NMN

Muscle and Antioxidant Support

Nicotinamide mononucleotide (NMN) is a nucleotide that can be converted into nicotinamide adenine dinucleotide (NAD+) in human cells.[1] NAD+ is a metabolic redox coenzyme that facilitates an array of enzymatic reactions such as gene expression and DNA repair.[2] The aging process naturally depletes NAD+ levels in the body and is associated with oxidative stress, cognitive impairment, reduced energy production, and inflammation.[3] Administering one of the key active precursors to NAD+ in the form of NMN can possibly protect against age-associated diseases by increasing NAD+ levels.[4]

NMN is made from nicotinamide, a water-soluble vitamin B3.[5] It can also be synthesized from nicotinamide riboside, another NAD+ intermediate, via the NR-kinase–mediated phosphorylation reaction.[6] It exists in α and β anomeric forms, with the β isoform being more metabolically active and better suited for supplementation.[7] NMN is also found in a variety of vegetables and fruits such as cabbage, cucumber, broccoli, tomato, mushroom, and avocado.[8] Within the body, NMN can be found in blood, urine, and the placenta.[9]

Most recently, β-NMN has been sought after as an antiaging product.[10] Preclinical studies now reveal that NMN can be used to treat a variety of age-related diseases like type 2 diabetes, Alzheimer's disease, obesity, heart failure, and other cardiomyopathies.[11] For instance, animal models with age-induced type 2 diabetes experienced a three-fold increase in NAD+ levels after NMN administration.[12] Mice showed increased insulin secretion, increased insulin sensitivity, and an improved lipid profile after treatment.[13] Beyond this, other animal studies have found NMN supplementation to promote SIRT1 or sirtuin-1 gene activation.[14] This then helps restore circadian rhythm and inflammatory responses, improve hepatic insulin sensitivity, and reduce oxidative stress.[15] SIRT1 activity is especially helpful in protecting the kidneys from age-related degeneration, lack of blood flow, and from chemotherapeutic agents like cisplatin.[16]

NMN supplementation in mice has also been shown to improve cardiovascular health by restoring maximum carotid artery endothelium-dependent dilation and nitric-oxide–mediated carotid-artery dilation.[17] In the process, it is also able to suppress aging-induced weight gain. [18] Furthermore, rat models of Alzheimer's disease have seen improvement with the use of NMN.[19] It protects neurons from cell death after ischemia or intracerebral hemorrhage while also improving cognition and memory.[20]

In human trials, β-NMN has been shown to improve insulin sensitivity, aerobic capacity, antioxidant status, fatigue, and arterial stiffness (see table next page). The dosages most commonly used in the scientific literature range anywhere from 100 mg/d to 1,250 mg/d.[21] Clinical and toxicological studies have shown that NMN supplements are largely well-tolerated and safe for consumption, after assessing a variety of clinical symptoms and objective parameters.[22] Nevertheless, studies analysing the safety of long-term NMN administration have yet to be conducted.[23]

To summarize, β-nicotinamide mononucleotide is one of the two intermediates of NAD+ biosynthesis.[24] It helps combat mitochondrial decay by increasing NAD+ levels in the body.[25] This provides an array of therapeutic effects, as documented in both clinical and preclinical research, for enhancement in insulin secretion as well as improvement in cognition.[26], [27]

Human trials of Beta NMN

Study Design	Outcomes	Réf.
Insulin Sensitivity		
25 postmenopausal, prediabetic women who were overweight or obese enlisted in this study. Subjects were randomized to receive NMN supplementation (250 mg/d) or a placebo, for 10 weeks.	After 10 weeks of treatment, NMN-supplemented subjects experienced an up-regulation in the expression of genes related to muscle remodelling including platelet-derived growth factor receptor-β. NMN increased muscle insulin sensitivity as well as insulin signalling and remodelling.	[28]
Antioxidant Status and Safety		
80 middle-aged adults were randomized to receive NMN or a placebo in doses of either 300 mg/d, 600 mg/d, or 900 mg/d, for 60 days.	NAD concentrations in the blood were increased in all treated subjects at days 30 and 60 of the trial. Subjects receiving doses of 600 mg/d and 900 mg/d experienced the highest serum amounts of NAD, an antioxidant. In addition, treated subjects had the longest walking distances as assessed during the six-minute walking test at both 30 and 60 days ($p < 0.01$).	[29]
In this randomized, double-blind controlled trial, 31 healthy adults were administered 1,250 mg of β-NMN or a placebo once daily, for 4 weeks.	Hematologic tests did not show any statistical differences between groups during the oral administration period, but β-NMN was shown to be safe and well-tolerated. No adverse events were reported.	[30]
32 overweight/obese adults were randomized to receive 1,000 mg of a β-NMN formulation once or twice daily or a placebo, for 14 days.	β-NMN supplementation was safe and well-tolerated. Both once-daily and twice-daily treatment doses were associated with substantial dose-related increases in blood NAD levels.	[31]
Aerobic Capacity and Performance		
48 young and middle-aged trained runners were randomized to receive supplementation with 300 mg/d, 600 mg/d, or 1,200mg/d of NMN. Runners underwent cardiopulmonary exercise testing at baseline and after 6 weeks of treatment.	Subjects receiving 600 mg/d or 1,200 mg/d of NMN demonstrated that oxygen uptake, power at first and second ventilatory threshold, and percentages of maximum oxygen uptake were higher compared to the control group. Thus, NMN increases aerobic capacity during exercise training.	[32]
Fatigue		
108 older adults were randomly provided with 250 mg/d of NMN or a placebo, for 12 weeks, at differing points in the day.	Groups receiving NMN in the afternoon demonstrated the largest effect size in a 5-time sit-to-stand test assessing fatigue and drowsiness. Overall, NMN supplementation effectively improves lower-limb function and reduces the feeling of sleepiness in older adults.	[33]
Arterial Stiffness		
36 middle-aged study participants were provided with 125 mg of NMN or a placebo twice daily, over the course of 12 weeks.	Nicotinamide levels were significantly higher in the group receiving NMN compared to the group receiving placebo. In addition, pulse-wave velocity values decreased in the NMN group, which demonstrates reduced arterial stiffness.	[34]

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Each vegetable capsule contains:

NMN (Nicotinamide mononucleotide) . . . . . 300 mg

Nonmedicinal ingredients: Microcrystalline cellulose, vegetable magnesium stearate, and silicon dioxide in a non-GMO vegetable capsule composed of vegetable carbohydrate gum and purified water.

Directions of use: **Adults:** Take 1 capsule daily or as directed by your health care practitioner.

Duration of use: Consult a health-care practitioner for use beyond 6 weeks.

Cautions and warnings: Consult a health-care practitioner prior to use if you have diabetes.

Contraindications: Do not use this product if you are pregnant or breast-feeding.

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