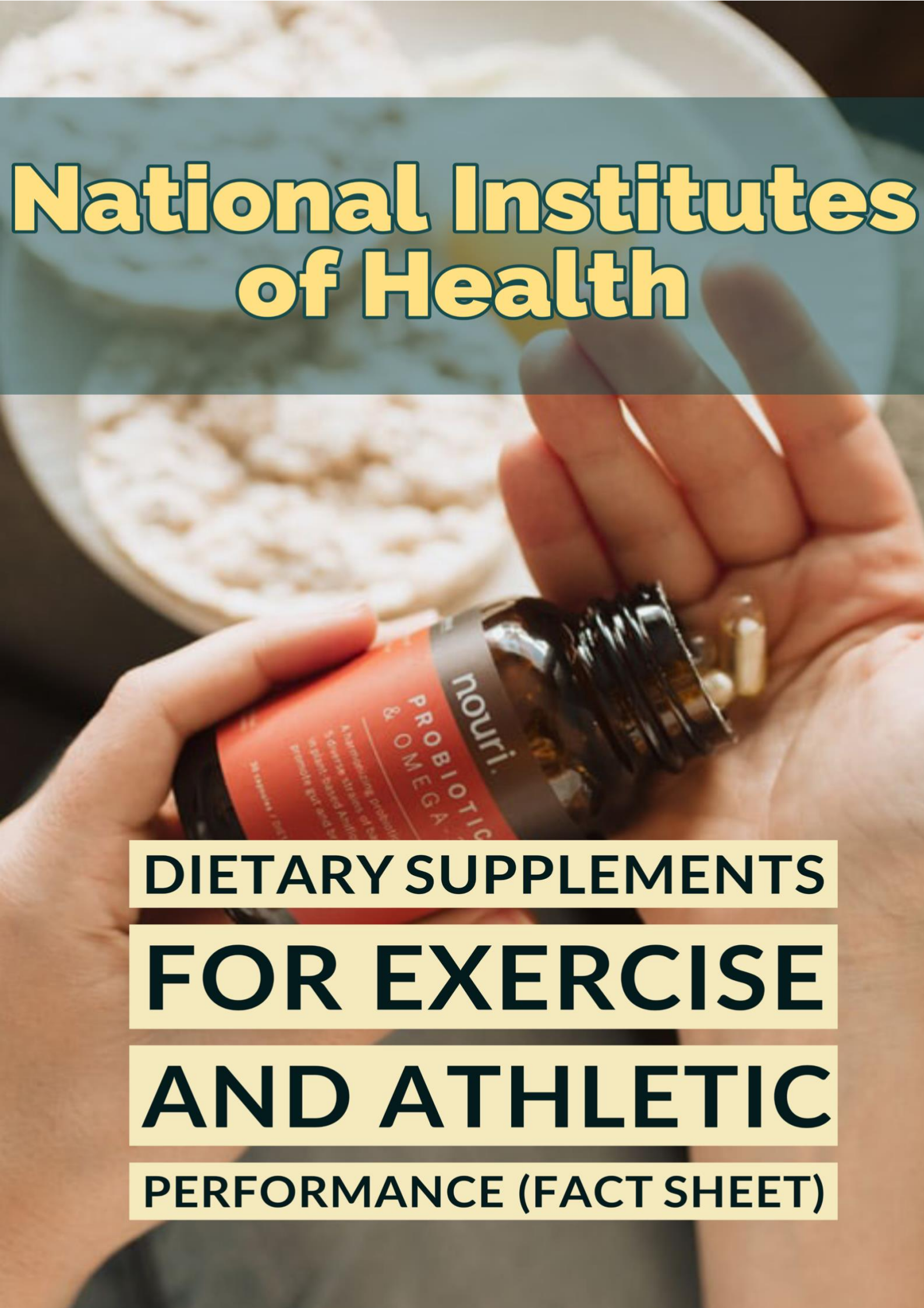
National Institutes of Health
nouri.
PROBIOTIC
& OMEGA
DIETARY SUPPLEMENTS
FOR EXERCISE
AND ATHLETIC
PERFORMANCE (FACT SHEET)

Ingredients in Dietary Supplements for Exercise and Athletic Performance			
Ingredient	**Proposed Mechanism of Action**	**Evidence of Efficacy**	**Evidence of Safety**
Antioxidants (vitamin C, vitamin E, and coenzyme Q_{10})	Minimize free-radical damage to skeletal muscle, thereby reducing muscle fatigue, inflammation, and soreness	Several small clinical trials **Research findings**: Do not directly improve performance; appear to hinder some physiological and physical exercise-induced adaptations	Safe at recommended intakes; some safety concerns reported with high doses
Arginine	Increases blood flow and delivery of oxygen and nutrients to skeletal muscle; serves as a substrate for creatine production; increases secretion of human growth hormone to stimulate muscle growth	Limited clinical trials with conflicting results **Research findings**: Little to no effect on vasodilation, blood flow, or exercise metabolites; little evidence of increases in muscle creatine content	No safety concerns reported for use of up to 9 g/day for weeks; adverse effects possible with larger doses
Beetroot or beet juice	Dilates blood vessels in exercising muscle, reduces oxygen use, and improves energy production	Limited clinical trials with conflicting results **Research findings**: Might improve performance and endurance to some degree in time trials and time-to-exhaustion tests among runners, swimmers, rowers, and cyclists; appears to be most effective in recreationally active non-athletes	No safety concerns reported for short-term use at commonly recommended amounts (approximately 2 cups)
Beta-alanine	Increases synthesis of carnosine, a dipeptide that buffers changes in muscle pH, thereby reducing muscle fatigue and loss of force production; considerable individual variation in associated muscle carnosine synthesis	Numerous clinical trials with conflicting results **Research findings**: Inconsistent effects on performance in competitive events requiring high-intensity effort over a short period, such as team sports; little or no performance benefit in activities lasting more than 10 minutes	No safety concerns reported for use of 1.6–6.4 g/day for up to 8 weeks **Reported adverse effects**: Paraesthesia (tingling) in face, neck, back of hands, and upper trunk with at least 800 mg or over 10 mg/kg body mass; pruritus (itchy skin)

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Beta-hydroxy-beta-methylbutyrate (HMB)	Helps stressed and damaged skeletal muscle cells restore their structure and function	Numerous clinical trials with conflicting results **Research findings**: Might help speed up recovery from exercise of sufficient amount and intensity to induce skeletal muscle damage	No safety concerns reported for typical dose of 3 g/day for up to 2 months
Betaine	Might increase creatine production, blood nitric-acid levels, or water retention in cells	Limited clinical trials in men with conflicting results **Research findings**: Potential but modest strength and power-based performance improvements in bodybuilders and cyclists	No safety concerns reported for 2–5 g/day for up to 15 days
Branched-chain amino acids (leucine, isoleucine, and valine)	Can be metabolised by mitochondria in skeletal muscle to provide energy during exercise	Limited number of short-term clinical trials **Research findings**: Little evidence of improved performance in endurance-related aerobic events; possibility of greater gains in muscle mass and strength during training	No safety concerns reported for 20 g/day or less for up to 6 weeks
Caffeine	Blocks activity of the neuromodulator adenosine; reduces perceived pain and exertion	Numerous clinical trials with mostly consistent results **Research findings**: Might enhance performance in endurance-type activities (e.g., running) and intermittent, long-duration activities (e.g., soccer) when taken before activity	Reasonably safe at up to 400–500 mg/day for adults **Reported adverse effects**: Insomnia, restlessness, nausea, vomiting, tachycardia, and arrhythmia; risk of death with acute oral dose of approximately 10–14 g pure caffeine (150–200 mg/kg)
Citrulline	Dilates blood vessels to increase delivery of oxygen and nutrients to skeletal muscle	Few clinical trials with conflicting results	Few safety concerns reported for up to 9 g for 1 day or 6 g/day for up to

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		Research findings: Little research support for use to enhance performance	16 days **Reported adverse effects**: Gastrointestinal discomfort
Creatine	Helps supply muscles with energy for short-term, predominantly anaerobic activity	Numerous clinical trials generally showing a benefit for high-intensity, intermittent activity; potential variation in individual responses **Research findings**: May increase strength, power, and work from maximal effort muscle contractions; over time helps body adapt to athlete-training regimens; of little value for endurance sports	Few safety concerns reported at typical dose (e.g., loading dose of 20 g/day for up to 7 days and 3–5 g/day for up to 12 weeks) **Reported adverse effects**: Weight gain due to water retention; anecdotal reports of nausea, diarrhea, muscle cramps, muscle stiffness, heat intolerance
Deer antler velvet	Contains growth factors (such as insulin-like growth factor-1 [IGF-1]) that could promote muscle tissue growth	Few short-term clinical trials that show no benefit for physical performance **Research findings**: No evidence for improving aerobic or anaerobic performance, muscular strength, or endurance	Safety not well studied **Reported adverse effects**: Hypoglycemia, headache, edema, and joint pain (from prescription IGF-1); banned in professional athletic competition
Dehydroepiandrosterone (DHEA)	Steroid hormone that can be converted into testosterone and estradiol	Small number of clinical trials that show no benefit for physical performance **Research findings**: No evidence of increases in strength, aerobic capacity, lean body mass, or testosterone levels in men	Safety not well studied; no safety concerns reported for up to 150 mg/day for 6–12 weeks **Reported adverse effects**: Over several months, raises testosterone

Ingredients in Dietary Supplements for Exercise and Athletic Performance			
Ingredient	**Proposed Mechanism of Action**	**Evidence of Efficacy**	**Evidence of Safety**
			levels in women, which can cause acne and growth of facial hair
Ginseng	Unknown mechanism of action; *Panax* ginseng used in traditional Chinese medicine as a tonic for stamina and vitality; Siberian ginseng used to reduce fatigue	Numerous small clinical trials, most showing no benefit for physical performance **Research findings**: In various doses and types of preparations, no effects on peak power output, time to exhaustion, perceived exertion, recovery from intense activity, oxygen consumption, or heart rate	Few safety concerns reported with short-term use **Reported adverse effects**: For *Panax* ginseng: headache, sleep disturbances, and gastrointestinal disorders; for Siberian ginseng: none known
Glutamine	Involved in metabolism and energy production; contributes nitrogen for many critical biochemical reactions	Few studies of use to enhance performance directly **Research findings**: In adult weight lifters, no effect on muscle performance, body composition, or muscle-protein degradation; may help with recovery of muscle strength and reduce muscle soreness after exercise	No safety concerns reported with about 45 g/day for 6 weeks; safe use of up to 0.42 g/kg body weight (e.g., 30 g/day in a person weighing 154 lb) by many patients with serious conditions (e.g., infections, intestinal diseases, and burns) **Reported adverse effects**: None known
Iron	Increases oxygen uptake, reduces heart rate, and decreases lactate concentrations during exercise	Numerous clinical trials with conflicting results **Research findings**: Improved work capacity with correction of iron deficiency anemia; conflicting evidence on whether milder iron deficiency without anemia impairs exercise performance	No safety concerns reported for use at recommended intakes (8 mg/day for healthy men and postmenopausal women and 18 mg/day for healthy premenopausal women)

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			Reported adverse effects: Gastric upset, constipation, nausea, abdominal pain, vomiting, and fainting at intakes above 45 mg/day
Protein	Builds, maintains, and repairs muscle	Numerous clinical trials **Research findings**: Optimizes muscle training response during exercise and subsequent recovery period	No safety concerns reported at daily recommended intakes for athletes of up to about 2.0 g/kg body weight (e.g., 136 g for a person weighing 150 lb) **Reported adverse effects**: None known
Quercetin	Increases mitochondria in muscle, reduces oxidative stress, decreases inflammation, and improves blood flow	Numerous small, short-term clinical trials **Research findings**: Little to no effect on endurance performance or maximal oxygen consumption	No safety concerns reported for 1,000 mg/day or less for up to 8 weeks **Reported adverse effects**: None known
Ribose	Involved in production of adenosine triphosphate (ATP)	A few small, short-term, clinical trials **Research findings**: Little to no effect on exercise capacity in both trained and untrained adults	Safety as a dietary supplement not well studied; no safety concerns reported for up to 10 g/day for 8 weeks **Reported adverse effects**: None known
Sodium bicarbonate	Enhances disposal of hydrogen ions generated from intense muscle activity,	Many small, short-term clinical trials	No safety concerns reported for short-term use of up to 300 mg/kg

Ingredients in Dietary Supplements for Exercise and Athletic Performance			
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	thereby reducing metabolic acidosis and resulting fatigue	**Research findings**: Might provide minor to moderate performance benefit for short-term and intermittent high-intensity activity, especially in trained athletes	body weight **Reported adverse effects**: Nausea, stomach pain, diarrhoea, and vomiting
Tart or sour cherry	Phytochemicals in tart cherries may facilitate exercise recovery by reducing pain and inflammation	A few clinical trials with conflicting results **Research findings**: Variable results for aiding muscle strength recovery, reducing soreness, or reducing inflammatory effects on lungs after exercise; insufficient research on ability to improve aerobic performance	No safety concerns reported for about 1/2 quart of juice or 480 mg freeze-dried Montmorency tart-cherry-skin powder per day for up to 2 weeks **Reported adverse effects**: None known
Tribulus terrestris	Increases serum testosterone and luteinizing hormone concentrations, thereby promoting skeletal muscle hypertrophy	A few small, short-term clinical trials **Research findings**: No effect on strength, lean body mass, or sex hormone levels	Safety not well studied; no safety concerns reported at up to 3.21 mg/kg/day for 8 weeks **Reported adverse effects**: One case report of harm from product labeled but not confirmed to contain *Tribulus terrestris*