DIETARY SUPPLEMENTS IN SPORT PERFORMANCE

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 Unverified

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 Altitude

Supplement	Fuel usage	Cardiovascular performance		Muscular performance		Neural performance		Hydration		Recovery						Weight and body composition		Special populations
										Short-term		Long-term						
		Maximal aerobic capacity: Speed	Improving aerobic capacity: Endurance	Strength and power	Endurance	Focus and cognition	Motivation and motor	Fluid balance	Electrolyte balance	Rehydration	Glycogen repletion	Joint, tendon, bone, and muscle health	Immunity	Endocrine support	Antioxidant protection	Muscle preservation and hypertrophy	Fat loss	
Acai berry															?			
Acetylcysteine		?			?										?			▲
Adenosine triphosphate (ATP)	?			?														
Agmatine							?					?						
Alpha-GPC				?		?	?							?				
Alpha-lipoic acid															?			●
Apple cider vinegar																	?	🥣
Arachidonic acid					?													
Arginine		?	?	?	?													⚧ 💼
Aspartates			?															
Astaxanthin															?			
Astragalus													?					
Avocado soybean unsaponifiables												?						⚧ ♀ 💼
Bacopa monnieri						?												🥣
Beetroot		✔	✔		?	?	?								?			♀ 🥣 ▲
Berberine																	!	🥣
Beta-alanine					✔	?	?											♀ 🥣 ▲
Beta-carotene															!			
Beta glucan												?	✔					
Betaine								?									?	
Boron (B)												?						⚧

[Description]

Supplement Finder *(continued)*

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Boswellia serrata (BS)												?						
Branched-chain amino acids (BCAAs)				?	?		?					?						
Bromelain												?						
Caffeine --Coffee	?	?	✓	✓	✓	✓	?				✓						?	
Calcium (Ca)							?		?*			?					?	
Cannabidiol (CBD)							?											
Capsicum	?				?		?					?			✓			
Carbohydrate (CHO)	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓		
Carnitine	?	?		?	?							?						
Casein				✓								?				✓		
Cat's claw												?						
Chia seeds																	?	
Chitosan																	?	
Choline		?			?	?	?					?						
Chondroitin												?						
Chromium (Cr)																	?	
Chrysin														⚠				
Cinnamon	?											?			✓		?	
Cissus quadrangularis												?			?			

*In deficient states

[Description]

Supplement Finder *(continued)*

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Citicoline						?												
Citrulline malate (CM)	?	?	?		?		?					?						
Cocoa		?	?									?			✓			
Coconut								✓		✓			?				?	
Coenzyme Q10 (CoQ10)												?			✓			💧
Colostrum			?	?	?							?	?	?		?	?	
Conjugated linoleic acid (CLA)																?	?	
Copper (Cu)												?						♀ 🚑
Cordyceps sinensis		?			?										?			⛰
Creatine				✓	✓							?				✓		🏋 🏃 ♀ 🍲
Curcumin													?		✓			🏋 🚑 🩹
Deer antler (DA)				⚠										⚠				
Dehydroepiandros-terone (DHEA)														?				
Dendrobium							⚠											
Devil's claw												⚠						
Dimethylamylamine (DMAA)							?											
Dimethylethanol-amine (DMAE)						?												
Ecdysteroids				?														
Echinacea												?	?					
Egg protein				✓								✓				✓		🏋 🏃 ♀ 🚑 ⛰ 🍲

[Description]

Supplement Finder *(continued)*

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Elderberry												?	?		✓			
Fenugreek	?			?							?					?	?	
Fiber													?				✓	
5-hydroxytryptophan (5-HTP)						?	?										?	
Flaxseed	?											?		✓	✓		✓	
Folic acid		?				?												
Fucoxanthin														?	✓		?	
Gamma-aminobutyric acid (GABA)						?												
Gamma-linolenic acid (GLA)												?				?	?	
Garlic											?	?	✓	?	✓			
Ginger												?	✓	✓	✓			
Ginkgo biloba															✓			
Ginseng		?				?	?					?		?				
Glucosamine												?						
Glucuronolactone							⚠											
Glutamine	?										?	?	?					
Glutathione															?			
Glycerol										?								
Grape seed						?						?	?		✓			
Green tea extract															?	?		
Gymnema sylvestre (GS)														?			?	

[Description]

Supplement Finder *(continued)*

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Hoodia gordonii												?					?	
Hordenine							?											
Horny goat weed														⚠				
Huperzine A						?	?											
Hyaluronic acid (HA)												?						
Hydroxy-beta-methylbutyrate (HMB)				?								?				?		
Hydroxycitric acid (HCA)																	?	
Hydroxytyrosol (HT)			?												?			
Inosine			⚠															
Inositol						?						?						
Iron		✓	✓		✓								✓	✓				
Isomaltulose	✓													✓				
Ketones	?																	
Leucine				✓	?							?				?	?	
Lutein						?									?			
Maca			?															
Magnesium (Mg)									✓			?		✓				
Medicinal mushrooms						?							?					
Medium-chain triglycerides (MCTs)	⚠																?	
Melatonin				?	?	?						?			✓			
Methylsulfonylmethane (MSM)												?			✓			

[Description]

Supplement Finder *(continued)*

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Mucuna pruriens														?				
Mycoprotein																✓		
Naringin																	⚠	
Nicotinamide riboside (NR)			?									?						
Omega-3 fatty acids						?	?					✓	✓				?	
Ornithine				?	?													
Pantothenic acid														?	?			
Phosphate salts		?	?		?													
Phosphatidic acid (PA)																?		
Phosphatidylserine (PS)		?				?						?		?				
Pine bark extract		?	?		?							?			✓			
Piperine																	⚠	
Potassium (K)								✓	✓	✓	✓	?						
Probiotics						?							✓					
Pterostilbene				?											?		?	
Pyruvate				?	?												⚠	
Quercetin		?	?								?	?	?		✓			
Raspberry ketone																	⚠	
Red yeast rice												?						
Resveratrol		?	?	?	?						?	?	?		✓			
Rhodiola rosea (RR)		?	?	?	?	?							?					

Description

Supplement Finder *(continued)*

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Riboflavin																		
Ribose												?						
Rutaecarpine																	⚠	
S-adenosyl methionine (SAMe)							?					?						
Salt								✓	✓	✓								
Sea buckthorn		?	?				?					?	?	?	✓			
Selenium (Se)													?		✓			
Sodium bicarbonate and sodium citrate		?	✓		✓													
Soy protein				?								✓			✓	✓		
Spirulina		?													?			
Superoxide dismutase (SOD)												?			✓			
Synephrine																	⚠	
Tart cherry			?									?		?	✓			
Taurine		?	?		?	?	?					?						
Theacrine							?											
Thiamine			?		?													
Tribulus														⚠			⚠	
Tyrosine						?												
Undenatured type II collagen (UC-II)												?						
Valerian																		
Vanadium (V)																	⚠	

[Description]

Supplement Finder *(continued)*

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Vinpocetine						?									?			
Vitamin B_{12}																		
Vitamin C												?	?		✓			
Vitamin D		?	?	?	?							✓	✓	✓		✓	✓	
Vitamin E												?	?		✓			
Whey protein				✓								✓				✓		
Willow bark												?						
Withania somnifera (WS)		?		?	?	?						?	?	?				
Yohimbe														?			?	
Zeaxanthin															?			
Zinc (Zn)													?		✓			
Zinc magnesium aspartate (ZMA)																		

[Description]

PREFACE

Each year, there are a handful of athletes who defy odds and break performance barriers once believed to be impossible. In 2019, Kenyan runner Eliud Kipchoge became the first man in recorded history to break 2 hours in the marathon, a feat once deemed impossible. Although the run was not recognized as a world record because Kipchoge had pacers and received outside nutritional aid from cyclists on course, it has paved the way for other athletes to further test the limits of human performance as they experiment with their own nutrition, training, and equipment. Late Kenyan professional runner Kelvin Kiptum established himself as the men's world-record holder at the 2023 Chicago Marathon, running a blazing 2:00:35, and Kenyan runner Ruth Chepngetich became the first woman to break 2:10:00 in the marathon, establishing a new world record at the 2024 Chicago Marathon with a time of 2:09:56. At the 2024 Summer Olympics in Paris, 17 new world records were established across multiple sports, and such barriers will continue to be broken as athletes apply the latest strategies to aid human performance.

The science of training athletes has come a long way in the last 100 years. Top-level sport scientists are developing new methods of training, strategies for nutrition and supplement use, recovery protocols, and psychological tools to assist athletes in optimizing their abilities. This is in large part why performance milestones continue to be broken. This book is designed to shed light on the truths behind nutritional supplements and strategies for their use to enhance health and performance.

Chapter 1 focuses on what you—the athlete, coach, or health professional—should know about supplements. We address the history of the sport supplement industry and provide you with insight

into the manufacturing practices and regulation of sport supplements. We give you the tools to assess, evaluate, and purchase supplements to fit your needs and the needs of your athletes. Common questions are addressed, especially concerning the efficacy of supplement use in sports.

Chapter 2 explores the performance variables that are often targeted by supplement industry marketing, including claims that these key performance indicators can be enhanced through supplementation with various ingredients. This chapter will give you a better understanding of how supplements might be beneficial and which areas of performance they could affect. To specifically address how a particular supplement may be ergogenic (i.e., enhance physical performance), each system is examined closely. There are also several other variables that have a profound impact on performance in sport, including hydration status, overall recovery, and body composition. Most athletes will tailor their training to focus on one or several of these performance factors depending on their specific needs.

In addition to training, athletes will often seek guidance from a sports dietitian or other health professional about nutrition strategies and supplements that may help give them a performance edge. Chapter 3 provides an alphabetical guide to some of the most popular performance-focused supplements marketed today. For each supplement, you'll find a description of the ingredient along with common supplement names and food sources, a discussion of the latest scientific research, practical applications for dosing, and, if applicable, recommended daily intake, deficiency and toxicity symptoms, and drug or supplement interactions.

As you flip through the supplement guide, you'll see that each performance variable is assigned a symbol that will serve as a quick reference tool. If a supplement has been proven to be beneficial for a particular performance variable, the supplement entry will be marked with the corresponding black symbol shown in table 3.1; if more research is needed to assess that performance variable, the entry will be marked with a gray corresponding symbol. Supplements that are applicable to special populations will also have corresponding

symbols. You can also use the supplement finder located at the beginning of the book to quickly identify supplements that have demonstrated benefits based on these performance variables.

Our final chapter explores the unique nutritional challenges certain populations have to overcome in order to perform at peak and details the supplements that may help them excel. This chapter includes nutritional recommendations for the following categories of athletes:

- Master athletes
- Child and adolescent athletes
- Female athletes
- Injured athletes
- Athletes with diabetes
- Athletes with food allergies or intolerances
- Plant-based athletes
- Athletes competing in hot environments
- Athletes competing at altitude

Finally, a complete list of references and resources can be found online at https://ancillaries.humankinetics.com/DietarySupplementsInSportPerformance.

ACKNOWLEDGMENTS

When esteemed publisher Human Kinetics first approached me about taking on this project, I enthusiastically took on the monumental challenge, one that had been a prominent part of my career bucket list since becoming a registered dietitian in 2000. I will forever be grateful for this wonderful opportunity to continue to help dispel the myths and discuss the truths that exist in the nutrition and dietary supplement industry and ultimately create an important reference tool for anyone involved in the training and development of athletes.

Much like the team of people who all aid in the success of an athlete, including coaches, teammates, parents, trainers, doctors, dietitians, and others, this project could not have been accomplished without the invaluable support of several key players over the years. My undergraduate and graduate studies and athletic career at both Illinois State University and Florida State University certainly laid the groundwork for my career passion as a sports dietitian. In particular, research collaboration with professors Dr. Robert Cullen and Dr. Dale Brown as well as work on the nutrition and dietary supplement front with former team physician Dr. Bryan Barootes of Illinois State University really opened my eyes to the nutritional issues in sports and fostered my determination to help fellow athletes safely and successfully achieve peak performance. Since taking on the reins as a Registered Dietitian 25 years ago, I have been thankful for all the athletes who trusted my expertise to help them as they chased down various health and performance goals. I am thankful for the career-paving experiences and the breakthrough research my fellow sport science colleagues continue to do to help facilitate some of the mind-blowing performances that have made history in recent years. I'd also like to extend a huge amount of gratitude to my brilliant

coauthors, Josh Hingst, for the thousands of hours he has put into our first edition project and Lonnie Lowery, for stepping up to help make critical updates to our second edition as well as to Korey Van Wyk, Anne Hall, and the team of editors and staff at Human Kinetics who have helped make this project a reality.

Finally, I'd like to thank my late husband, Daniel Kirby; two kids, Kaia and Kamren (aspiring athletes themselves); and family and friends for their unparalleled support, love, and encouragement to carpe diem as I have chased after my professional and athletic dreams.

—Kimberly Mueller

In 1983 my oldest sister, knowing I was enamored with my plastic-and-cement weight set, bought me a bodybuilding publication off the newsstand (back then the Internet was called magazines). She thought it was funny, but I was immediately hooked; what started as a family joke became the Big Bang of my athletic and academic career.

Forty years later, I am largely the product of that seminal passion and the friends and mentors who cultivated it. Their support led to professional and personal endeavors that necessitated the synthesis of two sometimes disparate fields—not to mention overcoming the stigma that can accompany bodybuilding. Thanks to Dr. Peter Lemon and Dr. Mike Jenkins, I received my master's degrees in exercise physiology and nutrition/dietetics, as well as my doctorate in the former and license to practice in the latter. This brought me to esteemed publishers like Human Kinetics, so I also owe many clever academic colleagues my gratitude in this regard. Admittedly, of the books, chapters, and manuscripts I've coauthored, most topics—uncommon fats, antioxidants, proteins, and coffees—are too specialized for a truly broad audience. What I've long felt was really necessary was a single compendium that an athlete or coach could hold up and say, "This has our answers to all things sport supplements." This is the book you are holding in your hands. I thank

editors Korey Van Wyk and Anne Hall and, of course, coauthor Kim Mueller for making this happen. Lastly, thanks in part to Rob “Fortress” Fortney, I have fond memories of placing in regional bodybuilding contests and writing for the magazines I once consumed so voraciously. No acknowledgement I could offer would be complete without The Mighty Fortress.

Now, as a bit of a veteran in more ways than one—to which my aching joints and former university students can attest—I have enormous gratitude for the family that started, and tolerated, all of this. Perhaps most importantly, I thank my mom, Gloria Whetstone, for her unwavering belief in me, and my brilliant and tolerant wife, Kelly Lowery, for doing things to support my obsession that few spouses would.

—Lonnie Lowery