CURRENT DEVELOPMENTS IN HEALTHIER PLANT-BASED ALTERNATIVES:

Nutritional Profiles, Nutrient Bioavailability and Novel Food Technology

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Plant-based meat alternatives market in Europe is estimated to be worth approximately USD 4.07 billion in 2024 [1]

This market is projected to continue growing at an annual rate of about 8.43% from 2024 to 2029, potentially reaching around USD 5.42 billion by 2029 [1]

In Europe, as of 2022, the plant-based milk market was valued at approximately € 2.21 billion, showing a 7% year-on-year growth and a 19% increase since 2020 [2].

Projections indicate that the market can reach USD 10.1 billion by 2029, driven by increasing consumer awareness, lactose intolerance, and vegan diets [2]

Introduction

Beyond Burger® Pea-protein Based Burger

The current surge in the plant-based meat market is a result of significant advancements in product formulation and a growing consumer preference for sustainable protein sources. As consumer awareness regarding health, environmental sustainability, and sensory qualities continues to rise, so does the demand for plant-based alternatives.

Despite their popularity, plant-based foods present complexities in terms of nutritional profiles and nutrient bioavailability, raising potential health concerns. Here we will explore the latest developments in the nutritional profiles, nutrient bioavailability, and consumer perceptions of plant-based meat alternatives.

Framing in the Sustainable Development Goals (SDGs)

Framed within the context of the Sustainable Development Goals (SDGs), this research underscores the role of plant-based alternatives in promoting sustainable food systems (SDG2: Zero hunger and SDG15: Life on Land), improving public health (SDG3: Good health and Well-being), and reducing environmental impacts (SDG13: Climate Action)

SDG 3: Good health and well-being

Health benefits of plant-based diets: lower cholesterol and fat levels, high fiber and lower calories

SDG 13: Climate action

Plant-based diets are linked to lower carbon footprints.

SDG 15: Life on Land

Switching to a plant-based diet we can reduce land degradation and biodiversity loss associated with extensive animal farming practices

Are Plant-Based Meat Alternative Products Healthier Than the Animal Meats They Mimic?

Beyond Burger® (pea-protein based burger)	No Bull® (Whole legume based burger)	100% Beef Burger

Nutrition Facts
Serving Size 1 patty (113g)

Amount Per Serving	
Calories 250	
	% Daily Value*
Total Fat 18g	28%
Saturated Fat 6g	30%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 390mg	16%
Total Carbohydrate 3g	1%
Dietary Fiber 2g	8%
Sugars 0g	
Protein 20g	40%

Calcium 8% • Iron 25%
*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Nutrition Facts
2 servings per container
Serving Size 1 burger (114g/4.0oz)

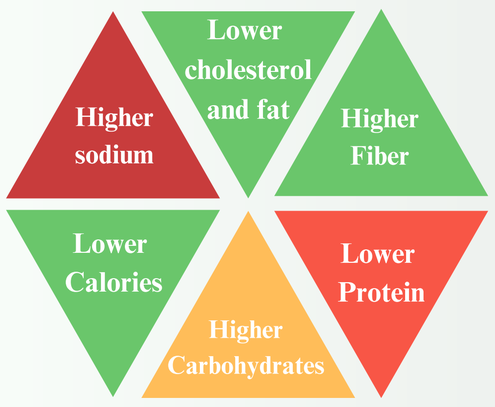
Amount per serving	
Calories	140
	% Daily Value*
Total Fat 2g	2%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 280mg	12%
Total Carbohydrate 23g	8%
Dietary Fiber 6g	20%
Total Sugars 1g	
Includes 0g Added Sugars	0%
Protein 8g	
Vitamin D 0mcg	0%
Calcium 32mg	2%
Iron 3mg	15%

Nutrition Facts
Serving Size 1 patty (113.5g)

Amount Per Serving	
Calories 310	
	% Daily Value*
Total Fat 26g	40%
Saturated Fat 13g	65%
Trans Fat 0g	
Cholesterol 55mg	18%
Sodium 65mg	3%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 21g	42%

Calcium 8% • Iron 8%
*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

Plant-based burgers have:



- The legume-based burger has significantly less calories than the pea-protein based one but 60% less protein;
- Compared with the 100% beef burger, the pea-protein burger contains only 4.7% less protein;
- The legume-based burger has 300% more fiber compared with the pea-protein-based burgers;
- The 100% Beef burger contains as much calcium as the pea-protein based burger and 1/3 of the iron. The legume-based burger also contains more iron but only 25% of the calcium.

Nutrient Bioavailability on Meat vs. Meat Replacements

DIAAS (DIGESTIBLE INDISPENSABLE AMINO ACID SCORE) → IS THE DIAAS A GOOD MODEL?

ANIMAL MEAT	PLANT-BASED FOODS
• 80-99% in bovine meat (depending on cooking method) [4]; • >100% in bacon, ham and pig loin [4];	• 86% in mung beans [3]; • 88% in kidney beans [3]; • 76% in chickpeas [3]; • 68% in peas [3];

The DIAAS should be avoided when evaluating protein quality in plant-based diets, as it was developed to access protein quality in nations with lack of food security and widespread malnutrition [5].

Limitations [5]:
- failure to translate differences in nitrogen-to-protein conversion factors between plant- and animal-based foods,
- limited representation of commonly consumed plant-based foods within the scoring framework,
- inadequate recognition of the increased digestibility of commonly consumed heat-treated and processed plant-based foods, its formulation centered on fast-growing animal models rather than humans
- focus on individual isolated foods vs the food matrix.

Most experts agree that there is no protein or amino acid deficiency in a plant-based diet that has enough calories.

IRON AVAILABILITY

HEME IRON	NON-HEME IRON
• Estimated absorption rate 15-35%; • Less affected by dietary factors.	• Absorption rate is lower and more variable 2-20%; • Influenced by various dietary factors such as Vitamin C.

INHIBITORS OF NON-HEME IRON ABSORPTION

- Phytates: Found in whole grains, legumes, nuts, and seeds, phytates can inhibit iron absorption;
- Polyphenols: Present in tea, coffee, wine, and some vegetables, polyphenols can inhibit iron absorption;
- Calcium: Calcium competes with iron for absorption.

RISKS ASSOCIATED WITH EXCESSIVE HEME-IRON INTAKE [6]

Meta-analysis including 13 studies and 252 164 participants

"The dose response analysed revealed a **7% increase in the risk of cardiovascular disease for each 1 mg/day** increase in dietary heme-iron"

"No significant trend was identified for either non-heme intake or total iron intake"

High heme-iron intake is also associated with:
- Type 2 diabetes;
- Gallstone disease;
- Breast cancer.

Ascorbic acid mitigation [7]: Ascorbic acid counteracts the inhibitory effects of phytates on iron absorption. In a study, adding 30 mg of ascorbic acid effectively overcame the inhibition caused by 58 mg of phytate phosphorus

ZINC BIOAVAILABILITY

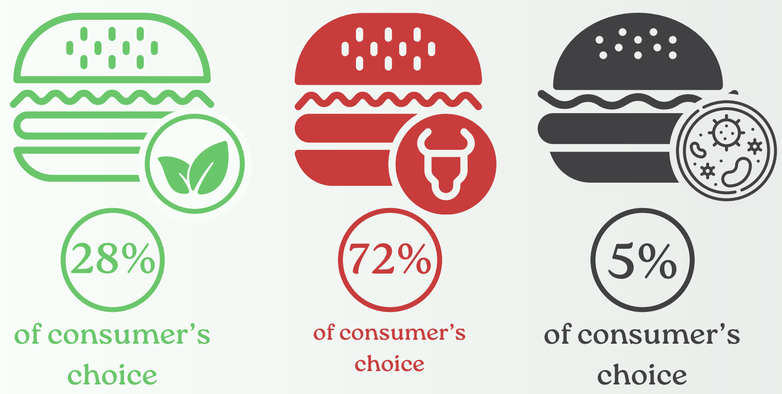
ANIMAL MEAT	PLANT-BASED FOODS
• High bioavailability, facilitated by heme iron and protein [8]; • Zinc absorption from beef is reported to be 26.4% [8].	• Contains zinc in less bioavailable forms due to the presence of phytates, which inhibit zinc absorption.

VITAMIN B12

- Often plant-based meats are enriched with Vit B12;
- Vitamin B12 is synthesized by bacteria including the ones present in the ruminant's stomach. It is naturally present in ruminant meat.

Consumer Preferences

Loo, E., Caputo, V., & Lusk, J. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: Does information or brand matter?. Food Policy. https://doi.org/10.1016/j.foodpol.2020.101931.



A significant portion of consumers opposed labeling plant-based and lab-grown products as "beef." Specifically, 70% opposed using the term "beef" for lab-grown meat, and 76% opposed it for plant-based alternatives.

Brand influence

The presence of brand names (e.g., Certified Angus Beef, Beyond Meat, Impossible Foods) increased the preference for farm-raised beef to 80%.

Information Effects

Providing environmental and technological information reduced the number of people opting out of purchasing any product, suggesting that such information can attract new consumers to the market.

Demographics

Vegetarians, males, younger individuals, and those with higher education levels showed relatively stronger preferences for plant-based and lab-grown alternatives compared to farm-raised beef.

Conclusion

INNOVATION	DEMAND	BENEFITS	CHALLENGES	CONCLUSION
Significant advancements in nutritional profiles, nutrient bioavailability, and food processing technologies.	Developments are driven by increasing consumer demand for sustainable, health-conscious dietary options.	Plant-based meat offers lower levels of saturated fat and cholesterol while providing higher dietary fiber.	Plant-based meat often fall short in essential nutrients like protein, zinc, and vitamin B12, and their bioavailability can be hampered.	Continued research and innovation are necessary to address their nutritional challenges.

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