

Viewpoint

McDonald's McLean Deluxe and Planetary Health: A Cautionary Tale at the Intersection of Alternative Meats and Ultra-Processed Marketing

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Abstract

Dietary choices and patterns have enormous consequences along the lines of individual, community, and planetary health. Excess meat consumption has been linked to chronic disease risk, and at large scales, the underlying industries maintain a massive environmental footprint. For these reasons, public and planetary health experts are unified in emphasizing a whole or minimally processed plant-based diet. In response, the purveyors of ultra-processed foods have added “meat alternatives” to their ultra-processed commercial portfolios; multinational corporations have been joined by “start-ups” with new ultra-processed meat analogues. Here, in our Viewpoint, we revisit the 1990s food industry rhetoric and product innovation, a time in which multinational corporations pushed a great “low-fat transition.” We focus on the McLean Deluxe burger, a carrageenan-rich product introduced by the McDonald's Corporation in 1991. Propelled by a marketing and media-driven fear of dietary fats, the lower-fat burger was presented with great fanfare. We reflect this history off the current “great protein transition,” a period once again rich in rhetoric, with similar displays of industry detachment from concerns about the health consequences of innovation. We scrutinize the safety of carrageenan and argue that the McLean burger should serve as a cautionary tale for planetary health and 21st century food innovation.



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1. Introduction

“It is difficult to recognize a wolf in sheep's clothing. This seems to be the situation with regard to carrageenan”

Dr. Joanne K. Tobacman, 2002 [1]

In recent years, dietary guidelines aimed at simultaneously promoting the health of individuals, communities, and the Earth's natural systems have entered mainstream discourse. It is generally accepted that a diet rich in minimally processed whole foods, including fiber-rich vegetables, fruits, whole grains, legumes, sustainably sourced fish/seafood, and minimal amounts of meat and other animal products, is a nutritional prescription for personal and planetary health [2–4]. Notwithstanding some debate concerning the types and levels of meat intake that might work for or against health at all scales [5,6],

there is very little argument that excessive amounts of red meat intake, and the associated operations of industrial feedlots, is a primary contributor to greenhouse gases and environmental degradation. In 2019, the McDonald's Corporation was responsible for 53 million metric tons of greenhouse gas emissions, one third of which is attributed to the rearing and slaughter of cattle on industrial feedlots [7,8].

As such, and given the urgency of climate change, it is not surprising that large sectors of the food industry are working vigorously to develop alternatives to animal meat. However, many of the products that are entering the global food market, especially “plant-based” burgers, sausages, etc., are ultra-processed foods, inclusive of additives such as emulsifiers, flavor enhancers, industrially produced fiber, and other plant isolates [9]. Indeed, individuals aiming for a vegetarian plant-based diet are more likely to consume ultra-processed foods [10]. Moreover, plant-based ultra-processed foods have been linked with an elevated risk of cardiovascular disease [11] and all-cause mortality [12].

In marketing campaigns, the conflation of the term “plant-based diet” with dietary patterns that include highly processed meat alternatives (commercial products typically dependent upon multiple additives to replicate the taste, texture, and sensory experience of meat) is commonplace. The rapid introduction of commercial ultra-processed meat alternatives has occurred without health-related scrutiny [13]. These commercial products are distinct from the minimally processed and whole foods that make up the traditional plant-based diet and might be better described as “food-like” [14].

Here, in our Viewpoint, we revisit the 1990s food industry rhetoric and product innovation, a time in which multinational corporations pushed a great “low-fat transition.” In particular, we focus on the McLean Deluxe burger, a carrageenan-rich product introduced by the McDonald's Corporation in 1991. Propelled by a marketing and media-driven fear of dietary fats, the lower-fat burger was presented with great fanfare, and its formulator was transformed into an international celebrity. The primary ingredient that acted as the fat substitute—carrageenan—was claimed to “allow Americans to fight the battle of the bulge while indulging in ‘fat-free’ desserts, sour cream, and salad dressings...it keeps McDonald's McLean burgers moist” [15]. We reflect this history off the current “great protein transition”, a period once again rich in rhetoric, with similar displays of industry detachment from concerns about the health consequences of innovation. We scrutinize the safety of carrageenan and argue that the McLean burger should serve as a cautionary tale for 21st century food innovation.

2. The Great Low-Fat Transition

In the 1990s, there were powerful calls to reduce dietary fat intake in the United States, including official recommendations by the United States Department of Agriculture and the United States Department of Health and Human Services. These agencies urged the public to “choose a diet low in fat” [16]. Experts argued that a large-scale transition to a low-fat diet could not occur without “modifying and reformulating traditional foods” [17]; industry responded with vigor, introducing a wide variety of “low-fat” and “no fat” new product offerings, many with questionable fat substitutes [18].

The zeitgeist was captured by scientist-journalist Edward R. Blonz in reporting on Food Expo '91, a trade show associated with the annual meeting of the Institute of Food Technology. Blonz described the scene: “Up and down the aisles there were countless examples of low/no-fat salad dressings, frozen yogurts, low-fat cheeses, entrees and bakery goods...with all the fat-replacement products at this year's show, expect to see a growing variety of growing variety of low- and no-fat alternatives to popular foods”. Blonz described the unfolding as the “low-fat transition” [19], and his predictions concerning the transformation of the retail marketplace certainly materialized. Between 1990 and

1992 alone, over 5600 “reduced fat” brand name products entered the marketplace [20]. As discussed below, in reference to the current development of ultra-processed meats, many of these products included added emulsifiers to reduce the need for fat and flavor enhancers to improve palatability; in some cases, industry succeeded in developing hyperpalatable foods in which the low-fat versions had even higher ratings of palatability vs. less processed versions [21]. Indeed, a recent analysis of the tobacco industry’s ownership of major US food brands in the 1990s (e.g., Phillip Morris owned Kraft and General Foods, and R.J. Reynolds owned Nabisco and other food brands) concludes that their carbohydrate and sodium formulations (vs. food products from non-tobacco-owned companies) were 80% more likely to be classified as hyperpalatable [22].

During the great low-fat transition, carrageenan emerged as a valuable additive for low-fat products. Derived from various species of red seaweed (marine algae of the class Rhodophyta), carrageenan can help retain moisture and increase viscosity in low-fat products, with the added value of helping to maintain the freeze–thaw stability of products [23]. Carrageenan already had a presence in a variety of dairy products, sauces, and relishes prior to the low-fat transition. However, the early 1990s witnessed a massive growth in carrageenan sales as the product found its way into low-fat products [24]. Although there are three primary fractions (or molecular sub-types) of carrageenan—*kappa*, *iota*, and *lambda*, each with differing gelling and thickening properties—the products entering the market in the 1990s were rarely pure in one fraction, and limitations on lab analytics made identification in commercial products a difficult task [25].

3. The McLean Deluxe

In the midst of the low/no-fat product boom, where ideology and rhetoric were stronger than science [26], McDonald’s introduced its “McLean Deluxe”, a product marketed as “a revolutionary 91% fat-free beef patty”. The *Chicago Tribune* announced its launch as a “breakthrough” with “much-deserved fanfare”, a burger that would help consumers lose weight in a “painless way” [27]; *Fortune* magazine announced it as one of the best new products of 1991. The “secret”, according to McDonald’s and enthusiastic press coverage, was the addition of a “plant-based” ingredient derived from seaweed. Specifically, the fat substitute in the McLean Deluxe burger was carrageenan, a thickener isolated from red seaweed.

The research and development behind the addition of an isolated *iota* carrageenan to the McDonald’s hamburger was swift. According to its formulator, Auburn University scientist Dale Huffman (whom the press dubbed a meat science celebrity), the time between his first pitch to McDonald’s and retail sales was only a matter of months and just six months to a national rollout: “*That’s the fastest McDonald’s has ever taken any product from concept to national rollout*”, said Huffman [28]. We can gather from this that there was very little in the way of concern for potential adverse events from *iota* carrageenan. Safety was paired with traditional Irish culture, and the legitimate idea that seaweeds as a whole food have an ancient past: “*For centuries, the Irish have used it in puddings*”, Huffman reassured the press. The “it” was in reference to a species of red algae, *Chondrus crispus*, used within a muslin bag during the boiling stage of milk pudding preparation in the 1800s [29]. This is distinct from adding *iota*-carrageenan, isolated through high-tech extraction methods, to a regularly consumed mass-market food (Figure 1).

Huffman’s formula called for 0.5% *iota* carrageenan, although it seems that McDonald’s own team of food technologists may have increased the carrageenan content to 1% based on press reporting [30,31]. Since each burger patty weighed 106 g, this level of carrageenan intake from a single burger (based on the 0.5 to 1% reports) was far in excess of the estimated daily intakes of 50–100 mg among US adults [32]. It is also worth noting that

carrageenan was a significant ingredient in liquid “slimming” products, as promoted by celebrities in the early 1990s [33], and the carrageenan meat products promoted by Huffman were not limited to McDonald’s. He promoted all manner of carrageenan-inclusive retail meat products in the early 1990s, products that found their way into Disney theme parks and over 8500 US supermarkets [34,35].



Figure 1. Carrageenan Deluxe: Terms such as plant-based are often conflated with ultra-processed products inclusive of multiple additives. (Image by author S.L.P.)

At the same time that carrageenan was being heralded as a solution to the assumed harms of all dietary fats, experimental models were demonstrating that oral administration of the extract could reliably promote gastrointestinal inflammation [36,37]. British scientists had observed signs of ulceration and inflammation in animals with 0.5 to 1% carrageenan in an oral aqueous solution [38]. In the decades since, animal studies indicate that as little as 1.7 mg/kg is enough to promote inflammation [39]; extrapolated to a 60 kg human, a 102 mg daily dose (one carrageenan-filled burger) would meet the threshold. The mechanisms whereby carrageenan promotes gastrointestinal inflammation appear to be direct (immune triggering) and indirect via microbial dysbiosis [40–43]; the inflammatory effects of 0.5% oral carrageenan in animals are made worse in the presence of a background diet high in sugar and salt [44]. Preclinical studies continue to show that dietary carrageenan has the potential to provoke inflammation in human intestinal cells [45]. Carrageenan-induced intestinal permeability (i.e., “leaky gut”) has been linked to subsequent systemic inflammation [46]. Moreover, animal models show a potentially detrimental synergy of carrageenan and a high-fat diet related to systemic inflammation and insulin resistance [47].

In the French NutriNet-Santé prospective cohort study, involving over 104,000 adults, dietary carrageenan intake has been associated with a higher risk of type 2 diabetes over time [48]. In a recent clinical trial, a small group of patients with in-remission ulcerative colitis were enrolled in a carrageenan-free diet and subsequently exposed to oral food-grade carrageenan (100–200 mg) or a placebo. Consumption of the carrageenan was associated with inflammation and relapse (none of the placebo group relapsed) and the trial was stopped when the statistical differences were observed [49]. Preliminary clinical research using similar carrageenan-avoidance diets have shown potential value in insulin signaling and glucose tolerance [50]. In a randomized cross-over study, it was shown that it does not take much carrageenan to promote intestinal permeability and low-grade inflammation in overweight but otherwise healthy adults; oral intake of carrageenan (250 mg, bid, vs. placebo) for two weeks led to significant increases in pro-inflammatory cytokines (i.e., IL-6,

IFN γ , and TNF α) and markers of leaky gut (i.e., lactulose absorption), with whole brain MRI indicating trends toward brain inflammation [51].

In a recent animal study, early life exposure to carrageenan (orally administered for two weeks) was associated with behavioral signs of anxiety, impaired immune function, and increased oxidative–inflammatory stress; remarkably, these disturbances continued into adulthood, long after the carrageenan exposure had ended [52]. These results, especially the links to brain inflammation, cast new light on animal studies that did not use an oral administration of carrageenan. For now, it is unclear to what extent the neurobehavioral disturbances associated with subdermal (and other injectable route) carrageenan administration translate to oral consumption and human mental health [53,54]. However, given the common presence of carrageenan in ultra-processed foods, and the links between ultra-processed foods and mental disorders [55], it is an important question for nutritional psychiatry and related disciplines.

4. Back to the Future

Ultimately, the McLean Deluxe was removed from the market just five years after its launch; while it is assumed that consumers were not fond of the taste, or the price, the health effects of high levels of carrageenan intake among frequent consumers was not considered. Is it possible that consumers were turned off carrageenan meat for reasons other than taste? Based on the emergent research on carrageenan, it is certainly plausible. For his part, formulator Huffman expressed disappointment that McDonald's removed the McLean burger from the market and blamed the company for failing to market it properly (even though they invested USD 33 million in marketing the McLean): *"It's almost as if they put it on the menu primarily for show"*, he told local Alabama media [56]. Local media also reflected on Huffman's short-lived McDonald's carrageenan meat fame: *"He was catapulted into fame. His product made headlines, both here and abroad; he was in demand on speakers' circuits; he was winning awards left and right; he was a star. . . but. . . sales went from sizzling to fizzling"* [56].

Today, the meat-scientist-formulated McLean Deluxe, despite floundering commercially, is celebrated as clearing a path for the current generation of "plant-based" meat alternatives [57]; at the same time, the carrageenan industry promotes the idea that the extract is entirely safe and that studies demonstrating negative effects are "controversial" [58]. Carrageenan has grown to be a staple in many ultra-processed foods. The carrageenan supplier for the McLean Deluxe was Marine Colloids Inc., a division of the Food and Machinery Corporation (FMC); in the 1970s, Marine Colloids produced about half (4000 tons) of the world's carrageenan supply [59], 60% of which was directed to the food industry [60]. Today, the global production of carrageenan is 60,000 tons, much of it destined for consumption via food [61], including meat analogue products [62]. Carrageenan is not alone as an emulsifier with potentially detrimental effects—various gums have been linked to gut microbial dysbiosis and inflammation [63].

When the McLean Deluxe was introduced, the McDonald's president Ed Rensi referred to it as *"the right product at the right time"* [64], a comment that closely resembles the rhetoric associated with the current ultra-processed meat-alternative products. Today, carrageenan is once again being touted for its ability to increase the sensory preferences for "plant-based" burger patties [65]. Although "plant-based" burgers and other meat alternatives are often thought to be healthy options, research does not support such broad assumptions; to ensure palatability, many of the ultra-processed burger alternatives are high in fat and sodium, inclusive of flavor enhancers and emulsifiers [9]. Researchers often evaluate meat vs. alternative meats based on nutrients alone (e.g., protein and fiber) without considering the health consequences of the ingredients used for palatability and/or those

used to provide label appeal. Adding isolated fibers such as inulin, fructo-oligosaccharides, and carrageenan, is one way in which the meatless burger industry provides finished products that provide their “good source of fiber” label appeal. Yet, there is very little critical analysis of the extent to which adding isolated fibers—removed from their own food matrix through industrial processing—is contributing to dysbiosis of the gut microbiota, intestinal barrier permeability, colonic tumor promotion, systemic inflammation, and/or glycemic dysregulation [66–71].

In addition to emulsifiers, isolated plant-sourced protein burgers often rely on monosodium glutamate (MSG) or similar ingredients to act as flavor enhancers. MSG can be added as a pure ingredient, visible on the label, or as a hidden ingredient via “yeast extract” or “hydrolyzed protein”, both containing high percentages of free glutamic acid [72]. Although detrimental effects of MSG have been dismissed by industry for decades, recent studies have shown that the elimination or minimization of MSG and related excitotoxins can improve mental health and pain in vulnerable populations [73,74]. Dietary emulsifiers have been linked to anxiety and social stress [75,76], and preclinical research indicates that ingredients isolated from whole soybeans can increase aggression and impair social behavior [77]. There is a need for research that queries behavior and neuropsychiatric outcomes in ways that more accurately reflect the consumption of commercial food-like products—i.e., how might soy isolates influence aggression and antisocial behavior when co-consumed with MSG, carrageenan, isolated fibers, emulsifiers, and other additives?

Industry-affiliated researchers have expressed concern about the NOVA food classification, claiming that the ultra-processed food category lacks precision in separating Twinkies and burgers inclusive of soy isolates [78]. The four-category NOVA food classification system is separated into (i) unprocessed/minimally processed foods, (ii) processed culinary ingredients, (iii) processed food products, and (iv) ultra-processed products [79]. While criticism of NOVA’s lack of precision has merit, there are obvious similarities between Twinkies and typical multi-ingredient “plant” burgers inclusive of soy protein and other soy components. Mass-market ultra-processed plant burgers, like Twinkies, typically contain various emulsifiers (Twinkies contain a soy-derived emulsifier) and both contain flavor enhancers—corn syrup adds flavor to the sugar in Twinkies, and monosodium-glutamate-like flavor enhancers often give flavor to the soy-inclusive burgers. Despite the industry criticism, the NOVA classification provides a clear distinction between steamed and lightly salted edamame, and a soy protein burger with as many as two dozen ingredients.

5. Conclusions

The Planetary Health Diet Index and the Mediterranean Diet share common ground in their emphases on whole plant foods, fruits, vegetables, nuts, and whole grains, with lesser amounts of meat and dairy products. Both diets can reduce mortality associated with chronic non-communicable diseases and, at the same time, provide a planetary health benefit in terms of environmental footprint [80]. Within the planetary health framework, minimally processed foods and culinary skills are emphasized as a unifying path in addressing health at the scales of individuals, institutions, communities, and the planet [81].

Despite the clear emphasis on whole or minimally processed plant foods in the planetary health concept, the terms plant-based and plant-forward diets are leveraged and conflated by commercial purveyors of ultra-processed foods. The global trends toward increased consumption of ultra-processed foods, including those with plant-derived proteins, is of significant concern to environmental destruction, biodiversity losses, and climate change [82,83]. There is little doubt that reductions in meat and greater consumption (and availability) of non-ultra-processed plant foods, inclusive of quality plant protein, is in the

interest of health at all scales. However, in the context of health—inextricably linked at the scales of persons, places, and the planet—public health practitioners should be skeptical of the intentions of multinational nutrition corporations and their spokespersons.

The “great low-fat transition” of the 1990s provides ample evidence that the response of industry is likely to be a profit-driven race to manufacture and distribute food-like products. The rapid introduction of a carrageenan-rich lower-fat burger exemplified this reflexive action. So far, in the “great protein transition”, history is repeating itself. The path toward healthy plant-based dietary patterns, wherein the term “plant-based” is not leveraged in ways that involve intellectual escapism and intellectual dishonesty is possible. It can be found in massive investments in reducing economic disparities, consumer-focused education (including cooking skills), and policies that address ultra-processed and hyperpalatable foods [84,85].

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