Whitepaper Ultro-Processed Foods (UPFs)

Examining Health Implications and the Rise of Plant-Based Alternatives

An Overview of UPFs and Their Role in Modern Nutrition and Plant-Based Food Choices







01. Executive Summary

This whitepaper provides an in-depth analysis of the NOVA food classification system, with a specific focus on its application to Ultra-Processed Foods (UPFs) within the context of plant-based alternatives. It critically examines the system's ability to assess the nutritional profile and compositional integrity of these products, highlighting key challenges and limitations. The paper questions the NOVA system's effectiveness in providing accurate and mean-ingful evaluations in an evolving market, particularly as the sector for plant-based alternatives continues to grow and innovate.

Key Findings



The NOVA system shows inconsistencies and limitations when applied to plant-based alternatives, potentially leading to misinterpretation by both consumers and regulators.

Plant-based products present unique considerations that are not adequately captured by the current NOVA framework, raising concerns about its validity for such foods.

Strategic Implications



The food industry and regulatory bodies need to adopt more refined and nuanced classification systems that better reflect the complexities of modern food products, particularly plant-based alternatives, to ensure informed decision-making and clearer consumer guidance.



What is this whitepaper about?

This whitepaper explores the impact of Ultra-Processed Foods (UPFs) and the NOVA classification system on health, with a focus on plant-based alternatives. It highlights the limitations of the current system, which emphasizes processing over nutritional content, potentially misclassifying plant-based products as UPFs and raising concerns about their evaluation.

What are the health implications of UPF consumption?

Higher total UPF consumption has a negative impact on multiple health parameters. However, it is important to recognize that not all UPFs exert the same level of impact on health. Emerging research suggests that plant-based alternatives, a subset of UPFs, may not contribute to higher morbidity rates. This highlights the need for further studies to explore the health effects of different UPF subcategories, as broad generalizations may overlook important nuances within the category.

What do consumers think?

The NOVA classification system has raised consumer concerns over additives in food, which may contribute to hesitancy toward plant-based alternatives, despite their health and environmental benefits. While convenience and accessibility are valued, the system's complexity and broad categorization often leave consumers confused about which foods are classified as UPFs, complicating their dietary decisions.

How can plant-based products be improved in the UPF context?

To improve plant-based products within the UPF context, companies should enhance nutritional profiles, offer cleaner labels, and incorporate whole foods to reduce perceived processing. Transparency about ingredients builds consumer trust, while staying updated on health research and training staff to address UPF concerns will help meet evolving consumer demands. Emphasizing the environmental and health benefits of plant-based alternatives is also key.

What is criticized about the NOVA system and how could it be improved?

The NOVA system is criticized for overlooking nutritional content and relying on overly broad categories that equate any and all processing with unhealthiness. It simplifies health impacts by not considering the complexity of processed ingredients, such as hydrolyzed proteins, which may not be harmful. Additionally, it excludes important health factors, leading to bias against novel ingredients. The lack of consensus on UPF definitions and the system's broad classifications further complicate studies.

Improvements could include integrating nutritional profiles, refining categories for better differentiation, and establishing a more precise, universally accepted UPF definition.

What is the NOVA System?

The NOVA system is a classification system for food based on the extent and purpose of food processing. It categorizes food into four groups:

Group I: Unprocessed or minimally processed foods

Group II: Processed culinary ingredients

Group II: Processed foods

Group IV: UPFs

The NOVA system states that ultra-processed foods should not be consumed.



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02. Introduction

The NOVA (Portuguese: nova classificação, "new classification") system has rapidly gained influence within both academic research and public health policy. Its four-tier structure distinguishes foods based on the extent of industrial processing they undergo, rather than their nutritional profile (Monteiro et al., 2019). While often mistakenly conflated with nutrient content, the NOVA classification is solely focused on how extensively a food has been industrially processed. As the fourth category of the system, Ultra-Processed Foods (UPFs) represent those subjected to the highest level of modifications. The increasing concern surrounding UPFs highlights a complex and growing area of research within nutrition science.

UPFs occupy the fourth and most processed category of the system. These products are typically industrial formulations that involve a series of mechanical and chemical pro-

cesses designed to enhance flavor, texture, and shelf-life. This includes techniques such as extrusion, pre-frying, and the addition of ingredients like high-fructose corn syrup, hydrogenated oils, and (artificial) additives. While originally intended to improve palatability and convenience, this level of processing can significantly alter the food matrix, potentially influencing health outcomes.

Common examples of UPFs range from everyday items like breakfast cereals, flavored yogurts, and ice creams to more complex formulations such as hot dogs, soft drinks, and a newer category - plant-based meat and dairy alternatives. The inclusion of plant-based products in this category has sparked debate, as these alternatives are often marketed as healthier or more sustainable choices. However, their classification as UPFs due to the use of extensive processing

Classic UPFs



techniques necessary to recreate the attributes of animalbased products, complicates their perceived health benefits. The challenge lies in separating the nutritional aspects of these foods from the methods used to produce them, and understanding how their UPF status might influence pubblic health. This distinction is crucial, as much of the pubblic health discourse around UPFs tends to focus on their association with poor health outcomes such as obesity, diabetes, and cardiovascular disease. However, this discussion often overlooks the fact that UPF classification is not synonymous with low nutritional value and the heterogeneity of the products classified as UPFs. This nuance is essential in moving beyond the assumption that all UPFs are inherently unhealthy, and requires a more comprehensive understanding of the role processing plays in both the food system and health.

Plant-Based Meat Alternatives



03. **Background: The NOVA Classification** System

The concept of UPFs was first introduced within the NOVA classification system in 2009 by researchers at the University of São Paulo, led by Carlos A. Monteiro. Published in Public Health Nutrition under the title "Nutrition and health: The issue is not food, nor nutrients, but processing," the framework aimed to highlight the changing dietary patterns in Brazil, particularly in response to increasing obesity rates. Its primary focus was to emphasize the role of food processing, rather than individual nutrients or foods, in shaping health outcomes.

The NOVA classification and the issue of Ultra-Processed Foods (UPFs) have garnered significant attention from both media and public health organizations. In 2014, Brazil's Ministry of Health integrated the NOVA system into its dietary guidelines, prioritizing natural or minimally processed foods over ultraprocessed ones, a stance later adopted by the **Pan American** Health Organization. More recently, France's 2024 dietary recommendations also advocated for reduced UPF consumption, while emphasizing the importance of considering nutritional information. However, organizations such as the **<u>British</u> Nutrition Foundation** and the **German Nutrition Society** have called for greater clarity on the criteria for classifying UPFs and a more rigorous evaluation of the system's ability to effectively differentiate between healthy and unhealthy food choices.

European Journal of Clinical Nutrition

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Industry Research

Ultra-processed foods: how functional is the NOVA system?

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BACKGROUND: In the NOVA classification system, descriptive criteria are used to assign foods to one of four groups based on processing-related criteria. Although NOVA is widely used, its robustness and functionality remain largely unexplored. We determined whether this system leads to consistent food assignments by users.

METHODS: French food and nutrition specialists completed an online survey in which they assigned foods to NOVA groups. The survey comprised two lists: one with 120 marketed food products with ingredient information and one with 111 generic food items

> A <u>study</u> involving 159 French food and nutrition specialists indicated that the current NOVA criteria are insufficient for making robust and functional food classifications.

The Four NOVA Categories

Group I: **Unprocessed or minimally** processed foods

Basis of the daily diet

Fresh, dry or frozen vegetables or fruits, grains, legumes, meat, fish, eggs, nuts, and seeds



Processing includes removal of inedible or unwanted parts and preparation for storage.

Group II: **Processed culinary** ingredients

Used in small quantities as ingredients for Group I

Plant oils (e.g. olive oils, coconut oil), animal fats (e.g. cream, butter), maple syrup, sugar, honey, and salt



Substance derived from Group I foods or nature by processes including milling, grinding, refining, pressing, and drying.

Group III: **Processed foods**

Combined with Group I or II should be eaten in limited quantities

Canned vegetables, canned fish, fruits in syrup, beer, wine, cheese, and freshly made bread

Created by adding salt, oil, sugar, or other substances from Group II to Group I foods.

Group IV: **Ultra-processed foods**

Should be avoided

Sweetened beverages, burgers, pizza, ice-cream, sweet and savory packaged snacks, instant soups, and chicken nuggets



Formulations made mostly or entirely from substances derived from foods and additives. Includes very little intact Group I.









04. Health Implications of UPFs

A 10 % increase in plant-sourced non-UPF consumption is associated with 7% reduced cardiovascular disease risk and 13% reduced mortality, while plant-sourced UPF is associated with 5% increased CVD risk and 12% increased mortality risk.

a multinational cohort study

Heinz Freisling⁴

Source: Cordova study

Subgroups

Total UPF intake

Ultra-processed breads and cerea

Sauces, spreads, and condiments

Sweets and desserts

Savory snacks

Plant-based alternatives

Animal-based products

Ready-to-eat/heat mixed dishes

Artificially and sugar-sweetened b

Other ultra-processed foods

Hazard



Forest plot of Hazard Ratios			
			HR(95% CI)
		⊢∎⊣	1.09 (1.05,1.12)
als	⊢ ∎		0.97 (0.94,1.00)
	6		1.03 (1.00, 1.06)
	⊢ ∎		0.99 (0.95, 1.03)
	H		1.00 (0.96, 1.04)
		-	0.97 (0.91, 1.02)
		⊢∎⊣	1.09 (1.05, 1.12)
	F	■1	1.01 (0.98, 1.04)
everages		⊨∎⊣	1.09 (1.06,1.12)
	F	8	1.01 (0.97,1.05)
0.8 1 1.2 Ratio per 1 SD (95% CI) – Subgroups of ultra-processed foods			

The study found that animal-based products and artificially and sugar-sweetened beverages were most associated with UPF risk, while ultra-processed breads, cereals, and plant-based alternatives were not.

Several studies, including those by Lane et al. (2024) and Pagliai et al. (2021), have demonstrated an association between the consumption of UPFs and an increased risk of adverse health outcomes. Given the broad and heterogeneous nature of UPFs, recent research has shifted toward examining specific subgroups within this classification. For example, Rauber et al. (2024), utilizing data from the UK Biobank cohort, revealed that a 10% increase in the consumption of plant-sourced, non-UPF foods was associated with a 7% reduction in cardiovascular disease (CVD) risk and a 13% decrease in all-cause mortality. Conversely, plant-sourced UPFs were linked to a 5% increase in CVD risk and a 12% rise in mortality.

A closer examination of this study's food categorization reveals that plant-based meat alternatives constitute only 0.2% of plant-sourced UPFs. Moreover, many items classified as plant-sourced UPFs, such as pre-packaged meals, frozen pizzas and non-vegan pastries, are not exclusively plantbased. Distilled alcoholic beverages were also included in this category, although their inclusion may warrant further consideration, given the relevance of their alcohol content and its potential health implications.

A separate study by **Cordova et al. (2023)**, based on data from the EPIC study, found that UPF-related health risks were more strongly associated with animal-based products and sugarsweetened beverages, while ultra-processed breads, cereals, and plant-based alternatives were not associated with risk of negative health outcomes.

Given the complexity of these findings, it would be valuable to explore the health impacts of specific product clusters within the UPF category to better identify opportunities for improving their nutritional profiles. However, the relative novelty of plantbased alternatives in the market underscores the need for more robust data. Ongoing research, such as the <u>COPLANT study</u> by the German Federal Institute for Risk Assessment (BfR) and the Max Rubner Institute (MRI), may provide crucial insights to address these gaps in understanding.

Key Findings of the Rauber et al. (2024) Study

Plant-Sourced Foods

Preserved Vegetables/Fruit •

Non-Ultra-Processed

Ultra-Processed

Industrial Packaged Breads • Pastries, Buns, and Cakes •

Margarine and Other Spreads • Industrial Chips (French Fries) • **Breakfast Cereals** • Soft Drinks, Fruit Drinks, and Fruit Juices • **Packaged Salty Snacks** • Packaged Pre-Prepared Meals • **Distilled Alcoholic Beverages** • Sauces, Dressings, and Gravies •

A recent study by **Rauber et al. (2024)** found that consuming plant-based ultra-processed foods (UPFs) is associated with an increased risk of cardiovascular diseases, whereas the intake of unprocessed plant foods is linked to a reduced risk. However, the study's categorization of "plant-based" also includes certain animal-based products such as pizza and sweet snacks, which does not necessarily align with the common definition of "plant-based" as being free from animal ingredients. Furthermore, distilled alcohol was also categorized within the scope of plant-based products in this study. Notably, plant-based meat alternatives accounted for only 0.2% of the total dietary intake in the study, highlighting the need for further research in populations with a higher consumption of these products.



- Fruit •
- Beer & Wine •
- **Cereals** •
- **Vegetables**
 - Pasta •
- **Roots & Tubers** •
- **Processed Bread**
 - Nuts & Seeds •
 - Table Sugar •

 - Legumes
 - Others^a •

 - **Biscuits** •
- **Confectionery**
- Industrial Pizza
- **Meat Alternatives** •

Animal-Sourced Foods

- Red Meat^b
- Milk
- Fish
- Cheese
- Poultry
- Animal Fats
- Eggs
- Milk-Based Drinks
- Sausage and Other
- **Reconstituted Red Meat Products^b**
- Nuggets and Other
- **Reconstituted Meat Products**
- Milk-Based Desserts
- Mayonnaise and Spreadable Cheese

Liquor, pizza with animal-based ingredients, soft drinks, and confectionery were considered plant-sourced in this study!



a Coffee and tea, fungi, homemade soup, plant oil. b Considered as red meat in the further analyses using non-red meat versus red meat, according to dietary contribution of UPF.





05. **All Ultra-Processed Foods Are Not Created Equal**

Plant-based meat alternatives often do not fit neatly into the category of UPFs commonly associated with negative health effects. A key distinction lies in their nutritional profile. For instance, plant-based meats tend to contain significantly more fiber, a nutrient lacking in many Western diets; in the EU and US people typically get only approximately 40-60% of the daily recommended intake (European Comission 2023; USDA, 2015). Although plant-based meats generally have slightly lower protein content per 100g than conventional meat, they offer a comparable percentage of calories from protein, aligning them more closely with nutritional guidelines. Additionally, they contain much less saturated fat, with fats derived from plant sources instead.

Salt content is another area of concern for UPFs, and while some plant-based meats may contain high amounts of salt, research shows variation across products and countries. In real-world settings, factors like seasoning can also affect salt intake, with some studies finding no significant difference in salt consumption between plant-based and conventional meat dishes. Overall, while both plant-based and conventional meats may share some processing characteristics, their nutritional differences suggest that plant-based alternatives do not fully align with typical UPF profiles.

Conventional Processed Meat

Plant-Based Meat

Processing level \neq nutrition content. Comparison of plant-based meat - referred to as UPF acc. to NOVA - relative to non-UPF definition criteria. The nutritional profile of plant-based meat is significantly more favorable compared to ultraprocessed animal-based products.



Source: gfi 2023 and Green Queen 2024



06. Challenges in Applying NOVA to Plant-Based Products

The NOVA classification system primarily evaluates foods based on visible processing methods, categorizing them as either harmful or not according to the degree of processing involved (Monteiro et al., 2019). A central rationale of the system is to prevent whole, minimally processed foods from being supplanted by more processed alternatives. However, there is limited evidence, particularly for plant-based alternatives, to substantiate whether this displacement truly occurs.

The NOVA framework operates under the assumption that unprocessed foods are inherently beneficial for health, a generalization that is not always accurate. For instance, unprocessed foods such as red meat and full-fat dairy – both high in saturated fats - are frequently recommended to be consumed only in moderation by major dietary guidelines (e.g., The German Nutrition Society, Dietary Guidelines for Americans, Eatwell Guide by Public Health England).

IARC's Carcinogen Classifications

Group 1: **Carcinogenic to humans**

Sufficient evidence in humans or strong evidence with a relevant mechanism identified.

Group 2a: Probably carcinogenic to humans

Limited or no evidence in humans. Sufficient evidence in animals



Group 2b: Possibly carcinogenic to humans

Limited or no evidence in humans. Limited to insufficient evidence in animals.

Group 3: Carcinogenicity not classifiable Inadequate evidence in humans. Inadequate evidence in animals. Often means further research needed.

Red meat has been classified as Group 2A (probably carcinogenic) by the International Agency for Research on Cancer (IARC, 2018). Even within the Brazilian dietary guidelines, which closely align with the NOVA system, the consumption of red meat and fatty dairy products is viewed with caution (Ministry of Health of Brazil, 2015), though this is not prominently emphasized. A key limitation of the NOVA system is its focus on visible processing techniques, such as extrusion, while neglecting less obvious processes like enzyme use or standardization. The absence of these methods in the classification does not necessarily imply that they are harmful, yet NOVA fails to account for their necessity in ensuring food safety and nutritional quality. For example, white flour, which undergoes substantial processing to remove beneficial fiber, is not classified as a UPF, revealing an inconsistency in the system's criteria.

- Smoking tobacco
- Exposure to solar radiation
- Alcoholic beverages
- Processed meats
- Emissions from high temperature frying
- Steroids
- Exposures from working in hairdressing
- Red meat
- Night shift work
- Gasoline & gasoline engine exhaust
- Welding fumes
- Pickled vegetabes
- Aloe vera whole leaf extract
- Tea
- Coffee
- Static magnetic fields
- Fluorescent lighting
- Polyethylene

At its core, NOVA adheres to an "appeal-tonature" philosophy, equating "natural" with "good" and "processed" or "unnatural" with "bad." This binary approach can be limiting, as it groups a diverse range of foods with varying health effects into the same categories.

07. Further Considerations and Suggestions for Improvement

To optimize the NOVA system, several strategic enhancements can be implemented:

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First, refining the categorization framework to prioritize nutritional value and evidence-based health outcomes, rather than focusing solely on the degree of food processing, is crucial.

This approach requires a comprehensive reassessment of processing techniques, recognizing that certain methods – such as fortification and fermentation – can improve both food safety and nutritional content.

2.

Additionally, a targeted evaluation of individual additives is imperative.

Assessing their specific health effects enables moving beyond generalized classifications based solely on ingredient lists.

3.

It is also essential to account for the functional impact of processing on overall dietary patterns, particularly with plant-based alternatives, which may serve as viable substitutes for animal products or potentially displace whole foods.

These refinements would create a more sophisticated framework that better aligns with real-world health outcomes and provides clearer, evidencebased guidance for consumers and policymakers.

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08. Consumer **Perception and Market Impacts**

Innova Market Research (2023/2024) highlights several global barriers to the adoption of plant-based alternatives. Among consumers, 35% cite cost, 32% express concerns about taste and texture, and 27% question the health and nutritional quality of these products. Additionally, 25% of respondents raise concerns about the safety of plant-based alternatives, while 20% avoid them due to perceptions of being overly processed. Although 48% of consumers acknowledge the convenience of plant-based options, a significant portion (22%) prefer these products to be less processed. In the U.S., health concerns are the primary driver of aversion to UPFs, with 49% of consumers avoiding UPFs for this reason, and 47% highlighting poor nutritional profiles. The presence of artificial ingredients plays a key role in this avoidance, as 59% of U.S. consumers associate UPFs with artificial flavors, 53% with preservatives, and over 50% with sweeteners and colors. These figures indicate a strong consumer preference for cleaner labels and natural ingredients, as the presence of artificial additives significantly impacts purchasing decisions (Innova Market Research 2024). A 2024 study by EIT, conducted across Europe, further emphasizes that consumers often underestimate their UPF consumption, driven by the appeal of convenience and affordability. Many find it difficult to accurately identify what qualifies as a UPF, complicating efforts to reduce intake. Despite the growing demand for plant-based alternatives, 54%

Innova Consumer Data for the U.S. Market (2024)

What Are Your Top 3 Reasons Against **Consuming UPFs?**



of consumers avoid these products due to concerns about their perceived high level of processing, posing a significant challenge for market adoption.

Research by Hässig et al. (2023) indicates that the NOVA classification aligns with consumer perceptions regarding the classification of UPFs. While the NOVA system offers benefits such as improved food safety and cost reduction, many consumers use the extent of processing to assess a product's healthiness, which can result in misconceptions and inaccurate evaluations of nutritional value.

Top 5 Ingredients Most Associated With UPFs



Innova Market Research (2023) Top 3 Barriers to the Adoption of Plant-Based **Alternatives**





09. **Case Studies and Best Practices**

"Plant-based alternatives will always be classified as UPFs under the NOVA system."

specific components.

A key opportunity lies in the reduction of salt, especially in meat and cheese alternatives, where high salt content is often not technologically necessary as it is in traditional animal products. Although these modifications do not classify the products as non-UPF, they contribute to a more positive consumer perception and directly address concerns regarding processed foods. Engaging a broad consumer base is essential for driving the protein transition forward.

Substituting coconut oil with alternatives like canola oil is another measure already being implemented. Additionally, integrating whole foods such as vegetables and legumes into plant-based products offers nutritional and functional benefits, though this approach may be more applicable when the objective is not to mimic meat precisely. However, market demand is increasingly shifting towards such innovative products. Further enhancement through fortification with essential minerals, vitamins, and fatty acids is also a valuable approach to aligning plant-based products with consumer nutritional expectations. By combining these strategies with clear educational efforts, plant-based alternatives can be optimized to support a successful and sustainable shift toward new protein sources.

Key Opportunities

As the global population continues to grow, identifying sustainable protein sources is imperative. Plant-based alternatives hold significant promise, but replicating the full functionality of certain animal-derived ingredients remains a scientific challenge. To enhance consumer confidence, it is crucial to adopt clean label solutions, ensuring transparency in ingredient lists and providing education on the functional roles of



1. Clean Label Alternatives



2. Salt Reduction



3. Saturated Fat Reduction



4. Whole Foods



5. Fortification



10. Future Directions and Conclusion

The ongoing evolution of UPF warrants close monitoring, particularly in the context of public health and nutrition. Establishing robust systems and criteria to evaluate the nutritional value of foods is crucial for ensuring long-term public health. These evaluation frameworks should aim to promote dietary choices that support public health without being overly prescriptive, instead encouraging a scientifically grounded approach. It is conceivable that the NOVA classification system could be expanded to include more nuanced categories. However, the scientific robustness of such an updated system would need to be thoroughly investigated to ensure its reliability and effectiveness.

A primary goal is to identify feasible strategies that can help improve the population's overall dietary quality. Concepts like these play an essential role in highlighting areas for improvement within the food system, but it is important that they remain adaptable and evidence-based rather than rigid or dogmatic. This approach will help to maximize their effectiveness while allowing flexibility for real-world application. This issue is particularly pressing in regions where dietary patterns are becoming more aligned with Western style eating habits, such as in parts of the Global South. These shifts often involve an increased consumption of UPFs, which may contribute to rising rates of diet-related diseases. Addressing this trend through improved food quality and nutrition policies is critical to preventing negative public health outcomes in these populations.

Recent trends, such as the shift toward plant-based diets, further underscore the importance of investigating not only the nutritional quality of individual foods but also the dietary components they replace. Understanding these trade-offs is essential for fully assessing the long-term health impacts. At this stage, a practical strategy would be to focus on enhancing the nutritional quality of available products.



Achieving meaningful progress in this area will require coordinated collaboration across the entire value chain — from producers and manufacturers to policymakers and public health experts. This integrated approach is essential for driving sustainable improvements in food quality and promoting better health outcomes globally.

The United Nations emphasizes that novel plantbased alternatives to conventional meat and dairy products hold significant potential to help mitigate the climate crisis. By reducing the environmental impacts of food systems, which contribute 21%-37% of global greenhouse gas emissions, these alternatives could play a pivotal role in reducing deforestation, biodiversity loss, and pollution (Mbow et al., 2019; UN, 2023).



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The Plant Based Pioneers

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