Introduction to Plant Based Diets

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Introduction to Plant Based Diets

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Overview

- Background
- Nutrient concerns
- Recommendations
- Health Benefits

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What is a Whole Foods Plant Based Diet?

An eating plan that includes plant foods in their whole, minimally processed form

JCAD 2020; 13(5): 38-43

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Classification of Whole Foods Plant Based Diets

Diet	Includes
Vegan	Excludes all animal products. Does not require consumption of whole foods or restrict fat or refined sugar
Lacto-vegetarian	Includes milk products
Ovo-vegetarian	Includes eggs
Lacto-ovo vegetarian	Excludes meat, seafood, & poultry & includes eggs & dairy products
Whole-foods, plant-based	Encourages plant foods in their whole form, especially vegetables, fruits, legumes, whole grains, seeds & nuts
Mediterranean	Similar to whole-foods, plant-based diet but allows small amounts of chicken, dairy products, eggs, & red meat once or twice per month. Fish & olive oil are encouraged. Fat is not restricted

Phillip J Tuso, MD; Mohamed H Ismail, MD; Benjamin P Ha, MD; Carole Bartolotto, MA, RD Perm J. 2013 Spring; 17(2): 61–66.

Why Choose a Plant Based Diet

- Lower the risk of chronic diseases: heart disease, type 2 diabetes, hypertension, certain cancers, & obesity
- Compassion for animals
- Religious & cultural beliefs
- Economic factors
- Environmental concerns

Nutrition Considerations for Vegetarians

- Protein
- Vitamin B12
- Calcium
- Vitamin D
- Iron
- Zinc
- Omega 3 Fats

Protein

Protein is important to build & repair tissues, making enzymes & hormones as well as the building block of bones, muscles, skin & blood

All plant foods contain all the essential amino acids; amino acid distribution profile is less optimal in some plant foods than animal foods

"Protein from a variety of plant foods, eaten during the course of a day, supplies enough of all essential amino acids when caloric requirements are met."

Soy, hemp, chia, quinoa & amaranth contain optimal amounts of all essential amino acids

J Acad Nutr Diet. 2016;116:1970-1980; Nutrients. 2019 Nov; 11(11): 2661

Sample Menu Showing How Easy It Is To Meet Protein Needs

		Protein (grams)
Breakfast:	1 cup Oatmeal	6
	1 cup Soy Milk	7
	1 medium Bagel	10
Lunch:	2 slices Whole Wheat Bread	7
	1 cup Vegetarian Baked Beans	12
Dinner:	5 oz firm Tofu	12
	1 cup cooked Broccoli	4
	1 cup cooked Brown Rice	5
	2 Tbsp Almonds	4
Snack:	2 Tbsp Peanut Butter	8
	6 Crackers	2
TOTAL		77 grams

https://www.vrg.org/nutrition/protein.php

Vitamin B12

- Vitamin B12 is needed for brain function & the production of red blood cells

- The European Prospective Investigation into Cancer & Nutrition (EPIC) Oxford cohort study found that **52%** vegans, **7%** vegetarians & **0.4%** omnivores were classed as vitamin B12-deficient

- Vegans must regularly consume B12 fortified foods or use supplements

Carol L Zeuschner, Bevan D Hokin, Kate A Marsh, Angela V Saunders, Michelle A Reid and Melinda R Ramsay
Med J Aust 2013; 199 (4): S27-S32

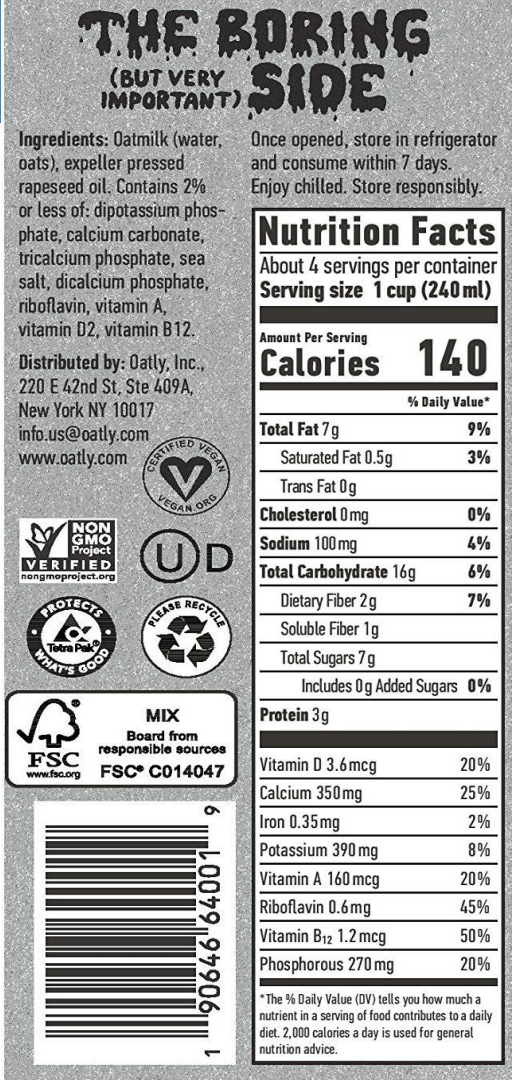
Dietary Vitamin B12

- Fermented foods: tempeh, nori, spirulina, & unfortified nutritional yeast not practical sources of B12

- Fortified vegan foods: cereals, plant-based milks, & nutritional yeast

RDA for Vitamin B12:

	Males	Females
	> 14 yr	2.4 mcg/day



Calcium

Diet	Male	Female
Lacto-ovo	~700-1600 mg/day	650-1150 mg/day
Vegan	400-900 mg/day	425-800 mg/day

RDA for Calcium:	Male	Female
19-50 yr	1000 mg	1000 mg
51-70 yr	1000 mg	1200 mg
71+ yr	1200 mg	1200 mg

Ann Reed Mangels, Bone nutrients for vegetarians, The American Journal of Clinical Nutrition, Volume 100, Issue suppl_1, July 2014, Pages 469S–475S
https://ods.od.nih.gov/factsheets/calcium-HealthProfessional/#h2

Calcium

- Epic-Oxford study: vegans had higher risk of total fractures compared with those who ate meat and dairy

- Calcium bioavailability in plant foods is affected by
  - oxalates & phytates

- Foods high in oxalates: Swiss chard, rhubarb, spinach

  Calcium absorption may be as low as 5%

- Foods high in phytates: wheat bran, legumes, seeds, nuts, soy

L. BMC Medicine (2020) 18:353 https://doi.org/10.1186/s12916-020-01815-3

Non-Dairy Calcium Rich Foods

Plant-Based Calcium and Vitamin D Food Sources	
Foods	**Calcium (mg)**
Blackstrap molasses, 2 T	400
Calcium-fortified orange juice, 8 oz*	350
Tofu, processed with calcium, 4 oz*	200 to 420
Soymilk, fortified, plain, 8 oz*	200 to 300
Kale, cooked, 1 cup	179
Soybeans, cooked, 1 cup	175
Bok choy, cooked, 1 cup	158
Mustard greens, cooked, 1 cup	152
Okra, cooked, 1 cup	135
Almond butter, 2 T	111
Broccoli, cooked, 1 cup	62
Foods	**Vitamin D (IU)**
Maitake mushrooms, cooked (grilled), exposed to UV light, 1 cup	786
Portabella mushrooms, exposed to UV light, 1 cup	634
Almond milk, fortified, 8 oz*	100
Orange juice, fortified, 8 oz*	100
Soymilk, fortified, 8 oz*	80 to 120
Soy yogurt, fortified, 150 g*	80
Breakfast cereal, ready-to-eat, fortified, ¾ to 1 cup*	40

*May vary depending on brand

— SOURCES: USDA, FOOD PACKAGES

Calcium Bioavailability in Common Foods

Food	Serving size	Average calcium content (mg)[8]	Estimated absorption (%)[9-11]	Calcium absorbed (mg)	Servings required to equal 250 mL (1 cup) of milk
Milk products					
Milk (whole, 2%, 1%, skim)	250 mL (1 cup)	310	32.1	99.5	1
Cheddar cheese	50g (1.5 oz)	337	32.1	108.2	1
Yogurt	175 mL (3/4 cup)	272	32.1	87.3	1
Vegetables (cooked)					
Bok choy	125 mL (1/2 cup)	84	53.8	45.2	2.25
Kale	125 mL (1/2 cup)	49	49.3	24.2	4
Broccoli	125 mL (1/2 cup)	33	61.3	20.2	5
Spinach	125 mL (1/2 cup)	129	5.1	6.6	15.25
Nuts & seeds					
Almonds	60 mL (1/4 cup)	97	21.2	20.6	4.75
Sesame seeds	60 mL (1/4 cup)	23	20.8	4.8	20.75
Legumes (cooked)					
White beans	125 mL (1/2 cup)	85	21.8	18.5	5.5
Pinto beans	125 mL (1/2 cup)	42	26.7	11.2	9
Red kidney beans	125 mL (1/2 cup)	26	24.4	6.3	15.75
Breads & Cereals					
Whole wheat bread	35 g (1 slice)	26	82	21.3	4.75
Wheat bran	27 g	19	38	7.2	13.75
Fortified foods					
Orange juice with calcium	125 mL (1/2 cup)	155	36.3	56.3	1.75
Tofu, regular, firm or extra firm, raw (prepared with calcium sulphate)	85 g	171*	31	53	2

Vitamin D

- The EPIC-Oxford study found that vegans had the lowest intake of vitamin D, compared with other diet patterns
- UV-treated mushrooms are the only non-animal, unfortified food source of vitamin D
- Skin Vit D production after sun exposure is dependent on:
  - Time of day, season, age, skin color, sunscreen
- Supplemental Vitamin D
  - Vitamin D_3 (cholecalciferol)
  - Vitamin D_2 (ergocalciferol)

RDA Vit D	
18-70 yr	600 IU
>70 yr	800 IU

Matthias Wacker & Michael F. Holick (2013) Sunlight and Vitamin D, Dermato-Endocrinology, 5:1, 51-108, Public Health Nutr. 2011;14(2):340-346.Ann Reed Mangels, Bone nutrients for vegetarians, The American Journal of Clinical Nutrition, Volume 100, Issue suppl_1, July 2014, Pages 469S–475S

Iron

- Iron is essential for hemoglobin formation & oxygen transport
- Heme iron: only in animal sources
- Non-heme iron: in plant foods
- **NHANES** study: iron intake was higher for vegetarians than for non-vegetarians
- Lower absorption of iron from plant foods when compared to animal sources of iron due to plant phytates that bind to iron
- Non-heme: **1-20%** absorption rate; heme: **15-35%** absorption rate

Journal of the AMERICAN DIETETIC ASSOCIATION June 2011 Volume 111 Number 6
MJA Open 2012; 1 Suppl 2: 11–16

Iron

Diet	
Animal Sources (heme)	Beef, sardines, chicken liver, mussels, oysters
Plant Sources (non-heme)	Lentils, dried beans, spinach, dried apricots
Enriched Foods	Breakfast cereals, breads, pasta, white rice

RDA for Iron:
8 mg/day Men & Women post-menopausal
18 mg/day premenopausal women

Comparison of Iron Sources

Food	Iron (mg/100 calories)
Spinach, cooked	15.6
Collard greens, cooked	4.5
Lentils, cooked	2.9
Broccoli, cooked	1.9
Chickpeas, cooked	1.7
Sirloin steak, choice, broiled	1.1
Hamburger, lean, broiled	0.8
Chicken, breast roasted, no skin	0.6
Pork chop, pan fried	0.4
Flounder, baked	0.3
Milk, skim	0.1

Note that the top iron sources are vegan.

https://www.vrg.org/nutrition/iron.php
USDA Nutrient Database for Standard Reference, Legacy, 2018 and Manufacturer´s information

To Increase Non-Heme Iron Absorption

Adding a source of vitamin C at meals (broccoli, tomatoes, red/yellow peppers, citrus fruits)

Avoiding tea & coffee at meals

Cooking foods in cast iron skillets

Avoiding calcium supplements with meals

Suggested that vegetarians consume 1.8 x more Iron to compensate for the reduced absorption

https://veganhealth.org/iron-part-1/#iron-plant-based-diet

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Zinc

- Zinc is needed for the immune system, plays a role in cell division & growth, & wound healing

- Plant phytates reduce dietary zinc absorption
  - Protein enhances zinc absorption; plant protein is high in phytates

- To enhance absorption: choose fermented foods like miso & tempeh

- The National Institutes of Health suggests that Vegetarians require as much as 50% more of the RDA for zinc than non-vegetarians

RDA for Zinc:
11 mg/day Adult Men
8 mg/day Adult Women

MJA Open 2012; 1 Suppl 2: 17–22
https://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/

Omega 3 Fatty Acids

- Omega 3 fats are part of cell membranes, have anti-inflammatory effects, vital for brain function, hormone production & eye health
- Omega 3 fats: **EPA, DHA, ALA**
- **EPA/DHA**: seafood (fish & shellfish)
- **ALA**: in plants: flaxseeds/oil, chia seeds, hemp seeds/oil, walnuts, & canola oil; intake similar in vegetarians & non-vegetarians
- Lacto-ovo vegetarians may obtain **EPA/DHA** from fortified milk & eggs
- The only plant sources of **EPA/DHA** for vegans are sea plants: Sea vegetables, seaweed & microalgae

Am J Clin Nutr. 2003;78 (3 Suppl):640S-646S. ***Int J Vit Nutr Res***. 1998;68(3):159-173.

Health Benefits of a Plant Based Diet

- Cancer risk reduction
- Cardiac disease risk reduction
- Blood pressure regulation
- Diabetes (type 2) risk reduction
- Obesity (decrease in weight & BMI)
- Slows aging
- Healthy microbiome

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Cancer Risk Reduction: EPIC-Oxford Study

The study recruited half a million participants

The Oxford component of the study includes 25,000 vegetarians & 2,000 vegans

The largest detailed study of vegetarians in the world

It will provide great information on the long-term health of vegetarians & vegans

Am J Clin Nutr 2014;100(suppl):394S–8S

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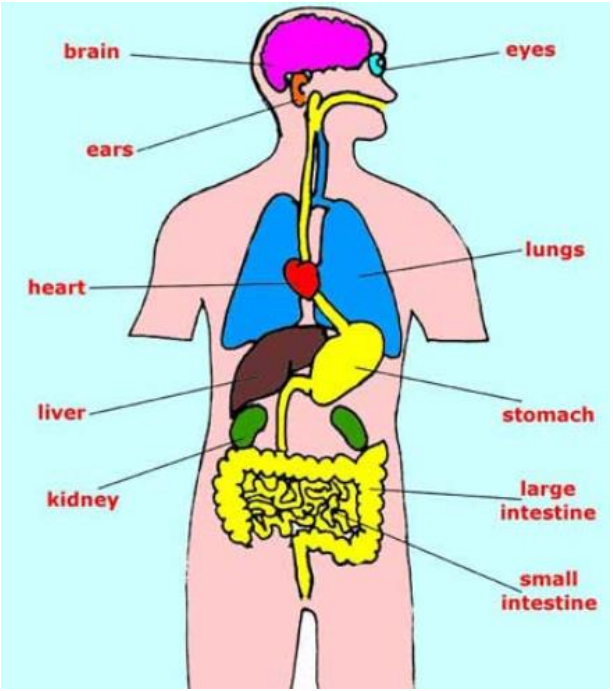
Cancer Risk Reduction: Findings From the EPIC-Oxford Study

Upper GI & Lung: Cancer risk was reduced with higher intakes of fruit, but not with vegetable intake

Colorectal & Liver: Cancer risk was reduced with higher intakes of total fruit, total vegetables & total fiber

Breast: Cancer risk was slightly reduced with fiber intake

Other 9 cancer sites studied: no reported significant associations of reduced cancer risk with intakes of total fruit, vegetables, or fiber



Bradbury KE, Appleby PN, Key TJ. Fruit, vegetable, and fiber intake in relation to cancer risk: findings from the European Prospective Investigation into Cancer and Nutrition (EPIC). Am J Clin Nutr. 2014 Jul;100 Suppl 1:394S-8S.

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Cancer Risk Reduction: Findings From the AHS-2 Study

This study looked at the association between all dietary patterns & prostate cancer occurrences among 26,500 male participants (65% were white, 27% were African American)

Study ran from 2001-2007, 96,000 participants ages 30-112 years, from U.S. & Canada

In total, 1,100 prostate cancer cases were identified

Results show a vegan diet may reduce the risk of prostate cancer when compared to males on a non-vegan diet - **Statistically significant for white males only**

Yessenia Tantamango-Bartley, Are strict vegetarians protected against prostate cancer?, *The American Journal of Clinical Nutrition*, Volume 103, Issue 1, January 2016, Pages 153–160

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Cardiac Risk

Risks for both deadly & non-deadly Heart Disease (HD) appear to be lower in vegetarians compared with non-vegetarians

A re-analysis in 1999 of data from 5 studies showed that death from HD was 24% lower in vegetarians than in non-vegetarians

EPIC-Oxford study also included the risk of hospitalization or death from HD which was 32% lower in vegetarians compared with non-vegetarians

The data suggests that the lower risk of HD in vegetarians, may be due to their lower LDL cholesterol, combined with their lower BMI & slightly lower systolic blood pressure

Timothy J Key, et al. Mortality in vegetarians and nonvegetarians: detailed findings from a collaborative analysis of 5 prospective studies, *The American Journal of Clinical Nutrition*, Volume 70, Issue 3, September 1999, Pages 516s–524s

Type 2 Diabetes Risk Reduction

- The Adventist Health Study (AHS) 2 study shows the frequency of type 2 Diabetes in vegans & lacto-ovo vegetarians was 1/2 that of non-vegetarians

- A 2009 review article in Nutrition Reviews, summarized the effect of vegetarian diets on type 2 Diabetes

  - Observational studies show a significantly reduced risk of developing type 2 Diabetes in people following a vegetarian or vegan diet

  - Evidence from clinical trials, indicates low-fat vegan diets are at least as effective as more conventional diabetes diets for weight reduction & glycemic control, & are significantly more effective for lipid management

Neal D Barnard, Heather I Katcher, David JA Jenkins, Joshua Cohen, Gabrielle Turner-McGrievy, Vegetarian and vegan diets in type 2 diabetes management, *Nutrition Reviews*, Volume 67, Issue 5, 1 May 2009, Pages 255–263

Obesity Risk Reduction

Data from the AHS-2 study shows a progressive weight increase when people transitioned from a total vegetarian diet toward a non-vegetarian diet

- Results showed non vegetarians weighed about 30 pounds more than vegans of similar height

Measures of cholesterol, diabetes, high blood pressure & metabolic syndrome all showed the same trend – the closer people were to being vegetarian, the lower their health risks were for these measures

Am J Clin Nutr 2009;89(suppl):1627S–33S

Whole Foods Plant Based (WFPB) Diet

TABLE 1. WFPB dietary sources of vitamins E, C, and A and chlorophyll[80–87]

NUTRIENT	WFPB FOODS CONTAINING HIGHEST NUTRIENT CONCENTRATION	EXAMPLE WFPB FOODS	COOKING EFFECT ON VITAMIN BIOAVAILABILITY COMPARED TO RAW
Vitamin E	Nuts, seeds, some oils, and green leafy vegetables	Wheat germ, sunflower seeds, almonds, spinach, kiwifruit, mango, tomatoes	Broccoli, spinach, and zucchini lead to a significant decrease in α-tocopherol; however, there was a trend toward higher retention of α-tocopherol in cooked rather than raw vegetables.
Vitamin C	Citrus fruits and vegetables	Red pepper, orange, grapefruit, kiwifruit, green pepper broccoli, strawberries, tomatoes, cantaloupe, potatoes	Broccoli and peppers decreased by at least 10%
Vitamin A	Leafy green, orange, and yellow vegetables, some fruits	Carrots, broccoli, cantaloupe, squash, tomato	Carrots increased by six times
Chlorophyll	Green vegetables	Kale, spinach	Broccoli was reduced by at least 16%

WFPB: whole-food, plant-based

J Clin Aesthet Dermatol. 2020;13(5):38–43

What is the Gut Microbiome?

- The collection of microorganisms including bacteria (happy bugs), fungi, & viruses, that live in the intestines ("gut")
- This is the largest group of microorganisms in the human body – about 100 trillion altogether
- About 1/3 of gut microorganisms are common to all humans
- Gut microenvironment is influenced by modifiable factors (diet, exercise) & nonmodifiable factors (genetics, age)

Sakkas H et al. Nutritional Status and the Influence of the Vegan Diet on the Gut Microbiota and Human Health. *Medicina* 56, 88, 2020.
European Society of Neurogastroeterology and Motility. https://www.gutmicrobiotaforhealth.com/about-gut-microbiota-info/

Effects of Plant-Based Diet on Microbiome

- Vegetarian & vegan diets seem to promote
  - Diversity of the microorganisms
  - Greater abundance of "beneficial" bacteria
  - Fewer antimicrobial resistant genes
  - Less inflammation

- Beneficial effects of a plant-based diet on the gut microbiome is likely the result of a variety of factors (what's eaten **AND** what's not eaten)
  - Particularly positive impact from various types of fiber (pre-biotics) & polyphenols from whole plant foods such as vegetables, fruit, whole grains, nuts, tea, & coffee

Sakkas H et al. Nutritional Status and the Influence of the Vegan Diet on the Gut Microbiota and Human Health. *Medicina* 56, 88, 2020.

Limits of Vegetarian/Vegan Diets

Possibility of eliminating all animal products like lean meat & calcium rich dairy such as yogurt & cheese

It is important to implement change over time

There are more replacement products in the market now, but some are highly processed

Some planning may be needed to meet nutrient needs, but the same is true with any diet

So Where's The Beef?

New Vegan Products: Healthy?

- Many of them are highly-processed foods, high in sodium & saturated fat

- **Beyond Burger Ingredients**: water, pea protein, expeller-pressed canola oil, refined coconut oil, rice protein, natural flavors, cocoa butter, mung bean protein, methylcellulose, potato starch, apple extract, pomegranate extract, salt, potassium chloride, vinegar, lemon juice concentrate, sunflower lecithin, beet juice extract

- **Impossible Burger Ingredients**: Water, Soy Protein Concentrate, Coconut Oil, Sunflower Oil, Natural Flavors, 2% Or Less Of: Potato Protein, Methylcellulose, Yeast Extract, Cultured Dextrose, Food Starch Modified, Soy Leghemoglobin, Salt, Mixed Tocopherols (Antioxidant), Soy Protein Isolate, Vitamins and Minerals (Zinc Gluconate, Thiamine Hydrochloride (Vitamin B1), Niacin, Pyridoxine Hydrochloride (Vitamin B6), Riboflavin (Vitamin B2), Vitamin B12).

Nutrition Facts: Beef vs Beyond vs Impossible

4 oz. Raw Beef Burger 80% lean

- *Calories:* 287
- *Fat:* 23 g (9 g sat fat)
- *Sodium:* 75 mg
- *Carbohydrates:* 0 g
- *Fiber:* 0 g
- *Sugars:* 0 g
- *Protein:* 19 g

4oz. Raw Beyond Burger

- *Calories:* 270
- *Fat:* 20 g (6 g sat fat)
- *Sodium:* 380 mg
- *Carbohydrates:* 5 g
- *Fiber:* 3 g
- *Sugars:* 0 g
- *Protein:* 20 g

4 oz. Raw Impossible Burger

- *Calories:* 220
- *Fat:* 13 g (10 g sat fat)
- *Sodium:* 430 mg
- *Carbohydrates*: 5 g
- *Fiber:* 0 g
- *Sugar:* <1 g
- *Protein:* 20 g

Inside The Lab

- **Impossible Burgers:** GMO heme (fermented yeast), has soy & more saturated fat than Beyond burgers

- **Beyond Meat:** Non-GMO proteins (pea, rice mung bran, fava bean) process of heating, cooling, & pressure to create the fibrous texture of meat & layer in plant-based fats, binders, flavors, & colors

Current Plant Food Trends

Plant Seafood

Ingredients :Water, **Good Catch® 6-plant Protein Blend** (Pea Protein Isolate, Soy Protein Concentrate, Chickpea Flour, Lentil Protein, Fava Protein, Navy Bean Flour), Sea Salt, Sunflower Oil, Seaweed Powder (Seaweed, Salt), Citric Acid, Onion Powder, Yeast Extract (Yeast, Salt), Garlic Powder, Soy Lecithin.

Nutrition Facts

1 serving per container

Serving size 1 pouch (94g)

Amount per serving

Calories 100

	% Daily Value*
Total Fat 2g	**3%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Polyunsaturated Fat 1g	
Monounsaturated Fat 0g	
Cholesterol 0mg	**0%**
Sodium 450mg	**20%**
Total Carbohydrate 4g	**1%**
Dietary Fiber 0g	**0%**
Total Sugars 0g	
Includes 0g Added Sugars	**0%**
Protein 17g	**28%**
Vitamin D 0mcg	0%
Calcium 40mg	4%
Iron 3mg	15%
Potassium 130mg	2%

* The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Current Plant Food Trends

Ingredients: Water, Sugar, Coconut oil, Sunflower Oil, Non-animal Whey protein, contains Less Than 2% Of maltodextrin, Natural flavor, Vanilla Bean seed, calcium Potassium phosphate Citrate, Salt, disodium Phosphate, carob Bean Gum, mono & Diglycerides

Vegan Milk Protein

Future Plant Food Trends

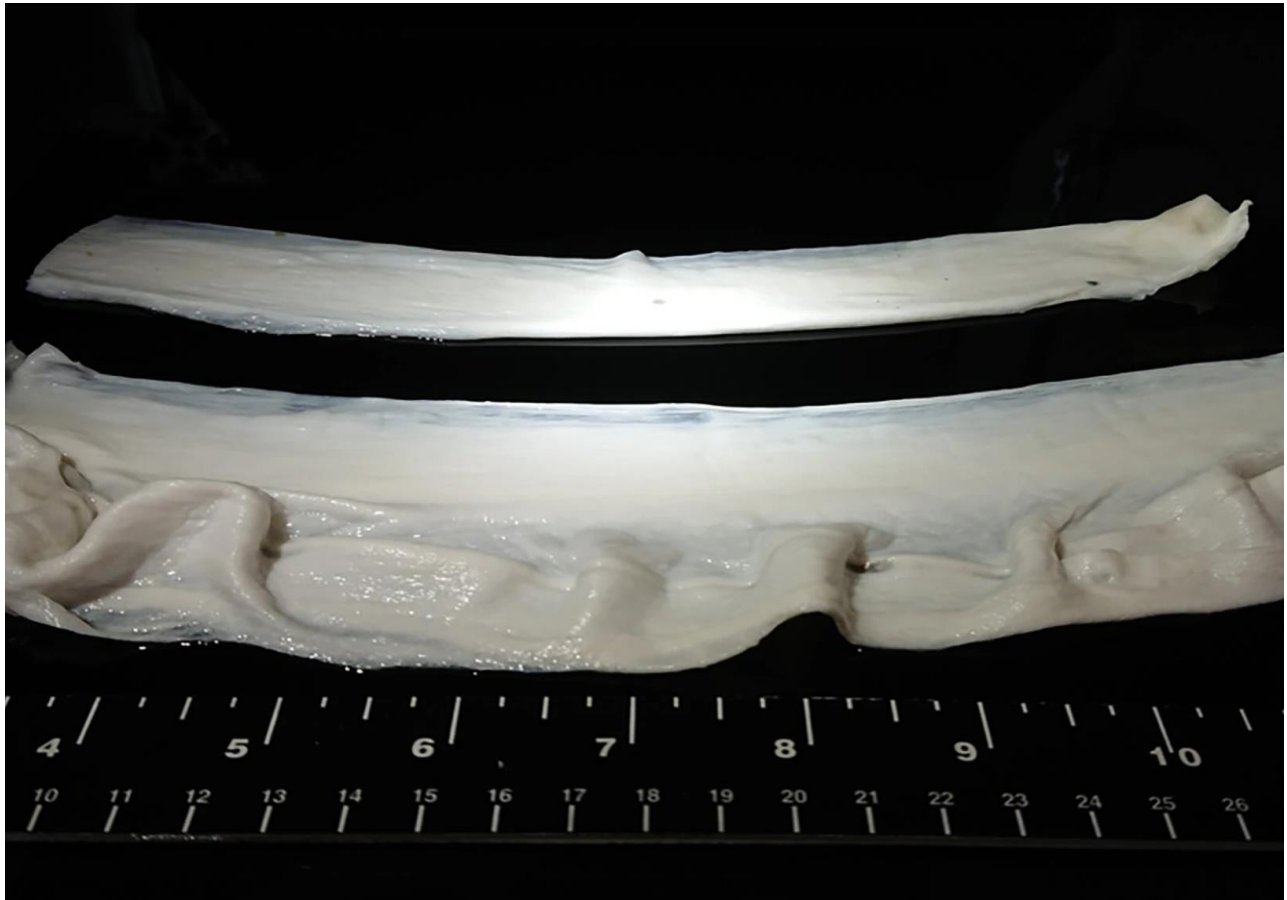
- Emerging Trends
  - Improvement of current plant-based products
  - Fishless fish
  - Proteins derived from fermenting microorganisms like fungi
  - The food industry is partnering with tech companies to reduce the carbon footprint

Inside The Lab: Animal Products

- Bioengineers at Harvard University are growing animal cells
- Lab cultured salmon
- Cell-based chicken nuggets made in the lab
- Restaurant based taste testing of cell-based chicken

Lab Made Gelatin Scaffold

Sheets of gelatin fibers that grow lab cultured meat



Harvard University

Environmental Costs: Do our food choices matter ?

- Meat production is one of the primary ways in which humanity affects the environment
- Livestock production is a major source of greenhouse gases
- Average water footprint per calorie for beef is **20 x** larger than for cereals & starchy roots
- Producing **2.2 lbs** of animal protein requires **100 x** more water than producing **2.2 lbs** of grain protein
- On a per acre basis, plant agriculture produces **14,000** more pounds than animal-based agriculture

David Pimentel, Marcia Pimentel, The American Journal of Clinical Nutrition, Volume 78, Issue 3, September 2003, Pages 660S–663S, https://waterfootprint.org/en/water-footprint/product-water-footprint/water-footprint-crop-and-animal-products/

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Summary

Vegetarians & vegans should be mindful of the following:

- Add vitamin & mineral supplements to your diet only as needed
- Pay attention to balance & making good choices
- Purchase highly processed vegetarian & vegan foods with caution
- Rely less on animal foods, to improve the earth

A Few Quotes to Takeaway

Michael Pollan:

- “Eat food. Not too much. Mostly plants.”
- “It’s not food if it arrived through the window of your car.”

Mark Bittman:

"The evidence is overwhelming at this point. You eat more plants, you eat less other stuff, you live longer.“

THANK YOU!