

Exploring the Future of Sustainable Foods  
through Nova Classification of Upcycled Certified Products

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**Abstract**

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In 2021, the world's first certification program for upcycled products, called Upcycled Certified, was established to allow consumers to easily identify products developed with ingredients that would otherwise have gone to waste. Current research has sought to understand the potential of upcycled foods to address food loss and nutritional inadequacies while meeting the worldwide increased demand for packaged food. This study adds to this growing body of research, with a focus on understanding the extent to which upcycled foods are consistent with dietary guidelines that emphasize minimal consumption of ultra-processed foods. The Nova classification system was used to assess the degree to which Upcycled Certified products had undergone processing. After eliminating non-food items and products without sufficient nutrition data, the final sample demonstrated that over half of currently Upcycled Certified foods are deemed ultra-processed

foods using Nova. Modern ultra-processed foods are increasingly different from those that have been associated with negative health outcomes in the past, and the benefits of upcycled foods extend far beyond planetary health. This study recommends improvements in the Nova classification system to reduce ambiguity and be more aligned with current research and for the Upcycled Certification to consider more holistic approaches to certification.

## INTRODUCTION

As of 2023, the double burden of malnutrition (of coexisting undernutrition and overnutrition) remains a major target of UN Sustainability Developments Goals (SDG). According to *The State of Food Security and Nutrition in the World 2023*, global hunger and food insecurity has remained far above pre-Covid 19 pandemic levels (affecting about 9.2 percent of the world in 2022 compared with 7.9 percent in 2019) and have been exacerbated by the impact of the war in Ukraine, particularly on food and energy prices and agricultural inputs (Food and Agriculture Organization of the United Nations [FAO] et al., 2023, p. 6). Between 2015 and 2022, the number of moderately or severely food-insecure people in the world rose from 1.612 billion to 2.357 billion people while risk of childhood overweight has continued to increase globally as a result of urbanization and reliance of packaged foods (FAO et al., 2023, p. 21, 34).

In the United States, more than 2 in 5 adults have BMI-defined obesity (CDC, 2024) while 1 in 8 households are food insecure (Shifler Bowers et al., 2018), suggesting that over 100 million Americans may suffer from a form of malnutrition. The consequences of such staggering figures of malnutrition are manifold, impacting not only individual and population-level health, but also social inequities, economic growth, and school performance (World Health Organization [WHO], 2017). Addressing this double burden of malnutrition – specifically, the coexistence of food insecurity with food excess and massive amounts of food loss and waste produced by Americans – is essential to achieving the Sustainable Development Goal (SDG) of “end[ing] hunger, achiev[ing] food security and improved nutrition, and promot[ing] sustainable agriculture” set by the United Nations in 2015 (United Nations, 2023). Because a major determinant of malnutrition is environmental, the main drivers of malnutrition in a population include food supply and systems, the quality and quantity of accessible foods, and the built environment (WHO, 2017). Improving the food system by creating sustainably produced nutritionally-dense foods could present one pathway for addressing these interrelated challenges, particularly because “innovations in food packaging can maintain the quality, safety and nutritional value of food products, meet consumer needs and preferences, reduce food loss and waste, and reduce the cost of nutritious foods” while meeting the worldwide increased demand for packaged foods (FAO et al., 2023).

While food loss and waste are often used interchangeably, food loss is defined by U.N. agencies as referring specifically to the loss of edible food mass “along the food supply chain from harvest/slaughter/catch up to, but not including, the retail level,” whereas food waste occurs at the retail and consumption level (FAO, 2019). SDG Target 12.3 calls for the halving of both global food waste and food loss, which would impact other Sustainable Development Goals such as SDG 6 (sustainable water management) and SDG 13 (climate change) while positively impacting the environment and improving human health (FAO, 2019). The practice of “upcycling” demonstrates one of many intersections between reducing food loss and maintaining the nutritional value of food products. “Upcycling” is a recent term, and “upcycled foods” were defined in 2020 by a task force formed by experts from Harvard Law School, the World Wildlife Fund, and other organizations as food that “use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment” (Upcycled Food Association [APA], 2023; Center for Health Law and Policy Innovation, 2020). The history of upcycling, however, is much older;

upcycling innovations have been practiced by societies and groups across history, such as the formation of cheese following the transportation of milk in the animal's stomach (McGee, 2004).

In 2021, the world's first certification program for products developed with ingredients that would have otherwise gone to waste, called Upcycled Certified, was established to allow consumers to easily identify upcycled products in the United States and Canada (UFA, 2023). Certified products have verifiable supply chains that source ingredients from surplus food and food by-products, and as of August 2023, 472 products have received this certification in one of three forms: Upcycled Ingredient (UI), Product Containing Upcycled Ingredients (PUI), or Products with Minimal Upcycled Ingredient Content (UFA, 2023). Upcycled food is an emerging market area that has burgeoned in popularity in recent years, in part due to its appeal to environmentally-conscious consumers as well as increasing demand for ready-to-eat food. Retailers and businesses benefit from carrying food products that are sustainable and have "clear and accurate information about the origin" because it can "increase stakeholder incomes while safeguarding consumers against food safety risk," mitigating potential health risks while being essential for informed consumer choices (FAO et al., 2023, p. 126). Cross-collaborative engagement across producers, processors, retailers and distributors promote circular approaches that ensure sustainability while maintaining food quality by facilitating market access through transparent and direct chains of production (FAO et al., 2023, p. 126). Furthermore, in today's era of e-commerce, reliance on intermediaries can be reduced for small-scale producers while increasing market access, which is encouraged by remote certifications like Upcycled Certified which underscore the digitization of food environments.

While the promotion of products in the American food supply that reduce food loss and promote environmental sustainability is consistent with sustainability goals that target undernutrition and human health, the ways in which these products contribute nutritionally to either the greater American food supply (or elsewhere in the world) have not yet been explored. Thorsen et al. (2022) highlighted the gap in current research and data surrounding the highly-processed nature of many upcycled foods – and its implications for public health and nutrition – while discussing the potential role of upcycled foods in Eat-Lancet's "planetary diet" for human health and environmental sustainability. As noted by Thorsen et al. (2022), "the standard [for Upcycled Certified] does not include nutritional criteria as part of its eligibility assessment," making it difficult to recommend widespread consumption of upcycled products from a nutritional standpoint despite their positive environmental impact and the interconnectedness of environmental sustainability and human health overall.

This project seeks to identify the extent to which Upcycled Certified products are consistent with dietary guidelines that emphasize minimal consumption of ultra-processed foods by using the Nova classification system to assess the degree to which a food has undergone processing (Monteiro et al., 2019a). To the best of our knowledge, Upcycled Certified products, which are certified based on standards of sustainability rather than nutrition, have never been classified by degree of processing, nor have they been nutritionally evaluated against major dietary recommendations. This research is relevant and important because of the potential of upcycled products to improve human health through environmental impacts as well as maintenance of nutritional quality and market access.

Using Nova, this study will explore the potential of upcycled foods to simultaneously address food waste and nutritional inadequacies. Nova was developed by a team of researchers led by Carlos Monteiro at the University of Sao Paulo, Brazil in 2010 and pioneered the concept of “ultra-processed foods,” which is one of four Nova categories (Monteiro et al., 2019a, p. 7). Of the six existing food classification systems that take into account food processing, Nova is by far the most applied in the scientific literature (Monteiro et al., 2019a, p. 6). In particular, Nova is the most frequently applied food processing classification system in nutritional research although the degree of processing a food has undergone is not a perfect proxy for the overall nutritional quality of a food product. This is especially true when it comes to medically-necessary food, culturally-significant food, and household staples such as infant formula and fortified noodles. Nonetheless, the strong associations between ultra-processed foods and negative health outcomes are compelling. Using the Nova system, the Food and Agriculture Organization [FAO] of the United Nations’ review of twenty-two peer-reviewed studies on ultra-processed food exposures and noncommunicable disease outcomes among adults found significant direct dose-response associations for chronic diseases including obesity, cardiovascular and metabolic diseases, cancer, and all-cause mortality after control for potential confounders such as total fat and sodium intake (FAO, 2019). This project will use the Nova classification system to gain a better understanding of the spectrum of the composition of upcycled foods with the qualification that further research and data is needed in this rapidly growing field.

## **METHODS**

This study used the four Nova groups as discrete categorical variables in order to better understand the nutritional breakdown of Upcycled Certified foods by evaluating the degree of processing they have undergone. This study began with a dataset of all current (as of August 2023) Upcycled Certified products provided by the Upcycled Food Association. The first step was to conduct quality control of the list of products in order to eliminate duplicates, resolve mistakes in grouping or spelling, and identify any other potential errors in the product list that could impede data analysis and research. Given that products may receive Upcycled Certification before becoming available on the market, or remain on the list after being discontinued or removed from circulation, products that did not yield search results or product information were eliminated.

The remaining products were separated into two categories: those meant for human consumption (i.e. products with nutritive value), and those not indicated for food-related purposes. Examples of products in the latter category included cosmetics and pet food, and were excluded from the research sample. Categorization of the remaining products began using the Nova classification system, which groups foods into four categories based on the degree of processing they have undergone.

Nova groups food “according to the nature, extent, and purposes of the industrial processes they undergo [and] involve physical, biological and chemical techniques used after foods are separated from nature” (Monteiro et al., 2019a, p. 8). This includes all food products whether

they are consumed by themselves in their raw form or have been produced using commercially industrialized additives.

The following descriptions have been paraphrased and adapted from *Ultra-processed foods, diet quality, and health using the NOVA classification system* (Monteiro et al., 2019a, p. 6-8).

Table 1. Nova food groups

Groups	Description	Examples
1. Unprocessed and minimally processed foods	Includes fully unprocessed foods such as fruits, roots, eggs, and algae as well as minimally processed foods. Minimally processed foods have undergone preparation for a variety of reasons ranging from preservation to making the food safer to consume. These methods include removing inedible parts of plants, pasteurizing, vacuuming-sealing for storage, and boiling. In general, foods in Group 1 are considered essential components of balanced diets.	Bolthouse Farms 100% carrot juice, The Ugly Company produce
2. Processed culinary ingredients	Foods derived from Group 1 foods. As ingredients, these foods are rarely consumed by themselves and therefore are generally not evaluated in isolation. The methods used to create these foods include milling and industrial processes, with examples including salt, sugar, and butter.	Just Date Organic Date Sugar
3. Processed foods	Foods that combine Group 1 and Group 2 foods. Like Group 2 foods, Group 3 foods are generally processed commercially although they may be produced without industrial methods as well. They may be added to dishes or consumed on their own and can undergo additional processes such as smoking or baking. Examples of processed foods are fruit preserved in syrup, freshly baked bread, and fish that has been canned with oil.	Del Monte Farmhouse Cut Green Beans
4. Ultra-processed foods	Created industrially through dividing whole foods into substances like starches and fiber and then processing them by a variety of methods such as hydrogenation and extrusion. Group 4 foods may be identified by the presence of ingredients that have no (or rare) culinary use such as soy protein isolate, maltodextrin, and hydrogenated oils. These products generally have additives such as artificial colors, gelling and anti-foaming agents as well as Group 2 ingredients such as salt. While consumption of many modern ultra-processed foods are generally discouraged by major nutritional guidelines, many ultra-processed foods have important cultural roles such as yeast, jam preserves, and chocolate. Others may be essential for life in the case of infant formula and foods that serve medical purposes.	Plant B plant-based egg substitute, GoodSport Nutrition sports drinks

To categorize foods through Nova, we examined full ingredient lists. The first phase of categorization therefore involved placing food products explicitly associated with each Nova category (either by being consistent with Nova’s definitions of each group or by matching their listed examples) into their respective groups based on the presence of ingredients used in ultra-

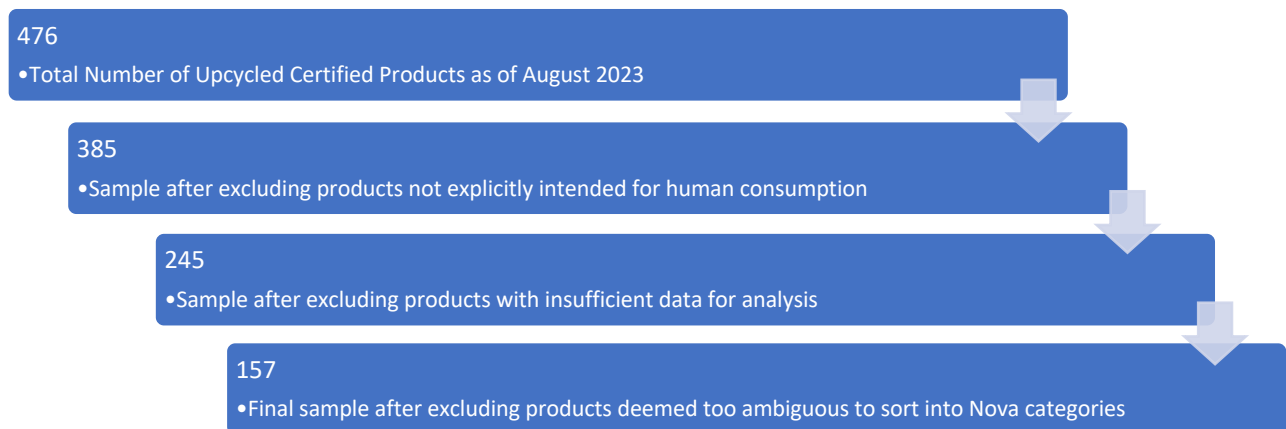
processed foods. Examples of products that fell into these categories were fully unprocessed produce (in group 1) and UPFs with many additives (in group 4).

In the second phase of categorization, when information on the full ingredient list was not publicly available, we documented the justification and judgment used to sort products that did not easily conform to one of the four Nova groups. This occurred primarily with products that did not have publicly available information or products that were not mentioned or described in Nova’s definitions as well as products that met criteria in more than one Nova group based on the different Nova criteria. This study took a conservative approach when products did not have precedent for Nova categorization in the existing literature excluding them from categorization.

After categorization was complete, the remaining list of products provided an overview of Upcycled Certified food products based on traditional methods of determining degrees of processing. This informed this paper’s discussion on the role and potential of Upcycled Certified food products within the greater American food supply and the environmental and nutritional impacts of these foods on human and planetary health.

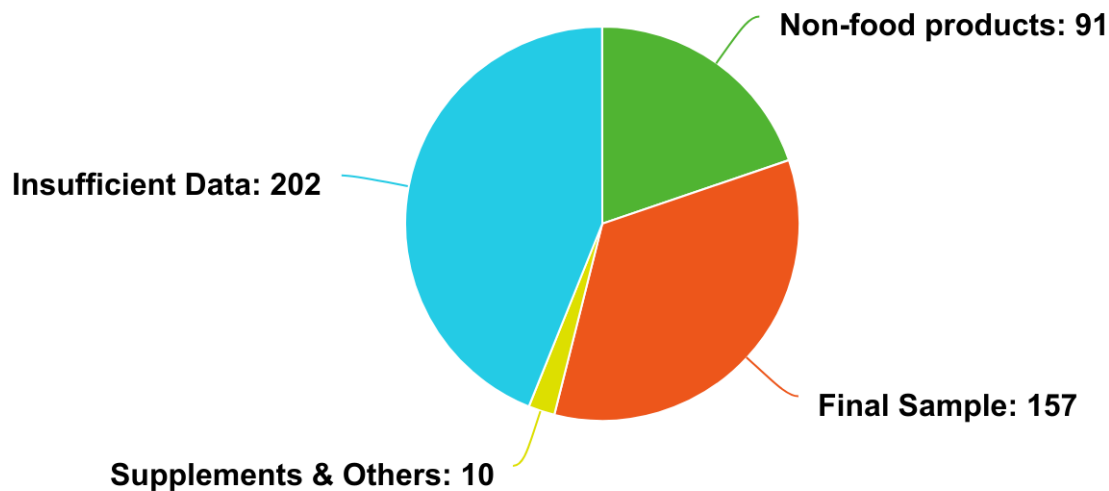
## **RESULTS**

Of 476 Upcycled Certified products, 91 were explicitly not intended for human consumption and consisted primarily of pet products, skincare, and beauty products. Of the remaining 385 products, 115 were excluded due to insufficient data or information, including 23 that were deemed to have unknown or ambiguous purpose (such as pigmented powders that may or may not have been intended for human consumption). Dietary supplements and wholesale bulk input products without sufficient information on methods and purposes of processing were excluded (n = 10) and of the remaining 245 food products, 87 were deemed too ambiguous to sort into a single Nova category.



**Figure 1: Flow diagram representing the final sample of Upcycled Certified products**

The final sample consisted of the remaining 157 Upcycled Certified products that were verified to be intended for human consumption, had accessible nutrition information available on their respective product webpages, and could justifiably fall into one of the four Nova categories.



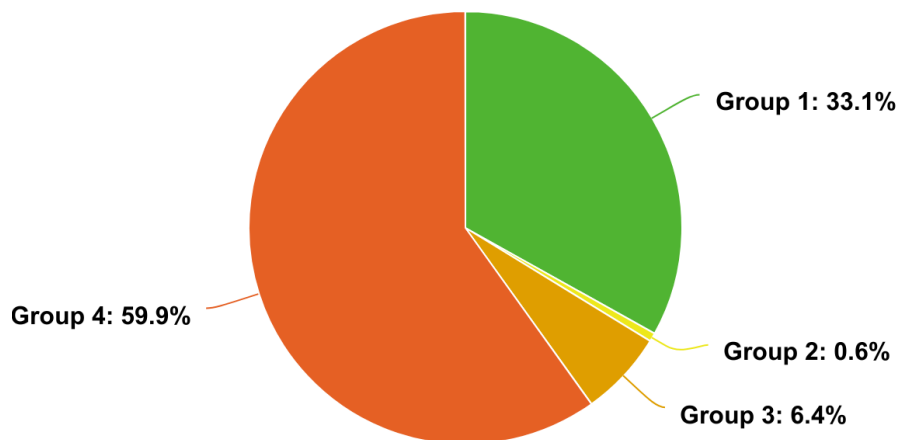
**Figure 2: Composition of Upcycled Foods as of August 2023**

This study found that 52 products were minimally processed/unprocessed foods, making up 33.1% of all Upcycled Certified products in the final sample. These products included 100% vegetable juice, ground green banana powder, and 100% dried fruit. Initially, 50 products were placed into this group, but during the second phase of categorization, two products that were previously not categorized were added to this group: two tea products made with “natural” ingredients. “Natural” ingredients remain undefined, but tea products were broadly considered to meet Nova group 1 category definitions for minimally processed and unprocessed foods with sufficient justification despite the possibility of added industrially-processed ingredients (Monteiro et al., 2019a, p. 11).

Just one product met the definition for processed culinary ingredients: organic date sugar, described as being ground and dried without added ingredients. While date sugar did not appear to have been previously categorized according to Nova classification, its similarities (both nutritionally and with regards to degree of processing) to organic cane sugar, honey, and 100% maple syrup (explicit examples of group 2 foods) established it as a processed culinary ingredient. This constituted 0.6% of the final sample.

10 products were placed into processed foods. Processed food is perhaps the most ambiguous of the four Nova categories because of the criteria that certain canned foods regardless of additives belong to this group, such as canned fish (which is considered processed foods with or without the presence of preservative ingredients). This made up just 6.4% of the final sample.

Ultra-processed foods, with 94 products, constituted 59.9% of Upcycled Certified foods. This category underwent the greatest degree of change between the first and second rounds of categorization due to the presence of ingredients that were difficult to categorize (e.g. citric acid, nutritional yeast, black pepper extract) as well as conflicting matches to definitions of foods in the other three groups. Ultimately, in order to avoid potentially unwarranted categorization of products as ultra-processed foods, 87 ambiguous products were left uncategorized.



**Figure 3: Upcycled Certified foods by Nova group**

## **DISCUSSION**

This study found that Upcycled food products generally fell into minimally processed/unprocessed foods or ultra-processed foods, with 33.1 % of the products being minimally processed/unprocessed food and 59.9% of analyzed products being ultra-processed foods. The remaining products were processed foods (6.4%) or processed culinary ingredients (0.6%). The single largest challenge to categorizing food products into Nova groups in this project stemmed from the different ways in which products could be categorized based on Nova’s definitions, descriptions, and listed examples. This study identified three major ways in which Nova classifies food products based on the literature authored by the team of Carlos Monteiro: first, by the location and scale of processing (mass-produced via industrial methods vs. made in a home kitchen), second, the purpose of processing (processing to create frozen, ready-to-eat meals for convenience as opposed to processing in order to make a food safer to consume), and third, by degree or extent of change from the original ingredient, typically by adding ingredients.

Sadler et. al’s (2021) review of food classification systems previously identified comparable themes underlying Nova classification with the exception of their addition of a fourth theme of classifying foods by “extent of change,” referring to the extent of change from the original ingredient while excluding the addition of ingredients, which was instead included in the theme of “nature of change.” For ease of categorization, this study combined these two themes into a single theme of Nova classification. Regardless of the number of different ways in which Nova suggests categorization, the significance of this ample space for interpretation and discrepancy lies in the lack of a single, comprehensive guide to categorizing most food products on the market.

Existing literature that categorizes foods using Nova often relies on applying just one or two of these themes to each food product rather than applying all major Nova classification methods to each product in a sample. Often times, one theme may serve as a proxy for all the ways in which Nova recommends classifying food products for the sake of uniformity and consistency. Buckley

et al.'s 2019 Nova classification of foods and beverages from 24-h recall data from 2013-2014 National Health and Nutrition Examination Survey (NHANES) data demonstrates a streamlining of Nova classification by applying one "theme" or method of classification to each food product rather than analyzing each product through the various Nova themes (i.e. by both the purpose of processing and by the addition of industrial ingredients to a product). For example, foods that were listed by NHANES as "frozen meals" were classified as ultra-processed foods without necessarily a further analysis of ingredients or investigation into processing methods, while foods described as being made from recipes were instead categorized based on the presence of ingredients that would deem the food item an ultra-processed food. While this yielded a robust classification of food items in Nova categories in an attempt to find associations of ultra-processed food consumption with the presence of environmental chemicals, the authors noted that "there may have been some misclassification due to a lack of detailed ingredient lists or product brands for some food items."

This study categorizing Upcycled Certified foods underscores the need for a more nuanced and complex approach. Given the much smaller sample size, it was feasible to consider foods simultaneously from various perspectives by evaluating not just a food's transformation but also its larger purpose and scale of production. For example, Blue Circle's frozen and pre-formed "original salmon burgers" (2024), by purpose, scale and location of production, would generally be classified as an ultra-processed food, particularly given its "easy to cook" presentation and its method of industrial "moulding," which is explicitly stated as a group 4 method of processing. A closer look at its ingredients, however, was cause for confusion: with just four ingredients and no industrial additives, it was unclear if this product's ingredient list of salmon (with natural color added in salmon diet), salt, white pepper, and lemon was more consistent with group 4 foods or with those of group 3. Given that Nova occasionally allows for industrially processed foods (such as pasteurized yogurt, or corn flour fortified with iron and folic acid) and "infrequently, minimally processed foods [that] contain additives that prolong product duration, protect original properties or prevent proliferation of microorganisms" to be included in its list of minimally processed/unprocessed foods, could a case be made for frozen salmon burgers to be a minimally processed food as well (Monteiro et al., 2019a, p. 11)?

Due to the "purely descriptive" classification approach of Nova, this research found that the existence of the various ways to categorize Nova foods often resulted in conflicting or ambiguous categorization (Braesco et al., 2022). Sadler et al. (2021) observed these contradictions as well, even within formal reports and instructions on the identification of ultra-processed foods, such as in Monteiro et al.'s (2019b) "Ultra-processed foods: what they are and how to identify them." In particular, Sadler et al. (2021) noted that the processes of hydrogenation and hydrolysis, which are often considered a hallmark of ultra-processed foods and are explicitly listed as processes that characterize a food as group 4, are elsewhere being associated instead with group 2 (of the production of culinary ingredients). This also underscores another point of confusion surrounding Nova classification: that Nova groups are *not* listed in numerical order of least processing to most. Instead, while groups 1, 3, and 4 fit this pattern, group 2 is a category reserved strictly for processed culinary ingredients – in other words, food products that are generally not consumed alone and are instead a component of a larger dish. It is possible and common, therefore, for group 2 foods to have undergone significantly more processing and industrialization than group 3 foods, with examples of group 2 foods including

starches extracted from corn or other plants, and salt with added drying agents (Monteiro et al., 2019a). While the Nova research team may not have intended for the impression of Nova groups to be that the group numbers increase by degree of processing, it is undeniable that this remains a common misconception. This is of particular importance in part because one of the most commonly-touted advantages of the Nova system over other classification systems is the purported ease of accessibility as a streamlined system with just four categories beginning with “unprocessed foods” and ending with “ultra-processed foods.” In comparison to the newer classification system Siga, this is certainly true – Siga combines Nova groups in its classification with newer subgroups while being dramatically more complex due to features such as its risk assessment of additives and application of industrial-processing techniques (Thorsen et al., 2022).

Of course, Nova’s usefulness is readily apparent on larger-scale analyses of a wide variety of food products, particularly for more “traditional” processed foods that have been linked to negative health outcomes. One question that arose during this study’s classification of Upcycled Certified foods, however, was whether or not the ultra-processed foods of today are, in fact, nutritionally identical to the ultra-processed foods of the past. One of the most prominent similarities shared across the majority of Upcycled Certified foods on the market was the promotion of healthy eating and lifestyles, with common claims ranging from “zero preservatives,” “non-GMO ingredients,” “100% organic.” These products often cited nutritional benefits in their descriptions in addition to their impact on improving planetary and environmental health. Given that some Upcycled Certified foods fell into group 4 despite being made up solely of naturally-derived ingredients, such as fiber produced from the waste byproduct of blueberry juice production, this study found that Upcycled Certified foods may identify a failing – or at the very least, a shortcoming – of Nova classification. From both a planetary health and human health perspective, it seems apparent that a product made of whole ingredients aside from the addition of upcycled fiber should be considered “healthier” than drugstore Twinkies loaded with industrial additives and not intended to provide nutritional benefits to consumers. Nova places these foods items in the same category and therefore offers the same recommendations to consumers with regards to these foods. In attempting to conform Upcycled foods into Nova’s classification system, this project found that the shortcomings of Nova have never been more apparent. The dramatic diversification of ultra-processed food products on the market to include anything from medically-necessary foods such as phenylalanine-free medical formula (or gluten-free foods, which are more available and accessible to consumers than they have ever been in the past) to traditional “junk food” means that the world of ultra-processed foods may be more difficult to generalize than ever before. Indeed, to the best of our knowledge, there is no precedent for separating ultra-processed foods into “healthy” and “unhealthy” in previous studies using Nova because the sources of data (such as 24-h diet recalls administered by NHANES) likely did not specify that their frozen burgers may have lacked industrial additives.

Upcycled foods, which represent market products that by and large promote health and nutrition alongside sustainability (in other words, both human and planetary health), may become a staple part of the human diet in the future. With the growing market demand for sustainable products and the increasingly commonplace stance that planetary health *is* human health, it may be that the term “ultra-processed” will evolve in connotation and implication. People may be able to eat

frozen meals that nourish them and support sustainable food markets, and in order to make space for this possibility in the world of nutrition and public health, Nova may need to not just create more robust standardization of categorization but also change its fundamental stance that ultra-processed foods are necessarily associated and tied with negative health outcomes.

The issue with Nova classification moving forward lies not just in the lack of consensus defining Nova categories, but in Nova's attempt to shape eating patterns and values using classifications that embody "social and cultural elements and subjective terms" (Sadler et al., 2021). Monteiro's early proposal of classifying foods by degree of processing in 2009 was titled "Nutrition and health. The issue is not food, nor nutrients, so much as processing," indicating the belief that higher degrees of processing correlate to poor nutrition and health even when the ultra-processed foods in question are nutritious and well-balanced. In essence, "NOVA postulates that the food itself (or how much of it is eaten) is unimportant, but rather that dietary effects are due to how the food is produced," which may rationalize the lack of clear and specific guidelines for ingredients and types of foods that fall into one Nova group over another (Visioli et al., 2022). Nova's concept of "purpose" of a food determining whether it is ultra-processed (and therefore to be avoided) also indicates subjectivity given that one of the defining characteristics of group 4 foods is that they are "profitable products" with "emphatic branding" (Monteiro et al., 2019a, p. 12).

Furthermore, Monteiro (2009) notes that "both 'regular' and 'premium' ultra-processed foods are 'fast' food, designed to be portable, convenient and accessible. They induce eating patterns such as 'grazing' and skipping main meals, eating when doing other things such as watching television, driving a car or working, and eating alone." The values expressed in these statements do not appear to address the environmental impact of creating ultra-processed foods from products that would otherwise have gone to waste, the proliferation of ultra-processed foods that cater to medically necessary or preferred diets, or the cultural value and role of tradition ultra-processed foods may have. The placement of important cultural foods into the "ultra-processed" category, as subjective judgments shaped by the perspective of the authors, may have unintended consequences such as engagement with stereotypes of cultural foods being less healthy than foods that may be more familiar to and staples of a traditionally western diet. For example, pasta, though a convenient product that can be cooked quickly, is classified strictly as a group 1 food as long as it is not pre-cooked. Noodles, in contrast, are listed exclusively in group 4.

Another assumption made by Nova is that store-bought food is always inferior to home-cooked food, stating that "packaged ready-to-heat products consumed at home or at fast food outlets [...] may look much the same as home-cooked food, but their formulations and the ingredients used in their pre-preparation render them ultra-processed" (Monteiro et al., 2019a, p. 9). This is a key criticism that has been levied at Nova, that "NOVA is based on the erroneous assumption that all commercially manufactured foods have low nutritional value, promote weight gain and chronic diseases" and that "food prepared from basic ingredients at home has superior nutritional qualities to those produced by processors" (Petrus et al., 2021). Previous studies have found that Nova's classification system contradicts others, such as Romero Ferreiro et al.'s (2021) comparison of Nutri-Score and Nova, which found that 26.08% of foods in the highest nutritional quality category (A) were deemed ultra-processed by Nova, and that more than 50% of foods in all other categories (B, C, D, and E) were also ultra-processed. While the authors of

the study noted that this may indicate a failure of Nutri-Score to identify “unhealthy” foods, it may be equally likely that Nova classification resulted in many highly nutritious and balanced food items being placed in the ultra-processed category. Ebner et al. (2022) found that of 28,747 industrially packaged foods, the ones with higher (more nutritionally favorable) Nutri-Score and Traffic Light Labelling System (TLLS) categories had higher proportions of ultra-processed foods (as indicated by Siga), indicating that highly-processed foods may have better food composition scores.

## **CONCLUSIONS**

Nova’s shortcomings, which include implied correlations between processing and nutrition, the ambiguity and level of interpretation required to categorize food items, and the social and subjective values that underlie the system, become increasingly more obvious when used to classify processed foods that promote nutrition and wellbeing. Upcycled foods highlight these shortcoming due to their positive impact on planetary health (and potentially on human nutrition), which belie Nova’s assertions that store-bought and industrially-processed foods are harmful for human health regardless of their ingredients and nutrient content. The inconsistencies and difficulties in applying Nova has been noted in an increasing number of studies, such as Braesco et al.’s 2022 investigation into the functionality of Nova:

We observed that a large percentage of the food assignments were discordant, regardless of whether ingredient information was provided, [raising] questions about how functional NOVA is in its current form [spurring] reflection on the reliability of conclusions from epidemiological studies that use NOVA as well as on NOVA’s ability to guide public health policy or provide useful information to consumers. (Braseco et al., 2022)

The recommendations below advocate for a more nuanced approach to categorizing the relative nutritional value of a sustainably produced upcycled food product. In order to better reflect the potential benefits and nutritional profiles of processed foods, this study presents the following recommendations in the context of the growing market of sustainably processed foods:

1. For the Nova classification system to create clear and unambiguous guidelines to categorize food items by Nova groups while adapting the ideology behind Nova to be more progressive and aligned with current research.
2. For Upcycled Certification to consider a more holistic approach to certification beyond sustainability and reduction of food loss alone.
3. For the blanket term “ultra-processed foods” to be reconsidered altogether in light of medically-necessary, culturally-significant, and sustainable products, and to consider the value of sustainability and planetary health in addition to nutrition.

This study found that nutritional analysis using the Nova classification system overlooks the varying nutritional quality and sustainability of processed food products. Upcycled Certified food products, which promote sustainability (often alongside nutritional quality), highlight the inability for Nova to address or identify the nuances of food products that are made using industrial processes, ingredients, or for the purpose of convenience. Nova remains a popular

classification tool worldwide despite these disadvantages due to the accessibility and simplicity of its application. There is a growing need for Nova to be adapted to be more aligned with the present and future of processed foods, however, especially given the potential of ultra-processed foods (including many Upcycled Certified foods) to address continuing concerns for both sustainability and nutrition.

## **LIMITATIONS**

This project was limited by reliance on publicly available nutrition information, unavoidable individual bias in categorizing food products by Nova group, and the timeframe and scope of a thesis project.

The inability to analyze all of the food items on the most current list of Upcycled Certified products was due to limited access to publicly available nutritional information. Without proprietary information, a full analysis of Upcycled Certified foods was not possible. The inability to access the processes involved in producing individual food items also made it difficult to identify appropriate categories for certain foods.

The analysis conducted was limited by the nature of evaluating foods based solely on descriptive and non-exhaustive guidelines. Although this study avoided categorizing food items that adhered to more than one Nova group or were overly difficult to classify due to insufficient guidance in the Nova guidelines, the methods used to categorize the remaining items in the sample were still subject to individual bias and perspective. All categorization was documented and justified, but without precedent in the literature for categorizing ultra-processed foods that promote environmental and human health, there may be limited consensus on the results and conclusions reached with regards to the nutritional landscape of Upcycled Certified foods.

Finally, time was also a major limiting factor for the scope of this thesis project.

This project declares no conflict of interest.

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