CAN PLANTS FUEL CHAMPIONS?

With vegans competing in high-profile competitions across the world, researchers and dietitians are asking if a plant-based diet limits—or enhances—athletic performance.

BY GRANT CURRIN

Heidi Lynch grew up on a meat-based diet. In her Chicago, Illinois-area home, fish and grilled chicken were weekly staples. On special occasions, they had pork chops. "My family was active and health conscious, but I never knew anyone vegetarian," she says.

She was also an athlete, swimming for Vernon Hills High School her sophomore through senior years. "I wasn't very fast, but I loved it," she says. "That's when I became interested in how food fueled athletic performance."

Though she had planned to become a physical therapist, Lynch decided to study nutrition. She earned a bachelor's degree in applied health science, a master's degree in nutrition, and a doctorate in physical activity, nutrition, and wellness.

For an athlete, eating well can help speed recovery. It can prevent injuries. The right diet can even mean the difference between victory and defeat. That's why so many athletes who compete at the highest levels and their coaches are obsessed with optimizing what they eat.

While most athletes—like most people—eat an omnivorous diet that includes plants, animals, and fungi, a sizable number of elite athletes have chosen to avoid eating animal-based food altogether.

And it works for them. Vegan and vegetarian athletes compete in the Olympics, the NBA and WNBA, and the highest levels of surfing, snowboarding, tennis, and soccer. They win everything from marathons to powerlifting competitions.

Of course, professional athletes aren't a random sample of the population. These athletes are different in several key ways. For one thing, they're likely to have exceptional physical traits, such as the ability to use oxygen more efficiently or a tendency to grow a certain type of muscle more easily. They also have the resources to focus on eating a fine-tuned diet tailored just for them, perhaps with the help of a team nutritionist.

So, a plant-based diet clearly can work for some people—but what about the rest of us?

What Does It Mean to Eat?

When you sit down for a meal, the body starts working to break down food before the first bite even enters your mouth. The saliva you produce contains enzymes that convert starches into sugars and lubricates your food as it passes through the digestive tract.

"The whole purpose of eating is to break food down into its constituent components for cells to use," says Lynch, who is a a registered dietitian.

The journey isn't easy. It takes food hours to travel through the 10-meter digestive tract. During that time, the body will crush food, saturate it in acid, and use enzymes and emulsifiers to extract basic nutrients. Then it will use a range of chemical reactions and highly specialized molecules to collect these vital materials and transport them through the body.

The reason diet is vital for peak athletic performance is because what a person eats determines what materials are available to the 30 trillion cells in their body. That's where the biggest differences between an omnivorous diet and a plant-based diet lie.

"Clearly there are differences in nutrient intake between the average omnivorous diet versus the average plant-based diet," Lynch says. "That's why it's important for researchers to study the impact of different diets on athletic performance and overall health."

Without the right fuel for their cells, an athlete can't compete to the best of their ability or recover properly.

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Energy to Run, Jump, and Survive

The energy an athlete uses to sprint, lift, or swing comes, ultimately, from nuclear reactions that occur near the center of the sun. Plants use photosynthesis to convert that electromagnetic energy from sunlight into glucose, which they use as an energy source and building block to grow leaves, stems, roots, and flowers.

When a human eats, the body digests the food and converts the carbohydrates, proteins, and fats into energy and materials that are useful for us. The biggest difference between animal-based food versus plant-based food is the distribution and composition of proteins and saturated and unsaturated fats. While it's possible for the body to use protein for energy, that only happens under certain circumstances, like deep into an ultramarathon.

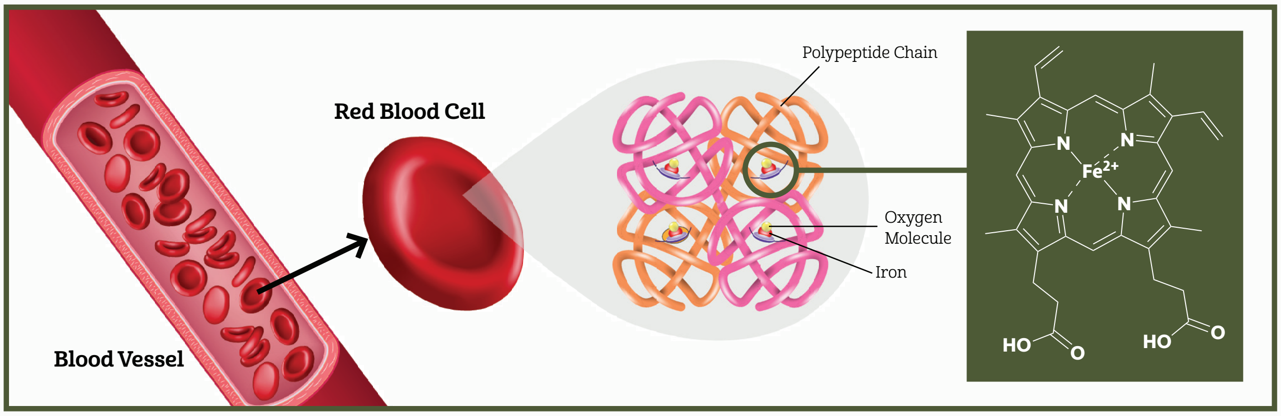
"Usually, the energy to do anything—from practicing sports to just walking to class—comes from carbohydrates and fat," Lynch says. "The body uses those carbohydrates and fats to make ATP." Adenosine triphosphate (ATP) provides energy to the cell when one of the three phosphate groups breaks away.

The energy in food is stored in the bonds that connect the atoms within carbohydrate or fat molecules. The body uses biochemical pathways with many, many steps to transform this chemical energy into a usable form.

Carbohydrates get broken down into the simple sugar glucose. From there, cells convert glucose into ATP through biochemical processes such as glycolysis and oxidative phosphorylation. Glycolysis is a series of reactions that extract energy in the form of ATP from glucose by splitting it into two three-carbon molecules called pyruvate. In the oxidative phosphorylation process, electrons are passed along a series of proteins and organic molecules found in the cell's mitochondria by a series of redox reactions that release energy. Fats are broken down through a process called beta-oxidation into molecules, such as acetyl-CoA, which then enter the citric acid cycle to produce ATP.

"The average omnivorous diet tends to be a little bit higher in total energy, as well as saturated fat, total fat, and cholesterol," Lynch says. "Plant-based diets tend to be higher in fiber and unsaturated fats and lower in omega-3 fatty acids, which humans need for specific functions." An unsaturated fat has double bonds in its long carbon chains, while a saturated fat has only single bonds in its carbon chains.

Researchers are still working to figure out



Hemoglobin is the primary protein in red blood cells. Embedded within each hemoglobin molecule are four heme porphyrins with an iron center that help transport oxygen throughout the body.

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how different forms of fat impact health, but most evidence suggests that eating a lot of saturated fat is associated with chronic health conditions.

But What About Protein?

After an intense practice session, when your muscles ache and you're still catching your breath, your body has already jumped into self-repair mode. The training will pay off when muscles grow back stronger.

Of course, your body needs the right building materials to make this happen. That's why protein is so vital. "We use proteins to make and repair all sorts of components in the body," Lynch says. "Everyone thinks of skeletal muscle, but there's also hormones, enzymes, transport proteins, and connective tissue, to name just a few."

Because athletic performance depends on overall health, these other tissues and substances are a vital piece of the puzzle. "Proteins get broken down into their individual amino acids and then reassembled to form various proteins in the body," Lynch says.

Amino acids are the building blocks of proteins. Our bodies need 20 amino acids to survive and thrive. The human body can produce 11 of those on its own, but the other 9 must come from food. Nutritionists call these amino acids essential amino acids.

Each amino acid has a central carbon bonded to an amino group ($-NH_2$), a carboxyl group ($-COOH$), a hydrogen atom, and a unique side chain called an R-group. The R-group determines the amino acid's properties. Like Legos snapping together, amino acids are linked through peptide bonds to form proteins. These proteins fold into specific shapes to do certain jobs within and between cells.

20 Human bodies need 20 amino acids to survive.

11 The body can make 11 amino acids on its own.

9 But it needs to get 9 essential amino acids from food.

"We get all amino acids in the proportions that our bodies need when we're eating animal-based sources of food," Lynch says. That's because humans, as mammals, are made of the same basic materials as chickens, cows, pigs, and fish. The picture with plants is a little more complicated.

"Some plant sources, like soy or the grain quinoa, do have all nine of the essential amino acids in proportions similar to animal protein, but most plants are low in at least one of them," Lynch says.

Does that mean plant-based athletes are destined for a lifetime of quinoa bowls and tofu burgers? Not anymore.

"People used to get pretty stressed about trying to pair complementary proteins together," Lynch says. The goal was to combine plant-based foods that were low in different essential amino acids. The idea was to make meals that offered a protein profile like meat.

"What the research has shown is that we don't need to do that, as long as people are eating a variety of foods over the course of the day," Lynch says. "Variety is key."

The importance of eating a wide range of foods extends beyond the nine essential amino acids. The body also needs small amounts of specific vitamins and minerals to maintain a baseline level of health. These micronutrients—such as iron, iodine, folate, zinc, and vitamins A and D—are only needed in small quantities, on the scale of a milligram or less, but they are essential for peak performance.

It's a Little More Complicated

When it comes to getting important macronutrients and micronutrients from food, the sheer amount of a particular substance doesn't tell the whole story. There are other factors to consider.

For instance, some plants will bind certain compounds to amino acids. Those larger molecules are harder for the body to digest, so a vegetarian may have to eat slightly more of a particular amino acid to get the same benefit as eating animal-based protein.

Similarly, vegetarians need nearly twice as much iron as nonvegetarians—but for a different reason.

In plants, iron exists by itself as an ion, usually Fe^{3+}. Fe^{3+} is not bioavailable—able to be used by the body—so, the first thing the human body must do is add an electron—reduce—the iron to Fe^{2+}. That limits the amount of iron our bodies can absorb.

In meat, the iron ions are coordinated to a special organic molecule, heme, which is a porphyrin that is found in proteins, such as hemoglobin and has an Fe^{2+} ion in the center. Heme iron is easier to absorb, so omnivores need less of it than people who are relying on plants for their micronutrients.

For vegetarians, “it’s important to consume sufficient amounts of plant-based iron,” Lynch says. She also suggested “being strategic” by pairing plant-based sources of iron with certain acids, such as vitamin C. Those can help reduce the Fe^{3+} by donating electrons, assisting the body’s effort to convert them into usable Fe^{2+} ions.

So, Can Plants Fuel Champions?

The history of sports is packed with stories of athletes fueling their victories with animal products. A hundred years ago, it was boxers downing raw eggs mixed with heavy cream between rounds. More recently, Michael Phelps—U.S. Olympic Swimming Gold Medalist—was starting his 10,000-calorie days with three fried-egg sandwiches and a five-egg omelet.

What does the evidence say? According to Lynch, eating a plant-based diet has surprisingly little impact on athletic performance.

“Considering all the data so far, we don’t see either an advantage or disadvantage,” Lynch says. “When we look at absolute outcomes—whether strength, power, or speed—we don’t see compelling differences between groups of athletes who eat animal products and those who follow a plant-based diet,” she says.

Researching the impact of nutrition is too difficult to make ironclad claims about how a particular diet affects any particular athlete, but the best available data suggests that a good plant-based diet is no better or worse than a good omnivorous diet.

As Lynch says, “it’s less about the specific foods on your plate and more about making sure those foods provide the nutrients your body needs.”

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