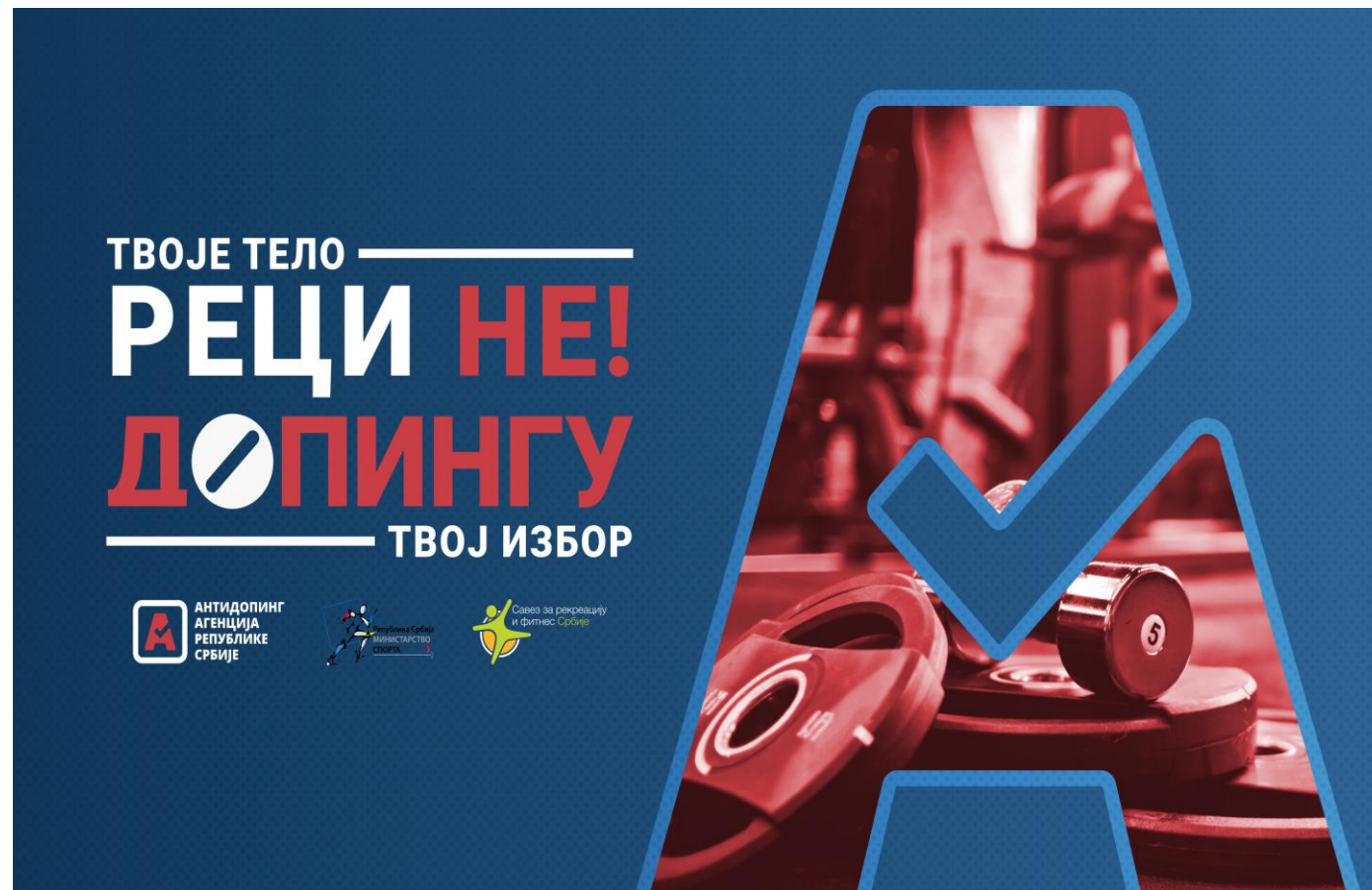


Usage of dietary supplements in the recreational sport



Mr ph Jelena Rasic Ozegovic
Anti-Doping Agency of Serbia



**ANTI-DOPING
AGENCY
OF
SERBIA**

**Physical activity is good for the
heart, body and mind**

**Any physical activity is better
than none**

**Physical activity is
important**

**Too much sedentary
behavior can be unhealthy**

**Strong muscles benefits
everyone**

**Everyone can benefit from increasing
physical activity and reducing sedentary
habits**





**Pharmaceutical
forms:**

- **Tablets**
- **Capsules**
- **Lozenges**
- **Powder**
- **Solutions**
- **Others**

Dietary supplements:

- **Vitamins**
- **Minerals**
- **Others with
nutritional and
physiological
effects**

**Dietary supplements
are available:**

- **Online**
- **Gyms**
- **Pharmacies**
- **health food stores**

Dietary supplements



Dietary supplements

**Increased needs of
nutrients**

**Reduced intake of
nutrients**

**Achieve a physiological
effect through controlled
supplementation**

General population

Athletes

Recreationists



ABCD Classification System

БУДИ ЗДРАВ - ИГРАЈ ПОШТЕНО
РЕЦИ НЕ!
ДОПИНГУ

AIS SUPPLEMENT FRAMEWORK

ABCD Classification System



Strong scientific evidence for use in specific situations in sport using evidence-based protocols

GROUP A

Sports foods

- Sports drinks
- Sports gels
- Sports confectionery
- Sports bars
- Electrolyte supplement
- Protein supplement
- Mixed macronutrient supplement (bar, powder, liquid meal)

Medical supplements

- Iron
- Calcium
- Multivitamin
- Probiotics
- Vitamin D
- Zinc

Performance supplements

- Caffeine
- B-Alanine
- Dietary nitrate / Beetroot juice
- Sodium Bicarbonate
- Creatine
- Glycerol



Emerging scientific support, deserving of further research. Considered for use by athletes under a research protocol or case-managed monitoring situation

GROUP B

- Fruit Derived Polyphenols (cherries, berries, blackcurrants and pomegranate)
- Vitamin C

Tastants

- Menthol
- Pickle juice
- Quinine

- Collagen support
- Carnitine
- Ketone supplements
- Fish oils
- Curcumin (Turmeric)
- N-Acetyl Cysteine



Scientific evidence indicates no benefit to athletes and/or no research undertaken to guide an informed opinion

GROUP C

These supplements remain under investigation and are subject to ongoing review

- Magnesium
- Alpha Lipoic Acid
- HMB (B-Hydroxy B-Methylbutyrate)

- BCAAs/Leucine
- Phosphate
- Prebiotics

- Vitamin E
- Tyrosine



Banned or at high risk of contamination with substances that could lead to a positive doping test

GROUP D

Consult WADA for full list (updated annually)

- Stimulants
- Prohormones and hormone boosters
- GH releasers and "Peptides"

- Beta-2 agonists
- Selective Androgen Receptor Modulators (SARMs)
- Metabolic Modulators

- Colostrum
- Tribulus terrestris and other testosterone boosters
- Maca root powder

Dietary supplements for improving performance, recovery and muscle growth

- Creatine monohydrate
- β -Hydroxy- β -Methylbutyrate (HMB)
- Caffeine



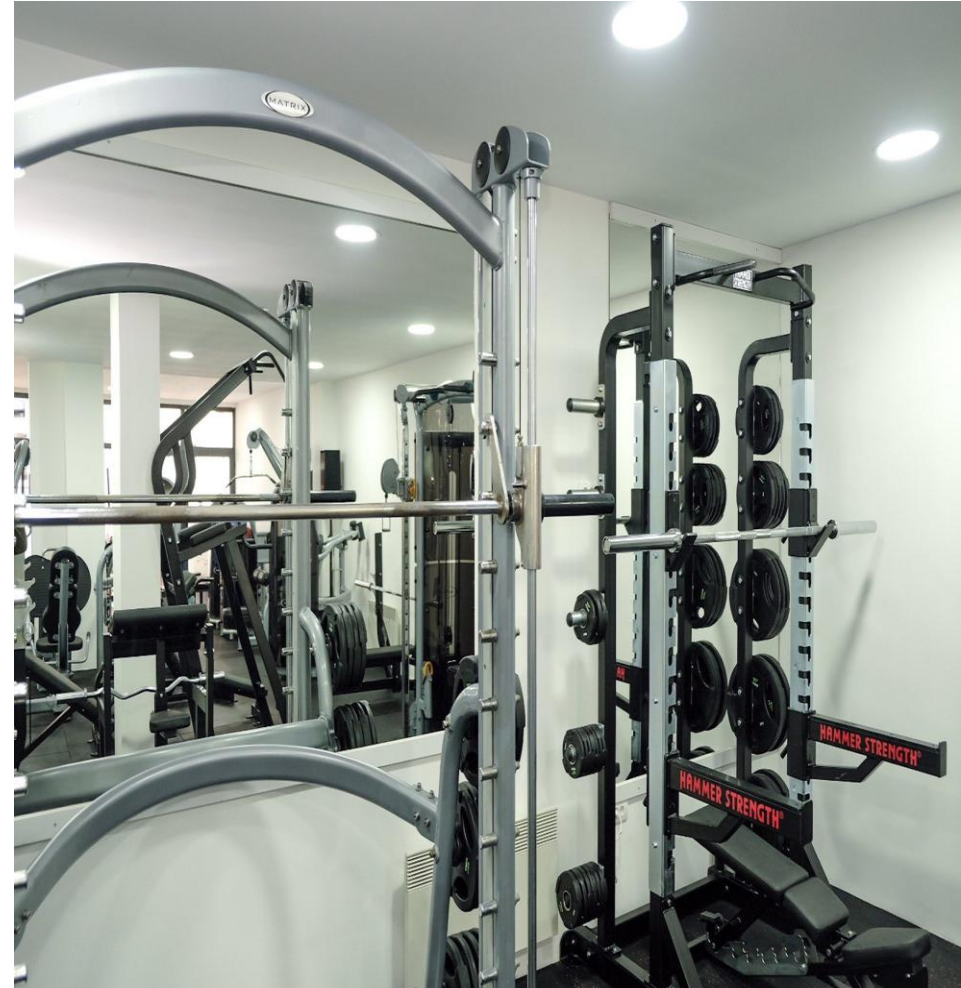
Creatine monohydrate

95% of creatine is found in skeletal muscle, 5% is distributed in the brain, testes and bones

It exists in free and phosphorylated forms (phosphorylcreatine) within cells

Both forms are spontaneously and irreversibly degraded to creatinine at a rate of approximately 2 g/day

Both forms are important for providing energy during short and intense physical activities





Creatine monohydrate

Creatine supplementation increases muscle strength and endurance

Creatine supplementation includes improving cognitive function and potentially reducing brain damage, recovery after minor traumatic injuries

Creatine improves results in short, high-intensity exercises (less than 30 seconds)

Considering the breakdown of creatine during training, it is recommended to take creatine after training with a meal

Helps recover from injuries when there is muscle inactivity



Creatine monohydrate

- ✓ Combining creatine with a meal can increase the amount of creatine absorbed by the muscles
- ✓ Safe and effective
- ✓ Creatine supplementation is associated with weight gain due to increased water retention

β -Hydroxi- β -Metylbutyrate (HMB)

- ✓ Derived from the essential branched-chain amino acid leucine
- ✓ Increases strength and muscle mass, especially in response to strength training (by increasing muscle protein synthesis)
- ✓ Reduces exercise-induced muscle damage and soreness, thereby accelerating recovery after strenuous exercise (high-intensity training and strength training)
- ✓ Positive effects on the immune system
- ✓ Prevention of muscle atrophy during injury or immobilization



β -Hydroxi- β -Metylbutyrate (HMB)

- ✓ Stimulates muscle anabolism (enhances muscle protein synthesis and reduces muscle protein breakdown)
- ✓ Less effective than leucine
- ✓ Less effective than consuming whole protein sources like whey protein



Caffeine

- ✓ Coffee, tea, energy drinks, chocolate, sports supplements
- ✓ Ergogenic effect (a series of metabolic, hormonal and physiological processes)
- ✓ Improvement of sports performance
- ✓ Effects include:
 - mobilization of fat from adipose tissue
 - changes in muscle contractility
 - in the CNS it blocks adenosine receptors that are responsible for the feeling of fatigue, while in the medulla oblongata, it leads to a state of increased alertness, changes in perception or reduced fatigue

Caffeine

- Taking caffeine in doses greater than 3mg per kilogram of body weight will not lead to additional improvements in athletic performance
- Adverse effects of caffeine include insomnia, nervousness, headache, tachycardia, arrhythmias, and nausea (occurring when taken in doses greater than 200mg of caffeine)
- Energy drinks (250 mL) have a caffeine content of at least 80mg
- Deaths have been recorded after consuming 3 grams of pure caffeine





Dietary supplements for performance enhancement

Vitamins

Minerals

Electrolytes

**Amino acids and
protein
supplementation**

Creatine



Class of Supplement	Actions	Benefits	Effectiveness	Side Effects
Vitamins	Supplementation with E and C may enhance antioxidant effects	Improve recovery from training	++	In excess may be toxic. Water-soluble vitamins rapidly excreted by kidneys
Minerals	Calcium in females	Involved in bone development and maintenance	+++ (important in females prone to osteoporosis)	
Electrolytes	Maintain physiological homeostasis	Critical for body physiological homeostasis	++++	
Amino acid and protein supplementation	Basic building blocks of muscle fibers	Ensure adequate foundation for exercise adaptation and repair	++++ (for basic muscle hypertrophy)	
Creatine	Enhances metabolism	Modestly increases muscle strength and recovery	++	Bloating, GI upset



ANTI-DOPING
AGENCY
OF
SERBIA

VITAMINS

VITAMIN E

VITAMIN C

VITAMIN D

VITAMIN C

- Hydrosoluble vitamin
- Antioxidant

It plays a role in sports performance and recovery, especially in athletes who are exposed to intense training (neutralizes free radicals)



Strengthening the immune system



Reduces the risk of exercise-induced bronchoconstriction - prevention of respiratory problems

High doses over 2000 mg per day – flatulence, diarrhea, risk of kidney stone formation, increases Fe absorption (hemochromatosis)



VITAMIN E

Liposoluble vitamin

Antioxidant

- ✓ Reduction of oxidative stress - neutralizes free radicals and protects cell membranes from oxidative damage, especially in muscle tissue
- ✓ Faster recovery - can contribute to faster recovery after training by reducing muscle damage and positively affecting immune functions



MINERALS

CALCIUM

MAGNESIUM

ZINC

IRON

Calcium

- ✓ **Bone health**
 - ✓ **Muscle function**
 - ✓ **Nerve signaling**
 - ✓ **Health of the cardiovascular system**
-
- Intense and repeated training can lead to a calcium imbalance where bone breakdown exceeds formation - insufficient recovery time between workouts
 - Intense physical activity stimulates calcium excretion through sweat and urine and leads to decreased serum calcium levels
 - The deficiency is manifested as tetany (muscle cramps), rickets, osteomalacia and osteoporosis



MAGNESIUM (Mg)

**Anti-inflammatory
action - relieves the
inflammatory response
- helps in recovery and
muscle remodeling**

**Smooth muscle
relaxation can
lower blood
pressure after
exercise**

**Improves
neuromuscular
strength**

**Mg deficiency is
associated with
mood disorders
and increased
stress**

**Important for bone
health by inducing
osteogenic effects**

**Fractures and traumatic
bone injuries may benefit
from Mg
supplementation along
with calcium and vitamin
D supplementation**

PROTEINS

Whey protein

Casein

Soyabeans

Eggs

A mixture of these proteins



Whey protein

Important in strength sports

Whey protein

- ✓ Whey proteins have a high biological value (a high percentage of amino acids are used for tissue growth)
- ✓ They are easily digestible and quickly increase blood levels of amino acids, which stimulates protein synthesis
- ✓ Contains the highest amount of branched-chain amino acids (BCAAs) as well as all essential amino acids
- ✓ It is best to consume whey protein immediately after training, to achieve rapid protein uptake

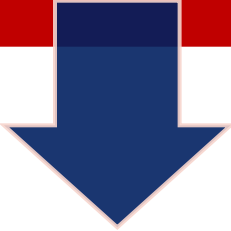
Casein

It has a high biological value, but not as much as whey

It is absorbed more slowly - helps maintain high levels of amino acids in the blood

BCAA/Leucine

Branched Chain Amino Acids (BCAA) – Isoleucine, Leucine, Valine
Lack of solid evidence of efficacy

- 
- Reduces muscle soreness after intense workouts
 - Participates in protein synthesis – leucine (the most important component of BCAA)
 - The effectiveness of BCAA or leucine supplements for muscle building is lower compared to consuming whey protein sources



GLUTAMINE

Non-essential amino acid

It is found in skeletal muscle and plasma

It is a source of energy for gastric mucosal cells, renal tubular cells, lymphocytes, macrophages and endothelial cells

Strenuous exercise is associated with reduced plasma glutamine levels and decreased immunity

Glutamine supplementation after endurance training may reduce infection



AMINO ACIDS

β -alanine

Aspartic acid

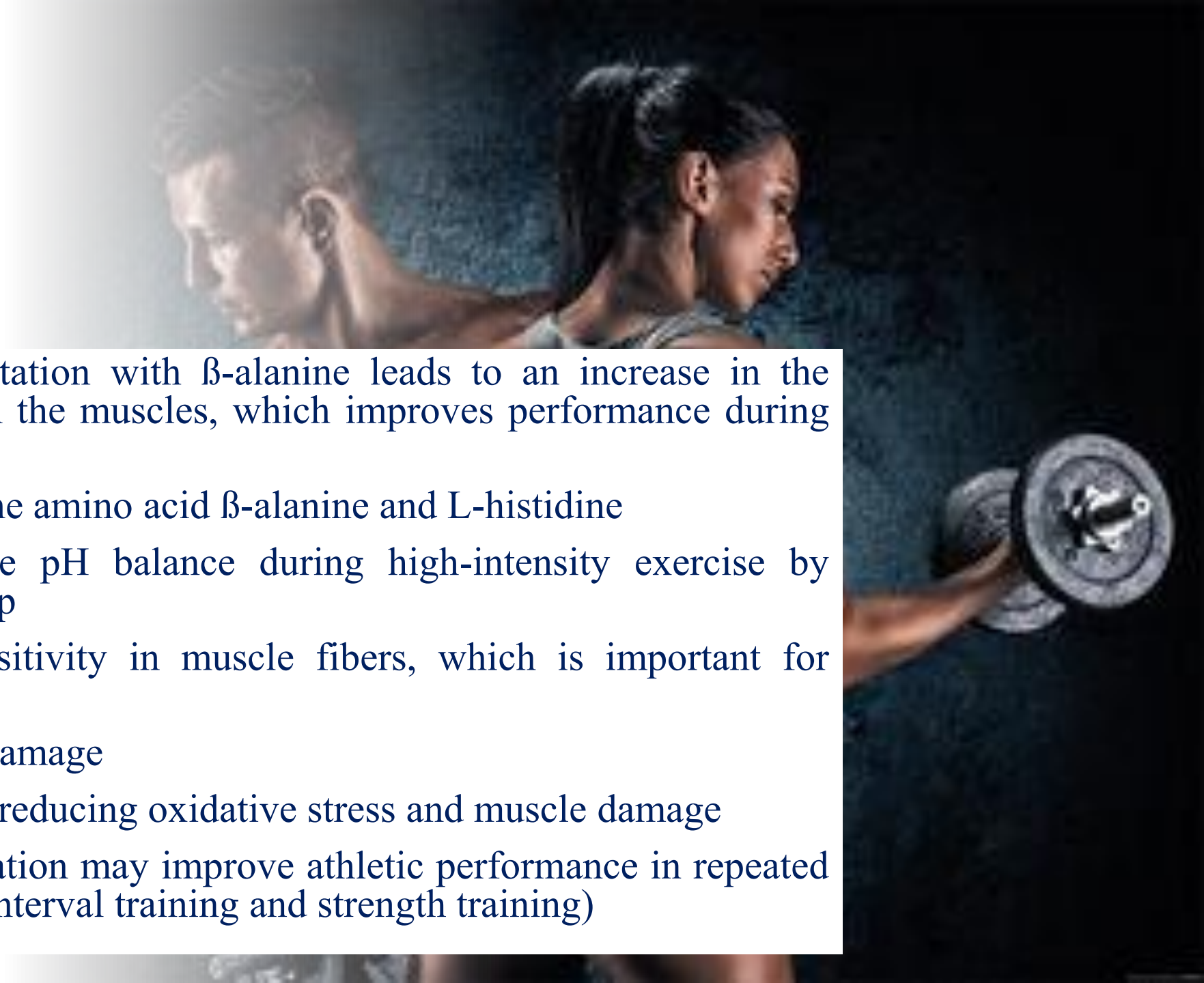
N–acetylcysteine

Ornithine-alpha-ketoglutarate (ornithine and glutamine)



β-alanine

- Continuous supplementation with β-alanine leads to an increase in the amount of carnosine in the muscles, which improves performance during high-intensity exercises
- Carnosine consists of the amino acid β-alanine and L-histidine
- Helps maintain muscle pH balance during high-intensity exercise by preventing acid build-up
- It affects calcium sensitivity in muscle fibers, which is important for muscle contraction
- Helps prevent protein damage
- Removes free radicals, reducing oxidative stress and muscle damage
- β-Alanine supplementation may improve athletic performance in repeated high-intensity efforts (interval training and strength training)





Energy (bars) chocolate bars

They contain more carbohydrates and less protein

Carbohydrates are the primary source of energy

They are intended mainly for people who do endurance sports

They can contain fast and slow absorbing CH, as well as the addition of minerals and vitamins, possibly caffeine

Quick recovery of energy

Consumption before, during or after training, when the need for carbohydrates is increase



Energy drinks

- ✓ Products that provide additional energy, increase alertness and improve physical and mental abilities
- ✓ May contain taurine, glucuronolactone, guarana and B vitamins, small amounts of plant extracts: ginseng, ginkgo biloba as well as a large amount of sugar
- ✓ Sugar (sucrose, glucose, fructose) is the main source of energy in these drinks. Most EDs contain a large amount of sugar, from 25-50g per package (50g is about 13 teaspoons of sugar)



Be careful with energy drinks

Side effects include
increased blood
pressure, dehydration,
thermogenic effect,
anxiety and irritability

EDs should not be used
for rehydration after
intense exercise



Dietary supplements for weight loss

**Carnitine
(L-carnitine)**

**Alpha-
lipoic acid**

Caffeine



Carnitine (L-carnitine)

- **Carboxylic acid is synthesized in the body from the amino acid's lysine and methionine**
- **Plays a central role in fatty acid metabolism**
- **95% of carnitine is found in skeletal and cardiac muscle**
- **Increased carnitine intake can increase fatty acid oxidation**
- **Improves exercise performance by improving the conversion of pyruvate to acetyl-CoA and thus reducing lactic acid (lactate)**
- **Common ingredient in weight loss supplements (“Fat burners”)**



Alpha-lipoic acid

Antioxidant – protects against oxidative stress caused by exercise

Affects weight loss – works by suppressing hypothalamic AMP-activated protein kinase

The actual impact of alpha-lipoic acid on body weight and fat loss is modest



Dietary supplements for joint and muscle pain

Collagen

**Hydrolyzed
collagen**

Curcumin



Collagen

- **The most abundant protein in the body**
- **Provides structure and support to various tissues (skin, bones, ligaments, tendons)**
- **Glycine – non-essential amino acid in collagen crucial for its synthesis after exercise**
- **After intense training, increased demand for glycine during periods of high collagen metabolism – supplementation can provide the necessary glycine for collagen synthesis – tissue recovery**
- **Proline and hydroxyproline are essential for collagen synthesis**
- **Proline is essential for collagen formation and when combined with ascorbic acid improves collagen content and tissue mechanics**
- **Glycine – anti-inflammatory properties, treatment of anti-inflammatory conditions such as tendinopathy**



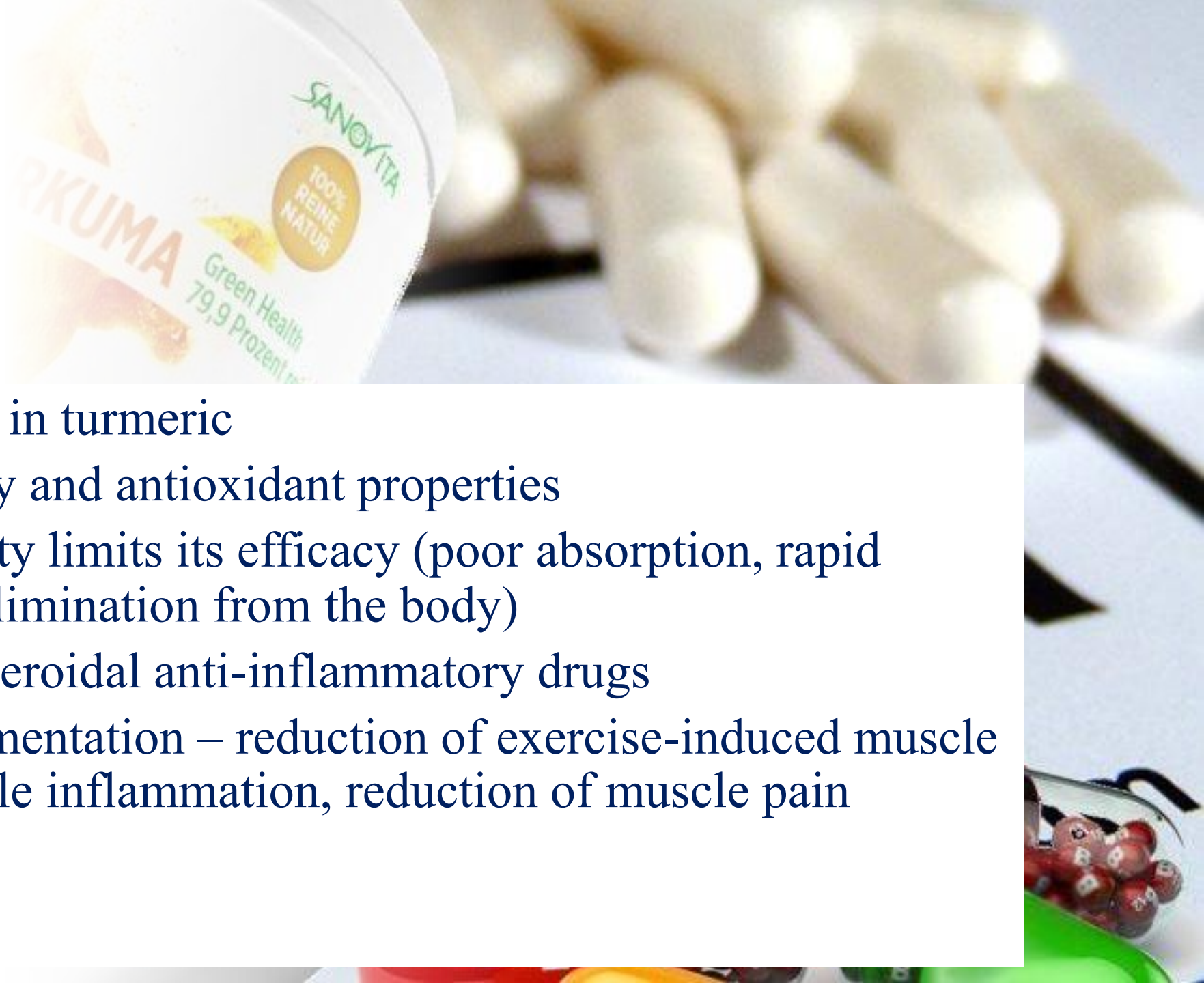
Hydrolyzed collagen

- ✓ **Mainly a supplement ingredient**
- ✓ **Collagen that has undergone enzymatic hydrolysis (solubility and absorption)**
- ✓ **Effective in tissue repair**
- ✓ **Collagen combined with exercise—supports tissue repair (tendons, cartilage, bone)**
- ✓ **Collagen intake before exercise—enhances collagen synthesis in tendons and ligaments—improving tissue mechanics and helping prevent injuries**
- ✓ **Collagen intake after exercise—reduces muscle soreness and supports muscle recovery**
- ✓ **Consuming collagen 40–60 minutes before exercise helps repair connective tissue during periods of intense activity**
- ✓ **Collagen supplementation reduces joint pain associated with physical activity—reduces inflammation and muscle damage after strenuous activity**



Curcumin

- ✓ Polyphenol found in turmeric
- ✓ Anti-inflammatory and antioxidant properties
- ✓ Poor bioavailability limits its efficacy (poor absorption, rapid metabolism and elimination from the body)
- ✓ Action like non-steroidal anti-inflammatory drugs
- ✓ Curcumin supplementation – reduction of exercise-induced muscle damage and muscle inflammation, reduction of muscle pain





Isotonic drink



- **Fluid Replacement**
- **Electrolytes sodium, potassium and chloride are lost through sweating**
- **Designed to replace electrolytes**
 - ✓ **Electrolytes**
 - ✓ **Carbohydrates (glucose, fructose or maltodextrin)**
 - ✓ **Water**
 - ✓ **Flavors and sweeteners to enhance taste**



THANK YOU FOR
YOUR ATTENTION

