I'm not a bot

 A creatina é um dos suplementos mais estudados e eficazes para a melhoria da performance humana. Ela desempenha um papel essencial na produção de energia celular e tem sido amplamente referenciada tanto por atletas quanto por pesquisadores interessados em seus efeitos orgânicos. Mas, afinal, para que serve a creatina? Quais são os principais benefícios da creatina para o corpo? E para o cérebro? Há benefícios comprovados?Este artigo explora as funções e vantagens da suplementação de creatina para o corpo e especialmente para o cérebro, com base em estudos científicos recentes, incluindo metanálises e revisões sistemáticas.Creatina, para que serve? Quais os benefícios?A creatina é um ácido orgânico nitrogenado produzido naturalmente pelo organismo a partir de três aminoácidos: metionina, glicina e arginina. É sintetizada principalmente no fígado, rins e pâncreas e armazenada nos músculos e no cérebro na forma de fosfocreatina. Em humanos, a maior parte da creatina (cerca de 95%) é armazenada nos músculos; o restante dela (cerca de 5%) encontra-se distribuído por outros tecidos, incluindo o cérebro.A função primordial da creatina é auxiliar na produção de adenosina trifosfato (ATP), a principal fonte de energia celular.Embora seja encontrada naturalmente em alimentos como carnes vermelhas e peixes, muitas pessoas optam por suplementá-la para maximizar seu desempenho físico e mental.A creatina tem um papel fundamental no fornecimento de energia para atividades de alta intensidade e curta duração. Durante o exercício, o ATP é rapidamente consumido e convertido em Adenosina Difosfato (ADP). É nesse momento que a creatina entra em cena, regenerando o ATP e permitindo que o corpo mantenha um desempenho elevado por mais tempo.Os principais benefícios da creatina para o corpo incluem:Aumento da força e potência muscular. Estudos mostram que a suplementação com creatina pode melhorar o desempenho em exercícios de força, como levantamento de peso.Recuperação muscular acelerada. A creatina pode ajudar na recuperação muscular, reduzindo o dano celular e a inflamação após treinos intensos.Hidratação celular e aumento do volume muscular. A creatina atrai água para dentro das células musculares, contribuindo para um maior volume muscular e um ambiente propício para o crescimento muscular.Redução da fadiga muscular. A suplementação com creatina pode ajudar a retardar a fadiga e aumentar a resistência durante treinos prolongados.A creatina é amplamente reconhecida por seus benefícios no desempenho físico. No entanto, ela não é apenas essencial para os músculos, mas também desempenha um papel vital no funcionamento cerebral, tendo recebido muito atenção da comunidade científica por seu papel nootrópico. A título de exemplo, os artigos Effects of creatine supplementation on brain function and health, publicado na revista Nutrients, e The effects of creatine supplementation on cognitive function in adults: a systematic review and meta-analysis, publicado na revista Frontiers in Nutrition, exploraram justamente esse tema. O cérebro é um órgão altamente dependente de energia, utilizando cerca de 20% do ATP total do corpo. A creatina auxilia na regeneração do ATP cerebral, a principal fonte de energia celular, permitindo um melhor funcionamento cognitivo. Dessa forma, sua suplementação tem sido associada a melhorias na memória, cognição e até mesmo na função executiva, especialmente em idosos e indivíduos sob estresse mental.Entre os principais efeitos benéficos da creatina no cérebro, destaca-se sua função energética, fornecendo suporte essencial para processos cognitivos. A creatina contribui significativamente para a (1) melhoria dos processos cognitivos, da memória e dos escores de inteligência, especialmente em tarefas que exigem processamento rápido. Outro ponto importante é sua (2) ação neuroprotetora, que ajuda a proteger os neurônios contra danos oxidativos e estresse metabólico, reduzindo o risco ou retardando a progressão de doenças neurodegenerativas, como Alzheimer e Parkinson.A suplementação de creatina também tem sido estudada como uma potencial intervenção para (3) tratar sintomas de depressão. Pesquisas indicam que ela pode (4) modular neurotransmissores como dopamina e serotonina, influenciando positivamente o humor e reduzindo sintomas depressivos. Além disso, evidências sugerem que a creatina pode (5) auxiliar na recuperação de lesões cerebrais traumáticas, melhorando os resultados cognitivos e funcionais de pacientes que sofreram impactos no sistema nervoso central.Outro benefício relevante da creatina é sua capacidade de (6) mitigar os efeitos da privação de sono na função cognitiva. Durante períodos de restrição do descanso, a suplementação pode ajudar a manter o desempenho mental, preservando a clareza de raciocínio e a capacidade de concentração. Da mesma forma, ela contribui para a (7) redução da fadiga mental, permitindo maior resistência em tarefas cognitivas prolongadas, aspecto especialmente útil para profissionais e estudantes sob alta demanda intelectual.Além dos efeitos já mencionados, a creatina se destaca especialmente por seu (9) impacto positivo no desempenho mental de idosos. O declínio cognitivo associado ao envelhecimento pode ser atenuado com a suplementação, auxiliando na preservação da memória e da função executiva. O fato é que além de seus benefícios bem estabelecidos no desempenho físico, a creatina mostra vantagens promissoras para a saúde cerebral e função cognitiva, tornando-se um suplemento de interesse tanto para atletas quanto para a população em geral.Existem diversas formas de creatina no mercado, mas a mais estudada e eficaz é a creatina monohidratada. Outras formas, como a creatina etil éster e a creatina tamponada, não demonstraram vantagens significativas sobre a monohidratada e podem ser menos eficazes.A retenção de creatina pelo corpo a partir da suplementação parece ser aumentada em cerca de 25% a partir da ingestão simultânea de carboidratos e/ou proteínas mediada por um aumento na secreção de insulina. Essa combinação produziria uma taxa de saturação mais rápida, mas aparentemente não demonstrou ter um efeito maior no desempenho.Existem diversos protocolos utilizados na suplementação de creatina. A dose recomendada para a maioria das pessoas é:Fase de saturação (opcional): 20 g por dia (divididos em 4 doses de 5 g) por 5 a 7 dias.Fase de manutenção: 3 a 5 g por dia.Não é necessário fazer “ciclos” de creatina, pois seu consumo contínuo é seguro e benéfico. Como vimos anteriormente, estudos também sugerem que a creatina pode ser melhor absorvida quando consumida junto com carboidratos e proteínas.A creatina é considerada amplamente segura, mesmo para uso prolongado. No entanto, algumas pessoas podem experimentar:Retenção de líquidos. Um aumento na hidratação intracelular pode causar um leve ganho de peso.Distúrbios gastrointestinais. Algumas pessoas podem sentir desconforto se consumirem doses muito altas de uma vez.Possível impacto renal. Não há evidências de que a creatina cause danos renais em indivíduos saudáveis, mas aqueles com doenças renais preexistentes devem consultar um médico antes de suplementar.A creatina é um suplemento extremamente eficaz e seguro, com benefícios tanto para o corpo quanto para o cérebro. Ela melhora a força e a performance física, acelera a recuperação muscular, aumenta a energia mental, protege os neurônios e pode influenciar positivamente o humor e a cognição.Para aqueles que buscam otimizar seu desempenho esportivo e cognitivo, a creatina monohidratada continua sendo uma das melhores opções de suplementação disponíveis. Almeida, D., Pereira, R., Borges, E. Q., Rawson, E. S., Rocha, L. S., & Machado, M. (2022). Creatine supplementation improves physical performance, without negative effects on health markers, in young weightlifters. Journal of Science in Sport and Exercise, 4(3), 255-265. → Ler Artigo Gutiérrez-Hellín, J., Del Coso, J., Franco-Andrés, A., Gamonales, J. M., Espada, M. 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Neuroscience research, 42(4), 279-285. → Ler Artigo A creatina é um dos suplementos mais utilizados pelos atletas no mundo do desporto. De origem natural, é utilizada para melhorar o desempenho físico, aumentar a massa muscular e prevenir o aparecimento de lesões. Muitas pessoas acreditam que a creatina é insegura e que provoca inúmeros efeitos secundários, mas na realidade é um dos suplementos, mais testados cientificamente e tem um grande perfil de segurança.A creatina é uma substância que se encontra naturalmente nas nossas células musculares. Ajuda os músculos a produzir energia quando realizamos um exercício mais pesado ou quando praticamos exercícios de alta intensidade. Diversos fatores podem afetar as reservas de creatina, incluindo a ingestão de carne, o exercício, a quantidade de massa muscular e os níveis de determinadas hormonas no nosso corpo. Cerca de 95% da creatina é armazenada nos músculos (na forma de fosfocreatina) e os outros 5% encontram-se no cérebro, rins e fígado.Quando toma um suplemento de creatina obtém diversos benefícios:- Aumenta as reservas de fosfocreatina, o que contribui para a maior produção de energia durante o exercício;- Contribui para o rápido crescimento do músculo através da criação de novas fibras musculares pelo aumento dos níveis de IGF-1 (hormona de crescimento) e pelo aumento da quantidade de água nos músculos que promove o aumento do seu volume;- Melhora a performance dos exercícios de alta intensidade no que diz respeito a força, resistência à fadiga e resistência muscular, recuperação, desempenho cerebral e capacidade de sprint;- Desacelera ou reduz a progressão de doenças de natureza neurológica (estudos realizados apenas em animais);- Diminui os níveis de açúcar no sangue pois promove a função do GLUT4 (molécula responsável pelo transporte de glucose do sangue para os músculos) e, desta forma, diminui o risco de desenvolvimento de diabetes;- Reduz o cansaço e fadiga. Relativamente à dose de suplementação, poderá começar por uma fase inicial em que consome 20g de creatina por dia durante 1 semana, divididas por 4 porções de 5g e depois mantém entre 3 a 5g diárias para manter os níveis de creatina ou então poderá consumir apenas 3 a 5g por dia sem fazer essa fase inicial.No entanto, desta forma, os efeitos poderão aparecer mais lentamente.Quanto à sua segurança, inúmeros são os estudos que não verificam qualquer efeito secundário na suplementação de creatina. No entanto, caso queira fazer algum tipo de suplementação procure a opinião do seu médico ou nutricionista.Um artigo de Catarina Sofia Correia, nutricionista na Clínica Tejo, parceira do Fitness Hut - Grupo Vivagym. Em nosso organismo, ela é armazenada em grande parte nos tecidos musculoesqueléticos e, em menor quantidade, no coração, músculos lisos, cérebro e testículos. Em geral, nosso corpo produz cerca de 1 grama de creatina por dia e outro 1 grama é ingerido na dieta. Para quem a creatina é indicada? Para pessoas que praticam esportes como a musculação, por exemplo Imagem: iStockPara que serve a creatina?O suplemento é recomendado para o aumento da força, da potência e da massa muscular (hipertrofia). A substância traz esses ganhos para o treino (quando aliada a uma boa dieta e um programa de exercícios adequado, é óbvio) por estar envolvida na produção de ATP, fonte de energia usada pelos músculos em exercícios predominantemente anaeróbicos (de alta intensidade e curta duração), como musculação, saltos, arremessos de peso e corridas muito curtas.É importante saber que consumir a creatina não aumenta a massa muscular (é preciso malhar para conseguir isso). Basicamente, o que o suplemento faz é elevar a tolerância do atleta ao esforço e retardar a fadiga, permitindo que ele use cargas maiores e tenha um melhor desempenho nos exercícios —o que consequentemente vai gerar ganhos maiores. Além disso, por ser armazenada nos músculos juntamente com a água, a substância leva a um aumento do volume muscular.Como tomar creatina?Grande parte dos suplementos de creatina é em pó, com ou sem sabor. A recomendação é que a substância seja diluída em água ou bebida de preferência de quem irá consumi-la (suco, leite, vitamina etc.), conforme orientação do nutricionista. Uma dica muito comum é misturar o suplemento a uma bebida com carboidrato (suco ou bebidas esportivas). A creatina é uma substância que fornece energia para os músculos, melhorando o desempenho físico, aumentando a massa muscular e prevenindo doenças crônicas. Encontre um Nutricionista perto de você! Parceria com Buscar Médico A creatina é produzida pelos rins, pâncreas e fígado, mas também está presente em alimentos como peixe, carne, frango, leite e derivados. Além disso, a creatina também pode ser encontrada, em maiores concentrações, na forma de suplementos em cápsula ou em pó, que podem ser ingeridos antes ou depois dos treinos. Ao ingerir a creatina, é indicado também comer alimentos ou suplementos fontes de proteínas, como tofu, ovo e whey protein, e carboidratos, como banana, melancia ou maltodextrina, por exemplo. Isso porque esses nutrientes melhoram a absorção e o uso da creatina pelos músculos. Confira mais sobre todos os benefícios da creatina no vídeo a seguir: Para que serve a creatina A creatina normalmente é indicada para: 1. Aumentar a massa muscular A creatina aumenta a massa muscular, porque fornece energia para os músculos, evitando a fadiga e melhorando o desempenho físico durante os treinos, o que promove o crescimento das fibras musculares. Conheça outros suplementos que aumentam a massa muscular. 2. Melhorar a recuperação muscular A creatina melhora a recuperação muscular após os exercícios físicos, que é o período fundamental para estimular o crescimento das fibras musculares e prevenir as lesões. 3. Prevenir doenças crônicas Algumas doenças crônicas como diabetes, osteoporose e doenças cardíacas podem ser prevenidas pelo uso da creatina, quando associada a práticas regulares de atividade física e alimentação saudável. Isso porque a creatina favorece o controle dos níveis de colesterol e glicose no sangue, promove o ganho de massa muscular, além de prevenir a perda de massa óssea. 4. Prevenir a sarcopenia A creatina ajuda a melhorar a prevenir a sarcopenia, que é a perda de massa muscular que geralmente acontece m pessoas com mais de 50 anos e idosos, causando perda da força e do desempenho físico. É importante lembrar que esses benefícios com o uso da creatina são obtidos principalmente em pessoas que mantêm uma alimentação saudável e praticam regularmente exercícios físicos de resistência, como musculação, pilates ou calistenia, por exemplo. Leia também: Creatina para idosos: 6 benefícios, como tomar (e contraindicações) tuasaude.com/creatina-para-idosos 5. Ajudar no tratamento de doenças neuromusculares O uso da creatina pode ajudar no tratamento de doenças musculares, como no caso da distrofia, doença de Huntington, esclerose lateral amiotrófica, doença de Parkinson e fibromialgia, melhorando as funções cognitivas e a força muscular. No entanto, são ainda necessários mais estudos que comprovem o benefício da creatina para o tratamento das doenças neuromusculares O que é creatina monohidratada A creatina monohidratada é a forma da creatina mais usada em suplementos alimentares, por ser bem absorvida e utilizada pelo organismo. Existem outros tipos de creatina, como creatina alcalina, creatina micronizada, creatina malato e creatina etil éster. No entanto, existem poucas evidências científicas sobre os benefícios desses tipos de creatina. Como tomar creatina A creatina pode ser tomada em qualquer horário do dia, antes ou após os treinos, sozinha ou junto com outros suplementos. No entanto, para ser melhor absorvida, a creatina deve ser ingerida de preferência com um alimento ou suplemento fonte de proteínas, como tofu, ovo e whey protein, e carboidratos, como banana, melancia ou maltodextrina, por exemplo. A creatina pode ser tomada na forma de cápsulas, devendo ser ingerida com 1 copo de água ou suco, ou em pó, podendo ser diluída com água, leite ou suco, por exemplo. Consulte o nutricionista mais próximo para ter mais orientações sobre como tomar a creatina: Parceria com agende sua consulta online Disponível em: São Paulo, Rio de Janeiro, Distrito Federal, Pernambuco, Bahia, Maranhão, Pará, Paraná, Sergipe e Ceará. Esquemas para tomar creatina A forma mais comum de se tomar creatina é ingerir de 3 a 5 g por dia, durante 3 meses ou mais. Outra opção é a suplementação de creatina com sobrecarga, onde nos primeiros 7 dias é feita uma dose diária de cerca de 20 g de creatina e, em seguida, essa dose é reduzida para 3 a 5 g por dia. Veja mais detalhes sobre os esquemas de creatina. Possíveis efeitos colaterais O efeito colateral mais comum com o uso do suplemento de creatina é o ganho de peso corporal, devido ao aumento da massa muscular. Além disso, a creatina também pode causar diarreia, desconforto gástrico, dor na barriga, náuseas e cãibras em algumas pessoas. Quem não deve usar creatina Até o momento, não existem contraindicações sobre o uso dos suplementos de creatina. No entanto, os estudos sobre o uso de creatina por pessoas com problemas nos rins ainda são inconclusivos. Por isso, a suplementação com creatina deve ser feita sempre sob a orientação de um nutricionista, ou médico, que vai avaliar as necessidades nutricionais e o histórico de saúde de cada pessoa. A creatina é um suplemento popular entre praticantes de atividades físicas, porém, ela pode ser indicada para qualquer pessoa devido aos benefícios proporcionados à saúde, entre eles o aumento da força e massa muscular; efeitos positivos na função cerebral, melhorando a memória e o desempenho cognitivo; e ajuda a preservar a massa muscular e a força em idosos, contribuindo para a manutenção da mobilidade e qualidade de vida. “É importante lembrar que, embora a creatina seja segura para a maioria das pessoas, é aconselhável consultar um profissional de saúde antes de iniciar qualquer suplementação, especialmente para aqueles com condições médicas preexistentes”, alerta Lorena. Veja Também A endocrinologista Lorena Lima Amato orienta como usar a creatina para ter os benefícios citados acima: Consumo Diário: A creatina deve ser consumida diariamente, mesmo nos dias em que não houver treino. A dose ideal na fase de manutenção é entre 3g e 5g por dia. Absorção Otimizada: Para melhor absorção, recomenda-se ingerir a creatina junto com carboidratos. Isso potencializa a eficácia do suplemento. Diluição Adequada: Nunca consuma o pó de creatina diretamente na boca. É essencial diluí-lo em água para evitar irritações e possíveis danos ao esmalte dos dentes. Escolha da Marca: Opte por marcas de qualidade comprovada para garantir a eficácia e segurança do suplemento. Chemical compound Not to be confused with creatinine or keratin. Creatine Skeletal formula of neutral form of creatineSkeletal formula of neutral form of creatine Skeletal formula of one of zwitterionic forms of creatineSkeletal formula of one of the zwitterionic forms of creatine Ball and stick model of creatineBall and stick model of one zwitterionic form of creatine Names Systematic IUPAC name 2-[Carbamimidoyl(methyl)amino]acetic acid Other names N-Carbamimidoyl-N-methylglycine; Methylguanidoacetic acid; N-amidinosarcosine Identifiers CAS Number 57-00-1 Y 3D model (JSmol) Interactive image Beilstein Reference 907175 ChEBI CHEBI:16919 Y ChEMBL ChEMBL283800 Y ChemSpider 566 Y DrugBank DB00148 Y ECHA InfoCard 100.000.278 EC Number 200-306-6 Gmelin Reference 240513 KEGG C00300 Y MeSH Creatine PubChem CID 586 RTECS number MB7706000 UNII MU72812GK0 Y CompTox Dashboard (EPA) DTXSID1040451 InChI InChI=1S/C4H9N3O2/c1-7(4(5)6)2-3(8)9/h2H2,1H3,(H3,5,6)(H,8,9) YKey: CVSVTCORWBXHQV-UHFFFAOYSA-N Y SMILES CN(CC(=O)O)C(=N)N Properties Chemical formula $C_4H_9N_3O_2$ Molar mass 131.135 g·mol−1 Appearance White crystals Odor Odourless Density 1.33 g/cm3 Melting point 255 °C (491 °F; 528 K) Solubility in water 13.3 g L−1 (at 18 °C) log P −1.258 Vapor pressure 0.001 mmHg Acidity (pKa) 3.429 Basicity (pKb) 10.568 Isoelectric point 8.47 Thermochemistry Heat capacity (C) 171.1 J K−1 mol−1 (at 23.2 °C) Std molarentropy (S298) 189.5 J K−1 mol−1 Std enthalpy offormation (ΔfH298) −538.06–−536.30 kJ mol−1 Std enthalpy ofcombustion (ΔcH298) −2.3239–−2.3223 MJ mol−1 Pharmacology ATC code C01EB06 (WHO) Pharmacokinetics: Biological half-life 3 hours Hazards GHS labelling: Pictograms Signal word Warning Hazard statements H315, H319, H335 Precautionary statements P261, P305+P351+P338 NFPA 704 (fire diamond) 1 1 0 Flash point 118.1 °C (244.6 °F; 391.2 K) Autoignitiontemperature > 400 °C Lethal dose or concentration (LD, LC): LD50 (median dose) > 2000 mg/kg (dermal, rat) Safety data sheet (SDS) ChemicalBook Related compounds Related alkanoic acids SarcosineDimethylglycineGlycocyamineN-Methyl-D-aspartic acidbeta-Methylamino-L-alanineGuanidinopropionic acid Related compounds Dimethylacetamide Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). N verify (what is YN ?) Infobox references Chemical compound Creatine (/ˈkriːətiːn/ or /ˈkriːətɪn/)[1] is an organic compound with the nominal formula (H2N)(HN)CN(CH3)CH2CO2H. It exists in various tautomers in solutions (among which are neutral form and various zwitterionic forms). Creatine is found in vertebrates, where it facilitates recycling of adenosine triphosphate (ATP), primarily in muscle and brain tissue. Recycling is achieved by converting adenosine diphosphate (ADP) back to ATP via donation of phosphate groups. Creatine also acts as a buffer.[2] Creatine was first identified in 1832 when Michel Eugène Chevreul isolated it from the basified water-extract of skeletal muscle. He later named the crystallized precipitate after the Greek word for meat, κρέας (kreas). In 1928, creatine was shown to exist in equilibrium with creatinine.[3] Studies in the 1920s showed that consumption of large amounts of creatine did not result in its excretion. This result pointed to the ability of the body to store creatine, which in turn suggested its use as a dietary supplement.[4] In 1912, Harvard University researchers Otto Folin and Willey Glover Denis found evidence that ingesting creatine can dramatically boost the creatine content of the muscle.[5][6] In the late 1920s, after finding that the intramuscular stores of creatine can be increased by ingesting creatine in larger than normal amounts, scientists discovered phosphocreatine (creatine phosphate), and determined that creatine is a key player in the metabolism of skeletal muscle. It is naturally formed in vertebrates.[7] The discovery of phosphocreatine[8][9] was reported in 1927.[10][11][9] In the 1960s, the enzyme creatine kinase (CK) was shown to phosphorylate ADP using phosphocreatine (PCr) to generate ATP. It follows that ATP - not PCr - is directly consumed in muscle contraction. CK uses creatine to "buffer" the ATP/ADP ratio.[12] While creatine's influence on physical performance has been well documented since the early twentieth century, it came into public view following the 1992 Olympics in Barcelona. An August 7, 1992 article in The Times reported that Linford Christie, the gold medal winner at 100 meters, had used creatine before the Olympics (however, it should also be noted that Christie was found guilty of doping later in his career).[13] An article in Bodybuilding Monthly named Sally Gunnell, who was the gold medalist in the 400-meter hurdles, as another creatine user. In addition, The Times also noted that 100 meter hurdler Colin Jackson began taking creatine before the Olympics.[14][15] Phosphocreatine relays phosphate to ADP. At the time, low-potency creatine supplements were available in Britain, but creatine supplements designed for strength enhancement were not commercially available until 1993 when a company called Experimental and Applied Sciences (EAS) introduced the compound to the sports nutrition market under the name Phosphagen.[16] Research performed thereafter demonstrated that the consumption of high glycemic carbohydrates in conjunction with creatine increases creatine muscle stores.[17] The cyclic derivative creatinine exists in equilibrium with its tautomer and with creatine. Creatine is a naturally occurring non-protein compound and the primary constituent of phosphocreatine, which is used to regenerate ATP within the cell. 95% of the human body's total creatine and phosphocreatine stores are found in skeletal muscle, while the remainder is distributed in the blood, brain, testes, and other tissues.[18][19] The typical creatine content of skeletal muscle (as both creatine and phosphocreatine) is 120 mmol per kilogram of dry muscle mass, but can reach up to 160 mmol/kg through supplementation.[20] Approximately 1–2% of intramuscular creatine is degraded per day and an individual would need about 1–3 grams of creatine per day to maintain average (unsupplemented) creatine storage.[20][21][22] An omnivorous diet provides roughly half of this value, with the remainder synthesized in the liver and kidneys.[18][19][23] Creatine is not an essential nutrient.[24] It is an amino acid derivative, naturally produced in the human body from the amino acids glycine and arginine, with an additional requirement for S-adenosyl methionine (a derivative of methionine) to catalyze the transformation of guanidinoacetate to creatine. In the first step of the biosynthesis, the enzyme arginine:glycine amidinotransferase (AGAT, EC:2.1.4.1) mediates the reaction of glycine and arginine to form guanidinoacetate. This product is then methylated by guanidinoacetate N-methyltransferase (GAMT, EC:2.1.1.2), using S-adenosyl methionine as the methyl donor. Creatine itself can be phosphorylated by creatine kinase to form phosphocreatine, which is used as an energy buffer in skeletal muscles and the brain. A cyclic form of creatine, called creatinine, exists in equilibrium with its tautomer and with creatine. Proposed creatine kinase/phosphocreatine (CK/PCr) energy shuttle. CRT = creatine transporter; ANT = adenine nucleotide translocator; ATP = adenine triphosphate; ADP = adenine diphosphate; OP = oxidative phosphorylation; mtCK = mitochondrial creatine kinase; G = glycolysis; CK-g = creatine kinase associated with glycolytic enzymes; CK-c = cytosolic creatine kinase; CK-a = creatine kinase associated with subcellular sites of ATP utilization; 1 – 4 sites of CK/ATP interaction. Creatine is transported through the blood and taken up by tissues with high energy demands, such as the brain and skeletal muscle, through an active transport system. The concentration of ATP in skeletal muscle is usually 2–5 mM, which would result in a muscle contraction of only a few seconds.[25] During times of increased energy demands, the phosphagen (or ATP/PCr) system rapidly resynthesizes ATP from ADP with the use of phosphocreatine (PCr) through a reversible reaction catalysed by the enzyme creatine kinase (CK). The phosphate group is attached to an NH center of the creatine. In skeletal muscle, PCr concentrations may reach 20–35 mM or more. Additionally, in most muscles, the ATP regeneration capacity of CK is very high and is therefore not a limiting factor. Although the cellular concentrations of ATP are small, changes are difficult to detect because ATP is continuously and efficiently replenished from the large pools of PCr and CK.[25] A proposed representation has been illustrated by Krieder et al.[26] Creatine has the ability to increase muscle stores of PCr, potentially increasing the muscle's ability to resynthesize ATP from ADP to meet increased energy demands.[27][28][29] Creatine supplementation appears to increase the number of myonuclei that satellite cells will 'donate' to damaged muscle fibers, which increases the potential for growth of those fibers. This increase in myonuclei probably stems from creatine's ability to increase levels of the myogenic transcription factor MRF4.[30] Genetic deficiencies in the creatine biosynthetic pathway lead to various severe neurological defects.[31] Clinically, there are three distinct disorders of creatine metabolism, termed cerebral creatine deficiencies. Deficiencies in the two synthesis enzymes can cause L-arginine:glycine amidinotransferase deficiency caused by variants in GATM and guanidinoacetate methyltransferase deficiency, caused by variants in GAMT. Both biosynthetic defects are inherited in an autosomal recessive manner. A third defect, creatine transporter defect, is caused by mutations in SLC6A8 and is inherited in a X-linked manner. This condition is related to the transport of creatine into the brain.[32] Vegan and vegetarian diets are associated with lower levels of muscle creatine, and athletes on these diets may benefit from creatine supplementation.[33] Most of the research to-date on creatine has predominantly focused on the pharmacological properties of creatine, yet there is a lack of research into the pharmacokinetics of creatine. Studies have not established pharmacokinetic parameters for clinical usage of creatine such as volume of distribution, clearance, bioavailability, mean residence time, absorption rate, and half life. A clear pharmacokinetic profile would need to be established prior to optimal clinical dosing.[34] An approximation of 0.3 g/kg/day divided into 4 equal spaced intervals has been suggested since creatine needs may vary based on body weight.[26][20] It has also been shown that taking a lower dose of 3 grams a day for 28 days can also increase total muscle creatine storage to the same amount as the rapid loading dose of 20 g/day for 6 days.[20] However, a 28-day loading phase does not allow for ergogenic benefits of creatine supplementation to be realized until fully saturated muscle storage. This elevation in muscle creatine storage has been correlated with ergogenic benefits discussed in the research section. However, higher doses for longer periods of time are being studied to offset creatine synthesis deficiencies and mitigating diseases.[35][36][32] After the 5–7 day loading phase, muscle creatine stores are fully saturated and supplementation only needs to cover the amount of creatine broken down per day. This maintenance dose was originally reported to be around 2–3 g/day (or 0.03 g/kg/day),[20] however, some studies have suggested 3–5 g/day maintenance dose to maintain saturated muscle creatine.[17][22][37][38] This graph shows the mean plasma creatine concentration (measured in μmol/L) over an 8-hour period following ingestion of 4.4 grams of creatine in the form of creatine monohydrate (CrM), tri-creatine citrate (CrC), or creatine pyruvate (CrPyr).[39] Endogenous serum or plasma creatine concentrations in healthy adults are normally in a range of 2–12 mg/L. A single 5 gram (5000 mg) oral dose in healthy adults results in a peak plasma creatine level of approximately 120 mg/L at 1–2 hours post-ingestion. Creatine has a fairly short elimination half life, averaging just less than 3 hours, so to maintain an elevated plasma level it would be necessary to take small oral doses every 3–6 hours throughout the day. Creatine supplements are marketed in ethyl ester, gluconate, monohydrate, and nitrate forms.[40] Creatine supplementation for sporting performance enhancement is considered safe for short-term use but there is a lack of safety data for long term use, or for use in children and adolescents.[41] According to a 2018 review article in the Journal of the International Society of Sports Nutrition creatine monohydrate is the most effective nutritional supplement to increase high intensity exercise capacity and muscle mass during training.[42] Creatine use can increase maximum power and performance in high-intensity anaerobic repetitive work (periods of work and rest) by 5% to 15%.[43][44][45] Creatine supplementation exerts positive ergogenic effects on single and multiple bouts of short-duration, high-intensity exercise activities, in addition to potentiating exercise training adaptations.[46] Creatine has no significant effect on aerobic endurance.[47][obsolete source][48][obsolete source] A 2014 survey of 21,000 college athletes showed that 14% of athletes take creatine supplements.[49] Creatine is sometimes reported to have a beneficial effect on brain function and cognitive processing, although the evidence is difficult to interpret systematically and the appropriate dosing is unknown.[50][51] The greatest effect appears to be in individuals who are stressed (due, for instance, to sleep deprivation) or cognitively impaired.[50][51][52] A 2018 systematic review found that "generally, there was evidence that short term memory and intelligence/reasoning may be improved by creatine administration", whereas for other cognitive domains "the results were conflicting".[53] Another 2023 review initially found evidence of improved memory function.[54] However, it was later determined that faulty statistics lead to the statistical significance and after fixing the "double counting", the effect was only significant in older adults.[55] A 2023 review study "...supported claims that creatine supplementation can increases [sic] brain creatine content but also demonstrated somewhat equivocal results for effects on cognition. It does, however, provide evidence to suggest that more research is required with stressed populations, as supplementation does appear to significantly affect brain content.[56] A meta-analysis found that creatine treatment increased muscle strength in muscular dystrophies, and potentially improved functional performance.[57] Creatine treatment does not appear to improve muscle strength in people who have metabolic myopathies.[57] High doses of creatine lead to increased muscle pain and an impairment in activities of daily living when taken by people who have McArdle disease.[57] According to a clinical study focusing on people with various muscular dystrophies, using a pure form of creatine monohydrate can be beneficial in rehabilitation after injuries and immobilization.[58] Creatine's impact on mitochondrial function has led to research on its efficacy and safety for slowing Parkinson's disease. As of 2014, the evidence did not provide a reliable foundation for treatment decisions, due to risk of bias, small sample sizes, and the short duration of trials.[59] Several primary studies[60][61][62] have been completed but no systematic review on Huntington's disease has been completed yet. It is ineffective as a treatment for amyotrophic lateral sclerosis.[63] A 2021 systemic review of studies found that "the current body of evidence does not indicate that creatine supplementation increases total testosterone, free testosterone, DHT or causes hair loss/baldness".[64] Side effects include:[65][66] Weight gain due to extra water retention to the muscle Potential muscle cramps / strains / pulls Upset stomach Diarrhea Dizziness One well-documented effect of creatine supplementation is weight gain within the first week of the supplement schedule, likely attributable to greater water retention due to the increased muscle creatine concentrations by means of osmosis.[67] A 2009 systematic review discredited concerns that creatine supplementation could affect hydration status and heat tolerance and lead to muscle cramping and diarrhea.[68][69] Despite weight gain due to water retention and potential cramps being two seemingly "common" side effects, new research indicates that these side effects are likely not the result of creatine usage. In addition, the initial water retention is attributed to more short-term creatine use (the "loading" phase). Studies have shown that creatine usage does not necessarily affect total body water relative to muscle mass in the long-term.[70] A 2019 systematic review published by the National Kidney Foundation investigated whether creatine supplementation had adverse effects on renal function.[71] They identified 15 studies from 1997 to 2013 that looked at standard creatine loading and maintenance protocols of 4–20 g/day of creatine versus placebo. They utilized serum creatinine, creatinine clearance, and serum urea levels as a measure of renal damage. While in general creatine supplementation resulted in slightly elevated creatinine levels that remained within normal limits, supplementation did not induce renal damage (P value< 0.001). Special populations included in the 2019 Systematic review included type 2 diabetic patients[72] and post-menopausal women,[73] bodybuilders,[74] athletes,[75] and resistance trained populations.[76][77][78] The study also discussed 3 case studies where there were reports that creatine affected renal function.[79][80][81] In a joint statement between the American College of Sports Medicine, Academy of Nutrition and Dietetics, and Dietitians in Canada on performance enhancing nutrition strategies, creatine was included in their list of ergogenic aids and they do not list renal function as a concern for use.[82] The most recent position stand on creatine from the Journal of International Society of Sports Nutrition states that creatine is safe to take in healthy populations from infants to the elderly to performance athletes. They also state that long term (5 years) use of creatine has been considered safe.[26] It is important to mention that kidneys themselves, for normal physiological function, need phosphocreatine and creatine and indeed kidneys express significant amounts of creatine kinases (BB-CK and u-mtCK isoenzymes).[83] At the same time, the first of two steps for endogenous creatine synthesis takes place in the kidneys themselves. Patients with kidney disease and those undergoing dialysis treatment generally show significantly lower levels of creatine in their organs, since the pathological kidneys are both hampered in creatine synthesis capability and are in back-resorption of creatine from the urine in the distal tubules. In addition, dialysis patients lose creatine due to wash out by the dialysis treatment itself and thus become chronically creatine depleted. This situation is exacerbated by the fact that dialysis patients generally consume less meat and fish, the alimentary sources of creatine. Therefore, to alleviate chronic creatine depletion in these patients and allow organs to replenish their stores of creatine, it was proposed in a 2017 article in Medical Hypotheses to supplement dialysis patients with extra creatine, preferably by intra-dialytic administration. Such a supplementation with creatine in dialysis patients is expected to significantly improve the health and quality of the patients by improving muscle strength, coordination of movement, brain function and to alleviate depression and chronic fatigue that are common in these patients.[84][unreliable medical source?] A 2011 survey of 33 supplements commercially available in Italy found that over 50% of them exceeded the European Food Safety Authority recommendations in at least one contaminant. The most prevalent of these contaminants was creatinine, a breakdown product of creatine also produced by the body.[85] Creatinine was present in higher concentrations than the European Food Safety Authority recommendations in 44% of the samples. About 15% of the samples had detectable levels of dihydro-1,3,5-triazine or a high dicyandiamide concentration. Heavy metals contamination was not found to be a concern, with only minor levels of mercury being detectable. Two studies reviewed in 2007 found no impurities.[86] When creatine is mixed with protein and sugar at high temperatures (above 148 °C), the resulting reaction produces carcinogenic heterocyclic amines (HCAs).[87] Such a reaction happens when grilling or pan-frying meat.[88] Creatine content (as a percentage of crude protein) can be used as an indicator of meat quality.[89] Creatine-monohydrate is suitable for vegetarians and vegans, as the raw materials used for the production of the supplement have no animal origin.[90] Beta-Alanine Creatine methyl ester ^ Stout JR, Antonio J, Kalman E, eds. (2008). Essentials of Creatine in Sports and Health. Humana. ISBN 978-1-59745-573-2. ^ Barcelos RP, Stefanello ST, Mauriz JL, Gonzalez-Gallego J, Soares FA (2016). "Creatine and the Liver: Metabolism and Possible Interactions". Mini Reviews in Medicinal Chemistry. 16 (1): 12–8. doi:10.2174/1389557515666150722102613. PMID 26202197. 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Synthesis predominately occurs in the liver, kidneys, and to a lesser extent in the pancreas. The remainder of the creatine available to the body is obtained through the diet at about 1 g/d for an omnivorous diet. 95% of the bodies creatine stores are found in the skeletal muscle and the remaining 5% is distributed in the brain, liver, kidney, and testes [1]. ^ a b Brosnan ME, Brosnan JT (August 2016). "The role of dietary creatine". Amino Acids. 48 (8): 1785–91. doi:10.1007/s00726-016-2188-1. PMID 26874700. S2CID 3700484. The daily requirement of a 70-kg male for creatine is about 2 g; up to half of this may be obtained from a typical omnivorous diet, with the remainder being synthesized in the body ... More than 90% of the body's creatine and phosphocreatine is present in muscle (Brosnan and Brosnan 2007), with some of the remainder being found in the brain (Braissant et al. 2011). ... 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For the river, see Vedița River. 1,3,5-Triazine 1,3,5-Triazine 1,3,5-Triazine Names Preferred IUPAC name 1,3,5-Triazine[1] Other names sym-Triazines-TriazineCyanidineHydrogen cyanide trimerVedita Identifiers CAS Number 290-87-9 Y 3D model (JSmol) Interactive image ChEBI CHEBI:30259 Y ChEMBL ChEMBL15698 Y ChemSpider 8905 Y ECHA InfoCard 100.005.481 EC Number 206-028-1 PubChem CID 9262 RTECS number XY2957000 UNII 8B5F4CM81E Y CompTox Dashboard (EPA) DTXSID7052785 InChI InChI=1S/C3H3N3/c1-4-2-6-3-5-1/h1-3H YKey: JIHQDMXYYFUGFV-UHFFFAOYSA-N YInChI=1/C3H3N3/c1-4-2-6-3-5-1/h1-3HKey: JIHQDMXYYFUGFV-UHFFFAOYAG SMILES n1cncnc1 Properties Chemical formula C3H3N3 Molar mass 81.08 g/mol Appearance White crystalline solid Melting point 81 to 83 °C (178 to 181 °F; 354 to 356 K) Structure Molecular shape planar Dipole moment zero Hazards Occupational safety and health (OHS/OSH): Main hazards Sensitive to water GHS labelling: Pictograms Signal word Danger Hazard statements H302, H314, H315, H335, H360 Precautionary statements P201, P202, P260, P261, P264, P270, P271, P280, P281, P301+P312, P301+P330+P331, P302+P352, P303+P361+P353, P304+P340, P305+P351+P338, P308+P313, P310, P312, P321, P330, P332+P313, P362, P363, P403+P233, P405, P501 Related compounds Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). Y verify (what is YN ?) Infobox references Chemical compound 1,3,5-Triazine, also called s-triazine, is an organic chemical compound with the formula (HCN)3. It is a six-membered heterocyclic aromatic ring, one of several isomeric triazines. s-Triazine —the "symmetric" isomer—and its derivatives are useful in a variety of applications. Symmetrical 1,3,5-triazines are prepared by trimerization of certain nitriles such as cyanogen chloride or cyanamide. Benzoguanamine (with one phenyl and 2 amino substituents) is synthesised from benzonitrile and dicyandiamide.[2] In the Pinner triazine synthesis (named after Adolf Pinner)[3] the reactants are an alkyl or aryl amidine and phosgene.[4][5] Insertion of an N-H moiety into a hydrazide by a copper carbenoid, followed by treatment with ammonium chloride also gives the triazine core.[6] Amine-substituted triazines called Guanamines are prepared by the condensation of cyanoguanidine with the corresponding nitrile:[7] (H2N)2C=NCN + RCN → (CNH2)2(CR)N3 As a reagent in organic synthesis, s-triazine is used as the equivalent of hydrogen cyanide (HCN). Being a solid (vs a gas for HCN), triazine is sometimes easier to handle in the laboratory. One application is in the Gattermann reaction, used to attach the formyl group to aromatic substrates.[8] N- and C-substituted triazines are used industrially. The most common derivative of 1,3,5-triazine is 1,3,5-triazine-2,4,6-triamine, commonly known as melamine or cyanuramide. Another important derivative is 1,3,5-triazine-2,4,6-triol better known as cyanuric acid. Cyanuric chloride (2,4,6-trichloro-1,3,5-triazine) is the starting point for the manufacture of many herbicides such as Simazine and atrazine. Chlorinated triazines are the basis of an important family of reactive dyes, which are covalently attached to cellulosic materials.[9] Methods for attaching reactive dyes to fibres (Cell = cellulose; R = chromophore). Triazines are also found in pharmaceutical products.[10] ^ Nomenclature of Organic Chemistry : IUPAC Recommendations and Preferred Names 2013 (Blue Book). Cambridge: The Royal Society of Chemistry. 2014. p. 147. doi:10.1039/9781849733069-FP001. ISBN 978-0-85404-182-4. ^ Benzoguanamine J. K. Simons and M. R. Saxton Organic Syntheses Coll. Vol. 4, p.78; Vol. 33, p.13 Article Archived 2012-07-16 at the Wayback Machine ^ A. 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View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Creatine (links | edit) Melamine (links | edit) Photosystem II (links | edit) Simple aromatic ring (links | edit) Triazine (links | edit) 1,3,5-triazine (redirect page) (links | edit) Trimer (chemistry) (links | edit) Atrazine (links | edit) Triazine (links | edit) Cyanuric chloride (links | edit) Polyamine (links | edit) Cyanuric triazide (links | edit) S-Triazine (redirect page) (links | edit) S-triazine (redirect page) (links | edit) Pesticide degradation (links | edit) 5-Aza-7-deazapurine (links | edit) 2,4,6-Tris(trinitromethyl)-1,3,5-triazine (links | edit) Nitrogen and Non-Protein Nitrogen's effects on Agriculture (links | edit) Melamine cyanurate (links | edit) Hydrogen cyanide trimer (redirect page) (links | edit) Vedita (redirect page) (links | edit) 1,3,5-Triazine (transclusion) (links | edit) Sym-triazine (redirect page) (links | edit) Cyanide trimer (redirect page) (links | edit) Talk:1,3,5-Triazine (transclusion) (links | edit) User:CleanupListingBot/Test Reports/WikiProject Chemistry (links | edit) User:Leyo/InfoCard/0–K (links | edit) User talk:H Padleckas/Archive 2 (links | edit) Wikipedia:WikiProject Chemicals/Organization (links | edit) Wikipedia:WikiProject Chemicals/AlphabeticalList (links | edit) Wikipedia:WikiProject Chemicals/Cleanup listing (links | edit) Wikipedia:WikiProject Chemicals/Log/2009-11-28 (links | edit) Wikipedia:WikiProject Chemicals/Log/2010-10-03 (links | edit) Wikipedia:WikiProject Chemicals/Log/2011-01-20 (links | edit) Wikipedia:WikiProject Chemicals/Log/2011-08-05 (links | edit) Wikipedia:WikiProject Chemicals/Log/2011-10-19 (links | edit) Wikipedia:WikiProject Chemistry/Lists of pages/Chembox articles (links | edit) Wikipedia:Chemical infobox/Wikipedia:WikiProject Chemistry and Template:Chembox articles (links | edit) Wikipedia talk:WikiProject Chemicals/Archive 2005 (links | edit) View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500) Retrieved from " WhatLinksHere/1,3,5-Triazine" A creatina é uma molécula que faz parte do sistema fosfagênico para a produção de energia (ATP) nas células. Este sistema é usado para gerar energia de forma rápida, por exemplo, fornecendo a energia necessária aos músculos durante levantamento de peso ou corrida. As principais fontes dietéticas são alimentos ricos em proteínas, incluindo carne, peixe e aves. Uma vez sintetizada ou ingerida, a creatina é transferida do plasma através da parede intestinal para outros tecidos por transportadores específicos de creatina localizados nos músculos esqueléticos, rins, coração, fígado e cérebro. Uma vez ingerida, a creatina atravessa a parede intestinal e chega a tecidos como músculos esqueléticos, rins, coração, fígado e cérebro.Conforme envelhecemos, produzimos menos creatina. Além disso, quem nao consome ou ingere poucos alimentos de origem animal beneficia-se mais da suplementação. A forma mais estudada é a creatina monohidratada. Composta por 88% de creatina e 12% de água, ela pode ser encontrada no formato de pó solúvel em água. Seus benefícios incluem:1) Melhoria da saúde óssea. Os mecanismos são o aumento da atividade das células osteoclásticas para formação óssea e redução da reabsorção óssea, melhorando a densidade óssea e prevenindo a osteopenia e osteoporose (Candow et al., 2022).2) Fornecimento de energia para o cérebro de forma mais rápida. As células cerebrais também usam a creatina para reciclar ADP em ATP de forma mais rápida. Estudos mostram que a suplementação de creatina por 28 dias aumenta o conteúdo deste composto em 14,6% no cérebro. Estes aumentos na creatina cerebral podem traduzir-se em melhorias no comportamento e na cognição, particularmente sob condições estressantes. A creatina também ajuda a regular o humor, tratar a depressão leve, melhorar a memória e o foco, reduzir a fadiga mental (Candow et al., 2023).3) Melhoria da recuperação após lesão, concussão, AVC. Os danos após lesão cerebral traumática (LCT) geram deficiências da função mitocondrial e aumento do estresse oxidativo, além de neuroinflamação acentuada. A creatina ajuda a melhorar a bionergética cerebral, reduzir lactato, aprimorar a função cerebrovascular e proteger o cérebro (Erdman, 2011). 4) Melhoria na qualidade do sono. Um estudo mostrou que homens jovens que receberam suplementos de creatina antes de experimentarem 36 horas de privação de sono tiveram melhor desempenho num teste de funcionamento executivo do que indivíduos não suplementados (McMorris et al., 2006). 5) Aumenta a massa muscular pelo aumento da atividade das células satélites, e fatores de crescimento (como IGF1), proteínas quinases, mtorc e fatores de transcrição miogênicos (Wu et al., 2022). 6) Aumenta a potência muscular. A creatina aumenta a hidratação dos músculos, melhorando seu funcionamento, sendo recomendada para ganho de força e também prevenção da perda muscular durante dietas de emagrecimento, no processo de envelhecimento e na menopausa.