to be honest with you, but at the same time I am here right now and I've got to deal with it."

"I feel like I haven't done anything differently than the last seven years and I've been playing internationally for the last seven years and lots of games and haven't seen this before."

Mark Aubry, the International Ice Hockey Federation's chief medical officer, called Backstrom "an innocent victim of circumstances."

Backstrom was at the Bolshoy Ice Dome preparing for the game when Boustedt
Doping: A Lengthy History of Cheating

• 1968 – In response to reports of cheating via the use of drugs and other performance enhancers, the International Olympic Committee (IOC) publishes first banned list of drugs for the 1968 Summer Olympics.

• 1975 – Canada’s first positive test result for a non-steroid infraction occurs at the 1975 Pan American Games.

• 1981 – Canada's first positive test result for steroids occurs at the Pacific Conference Games of Athletics in New Zealand.

• 1988 – Canadian Sprinter Ben Johnson wins the gold medal in the 100 m sprint at the Seoul Olympic Games. He is later stripped of his medal after testing positive for anabolic steroids.

• 1999 – The World Anti-Doping Agency (WADA) is established as an international independent agency composed and funded equally by the sport movement and governments of the world.
  – Its key activities include scientific research, education, development of anti-doping capacities, and monitoring of the World Anti Doping Code (Code) – the document harmonizing anti-doping policies in all sports and all countries.
Doping: A Lengthy History of Cheating

• 2007 – U.S. track superstar Marion Jones comes forward to acknowledges that she took performance enhancing substances. She is stripped of her medals and banned from competition.

• 2008 - 20 cases of doping violations were identified at the Beijing Olympic Games. In 1968, only 1 case was identified.
  – The 20 cases are thought to reflect only a handful of the actual competitors using banned substances or practices

The List of Prohibited Substances and Methods is the International Standard which establishes which substances are banned in sport
Why Do Athletes Use Nutritional Ergogenic Aids and Supplements?

• Improve performance
  – Speed, power, endurance, flexibility

• Delay fatigue
  – Which, in turn, may allow the athlete to train more frequently or at higher intensities

• Change body composition
  – Gain muscle OR loss fat OR both

• Improve general health and well-being
Why Do Athletes Use Nutritional Ergogenic Aids and Supplements?

• Searching for an “edge”
  – Medals are lost and won based on milliseconds in many sports

• Product ads
  – The promise of winning

• Other athletes promote their use
  – Fear of the “other guy” winning

• Considered harmless
  – This view is especially common with respect to nutritional ergogenic aids
Desire to Win by Elite Athletes:
Fear of disgrace and loss of personal income is greater than fear of harm
A 1997 *Sports Illustrated* survey of elite US athletes asked whether they would take an illegal drug that guaranteed an Olympic gold medal

– 195 of 198 athletes would take illegal drug if they were assured of not being caught

– 50% would take illegal drugs even if the side effects were lethal in 5 years

Prevalence: Ergogenic Aid Use

• Survey of 3248 high school students:
  – 71% use at least 1 supplement  (Med Sci Sports Exerc 2008)

• Survey of 582 elite Canadian athletes in 27 sports:
  – 88% use at least 1 supplement  (Clin J Sp Med 2007)

• Survey of Division 1 collegiate ice hockey players;
  – 58% have used stimulants, 38% used ephedrine at least once, 33% would use a banned substance if it would help them get to the NHL  (Physician & Sp Med 2004)
Keeping Pace

• The types of ergogenic aids sold to athletes change quickly
• Ineffective products move out of the market equally quickly
• There is limited value in trying to memorize or know a great deal about all the various types of supplements
• Key considerations are more important
EVALUATING NUTRITIONAL ERGOGENIC AIDS
Key Considerations

• Is the supplement safe **and** effective?

  – **Safety:**
    • Primum non nocere – “First, do no harm”
    • Unethical to recommend or support use of potentially harmful products

  – **Effectiveness:**
    • What is the mechanism of action?
    • Is the mechanism biologically plausible?
    • What are the purported ergogenic effect
    • Are the known benefits worth any risk associated with use?
Key Considerations

• Doping:
  – Could the supplement cause an athlete to test positive for a prohibited substance?

• What is known about the quality of the product:
  – Identity of all ingredients
  – Potency of active ingredients
  – Purity
  – Availability
    • Is it available on an ongoing basis at a reasonable cost?
Sport Supplement Decision Tree

• Rowing Australia's Sport Supplement Decision Tree (posted on e-Class) is a tool for rationalizing decisions related to ergogenic aids and nutritional supplements.
  – Considers both safety and efficacy in a risk-benefit framework.
  – Designed to allow the athlete choices where possible and to protect the athlete where the safety and doping status of a supplement cannot be determined.
Is the supplement/ergogenic aid for training or competition?

1.1 Training

1.2 Special Circumstances - NRCE Head Coach, Nutritionist and Physiologist must be fully involved in decision of how, when and where supplement/ergogenic aid is to be used

2.1 What is the age/elite training history of the athlete?

3.1 Less than 5 years

3.2 Five years or more

4.1 No supplement or ergogenic aid should be prescribed. Optimize training capacity and basic nutrition education.

4.2 Is there a recent history of injury?

5.1 Yes

5.2 No

6.1 Does the supplement have efficacy to enhance injury rehabilitation?

6.2 Does the athlete know why they want to use the product and have sufficient knowledge of its effects?

7.1 Yes

7.2 No

7.3 Yes

7.4 No

8.1 Individual case management. Supervised by Medical staff, Nutritionist and Coach.

8.2 Has the injury been resolved to the satisfaction of medical/support staff and coach?

8.3 Product can be used under supervision of Nutritionist and Coach. Regular reviews required.

8.4 Discuss further with Nutritionist and Coach. Further education required and review as necessary resume at 2.1

9.1 Yes

9.2 No

9.1 Yes

Allow time for injury to resolve and resume at 4.2

10.1 Progress to 4.2
Canadian Sport Centre Program

• The Canadian Sport Centre Calgary has had some dietary supplements tested in a lab that uses current World Anti-Doping Agency (WADA) standards to ensure the lowest risk of supplement contamination and makes these available to carded athletes at select pharmacies in Calgary.

Where Can Sport Nutritionists Learn More?

- Health Canada
- NCAA
- Center for Food Safety and Applied Nutrition (CFSAN)
- ACSM
- NIH Office of Dietary Supplements
- U.S. Pharmacopoeia
- MedWatch

- Food and Nutrition Information Council
- Consumer labs
- Books
  - *Ergogenic Edge*
  - *Sport Supplements*
- Supplement Watch
- WADA and CCES
Tools for Researching Nutritional Ergogenic Aids

- Australian Institute of Sport Supplement Program
- MEDLINE: Includes research/professional journals in the medical field
- CINAHL: Includes research/professional journals in nursing and allied health fields
- Sport Discus: Database that includes general media sources involving sport
Protein needs for an adult building muscle mass:

1.4g to 1.8g protein/kg/body weight

Example: Meet Brian!
Brian is a 170lb hockey player (77 kg)
1.8g x 77 kg = 138.6 grams of dietary protein/day
So what does 138.6 gm protein look like in food?

1. Ham and cheese sandwich at lunch:
   - two slices of luncheon ham (5 g protein each) = 10 g
   - 2 slices of cheese (11 g protein) = 22 g

2. Chicken breast for supper (2 servings of 86 grams each)
   = 27 g protein x 2 = 54 g

3. 750 ml of skim milk throughout the day = 27 g

10 g + 22 g + 54 g + 27 g = 113 grams of protein so far!
The rest of Brian’s food........

- 250 ml orange juice = 5 g
- Bagel = 7 g
- 2 slices of bread from Brian’s sandwich = 4 g
- 250 ml of broccoli = 5 g
- 500 ml of white rice = 8 g
- Apple = 1 g
- Blueberry muffin = 3 g

33 g protein + 113 g protein = 146 g protein
CURRENT AND/OR COMMON NUTRITIONAL ERGOGENIC AIDS
“There is still no sphere of nutrition in which faddism, misconceptions, ignorance, and quackery are more obvious than in athletics.”

(M.H. Williams in *Nutrition for Fitness and Sport*, 4th ed., 1995)
L-Carnitine

- A short-chain carboxylic acid containing nitrogen
- Vitamin-like compound with well-established functions in intermediary metabolism
- Found mostly in meat and dairy products
- Liver and kidneys synthesize L-carnitine from methionine and lysine.
- Vital to normal metabolism
Ergogenic Claims: L-Carnitine

- Acts as a vasodilator in peripheral tissues
- May enhance regional blood flow and oxygen delivery
- Might improve oxygen supply to injured tissue and promote clearance of muscle damage byproducts, thus reducing delayed-onset muscle soreness (DOMS)
L-Carnitine as an Ergogenic Aid

- Few data suggest that healthy adults require carnitine above levels in a well-balanced diet.

- Research shows:
  - No ergogenic benefits
  - No positive metabolic alterations (aerobic or anaerobic)
  - No enhanced recovery effect
  - No body fat–reducing effects
Coenzyme Q\textsubscript{10}

- Found primarily in meats, peanuts, and soybean oil
- Functions as an integral component of the mitochondrion’s electron transport system of oxidative phosphorylation
- Lipid soluble
- Exists in high concentrations within myocardial tissue
- Has antioxidant properties
Ergogenic Claims: Coenzyme Q$_{10}$

- Enhances function of electron transport chain
- Optimizes aerobic metabolism
- Improves endurance performance
Coenzyme Q\textsubscript{10} as an Ergogenic Aid

- Research has found that coenzyme Q\textsubscript{10}:
  - Does not improve aerobic capacity
  - Does not improve endurance performance
  - Does not improve plasma glucose
  - Does not improve lactate levels at submaximal workloads
  - Does not improve cardiovascular dynamics
Hydroxycitrate

- A principal constituent of the rind of the fruit of *Garcinia cambogia* used in Asian cuisine
- Appears as an ingredient in multiple different products such as the No-Diet Diet, Bio-Max 3000, PhytriMax, Lite Bites, Garcinia Trim-Plus, Garcinia-Max Diet System, Citrilite, Citrichrome, Lipotrol, MicroSlim, Body Busters, and Super Prolean Mega Fat Burner.
Ergogenic Claims: Hydroxycitrate

- Promoted as a “natural fat burner” to facilitate weight loss.

- Touted generally as being able to enhance endurance performance.
Hydroxycitrate as an Ergogenic Aid

- Research findings indicate that increasing plasma HCA availability with supplementation exerts no effect on skeletal muscle fat oxidation during rest or exercise.
- In other words . . . . it does nothing!
DHEA (Dehydroepiandrosterone)

What is it?
- Produced by the Adrenal Gland
- Building Block for Test/Estrogen
- Food Source: None
- Banned: WADA Code, COC, USOC, NCAA, and NFL
Ergogenic Claims - DHEA

✓ Eternal Youth
✓ Enhances Immune System
✓ Disease Fighter
✓ Weight Loss Aid
✓ Increases Muscle Mass
✓ Increases Energy
✓ Increases Libido
✓ Counteracts Stress
DHEA as an Ergogenic Aid

- DHEA is a pre-cursor to testosterone and theoretically could enhance athletic performance in a manner similar to anabolic steroids.

- Existing studies do not support a significant increase in lean body mass, strength, or testosterone levels with the use of DHEA in athletes.

- Long-term side effects of DHEA use are currently unknown.
Potential Side-Effects – DHEA

✓ Long-term unknown
✓ Alter levels of hormones
✓ Facial hair
✓ Acne
✓ Baldness
✓ Deepening of voice
✓ Menstrual irregularities

✓ Prostate cancer
✓ Breast cancer
✓ Endometrial cancer
Tribulus Terrestris

What is it?
- Herb known as Puncture Vine
- No Standard Recommendation
- Used with Other Supplements
- Capsules
- Banned: None
Ergogenic Claims - Tribulus

- Increases Testosterone
- Better Sex Life
- Increase Muscle Mass
Tribulus Terrestris as an Ergogenic Aid

- Research is of very poor quality.
- Limited human data has found no changes in:
  - body weight,
  - % fat,
  - total body water,
  - mood states
- No ergogenic effect,
- Claims based largely on animal data
Beta-hydroxy beta-methylbutyrate (HMB)

- HMB is a metabolite of the amino acid leucine.
  - Synthesized by the body
  - Found naturally in small quantities in catfish, citrus fruits and breast milk.
  - Supplementally it is sold as a salt – mixed with calcium
Ergogenic Claims - HMB

- Leucine is an essential amino acid that has the highest oxidation rate of all amino acids during exercise.
- HMB derived from leucine is converted to HMG-CoA in some tissues and serves as a key carbon source for cholesterol synthesis in various cell types.
- Theoretically, saturating the cell with HMG-CoA would allow the cell to undergo the maximum growth response (athletes, muscle hypertrophy in response to resistance training)
HMB as an Ergogenic Aid

- Limited research suggests that supplementing with 1.5-3g/d of calcium HMB increases in muscle mass and strength (especially in untrained individuals initiating a training program)
  - Gains are typically 0.5 to 1kg greater than controls during 3-6 weeks of training.
- Also evidence that HMB is anti-catabolic.
- BUT – number of studies is limited - more research is necessary.
PRE-WORKOUT WITH NO3 GENERATES EXPLOSIVE WORKOUTS

“C4 Extreme is powdered energy. Harnessing unparalleled NO3 technology and exclusive, premium ingredients such as Creatine Nitrate,

C4 Extreme is a more advanced than any pre-workout supplement in its class, possessing the power to ignite your mind, muscles, and workout regimen, workout after workout after workout.”
Could it Work?

![Supplement Facts](image)

- **Amount Per Serving**
  - Calories: 5
  - Total Carbohydrates: 1g (<1% DV)
  - Vitamin C: 250mg (417% DV)
  - Calcium: 28mg (3% DV)
  - Niacin (as Niacinamide): 30mg (150% DV)
  - Folic Acid: 250mcg (62% DV)
  - Vitamin B12: 35mcg (588% DV)
  - Beta Alanine: 1500mg
  - Creatine Nitrate: 1000mg
  - Arginine AKG: 1000mg

**Explosive Energy Blend**
- Vitamin C (as Ascorbic Acid), N-Acetyl-L-Tyrosine, Caffeine Anhydrous (135mg), Mucuna pruriens (Standardized for L-Dopa), Bitter orange (Citrus aurantium) (fruit) (30% Sympnofrine) (Advantra Z®), Niacinamide, Folate (as Folic Acid), Pyridoxal 5-Phosphate, Vitamin B12 (as Methylcobalamin)

**Other Ingredients:** Artificial Flavors, Citric Acid, Malic Acid, Silicon Dioxide, Calcium Silicate, Sucralose, Acesulfame Potassium (Ace-K), FD&C Red Lake #40.

Advantra Z® is a registered trademark of Nutratech Inc. under U.S. patents 6,224,873; 6,316,499; 6,340,481; 6,340,482.
C4 – Risk/Benefit Analysis

• A majority of the ingredients are either completely ineffective or potentially harmful or both

• Dosage:
  – 2 Scoops of C4 Extreme with water (or juice) 15-30 minutes prior to your workout.

• Cost is a consideration
  – This product sells for $39.99 US for 30 servings (scoops) – monthly cost ~$40.00-$60.00
  – One hour of top-tier personal training ~ $60.00
Nitrates

- Nitric oxide (NO) claims:
  - Improves exercise performance
  - Reduces O2 cost of exercise
  - Reduces resting blood pressure

- Nitric oxide evidence:
  - One study of 0.5L/day of beetroot juice extended time to exhaustion by 16%
  - Long-term studies on NO suppl. lacking
  - Potential toxicity from large doses
β-Alanine

- Supplementation results in higher skeletal muscle carnosine, an intracellular buffer
- Limited research suggests that it *may* offer benefits in high-intensity anaerobic performance
  - >1 to <5 min duration
  - Delays onset of neuromuscular fatigue
  - Increased time to exhaustion
  - (no change in VO2max or max strength)
Vitargo - The best carbohydrate in the world

Vitargo is a revolutionary life source of energy that is used amongst Olympic athletes, medical professionals and millions of people wanting to improve their health, fitness and appearance goals.

Vitargo is a patented carbohydrate with unique properties to give an effective loading of easily accessible muscle energy in the body.

Studies show that

- **Restoring Muscle Glycogen**
  - Vitargo® 70% faster
    - Comparing carbohydrates

- **Leaving the Stomach**
  - Vitargo® 80% faster
    - Comparing carbohydrates

- **Leaving the Stomach First 10 Min.**
  - Vitargo® 130% faster
    - Comparing carbohydrates

- **Performance**
  - Vitargo® 23% higher
    - Comparing carbohydrates

- **Insulin Response**
  - Vitargo® 78% higher
    - Comparing carbohydrates
Could it Work?

Supplement Facts

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>% DV*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>280</td>
</tr>
<tr>
<td>Calories From Fat</td>
<td>0</td>
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<tr>
<td>Total Fat</td>
<td>0 g</td>
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<tr>
<td>Total Carbohydrate</td>
<td>70 g</td>
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<tr>
<td>Sugars</td>
<td>0 g</td>
</tr>
<tr>
<td>Protein</td>
<td>0 g</td>
</tr>
</tbody>
</table>

* Percent Daily Values (DV) are based on a 2,000 calorie diet

Ingredients

Fractionated Barley Amylopectin (Vitargo S2) [Source: Europe], Citric Acid, Maltodextrin, Gum Arabic, Natural Flavor, Sucralose, Cochineal Extract (Color), Turmeric Extract (Color).
Contains Gluten From Barley.
Research Findings

• 3 published studies to date of this specific proprietary blend of ingredients.
  – The form of CHO in Vitargo, empties from the stomach faster than that of an isoenergetic CHO solution (without potentiating increased circulating blood glucose or insulin levels.
  – Consumption of the low osmolality CHO blend in Vitagro restored muscle glycogen faster than an energy equivalent solution containing monomers with a high osmolality 2 hours post exercise
  – The ingestion of Vitargo increased work output in all participants during a subsequent highly reproducible, high-intensity sub-maximal time-trial cycling test.
Vitargo – Risk/Benefit Analysis

• The ingredients are fractionated versions of CHO which is known to be safe.

• Research suggests the potential for performance enhancement at low risk for side effects.
  – Sample sizes were small and selective
    • Degree to which findings can be generalized should be questioned.

• Contains no apparent banned substances.

• Cost: 30 servings = monthly cost of ~ $78.00
Questions