

The Nutrition X — CHANGE



10

PLANT-BASED AND VEGAN DIETS IN EXERCISE AND SPORT

A comprehensive look at maximising performance on a plant-based diet.

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Practical Implications

- + Whole foods plant-based diets are increasing in popularity as mounting evidence suggests that they decrease the risk of cardiovascular diseases, diabetes, cancer and all-cause mortality and also promote a healthier environment and help mitigate global warming.
- + Motivations for following a plant-based diet may include improving physical health, reducing the environmental impact of food choices, animal rights/ethics, and in the case of athletes optimizing body composition and exercise and sport performance.
- + As with omnivorous diets, there are certain nutrients for which athletes following a plant-based diet should be mindful of consuming in appropriate quantities.
- + Although vitamin B-12 is the only nutrient that cannot be sourced exclusively from plants, nutrients to be mindful of on a plant-based diet include protein, omega-3 fats, iron, zinc, calcium, and vitamin D.
- + Several studies show that plant-based eating patterns neither improve nor hinder physical performance or resistance-training goals, which may bring comfort to those committed to a vegan lifestyle for ethical reasons.
- + Animal protein is not required to build and repair muscle since well-balanced plant-protein meals can provide an excess of all the essential amino acids with sufficient bioavailability.
- + Select ergogenic aids (creatine, carnosine [via beta-alanine]) are required in supplement form to enhance performance in both omnivorous and plant-based athletes.
- + Athletes who decide to transition to a diet that is mostly or exclusively plant-based can feel confident that they will typically see an improvement in their overall nutrient intake due to increased intakes of fruits, vegetables, beans, nuts and seeds, and whole grains that provide high levels of vitamins, minerals, antioxidants and fiber, while also being very low in saturated fat.

Introduction

Interest in the benefits of a plant-based (PB) diet has risen sharply in recent years. Accordingly, it is important to examine the impact of PB diets not only on physical health, but also on exercise capacity and performance in athletes and active individuals. Athletes' dietary patterns range substantially in the degree of inclusion of animal-sourced foods (ASF), from high intakes to the complete avoidance of foods or food ingredients of animal origin. With many athletes making the "switch" to a PB diet, it is relevant to consider whether the replacement of ASF with plant proteins and plant-focused eating in general may impact exercise and sport performance.

Under the umbrella of "plant-based", vegans and vegetarians share a disavowal of meat or animal flesh consumption but differ regarding the use of ASF (e.g., eggs) and animal by-products (e.g., casein). The term "plant-based" is sometimes used interchangeably with "vegan" to describe a dietary pattern that is 100% plant-based or exclusively derived from plants [1], but most individuals seem to understand "plant-based" as being more like vegetarian, i.e., "mostly" plant-based. This review will use the term "plant-based" to indicate that the diet is based on "all" or "almost all" plants, consumed never or rarely, i.e., no more than 1-2 times per week



This implies that a serving of milk, cheese, eggs, fish or foods containing animal-derived ingredients are consumed never or rarely, i.e., no more than 1-2 times per week. In comparison, the term “vegan” or “veganism” is characterized as a justice movement and lifestyle that not only includes a strict PB diet, but also condemns the exploitation and use of animals in any form (e.g., for use as food, clothing and or entertainment). Accordingly, all vegans consume a PB diet but not all PB eaters are vegan.

Factors contributing to the rise in popularity of PB diets include: (1) health benefits associated with increased intakes of plant-sourced proteins; (2) concerns regarding adverse health effects of consuming diets high in animal protein (e.g., increased saturated fat); (3) the impact of meat on climate change and the environment; and (4) ethical issues regarding the treatment of animals, including concerns for the increased risk of future pandemics through high-density livestock operations [2, 3]. For many athletes, however, the question is at what degree of restriction of animal foods will I see a performance benefit? But perhaps a more appropriate question to ask is “Can a plant-centered diet adequately serve my health, body composition and performance goals”? That is, can an athlete adopt a strictly PB diet and still expect to perform optimally? Beliefs and attitudes in the sporting community surrounding the need for animal-sourced proteins must embrace a conceptual paradigm shift if we are strictly basing nutritional strategies on how it relates to performance outcomes. In essence, a PB diet need not be superior to one including ASF, but it must be at least equivalent, which then makes it a viable and acceptable option for athletes.

This review will outline which nutrients may need more consideration when adopting a PB dietary pattern, how this may impact exercise performance and recovery, and address concerns framing the appropriacy of plant proteins for hypertrophy and strength. Concern for adequacy and bioavailability

for plant-sourced micronutrients and the need for nutritional supplements for general health or ergogenic performance enhancement will also be discussed.

Plant-Based Diets, Health and Performance

The accumulating evidence on the health benefits of PB diets have made them of interest not only to consumers, but also to healthcare professionals and researchers. Among Western populations PB diets are being adopted for their role in optimizing health and the ability to lower the risk of many chronic diseases [4]. Although there is significant heterogeneity in the types and specific definitions of PB diets, the complete exclusion of animal products has been found to be significantly associated with beneficial changes to health. These beneficial changes mainly impact cardiometabolic CVD risk factors, through lower BMIs, improved blood glucose and lipid profiles, lowered inflammation, and blood pressure [1, 2, 5-9], while also showing a reduced risk of several cancers [10-12] compared to most animal-heavy omnivorous diets, which are typically lower in whole grains, vegetables, fruits, nuts and seeds, and legumes [13].

Habitual dietary intake also has a profound effect on shaping the human microbiome which is not a fixed trait but instead responds to environmental stimuli such as nutrition, and is a malleable part of the human health. The benefits of plant-derived nutrition on the composition and diversity of the human gut microbiota have been noted after the adoption of a PB diet [14, 15]. For example, prebiotics are nondigestible dietary plant fibers that stimulate growth of beneficial gut bacteria and confer a health benefit upon the host [16]. Common food sources of prebiotics are pulses, artichokes, whole grains, bananas, peas, beans, asparagus, and garlic, leeks and onions [16].

Summary

In summary, a well-designed whole foods PB diet that includes some fortified foods and optional supplements, can provide adequate macro- and micro-nutrient intakes in athletes and active individuals to support health and performance. Abundant choices in the marketplace also offer convenience and novelty with a wide selection of fortified food products and supplements for those choosing to follow a PB diet. Athletes in general should be taking extra care to plan out their sport nutrition strategies whether they choose to follow a strict an omnivore diet or a PB diet.

Although we have a vast amount of evidence in support of the nutritional adequacy and health benefits of PB diets, the sporting world's perception of PB diets may still create challenges to widespread implementation. Sports nutrition guidelines are regularly reviewed to incorporate new scientific evidence, and it is now time to welcome the viability of PB options to athletes. With the increasing evidence that plant-based diets support optimal health, performance, recovery and body composition goals, the dissemination of accurate information to athletes and coaches is an important step in supporting the widespread transition to diets richer in traditional plants such as fruits, vegetables and whole grains as well as plant-proteins such as nuts, seeds, legumes and novel minimally processed meat and dairy alternatives.

Overview of the major food categories in a plant-based diet, with examples:

- Fruits:** any type of fresh fruit including berries, apples, bananas, grapes, strawberries, citrus fruits, avocado etc. Dried fruits including figs dates, raisins, apricots and others.
- Vegetables:** plenty of veggies including peppers, broccoli, corn, asparagus, avocados, lettuce, spinach, kale, peas, collards, and others.
- Tubers:** root vegetables like potatoes, carrots, parsnips, sweet potatoes, beets, and others.
- Whole grains:** grains, cereals, popcorn and other starches in their whole form, such as quinoa, brown rice, millet, whole wheat, oats, barley, and others.

Nuts, Seeds & Oils: walnuts, almonds, cashews, brazil nuts, peanuts, and pumpkin, hemp, flax and chia seeds. Olive, pumpkinseed, sunflower, soybean, canola, avocado and sesame oil and others.

Legumes: beans of any kind, lentils, pulses, and soy.

What does a Plant-Based Performance throughout the day Diet Look Like?

The Plant-Based Athlete's Plate in **Figure 4** is adapted from the original 'The Athlete's Plate®' which is a visual tool designed to help sports dietitians working with athletes and athletes themselves adjust their dietary strategies to variable training loads and energy expenditures during training and competition. The new Vegan/Vegetarian Athlete's Plate® is based on the Athlete's Plate® and was developed by University of Colorado, Colorado Springs Sport Nutrition Graduate Program in collaboration with the US Olympic Committee's Food and Nutrition Services. The plates are now being scientifically tested (validated) against sport nutrition recommendations and will likely be published in 2022. This figure has modified some of the details according to filed experience with athletes, but you can find the original figure here: <https://swell.uccs.edu/vegetarianvegan-athletes-plate>.

The 100% plant-based vegan menu in **Figure 5** is a viable option to meet the needs of a high performance athlete that is seeking a highly palatable nutritionally-balanced sport-focused meal plan. This detailed three-day meal plan (**Figure 5**) provides variety while exceeding all of the macro and micro-nutrient requirements of an adult male **training** and competing for up to 15hrs per week. The meal plan also supports maintenance of muscle mass to include recovery and repair. The nutritionally complete plan places emphasis on those nutrients in need of greater consideration when excluding animal-sourced food from the diet.

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Easy Training

Lowest energy intake (kcal)

Pasta, rice, cereals, potatoes, bread

Soy, pulses/lentils, nuts/seeds

Cooked vegetables, raw vegetables

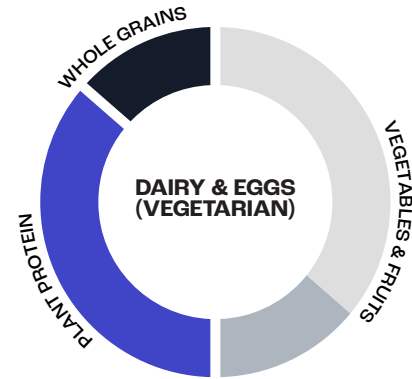
Fresh fruit

Fats (1-2 tablespoons) - Oils, nuts, seeds, nut butters, 1/4 avocado

Fluids - Water, plant milk, juice, coffee, tea

Flavours - Salt/pepper, herbs, spices, vinegar, salsa, mustard, ketchup, nutritional yeast

Eat at least one serving of fermented food daily. Consider using fortified foods or supplements for additional vitamin B12, D, Iron and possibly Zinc, Calcium. Consume protein rich snacks throughout the day.



Moderate Training

Moderate energy intake (kcal)

Pasta, rice, cereals, potatoes, bread

Soy, pulses/lentils, nuts/seeds

Cooked vegetables, raw vegetables

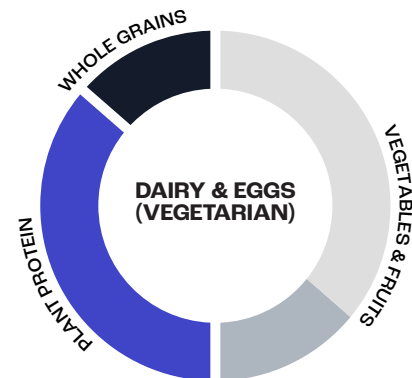
Fresh fruit

Fats (1-2 tablespoons) - Oils, nuts, seeds, nut butters, 1/4 avocado

Fluids - Water, plant milk, juice, coffee, tea

Flavours - Salt/pepper, herbs, spices, vinegar, salsa, mustard, ketchup, nutritional yeast

Eat at least one serving of fermented food daily. Consider using fortified foods or supplements for additional vitamin B12, D, Iron and possibly Zinc, Calcium. Consume protein rich snacks throughout the day.



Hard Training

Highest energy intake (kcal)

Pasta, rice, cereals, potatoes, bread

Soy, pulses/lentils, nuts/seeds

Cooked vegetables, raw vegetables

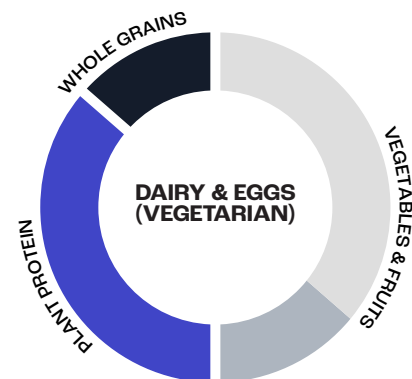
Fresh & dried fruit

Fats (1-2 tablespoons) - Oils, nuts, seeds, nut butters, 1/4 avocado

Fluids - Water, plant milk, juice, coffee, tea

Flavours - Salt/pepper, herbs, spices, vinegar, salsa, mustard, ketchup, nutritional yeast

Eat at least one serving of fermented food daily. Consider using fortified foods or supplements for additional vitamin B12, D, Iron and possibly Zinc, Calcium. Consume protein rich snacks throughout the day.



Three-day Meal Plan for Adult Male Vegan Team Sport Athlete (80 kg).

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Nutritional Content (across 3 days) for plant-sourced 'nutrients of concern': 613 g protein, 124 mg iron (non-heme), 7000 mg calcium, 18 g ALA, 75 mg zinc, and 18.7 µg vitamin B12

Sample Menu Day 1: adult male training 12-15 hours per week, muscle mass maintenance

MENU ITEM	PROTEIN	IRON	CALCIUM	ALA ²	ZINC
Nutritional Goal	1.6 g/kg = 128 g	RDA = 14 mg ³	RDA = 1,000 mg	AI = 1.6 g	RDA = 17 mg ⁴
Actual Meal Plan Content with 5.8 µg vitamin B12 from fortified foods	186 g	35 mg	2,477 mg	3.0 g	25 mg

7:00AM WAKE-UP 7:15AM BREAKFAST

PEANUT, BUTTER, FRUIT & TOAST

1 cup grapes or cherries	1 g	0.5 mg	15 mg	-	0.1 mg
2 slices ancient grains bread, toasted (75 g)	8 g	2 mg	75 mg	0.5 g	1.3 mg
3 tbsp all-fruit jam or 1/4 cup crushed berries	-	-	-	-	-
3 tbsp almond butter	10 g	1.8 mg	165 mg	-	1.5 mg
1.5 cup fortified vanilla plant milk ⁶	12 g	-	660 m	-	-

9:00-11:00AM SPORT PRACTICE 10:00AM MID-PRACTICE SNACK

4 DATES, MEDJOO (96 g)	1.7 g	0.8 mg	61 mg	-	0.4 mg
HOMEMADE ICED-WATERMELON SPORTS DRINK					
2 cups watermelon	2 g	0.8 mg	21 mg	-	0.3 mg
Pinch of salt, 3 cups water, 1 cup ice: mixed in blender	-	-	-	-	-

11:00AM POST-WORKOUT SHAKE

MIXED BERRY PROTEIN SHAKE TOPPED WITH CHIA

1 scoop plant-based protein powder (40 g)	27 g	-	-	-	-
1 cup soy milk	7 g	1 mg	300 mg	0.1 g	0.5 mg
1 banana	1 g	0.25 mg	5 mg	-	0.15 mg
1 tbsp chia seeds (9 g)	1.6 g	0.5 mg	23 mg	-	0.5 mg

1:00PM LUNCH

THE VEGAN MEXICAN WRAP CLASSIC

1 whole wheat tortilla, large (71 g)	7 g	1.8 mg	173 mg	-	1.3 mg
3/4 cup brown rice (146 g)	4 g	0.8 mg	4.4 mg	-	1 mg
1/2 cup black beans (130 g)	6 g	2 mg	60 mg	0.1 g	3 mg

¹nutritional facts sourced from USDA, FoodData Central, 2021

²alpha-linolenic acid

³the recommended dietary allowance (RDA) for iron is 1.8 times higher for vegans and vegetarians than for omnivores

⁴the RDA for zinc is 1.5 times higher for vegans and vegetarians than for omnivores

⁵fortified vanilla plant milk and soymilk (RDA for vitamin B12: 2.4 µg/day)

⁶based on Ripple Pea-Based Milk Vanilla

⁷it is recommended that athletes invest in a good-quality blender for multi-ingredient protein shakes and smoothies

⁸if no blender and on-the-go, mix protein powder with chilled plant milk and instead add chia seeds to today's lunch wrap



TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5

*Single amino acid measurements are in grams **full recipe provided in the menu plan



TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5



TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5

CHICKEN BREAST

TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5

STEAK

TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5

EGGS

TOTAL PROTEIN (G)	His	Ile	Leu	Lys	Met	Phe	Thr	Trp	Val
50	1.2	2.2	3.7	2.3	0.7	2.3	2.0	0.6	2.5

Figure 2. - High protein plant-based meals containing similar or greater protein and leucine content compared to animal proteins.