TECHNICAL BRIEF

# Looking into the Nutritional Aspects of Plant-based Meat in the Brazilian Market

gfi / Brazil™

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The Good Food Institute is a non-profit organization working globally to accelerate innovation in the alternative protein market. We believe that the transition to a more sustainable food system is fundamental to addressing the climate crisis, reducing the risk of zoonotic diseases, and feeding more people with fewer resources. Therefore, we collaborate with scientists, companies, investors, entrepreneurs, and government officials to develop plant-based, cultivated, or fermentation-derived food analogs.

**Our work focuses on three main areas:**

**Corporate Engagement**
We support companies of all sizes in developing, launching, and marketing alternative protein products, connect startups with investors, mentors, and partners, provide market intelligence to help companies make informed decisions, and conduct research to identify and overcome industry challenges.

**Science and Technology**
We fund cutting-edge research on alternative proteins, promote collaborations between scientists, companies, and governments, publish data and discoveries to drive scientific progress and design educational programs to train the next generation of alternative protein leaders.

**Public Policy**
We advocate for public policies that support the development and commercialization of alternative proteins, work with governments to create a favorable regulatory environment, educate the public about the benefits of alternative proteins, monitor the political landscape, and defend the interests of the sector.

**With our work, we seek solutions to:**

Feed nearly ten billion people safely, fairly, and sustainably by 2050;

Contain climate change caused by the current food production system;

Create a food production chain that does not rely on animals;

Reduce the food sector's contribution to developing new infectious diseases, some with pandemic potential.

In just over six years of operation in Brazil, GFI has already helped the country become one of the leading players in the global plant-based protein market. The intention is to continue developing this work to transform the future of food, promoting new sources of protein and offering alternatives analogous to those of animal origin.

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# Nutritional Quality Aspects of Plant-based Meat in the Brazilian Market

This technical brief is based on two studies, carried out between 2021 and 2023, in which two approaches are used to understand the nutritional quality of plant-based meat products sold in the Brazilian market: (i) Information provided on the nutritional labels (Study 1[1] and Study 2[2]) and (ii) Categorization of products according to different nutritional indicators: Nutri-Score, NOVA, and the LOUPE (RDC 429/2020 and IN 75/2020, ANVISA) (Study 2). The market for plant-based meat in Brazil has grown since the first study was carried out in 2021, and new products have been launched. Also, many products were reformulated, primarily focusing on reductions of sodium and saturated fat, to avoid the front-of-packing warning made mandatory by the RDC 429/2020, which has been in place since October 9, 2022.



**WHAT HAS BEEN DONE TO UNDERSTAND THE NUTRITIONAL QUALITY OF PLANT-BASED MEAT IN THE BRAZILIAN MARKET?**

**STUDY 1**

HOW MANY
**33 products**

WHICH ONES
**Burger, Breaded / battered, Kibbeh, Sausage, Meatball.**

WHEN
**Between March and April 2021.**

WHERE
**Southeast: SP and RJ.**

WHAT
**Nutritional evaluation based on data collected on labels (saturated fat, protein, fiber and sodium).**

**STUDY 2**

HOW MANY
**349 products**

WHICH ONES
**Burger, Breaded / battered, Kibbeh, Sausage and Ham, Meatball and Kafta, Meat**

WHEN
**Between July 2022 and June 2023**

WHERE
**North:** PA.
**Northeast:** BA and PI.
**Central-West:** DF, MT and MS.
**Southeast:** SP and MG.
**South:** SC, RS and PR.

WHAT
**Nutritional evaluation based on data collected on labels (saturated fat, protein, fiber and sodium) and classification according to nutritional indicators (Nutri-Score, LOUPE (RDC 429/2020, ANVISA), NOVA).**

## What Labels <u>Do</u> or <u>Don't</u> Say

The food industry is constantly innovating and bringing diversified and improved products to the market to meet the nutritional quality desired by health-conscious consumers. The nutritional quality of a food product depends on multiple aspects, some of which are explicit in the labeling and others not. This

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[1]  Ambiel, C., Pinho, L. Estudo nutricional: análise comparativa entre produtos cárneos de origem animal e seus análogos vegetais. São Paulo: The Good Food Institute Brasil, 2022.

[2]  Locatelli, N.T., Chen, G. F. N., Batista, M.F., Furlan, J.M., Wagner, R., Bandoni, D.H., de Rosso, V.V. Nutrition Classification Schemes for Plant-Based Meat Analogues: Drivers to Assess Nutritional Quality and Identity Profile. C urrent Research in Food Science, p. 100796, 2024.

technical brief presents key findings derived from the comprehensive analysis of food labels from Studies 1 and 2 and investigations into nutritional aspects beyond labeling.



**WHAT LABELS DO (NOT) TELL US**

**MANDATORY**

**Macronutrients:** protein, total fat, saturated fat, carbohydrates, fibers.

**Micronutrients1:** sodium.

**List of ingredients.**

**USUALLY NOT REPORTED**

Mineral bioavailability.

Protein digestibility.

Amino acid (protein) and fatty acid (fat) profile.

Antinutritionals.

Bioactive compounds.

1 Other minerals and vitamins are only mandatory in the case of using functionality or health claims.
**Please note: This figure reflects Brazilian labeling regulations and may not be applicable in all countries.**
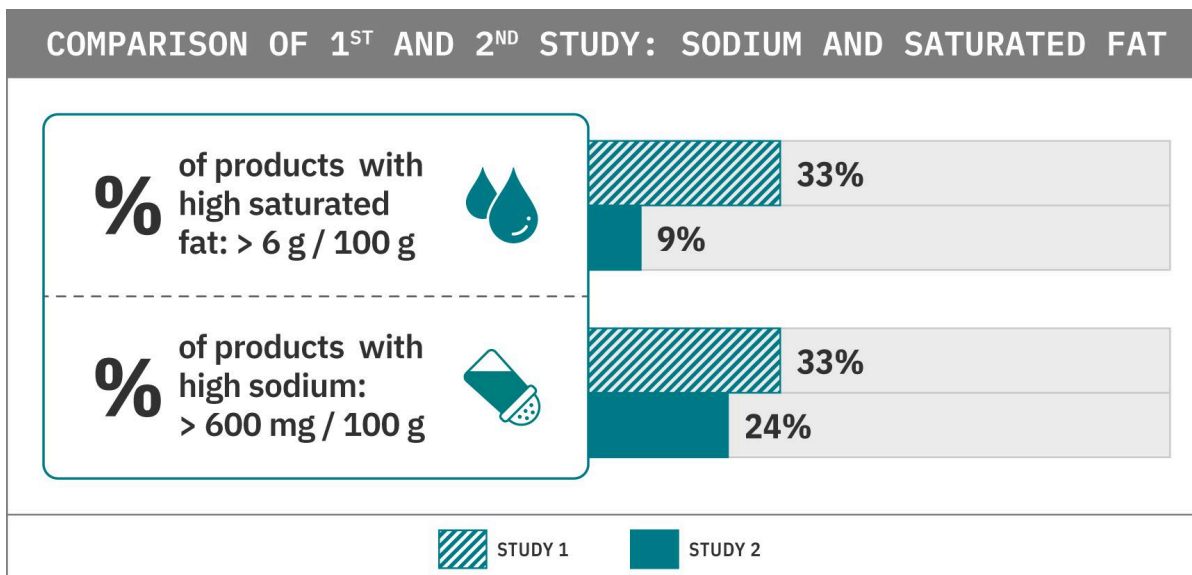
# Sodium, Saturated Fat, and Fatty Acids

Sodium and saturated fat added to food formulations are essential to achieve the product's technological characteristics and consumers' acceptance. However, they may reduce the nutritional quality of the products if added in high concentrations. Diets high in sodium[3] are mainly associated with raised blood pressure and increasing risk of cardiovascular diseases (CVDs) and other health outcomes such as gastric cancer, obesity, osteoporosis, and Meniere's disease. Diets high in saturated fat[4] also often correlate with CVDs as they increase the total and low-density lipoprotein (LDL) cholesterol. Therefore, reducing sodium and saturated fat is paramount while maintaining the products' desirable functional (i.e., conservation and emulsification) and sensory (i.e., taste, aroma, texture, and juiciness) characteristics. Accordingly, the product is expected to remain tasty while having good nutritional quality.

The study's results indicate that food manufacturers are reducing the saturated fat and sodium content of plant-based meat, reflecting a positive trend toward healthier products.

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[3] WORLD HEALTH ORGANIZATION. WHO global report on sodium intake reduction. Geneva: WHO, 2023.
[4] WORLD HEALTH ORGANIZATION. Saturated fatty acid and trans-fatty acid intake for adults and children: WHO guideline summary. Geneva: WHO, 2023.

## COMPARISON OF 1ST AND 2ND STUDY: SODIUM AND SATURATED FAT

**%** of products with high saturated fat: > 6 g / 100 g
- 33%
- 9%

**%** of products with high sodium: > 600 mg / 100 g
- 33%
- 24%

STUDY 1    STUDY 2

Fatty acids (FAs) are the building blocks of the fat in our bodies and food. Apart from being a source of energy, FAs serve as a structural component of our body cells, facilitating the absorption of fat-soluble vitamins (i.e., A, D, E, and K) and helping the brain to develop and function. They are classified as saturated fatty acids (SFA), *trans* fatty acids (TFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA). There is a consensus that saturated fatty acids and *trans* fatty acids consumption should be kept as low as possible, whereas monounsaturated and polyunsaturated fatty acids are recommended up to certain levels. In fact, according to a World Health Organization (WHO) report[4], replacing saturated fatty acids with unsaturated fatty acids and carbohydrates lowers LDL cholesterol and is associated with reduced risk of all-cause mortality.

Oil and fat types have distinct fatty acid profiles and consequently differ in nutritional aspects. Therefore, the fat content quality of plant-based meat directly depends on the fatty acid profile of the oil or fat and the amount used. Even though the amount of saturated fatty acids and polyunsaturated fatty acids are usually declared on the nutritional label, the complete fatty acid profile is not given, although it also plays an important role in the product's nutritional quality, but can be estimated by analyzing the source of added fat.

## FATTY ACID COMPOSITION IN CULINARY FATS AND OIL AND MOST USED FATS AND OILS IN PLANT-BASED MEAT EVALUATED IN STUDY 1 AND 2
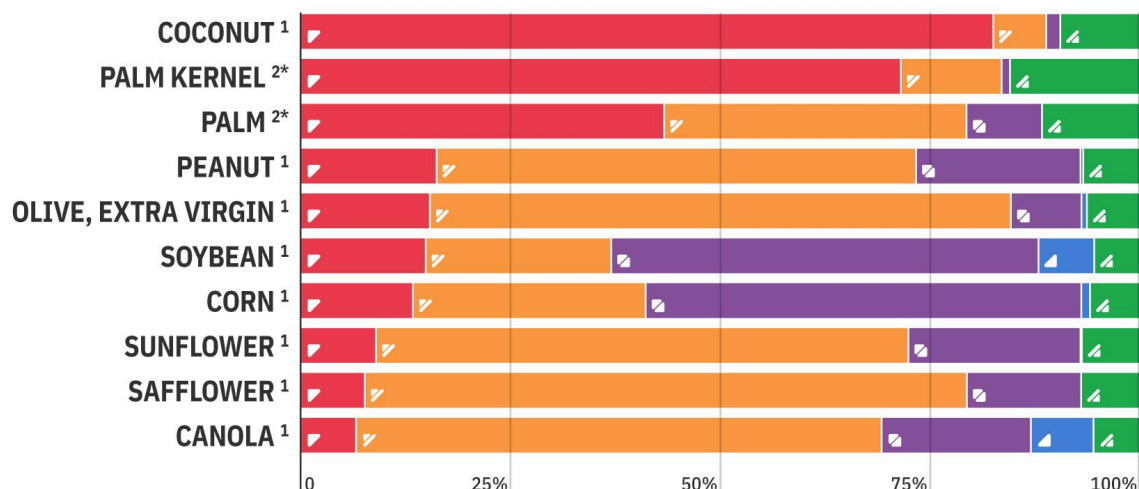


**Legend:** SATURATED | MONOUNSATURATED | OMEGA-6 (C18:2) | OMEGA-3 (C18:3) | OTHERS

[1] USDA. FoodData Central. Washington DC: **United States Department of Agriculture**, 2024.
[2] Codex Alimentarius Commission. Codex standards for fats and oils from vegetable sources. Rome: **Codex Alimentarius Commission**, 1999.
* When a range was provided, the minimum value was considered.

| STUDY 1 (%) | MAIN FAT SOURCE | STUDY 2 (%) |
|---|---|---|
| 48.5 [1] | UNSATURATED FA* | 55.3 [3] |
| 48.5 | SATURATED FA* [2] | 23.2 |
| 3.0 | NO FAT SOURCE | 21.5 |

[1] Sunflower, cotton, canola, soybean, and vegetable (not specified which) oil
[2] Coconut, palm, and vegetable (not specified which) fat
[3] Virgin and extra virgin, corn, soy, sunflower, canola, cotton, patuã, and vegetable (not specified which) oil
* FA: Fatty Acid.

# Protein, Amino Acids Profile, and Digestibility

Conventional meat is associated with high-quality protein, which comprises a protein profile with essential amino acids. Essential amino acids perform important metabolic functions but cannot be synthesized by humans and, therefore, should be obtained from the diet. For instance, cereals are low in lysine, while legumes lack sulfur-containing essential amino acids like methionine and cysteine. However, combined, they provide a complete set of essential amino acids. Therefore, plant-based meat can offer a similar nutritional profile to conventional meat if soy, which contains all 09 essential amino acids, or protein mixtures with complementary amino acid profiles, are used in the product's formulation.

Plant-based meat manufacturers commonly mix plant protein sources. However, soy is still the main protein used individually and in mixtures in flour, concentrated protein, textured protein, and

isolated protein. The study also shows a considerable variation in plant-based meat protein content (from 0 to 54%). Yet, a regulation defining the minimum protein content should help strengthen the identity of plant-based meat and reduce variations. In fact, the definition of identity and quality standards for plant-based products in Brazil was included in Anvisa's 2024-2025 Regulatory Agenda (item 3.11 of Ordinance 1.409 of December 15, 2023).

| MAIN PROTEIN SOURCES IN PLANT-BASED MEAT | | |
|---|---|---|
| STUDY 1 (%) | MAIN PROTEIN SOURCE | STUDY 2 (%) |
| 60.6 | SOY | 52.2 |
| 21.2 | PEA | 16.3 |
| 18.2 | OTHER* | 19.2 |
| 0.0 | NO PROTEIN SOURCE | 12.3 |
| *CHICKPEA, LENTIL, BEAN, WHEAT, GLUTEN, RICE, MIX (SOY, PEA AND CHICKPEA). | | |

| PROTEIN CONTENT IN PLANT-BASE MEAT | | |
|---|---|---|
| STUDY 1 (%) | RANGE (%) | STUDY 2 (%) |
| 3 | 0 - 5.9 | 17 |
| 21 | 6 - 10.9 | 23 |
| 48 | 11 - 15.9 | 32 |
| 24 | 16 - 20.9 | 16 |
| 3 | 21 - 24.9 | 5 |
| 0 | 25 - 54 | 6 |

Apart from the protein profile, its digestibility is also vital. Protein digestibility quantifies the degree of protein hydrolysis (breakage into amino acids) within the digestive tract and subsequently absorption by the small intestine. It quantifies the portion of ingested protein available for the body's metabolic needs. Antinutritional factors are also a point to consider, as they can impair the digestibility and metabolism of proteins and other nutrients.
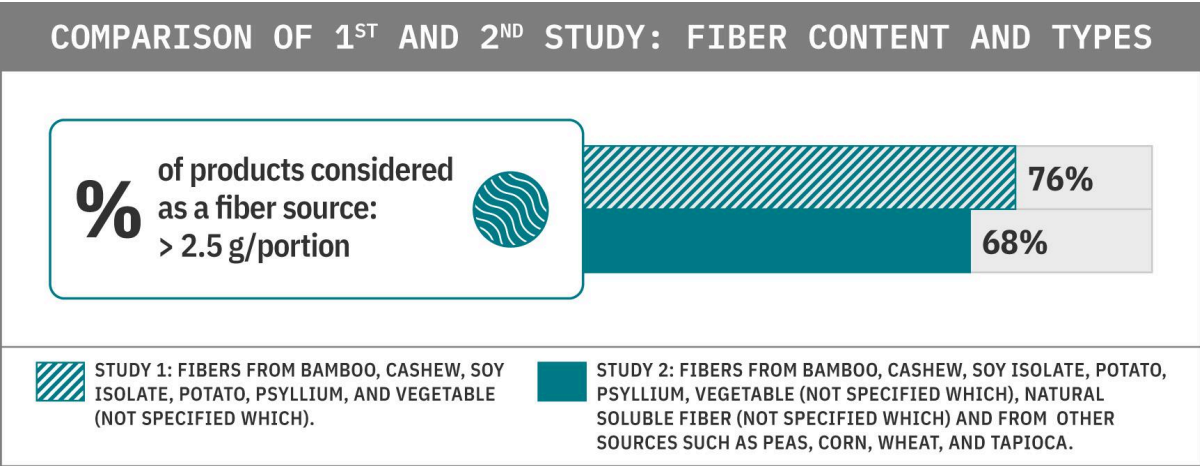
# Dietary Fibers

Unlike other macronutrients, such as fats, proteins or carbohydrates, which the body breaks down and absorbs, the body does not digest fiber. Yet, it plays a fundamental role in keeping the digestive

system healthy. Dietary fibers can be classified based on viscosity, fermentability, and solubility in water (soluble and insoluble fiber). Insoluble fibers (e.g., cellulose and lignin commonly present in whole-wheat flour, wheat bran, nuts, beans and vegetables, such as cauliflower, green beans and potatoes) speed up the transit of food in the gastrointestinal tract and increase fecal bulk, thereby helping prevent constipation. Soluble fibers (e.g., pectin and β-glucans commonly present in oats, legumes, vegetables, barley and psyllium) can partially or entirely ferment, commonly producing valuable byproducts for health (e.g., short-chain fatty acids)[5]. Therefore, fibers are considered health-promoting macronutrients from a nutritional perspective as they can help alleviate diseases (e.g., diabetes, cancer, cardiovascular, obesity and irritable bowel syndrome). From a technological perspective, fibers are used in plant-based meat to enhance functionality since they can absorb water and oil for juiciness, provide texture, and increase yield, as they can partially replace the textured protein.

Plant-based meat stands out for its fiber content compared to conventional meat, which usually lacks dietary fiber. These fibers can be intrinsic to the ingredients used in the formulation of plant-based meat, such as in vegetable flours, which naturally contain complex carbohydrates or are added as rich fiber ingredients.

The study's results show that manufacturers continue to include fiber ingredients in their formulations to provide nutritional and technological benefits, possibly improving consumers' acceptance of foods. In fact, food dietary guides highly recommend the consumption of fiber-enriched products.



COMPARISON OF 1ST AND 2ND STUDY: FIBER CONTENT AND TYPES

% of products considered as a fiber source: > 2.5 g/portion

76%
68%

STUDY 1: FIBERS FROM BAMBOO, CASHEW, SOY ISOLATE, POTATO, PSYLLIUM, AND VEGETABLE (NOT SPECIFIED WHICH).

STUDY 2: FIBERS FROM BAMBOO, CASHEW, SOY ISOLATE, POTATO, PSYLLIUM, VEGETABLE (NOT SPECIFIED WHICH), NATURAL SOLUBLE FIBER (NOT SPECIFIED WHICH) AND FROM OTHER SOURCES SUCH AS PEAS, CORN, WHEAT, AND TAPIOCA.

# Micronutrients

The micronutrients present in plant-based meat can vary significantly based on the ingredients used for its formulation. For instance, vitamin C, vitamin A, folate, and minerals like magnesium, potassium, and zinc are present in legumes and cereals, yet they lack vitamin $B_{12}$ and iron. However, fortification of plant-based meat is an effective strategy to make up for the lack of these micronutrients. In this way, these products can offer a nutritional profile comparable to that of conventional meat.

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[5] Khorasaniha, R., Olof, H., Voisin, A., Armstrong, K., Wine, E., Vasanthan, T., & Armstrong, H. Diversity of fibers in common foods: Key to advancing dietary research. Food Hydrocolloids, 139, 108495; 2023.

The bioavailability of some minerals in food products can be reduced due to antinutritional factors. The main antinutritional factors found in grains and legumes are oligosaccharides, trypsin inhibitors, phytic acid, tannin and hemagglutinins, also called lectins. Therefore, there is a need for in-depth studies to fully understand how the presence of antinutritional factors in the ingredients used to produce plant-based meat can affect the bioavailability of minerals.

## Bioactive Compounds

Bioactive compounds are present in small amounts in plants and certain food products such as fruits, vegetables, nuts, oils, and whole grains. It is well known that they have actions that may promote good health due to their antioxidant and anti-inflammatory properties. Examples of bioactive compounds include polyphenols (e.g., phenolic acids, tannins, flavonoids, stilbenes and lignans), dietary fiber, carotenoids (e.g., carotenes and xanthophylls), and vitamins, which are commonly present in ingredients used in the production of plant-based meat. Certain polyphenols can have antinutritional properties, but their influence on protein digestibility and nutrient absorption depends on individual factors, dosage, and cooking techniques. Some antinutrients can be mitigated through soaking, sprouting, or fermenting.

In most cases, the health benefits of polyphenols, such as their antioxidant and anti-inflammatory properties, outweigh their potential drawbacks. In addition, the role of bioactive compounds in enhancing the nutritional value of plant-based meat warrants further investigation. This research can be reflected in more precise labeling, allowing consumers to understand plant-based foods' health benefits better.

## Categorization of Plant-based Meat According to Different Indicators

The indicators used differ conceptually; the NOVA indicator reflects the presence of ingredients extracted from food matrices (e.g., proteins, starch and oils) and additives; Nutri-Score reflects the presence of more desirable (e.g., proteins and fibers) and less desirable (e.g., high amounts of energy, saturated fat, sugar, and salt) nutrients; and the LOUPE (RDC 429/2020, ANVISA) informs consumers, using front-of-packages warning labels, if foods are high in sugar, saturated fat, or sodium.

## NUTRITIONAL INDICATORS

**LOUPE: a nutrient-based indicator adopted in Brazil, according to Resolution RDC 429/2020 and IN 75/2020 (ANVISA), to inform consumers about the high content of three nutrients: added sugars, saturated fats and sodium.**

It established mandatory front-of-package warning labels for food products containing higher amounts of these maximum values:

**Added sugar**
15 g or more in every 100 g for solid or semi-solid foods and 7.5 g or more per 100 mL for liquid foods.

**Saturated fat**
6 g or more in every 100 g for solid or semi-solid foods and 3 g or more per 100 mL for liquid foods.

**Sodium**
600 mg or more in every 100 g for solid or semi-solid foods and 300 mg or more per 100 mL for liquid foods.

**Nutri-Score: a nutrient-based indicator for evaluating the nutritional profiles of foods to help consumers choose healthier products.**

It is a front-of-pack labeling based on five categories associated with letters A (best nutritional quality) to E (worst nutritional quality). High amounts of energy, saturated fat, sugar, and salt contribute to less favorable results (classification D or E) while rich in fiber, proteins, vegetables, and fruits obtain a favorable classification (A, B or C).

**NOVA: a food-processing-based indicator for evaluating the foods according to the degree of processing. This scheme is divided into 4 categories:**

**NOVA1
(Unprocessed or minimally processed foods):** Minimal processing includes the removal of inedible or unwanted parts. In this category, nothing is added to the original food.

**NOVA2
(Processed culinary ingredients):** Substances made from NOVA1 foods or from nature that are processed for use in cooking.

**NOVA3
(Processed foods):** Foods from NOVA1 that have been processed and/or combined with foods from NOVA1 or NOVA2 foods that have been further processed.

**NOVA4 (Ultra-processed foods):** Foods made using a series of processes, contain artificial ingredients and usually have few intact NOVA1 foods.

Some discussions on the nutritional quality of food products suggest that only one dimension (nutritional quality or classification according to the purpose of food processing) would be sufficient to summarize the other. However, this can be misleading, especially for consumers. Results from Study 2 suggest that more than the NOVA indicator is needed to evaluate the quality of plant-based meat products available in the Brazilian market. The results of Study 2 make it clear that one indicator does not replace the other since they evaluate different dimensions. Classifying a food as ultra-processed without delving into aspects of its nutritional quality can lead consumers to incorrect conclusions. The complementarity of these concepts is essential for an informed buying decision. Therefore, labeling, the main element of nutritional information for the consumer, is of utmost importance.

| NUTRITIONAL INDICATORS FOR PLANT-BASED MEAT IN THE BRAZILIAN MARKET | |
|---|---|
| **NUTRI-SCORE** | |
| **Nutri-Score A+B+C** | 80% |
| **Nutri-Score D+E** | 20% |
| **NOVA** | |
| **Ultra-processed** | 73% |
| **Non-ultra-processed** | 27% |
| **LOUPE*** | |
| **Good Quality** | 68% |
| **Low Quality** | 32% |

*LOUPE (RDC429/2020, ANVISA).
**Good Quality:** saturated fat and sodium did not exceed the established limits.
**Low Quality:** at least one of the limits was exceeded.
**32 products exceeded the limit of 6.0 g of saturated fat/100 g and 85 products exceeded the limit of 600 mg sodium/100g.**
**Please note this data was obtained from "Locatelli, N.T., Chen, G. F. N., Batista, M.F., Furlan, J.M., Wagner, R., Bandoni, D.H., de Rosso, V.V. Nutrition Classification Schemes for Plant-Based Meat Analogues: Drivers to Assess Nutritional Quality and Identity Profile. Current Research in Food Science, p. 100796, 2024.**

# Overall Conclusions

Comparing these studies reveals the evolution of the plant-based meat market in Brazil, from its nascent stage with limited options to a more established market with a growing base of informed consumers. In addition, the studies shed light on the wide variation between the products regarding their composition in macronutrients and nutritional quality according to different indicators. Results showed that even though these products are mainly classified as ultra-processed, they have good nutritional quality, according to the Nutri-Score and LOUPE indicators.

Understanding the heterogeneity of the plant-based meat category, based on information available on the labels, is the first step needed to incite reflection on how the category is currently positioned in the market regarding its nutritional aspects. These results serve as a common ground for the regulating agencies to understand the plant-based meat category in Brazil and should be used in the design of their regulatory aspects and identity and quality standards.

The second step is to understand other nutritional aspects beyond evaluating the nutritional labels, the ones related to mineral bioavailability, protein digestibility, fatty acid and amino acid profile, and the presence of antinutritional and bioactive compounds. Analyses associated with the profile of amino acids and fatty acids are fundamental for evaluating the nutritional quality of plant-based meat, as is for any food product, and are crucial in answering the question of nutritional adequacy when replacing. Knowing the amino acid profile, one could use claims such as "rich in proteins" or "contains all essential amino acids". Yet, one must also keep in mind that evaluation of a single replacement (e.g., an animal-based burger for a plant-based burger) is also not adequate as the overall daily food intake should,

ideally, include various food products that are complementary in terms of fulfilling the total amino acid composition, vitamins and minerals requirements; in other words, what counts is the total nutrients ingested throughout the day. Besides the nutritional aspects, the environmental impact of diet should also be considered.

# Way Forward

To advance, different actors must work together to boost the nutritional aspects of plant-based foods, aiming to balance nutrition and taste. The industry's commitment to the constant improvement of nutritional aspects is paramount, as is the need to find ways to clearly communicate the nutritional value of their products to consumers, as the healthiness of these products goes beyond the labeled information. Researchers' dedication to addressing the absorption of nutrients and their contribution to health, as well as optimizing methodologies to establish standardized protocols for evaluating the nutritional aspects of the plant-based category, is also paramount. From a regulator's perspective, it is of prime importance to promote adequate nutritional indicators and labeling information that are clear and capable of addressing the nutritional aspects of foods to consumers, as well as assessing the need for minimum quality criteria for better nutritional homogeneity of final products.

The studies' comparison clarified how public policies, such as the obligation of warning labels for products not considered healthy, can improve the nutritional quality of food products and lead to a positive dietary change. Nevertheless, public policies must be cautiously elaborated with robust scientific-based evidence. In this sense, it is important that all actors use and promote scientific evidence to establish a sound relationship between plant-based meat, nutrition, health and emerging sustainability concerns.
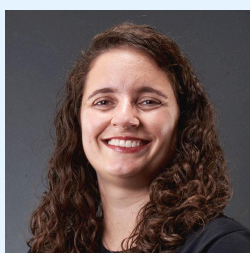
*"While the NOVA classification system identifies plant-based meat as ultra-processed due to its ingredients and processing, this indicator may not fully capture the unique nutritional profile of these products. Therefore, a more nuanced approach is necessary to accurately evaluate plant-based meat's health benefits."*

**Graziele Grossi Bovi Karatay**
**Science and Technology Plant-based Specialist at GFI Brazil**

*"This study provides valuable insights into the nutritional value of plant-based meat. With the growing adoption of flexitarian, vegetarian, and vegan diets, this analysis can help industries develop products with nutritional quality that make them increasingly viable as healthy substitutes for meat products and offer consumers the possibility of making informed and conscious choices."*

**Cristiana Ambiel**
**Science and Technology Manager at GFI Brazil**



*"We believe that the data obtained can also guide regulatory agencies in formulating public policies to define minimum nutritional quality parameters for these products in the debates that we expect to take place in 2024 and 2025 between Anvisa, the Ministry of Agriculture, and the Legislative Branch, involving both the food and ingredient industry and organized civil society in public hearings on the subject."*

**Alexandre Cabral**
**Public Policies Vice President at GFI Brazil**

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