

Chapter 16 FUEL

I get embarrassed when I see how slim I was.
-- EDDY MERCKX

The focus of this book is training, not diet, but there is no denying the complex connections between nutritional practices and exhaustive exercise. Eating foods to which the human body is optimally adapted will reduce body fat, improve recovery, decrease down time due to illness, and generally enhance athletic performance. The older you are, the more important diet is for performance. At age 20, you can make some dietary mistakes and get away with it. At age 50 everything is crucial, especially diet. Age is not the only individual variable for which diet is critical. For many female athletes who are chronically low in iron stores and fighting a seemingly endless battle to keep off excess pounds, getting their diet right is crucial to athletic success. For the athlete who eats a junk food diet low in micronutrients, recovery and performance will ultimately suffer due to illness and constant fatigue. Even something as seemingly innocuous as eating the right foods but at the wrong times relative to training will pro- long recovery and reduce performance levels. Other than training and rest, nothing is as important for your race results as what you eat and when you eat it.

So what should you eat? Suppose you were a zookeeper and in charge of selecting food for the animal. It wouldn't be too difficult to figure out that the lions thrive on a diet made up primarily of the protein in meat and the giraffes do best when allowed to graze on vegetation. You wouldn't feed leaves and grass to the lions. Nor would you feed the giraffes meat. Their health and well-being would decline if you did. So there are foods that are optimal for different types of animal. Why are these particular foods optimal for these animals? Because they evolved eating such foods. For as long as lions and giraffes have been on the planet they have eaten these foods. As the zookeeper, you will not change that. It's

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我很尴尬我居然如此苗条。
—— EDDY MERCKX

此书的重点的是训练，而非饮食，但是不可否认营养工作和艰苦的练习之间有着非常复杂的关系。如果摄入正好适合人体的食物的话，将能帮助减少身体脂肪，促进恢复，减少因疾病导致的中断训练，并能全面的提高运动能力。你的年龄越大，饮食对运动能力的影响也越重要。当你 20 岁的时候，你犯下饮食方面的错误时还能顺利地摆脱其影响；可当你 50 岁时，所有的事情都变得至关重要，尤其是饮食。饮食之所以重要并不仅仅因为年龄。对于很多慢性缺铁并且要长期保持体重的女运动员来说，她们的饮食是否正确直接关系到她们的成绩。对于运动员来说，若总是吃低营养的垃圾食品，最终就会因为疾病和持久疲劳导致恢复和训练效果方面的麻烦。甚至于吃一些看起来没有危害的食物，或者是该吃的食物放在了错误的时间段吃，也会延长恢复时间和降低训练效果。除了训练和休息，没有什么能比你吃什么和什么时候吃更重要的了。

所以你该吃些什么呢？设想你是个动物园管理者，负责给动物挑选食物。那么不难想到，要给狮子喂以蛋白质为主的肉类，而给长颈鹿喂植物，这对它们都是最好的。你不会给狮子吃草，或给长颈鹿喂肉。如果你这么做，狮子和长颈鹿的健康状况会下降。所以不同种类的动物都有其最适合的食物。为什么某些动物偏偏就适合吃某些食物呢？因为长期的进化使它们这样吃东西的。只要狮子和长颈鹿还在这个地球上存在它们就这么吃。作为动物管理员，你无法改变这个情况，所以你最好能接受这个事实。

best to accept it.

So what would you do if the zoo received an exotic animal that no other zoo has and for which the diet is unknown? Well, the obvious answer would be to study that animal in its natural environment to see what it eats there, and then feed it the same foods in your zoo. That would be the optimal food for that animal. Seems simple enough.

So what foods are optimal for homo sapiens—you and me? One way to answer that question would be through the science of paleontology—the study of man before the advent of farming and civilization. Why would we not want to study human eating patterns after the introduction of farming? The reason has to do with time and evolution.

The evolutionary process is slow, taking hundreds of thousands of years to bring 1-percent changes. Homo sapiens have been on the planet for about five million years. Farming was introduced in the Middle East some 10,000 years ago. Dairy is even younger with its roots going back about 5,000 years. In the big picture these developments are “recent.” If our five million years on the planet were represented by a twenty-four hour clock, farming would have been with us for only the last two minutes and fifty-two seconds. Dairy would have been around less than ninety seconds. These time spans are simply not long enough for humans to evolve and adapt to the foods that are unique to farming and dairy production.

So what did humans eat prior to farming? What are the optimal foods for humans? Paleontology tells us those foods were vegetables, fruits, and lean meats (fish, poultry, and other wild or free-ranging game). Nuts, some seeds, berries, and honey are also foods that humans have eaten for millions of years, although in far smaller amounts than those listed above. Non-optimal foods are those we have eaten only for the last 10,000-or-so years such as grains, milk, and cheese. Does this mean humans should never eat these non-optimal foods? No, it merely means that we

如果动物园接收了一个外国来的动物，从没有被其他动物园饲养过，其饮食习惯也未知，你该怎么办？一个显而易见的回答是研究此类动物在自然环境中吃什么，然后你在动物园中也喂同样的食物就可以了。这应该是这种动物最合适的食物。看起来很简单哦。

那么什么食物最适合你我这样的现在人类呢？要回答这个问题，其中一个方法就是参考古生物学——对进入农牧业和文明时代以前的人类的研究。为什么我们不想研究在学会耕作之后的人类的饮食习惯呢？原因在于时间和进化。

进化的过程是非常缓慢的，成千上万年的时间只能带来 1% 的改变。现代人类在这个地球上已存在 500 万年，而农牧业最早在大约一万年才出现在中东地区，而奶制品的出现则更加晚了大概五千年左右，在人类进化的总图里，这些都是“最近”才发生的事情。如果把我们生存在地球上的这五百万年时间以 24 小时来代表的话，那么农牧业是在最后的 2 分 52 秒才出现的，而奶制品则是在最后不到 90 秒才出现的。这么短的时间跨度不足以让人类的身体进化到完全适应农牧业和奶制品类的食物。

那么人类在农牧业时代以前吃什么呢？或者说什么才是人类的最佳食物呢？古生物学告诉我们这些食物是：蔬菜，水果和瘦肉（鱼，家禽和其它一些野生或放养的野味）。坚果类，某些种子，浆果和蜂蜜也是人类吃了几百万年的食物，虽然吃的数量比前面所列出的那些食物要少很多。而非最佳食物都是在最近一万年左右才出现并开始被食用的，例如谷物，牛奶和奶酪。这是不是意味着人类不应该吃这些非最佳食物呢？当然不，这只不过意味着如果我们吃以蔬菜，水果和瘦肉为主的食物会长得更茁壮。这种

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will thrive on a diet made up primarily of vegetables, fruits, and lean meats. The more of these nutrient-dense foods you eat the better your health and athletic performance will be. The scientific evidence in support of the optimal foods as health-promoting is overwhelming. Replace them with non-optimal foods and, just as with the exotic animal in you zoo, your health and vitality will diminish. Fitness will also suffer.

Paleontology also tells us that our Homo sapien ancestors in the distant past would never have considered putting in multi-hour bouts of exercise, much of it at high intensity, day after day, week after week. This was unheard of until relatively recent times. Man evolved to do only what is necessary to provide food, shelter, and safety and nothing more. We are meant to be lazy, making our couch potato friends the true descendants of earliest man, at least philosophically. Serious athletes are an anomaly.

Because of this latter point my experience has taught me that we must “break the rules” to some extent when it comes to eating. Certain non-optimal foods, such as grains and other starches, are energy-dense. While this is a disadvantage to our friend the couch potato, one that helps to explain his being so overweight and unhealthy, it has the potential to be quite advantageous to the athlete seeking quick restoration of glycogen stores following a hard workout. This does not contradict the concept that the athlete's diet should be primarily composed of optimal foods; it merely suggests that there are small windows of time when non-optimal foods may well be beneficial to recovery.

The details of how to blend all of these elements into the “athlete's diet” is the focus of this chapter. To learn more about the concept of optimal foods read *The Paleo Diet* by Loren Cordain (2002).

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丰富营养的食物吃得越多，你的健康状况就越好，运动能力也越强。已经有太多的科学方面的证据支持这一结论，即食用这种最佳食物能提高人们的健康状况。若你换成吃非最佳的食物的话，就会象动物园的外来动物一样，你的生理健康和生命活力都会下降，身体素质也会受到损害。

古生物学还告诉我们，我们那些远古时期的人类祖先从没想过要做数小时的多回合的练习——其中很多是高强度的——而且日复一日，年复一年。这种事直到相当近期的时代还是闻所未闻的。人类只是为了获取食物，住所和安全才做必要的活动，除此之外再无其它。这意味着我们应该懒惰，那些终日懒散的家伙才是这些早期人类的真正后代——起码在生活哲学上是的——而认真的运动员可以说全都是异类。

由于后一种事实，我的经验告诉我在吃东西方面必须在某种程度上“打破常规”。某些非最佳食物，比如谷物和其它淀粉类，是有丰富能量的，虽然这些食物对那些终日懒散的朋友们的身体不利——这也从一个方面帮助解释了为什么他们会变得超重而且不健康——但却很可能对那些艰苦训练后需要快速恢复糖原储备的运动员们很有利。这一观念并不与主流概念相冲突，即运动员的饮食也应该以最佳食物为主；它只是建议在某些小的时间段，非最佳食物可能会对身体恢复相当有利。

本章的重点是讲如何将所有这些细节合成“运动员的食谱”。要学习更多的最佳食物的概念，请参考 Loren Cordain 的著作《远古食物》（2002）

Food as Fuel

While the human genetic code has changed very little, dietary recommendations change often. In the mid-twentieth century, endurance athletes were advised to avoid starchy foods such as bread and potatoes, and to eat more vegetables and meats instead. In the 1970s, a dietary shift away from protein began with an increase in carbohydrates, especially starchy grains. The 1980s brought concerns for fat in the diet, and low-fat and fat-free foods boomed, with an accompanying increase in sugar consumption. Now the pendulum is swinging back the other way, with the realizations that certain fats are beneficial and that some carbohydrates are deleterious in large quantities.

The crux of your daily dietary decisions is the relative mix of the four macro-nutrients you consume – protein, fat, carbohydrates, and water. How much of each you include in your diet has a great deal to do with how well you train and race.

Protein

The word protein is derived from the Greek word *proteios*, meaning “first” or “of primary importance.” That’s fitting, because determining macronutrient balance begins with protein intake.

Protein has a checkered history in the world of athletes. Greek and Roman competitors believed that the strength, speed, and endurance qualities of animals could be gained by merely eating their meat. Lion meat was in great demand. In the 1800s, protein was considered the major fuel of exercise, so athletes also ate prodigious quantities of meat. In the early part of the twentieth century, scientists came to understand that fat and carbohydrates provide most of our energy for movement. By the 1960s, athletic diets began to change, reflecting this shift in knowledge. In fact, little interest was paid to the role of

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虽然人类的遗传密码几乎没有改变，但饮食规范的建议却改了好多次了。在 20 世纪中期，人们建议耐力运动员不要吃淀粉类食物，比如面包和土豆，而是吃较多的蔬菜和肉食；20 世纪 70 年代，饮食规范开始偏离蛋白质，转而增加碳水化合物，特别是谷物淀粉；而 80 年代起人们开始关心饮食中的脂肪，低脂和无脂食物开始兴旺，伴之而起的是食糖消费的增加。到了现在我们象钟摆一样又摆到另一边去了，因为研究发现有些脂肪是对身体有益的，而有些碳水化合物大量食用也是有害的。

你的每日饮食涉及到四大类营养——蛋白质，脂肪，碳水化合物和水——如何决定各类营养的比例是饮食规范的关键。每种营养成分占你饮食中的比例会对你的训练和比赛产生重要影响。

蛋白质

蛋白质一词出自希腊语 *proteios*，意思是“第一位的”或“最重要的”。这很贴切，因为决定多种营养成分平衡起始于蛋白质的摄入。

蛋白质在运动员世界里有着多变的历史。希腊和罗马的竞技者都相信吃掉某种动物的肉，就能获得这种动物的力量，速度和耐力等特征，所以狮子肉的需求量很大。在 19 世纪初，蛋白质被认为是运动的主要燃料，所以运动员也开始吃大量的肉。在 20 世纪上半叶，科学家逐渐明白了脂肪和碳水化合物才是供给运动的主要能量来源。到了 20 世纪 60 年代，这一知识的运用开始反应在运动员的饮食变化上。事实上，在整个 70 年代和 80 年代几乎就没有人有兴趣去研究蛋白质在体育运动补给中的地位。一直到

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protein in sports fuel throughout most of the 1970s and 1980s. That changed in the latter years of the twentieth century as more research was done on this almost forgotten macronutrient.

Protein plays a key role in health and athletic performance. It is necessary to repair muscle damage, maintain the immune system, manufacture hormones and enzymes, replace red blood cells that carry oxygen to the muscles, and produce up to 10 percent of the energy needed for long or intense workouts and races. It also stimulates the secretion of glucagon, a hormone that allows the body to use fat for fuel more efficiently.

Protein is so important to the athlete that it may even determine the outcome of races. For example, a study of Olympians by the International Center for Sports Nutrition in Omaha, Nebraska, compared the diets of medal winners and non-medalists. The only significant difference found was that the winners ate more protein than those who did not medal.

Performance is dependent on dietary protein because the body is unable to produce all it needs from scratch. And, unlike carbohydrates and fat, protein is not stored in the body at fuel depot sites for later use. The protein you eat is used to meet immediate needs, with excess intakes converted to the storage forms of carbohydrates or fat.

Dietary protein is made up of twenty amino acids useable by the human body as building blocks for replacing damaged cells. Most of these amino acids are readily produced by the body when a need arises, but there are nine that the body cannot manufacture. These "essential" amino acids must come from the diet in order for all the protein-related functions to continue normally. If the diet is lacking in protein, your body is likely to break down muscle tissues to provide what is necessary for areas of greater need, thus resulting in muscle wasting. This was evidenced in 1988 by the 7-Eleven cycling team during the Tour de France.

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了 20 世纪末这一情况才开始改变，越来越多地研究投入到了这种几乎被人遗忘的营养素上面。

蛋白质对健康和运动能力非常重要，身体需要用它来修补肌肉损伤，维持免疫系统，制造荷尔蒙和酶，更换红细胞（用来携带氧气到肌肉），并且在高强度或长距离训练和比赛中提供将近 10% 的能量供应。它还能刺激身体分泌胰高糖素，一种让身体更有效燃烧脂肪的荷尔蒙。

蛋白质对运动员是如此重要，甚至可能会决定比赛结果。例如，位于内布拉斯加州奥马哈市的国际运动营养中心对奥运选手做过一次调查，比较获奖牌选手和未获奖牌选手的饮食。结果发现唯一显著的不同就是奖牌选手比非奖牌选手吃了更多的蛋白质。

食物蛋白质对运动能力如此重要，是因为身体无法从零开始制作所需的一切。而且，不象碳水化合物和脂肪那样，蛋白质无法在身体内储存留待以后使用，你吃进去的蛋白质会马上供应身体需要，而多余的部分则被转换成碳水化合物或脂肪的形式存贮在体内。

食物蛋白质由 20 种氨基酸组成，被人体用于构建组织和更换受损的细胞。大多数氨基酸很容易由身体根据需要合成，但是有 9 种氨基酸是身体无法合成的。这类“关键”氨基酸必须通过饮食摄入，从而使所有与蛋白质相关的功能正常继续。如果饮食中缺乏蛋白质，你的身体就有可能分解肌肉组织来满足更重要的功能所需的蛋白质需求，这样就会造成肌肉流失。这一结论在 1988 年的环法大赛中得到证实，当时参赛队伍之一的“7-eleven”车队发现经过 3 周的比赛，车队骑手的大腿周长减小了，队医研究了他们的饮食后发现，他们都是蛋白质摄入

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It was discovered that the circumferences of the riders' thighs decreased during three weeks of racing. After studying their diets, the team doctor determined that they were protein deficient.

Protein is more important for endurance athletes than for those in power sports such as American football, baseball, and basketball. An intense, one-hour criterium can cause the depletion of up to 30 grams of protein, about equal to the amount of protein in a 3-ounce can of tuna. Replacing these losses is critical to recovery and improved fitness. Without such replenishment, the endurance athlete's body is forced to cannibalize protein from muscle.

Unfortunately, there is not a general agreement within the nutritional field regarding the recommended protein intake for endurance athletes. The U.S recommended daily allowance (RDA) for protein is 0.013 ounces per pound of body weight (0.8gm/kg), but that is likely too low for an athlete. Peter Lemon, a noted protein researcher at Kent State University, suggests athletes eat about 0.020 to 0.022 ounces of protein per pound of body weight each day (1.2 – 1.4gm/kg). During a period of heavy weight lifting, such as in the MS phase described in Chapter 12, Lemon recommends a high of 0.028 ounces per pound (1.8gm/kg). The American Dietetic Association suggests a high-end protein intake of 0.032 ounces per pound (2.0gm/kg) each day. A non-scientific survey of sports scientists from around the world found a rather broad range of 0.020 to 0.040 ounces per pound (1.2 – 2.5 gm/kg) suggested for endurance athletes daily. Applying these recommendations for a 150-pound (68 kilogram) athlete, the possible range, excluding the U.S RDA, would be 3 to 6 ounces (84 to 168 grams) of protein each day. Table 16.1 shows how much protein is found in common foods.

Protein is found in both vegetable and animal forms, and the quantity required, regardless of the source, can be difficult to consume unless you closely watch your diet. To get 127 grams of protein from vegetable

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不足。

相比于力量型运动，比如美式足球，棒球和篮球，蛋白质对耐力型运动员尤其重要。一次高强度 1 小时左右的绕圈赛会消耗掉将近 30 克蛋白质，大约相当于一个 3 盎司的金枪鱼罐头的蛋白质含量。补充损失是恢复和提高身体素质的关键，如果不能及时补充的话，耐力运动员的身体只好被迫消耗肌肉来满足需要。

不幸的是，目前还没有一个营养学界公认的关于耐力运动员的推荐的蛋白质摄入量。美国标准的蛋白质每日推荐量（RDA）是每公斤体重 0.8 克，但对运动员来说这个量太少了。肯特州立大学的著名蛋白质研究员 Peter Lemon 建议，运动员每天摄入蛋白质每公斤体重 1.2–1.4 克；在高负荷举重时期，比如第 12 章介绍的最大力量阶段，Lemon 建议每公斤体重摄入 1.8 克蛋白质。美国饮食协会建议的每日摄入的上限值为每公斤体重 2.0 克。一个非科学性的对全球运动科学家的民意调查显示，对耐力运动员每日每公斤体重的摄入蛋白质的推荐量分布在从 1.2–2.5 克的广大范围内。将这些推荐量运用到 150 磅（68 公斤）的运动员身上的话，排除美国标准 RDA 以外，每天的蛋白质摄入量应该是在 84–168 克之间。表 16.1 显示了各种日常食物中的蛋白质含量。

蛋白质在蔬菜和动物中都有，但如果不关心蛋白质来源的话，那么除非你天天盯着饮食，否则很难吃掉足够量的食物。要从蔬菜类食物中获取 127 克蛋白质，就意味着吃掉 17 盘意大利面，14 杯酸奶，或者 21 个百

sources would mean eating 17 cups of spaghetti, 14 cups of yogurt, or 21 bagels. The same 127 grams could also come from 15 ounces of chicken or lean steak, or 17 ounces of tuna. This is a lot of food from either type, but there is an added benefit in getting protein from animal sources: All of the necessary amino acids in the right proportions, easily absorbable iron, zinc, calcium, and vitamin B-12 are present and the protein is more absorbable due to less fiber in the meat.

吉饼，但同样 127 克蛋白质也能从 15 盎司（425 克）鸡肉或瘦肉，或 17 盎司（482 克）金枪鱼中获得。当然这也是很大一份的食物，但从动物身上获取蛋白质还有个好处：动物蛋白中所有的必须氨基酸的比例都是合适的，而且其中的铁，锌，钙和维生素 B12 更容易吸收，另外肉中的纤维素较少，所以其营养也更容易被人体吸收。

动物来源	蛋白质（克）	植物来源	蛋白质（克）
烤牛排	30.0	干杏仁	20.0
鸡胸肉	30.0	老豆腐	11.0
瑞士硬干酪	29.0	百吉饼	11.0
猪腰肉	26.0	扁豆	9.0
汉堡包	26.0	黑面包	8.0
Cheddar 干酪	24.5	麦片（玉米片）	8.0
金枪鱼	23.0	炸豆泥	6.0
鳕鱼	23.0	烘豆干	5.0
鹿肉	21.0	鹰嘴豆泥	5.0
脱脂软干酪	12.0	豆奶	3.0
鸡蛋（整个）	12.0	糙米（煮）	2.5
蛋白	10.0	西红柿（红）	1.0
牛奶（脱脂）	3.0		

Table 16.1 Protein Content of Common Foods per 3.5-ounce (100g) Serving

表 16.1 普通食物每 100 克中的蛋白质含量

So what happens if you fail to get your daily need for protein when training hard? Occasionally missing out on your daily protein intake probably has no measurable impact on performance, but regular avoidance of high quality protein accompanied by a volume of high-intensity exercise can have a significant impact on training and racing. Besides being a minor fuel source during strenuous exercise, protein is responsible for building muscle, making hormones that regulate basal metabolic rate, and for fighting off disease.

那么如果你训练地很辛苦，却没有摄入足够的蛋白质，那会怎么样呢？偶尔几天蛋白质摄入不足好象对运动能力没有什么能够测量到的影响，但经常性地高强度训练后不能摄入高质量蛋白质，却会对训练和比赛产生重大影响。除了减少了一种对艰苦训练的次要供能来源以外，蛋白质还负责重建肌肉，生成荷尔蒙用来调节基础代谢，以及抵抗疾病。

There's no doubt that during prolonged, high-intensity exercise, the body turns to stored protein, eventually resulting in the loss of muscle. A 1992 study of sixteen hikers who spent twenty-one days in the Andes Mountains

毫无疑问，在长时间高强度的运动中，身体会依靠储备的蛋白质供能，最终会导致肌肉的流失。1992 年的一项对 16 名徒步穿越安第斯山的旅行者的研究表明，这些每天需要徒步 5 个小时，并且平均爬升 2500 英

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traveling five hours a day on foot with an average elevation gain of 2,500 feet per day, found significant loss of muscle mass. This may explain why some endurance athletes have a gaunt look during several weeks of rigorous training with low intake of protein.

Without meat in the diet, the risk of low iron levels is also high. One study linked low iron levels with injuries in runners. Those lowest in iron had twice as many injuries as those highest in iron. Besides providing protein, lean red meat is also a good source of easily absorbed iron.

Are you getting enough protein? One way to determine this is to evaluate your physical and mental well-being. Indicators that you need more protein in your diet include:

- Frequent colds or sore throats
- Slow recovery following workouts
- An irritable demeanor
- Poor response to training (slow to get in shape)
- Slow fingernail growth and easily broken nails
- Thin hair or unusual hair loss
- Chronic fatigue
- Poor mental focus
- Sugar cravings
- Pallid complexion
- Cessation of menstrual periods

Note that none of these indicators is certain proof of the need for more protein, as each may have other causes. A dietary analysis by a registered dietitian, or by the use of a computer software program such as DietBalancer, may help make the determination if you have concerns. Increasing your protein intake to see how it affects you is another simple option. It's unlikely that you will eat too much protein. Even at 30 percent of daily calories, as recommended in some diets, the excess, if any, will be converted to glycogen or fat and stored. There is no research suggesting that moderately high protein diets pose a health risk for otherwise healthy individuals, as long as plenty of water is consumed each day to help with the

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尺的人的肌肉组织明显减少了。这也许可以解释为什么耐力运动员经过数周艰苦训练和低蛋白质摄入后会看上去非常憔悴。

饮食中缺少肉的话，缺铁的风险会比较高。有一项研究表明缺铁会引起跑步者容易受伤。那些铁质最少的人比铁质最多的人的受伤的比例高一倍。红的瘦肉除了提供蛋白质外，也含有容易吸收的铁质。

你摄入的蛋白质足够吗？其中一种判定方法就是评估你的生理和精神状态。如果出现以下情况，那么你就需要在饮食中增加更多的蛋白质：

- 经常感冒或喉咙疼
- 高强度训练后恢复地很慢
- 行为暴躁
- 训练反应迟缓（进入状态慢）
- 指甲长得慢，并且很容易断
- 头发稀少，或非正常地掉头发
- 慢性疲劳
- 精神不能集中
- 渴望吃糖
- 面色苍白
- 月经周期停止

请注意以上这些指标都不能证明你需要更多蛋白质，因为其他原因也会导致这些情况。如果你有这方面的疑问，由注册营养师，或使用计算机软件，如 DietBalancer 作饮食分析，也许能帮助你做出判断。另一个简单的方法就是增加你的蛋白质摄入来看看是否有效果。你不太会吃进太多的蛋白质。即使蛋白质占到每天摄入的热量的 30%，如某些饮食方案所推荐，超出的部分会转化并储存成糖原或脂肪。目前没有研究表明对健康人群来说，摄入相对较高的蛋白质会引起健康方面的问题，只要每天喝足够的水帮助把氮——蛋白质代谢产生的副产品——排出就可以了。

removal of nitrogen, a byproduct of protein metabolism.

ARE YOU REALLY OVERTRAINED?

Low dietary intake of the mineral iron may be the most common nutritional deficiency for serious multisport athletes, especially women. Unfortunately it goes undetected in most.

A 1998 university study of female high school cross-country runners found 45 percent had low iron stores. In the same study, 17 percent of the boys were low. Other research conducted on female college athletes showed that 31 percent were iron deficient. Up to 80 percent of women runners were below normal iron stores in a 1983 study.

Common accepted, although still debated, causes of iron depletion include high-volume running, especially on hard surfaces; too much anaerobic training; chronic intake of aspirin; travel to high altitude; excessive menstrual flow; and a diet low in animal-food products. Athletes most at risk for iron deficiency, in the order of their risk, are runners, women, endurance athletes, vegetarians, those who sweat heavily, dieters and those who have recently donated blood.

The symptoms of iron deficiency include loss of endurance, chronic fatigue, high exercise heart rate, low power, frequent injury, recurring illness and an attitude problem. Since many of these symptoms are the same as in overtraining, the athlete may correctly cut back on exercise, begin feeling better, and return to training only to find an almost immediate relapse. In the early stages of iron depletion, performance may show only slight decrements, but additional training volume and intensity cause further declines. Many unknowingly flirt with this level of “tired blood” frequently.

If a deficiency is suspected, what should you do? Once a year have a blood test to determine your healthy baseline levels of serum ferritin, hemoglobin, reticulocytes and haptoglobin. This should be done during the Transition, Prep, or Base training periods when training volume and intensity are low. This blood test should be done in a fasted state with no exercise for fifteen hours prior. Your health-care provider will help you understand the results. Then, if the symptoms of low iron appear, a follow-up test may support or rule this out as the culprit. Your blood indicators of iron status may be

你真的是训练过度了吗？

对许多严肃的多项运动的运动员，特别是女运动员来说，最普遍的营养不良现象也许就是饮食摄入的铁质不足。不幸的是大多数情况下没人会觉察到。

1998 年的一次大学研究发现，跑步横穿美国的女子高中生中 45% 的人铁质含量偏低，而男生中有 17% 铁质偏低。另一项针对大学女子运动员的研究发现 31% 的人铁质缺乏。1983 年的一个研究发现 80% 的女跑步者的铁质含量低于正常值。

虽然还有争议，但普遍接受的铁质缺乏的原因包括大运动量的跑步，特别是在硬路面上跑；太多的无氧训练；长期服用阿司匹林；高海拔地区的旅行；太多的月经血量；以及动物性食物吃得太少。运动员按他们铁质缺乏的风险从高到低排序，依次为：跑步者，女运动员，耐力运动员，素食者，出汗很多的人，节食者，以及最近献过血的人。

身体缺铁的症状包括耐力减退，慢性疲劳，训练时心率过快，力量减退，经常受伤，总是生病，以及精神状态方面的问题。这些症状和过度训练的症状很相似，所以运动员可能会明智地降低训练量，然后感觉好些了，但重新训练后马上发现故态复萌。在身体缺铁的早期阶段，运动能力也许只减退了一点点，但继续增加的训练量和强度会引起更大的衰退。许多人经常不自觉地轻视这种级别的“太累的血”。

如果你怀疑身体缺铁，应该怎么办？每年做一次血检，检查血清铁蛋白，血色素，网织红细胞，结合珠蛋白的基本健康水平。你可以在过渡期，准备期，或基础期等训练量和强度较低的时期做这种检查。血检前要禁食，并在 15 小时前停止运动。给你做体检的机构会帮助你了解体检结果。然后，如果你感到缺铁的症状出现的话，再做一次检查来验证或排除这种可能。你的血液指标也许还在“正常”的参考范围内，但却比你的基线水平要低。许多运动科学家相信，即使是这样的“正常”范围内的明显下降也会对运动水

“normal” based on the reference range, but low in relation to your baseline. Many exercise scientists believe that even this obvious dip may adversely affect performance.

Should the blood test indicate an abnormally low iron status, an increased dietary intake of iron is necessary. You may want to have a registered dietitian analyze your eating habits for adequate iron consumption. The RDA for women and teenagers is 15 mg per day. Men should consume 10 mg. Endurance athletes may need more. The normal North American diet contains about 6 mg of iron for every 1,000 calories eaten, so a female athlete restricting food intake to 2,000 calories a day while exercising strenuously can easily create a low-iron condition in a few weeks.

Dietary iron comes in two forms – heme and non-heme. Heme iron is found in animal meat. Plant foods are the source of non-heme iron. Very little of the iron you eat is absorbed by the body regardless of the source, but heme iron has the best absorption rate at about 15 percent. Up to 5 percent of non-heme iron is taken up by the body. So the most effective way to increase iron status is by eating meat, especially red meat. Humans probably developed this capacity to absorb iron from red meat as a result of our omnivorous, hunter-gatherer origins. Plant sources of iron, although not very available to the human body due to their accompanying phytates, are raisins, leafy green vegetables, dates, dried fruits, lima beans, baked beans, broccoli, baked potatoes, soybeans and brussels sprouts. Other sources are listed in Table 16.1.

Iron absorption from any of these foods, whether plant or animal, is decreased if they are accompanied at meals by egg yolk, coffee, tea, wheat, or cereal grains. Calcium and zinc also reduce the ability of the body to take up iron. Including fruits, especially citrus fruit, in meals enhances iron absorption.

Don't use iron supplements unless under the supervision of your health-care provider. Some people are susceptible to iron overload, a condition called hemochromatosis marked by toxic deposits in the skin, joints, and liver. Other symptoms, including fatigue and malaise, may mimic iron deficiency and overtraining. Also note that ingesting iron supplements is the second leading cause of poisoning in children. Aspirin is first.

平产生消极作用。

如果血检报告显示非正常的低铁质状态，那么就必须要在饮食中增加铁的摄入。你也许需要一个注册营养师帮你分析饮食习惯以保证足够的铁质吸收。妇女和青少年的 RDA（每日推荐量）为每天 15mg，成年男子为 10mg。耐力运动员需要更多一些。一般的北美人的食物中每 1000 大卡热量含大约 6mg 的铁，所以一个每天限定摄入 2000 大卡热量的女运动员很容易在艰苦训练几周以后导致缺铁的状况。

饮食中的铁有两种来源——亚铁类与非亚铁类。亚铁类存在于动物肉中，植物性食物是非亚铁类的来源。不管哪种来源，身体对铁的吸收率是非常低的，但亚铁类食物的吸收率最高，大约 15%，所以最有效的补铁方式就是吃肉，尤其是红肉。人类也许是从我们杂事性的从事狩猎采集的祖先那里继承了这种从红肉中吸收铁质的能力。植物性的铁质来源，如葡萄干，阔叶绿色蔬菜，枣子，干果，利马豆，烘豆子，花椰菜，烘土豆，大豆和芽甘蓝，由于其中的铁结合了肌醇六磷酸因而不适合人体吸收。其他的铁质来源请参考表 16.1。

如果和蛋黄，咖啡，茶，小麦或谷物类食品一起吃的话，那么无论从动物类还是植物类食物中的铁质的吸收率都会降低。钙和锌也会降低人体吸收铁的能力。和水果一起吃，特别是柑桔类水果，可以提高铁的吸收能力。

不要服用补铁制剂，除非在你的保健医生的监督下。有些人容易受服铁过量的影响而得一种叫做“血色沉着症”的病，在皮肤，关节和肝脏产生有毒的沉淀。其他症状包括可能与缺铁及训练过度相似的疲劳和不舒服。另外请注意补铁制剂是引起儿童中毒的排名第二位的病因，第一位是阿司匹林。

Carbohydrates

Carbohydrates are critical for performance in endurance events, as they provide much of the fuel in the forms of glycogen and glucose that is converted to useable energy by the body. Low carbohydrates stores are likely to result in poor endurance and lackluster racing.

The zealous athlete who learns this often overeats carbohydrates at the expense of protein and fat. A day in the life of such a person may find that breakfast is cereal, toast, and orange juice; a bagel is eaten as a midmorning snack; lunch is a baked potato with vegetables; sports bars or pretzels are eaten in the afternoon; and supper is pasta with bread. Not only is such a diet excessively high in starch with an overemphasis on wheat, but it is also likely to provide dangerously low protein and fat levels. Such a dietary plan could be improved by replacing the cereal with an egg-white omelet and including fresh fruit, topping the potato with tuna, snacking on mixed nuts and dried fruit, and eating fish with vegetables for supper.

When you eat a high-carbohydrate meal or snack, the pancreas releases insulin to regulate the level of blood sugar. That insulin stays in the blood for up to two hours, during which time it has other effects, such as preventing the body from utilizing stored fat, converting carbohydrates and protein to body fat, and moving fat in the blood to storage sites. This may explain why, despite serious training and eating a “healthy” diet, some athletes are unable to lose body fat.

Some carbohydrates enter the bloodstream quicker than others, producing an elevated blood-sugar response and quickly bringing about all the negative aspects of high insulin described above. These rapidly digested carbohydrates are high on the glycemic index – a food rating system developed for diabetics. Foods with a low glycemic index produce a

碳水化合物

碳水化合物对耐力运动至关重要，因为它以糖原和葡萄糖的形式储存在体内，并提供运动所需的大多数能量。碳水化合物储备过低有可能导致耐力不足以及糟糕的比赛成绩。

这就使得某些狂热的运动员会吃太多的碳水化合物，因而减少了蛋白质和脂肪摄入。如果观察这个人的一天的话，早餐也许是吃麦片，烤面包和橙汁；上午的甜点是百吉饼；中午吃烤土豆和蔬菜；下午吃脆饼干或去运动酒吧；晚餐则是意大利面食和面包。这样的膳食结构的问题是太强调面食而导致淀粉过多，而且蛋白质和脂肪水平又太少了。如果要改善这样的膳食计划的话，可以把麦片换成用蛋白做的煎蛋卷以及新鲜水果，把土豆换成金枪鱼，甜点换成坚果和干果，而晚餐则吃鱼和蔬菜。

当你吃进高碳水化合物食品和小吃时，胰腺会分泌胰岛素来调节血糖浓度。胰岛素会在血液中存留 2 小时，在这期间它还有其他作用，比如阻止身体利用脂肪，把碳水化合物和蛋白质转化为脂肪，以及把血液中的脂肪转移到储存处。这也许能解释为什么有些运动员虽然训练得很刻苦，吃得也很“健康”，但就是无法减轻体重。

有些碳水化合物进入血液的速度比较快，引起的血糖升高很快导致大量胰岛素的分泌并引起上述所有的消极作用。这些能够被快速消化的碳水化合物有较高的“升糖指数”——一种为糖尿病患者制定的食品分级系统。低升糖指数的食物引起血糖升高的速度比较慢，从而避免吃高升糖指数食物引

less dramatic rise in blood sugar, and help avoid the craving for more sugary food that comes with eating high-glycemic carbohydrates. Table 16.2 lists some common high-, moderate-, low-, and very low-glycemic foods.

起的总想吃更多含糖食物的渴望。表 16.2 列举了一些常用的高，中，低升糖指数的食品。

高升糖指数 (> 80%)				
法式面包	糖浆	烘土豆	米饭 chex	白米饭
玉米麦片	欧洲萝卜	速食土豆	速食米饭	木薯
粒状麦粉	面食，米饭	米糕	米饭 krispies	冻豆腐
中等升糖指数 (50-80%)				
全麸麦片	黑面包	油炸甜甜圈	浓豌豆汤	南瓜
杏	全麦面包	冰激凌	菠萝	葡萄干
百吉饼	白面包	芒果	爆米花	糙米
香蕉	玉米片	牛奶什锦早餐	薯片	黑麦面包片
大麦	玉米粉	松饼	煮土豆	软饮料
甜菜	甜玉米	麸皮燕麦粥	土豆泥	墨西哥卷
黑豆汤	蒸粗麦粉	燕麦片	甜土豆	西瓜
Pita 面包	饼干	橙汁	能量棒	山药
低升糖指数 (30-49%)				
苹果	黑豆	葡萄汁	意大利面点	黑麦
苹果汁	利马豆	葡萄	梨	番茄汤
苹果沙司	杂色豆	猕猴桃	黑眼豌豆	水果酸奶
烘豆子	巧克力	橙子	鹰嘴豆	
极低的升糖指数 (LESS THAN 30%)				
大麦	樱桃	小扁豆	桃子	李子
四季豆	葡萄柚	牛奶	花生	黄豆

Table 16.2 Glycemic index of Common Foods

表 16.2 一般食物的升糖指数

How a carbohydrate food is prepared and what other foods it is eaten with affects its glycemic index. Adding fat to high-glycemic-index food lowers its glycemic index by slowing down digestion. An example of this is ice cream, which has a moderate glycemic index despite the presence of large amounts of sugar. In the same way, adding fiber to a meal that includes a high- or moderate-glycemic-index carbohydrate reduces the meal’s effect on your blood sugar and insulin level and turns it into timed-release energy.

碳水化合物食物如何吃以及和什么食物一起吃都会影响它的升糖指数。把脂肪和高升糖指数食物一起吃会因消化减慢而降低它的升糖指数。典型的例子就是冰激凌，虽然它含有大量的糖，但却是中等升糖指数的食品。同样，在吃高和中等升糖指数食物时添加食物纤维也能降低对血糖的影响，以及胰岛素的水平，从而把碳水化合物变成可控释放的能量。

Notice in Table 16.2 that many of the foods that have a moderate- to high-glycemic index are the ones we have typically thought of as “healthy” and therefore eaten liberally.

注意在表 16.2 中列出的很多中等和高升糖指数的食物是我们所公认的“健康”食物，因此被不加限制地食用。这些包括淀粉

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These include the starchy foods – cereal, bread, rice, pasta, potatoes, crackers, bagels, pancakes, and bananas. No wonder so many endurance athletes are always hungry and have a hard time losing excess body fat. Their blood sugar levels are routinely kept at high levels, causing regular cascades of insulin. Not only do high insulin levels produce regular and frequent food cravings and excess body fat, they are also associated with such widespread health problems as high blood pressure, heart disease, and adult-onset diabetes.

But moderate- and high-glycemic-index foods have an important role in the athlete's diet. During long and intense training sessions and races it is necessary to replenish carbohydrate stores in the muscles and liver. That's why sports drinks and gels are used during exercise. The thirty minutes immediately following a hard training session is when moderate- to high-glycemic-index carbohydrates and insulin are also beneficial. This is the time to use a commercial recovery drink or starchy food. Combining protein with a high-glycemic-index food at this time has been shown to effectively boost recovery. For very hard workouts, this recovery window during which higher glycemic carbohydrates are eaten may extend as long as the duration of the preceding workout. So if you do a very intense two-hour ride, continue taking in high-glycemic foods for two hours post-workout.

Except for during and immediately after exercise, sports drinks, gels, and soft drinks should be avoided, however. Other high- and moderate-glycemic-index foods should be consumed in quite limited quantities throughout the day, also.

Eating a diet extremely high in carbohydrates is not unanimously supported by the sports science literature. A high-carbohydrate diet may cause your body to rely heavily on glycogen for fuel during exercise, with an associated increase in blood lactate levels, while reducing your use of fat as a fuel for exercise.

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类食物——麦片，面包，米饭，意大利面，土豆，饼干，百吉饼，煎饼和香蕉。怪不得有那么多的耐力运动员总是觉得饿，而且降低身体多余脂肪如此地困难。他们的血糖水平总是周期性地保持在高水平，从而导致胰岛素的大量分泌。高胰岛素水平除了会导致经常性的对食物的渴望以及多余的身体脂肪，它还与许多很普遍的健康问题有关系，比如高血压，心脏病，以及后天性糖尿病。

但中等和高升糖指数食物在运动员的膳食中仍然扮演重要角色。在长距离和高强度的训练和比赛中，补充肌肉和肝脏中储存的碳水化合物是非常必要的。这就是为什么在运动中需要吃运动饮料和能量棒（凝胶）。艰苦训练后的 30 分钟内，吃高和中等升糖指数的碳水化合物包括胰岛素的分泌对身体都是有利的。在这段时间内也适合喝市面上卖的恢复性饮料或淀粉类食物，另外研究表明在这段时间里把高升糖指数食物和蛋白质一起吃也能够有效地促进恢复。对于那些非常艰苦的训练来说，适合吃高升糖指数食物的时间段也许可以延长到与前期训练大致相当的持续时间。这就是说，如果你做了一次 2 小时的非常高强度的骑行，训练后的两小时内你都可以吃高升糖指数的食物。

除了在训练中和训练刚结束时可以吃运动饮料，能量棒（凝胶）以及软饮料以外，在其他时间段应该避免吃这些东西。另外高和中等升糖指数的食物的摄入在平时也应该限制在非常有限的量。

对于极端高碳水化合物的饮食的使用，运动科学文献对此看法不一。高碳水化合物饮食会导致你的身体高度以来糖原作为运动的能量来源，相应地会增加血乳酸盐水平，并降低你使用脂肪作为运动能量来源的机会。

Fat

In the 1980s, Western society painted dietary fat as such a terrifying specter that many athletes still see all types of fat as the enemy and try to eliminate it entirely from their diet. Indeed, there are some types of fat that should be kept at low levels. These are saturated fat, found in prodigious quantities in feedlot cattle, and trans fatty acids, the man-made fats found in many highly processed foods and called “hydrogenated” on the label. Hydrogenated fats lead to artery clogging the same as the saturated variety.

Don't confuse these “bad” fats with all types of fat. There are, in fact, “good” fats that not only prevent dry skin and dull hair, but more importantly help maintain a regular menstrual cycle in women and prevent colds and other infections common to serious athletes. Such fats also assist with the manufacture of hormones, such as testosterone and estrogen, and nerve and brain cells, and are important for carrying and absorbing the vitamins A, D, E, and K. Fat is also the body's most efficient source of energy. Every gram of fat provides nine calories, compared with four each for protein and carbohydrates. You may find that eating these essential fats improves your long-term recovery and capacity to train at a high level, if you previously have been low in them.

After three decades of believing that very high-carbohydrate eating is best for performance, there is now compelling evidence, albeit in the early stages, that increasing fat intake while decreasing and properly timing carbohydrate consumption may be good for endurance athletes, especially in events lasting four hours or longer. Several studies reveal that eating a diet high in fat causes the body to preferentially use fat for fuel, and that eating a high-carbohydrate diet results in the body relying more easily on limited stores of muscle glycogen for fuel. Theoretically, even the skinniest athlete has enough fat stored to last for forty hours or more

脂肪

在 20 世纪 80 年代，西方社会把膳食脂肪描述成可怕的幽灵，以致于许多运动员仍然把所有的脂肪视为敌人，并努力把所有的脂肪从他们的餐桌上全部清除。实际上，有些类型的脂肪是应该在某种程度上保留的。我们知道饱和脂肪——大量存在于饲养牲畜体内，以及反式脂肪酸，一种人造脂肪，在许多高度加工食品中存在，被冠以“氢化合物”的标签。氢化脂肪与饱和类脂肪都会导致动脉阻塞。

但是不要认为这些“坏”脂肪就代表了所有的脂肪。实际上，确实有“好”脂肪，不但能防止皮肤干燥和头发干枯，更重要的是能帮助女性保持月经周期，并帮助认真的运动员防止感冒和其他感染。这类脂肪还能辅助制造荷尔蒙（比如睾丸激素和雌性激素）以及神经和脑细胞，并且能够帮助运载和吸收维生素 A、D、E 和 K。脂肪还是身体最有效的能量来源。每克脂肪燃烧能提供 9 千卡热量，而蛋白质和碳水化合物是 4 千卡。你也许会发现吃这些关键性的脂肪能改善你的长期恢复以及在高水平下训练的能力，如果你原先这方面能力较差的话。

30 年前人们开始相信超高碳水化合物的饮食对运动能力是百利无害的，但现在有些引入注目的证据显示，在早期吃高碳水化合物饮食，然后逐渐增加脂肪摄入同时减少并在适当时间补充碳水化合物，这样对耐力运动员比较有益，特别是那些需要持续 4 小时甚至更长时间的运动。有些研究表明膳食中脂肪含量高会使身体偏向于使用脂肪做为燃料，而吃高碳水化合物饮食会造成身体更容易依赖肌肉中有限的糖原储备做为燃料。理论上说，即使是最瘦的运动员也有足够的脂肪储备在低强度下无需补充地骑 40 个小时或更长时间，但使用碳水化合物却最多只

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at a low intensity without refueling, but only enough carbohydrates for about three hours at most.

A study at State University of New York illustrates the performance benefits of fat. Researchers had a group of runners eat a higher-than-usual fat diet consisting of 38-percent fat and 50-percent carbohydrate calories for one week. The second week they ate a more typical high-carbohydrate diet with 73 percent of calories coming from carbs and 15 percent from fat. At the end of each week the subjects were tested for maximum aerobic capacities and then ran themselves to exhaustion on a treadmill. On the higher-fat diet their VO₂max was 11 percent greater than when they were on the high-carbohydrate diet and they lasted 9 percent longer on the run to exhaustion. One confounding element of the study, however, was that the subjects were glycogen-depleted before starting the endurance run.

A 1994 study conducted by Tim Noakes, M.D., Ph.D., author of *The Lore of Running* (1991), and colleagues at the University of Cape Town in South Africa found that after cyclists ate a diet of 70 percent fat for two weeks, their endurance at a low intensity improved significantly compared with cycling after consuming a diet high in carbohydrates for two weeks. At high intensities, there was no difference in the performances – fat did just as well as carbohydrates.

Other research has shown that our greatest fears associated with dietary fat – risk for heart disease and weight gain – do not occur when eating a diet that includes what might be called “good” fats. The good fats are monounsaturated and omega-3, polyunsaturated fatty acids, which were plentiful in our Stone Age ancestors’ diets according to paleontology. The oils and spreads of almonds, avocado, hazelnuts, macadamia nuts, pecans, cashews, and olives are high in these fats. Other good sources are the oils of cold-water fish such as tuna, salmon, and mackerel. The red meat of wild game also

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能坚持 3 个小时。

纽约州立大学的一项研究表明脂肪对运动能力的好处。研究者让一组长跑者吃超出常规的高脂肪膳食，第 1 周的饮食中含 38 % 的脂肪和 50 % 的碳水化合物。第二周，让他们吃更多的高碳水化合物食物，达到 73 % 的碳水化合物和 15 % 的脂肪。每周结束前会测试他们的最大摄氧量，并让他们在跑步机上跑到精疲力尽。测试结果：采用高脂肪膳食时，他们的 VO₂max 比采用高碳水化合物膳食时高 11 %，跑到精疲力尽的时间延长了 9 %。不过这项研究的一个令人困惑的元素在于研究的课题是在耐力长跑前的糖原损耗。

1994 年，由 Tim Noakes（医学和科学博士，《跑步的学问》的作者）和南非开普敦大学的同事一起主持的一项研究发现，给骑手们吃含 70 % 脂肪的膳食，两个星期后，他们在低强度下的耐力水平相比于吃两周的高碳水化合物饮食，大幅度提高了；而在高强度运动中，他们的表现没有区别——脂肪的表现和碳水化合物一样棒。

其他的研究显示我们对膳食脂肪的最大恐惧——心脏病和体重增加的危险——如果我们吃所谓的“好”脂肪的话并不会发生。这些好脂肪是单不饱和脂肪酸，Omega-3 脂肪酸，和多不饱和脂肪酸。根据古生物学的研究，这些脂肪在我们石器时代的祖先的膳食中非常丰富，杏仁，鳄梨，榛子，澳洲坚果，美洲山核桃，腰果和橄榄中这些脂肪的含量很丰富。其他的来源如冷水鱼的油，比如金枪鱼，三文鱼和鲭鱼。野味的红肉中也提供了很多的单不饱和脂肪酸和 Omega-3 脂肪酸。芥花子油是另一种很好的来源。

provides significant amounts of monounsaturated and omega-3 fats. Canola oil is another good source.

The bottom line on fat is to select the leanest cuts of meat (wild game or free-range cattle, if possible); trim away all visible fat from meat, including fish and fowl; eat low- or non-fat dairy in small quantities; avoid trans fatty acids in packaged foods; and regularly include monounsaturated and omega-3 fats in your diet. Eating 20 to 30 percent of calories from fat, with an emphasis on the good fats, is not harmful, and may actually be helpful for training and racing if your fat intake has been low.

Water

Many athletes don't drink enough fluids, leaving them perpetually on the edge of dehydration. In this state, recovery is compromised and the risk of illness rises. Drinking throughout the day is one of the simplest and yet most effective means of boosting performance for these athletes. Since sports drinks and most fruit juices are high to moderate on the glycemic index, the best fluid replacement between workouts is water.

Dehydration results in a reduction of plasma, making the blood thick and forcing the heart and body to work harder moving it. Even with slight dehydration, exercise intensity and duration are negatively affected. A 2-percent loss of body weight as fluids will slow a racer by about 4 percent – that's nearly five minutes in a two-hour race. When race intensity is high, you must stay well hydrated to keep up.

A 150-pound (68 kg) adult loses a little more than a half-gallon (2 liters) of body fluids a day just in living, not including training. Up to half of this loss is through urine at the rate of about 2 ounces (30 ml) per hour. Heavy training or a hot and humid environment can increase the loss to 2 gallon (8 liters) daily through heavy sweating.

脂肪摄入的底线是挑选肉中最瘦的部分（如果可能，尽量吃野味或放养的牲畜）；从肉上剔掉可见的脂肪，包括鱼和家禽；吃少量的低脂或脱脂牛奶；避免打包食品中的反式脂肪酸；定期在膳食中增加单不饱和脂肪酸和 Omega-3 脂肪酸。每日摄入热量中有 20—30% 来自脂肪——主要是好脂肪——对身体无害，而且如果你原先的脂肪摄入较低的话，也许还会对你的训练和比赛有好处。

水

许多运动员喝水不足，使得他们总是处在脱水的边缘。在这种状态下，恢复会比较慢，生病的危险也会增加。对这些运动员来说，全天不断喝水是一项最简单也是最有效的提高运动能力的方法。由于运动饮料和大多数果汁有高或中等的升糖指数，所以在不运动时的最好的饮料就是水。

脱水会导致血浆的减少，使得血液粘稠，从而加重心脏和身体负担。即使是轻微的脱水也会对运动强度和持续时间产生负面影响。身体如果失去占体重 2% 的体液，就会使比赛者降低 4% 的运动能力——相当于在 2 小时的比赛中慢 5 分钟。如果比赛强度很大的话，你必须保持充足水分才能坚持下去。

一个 68 公斤的成年人每天会失去 2 升多的体液，这还不包括训练。失去的水分中有一半是尿，差不多每小时排尿 30 毫升。高强度训练或潮湿炎热的环境能够引起大量出汗，使体液损失增加到每天 8 升。

Unfortunately, the human thirst mechanism is not very effective. By the time we sense thirst, dehydration is already well under way. Following prolonged and intense training or racing, it may take twenty-four to forty-eight hours to rehydrate if thirst is the controlling factor. In contrast, a dog will drink up to 10 percent of its body weight immediately following exercise, replacing all lost water. It's important to drink water steadily throughout the day when you are training whether you are thirsty or not.

Get in 8 to 12 cups (1 to 1.5 liters) a day, depending on your body size and training load. For every pound (450 g) lost during exercise, an additional 2 cups (500 ml) of water is needed. You can also use your rate of urination and urine color as a guide. You should need to visit the toilet at least once every two hours during the day and your urine should be clear to straw-colored. If you aren't achieving these standards, drink more.

Periodization of Diet

The optimal diet for peak performance must vary with the athlete just as the optimal training protocol must vary from person to person. We can't all eat the same things in the same relative amounts and reap the same benefits. Where your ancestors originated on the planet and what was available for them to eat for the last 100,000 years or so, is important for what you should eat now.

So the bottom line is that you must discover what mix of foods works best for you. If you have never experimented with this, don't automatically assume you have found it already. You may be surprised at what happens when changes are made at the training table. A word of caution: Make changes gradually and allow at least three weeks for your body to adapt to a new diet before passing judgment based on how you feel and your performance in training. It usually takes at least two weeks to adapt to significant changes before seeing any benefit. During the adaptation period you may

不幸的是，人体的口渴机制不是非常有效。当我们感到口渴时，实际上已经脱水了。如果靠口渴来控制喝水，在持续时间较长的高强度训练或比赛以后，也许会需要 24 到 48 小时才能恢复身体的水分。相比之下，狗能运动之后马上喝下占其体重 10% 的水以补充它失去的所有体液。所以在你训练的时候，不管是否口渴，都要不断地喝水，这一点非常重要。

根据你的体型喝训练量，每天喝 8 到 12 杯水（1—1.5 升）。在训练中每失去 1 磅（450 克）体重，就需要补充 2 杯水（500 毫升）。你也可以根据排尿的频率和尿液的颜色指导喝水。你应该至少每隔两小时光顾一次洗手间，而尿液应该是无色或淡黄色。如果你达不到上述标准，多喝点水。

饮食的周期性

高峰期的最佳饮食对不同运动员来说肯定是不一样的，就象最佳的训练方案也是因人而异的一样。我们不可能都吃同样的东西，或吃同样多的食物，并获得同样的好处。但是了解你的祖先最早在地球上吃什么以及最近 10 万年来都吃了些什么，对指导你应该如何吃是很重要的。

所以底线就是你必须了解如何搭配食物对你最有利。如果你从没有做过这方面的实验，那么就别想当然地以为你已经了解了。你的训练表格的改变也许会使你对引起的变化感到吃惊，所以记住这句话：慢慢的改变饮食，让身体至少有 3 周的时间适应新的饮食，而不要过早地根据训练表现和感觉来下结论。饮食的重大调整需要至少两周才能被身体适应，在这之前你看不到任何好处，在适应期你也许会感到昏昏欲睡以及状态很差。因此，饮食调整最好是放在赛季最初时

feel lethargic and train poorly. For this reason, changes in diet are best done in the Transition and Preparation periods early in the season. Also, be aware that as you age, changes may occur in your body chemistry requiring further shifts in the diet.

That said, an optimal diet to enhance training, racing, and recovery involves not only eating moderate amounts of protein, carbohydrates, and fat, but also varying the mix of these macronutrients throughout the year. In other words, diet should cycle just as training cycles within a periodization plan. Protein serves as the anchor for the diet and stays relatively constant throughout the year as fat and carbohydrates rise and fall alternately with the training periods. Figure 16.1 illustrates this “see-saw” effect of the periodized diet. Note that the numbers used in this figure are merely an example, and the diet right for you may vary considerably.

的过渡期和准备期。另外，请注意随着年龄增长，你会更加需要饮食的改变来调整身体的化学状态。

这就是说，能够提高训练，比赛和恢复的最佳饮食不光包括要吃适量的蛋白质，碳水化合物和脂肪，还包括在整个年度中调整各种营养素的混合比例。换句话说，就象周期性计划中的训练周期一样，饮食计划也有周期。蛋白质就象是周期的支点，在全年饮食中保持相对恒定的摄入；脂肪和碳水化合物的摄入则根据训练周期的变化交替地升高或降低。图 16.1 显示了这种“跷跷板”式的周期性的饮食。注意图中使用的数据只是用作示例，而完全适合你的饮食数据可能与之有所出入。

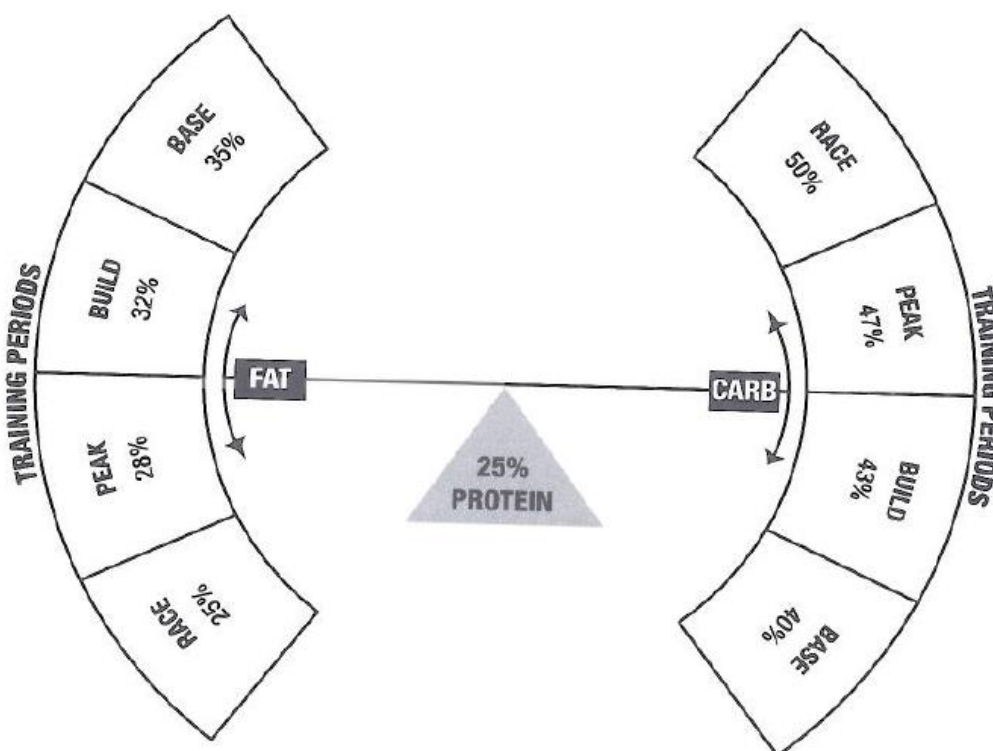


Figure 16.1 The dietary periodization “seesaw”. The percentages are for illustration only and will vary between athletes.

图 16.1 “跷跷板”式的饮食周期性。百分比数据只用作示例，对不同运动员各不相同。

Antioxidant Supplements

Generally it's a good idea to meet your nutritional needs with real foods and use food supplements sparingly. Scientists and supplement designers just aren't as smart as Mother Nature when it comes to deciding what to include and what to leave out of foods. Real food provides everything needed for health and fitness. Adding lots of pills and potions to your diet is usually not wise. The exception is antioxidant supplements. Here's why.

The process of metabolizing food and oxygen for exercise releases free radicals that cause damage to healthy cells. This is much like the rusting of metal – a breakdown caused by oxidation. Hard training produces large numbers of free radicals, which threaten your health and ability to recover following workouts.

For example, one study measured by-products of free radical damage in highly trained athletes, moderately trained athletes, and a sedentary group. The researchers found that the highly trained athletes had the highest levels of damage, while the moderately trained subjects had the least. The sedentary group was in the middle. A little exercise appears to be a healthy thing when it comes to free radicals, but extensive exercise or none at all causes problems.

In recent years, studies have shown that vitamins C and E reduce damage and prevent colds associated with extreme physical exertion by combining with the free radicals to stop the oxidative process. The research studies typically use large doses of each of these micronutrients – usually hundreds of times the RDA. Because the calculation involves variables such as age, sex, diet, body fat, size, and training load, it is difficult to determine the necessary amounts for each individual. Recommended daily intakes based on these studies generally fall into the following ranges:

Vitamin E 400 -- 800 IU

抗氧化剂

一般来说，我们应该吃真正的食物来满足身体的营养需求，而且尽量少吃营养品补剂。在决定应该在食物中加入什么，去除什么的问题上，科学家和营养品设计者没法比大自然母亲更聪明。真正的食物能提供保持健康和体质所需的所有营养，所以在饮食中加入太多的药丸和补剂是不明智的。但抗氧化剂是个例外。原因如下。

在活动时，身体在食物和氧气的代谢过程中会释放对健康细胞有损害的自由基。这就象金属会生锈一样——都是由氧化带来的毁损。艰苦训练会制造大量的自由基，这会威胁你的健康，以及训练后的身体恢复能力

例如，有一项研究测量了三组人群的因自由基造成的身体损害，分别是高度训练的运动员，中等训练的运动员，和久坐人群。研究发现高度训练的运动员受到的身体损害最大，中等训练的运动员损害最小，而久坐人群处于中间位置。看起来在关于自由基的问题上，少量运动对身体是有好处的，而太剧烈的运动或一点不运动都会有问题。

最近几年的研究表明维生素 C 和 E 能与自由基结合并阻止其氧化过程，从而减少其对身体的损害，以及因竭力运动引起的感冒发生。在这些研究中，一般会让受试人群服用大剂量的各种营养素——一般比美国标准每日推荐量（RDA）高上百倍。但因为需要考虑到各种变数，比如年龄，性别，饮食习惯，体脂含量，身高，以及训练量，所以很难确定一个适合所有人的必须摄入量。以下是基于各项研究的推荐的每日摄入量所分布的范围：

维生素 E 400—800 国际单位

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Vitamin C 300 – 1,000 mg

The problem is that in order to get even the lowest of these dosages you would have to eat all of the following foods every day:

Asparagus	15 spears
Avocados	31
Broccoli	4 cups
Peaches	33
Prunes	30
Tomato juice	12 ounces
Spinach	17 cups
Wheat germ	¼ cup

While some cyclists I know put away 3,000 to 4,000 calories a day, none eat such foods in these volumes.

While eating a wholesome diet from a wide-ranging menu is absolutely necessary for optimal health and fitness, few people, including athletes, achieve the recommended standards. For example, it has been estimated that the minimum goal of eating five fruit and vegetable servings per day is accomplished by less than 10 percent of the American population.

While it is true that serious athletes tend to eat more than average citizens, they seldom eat enough of the right foods. A 1989 study of triathletes who competed in the national championship; the Hawaii Ironman; or the Huntsville, Alabama, Double Ironman® found that as a group they had inadequate caloric intakes due to unusual eating habits. They also demonstrated poor food selection resulting from rigorous training schedules and limited time for eating.

Athletes often rely on daily multiple vitamins, but these seldom provide vitamins C and E in large enough volumes. Highly-trained athletes may need to supplement their diets with individual dosages, especially vitamin E. It appears that these supplements should be taken with meals twice a day for best results.

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维生素 C 300—1000 毫克

但问题是即便只是为了达到上述的最小摄入量，你也必须每天吃下所有下列的食物：

芦笋	15 根
鳄梨	31 个
花椰菜	4 杯（0.96 公斤）
梨子	33 颗
干洋李	30 个
番茄汁	12 盎司（340 毫升）
菠菜	17 杯（4 公斤）
麦芽	¼ 杯（60 毫升）

我知道有些骑手每天能吃进 3000 到 4000 大卡的热量，但却没人能吃得下这么多东西。

虽然吃范围广泛的有益健康的食物对健康和身体素质来说是绝对必要的，但很少有人，包括运动员，能够达到推荐的摄入标准。比如说，只有不到 10% 的美国人能达到每天吃 5 个水果和蔬菜的最低目标。

当然认真的运动员确实会比平常人吃得多一些，但他们却没吃进应该吃的东西。在 1989 年有一项研究，针对的都是参加全国锦标赛的铁人三项运动员，比如夏威夷铁人赛，或亚拉巴马州 Huntsville 镇的双倍铁人赛。研究发现他们都因为不正常的饮食习惯而造成集体性的热量摄入不足，而且这些运动员所吃的食物选择性不够，因为训练日程太满，吃饭的时间太少了。

运动员常常依赖于每天吃多种维生素片，但其中所含的维生素 C 和 E 的成分却不够多。高度训练的运动员也许应该在他们的饮食中补充一些剂量，特别是维生素 E。这些补剂应该在就餐时吃，一日两次，以达到最佳效果。

Vitamin C has a low level of risk associated with usage at the above level, but high dosages of vitamin E can cause problems for those who are deficient in vitamin K. Check with your health-care provider before starting supplementation.

Ergogenic Aids

Several years ago university researchers asked a group of elite athletes to answer a question: "If you could take a pill that would ensure a gold medal in the next Olympics, but you would die within five years, would you take it?" The overwhelming answer was "Yes!"

Such attitudes have led elite athletes to experiment with anabolic steroids, erythropoietin (EPO), amphetamines, and other banned ergogenic aids. Some have consequently died in their quest for athletic excellence. Others have simply wasted their money on products that have no benefit beyond a placebo effect and have not withstood scientific investigation.

There is no magic pill that will guarantee an Olympic medal – or even a better-than-average race performance in your local crit. Training is still the single most important component of athletic excellence. There are, however, a few products that go beyond a normal diet and which science has generally found effective. I say "generally," because as with the scientific study of almost anything, there are often contradictory results. Also, not all ergogenic aids have the same benefits for everyone. Individualization applies here just as it does in training.

Before deciding upon the use of certain ergogenic aids, the following five questions should be answered:

1. **Is it legal?** Products are often promoted to athletes despite the fact that they contain a banned substance. There have been many instances of blind trust resulting in a disqualification or worse for an elite

维生素 C 若服用过量，其危险性比较小，但大剂量的维生素 E 会对那些维生素 K 缺乏的人造成问题。所以在开始吃之前，请和你的保健医生确认一下。

增进机能的辅助物品

几年以前的某大学研究中，请一组精英运动员回答以下问题：“如果给你吃一种药丸能让你在下届奥运会里拿到金牌，但你会因此而在 5 年中死掉，你会吃吗？”结果得到的回答几乎全是“要吃”！

正是这种态度导致精英运动员们尝试合成代谢类固醇，促红细胞生成素（EPO），安非他命，以及其他一些违禁的增进机能药物。有些人已经为他们对运动巅峰能力的探索付出生命代价，另一些人只是因为抵挡不住所谓的科学研究而浪费金钱去吃那些和安慰剂没什么区别的东西。

没有什么能保证得到奥运会奖牌的所谓神奇药丸——甚至没有什么药物能让你在本地区的绕圈赛中发挥得比平时好。训练仍然是决定运动能力的唯一最重要的因素。当然了，确实有一些不同于普通饮食的药品，科学也证实是普遍有效的。我说“普遍”，是因为科学研究的对象无所不包，常常会发生相互矛盾的结果。另外，增进机能的辅助物品的效果也是引人注异的，就象训练需要个性化设计一样。

在决定使用某种增进机能的辅助物品之前，你应该先考虑以下 5 个问题：

1. **吃它合法吗？** 有一些药物确实能提高运动员成绩的，但其中含有违禁的成分。有许许多多这样的例子，精英运动员因为盲目的信赖导致禁赛甚至更糟的结

athlete. To check on a specific product, visit the U.S. Olympic Committee's Anti-Doping Policies link at the Web site at www.olympic-usa.org.

2. **Is it ethical?** Only you can answer this question. Some believe that sport must be conducted in its purest form with absolutely no artificial assistance. But once we begin to ponder such ergogenic aids as carbohydrate loading and vitamin and mineral supplements, it becomes clear that drawing a line in the sand is difficult.
3. **Is it safe?** Studies on the effects of various sports aids are often limited to a few weeks, as most subjects don't want to donate their entire lives to science. Such short periods of observation may not produce observable effects that might otherwise occur with long-term use. There is also the outside possibility that using multiple substances simultaneously or in combination with common medications may produce undesirable side effects. Another complication is that the U.S. Food and Drug Administration (FDA) safety regulations for supplements are more lenient than for food products. It's always a good idea to check with your family physician before supplementing.
4. **Is its use supported by the research?** There may be an isolated study on any product that demonstrates a benefit, but does the bulk of the literature agree? To search the scientific journals for studies, point your browser at the government's PubMed Web site (www.ncbi.nlm.nih.gov/PubMed/), enter the substance of interest, and select "search". You'll be presented with a list of archived studies and their abstracts. Have fun reading the list – it could be a thousand or more items long. Better yet, ask a knowledgeable and trusted coach, trainer, registered dietitian, or medical professional for their insights on the product in question.

局。要想了解某个特殊药物，可以访问美国奥委会官方网站 www.olympic-usa.org 的反兴奋剂政策的链接。

2. **吃它道德吗？** 只有你能回答这个问题。有些人相信体育运动必须回归到最初没有任何人工辅助的最纯洁的状态。但自从我们开始考虑吃碳水化合物和维生素以及矿物质营养品来辅助提高机能开始，我们就发现想要划一道清楚的界限是非常困难的。
3. **吃它安全吗？** 用于研究药物对运动的辅助效果的时间往往限制在几周之内，因为绝大多数被测试对象不可能终其一生献身于科学研究。这么短的观察时间也许不足以发现长期服用后也许会出现的一些效果和反应。另外还有一些外在的可能性，比如多种物质一起吃，或与一些常用药物一起服用，也许会造成一些未预料到的副作用。还有一个因素使问题更加复杂，那就是美国食物与药品管理局（FDA）对营养品的安全标准要比对食品的安全标准更宽松。所以你最好还是先和你的家庭医生先沟通一下，然后再决定是否服用。
4. **它的药效是否已经被研究证实？** 也许某个孤立的研究展示了某药物的好处，但整个学术界是否支持呢？要想搜索这方面的科学研究期刊，请浏览政府的公共药物网址 (www.ncbi.nlm.nih.gov/PubMed/)，输入你感兴趣的药物，然后选择“搜索”。你会看到一个研究论文的清单和它们的摘要，慢慢看吧——清单可能会有一千条以上。更好的办法是，请教那些知识渊博并值得信赖的教练，训练师，注册营养师，或职业医生，听听他们对这些有疑问的药物是如何的看法。

5. **Will it help in my race?** Even if generally supported by the research, not all ergogenic aids benefit all people in all events. There are many individual differences that may affect the use of a given product. It may not work well for you because of some combination of your age, sex, health status, medications used, and years of experience in the sport. Some aids have been shown to provide a benefit for short events such as the 100-meter dash, but not for events lasting for several hours.

The following is a discussion of several currently popular and legal ergogenic aids that are probably safe for most athletes and beneficial at some level in cycling. Before using any of these, consult with your health-care provider. Never use a product immediately before or in an important race without having first tried it in training or in a C-priority event.

Branched-Chain Amino Acids

During workouts lasting longer than about three hours, the body turns to protein to provide fuel – perhaps as much as 10 percent of the energy requirement. Three essential amino acids – ones that must be present in the diet since the body can't synthesize them – make up about a third of muscle. These are leucine, isoleucine, and valine. Collectively they are called branched chain amino acids (BCAA).

Those who eat little protein, especially from animal sources, are likely to get the most benefit from using BCAA. Since vegetarians are often deficient in protein intake levels, BCAA supplementation may prove especially helpful for them.

BCAA may be purchased in health food stores and drug stores that sell food supplements. They should come in a brown bottle to protect the capsules from light, and the label should indicate each of the individual amino acids, preceded by an "L" as in "L-valine". This ensures adequate absorption.

5. **吃它对我的比赛有帮助吗？**即使是那些被研究项目广泛支持的增进机能的辅助物品，也不一定能适用于所有人和所有比赛。个体之间的差异可能会对同样药物产生不同的效果。它可能会不适合于你，由于某些因素的组合，比如年龄，性别，健康状况，用药经历，从事运动的年头等等。有些辅助效果只体现在短距离项目上，例如 100 米跑，但对持续几个小时的项目却没什么用。

下面将会讨论一些目前广泛使用的合法的增进机能的辅助物品，他们对大多数运动员都应该是安全的，并在一定程度上对骑车是有帮助的。但在使用之前，请先询问你的保健医生。另外绝对不要在重大比赛前或比赛时仓促使用，如果你还没有在 C 级赛事或训练中预先尝试过它们的话。

支链氨基酸（BCAA）

在超过 3 小时的高强度训练中，身体会使用蛋白质做为能量来源——大约占中能量需求的 10%。有三种关键氨基酸——因为身体无法合成它们，所以必须依靠饮食摄入——组成了大约 1/3 的肌肉组织。它们是亮氨酸，异亮氨酸和缬氨酸，它们被统称为支链氨基酸（BCAA）。

那些不太吃蛋白质，特别是不太吃肉的人，可能会更多地从 BCAA 中获益。因为素食主义者经常处于蛋白质摄入不足的水平，因此补充 BCAA 可能对他们特别地有帮助。

BCAA 能够从保健品商店和药店的食物增补剂柜台买到。它们应该是些胶囊，装在棕色瓶子里以防光线照射，标签上应该以“L”打头说明每种氨基酸，比如“L-valine”就是缬氨酸的说明。这样是为了确保适当的吸收。

Research on the use of BCAA is inconclusive. Some studies have shown that supplementing the diet with BCAA enhances endurance performance in long events, especially those lasting three hours or longer. A few have found that it even helps in events of one-hour duration. When benefits are seen in research they typically fall into these categories:

- High workloads and exhaustive workouts and races are likely to weaken the immune system and lead to illness. BCAA help to maintain the immune system following exhaustive workouts and races, reducing the likelihood of training breakdowns. Thus they have the potential to speed recovery.
- Some studies have shown BCAA to maintain muscle mass, power, and endurance during exhaustive, multi-day endurance events such as stage races or crash training (see Chapter 10).
- BCAA may help to reduce central nervous system fatigue, thus maintaining performance late in a race. This is a recent theory that is still under investigation in the sports science community.
- BCAA promote the use of fat for fuel while conserving glycogen.

There are four times in your training season when using BCAA may be beneficial: during the Maximum Strength (MS) phase, in the Build and Peak training periods, for long and intense races, and while training intensely at high altitudes. It is important to observe the following guidelines for supplementing with BCAA.

- Take about 35 mg of BCAA for each pound of body weight daily, but only at the times indicated above. A 150-pound (68kg) cyclist would take 5,250 milligrams or about five grams daily. A 120-pound cyclist could consume 4,200 milligrams or about four grams a day.
- One to two hours before an MS strength workout, a high-intensity workout in the Build or Peak periods, or an A-priority

对使用 BCAA 的研究还没有定论。有些研究表明在饮食中增补 BCAA 能在长距离项目中增强耐力发挥，特别是那些持续 3 小时或更长的比赛。有些研究甚至发现在 1 小时的比赛中也有帮助。研究中发现的 BCAA 的好处主要体现在以下类别：

- 高强度训练或竭尽全力的训练和比赛有可能会削弱免疫系统而导致生病。BCAA 帮助在竭尽全力的训练和比赛后保持免疫系统正常运行，减少训练中断的可能性，从而也潜在地加快了身体的恢复。
- 有些研究显示，在竭尽全力的多日的耐力比赛，比如系列赛或破坏性训练中，BCAA 能保持肌肉组织，力量和耐力不减少（参见第 10 章）。
- BCAA 也许能帮助减少中枢神经系统的疲劳，从而在比赛后期保持运动能力。这是个很新的理论，目前在运动科学界还正处于调查研究阶段。
- BCAA 提高使用脂肪做为燃料的能力，从而节省糖原的使用。

在你的训练年度中有 4 个时间段，在此期间使用 BCAA 也许会有好处的：最大力量阶段（MS），发展期和高峰期，时间长强度大的比赛，以及在高水平下间歇训练时。补充 BCAA 时，注意以下一些指导方针非常重要：

- 每磅体重每天摄入 35 毫克 BCAA，而且只在以上所说的时间段服用。一个 150 磅（68 公斤）的车手每天需要摄入 5250 毫克或者说 5 克。一个 120 磅的车手每天应该摄入 4200 毫克或者说 4 克 BCAA。
- 在最大力量训练，发展期或高峰期的高强度训练，或 A 级赛事之前 1-2 小时吃当日剂量的一半。然后，当天睡觉之

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race, take one-half of your daily dose. Then, one to two hours before bedtime the same day, take the other half.

- During a stage race, double your normal dosage taking one-third before the race, one-third an hour or two before your post-race nap, and one-third before turning in for the day.

One potential negative side effect of taking BCAA has to do with imbalances in dietary intakes of amino acids. When eating meat, all of the amino acids are present in the proper ratios, but excessive supplementation with BCAA may upset the balance between them. Some scientists and nutritionists are concerned that this may have long-term health implications.

Medium-Chain Triglycerides

Medium-chain triglycerides (MCT) are processed fats that are metabolically different from other fats in that they are not readily stored as body fat and are quickly absorbed by the digestive system like carbohydrates, thus offering quick energy. They also provide about twice the calories per gram when compared to carbohydrates. Some studies have shown that mixing MCT and carbohydrates in sports drinks can improve endurance and maintain the pace in the latter stages of races lasting two hours or longer.

In a 1990s study at the University of Capetown in South Africa, six experienced cyclists rode for two hours at about 73 percent of maximum heart rate. Immediately after this steady, but low-intensity ride, they time trialed 40 kilometers at maximum effort. They did this three times over a ten-day period using a different drink for each attempt. One drink was a normal carbohydrate sports drink. Another was an MCT-only beverage. The third ride used a sports drink spiked with MCT.

With the MCT-only drink their average 40k time was 1:12:08. The carbohydrate sports drink produced a 1:06:45. With the mixed

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前 1—2 小时吃另一半。

- 在系列赛期间，摄入量要比平时加倍。当日比赛前吃三分之一，赛后小睡前 1—2 小时吃三分之一，当天结束前再吃三分之一。

摄入 BCAA 的一个潜在的副作用是会打破膳食摄入氨基酸的平衡。你吃肉的时候，所有吃进的氨基酸都保持合适的比例，但 BCAA 的额外增补会打破这种平衡。有些科学家和营养学家担心这有可能会引起长期性的健康问题。

中链甘油三酯（MCT）

中链甘油三酯（MCT）是一种加工过的脂肪，它与其他脂肪的新陈代谢过程有所不同。它不太容易在体内储存堆积，而是象碳水化合物一样会被消化系统快速吸收，从而提供快捷的能量，每克提供的能量是碳水化合物的两倍。有些研究显示把 MCT 与碳水化合物混合在运动饮料中能改善耐力和保持节奏，特别是在持续两小时甚至更长的比赛的后阶段里。

20 世纪 90 年代在南非开普敦大学进行的一项研究中，要求 6 名资深车手在 73% 的最大心率下骑行 2 小时。在这段平稳但低强度的骑行结束之后马上让他们以最大努力做 40 公里个人计时测验。在 10 天时间里他们做了三次这样的测试，每次测试时使用不同的饮料。一种是普通的碳水化合物运动饮料，一种是只含 MCT 的饮料，第三种是混合了 MCT 的运动饮料。

喝只含 MCT 的饮料时，他们的 40 公里平均成绩是 1:12:08；喝碳水化合物运动饮料时成绩为 1:06:45；而喝混合 MCT 与碳水

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MCT-carbohydrate beverage their time was 1:05:00 – a significant improvement. The study's authors believe that the MCT spared glycogen during the two-hour steady ride, allowing the riders to better utilize carbohydrates during the more intense time trial late in the season.

An MCT-sports drink mix may benefit your performance late in races that last three hours or longer. You can create such a long-race drink for yourself by mixing 16 ounces of your favorite sports drink with four tablespoons of MCT. You can purchase liquid MCT at a local health food store. There are no known side effects for MCT used in this manner.

Creatine

Creatine is one of the most recent additions to the ergogenics field, having its first known usage in athletics in 1993. Since then, the number of Creatine studies has steadily increased, but a lot of questions remain unanswered.

Creatine is a substance found in dietary meat and fish, but can also be created in your liver, kidneys, and pancreas. It is stored in muscle tissue in the form of Creatine phosphate, a fuel used mostly during maximum efforts of up to about twelve seconds and, to a lesser extent, in intense efforts lasting a few minutes.

The amount of Creatine formed by the human body is not enough to boost performance for endurance events, but scientists have found that by supplementing the diet for a few days preceding the event, certain types of performance can be enhanced. In order to get an adequate amount of Creatine from the diet to improve performance, an athlete would have to eat up to five pounds of rare meat or fish daily. Supplementing appears to be quite effective in increasing stored creatine.

A few years ago, scientists from Sweden, Britain, and Estonia tried creatine supplements

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化合物的饮料时他们的成绩是 1:05:00——很明显的提高。该项研究的主持者相信 MCT 能在 2 小时的平稳骑行中节省糖原的消耗，从而让骑手在接下来的强度更大的个人计时赛中更好地使用碳水化合物。

在持续 3 小时或更长的比赛中，混合 MCT 的运动饮料也许会对你在比赛后期的运动能力有所帮助。你可以自己制造这样的长途比赛饮料：在你最喜爱的运动饮料中每 450 毫升加 4 大汤匙 MCT。你可以在当地的保健品商店买到液态的 MCT。尚未发现如此使用 MCT 有什么副作用。

肌氨酸

肌氨酸是一种最近才进入增进机能领域的新产品，最早于 1993 年应用于运动领域。从那时起，关于肌氨酸的研究开始稳步增加，但很多问题仍然没有答案。

肌氨酸是一种在肉类和鱼类中发现的物质，它也能在你的肝脏，肾脏和胰脏中制造出来。它以磷酸肌酸的形式储存于肌肉组织中。磷酸肌酸是一种能量物质，主要为 12 秒以内的最大强度运动供能，也可以为持续几分钟的但强度稍降低一些的运动供能。

身体自身合成的肌氨酸不足以在耐力运动中提高运动水平，但科学家发现在比赛前的几天里在饮食中增补该成分，有些运动指标能够被提升。但是为了从饮食中获得足够的肌氨酸来改善运动能力，一个运动员需要每天吃 5 磅的鲜肉或鱼类。所以看起来增补现成的能买到的肌氨酸会更加有效一些。

几年前，来自瑞典，英国和爱沙尼亚的科学家为一组跑步运动员做了一次增补肌氨

on a group of runners. Following a creatine-loading period the subjects ran a 4*1,000-meter interval workout at maximum effort. Compared with the pre-test results, the creatine-supplemented subjects improved their total 4,000-meter times by an average of 17 seconds while the placebo-control group slowed by one second. The relative advantage the creatine users experienced increased as the workout progressed. In other words, they experienced less fatigue and were faster at the end. Be aware, however, that a few other studies using swimmers and cyclists found no performance enhancement from creatine supplementation in repeated short, anaerobic efforts.

There is still not a lot known about creatine supplementation, but the benefits are probably greatest for maximizing the gains from interval and hill repeat workouts, in races on the track, and in short races on the road such as criteriums. Some users believe that it decreases body fat, but it may only appear that way since body weight increases due to water retention as fat stays the same. Body-weight gains have been in the range of two to five pounds (0.9 to 2.3kg). Also, creatine does not directly build muscle tissue. Instead it provides the fuel so more power training is possible within a given workout, thus stimulating muscle fiber growth. The use of creatine by endurance athletes is equivocal. The best times to supplement with creatine for an endurance athlete, if at all, are during the Maximum Strength weight training phase and the higher-intensity Build period of training. Athletes who are low in force and power qualities stand to benefit the most at these times. It is best to avoid its use in the Peak period, when water-weight gains may be difficult to reduce prior to important races. About 20 to 30 percent of those who take creatine experience no measurable physiological changes. Vegetarians may stand to realize greater gain from using creatine since they typically have low levels.

Most studies have used huge dosages, such as 20 to 30 grams of creatine a day taken in four to five doses during a four- to seven-day loading phase. One found the same muscle

酸的测试。在增补肌氨酸一段时期之后，测试对象要以最大努力做 4×1000 米的间歇跑步测试。与增补前的测试结果对比后发现，增补肌氨酸的测试对象的 4000 米跑步成绩平均提高了 17 秒，而吃安慰剂的一组运动员的平均成绩慢了 1 秒。随着测试的进行肌氨酸使用者也更多地感觉到了这种进步，换句话说，他们感到测试时跑地更快了，疲劳更少了。但是请注意，另外有一些对游泳运动员和自行车手的研究却发现，增补肌氨酸对重复性的短距离无氧运动没有任何提高作用。

关于增补肌氨酸我们还有很多未知数，但是其好处也许能在间歇训练，重复爬山，跑道上的比赛，公路上的短距离比赛例如绕圈赛上得到最大的体现。有些使用者相信它能降低身体脂肪率，但实际上这是因为身体保持了更多的水分因而体重增加但脂肪仍维持原样不变。增加的体重会维持在 2—5 磅之间（0.9—2.3 公斤）。另外，肌氨酸不能直接构成肌肉组织，它只是提供了更多的能量来源从而使高强度训练中的大功率输出成为可能，从而刺激肌肉纤维生长。耐力运动员使用肌氨酸的效果并不明确。如果一定要使用的话，对于耐力运动员来说最好的增补时间是在最大力量阶段的力量训练时期，以及发展期的较高强度的训练时期。力量和功率输出较弱的运动员能在这些阶段里从增补中获得最大的收益。在高峰阶段最好不要使用肌氨酸，因为身体增加的水分重量很难在比赛之前减掉。大约 20%—30% 的增补肌氨酸的人没有体会到任何可测量的身体变化。素食主义者也许会从服用肌氨酸中获得更多的收益，因为他们常常处于低水平的肌氨酸状态。

很多研究中使用的肌氨酸剂量都很大，例如在 4 到 7 天的服用期，每天摄入 20—30 克，分 4 到 5 次服用。但有研究显示，每天服用 3 克，连续服用 30 天，也能达到同

levels, however, on as little as 3 grams daily for thirty days. After loading, muscle creatine can be maintained at high levels for four to five weeks with 2 grams taken daily. Dissolving creatine in grape or orange juice seems to improve absorption. In these studies, not all the subjects experienced an increase in muscle creatine levels despite high dosages.

According to scientists who have been working with creatine, there appears to be little health risk since it is passively filtered from the blood and puts no extra workload on kidneys, but the longest study is only ten weeks. Scientists do know that once you stop short-term use, your natural production of creatine is regained. The only well-established side effect is the addition of body weight during the loading phase, which soon disappears. A greater concern is that creatine may give you a false positive in a urine test for kidney problems. There have also been anecdotal accounts of muscle spasm and cramping in power athletes using creatine on a long-term basis, perhaps due to a lowered concentration of electrolytes in the muscles. Talk with your health-care provider before supplementing with creatine.

Creatine can be purchased at health food stores and will probably cost \$2-\$3 a day during the loading phase. It is wise to talk with your health-care provider before supplementing with creatine.

Sodium Phosphate

The German Army used sodium phosphate in World War I, and even in the 1930s, German athletes knew of its worth. It has not received a great deal of publicity in recent years, though some athletes have known about it for years, but kept the secret.

Sodium phosphate has the potential to improve a 40k time trial significantly, allow you to hang on when the pace would normally have you off the back and make high-intensity efforts feel much easier.

样的肌肉水平；接着每天服用 2 克，肌肉中的肌氨酸仍能维持在高水平状态 4—5 个星期。把肌氨酸溶解在葡萄汁或橙汁中好象能提高吸收率。另外在以上研究中也发现，不是所有的测试对象的肌肉中的肌氨酸水平都有提高，虽然他们都服用了很高的剂量。

按照研究肌氨酸的科学家们的看法，这种物质几乎没有健康损害，因为它们只是从血液中被过滤出来，因此不会对肾脏造成额外负担。但最长的研究也只有 10 个星期。科学家确实知道一但你在短期使用后停服，你的身体就会重新恢复自然的肌氨酸合成功能。唯一确切知道的副作用就是在服用期间体重会增加，但停服后就会快速消失。关于它的更大担忧在于如果肾脏出问题，则肌氨酸会导致尿检呈阳性。另外还有一些传闻，说一些强壮的运动员因为长期使用肌氨酸导致肌肉痉挛和抽搐，也许是因为肌肉中的电解质浓度降低所致。所以在增补肌氨酸之前先和你的保健医生谈谈。

肌氨酸可以在保健品商店买到，在增补期间可能每天会花费 2—3 美元。在增补肌氨酸之前先和你的保健医生谈谈是比较明智的。

磷酸钠

德国陆军在第一次世界大战时就使用磷酸钠，甚至到 20 世纪 30 年代仍在用，德国运动员也早就知道它的价值。但直到近些年它才被公开出来，虽然有些运动员很早就知道它，但却一直守口如瓶。

磷酸钠可以显著改善你的 40 公里个人计时的潜力，能让你跟上平常会把你甩开的节奏，还能让高强度的努力感觉更容易一些。

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In 1983, researchers working with elite runners found that sodium phosphate increased aerobic capacity by 9 percent and improved ventilatory threshold (like lactate threshold) by 12 percent. A more recent study of cyclists in Florida showed that using phosphate improved low-level endurance time significantly, lowered 40k time trial times by 8 percent, and raised lactate threshold by 10 percent, while lowering perceived effort. These results seem a bit extreme, but there is limited research on sodium phosphate.

It appears to produce benefits by causing the hemoglobin in the red blood cells to completely unload their stores of oxygen at the muscle. A greater supply of oxygen allows the muscles to operate aerobically at higher speeds and power outputs that would normally cause an anaerobic state.

Supplementation is similar to creatine loading. Take 4 grams of sodium phosphate for three days before an A-priority race. To prepare your gut for the change, take 1 or 2 grams for one or two days before starting the loading procedure. Spread out the daily dosage by taking one-third of it with each meal. Don't take it on an empty stomach. It's best not to continue using it more than three or four times each season, as continued supplementation reduces the benefits. In studies, the gains from sodium phosphate were still apparent one week after the loading stopped, meaning that consecutive races over two weeks can reap the benefits.

A side effect many athletes experience when sodium phosphate loading is an upset stomach. This may not appear until several days into the routine. Feeling sick right before a race is not good for your confidence, so it's best to try the loading procedure for the first time before an early-season C-priority race or workout. If you find it upsets your stomach, try the loading procedure shown in Table 16.3. Twin Labs, Inc. makes a product called Phos Fuel that works well. Take one capsule with a meal on each dosage day.

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1983 年，研究者发现磷酸钠可以让精英运动员的有氧能力提高 9%，并使肺通气极限（类似于乳酸盐极限）改善 12%。更新的一项在佛罗里达进行的关于自行车手的研究显示磷酸盐能够显著改善低强度耐力水平，使 40 公里个人计时成绩提高 8%，提高乳酸盐极限水平 10%，个人感知的费力程度也相应降低。这些结果看上去有点太极端了，但关于磷酸钠的研究确实很有限。

磷酸钠的好处体现在能让红血球中的血红蛋白完全释放它所携带的氧气到肌肉中。更充足的氧气供应能让肌肉在有氧状态下以更快速度和更大功率输出工作，而不是象平时那样导致无氧工作状态。

磷酸钠的增补类似于肌氨酸。在 A 级赛事前 3 天吃 4 克。为了让你的内脏适应变化，在开始正式增补前一两天先吃 1—2 克过渡一下，然后在比赛前 3 天每天吃饭时服用 1/3 的剂量。不要空腹吃。每个赛季服用磷酸钠的次数最好不要超过 3—4 次，因为连续的增补会降低它的效果。研究还发现，磷酸钠的效果在服用停止后一周之内仍然存在，这就说明超过两周的连续比赛仍能从中获得收益。

许多运动员感受到的副作用就是服用磷酸钠会使肚子不舒服。有时也许要到服用后几天才会出现。在比赛前感觉不舒服对你的自信心是个打击，所以第一次尝试增补过程最好是放在赛季初的 C 级赛事上，或者高强度训练中。如果你发现它使你的肚子不舒服，请参考尝试表 16.3 的服用流程。另外 Twin Labs 公司制造了一种叫做 Phos Fuel 的药丸，效果很好。在增补时期每天吃饭时吃一个胶囊即可。

A 级赛事前的天数（天）

16—19
14-15
9—13
7—8
6—比赛日

Table 16.3 Sodium Phosphate Loading

If you have a low dietary intake of calcium, sodium phosphate can cause a calcium deficiency. In this case, you'd advised not to use it. Better yet, increase your intake of dietary calcium. Do not use calcium phosphate, as no performance benefits have been linked with it.

磷酸钠每日服用量（克）

1—1.5
无
1—1.5
无
1—1.5

表 16.3 磷酸钠的服用剂量

如果你的饮食中摄入的钙较少的话，磷酸钠会导致身体缺钙。在这种情况下，你最好不要使用它。当然更好的办法是增加饮食中的钙的摄入。千万别吃磷酸钙，因为它对运动能力没有一点好处。

Caffeine

This is one of the oldest and most popular ergogenic aids. Caffeine has been shown to increase fatty acids in the blood, thus reducing the reliance on limited glycogen stores in the muscles. It also stimulates the central nervous system, decreasing the perception of fatigue, and may enhance muscle contractions. Most studies show benefits for intense events lasting an hour or longer when 300 to 600 milligrams of caffeine (two to four cups of coffee) are consumed forty-five minutes to an hour prior to the start. Table 16.4 lists the caffeine content of common products.

PRODUCT（饮品）

Drip coffee 滴漏式咖啡
Instant coffee 速溶咖啡
Percolated coffee 过滤式咖啡
Brewed tea 红茶
Mountain Dew 私酿威士忌酒
Chocolate syrup 巧克力糖浆
Coca-Cola 可口可乐
Pepsi Cola 百事可乐

Table 16.4 Caffeine Content in 6 ounces (180 ml) of Common Products

Numerous scientific studies of caffeine's effects over the past twenty years have produced many contradictions. Most have

咖啡因

这是一种最古老的也最流行的增进机能的物品。咖啡因能够增加进入血液的脂肪酸，从而使身体减少使用储存在肌肉中的有限的糖原。它还刺激中枢神经系统降低对疲劳的感受度，还有可能提高肌肉的收缩能力。大多数研究表明，持续 1 小时或更长的高强度比赛开始前 55 分钟或 1 小时，摄入 300 到 600 毫克的咖啡因（2—4 杯咖啡）是有好处的。表 16.4 列出了常用饮品中的咖啡因含量。

CAFFEINE CONTENT（咖啡因含量）

180mg
165mg
149mg
60 mg
28 mg
24 mg
23 mg
19 mg

表 16.4 常用饮品（180 毫升）中咖啡因的含量

过去 20 年里有无数的关于咖啡因的研究，也产生了很多相互矛盾的结论。大多数结论都表明咖啡因对耐力运动员是有好处

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shown benefits for endurance athletes. A recent English study, however, found no benefits for marathon runners, but significant aid for milers. The majority of studies have suggested that caffeine only helps in events lasting longer than ninety minutes, but others have shown improvement in sixty- and even forty-five-minute competitions.

While the author of one study concluded that caffeine causes a complex chemical change in the muscles that stimulates more forceful contractions during a longer period of time than without it, most have found that caffeine simply spares muscle glycogen during endurance exercise. The beneficial effects peak at about one hour after consumption and seem to last three to five hours.

Glycogen is an energy source stored in the muscles. When glycogen runs low, the rider is forced to slow down or stop. Anything that causes the body to conserve this precious fuel, as caffeine appears to do, allows a cyclist to maintain a fast pace for a longer time. For example, a study of cyclists reported a 20-percent improvement in time to exhaustion following two cups of coffee one hour before testing.

The IOC's illegal limit requires about six to eight 5-ounce cups of coffee in an hour, depending on the athlete's size. While that's quite a bit to drink, it's certainly possible. It's interesting to note that other recent research suggested that caffeine at the illegal level actually had a negative effect on performance.

Most studies find that 1.4 to 2.8 milligrams of caffeine per pound of body weight taken an hour before exercise benefits most subjects engaged in endurance exercise. That's about two or three cups of coffee for a 154-pound person. Athletes have also been known to use other products high in caffeine before and during competition.

While caffeine may sound like a safe and effective aid, be aware that there are possible complications. Most studies have shown it to

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的。但是最近英国的一项研究却发现咖啡因对马拉松运动员没有效果，但对 1500 米选手很有帮助。绝大多数研究都认为咖啡因只对时间超过 90 分钟的项目有帮助，但也有一些研究认为对 60 分钟甚至 45 分钟的竞技项目也是有改善的。

虽然有一项研究的组织者声称咖啡因能够在肌肉中产生复杂的化学反应，并能在较长时段里刺激肌肉更有力地收缩，但大多数研究发现咖啡因只是在耐力运动中节省了肌糖原的消耗。其作用在运动开始后 1 小时达到高峰，并能持续 3—5 小时。

糖原是储存在肌肉中的一种能量来源。如果糖原消耗太多的话，骑手将被迫慢下来甚至停下来。任何能够使身体保留这种珍贵能源的东西，比如咖啡因，都能让骑手在更长的时间里保持快速的节奏。例如，一项关于骑手的研究显示，在测试开始前 1 小时喝两杯咖啡，结果他骑到力竭的时间提高了 20%。

国际奥委会所要求的违禁限制是不能在一小时内连喝 6—8 杯咖啡（每杯 5 盎司），具体根据运动员的体型。但这点饮料实在是小菜一碟，太有可能发生了。有趣的是最近的研究还认为违禁标准的咖啡因摄入量实际上对运动能力有消极作用。

大多数研究发现，以每磅体重 1.4—2.8 毫克的摄入量在耐力比赛前 1 小时摄入咖啡因，能够对大多数测试对象产生好处。对于 154 磅的人来说相当于 2—3 杯咖啡。另外还有一些运动员在比赛前和比赛中使用含高度咖啡因的药品。

虽然咖啡因看上去很安全而且有效，但要注意它也可能引起的一些问题。大多数研究显示它可能对不运动的人会产生利尿效果，

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have a diuretic effect on non-exercisers, although one using athletes found little increased fluid losses during exercise. In people not used to caffeine, it may bring on anxiety, muscle tremors, gastrointestinal cramps, diarrhea, upset stomach, and nausea. These are not good things to experience before a race. Caffeine also inhibits the absorption of thiamin, a vitamin needed for carbohydrate metabolism, and several minerals, including calcium and iron.

If you normally have a cup or two of coffee in the morning, you'll probably have no side effects if it's used before a race. It appears that the benefits are greater for non-coffee drinkers than for regular users. If you don't drink coffee but are considering using it before a competition, try it several times before workouts to see how it affects you.

Glycerol

Do you wither in the heat? In long, hot races do you cramp up in the last few miles? Do you dread riding on days when the temperature reaches the 90s? If so, glycerol may be just what you need.

As your body loses fluid there is a corresponding drop in performance. As pointed out earlier, even a 1-percent drop in body weight due to dehydration reduces maximum work output by about 2-percent. This reduction is a result of decreased blood volume, since the plasma in blood supplies sweat. A 5-percent loss of body weight is common in hot, long races. Losing 7 percent of body weight due to fluid depletion is dangerous to health and may even require hospitalization. Some athletes suffer the effects of heat more than others.

Other factors besides heat may cause you to dehydrate. Sometimes all it takes is a missed feed during a race or a dropped bottle. Beyond these problems, there are also physiological limits on how much fluid the human digestive tract can absorb during high-intensity racing. All of this can lead to disaster in what might

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虽然使用它的运动员在运动中感觉不到体液流失的增加。在不习惯咖啡因的人群中，它会导致焦虑，肌肉颤动，胃肠痉挛，腹泻，肚子不适，和反胃。在比赛前经历这些感觉可不太好。咖啡因还会抑制硫胺（维生素 B1）的吸收，一种碳水化合物代谢所需的维生素，以及某些矿物质的吸收，如钙和铁。

如果你平时每天早上习惯于喝 1—2 杯咖啡，那你在比赛前使用它也许不会有什么副作用。另外咖啡因对于平时不喝咖啡的人的效果要比常喝咖啡的人要好。所以如果你平时不喝咖啡而且考虑在比赛前使用它的话，先在高强度训练前试几次看看它是否对你有效。

甘油

在烈日下你会打蔫吗？在炎热的长途比赛的最后几公里你会抽筋吗？在华氏 90 多度（摄氏 33 度以上）的高温下骑车是否是你的恶梦？如果是，那么甘油也许正是你所需要的。

当你的身体水分流失时，你的运动能力也相应地下降。前文已经指出，即使 1% 的因脱水造成的体重下降也会使最大运动输出降低 2%。这是由于总血液量的下降导致的，因为血液中的血浆由于排汗变少了。在炎热的长距离比赛中，降低 5% 的体重是很常见的。而由于体液减少导致 7% 的体重下降会危及健康甚至需要医疗护理。有些运动员比其他人更容易受天热的影响。

除了天热以外，其他一些因素也会导致脱水。有时是因为少吃了一顿饭，或者掉了一瓶水。除了这些问题外，还有一个生理限制，即人类的消化道在高强度比赛中能吸收多少液体。所有这些因素本来也许只是导致一场例外的比赛，但处理不好都会导致灾

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have otherwise been an exceptional race.

Glycerol, a syrupy, sweet-tasting liquid, turns your body into a water-hoarding sponge. Used prior to a race, it causes the body to hold on to 50-percent more fluid than when using water alone. Because of this, fluid losses through urination are decreased and there is more water available for sweat.

In one study using cyclists, body temperatures increased 40 percent less when using glycerol, compared with water only. Also, heart rate increased 5 percent less with glycerol, and there was a 32-percent improvement in endurance. There are tremendous advantages that could take you from the DNF listing to the top 10. Who would not want these benefits?

In recent years, glycerol products for endurance athletes have become available in running stores, bike shops, health food and specialty stores, and through catalog sales. Simply mix and drink the product according to the instructions on the label. Using more will not help you and may even cause problems.

As with anything new, you should experiment with glycerol before a workout – not a race. It has been known to cause headaches and nausea in some athletes. Better to find that out in training rather than in the most important race of the season.

There have been no long-term studies on the effect of large doses of glycerol, but it is generally considered safe as it is found naturally in dietary fats.

The supplement industry in the United States is not closely regulated by the government, and consequently product purity may be an issue if any of the above products are purchased from unscrupulous manufacturers. For example, a recent analysis of widely advertised category of dietary supplements found unidentifiable impurities in most of the products. Some of these have turned out to be banned substances

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难。

甘油是一种糖浆状的，甜味的液体，它会把你的身体变成吸水的海绵。比赛前使用它，会比只喝水使身体多保持 50% 的水分。因此，通过排尿导致的水分流失减少，这样就有更多的水能用于排汗了。

在某项针对骑手的研究中，使用甘油的人体表上升的温度与只喝水的人相比，要低 40%，另外使用甘油时增加的心率也比只喝水的人要少 5%，对耐力的改善是 32%。这种巨大的优势能让你从 DNF（未完赛）名单一跃进入前十名。谁会拒绝这种好处呢？

近些年来，适合耐力运动员的甘油产品开始出现在跑步用品店，单车店，保健食品和专用品店里，以及销售目录中。只要按照标签上的指示，把它混入饮料即可。过量使用不会对你有帮助而且可能会引起问题。

象其他所有新东西一样，你也应该在训练之前而不是比赛前先尝试一下甘油。已经发现甘油会导致有些运动员头痛或反胃，所以最好是在训练中发现是否有不良反应，而不是在赛季中最重要的比赛中发现。

目前没有对大剂量地使用甘油所引起的反应的长期性的研究，但一般都认为它是安全的，因为它本来就存在于饮食脂肪中。

美国的增补品产业不是被政府严格控制的，所以一些无良商家制造的上述产品其纯净度也许会有问题。例如，最近的一项对那些大做广告的饮食增补品的分析发现，大部分产品都含有无法辨别的杂质，有些甚至含有违禁成分，会导致运动员们在数月之内无法参加比赛。所以只买那些著名公司生产的在市场上广泛销售的产品，不要尝试其他的任何

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that have cost athletes their eligibilities for several months. Buy only from reputable companies whose products are well-established in the marketplace. Don't take anything unless you are sure that it does not contain banned substances.

Also, no studies have been done on how any of the ergogenic aids described here may interact if all of them are used together, with other supplements, or even with many of the medications commonly used by athletes such as ibuprofen or aspirin. It's always a good idea to talk with your health-care provider before taking any supplement, all the more so if you are on any medications.

When using an ergogenic aid, it's important that you assess the benefits, if any, for your performance. Not only does using several concurrently increase your risk of side effects, it also clouds the issue of which one provided the most performance gain – or prevented it. In addition, you should always be skeptical of better race performances as a result of supplementation. Was it really the pill, or was it the placebo effect? While many athletes probably don't care, coming to understand what helps you and what doesn't will ultimately lead to your best races.

In the final analysis, training and diet provide 99.9 percent of the impetus for performance improvements. Supplements offer only a small benefit. If your training and diet are less than desirable, there is no reason to add any ergogenic supplement to the mix.

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东西，除非你能确认其中没有违禁成分。

另外，以上介绍的这些增进机能的辅助物一起使用时是否会相互影响，或者与许多常用药物如布洛芬或阿司匹林一起使用情况如何，目前没有任何关于这方面的研究。所以在使用任何增补品前，先和你的保健医生谈谈总是没错的；如果你还在做任何药物治疗的话，就更应该这么做了。

当使用机能增进物品时，很重要的一点就是要评估它对你的运动能力带来的好处，如果有的话。如果同时服用几种增补品，那么一方面增加了产生副作用的风险，另一方面也搞不清楚哪个增补品对运动能力好处最大——所以别这么做。另外，你应该时时对增补品带来的更好的运动比赛能力持怀疑态度。真的是因为药丸的作用吗？还是你的心理作用？虽然很多运动员都不关心这个，但慢慢地了解到哪些物品对你有用，哪些没有用，最终会使你的比赛达到最佳状态。

总而言之，运动能力的提高的 99.9% 需要靠训练和饮食，而增补品只提供了很小的帮助。如果你的训练和饮食不如所愿的话，那么就没有理由去添加任何增进机能的增补品了。