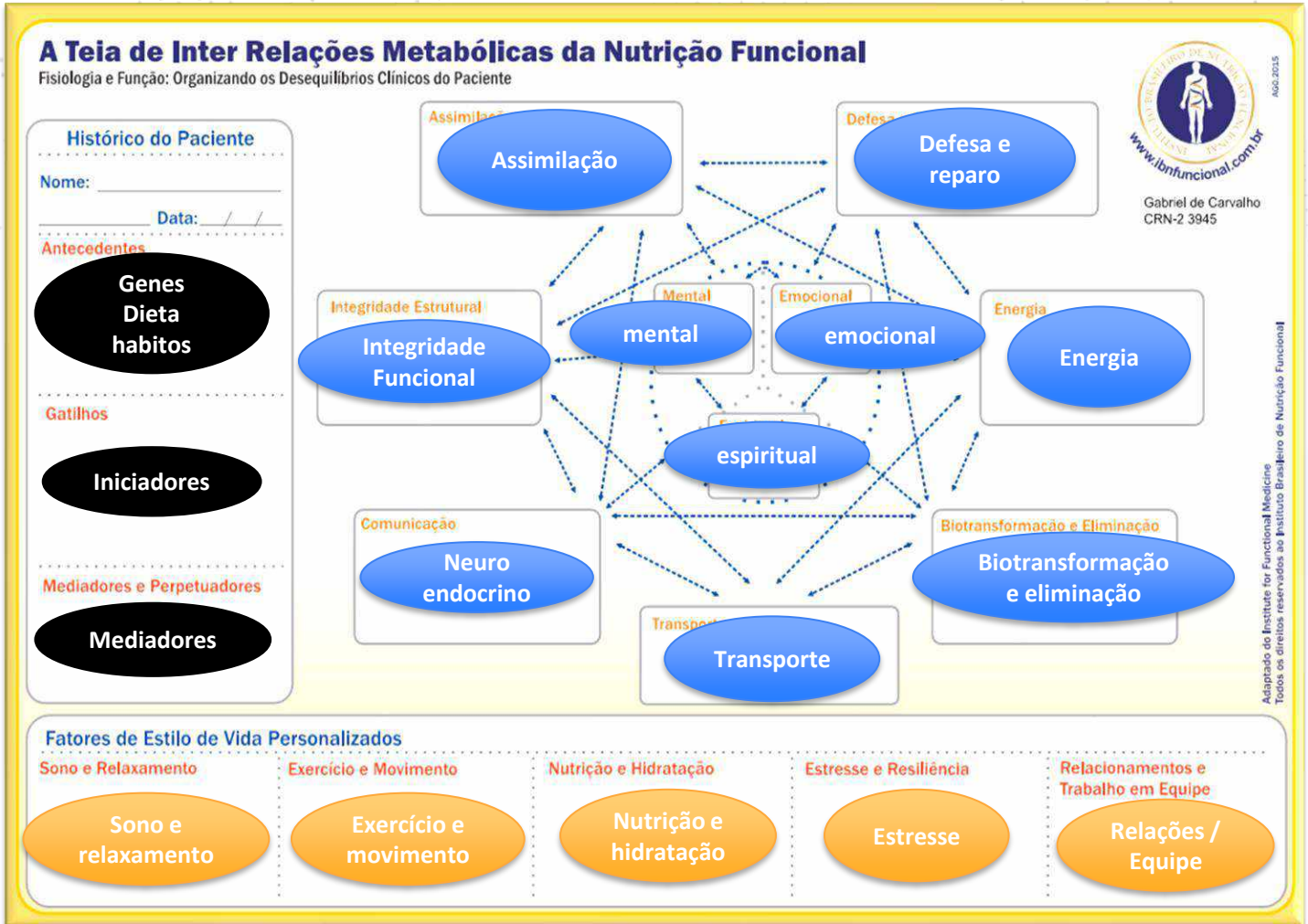

DESAFIE-SE
INSPIRE-SE
MOVA-SE
CENTRAL
nutrition

Otimização do metabolismo energético e a importância do catabolismo de gordura para o desempenho físico.

Gabriel de Carvalho
Nutricionista e Farmacêutico Bioquímico
Introdutor da Nutrição Funcional no Brasil em 1999
Co-fundador da Faculdade de Saúde Avançada

CENTRAL
nutrition


A Teia de Inter Relações Metabólicas da Nutrição Funcional
Fisiologia e Função: Organizando os Desequilíbrios Clínicos do Paciente
www.ibnfuncional.com.br
Gabriel de Carvalho
CRN-2 3945
Histórico do Paciente
Nome:
Data:
Antecedentes
Genes
Dieta
habitos
Gatilhos
Iniciadores
Mediadores e Perpetuadores
Mediadores
Assimilação
Defesa e reparo
Integridade Estrutural
Integridade Funcional
Mental
mental
Emocional
emocional
Energia
Energia
espiritual
Comunicação
Neuro endocrino
Biotransformação e Eliminação
Biotransformação e eliminação
Transporte
Transporte
Fatores de Estilo de Vida Personalizados
Sono e Relaxamento
Sono e relaxamento
Exercício e Movimento
Exercício e movimento
Nutrição e Hidratação
Nutrição e hidratação
Estresse e Resiliência
Estresse
Relacionamentos e Trabalho em Equipe
Relações / Equipe
Adaptado do Institute for Functional Medicine
Todos os direitos reservados ao Instituto Brasileiro de Nutrição Funcional


30
trilhões
de células


40 quadrilhões
de
mitocôndrias

Por que temos tantos problemas mitocondriais?

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nutrition

Deficiências Nutricionais

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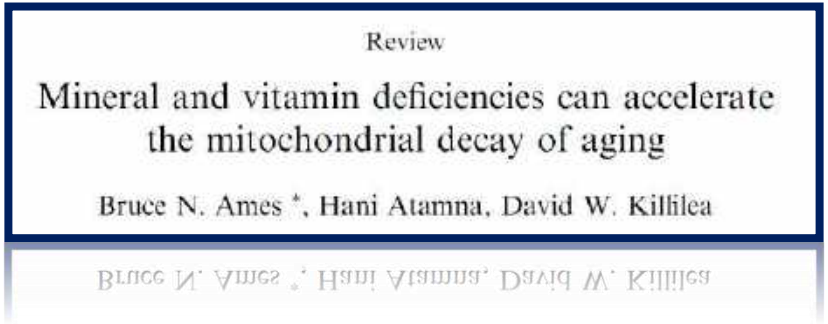
nutrition

Molecular Aspects of Medicine 26 (2005) 363–378

Deficiências de vitaminas e minerais: aceleram o enfraquecimento mitocondrial do envelhecimento



Review

Mineral and vitamin deficiencies can accelerate the mitochondrial decay of aging

Bruce N. Ames *, Hani Atamna, David W. Killilea

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B3, B2, ferro, enxofre, Q10/Q10H, hemo, cobre

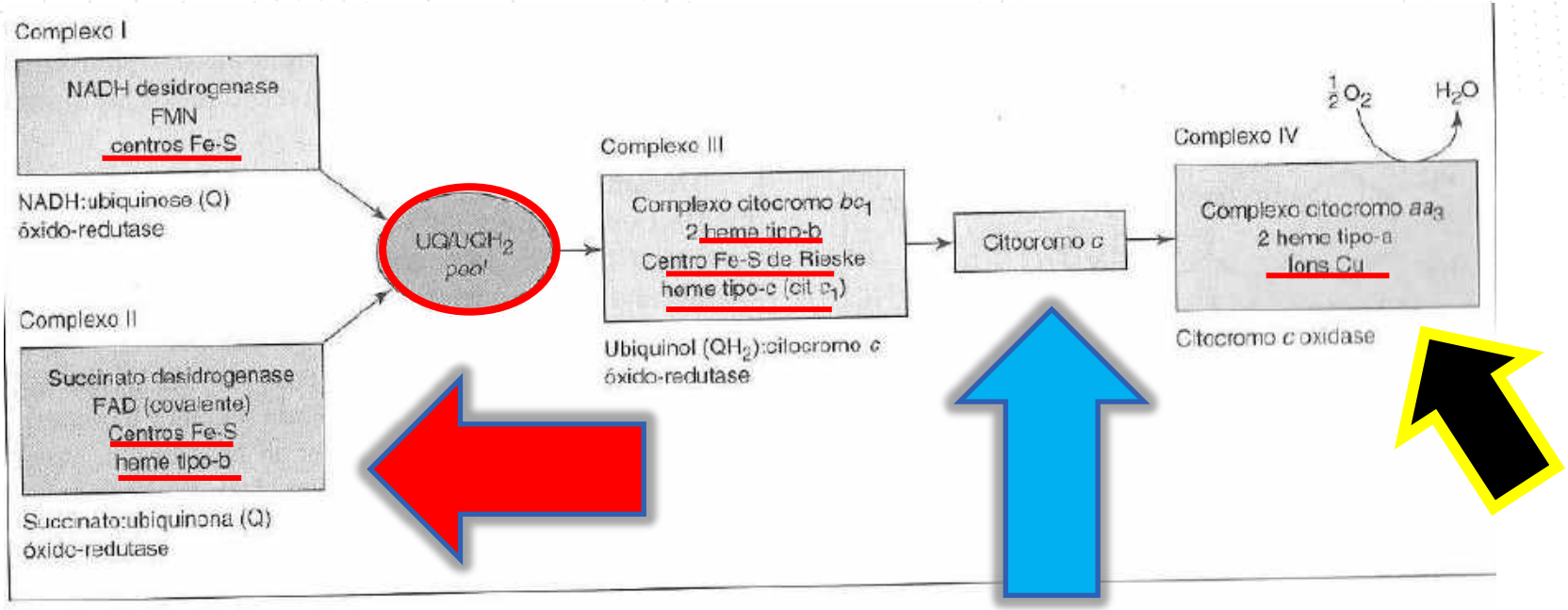

FIGURA 13.30
Visão geral de complexos e vias de transferência de elétrons na cadeia mitocondrial de transporte de elétrons.

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Jones, DS. Textbook of Functional Medicine, 2005

Molecular Aspects of Medicine 26 (2005) 363–378

↓ síntese do hemo

↓ hemo-a (exclusivo complexo IV)

= liberação de oxidantes + dano mitocondrial

Jones, DS. Textbook of Functional Medicine, 2005

Assim

... ↓ síntese do hemo causa dano mitocondrial e dano ao DNA

antes de haver anemia!

Algo mais??

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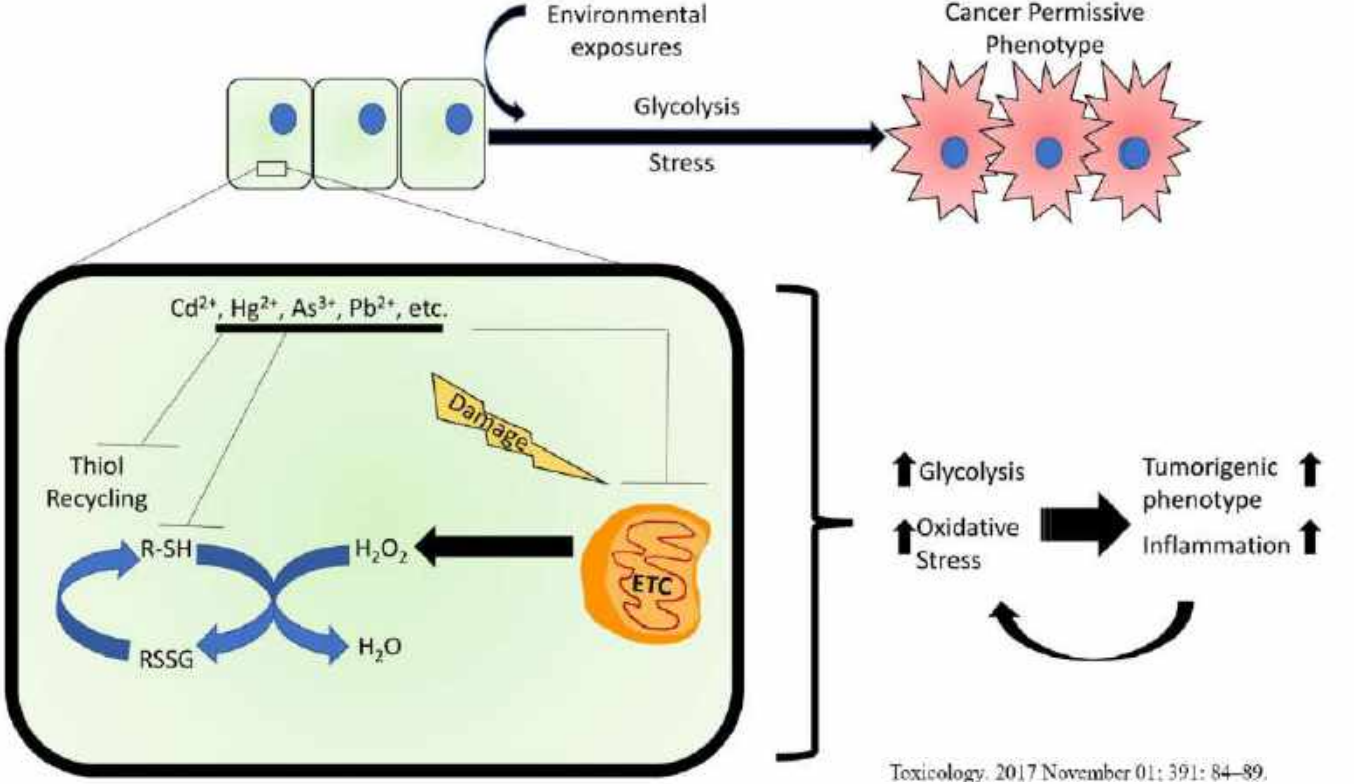
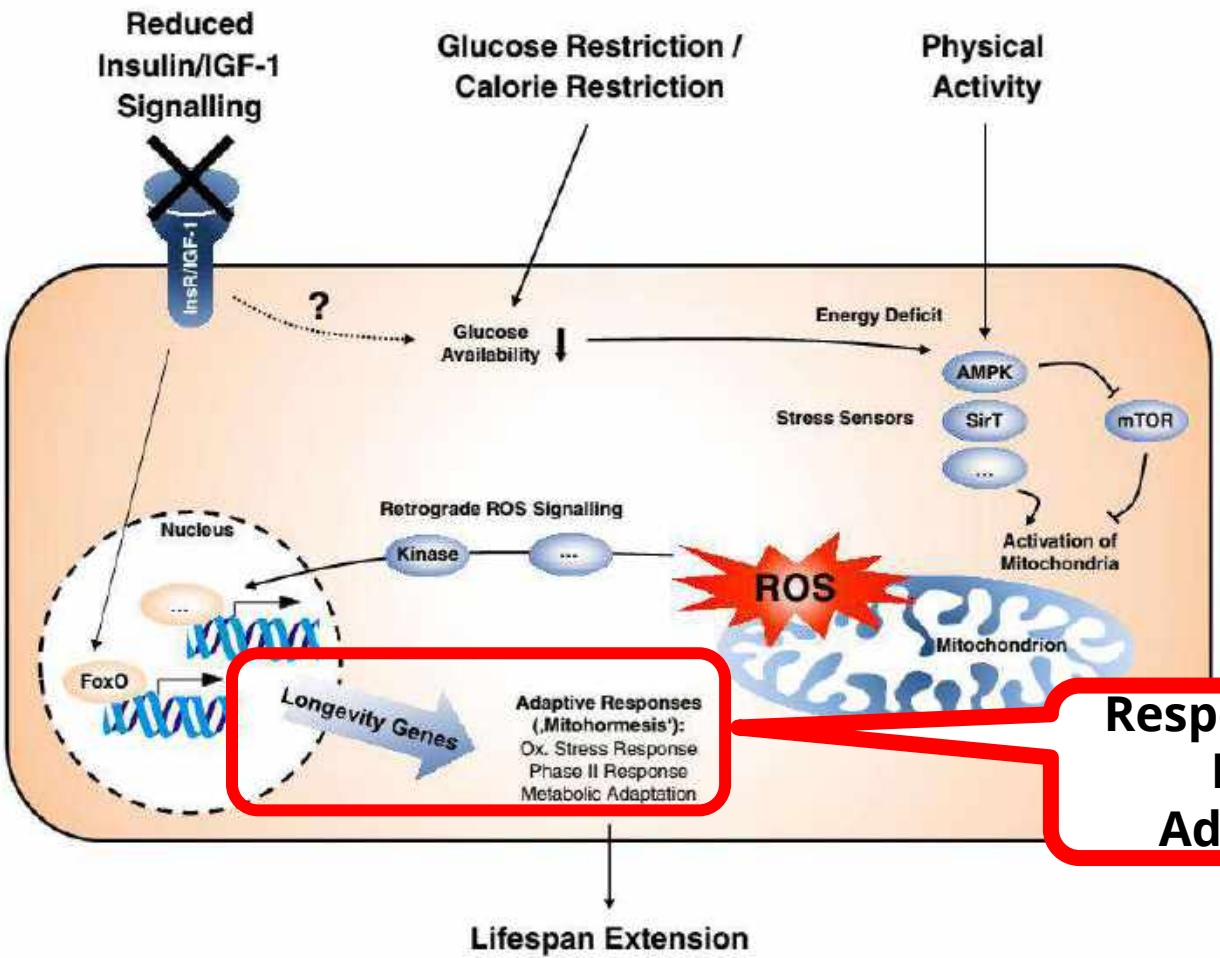
Metais tóxicos danificam a mitocôndria



Toxicology. 2017 November 01; 391: 84–89.

CENTRAL nutrition

Free Radical Biology & Medicine 51 (2011) 327–336

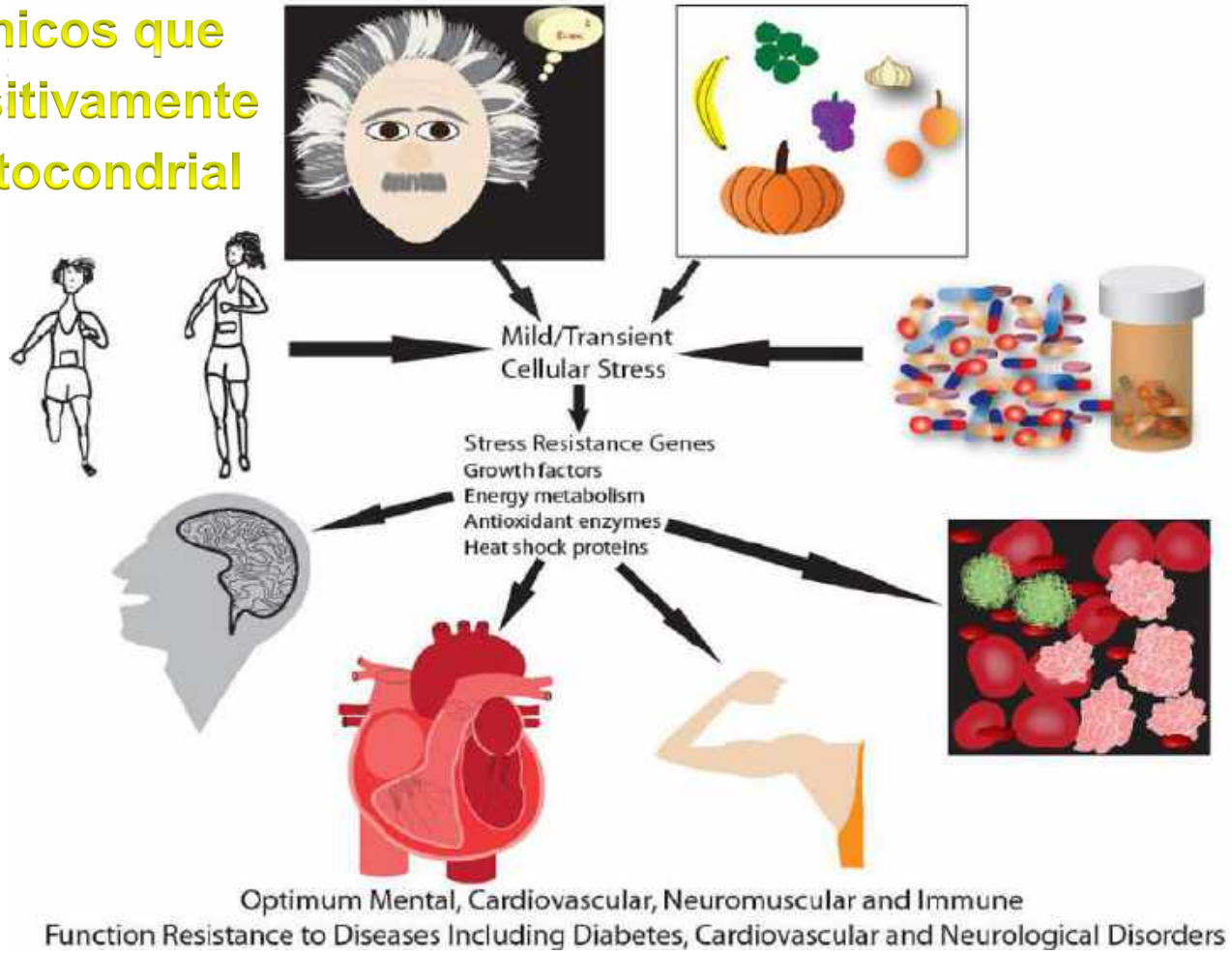


Resposta ao Estr. oxidativo
Enzimas de Fase II
Adaptação Metabólica

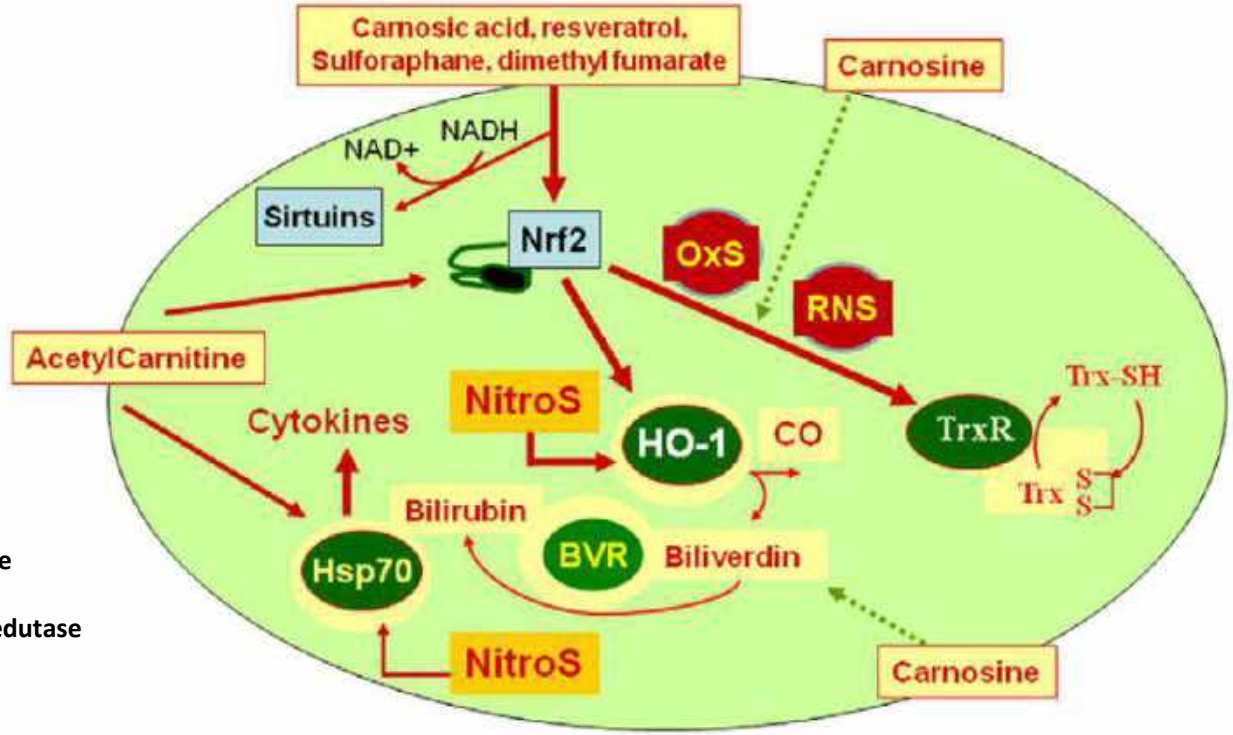
Faculdade de Saúde Avançada

Ageing Res Rev. 2008 January ; 7(1): 43–48.

Alguns fitoquímicos que impactam positivamente na função mitocondrial



Resveratrol, sulforafano, ácido carnosóico, acetil-L-carnitina, dimetil fumarato e carnosina ativam vitagenes!



Alguns Vitagenes:
HO = hemo oxigenase
Hsp70,
TrxR = tioredoxina redutase
Sirtuínas

Biochimica et Biophysica Acta 1822 (2012) 753–783

Faculdade de Saúde Avançada

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Review

Feeding mitochondria: Potential role of nutritional components to improve critical illness convalescence

E. Wesselink [a], W.A.C. Koekkoek [b], S. Grefte [c], R.F. Witkamp [a], A.R.H. van Zanten [b, *]

[a] Division of Human Nutrition and Health, Wageningen University, Stippeneng 4, 6708 WE, Wageningen, The Netherlands
[b] Department of Intensive Care Medicine, Gelderse Vallei Hospital, Willy Brandtlaan 10, 6716, Ede, The Netherlands
[c] Human and Animal Physiology, Wageningen University, De Elst 1, 6708 DW, Wageningen, The Netherlands

Alimentando a mitocôndria:
possível papel de componentes nutricionais

Alimentando a mitocôndria:
possível papel de componentes nutricionais

ARTICLE IN PRESS

Clinical Nutrition

Review

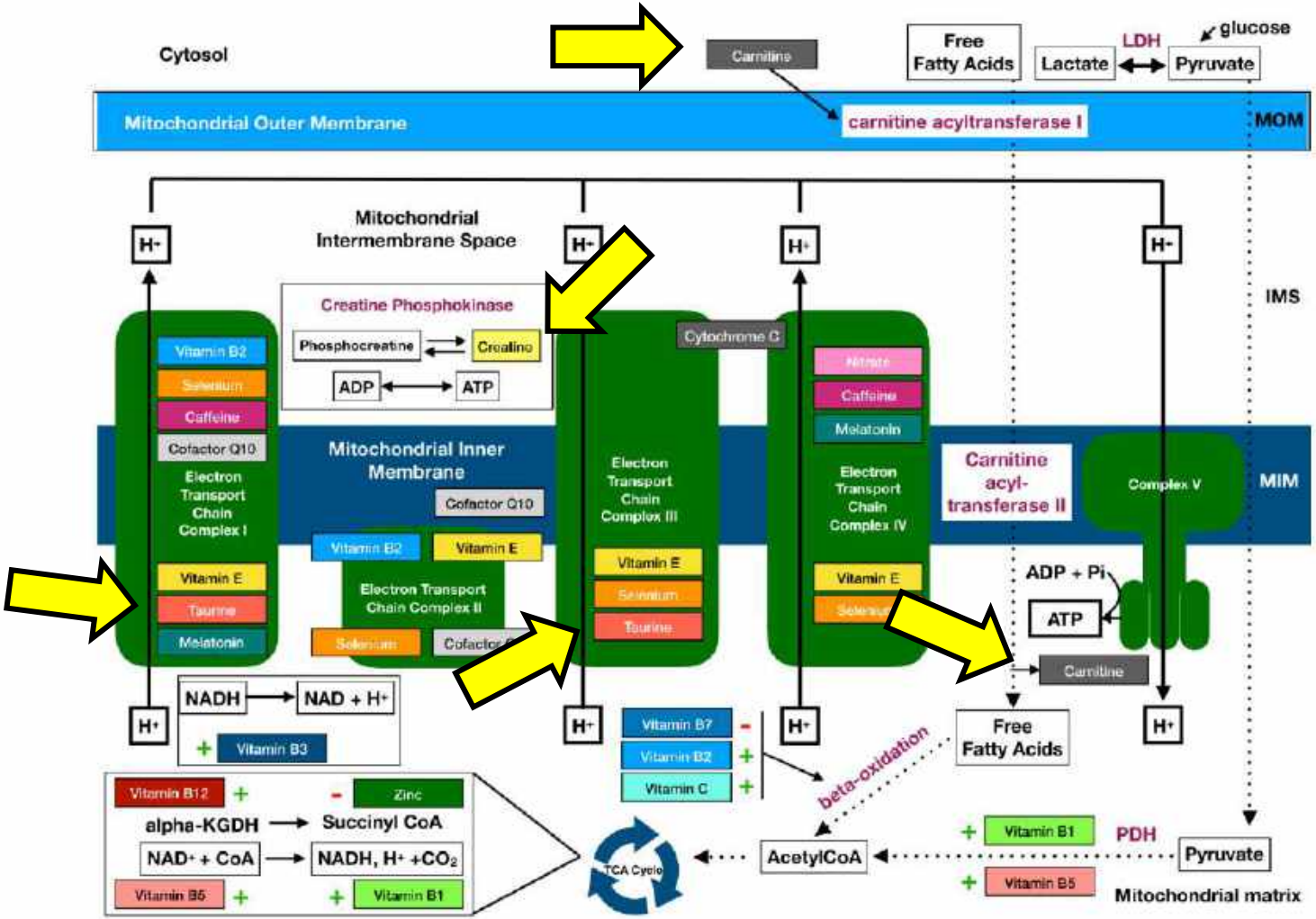
Feeding mitochondria: Potential role of nutritional components to improve critical illness convalescence

E. Wesselink, W.A.C. Koekkoek, S. Grefte, R.F. Witkamp, A.R.H. van Zanten

ARTICLE INFO

SUMMARY

1. Introduction



E. Wesselink et al. / Clinical Nutrition xxx (2018) 1–14

L-carnitina

CENTRAL
nutrition

nutrients

MDPI

Review

L-Carnitine Supplementation in Recovery after Exercise

Roger Fielding [1], Linda Riede [2], James P. Lugo [3] and Aouatef Bellamine [3,*]

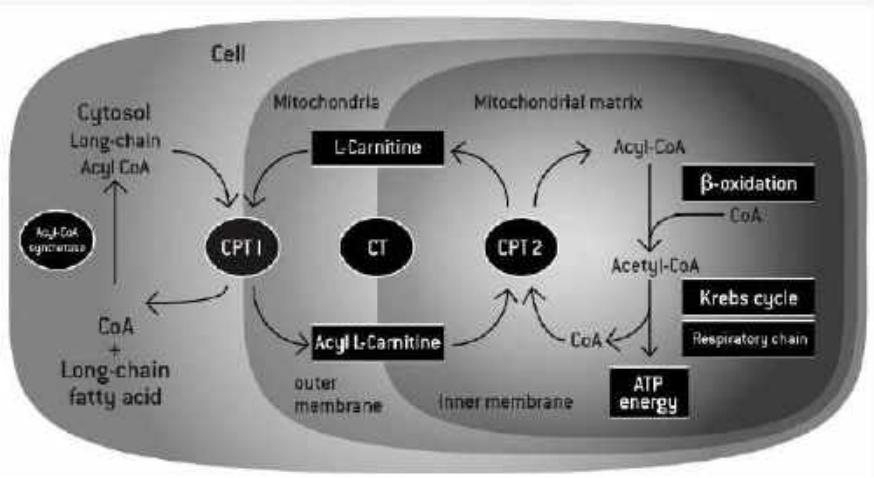
Abstract: Given its pivotal role in fatty acid oxidation and energy metabolism, L-carnitine has been investigated as ergogenic aid for enhancing exercise capacity in the healthy athletic population. Early research indicates its beneficial effects on acute physical performance, such as increased maximum oxygen consumption and higher power output. Later studies point to the positive impact of dietary supplementation with L-carnitine on the recovery process after exercise. It is demonstrated that L-carnitine alleviates muscle injury and reduces markers of cellular damage and free radical formation accompanied by attenuation of muscle soreness. The supplementation-based increase in serum and muscle L-carnitine contents is suggested to enhance blood flow and oxygen supply to the muscle tissue via improved endothelial function thereby, reducing hypoxia-induced cellular and biochemical disruptions. Studies in older adults further suggest that L-carnitine intake can lead to increased muscle mass accompanied by a decrease in body weight and reduced physical and mental fatigue. Based on current animal studies, a role of L-carnitine in the prevention of age-associated muscle protein degradation and regulation of mitochondrial homeostasis is suggested.

Keywords: L-carnitine; exercise recovery; physical performance; muscle metabolism; aging

1. Introduction

Naturally occurring, L-carnitine is a quaternary amine (3-hydroxy-4-N-trimethylaminobutyrate) found in all mammalian species. After the discovery of L-carnitine in muscle extracts in 1905 [1] and its structural identification in 1927 [2], the importance of L-carnitine in fatty acid oxidation in the liver and the heart was first described by Fritz in 1959 [3]. 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 activated fatty acids into the mitochondria and for their subsequent β-oxidation in the matrix (Figure 1) [4]. 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.

L-carnitine is synthesized endogenously in the liver, the kidney, and the brain from the essential amino acids lysine and methionine [5,6] or ingested via animal-based food products. Its synthesis is catalyzed by four enzymatic reactions reviewed in detail by Vaz et al. [7] and requires vitamin C, vitamin B_6, niacin, and reduced iron as cofactors [8]. Biosynthesis of L-carnitine accounts only for 25% of the daily needs [7,9]. Thus, supplementation either in the diet or as a nutritional supplement is required. At the tissue levels, the primary storage of L-carnitine is in the heart and the skeletal muscle with an estimated 95%, while much lower concentrations are found in the liver, the kidneys, and the plasma [10]. It is estimated that the muscle content is about 70-fold higher than the blood plasma



L-carnitina

- **Alivia o dano** muscular
- **Reduz** marcadores de **dano celular** (CK e mioglobina)
- **Reduz** a formação de **radicais livres**
- **Atenua a dor** muscular
- Aumenta os **níveis séricos**
- Aumenta os níveis musculares*
    - Provavelmente depende do conteúdo muscular prévio.
- Melhora o **fluxo sanguíneo** e o **fornecimento de O2** ao músculo (melhora endotelial)
- Aumenta o **receptor androgênico** muscular *Molecules* **2020**, *25*, 182
- **Nos mais velhos:** aumento da massa muscular, redução peso corporal e da fadiga física e mental
- **Mecanismo:** previne degradação de proteínas musculares e regulação mitocondrial

Nutrients **2018**, *10*, 349; doi:10.3390/nu10030349

CENTRAL nutrition

Detalhes importantes:

molecules

MDPI

Review

Carnitine in Human Muscle Bioenergetics: Can Carnitine Supplementation Improve Physical Exercise?

Antonio Guarni [1], Serena Longo [2], Gabriele V. Guarni [3] and Anna M. Giudetti [1,4,*]

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[2] Department of Biological and Environmental Sciences and Technologies, University of Salento, 73100 Lecce, Italy; serena.longo@unisalento.it (S.L.); gabriele.guarni@unisalento.it (G.V.G.)

* Correspondence: anna.giudetti@uniba.it

Academic Editors: Cesare Indiveri and Lara Gamoh

Received: 8 November 2019; Accepted: 31 December 2019; Published: 1 January 2020

Abstract: L-Carnitine is an amino acid derivative widely known for its involvement in the transport of long chain fatty acids into the mitochondrial matrix, where fatty acid oxidation occurs. Moreover, L-Carnitine promotes the cell from acyl-CoA accretion through the generation of acylcarnitines. Circulating carnitine is mainly supplied by animal-based food products and to a lesser extent by endogenous biosynthesis in the liver and kidney. Human muscle contains high amounts of carnitine but it depends on the uptake of this compound from the bloodstream, due to muscle inability to synthesize carnitine. Mitochondrial fatty acid oxidation represents an important energy source for muscle metabolism, particularly during physical exercise. However, especially during high-intensity exercise this process seems to be limited by the mitochondrial availability of free L-carnitine. Hence, fatty acid oxidation rapidly declines, increasing exercise intensity from moderate to high. Considering the important role of fatty acids in muscle bioenergetics, and the limiting effect of free carnitine in fatty acid metabolism during each bout of exercise, L-carnitine supplementation has been hypothesized to improve exercise performance. So far, the question of the role of L-carnitine supplementation on muscle performance has not definitively been clarified. Differences in exercise intensity, training or conditioning of the subjects, amount of L-carnitine administered, route and timing of administration relative to the exercise bout in different reported results. In this review, we will describe the role of L-carnitine in muscle energetics and the main causes that led to conflicting data on the use of L-carnitine as a supplement.

Keywords: L-carnitine; fatty acid oxidation; muscle energetics; physical exercise

1. Introduction

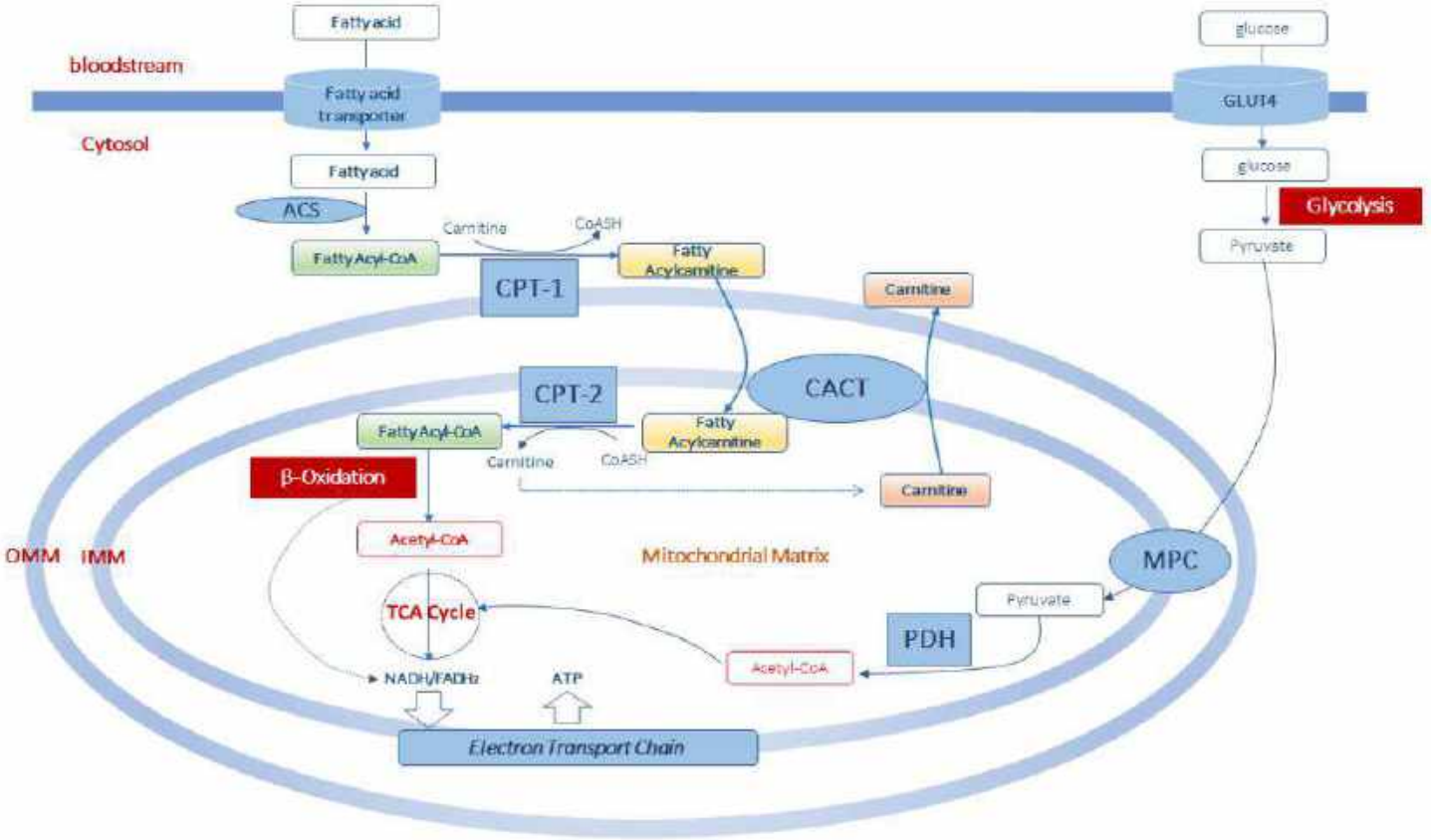
L-carnitine (3-hydroxy-4-N-trimethylaminobutyrate) represents an amino acid derivative and a zwitterion that plays a key role in intermediary metabolism with the main function being the transport of long-chain fatty acids from the cytosol to the mitochondrial matrix, where fatty acid β-oxidation occurs. Other established functions of carnitine are the preservation of membrane integrity [1], the stabilization of a physiologic ratio of free coenzyme A (CoASH)/acetyl-CoA ratio in mitochondria, and the reduction of lactate production [2,3].

Carnitine is present in most, if not all, animal species and in several micro-organisms and plants. In the human body, carnitine is mainly found as a free form (free carnitine) and as the form of acylcarnitine esters, a pool of carnitine bounded to various acyl groups that are delivered throughout the body for a wide range of functions [4]. At rest, the skeletal muscle carnitine pool is distributed as

- **Conteúdo corporal: ≅20g**
- **Biodisponibilidade: 5-15%**
- **Limiar renal: próximo a nível plasmático usual**
- **Suplementação de “grandes doses”: quase o total é recuperado na urina**
- **Conclusão: longo período é necessário para mudanças na concentração *muscular* de carnitina**

Molecules **2020**, *25*, 182

CENTRAL nutrition



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CARNITINA

A L-carnitina é encontrada predominantemente nos músculos e sintetizada endogenamente pelo nosso organismo no fígado e nos rins, a partir de aminoácidos essenciais, como a lisina, metionina e serina.

Pode ser encontrada em muitos alimentos, mas as carnes vermelhas, como carne bovina e de cordeiro, são as melhores opções para adicionar carnitina à dieta.

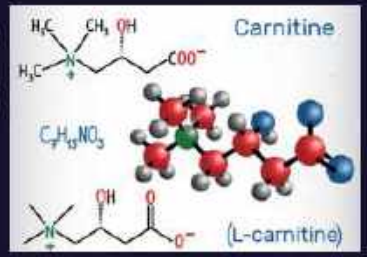
Funções:

- Ligada no processo de formação de energia (ATP) pois é essencial no transporte de ácidos graxos de cadeia longa para oxidação na mitocôndria
- Antioxidante

SUPLEMENTAÇÃO

- L-carnitina
- Acetil-L-carnitina
- Propionil-L-carnitina

Dose usual – 1 g
Dose mínima – 500 mg
Dose máxima – 3000 mg



PRINCIPAIS APLICAÇÕES CLÍNICAS

- Fadiga crônica
- Depressão
- Atividade física
- Doença cardiovascular
- Síndrome metabólica
- Fibromialgia

EFEITOS ADVERSOS

- Não há evidências de efeitos colaterais descritos pela literatura

CONTRAINDICAÇÃO

- Não há evidências

Creatina

CENTRAL
nutrition

Sintetizada a partir de **glicina, arginina e metionina**

Tem um papel chave **no metabolismo celular**

95% é armazenada no músculo → restante em outros tecidos (coração e cérebro)

Journal of the International Society of Sports Nutrition

REVIEW Open Access

International Society of Sports Nutrition position stand: safety and efficacy of creatine supplementation in exercise, sport, and medicine

Richard B. Kreider[1*], Douglas S. Kalman[2], Jose Antonio[3], Tim N. Ziegenfuss[4], Robert Wildman[5], Rick Collins[6], Darren G. Candow[7], Susan M. Kleiner[8], Anthony L. Almada[9] and Hector L. Lopez[10,11]

Abstract

Creatine is one of the most popular nutritional ergogenic aids for athletes. Studies have consistently shown that creatine supplementation increases intramuscular creatine concentrations which may help explain the observed improvements in high intensity exercise performance leading to greater training adaptations. In addition to athletic and exercise improvement, research has shown that creatine supplementation may enhance post-exercise recovery, injury prevention, thermoregulation, rehabilitation, and concussion and/or spinal cord neuroprotection. Additionally, a number of clinical applications of creatine supplementation have been studied involving neurodegenerative diseases (e.g., muscular dystrophy, Parkinson's, Huntington's disease), diabetes, osteoarthritis, fibromyalgia, aging, brain and heart ischemia, adolescent depression, and pregnancy. These studies provide a large body of evidence that creatine can not only improve exercise performance but can play a role in preventing and/or reducing the severity of injury, enhancing rehabilitation from injuries, and helping athletes tolerate heavy training loads. Additionally, researchers have identified a number of potentially beneficial clinical uses of creatine supplementation. These studies show that short and long-term supplementation (up to 30 g/day for 5 years) is safe and well-tolerated in healthy individuals and in a number of patient populations ranging from infants to the elderly. Moreover, significant health benefits may be provided by ensuring habitual low dietary creatine ingestion (e.g., 3 g/day) throughout the lifespan. The purpose of this review is to provide an update to the current literature regarding the role and safety of creatine supplementation in exercise, sport, and medicine and to update the position stand of International Society of Sports Nutrition (ISSN) related to creatine supplementation.

Keywords: Ergogenic aids, Performance enhancement, Sport nutrition, Athletes, Muscular strength, Muscle power, Clinical applications, Safety, Children, Adolescents

Background

Creatine is one of the most popular nutritional ergogenic aids for athletes. Studies have consistently shown that creatine supplementation increases intramuscular creatine concentrations, can improve exercise performance, and/or improve training adaptations. Research has indicated that creatine supplementation may enhance post-exercise recovery, injury prevention, thermoregulation, rehabilitation, and concussion and/or spinal cord neuroprotection. A number of clinical applications of creatine supplementation have also been studied involving neurodegenerative diseases (e.g., muscular dystrophy, Parkinson's, Huntington's disease), diabetes, osteoarthritis, fibromyalgia, aging, brain and heart ischemia, adolescent depression, and pregnancy. The purpose of this review is to provide an update to the current literature regarding the role and safety of creatine supplementation in exercise, sport, and medicine and to update the position stand of International Society of Sports Nutrition (ISSN) related to creatine supplementation.

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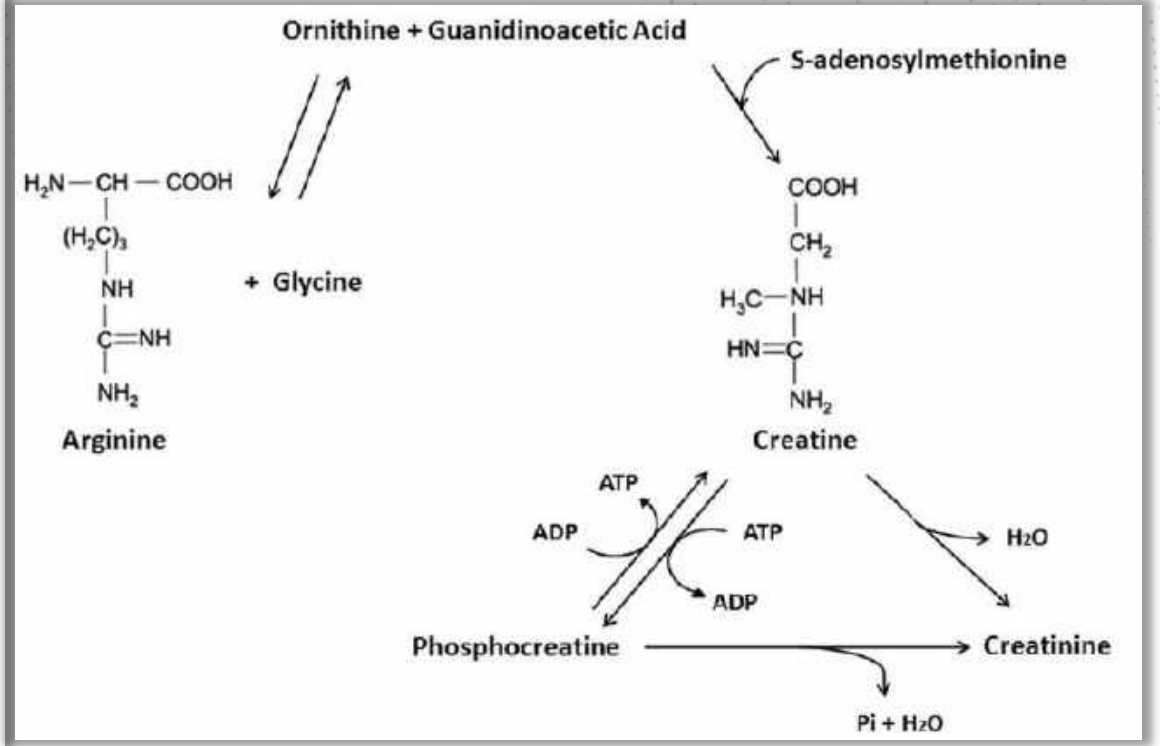

Kreider *et al. Journal of the International Society of Sports Nutrition* (2017) 14:18

nutrients MDPI

Review

Role of Creatine Supplementation in Conditions Involving Mitochondrial Dysfunction: A Narrative Review

Robert Percy Marshall [1,*], Jan-Niklas Droste [1], Jürgen Giessing [2] and Richard B. Kreider [3]

Nutrients **2022**, *14*, 529

"A suplementação de **creatina** pode ter um papel **na melhoria da bioenergética celular** em várias doenças relacionadas à **disfunção mitocondrial**, **condições isquêmicas** e **patologia de lesão**, podendo **fornecer benefícios terapêuticos"**

Review > J Int Soc Sports Nutr. 2023 Dec;20(1):2204071. doi: 10.1080/15502783.2023.2204071.

Creatine supplementation and endurance performance: surges and sprints to win the race

Scott C Forbes [1], Darren G Candow [2], Joao Henrique Falk Neto [3], Michael D Kennedy [3], Jennifer L Forbes [1], Marco Machado [4], Erik Bustillo [5], Jose Gomez-Lopez [6], Andres Zapata [7], Jose Antonio [8]

"Dada a capacidade da creatina de aumentar a capacidade de trabalho anaeróbico, a suplementação pode ser benéfica para esportes, como esqui cross-country, mountain bike, ciclismo, triatlo e para eventos de curta duração em que os surtos finais são críticos para desempenho, como remo, caiaque e ciclismo de pista"

- **Melhora o desempenho nos exercícios**
- **Melhora a reabilitação de lesões**
- **Pode melhorar a recuperação pós-exercício, prevenir ou reduzir gravidade de lesões**
- **Ajuda atletas a tolerar cargas pesadas de treinamento**
- Melhora a **termorregulação**
- **Útil na reabilitação e concussão e/ou neuro proteção da medula espinhal**
- **Útil em doenças neurodegenerativas** (ex:, distrofia muscular, Parkinson, doença de Huntington)
- **Diabetes**
- **Osteoartrite**
- **Fibromialgia**
- **Gestação, envelhecimento, isquemia cerebral e cardíaca, depressão na adolescência.**

Journal of the International Society of Sports Nutrition

REVIEW Open Access

International Society of Sports Nutrition position stand: safety and efficacy of creatine supplementation in exercise, sport, and medicine

Abstract

Keywords

Background

- **Suplementação** de até 30g por dia, por 5 anos, **é segura e bem tolerada**, em indivíduos saudáveis e em pacientes (de crianças a idosos)
- **Efeitos significativos podem ser alcançados pela ingestão de doses como 3g por dia, ao longo da vida.**

Kreider *et al. Journal of the International Society of Sports Nutrition* (2017) 14:18

Journal of the International Society of Sports Nutrition

REVIEW Open Access

International Society of Sports Nutrition position stand: safety and efficacy of creatine supplementation in exercise, sport, and medicine

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Abstract

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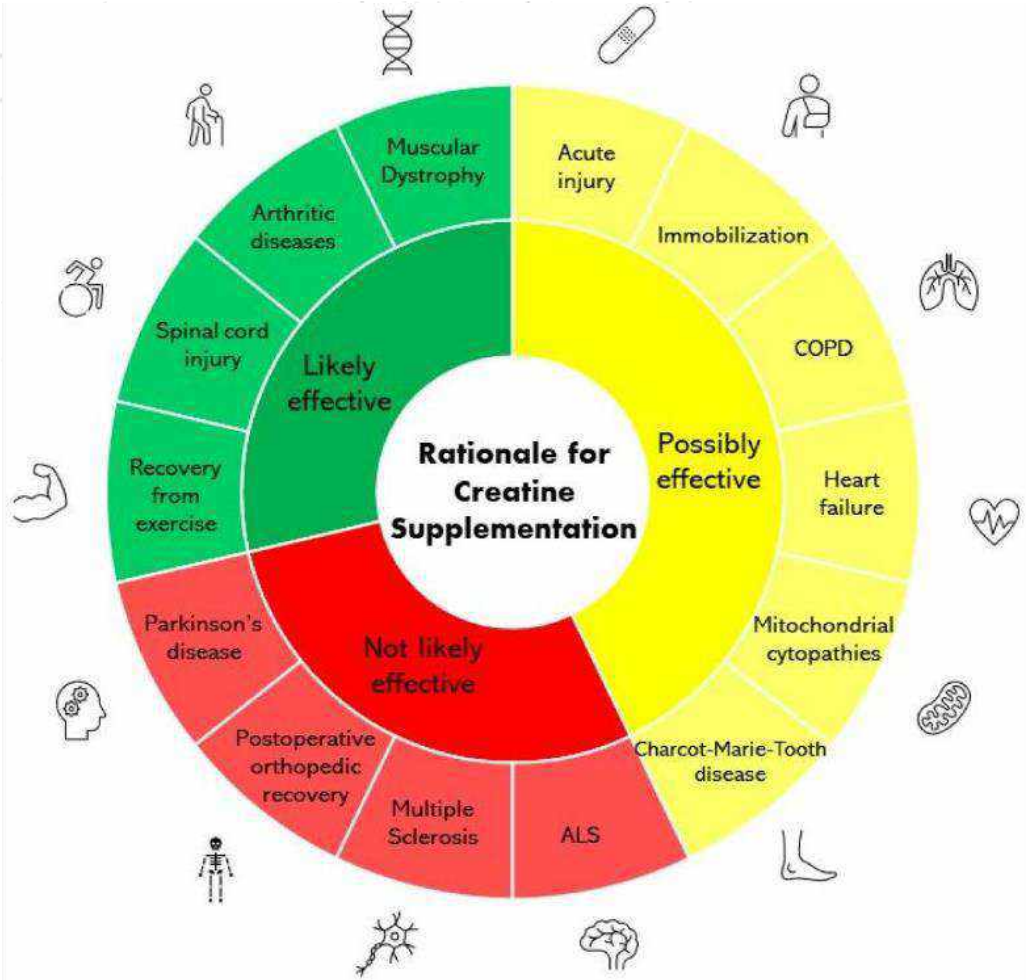
BioMed Central



Visão geral dos usos da suplementação de creatina

Nutrients **2021**, *13*, 1825

CENTRAL nutrition

Faculdade de Saúde Avançada

CREATINA

A creatina desempenha um papel integral no metabolismo celular.

Cerca de 95% da creatina é armazenada no músculo, com a quantidade restante encontrada em outros tecidos como coração e cérebro.

Sintetizada a partir de glicina, arginina e metionina.

- O principal papel: se liga ao fosfato inorgânico (Pi) para formar fosfocreatina (PCr) e, assim, serve como uma fonte fosfato para conversão de ADP em ATP
- Níveis aumentados de creatina melhoram o desempenho do exercício de alta intensidade e as adaptações do treinamento físico

SUPLEMENTAÇÃO

- Creatina monohidratada
  - Dose mínima: 3 g
  - Dose máxima: 30 g
  - Dose usual: 5 g*

PRINCIPAIS APLICAÇÕES CLÍNICAS

- Diabetes
- Hipertrofia, Força Muscular e Sarcopenia
- Doenças neurodegenerativas
- Fibromialgia
- Depressão
- Performance física

EFEITOS ADVERSOS

- O uso desse produto pode provocar diarreia, dor de estômago e distensão abdominal.

CONTRAINDICAÇÃO

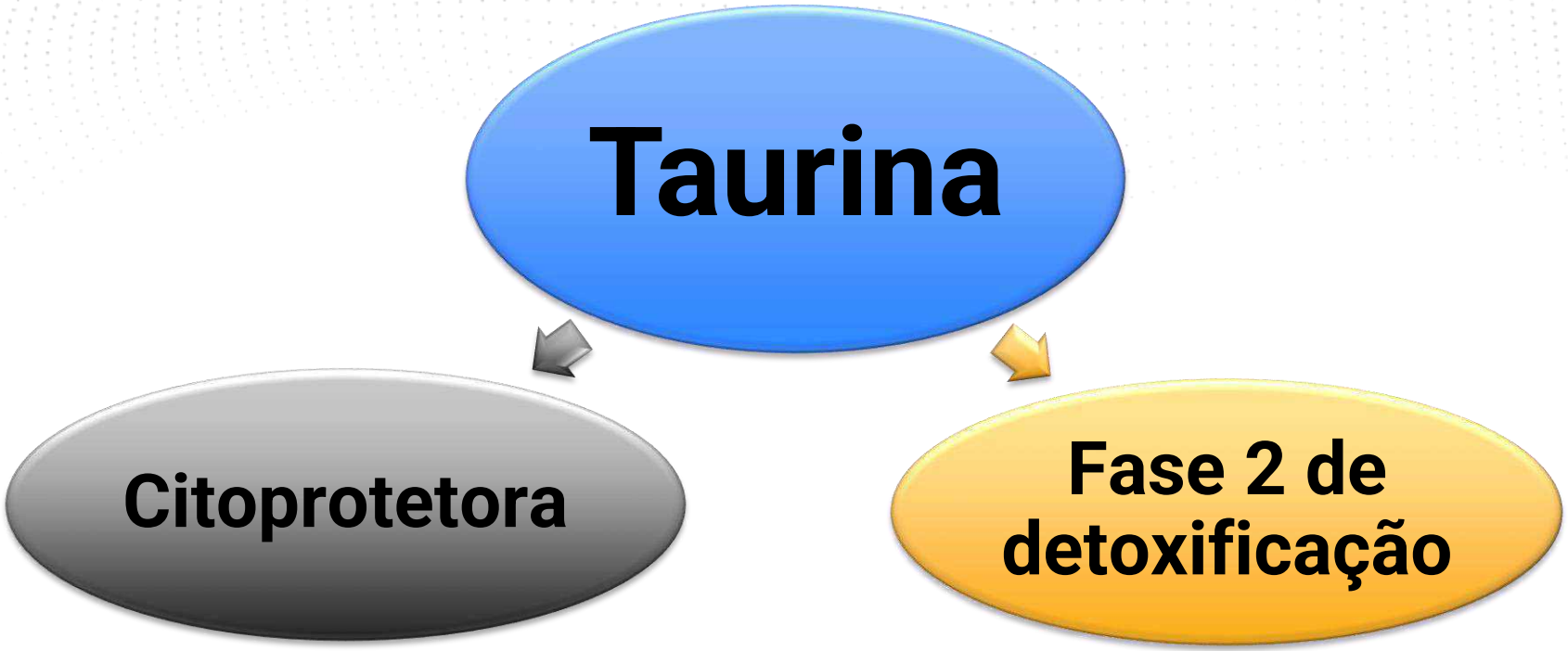
- Pode prejudicar alguns pacientes com transtorno bipolar, mas auxilia a maioria

*DOSES USUAIS PARA ADULTOS

CENTRAL nutrition

Taurina

CENTRAL
nutrition



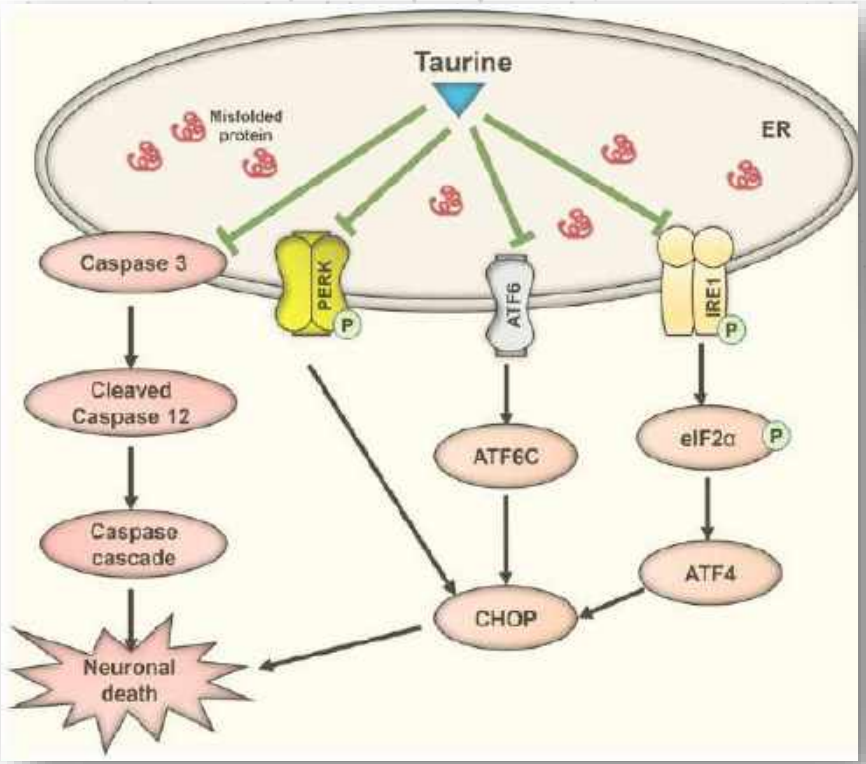
CENTRAL nutrition

Situações de alta demanda / necessidade de L-taurina

Ansiedade

Neuro proteção

CENTRAL nutrition



Review article

Taurine and its analogs in neurological disorders: Focus on therapeutic potential and molecular mechanisms

Md. Jakaria[a], Shofiul Azam[a], Md. Ezazul Haque[a], Song-Hee Jo[a], Md. Sahab Uddin[b], In-Su Kim[a,c], Dong-Kug Choi[a,c,*]

[a] Department of Applied Life Sciences and Integrated Bioscience, Graduate School, Konkuk University, Chungju, South Korea
[b] Department of Pharmacy, Southeast University, Dhaka, Bangladesh
[c] Department of Integrated Bioscience and Biotechnology, College of Biomedical and Health Sciences, and Research Institute of Inflammatory Disease (RID), Konkuk University, Chungju, South Korea

CENTRAL nutrition

Taurina é essencial a função mitocondrial normal

Hansen et al. Journal of Biomedical Science 2010, 17(Suppl 1):S23
http://www.jbiomedsci.com/content/17/S1/S23

NSC
The cost of publication in Journal of Biomedical Science is borne by the National Science Council, Taiwan

JBS JOURNAL OF BIOMEDICAL SCIENCE

REVIEW Open Access

A role for taurine in mitochondrial function

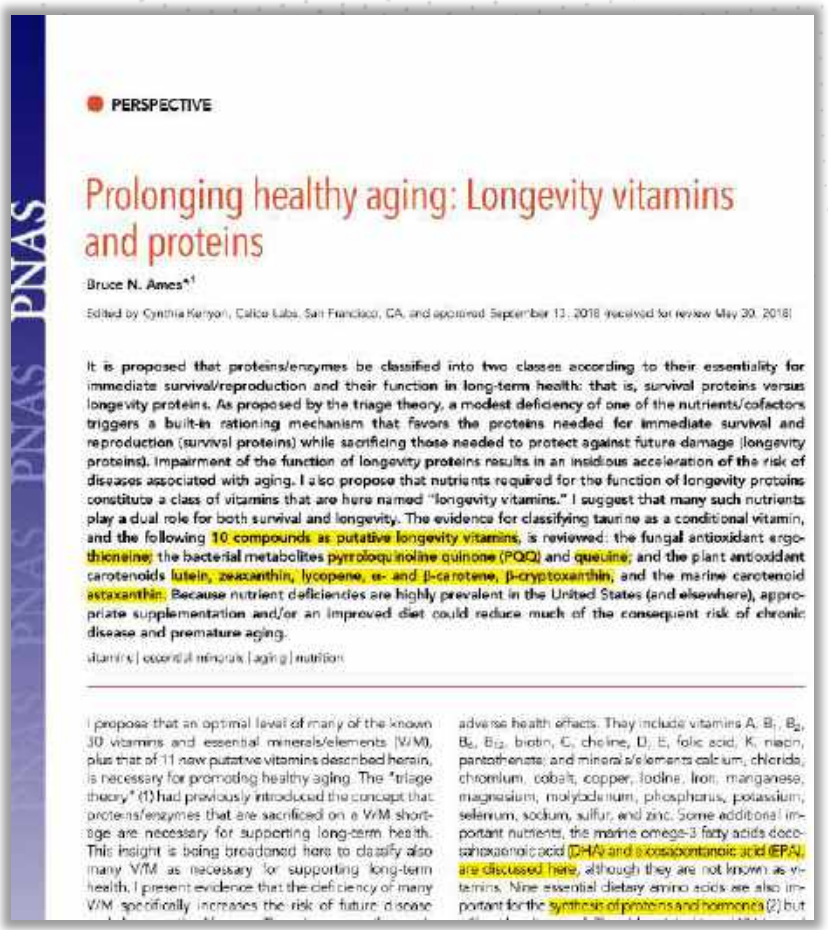
Svend Høime Hansen[1*], Mogens Larsen Andersen[2], Claus Cornett[3], Robert Gradinaru[4], Niels Grunnet[5]

From 17th International Meeting of Taurine
Fort Lauderdale, FL, USA. 14-19 December 2009

Abstract

The mitochondrial pH gradient across the inner-membrane is stabilised by buffering of the matrix. A low-molecular mass buffer compound has to be localised in the matrix to maintain its alkaline pH value. Taurine is found ubiquitously in animal cells with concentrations in the millimolar range and its pKa value is determined to 9.0 (25°C) and 8.6 (37°C), respectively. Localisation of such a low-molecular buffer in the mitochondrial matrix, transforms the matrix into a biochemical reaction chamber for the important matrix-localised enzyme systems. Three acyl-CoA dehydrogenase enzymes, which are pivotal for beta-oxidation of fatty acids, are demonstrated to have optimal activity in a taurine buffer. By application of the model presented, taurine depletion caused by hyperglycemia could provide a link between mitochondrial dysfunction and diabetes.

CENTRAL nutrition



PERSPECTIVE

Prolonging healthy aging: Longevity vitamins and proteins

Bruce N. Ames*[1]

Edited by Cynthia Kenyon, Calico Labs, San Francisco, CA, and approved September 13, 2018 (received for review May 30, 2018)

It is proposed that proteins/enzymes be classified into two classes according to their essentiality for immediate survival/reproduction and their function in long-term health: that is, survival proteins versus longevity proteins. As proposed by the triage theory, a modest deficiency of one of the nutrients/cofactors triggers a built-in rationing mechanism that favors the proteins needed for immediate survival and reproduction (survival proteins) while sacrificing those needed to protect against future damage (longevity proteins). Impairment of the function of longevity proteins results in an insidious acceleration of the risk of diseases associated with aging. I also propose that nutrients required for the function of longevity proteins constitute a class of vitamins that are here named "longevity vitamins." I suggest that many such nutrients play a dual role for both survival and longevity. The evidence for classifying taurine as a conditional vitamin, and the following 10 compounds as putative longevity vitamins, is reviewed: the fungal antioxidant ergothioneine; the bacterial metabolites pyrroloquinoline quinone (PQQ) and queuine; and the plant antioxidant carotenoids lutein, zeaxanthin, lycopene, α- and β-carotene, β-cryptoxanthin, and the marine carotenoid astaxanthin. Because nutrient deficiencies are highly prevalent in the United States (and elsewhere), appropriate supplementation and/or an improved diet could reduce much of the consequent risk of chronic disease and premature aging.

vitamins | essential minerals | aging | nutrition

I propose that an optimal level of many of the known 30 vitamins and essential minerals/elements (V/M), plus that of 11 new putative vitamins described herein, is necessary for promoting healthy aging. The "triage theory" (1) had previously introduced the concept that proteins/enzymes that are sacrificed on a V/M shortage are necessary for supporting long-term health. This insight is being broadened here to classify also many V/M as necessary for supporting long-term health. I present evidence that the deficiency of many V/M specifically increases the risk of future disease adverse health effects. They include vitamins A, B_1, B_2, B_6, B_{12}, biotin, C, choline, D, E, folic acid, K, niacin, pantothenate; and mineral elements calcium, chloride, chromium, cobalt, copper, iodine, iron, manganese, magnesium, molybdenum, phosphorus, potassium, selenium, sodium, sulfur, and zinc. Some additional important nutrients, the marine omega-3 fatty acids docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), are discussed here, although they are not known as vitamins. Nine essential dietary amino acids are also important for the synthesis of proteins and hormones (2) but

"Um ser humano de 70kg contém cerca de 70g de taurina"

"Taurina é particularmente importante na mitocôndria"

Proc Natl Acad Sci U S A. 2018 Oct 23;115(43):10836-10844

CENTRAL nutrition

Proc Natl Acad Sci U S A. 2018 Oct 23;115(43):10836-10844

Fontes de Taurina

A maior parte da taurina vem da dieta, principalmente de:

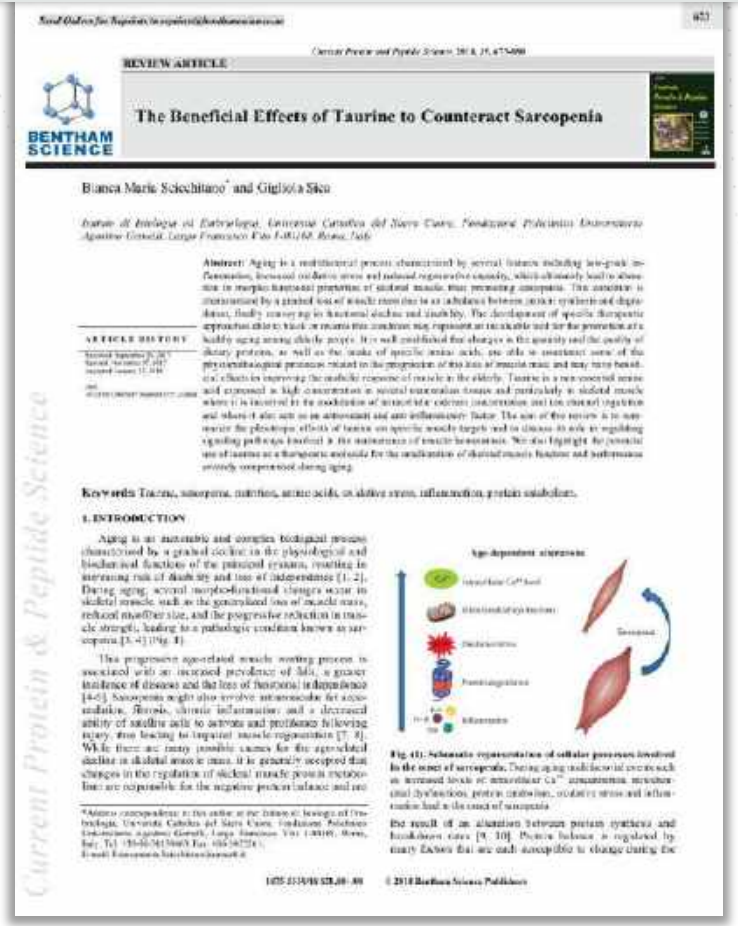
Peixes e frutos do mar

Algas marinhas

Ovos

Carne escura da aves

The Beneficial Effects of Taurine to Counteract Sarcopenia



REVIEW ARTICLE

BENTHAM SCIENCE

The Beneficial Effects of Taurine to Counteract Sarcopenia

Bianca Maria Scicchitano* and Gigliola Sica

Istituto di Biologia ed Embriologia, Università Cattolica del Sacro Cuore, Fondazione Policlinico Universitario Agostino Gemelli, Largo Francesco Vito 1-00168, Roma, Italy

Abstract: Aging is a multifactorial process characterized by several features including low-grade inflammation, increased oxidative stress and reduced regenerative capacity, which ultimately lead to abnormalities in complex functional properties of skeletal muscle, thus promoting sarcopenia. This condition is characterized by a gradual loss of muscle mass due to an imbalance between protein synthesis and degradation, finally converging in functional decline and disability. The development of specific therapeutic approaches able to track or reverse this condition may represent an invaluable tool for the promotion of a healthy aging among elderly people. It is well established that changes in the quantity and the quality of dietary proteins, as well as the intake of specific amino acids, can offer an important array of the physiopathological processes related to the progression of the loss of muscle mass and may exert beneficial effects in improving the anabolic response of muscle in the elderly. Taurine is a non-essential amino acid expressed at high concentration in several mammalian tissues and particularly in skeletal muscle where it is involved in the modulation of intracellular calcium concentration and ion channel regulation and where it also acts as an antioxidant and anti-inflammatory factor. The aim of this review is to summarize the pleiotropic effects of taurine on specific muscle targets and to discuss its role in regulating signaling pathways involved in the maintenance of muscle homeostasis. We also highlight the potential use of taurine as a therapeutic molecule for the amelioration of skeletal muscle function and performance severely compromised during aging.

Keywords: Taurine, sarcopenia, nutrition, amino acids, oxidative stress, inflammation, protein metabolism.

1. INTRODUCTION

Aging is an inexorable and complex biological process characterized by a gradual decline in the physiological and biochemical functions of the principal systems, resulting in increasing risk of disability and loss of independence [1, 2]. During aging, several morpho-functional changes occur in skeletal muscle, such as the generalized loss of muscle mass, reduced myofiber size, and the progressive reduction in muscle strength, leading to a pathologic condition known as sarcopenia [3, 4] (Fig. 1).

This progressive age-related muscle wasting process is associated with an increased prevalence of falls, a greater incidence of diseases and the loss of functional independence [4-6]. Sarcopenia might also involve intramuscular fat accumulation, fibrosis, chronic inflammation and a decreased ability of satellite cells to activate and proliferate following injury, thus leading to impaired muscle regeneration [7, 8]. While there are many possible causes for the age-related decline in skeletal muscle mass, it is generally accepted that changes in the regulation of skeletal muscle protein metabolism are responsible for the negative protein balance and are

Fig. (1). Schematic representation of cellular processes involved in the onset of sarcopenia. During aging multifactorial events such as increased levels of intracellular Ca^{2+} concentration, mitochondrial dysfunctions, protein catabolism, oxidative stress and inflammation lead to the onset of sarcopenia.

the result of an alteration between protein synthesis and breakdown rates [9, 10]. Protein balance is regulated by many factors that are easily susceptible to change during the

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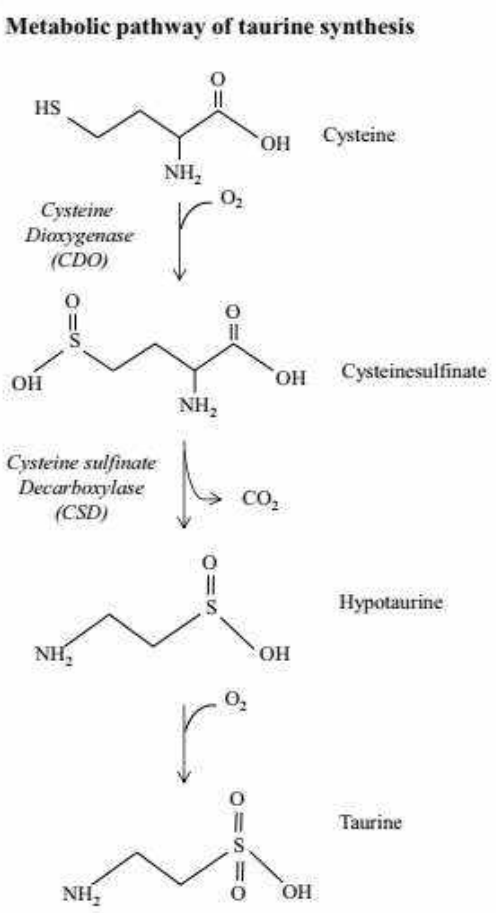
1875-5550/18 $58.00+.00

Current Protein and Peptide Science, 2018, *19*, 673-680

CENTRAL nutrition

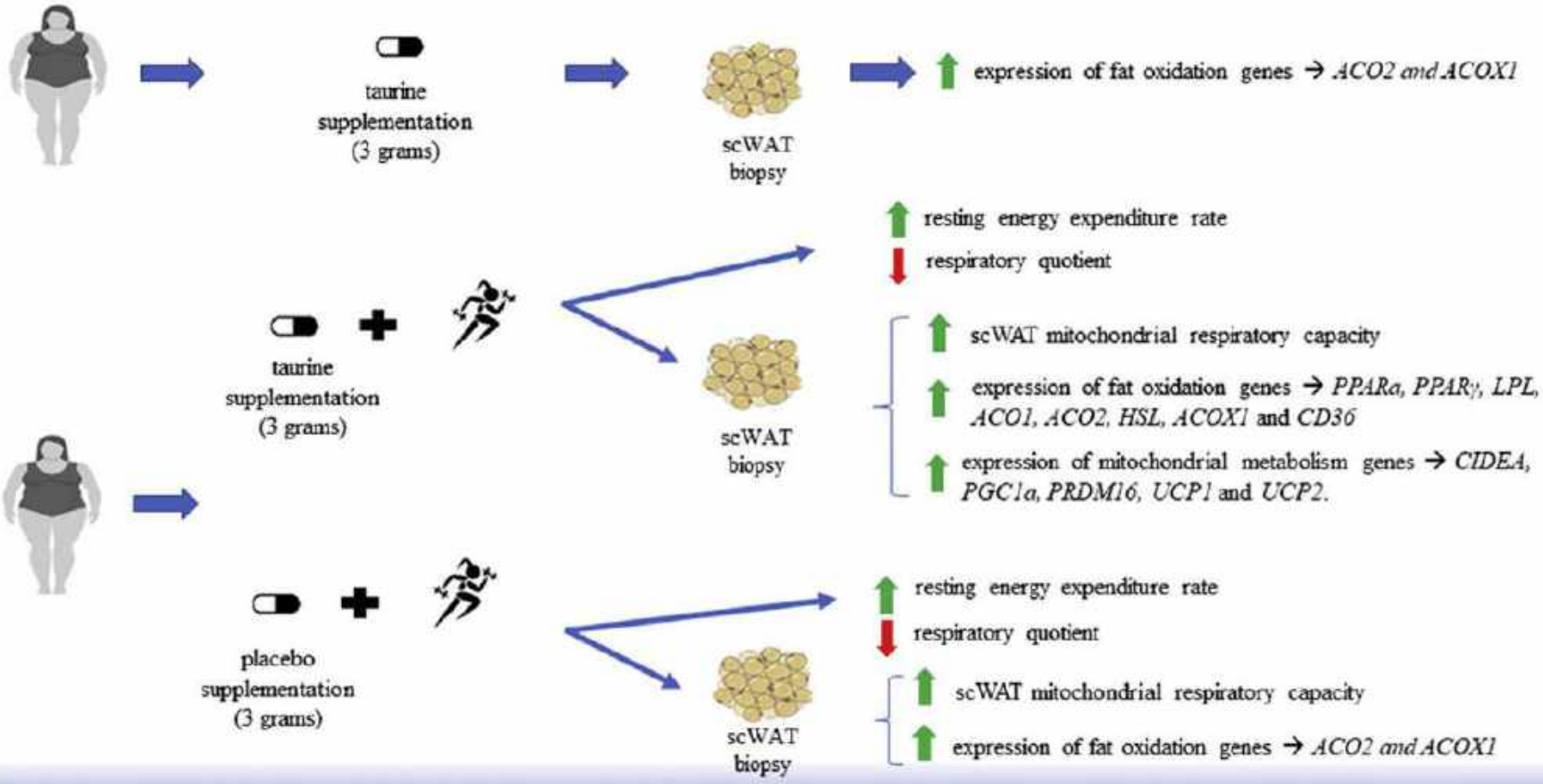
Current Protein and Peptide Science, 2018, *19*, 673-680



Taurina...

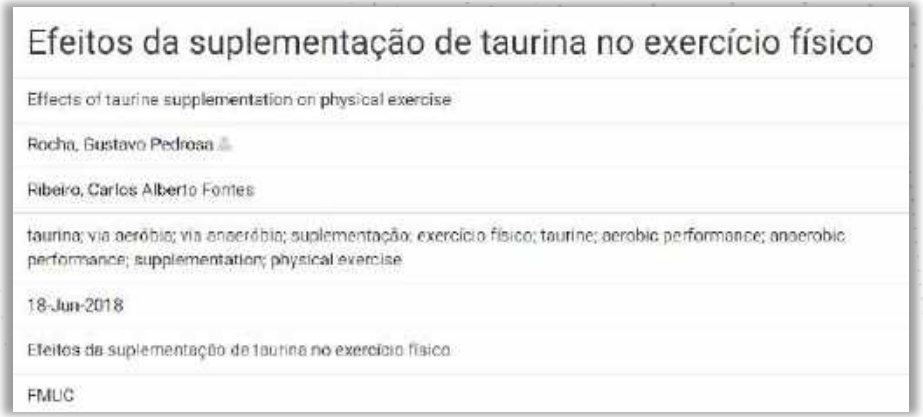
- ...tem feitos pleiotrópicos em **alvos musculares** específicos
- ... regula **rotas de sinalização envolvidas na manutenção muscular**
- Taurina **pode ser usada para melhora da função muscular e da performance**, comprometidas, por exemplo, pelo envelhecimento

8 weeks of taurine/placebo supplementation associated or not with exercise in obese women



Suplementação de taurina com exercício melhorou o metabolismo lipídico através da modulação de genes relacionados a atividade mitocondrial e a oxidação de gorduras, sugerindo um efeito "amarronzador" do tecido adiposo subcutâneo branco de mulheres obesas"

Taurina no exercício físico



- **O principal efeito ergogênico observado no exercício aeróbio está centrado no aumento da capacidade cardiorrespiratória.**
- **Na atividade anaeróbia, teve como principal efeito a melhoria no dano muscular**

https://hdl.handle.net/10316/82143

Faculdade de Saúde Avançada

TAURINA

A taurina é um aminoácido que contém enxofre e está presente em altas concentrações no plasma e em muitos tecidos.

Possui propriedades citoprotetoras devido suas ações de destoxificação, especialmente na fase II e nas reações de conjugação dos ácidos biliares.

Funções:

- Regulação da homeostase da glicose
- Modulação do cálcio
- Atividade antioxidante
- Estabilização das membranas;
- Reprodução e imunidade
- Restauração da função dos receptores do ácido γ-aminobutírico (GABA)
- Redução da neuroinflamação;
- Redução do estresse oxidativo
- Aumento da biogênese mitocondrial e da neurogênese

SUPLEMENTAÇÃO

- L-Taurina
- Dose mínima: 250 mg
- Dose máxima: 5.000 mg
- Dose usual v.o: 500 mg/dia
- Dose usual sublingual: 50-75mg - várias vezes ao dia
- Atletas: 1-3 g/dia, 1-3 h antes do treino

PRINCIPAIS APLICAÇÕES CLÍNICAS

- Destoxificação
- Antioxidante
- Anti-inflamatório
- Saúde mitocondrial
- Cardioproteção
- Neuroproteção
- Imunoproteção
- Proteção ocular (retinopatia)
- Recurso ergogênico

EFEITOS ADVERSOS

- Não há evidências de efeitos colaterais descritos pela literatura

CONTRAINDICAÇÃO

- Não há evidências

*DOSES USUAIS PARA ADULTOS

CENTRAL nutrition

HMB

hidroxi-beta-metil-butirato

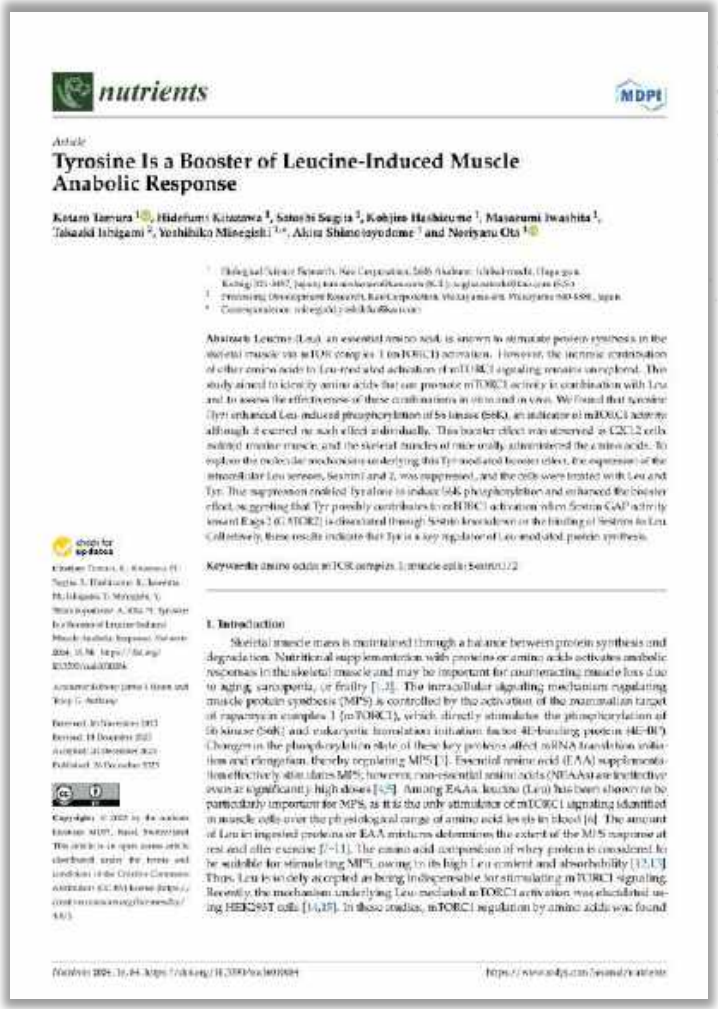
CENTRAL
nutrition

- **Suplementação de HMB leva a:**
- **Aumento da massa livre de gordura**
- **Redução da massa gorda**
- **Os efeitos variam conforme a população e a faixa etária, e tipo de atividade física.**

- Jakubowski, J., Nunes, E., Teixeira, F., Vescio, V., Morton, R., Banfield, L., & Phillips, S. (2020). Supplementation with the Leucine Metabolite β-hydroxy-β-methylbutyrate (HMB) does not Improve Resistance Exercise-Induced Changes in Body Composition or Strength in Young Subjects: A Systematic Review and Meta-Analysis. *Nutrients*, 12.
- Kaczka, P., Michalczyk, M., Jastrząb, R., Gawelczyk, M., & Kubicka, K. (2019). Mechanism of Action and the Effect of Beta-Hydroxy-Beta-Methylbutyrate (HMB) Supplementation on Different Types of Physical Performance - A Systematic Review. *Journal of Human Kinetics*, 68, 211 - 222.
- Durkalec–Michalski, K., Jeszka, J., & Podgórski, T. (2017). The Effect of a 12-Week Beta-hydroxy-beta-methylbutyrate (HMB) Supplementation on Highly-Trained Combat Sports Athletes: A Randomised, Double-Blind, Placebo-Controlled Crossover Study. *Nutrients*, 9.

L-tirosina

CENTRAL
nutrition



nutrients

MDPI

Article

Tyrosine Is a Booster of Leucine-Induced Muscle Anabolic Response

Kotaro Tamura [1], Hidefumi Kitazawa [1], Satoshi Sagita [2], Kohjiro Hashizume [1], Masayumi Iwashita [1], Takaaki Ishigami [2], Yoshihiko Minegishi [1,*], Akira Shimotoyodome [1] and Noriyasu Ota [1]

Abstract: Leucine (Leu), an essential amino acid, is known to stimulate protein synthesis in the skeletal muscle via mTOR complex 1 (mTORC1) activation. However, the intrinsic combination of other amino acids to Leu-mediated activation of mTORC1 signaling remains unexplored. This study aimed to identify amino acids that can promote mTORC1 activity in combination with Leu and to assess the effectiveness of these combinations in vitro and in vivo. We found that tyrosine (Tyr) enhanced Leu-induced phosphorylation of S6 kinase (S6K), an indicator of mTORC1 activity, although it exerted no such effect individually. This booster effect was observed in C2C12 cells, isolated murine muscle, and the skeletal muscles of mice orally administered the amino acids. To explore the molecular mechanism underlying this Tyr-mediated booster effect, the expression of the intracellular Leu sensors, Sestrin1 and 2, was suppressed, and the cells were treated with Leu and Tyr. The suppression nullified Tyr-induced S6K phosphorylation and enhanced the booster effect, suggesting that Tyr possibly contributes to mTORC1 activation when Sestrin GAP activity toward Rags 2 (GATOR2) is dissociated through Sestrin knockdown or the binding of Sestrins to Leu. Collectively, these results indicate that Tyr is a key regulator of Leu-mediated protein synthesis.

Keywords: amino acids; mTOR complex 1; muscle cells; Sestrin1/2

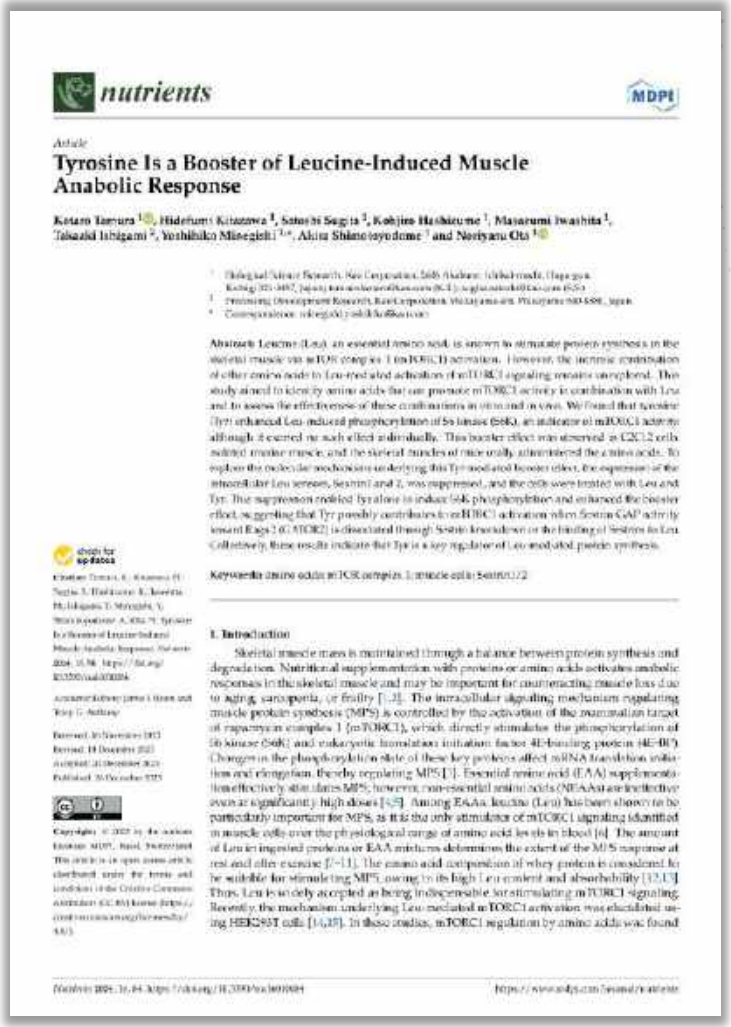
1. Introduction

Skeletal muscle mass is maintained through a balance between protein synthesis and degradation. Nutritional supplementation with proteins or amino acids activates anabolic responses in the skeletal muscle and may be important for counteracting muscle loss due to aging, sarcopenia, or frailty [1,2]. The intracellular signaling mechanism regulating muscle protein synthesis (MPS) is controlled by the activation of the mammalian target of rapamycin complex 1 (mTORC1), which directly stimulates the phosphorylation of S6 kinase (S6K) and eukaryotic translation initiation factor 4E-binding protein (4E-BP). Changes in the phosphorylation state of these key proteins affect mRNA translation initiation and elongation, thereby regulating MPS [3]. Essential amino acid (EAA) supplementation effectively stimulates MPS; however, non-essential amino acids (NEAAs) are ineffective even at significantly high doses [4,5]. Among EAAs, leucine (Leu) has been shown to be particularly important for MPS, as it is the only stimulator of mTORC1 signaling identified in muscle cells over the physiological range of amino acid levels in blood [6]. The amount of Leu in ingested proteins or EAA mixtures determines the extent of the MPS response at rest and after exercise [7–11]. The amino acid composition of whey protein is considered to be suitable for stimulating MPS, owing to its high Leu content and absorbability [12,13]. Thus, Leu is widely accepted as being indispensable for stimulating mTORC1 signaling. Recently, the mechanism underlying Leu-mediated mTORC1 activation was elucidated using HEK293T cells [14,15]. In these studies, mTORC1 regulation by amino acids was found

“Descobrimos que a tirosina aumentou a fosforilação induzida por Leu da quinase S6, um indicador da atividade do mTORC1, embora não tenha exercido tal efeito individualmente”

Nutrients **2024**, *16*, 84. https://doi.org/10.3390/nu16010084

CENTRAL nutrition



nutrients

MDPI

Article

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Article

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"Esse ***efeito booster*** foi observado em **células C2C12**, **músculo murino isolado** e **músculos esqueléticos de camundongos que receberam** os aminoácidos por via oral"

Estes resultados indicam que Tyr é um **regulador chave da síntese proteica mediada por Leu"**

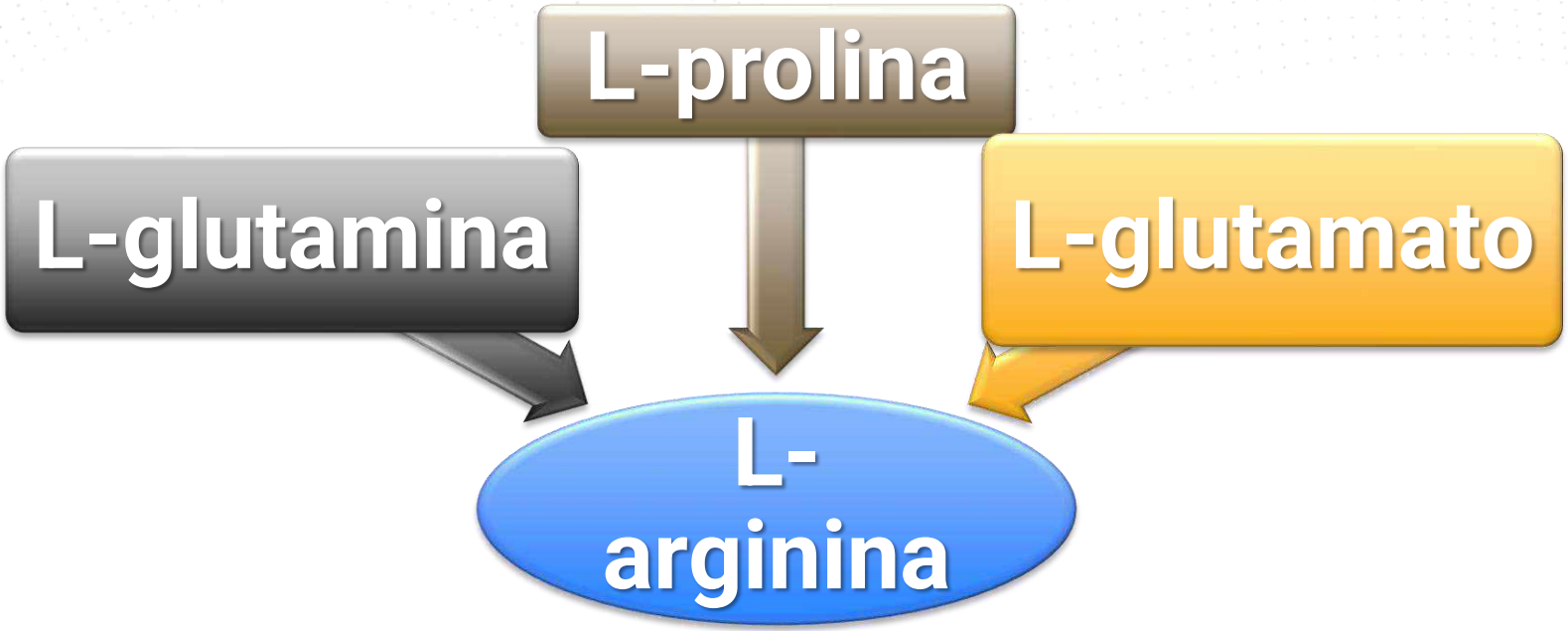
Nutrients **2024**, *16*, 84. https://doi.org/10.3390/nu16010084

CENTRAL nutrition

L-arginina

CENTRAL
nutrition

Síntese endógena



CENTRAL nutrition

Situações de alta demanda / necessidade de L-arginina

Crescimento na Infância

e Gestação

Queimaduras

Deficiência imunológica grave

CENTRAL nutrition

Faculdade de Saúde Avançada

ARGININA

Condicionalmente essencial. A síntese endógena pode não ser suficiente nas seguintes situações:

- crescimento durante a infância
- e gestação
- deficiência imunológica grave
- queimaduras

Biossintetizada a partir de glutamina, glutamato e prolina.

Funções:

- Síntese proteica (ativação m-TOR);
- Desintoxicação de amônia
- Antioxidante
- Liberação hormonal (GH, testosterona)
- Ativação da síntese de BH4 (=síntese neurotransmissores)

Via NO:

- regulação do tônus vascular
- biogênese mitocondrial
- função imune (macrófagos, células dendríticas e células T)
- neurotransmissão
- cicatrização
- espermatogênese, embiogênese e fertilidade

Precursora da creatina e ornitina, que gera poliaminas, prolina e glutamato

SUPLEMENTAÇÃO

- L-arginina: uso geral
- Arginina Alpha Cetoglutarato (AAKG): utilizado na suplementação esportiva
- Dose mínima: 500 mg
- Dose máxima: 3.500 mg
- Dose usual: 1.000 mg/dia

PRINCIPAIS APLICAÇÕES CLÍNICAS

- Imunomodulação
- GH e Testosterona
- Exercício físico
- Cicatrização
- HAS e disfunção endotelial

EFEITOS ADVERSOS

- Em altas doses pode elevar os níveis de uréia no sangue e causar hipercalcemia, em pacientes com disfunção renal

CONTRAINDICAÇÃO

- Em longo prazo: pacientes com alergias respiratórias, asma e cirrose
- Infecções por herpes: estimula a replicação do vírus
- Hipotensão arterial
- Pode potencializar fármacos hipotensores

*DOSES USUAIS PARA ADULTOS

CENTRAL nutrition


PRÉ-TREINO
ENERGY
ATP
CARBO FREE
CENTRAL
-nutrition-
ENERGY
ATP
SUPLEMENTO ALIMENTAR EM PÓ A BASE DE HIDROXIMETILBUTIRATO (HMB), CREATINA, AMINOÁCIDOS E MINERAIS
Contém 30 sachês de 10g
Peso líquido 300g
SABOR
LIMÃO
& CAFÉ VERDE
Peso líquido
10g

ATIVOS

ENERGY®

ATP

- **HMB:** Promove rápida queima de gordura, transformando-a em energia para os treinos.
- **Creatina:** Aumenta a energia em 20% e melhora o desempenho atlético.
- **L-Alanina:** Ativa o metabolismo muscular, gerando força, ganho de massa magra e definição.
- **L-Arginina:** Melhora a oxigenação celular, acelera a recuperação muscular e reduz a fadiga.
- **L-Tirosina:** Aumenta o foco e a concentração, e melhora o desempenho físico e mental.
- **L-Taurina:** Melhora a resistência, performance e o metabolismo muscular.
- **L-Carnitina:** Reduz a gordura corporal, a fadiga e os danos ao tecido muscular.
- **Magnésio:** Colabora para maior nutrição e reduz as dores nos músculos.
- **Extrato de Café Verde:** Contribui para perda do peso de forma natural.

O QUE É O

ENERGY®

ATP

SUPLEMENTO IDEAL PARA PROPORCIONAR **MAIS ENERGIA!**

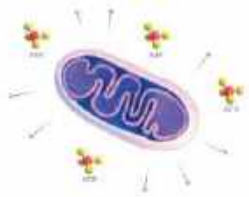
A sinergia dos ativos presente no ENERGY ATP proporciona ativação mitocondrial para aumentar a produção de ATP, contribuindo para melhora da performance no treino e fadiga muscular. A combinação de nutrientes auxilia a β-oxidação lipídica, promovendo maior energia corporal e cognitiva.

Usos / benefícios

INFORMAÇÃO NUTRICIONAL

porção de 20 g (2 sachês)

Quantidade por porção		%VD*
HMB (Hidroximetilbutirato de cálcio)	2990 mg	**
Creatina Monohidratada	3000 mg	**
L-Alanina	1000 mg	**
L-Arginina	1500 mg	**
L-Carnitina	500 mg	**
L-Taurina	2000 mg	**
L-Tirosina	500 mg	**
Magnésio	100 mg	38%



CENTRAL nutrition

1 sachê

- HMB 1500mg
- **Creatina 1500mg**
- **Taurina 1000mg**
- **L-arginina 750mg**
- L-alanina 500mg
- **L-carnitina 250mg**
- L-tirosina 250mg
- **Magnésio 50mg (+malato)**

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Nossa essência
é **ciência!**

OBRIGADO!

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