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Original Research Article

# Producing protein: Fractionation of animal bodies, mass consumption of cheap protein, and the value of protein sourced from industrial hog operations

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## Abstract

This article claims that the pursuit of *protein* specifically, not *meat* in general, is woven into the very fabric of industrial hog farming and the devalued animals at its centre. Further, this piece forces a critical lens and reclassification of the value of protein sourced from confined animal feeding operations (CAFOs), using Goodman, Sorj and Wilkinson's (1987) concepts of substitutionism and appropriationism as a framework to unpack how hog production in Canada is structured on producing protein for mass consumption. Lastly, this article categorically extends the work of Goodman et al., (1987) to argue that hogs are not only industrialized within a capitalist food system, but now hog flesh is able to supplant or be used interchangeably with other forms of protein – a sort of *proteinaceous substitutionism*: the creation of generic, atomized, protein inputs. Commodity hogs are so valueless, the animal now exists to be a source of cheap protein.

Keywords: Protein; meat; hogs; CAFOs; substitutionism; Canada

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## Résumé

Cet article affirme que la recherche de protéines en particulier, et non de viande en général, fait partie intégrante du tissu même de l'élevage porcin industriel et de la dévalorisation des animaux qui en est le centre. En outre, cet article impose un regard critique et une reclassification de la valeur des protéines provenant des exploitations d'engraissement d'animaux confinés, en utilisant les concepts de substitution et d'appropriation de Goodman, Sorj et Wilkinson (1987) comme cadre pour expliquer comment la production porcine au Canada est structurée pour produire des protéines destinées à la consommation de masse. Enfin, cet article élargit catégoriquement les travaux de Goodman et al. (1987) pour affirmer que les porcs ne sont pas seulement industrialisés au sein d'un système alimentaire capitaliste, mais que la chair de porc peut désormais supplanter d'autres formes de protéines ou être utilisée de manière interchangeable avec celles-ci – une sorte de *substitution protéique* par la création d'intrants protéiques génériques et atomisés. Les porcs élevés comme marchandises sont si peu précieux que l'animal n'existe plus qu'en tant que source de protéines à bas prix.

## Introduction

The consumption of animals and their derivatives is an evolving and contentious issue. Current industrial hog farming practices in central Canada have been problematically sculpted and rationalized. The perhaps once-rural idyll of grunting, pastured pigs has rapidly been supplanted by industrial efficiency that demands a precarious labour force and uniformity via state-of-the-art genetics to raise those animal bodies until they are sufficiently plumped for harvest. I propose that the pursuit of *protein* specifically, and not *meat* in general, is woven into the fabric of industrial hog farming, devaluing the animals at its centre. I use pork as an example of a food that, through a series of economic, social, and political processes, has given way to a reductivist reimagining of the distinction between meat and protein (Scrinis, 2008), typifying a broken food system that proliferates poor animal welfare and limited consumer choices.

With this article, I aim to explore the distinction between meat and protein, drawing on Scrinis' (2008) understanding of *nutritionism,* an ideology or paradigm based on a reductive emphasis on both the nutrient value of food components and bodily health impacts. This article also aims to encourage eaters to consider the frames and metrics with which they sculpt their own dietary practices. At a broader scale, this piece contributes a critical lens and reclassification of the value of protein sourced from confined animal feeding operations (CAFOs), using Goodman et al.'s (1987) concepts of substitutionism and appropriationism; I use their framework to unpack how hog production in Canada is structured on producing protein for mass consumption. Lastly, this article extends the work of Goodman et al. (1987), arguing that hogs are not only industrialized within a capitalist food system, but also that hog flesh is now able to supplant or be understood as interchangeable with other forms of protein—a sort of

*proteinaceous substitutionism* that makes protein inputs to the human body both generic and atomized. The modern iterations of hog bodies have been refined for maximum protein output, existing the entirely of their lives in confinement as well as in abstraction—protein content to be harvested and remixed into nearly anything. Hogs have become meaty cogs in an unrelenting food factory, their nature re-sculpted by a few corporate players.

## Which came first: The chicken or the pig?

While this article focusses on industrial pork, it is useful first to consider the path of industrially raised chicken, as its place in the de-animalization of meat production has been extensively addressed (Drabenstott, 1998; Stull & Broadway, 2004; Lawrence & Stott, 2010). In his seminal piece on the subject, "Making Meat," Boyd (2001) outlines the post-WWII boom in the consumption of poultry. The article outlines the tensions of reformulating and subordinating biological organisms as agricultural commodities in the pursuit of capital. Boyd shows how technoscientific gains emerging from the exploitation of broiler chickens' biological productivity and genetic improvements have resulted in a "highly efficient machine" (2001, p. 638) for turning grain into meat. Following the marketing success of ultra-low fat chicken in the late 1980s, hogs' genetics have also been tweaked to express leanness. While this and many other parallels exist between industrialized chicken and hog farming, in this text I argue that commodity hog farming is no longer in the business of *making meat,* as Boyd describes it, but is instead in the business of *producing protein*.

## Methods

Towards these objectives, I have conducted extensive content analysis of existing literature on intensive animal agricultural practices, hog development and production, and data on food-based commodity chains (Boyd & Watts, 1997; MacLachlan, 2001; Barndt, 2008; Stull & Broadway, 2008). MacLachlan's (2001) pivotal contribution to unpacking the Canadian agro-industrial meat chain served as a key document to track the structural elements of industrial animal production and killing. His piece traces the history of beef-calf production, cattle feeding, and the changing meat processing and retailing sectors and pays particular attention to the changing hands within Canada's concentrated slaughter/processing industry (MacLachlan, 2001). Within the social sciences, content analysis and in-depth interviewing stand as prominent qualitative research methodologies (Van den Hoonaard, 2015; Jackson & Verberg, 2007). I draw extensively on forty-four in-person, in-depth interviews followed by transcript content analysis and the coding of interview data for manifest/explicit and latent/implicit themes, which provided a rich, qualitative data set for the basis

of discussion in this paper. Interviewees included twenty-six pork producers, primarily from Southwestern Ontario and eighteen key industry informants, many of whom spoke/operated at a national scale. The counties of Bruce, Middlesex, Oxford, Wellington, Perth, and Huron, and the Municipality of Waterloo in Southwestern Ontario were specifically targeted, which together represented more than half of all hogs produced in Ontario at time of data collection (Statistics Canada, 2014). These seven counties currently account for more than 70 percent of all hogs in Ontario (Statistics Canada, 2021). Industry interviewees were intentionally selected based on the prominence of their roles and place of employment within the industry.

## Substitutionism and appropriationism as categorical framework

*Substitutionism* has been put forward as industry players' efforts to reduce, replace, or entirely supplant agricultural components needed as inputs (Goodman et al., 1987). Similarly, *appropriationism* describes industrial capital used to reconfigure and restructure agricultural production processes including labour (Goodman et al., 1987). Together, the two concepts provide insight into the industrialization of agriculture and subsequent displacement/disenfranchisement of rural-based farm work. A number of agro-industrial processes that are now commonplace in modern food manufacturing embody the development of substitutionism. They include: the application of research and development and high-capital investments; the decoupling of place of production and place of consumption, of both inputs and final-use products; the reduction of agricultural outputs to otherwise interchangeable industrial inputs; and the "fractionation" of agricultural products into their constituent parts to permit reconstitution into value-added items. Additional conditions for the proliferation of substitutionism are economy of scale and standardization. Substitutionism counters, effectively, concepts such as terroir, localized cuisine, and "short" food chains, which seek to re-establish more intimate linkages between producers and eaters. Hog farming, like most industrialized meat production, is already a form of precision agriculture. Stull and Broadway (2004) have noted that meat production has been transformed through agricultural industrialization, specifically through intensification, concentration, and specialization, which have emerged as major drivers. However, massive capital, technological, and cultural investments are also required for living, breathing organisms to be reduced to mere macronutrients.

Boyd, too, conceptualizes the techno-scientific underpinnings required for the industrialization of modern meat production (2001). Boyd's emphasis on the blending of biological organism and mechanical efficiency evokes a much earlier work—Ruth Harrison's *Animal Machines* (1964)—in which the author argues that food animals have been forced to exist robotically and hollowly for human uses. Modern industrial commodity hog production has been materially supplanted via the same processes of substitutionism and appropriationism presented by Goodman and colleagues (1987). The commodity hog industry has fully embraced high capital investment,

furthering the concentration of power within transnational food companies due to a series of mergers and acquisitions with aims of capitalizing on opportunistic trends in the mass consumption of generic protein (iPES, 2022). In addition, the fractionation of industrial hogs and the protein they produce can be demonstrated by intentional, technocratic carcass leaning that has given shape to an industry run on high-volume, low-margin, cheap protein inputs for value-added profit. National retailers and large integrators, like Maple Leaf Foods (who have shifted focus away from pig slaughter and toward pork processing), exercise tremendous power over both production and consumption. Appropriationism and the subsequent disenfranchisement of rural-based farm work is also occurring as hog producers bend to processor demands for lean and uniform carcasses or else find their animals unsellable after slaughter. Further—as many of the producers I spoke with confirmed—farmers often do not even own the animals they raise, and instead participate in contractual arrangements for barn space and labour with large agro-food companies (MacDonald, 2016). As such change takes place, hog farmers are increasingly "the equivalent of wage labourers on their own land" (Page, 1997, p. 102).

## Protein-ification of animal derivatives

Protein is one of three macronutrients essential to human health and a cornerstone of dietary intake; fat and carbohydrate are the other two. Proteins in the body create and regulate insulin, produce lactase (a digestive enzyme), maintain fluid balance in the blood, and build structural components like muscle, hair, bone, and organ tissues. Protein in the diet is assessed by its amino acid profile. There are twenty amino acids, nine of which are essential, meaning that the body cannot produce them and must be sourced from food. Animal-based products like meat and eggs are termed "complete protein sources," since they contain all nine essential amino acids.

In contrast, non-animal sources of protein are labeled "incomplete" sources of protein. This is not because they are insufficient sources, but because some of the nine essential amino acids are not present. While all whole foods contain some protein, and a varied diet supports multiple health benefits (Lichenstein et al., 2021; Health Canada, 2019), animal-based sources of protein are often lauded for their protein content. Nonetheless, foods such as grains and legumes eaten in combination (e.g., rice and beans) mutually supplement their amino acid profiles, creating a complete protein in the diet.

While nutritional science is a fairly new field of study, early publications from the meat industry promote the value of meat in the diet. One 1933 publication targeted at housewives, titled *Tasty Meals For Every Day,* claims that "because the protein found in meat so closely resembles the protein contained in the human body, it is particularly adaptable to human uses" (Canadian Packers Limited, 1933, p. 4). Nutrition policy in Canada until the 1920s stated that animal-derived products, particularly cow's milk—which emerged as a substitute for breast milk as awareness of vitamins and trace minerals grew—were deemed to be protective and healthful (Ostry, 2006). It is notable that this emphasis on the *likeness* between animal tissue and human tissue seems obscure in today's context, as

consumers grow increasingly distanced—and intentionally so—from the notion that meat comes from the body of a killed animal. The rhetoric about protein has shifted to how vital it is and how eaters should consume more of it. Moreover, as food and technology continue to mingle, messaging about protein and its sources (plants, insects, cell cultures) further disrupt our preconceptions of and relationship to food.

Another macronutrient around which messaging has become increasingly difficult to understand is fat. Fat, particularly trans fats, and saturated animal fats, have in particular been blamed for the onset of several chronic health conditions (MacLachlan, 2001; Guasch-Ferré et al., 2019; Weis, 2013). As a result, there has been a drastic reduction in domestic red meat consumption in Canada, Britain, and the US since the 1970s, where research has linked increased risk of cardiovascular disease to fattier red meats, especially beef and pork (MacLachlan, 2001; Guasch-Ferré et al., 2019; Weis, 2013).. Cordain and colleagues noted the high occurrence of chronic disease such as hypertension, type II diabetes, and cardiovascular disease (Cordain et al., 2005). Taking an evolutionary approach to human health and nutrition, they note how domesticated food species and processing techniques have altered the conditions and quality of much of the food found in a Westernized diet. Cordain et al. (2005) further assert that drastic changes in the composition of human health emerged with the development of agricultural practices and animal husbandry approximately 10,000 years ago, and that one of the most drastic shifts is in animal carcass fat and the fatty acid composition of animal products.

As nutritional sciences continue to investigate the nature and effects of macronutrients in human bodies, a number of new dietary regimes have emerged, such as the keto diet. Early twentieth-century research on fasting for improvement in epilepsy patients was expanded upon by R.M. Wilder in the 1920s who coined the "ketonemia diet" (Kim, 2017; Masood et al., 2023). The ketonemia diet was intended to mimic the benefits of fasting seen in epilepsy patients, but over a longer term though high fat consumption and severe carbohydrate restriction (Williams & Cervenka, 2017). Today, the "keto diet" for weight loss is intended to induce *ketosis,* a metabolic state in which the body is starved of carbohydrates as an energy source and shifts to using fat as fuel (Dowis & Banga, 2021). Fat stores in the body are metabolized by the liver and turned into ketones as an alternate source of energy (Dowis & Banga, 2021).

A similar metabolic process takes place when the body is inundated with high levels of protein. In the absence or near-absence of carbohydrate and fats, the amino acids in dietary protein must be processed by the liver into urea and excreted by the kidneys, a process that can cause stress to both the kidneys and liver (Thompson, Manore & Sheeshka, 2007). That is, while protein is an essential part of the diet in combination with other macronutrients, it is not a pure, clean fuel to be consumed abundantly, as some diets promote. The average human needs just 0.8 grams of protein per kilogram of body weight for positive physiological maintenance (Institute of Medicine, 2002). Because almost all whole foods contain some protein, this level of intake is achievable without relying on an ultra-high protein diet.

It is within this context of nutritional research, science communication, and the popularization of commercialized diets that hogs have been systematically developed and promoted by industrial agribusiness as a cheap, macronutrient-siloed input for food processing, exploiting the value that consumers now attribute to lean protein. Lean meat production—particularly pork and the systematic "leaning" of hogs—has been

instigated as a move toward capital protection for large corporations, rather than concern for consumer health. To echo Goodman et al. (1987), hogs have gone through fractionation. Today, there is a seemingly endless supply of uniform animals due to overproduction, genetic research and development, and prolific reproduction rates (MacDonald, 2016).

## Fractionation: Hog carcass leaning

Historically, there were two varieties of hogs raised for human consumption: bacon hogs and lard/butcher hogs (Canada Packers Limited, 1943). The former yielded a more muscled carcass, the latter a fattier, lard-rich carcass. Throughout the 1930s, continuous calls for hog improvement from slaughterhouses were made and, in 1938, the Whyte Packing Co. developed an "on the rail" grading system (Rennie & Meat Packers Council of Canada, 1969, p. 58). This rail grading system allowed for animals to be hoisted into the air by their back legs immediately following stunning and allowed the carcasses to move through the plant along an overhead rail, which stationary workers then individually assessed and disassembled (MacLachlan, 2001). By 1940, rail grading of individual hogs became the standard method of carcass grading. On December 30, 1968, a new rail grading system arose from the joint efforts of the Canadian Swine Council, the Meat Packers Council of Canada, and Agriculture and Agri-Food Canada (AAFC) and was implemented after a "definite relationship was proven between the total backfat and the yield of lean meat in the hog carcass…to determine grade" (Rennie & Meat Packers Council of Canada, 1969, p. 64). In addition, Canada Packers Limited claimed that grading hogs was done to "stimulate the production of hog of the type that will make high quality Wiltshire sides for shipment to Britain" (1943, p. 95).

With an export market based on leaner bacon hogs established early in history of the Canadian hog industry, the conditions were in place for expansion as advancements in machinery and agricultural technology took place. In particular, there is an argument to be made that the modern commercial livestock industry developed in tandem with the boom in cheaply produced vegetable oils, such as palm and canola, alongside the industrial mono-cropping of feed grains like corn and soybeans. Weis has termed this process "the industrial grain-oilseed-livestock complex" (2013, p. 93). Specialized industrial livestock production sites, housing thousands of animals within a confined area, could only be possible through the plethora of grains produced for use as animal feed. Only through the mass production of cheap oils and grain could the mass production of animal-derived protein occur. Similarly, the cheap grains used to feed lean hogs can also be supplemented with cheaper fats at the processing level—themselves having gone through the process of substitutionism—improving the mouth feel, palatability, and appeal of processed meat products. Faced with the demand for leaner protein and the need to grow hogs in large numbers due to low margins, commodity producers have little choice about the breed of pig they house in their barns. Because these same lean hogs are individually graded, the machine that is the commercial pork industry must be fed by a continuous influx of uniformly sized, rapid-growing, high-littered, and genetically perfected hogs. Such specificity of breed and genetic tinkering has enabled hog genetics companies to create *the* benchmark meat hog: an F1

cross. The F1 cross is touted as the premium hybrid for commercial production as the pigs grow uniformly. A number of producer interviewees reporting raising a three-way cross F1 breed, a landrace crossed with a Yorkshire female, bred to a Duroc boar. Producer associations echo that the F1 cross genetics produce "the most uniform commercial growing finishing pig, as well as the most consistent carcass in the slaughterhouse" (Canadian Swine Exporters Association, 2023, para.3). However, Weis (2013) notes that despite the rapid rationalization of inputs to produce flesh, eggs, and milk, there are "inescapable biophysical limits" (p. 115) in commercial livestock production. When the genetics of a perfectly sculpted hog meet innovative pharmaceuticals intended to result in perfect, rational efficiency, both the provenance of that animal, and the larger system of which it is a part, become distanced from the consumer. National retailers and large integrators like Maple Leaf Foods, exercise tremendous power over both production and consumption, and stand as a model of problematic production processes.

Kill plants have become incredibly costly to operate, requiring labour, health and safety personnel and regulatory oversight, specialized equipment for each component of the carcass breakdown, and many inputs, such as the water needed for frequent cleaning and electricity for refrigeration units (MacLachlan, 2001). Where labour costs have been rationalized, expensive automation has emerged. The substantial cost of operating a kill plant and increasing regulatory hurdles such as phytosanitary regulation, residue testing, and third-party welfare audits also contribute to the speed and scale of operation (MacDonald, 2016). Plants must operate ceaselessly at capacity to ensure maximum efficiency and maximum return on investment (MacLachlan, 2001; Stull & Broadway, 2004). Frequent COVID-19 outbreaks and even deaths from transmission traced to slaughter facilities around the world further evidence how tightly these facilities must operate (Dryden, 2020; McEwan et al., 2020).

## Fractionation of meaty, animal bodies

Despite acknowledgement from numerous producers and industry personnel with whom I spoke that a fattier hog is also a tastier hog, processors continue to drive demand for generic lean protein. One industry interviewee, situated high within the Ontario Pork marketing board, noted that despite producers' feelings on the dilemma of producing commodity-grade protein, "until the model changes, producers will produce lean." Because further processers and value-added pork products require cheaper material for processing, the model central to the industry is for producers to *supply* processors like Maple Leaf Foods and Olymel with a consistent source of cheap, generic, animal protein for their wares. While producers raising pastured animals are often able to reach emergent markets and consumers willing to pay more for better taste (but less volume), commodity producers are limited in their options. Even fresh meat retail sales are affected by the perpetual cheapening of pork, setting consumer prices far below producers' own costs. This further reinforces the notion that pork is just *cheap protein*.

Four key production processes contribute to the current commodity "model": (1) Fat costs more in terms of feed volume and grow times, adding more days to finishing hogs before they reach market; (2) Lean,

tough, or otherwise unpalatable cuts of meat can be "fat-corrected" during processing, meaning that high-quality fat is "unnecessary" for industrially transformed products; (3) Highly processed pork products such as hot dogs, sausages, and deli meats have longer shelf lives and therefore can be shipped further and be stocked longer on retailer shelves than fresh product; (4) Highly processed, value-added items also generate larger profit, being based on cheap, lean hogs, further decreasing producers' control over their animals' standards.

Processor-driven monetary bonuses and penalties have also influenced the type of hogs that producers raise in-barn. While domestic pork consumption is declining, up to 70 percent of all processed meats in Canada are made with pork (Agriculture and Agri-Food Canada, 2022). As noted above, because meat processing can enhance, correct, and amplify flavours with a plethora of additives, such value-added goods can provide variety and taste while also exploiting consumers' perceptions of the value of a high-protein diet. Together, these processes and contexts continue to reinforce the demand for hog leanness across the pork industry. The leaning of hogs for generic protein has thus provided capital protection for large integrator-processors, guarding against many of the issues that arise from fresh meat sales, such as perishability and profitability.

## Rural appropriationism: Bend or bankruptcy

Breeding for uniformity, in both animals and crops, has become a defining feature of large-scale, corporate, monoculture food production (Howard, 2016; Boyd, 2001; Weis, 2013). However, in parallel to the move to breed broiler chickens with heavier (and more valuable) breast meat, genetics companies have targeted a number of desirable traits in hogs (Ufkes, 1995, 1998). These include improved feed-conversion rates for rapid growth (using a primarily corn-based diet), sturdy feet and legs for growth on concrete flooring slats (through which feces and urine fall), prolific litter sizes, and, as discussed, leanness (Canadian Swine Breeders Association, 2015; MacDonald, 2016, 2018).

Hog leanness is a device for reinforcing the value of protein within the hog value chain, and the mechanics of measuring hogs' backfat (in order to determine overall leanness) contributes to the reduction of animal bodies to structures that grow protein. Backfat is graded while hogs are alive in order to adjust feeding schedules before slaughter using ultrasound. Not all hogs are graded for leanness, but through sampling and assumption that genetic lines are uniform, fat grade is extrapolated throughout the barn. Once a crop of hogs are leaned to the desired weight and backfat, they are sent to slaughter. Hogs with more backfat receive a lower grading, meaning producers are paid less (OMAFRA Swine Team, 2015; MacDonald, 2016).

Other factors are also considered in constructing hog prices. Dutkiewicz (2020) outlines how futures markets and speculative pricing are built upon the illusory notion that "the market" exists as a physical actor, rather than as a constructed framework. Hogs, while at the centre of pork production and pork pricing schemes, merely serve as a standardized "biological instrument of market intervention" (Dutkiewicz, 2020, p. 283). For many commodity producers, the base price is set in American dollars (USD) and United States Department of Agriculture (USDA) cash number products for select pork cuts that are released on a daily basis upon the Chicago Mercantile Exchange (CME), a

speculative hog futures stock exchange (Grier, 2007). As a result, the projected prices are often set months ahead of time. Processors take this array of numbers and, using a similar formula, establish a price based on the market they are servicing at that time (Ontario Pork, 2021). Many grading grids are proprietary information, maintaining competition among slaughterhouses and allowing different plants to serve different protein markets (MacDonald, 2016). Today, there is an increasing demand from processors for heavier hogs, at times exceeding 300 pounds, a weight that would have been excessive and heavily penalized just fifteen years ago (MacDonald, 2016). To the processor, therefore, it makes more financial sense to buy heavier hogs, which increases profit.

These issues mean that producers must either adapt to the processor-driven changes in demand or be penalized. If a hog is deemed too small, too large, or too fat, producers may be paid just 10 percent of the 100 percent Formula Price, a rate set by pork marketing boards and used to dictate prices paid at slaughterhouses[1] (Ontario Pork, 2021). Although the term "precision agriculture" is often associated with crop farming, it is evidently applicable to hog production. As hogs' genetics are constantly tweaked to produce more piglets per sow, more lean carcass meat, and in less time with less feed, advanced technological systems are also emerging in-barn (MacDonald, 2018). Those unable to keep up with the advancements in technologically precise growth methods end up having greater feed costs relative to tremendously volatile returns.

Sophisticated equipment and technical systems are becoming necessary to compete in this industry. Electronic sow feeding (ESF) systems are just one example of what comprises the "technological treadmill" (Buckland, 2004, p. 152). Seeing greater gains in efficiency or productivity, producers adopt cutting-edge technologies with hopes of improved returns on larger farms with less labour. However, larger production sites, particularly those that are vertically integrated, also have a greater ability to source the capital needed for such investments (Drabenstott, 1998). Much like the advancements of threshers and tractors in crop agriculture, which encouraged the use of larger parcels of land to make operational costs worthwhile, ESF systems also favour expanded hog production, with the corollary effect of disadvantaging smaller producers who cannot compete at that scale. While such changes are normative to capitalist agriculture, hog producers tend to associate the increasing consolidation of their industry as reflective of poor individual production decisions. One interviewee stated that, throughout his time hog farming, "We made a ton of money, we lost a ton of money, we made a ton of money, but it's, it's the game I know, right?.... Yes, there was casualties along the way...we lost some good producers, you know the first casualties are always the bad producers so some of that's not the end of the world." Another interviewee stated, "farmers are their own worst enemies, and instead of having a single voice, when the prices are down, you should hear them at the meetings we have." A similar sentiment was echoed by yet another producer, who noted that he has grown to

[1] Pork marketing boards utilize US Department of Agriculture swine data to construct the following pricing formula to pay producers at time of slaughter: CME Constructed 201 Price = (Producer Sold Negotiated Hogs (Head Count * Average Net Price * Average Carcass Weight) + Producer Sold Swine or Pork Market Formula hogs (Head Count * Average Net Price * Average Carcass Weight)+Negotiated Formula(Head Count * Average Net Price * Average Carcass Weight)) divided by (Producer Sold Negotiated Hogs (Head Count * Average Carcass Weight) + Producer Sold Swine or Pork Market Formula hogs (Head Count * Average Carcass Weight)+Negotiated Formula (Head Count * Average Carcass Weight) (Ontario Pork, 2021).

dislike interacting with other farmers throughout his time in the hog industry. He stated, "I don't like working with farmers because they're the toughest bunch to work with, they're never satisfied, there is always something wrong" to describe the difficulty of working co-operatively with other hog producers. Despite processors' demand for lean, protein-rich inputs from hog bodies consumers' demand for the ultimate in greasy, salty, pork—bacon—is booming.

## Bacon boom

The sharp increase in consumer demand for bacon in the 1990s is linked to lobbying efforts by the Illinois Pork Producers' Association, an effort to combat slumping pork belly prices (Sax, 2014). Sax (2014) notes that "because the belly was the largest single cut on the pig, the corresponding prices of hogs slumped, and farmers tried to salvage what they could from leaner loins and chops by breeding thinner, more muscular pigs" (para.11). Earlier, in the 1980s, the US National Pork Board—the national lobbying voice of US hog producers—used the "Pork: The Other White Meat" campaign to appeal to increasingly fat-conscious consumers (Sax, 2014; National Pork Board, 2015). To overcome the resulting belly price slump, the Pork Board approached fast food restaurateurs, who had also begun offering leaner options, to encourage the addition of bacon to sandwiches for added flavour (Sax, 2014, np). This fractionation of pork into both ultra-low *and* ultra-high fat cuts further illustrates the bifurcation of the "modernized" pork industry.

Despite acknowledgement from many of the producers that I spoke with that they are being guided by processors to produce leaner, yet larger hogs, there was disagreement as to the origins of this preference. Many producers noted that consumers were afraid of fat, and that processors, in an attempt to satisfy those consumers, were demanding lean hogs. Others tended to blame consumers directly, noting a lack of savviness in the kitchen, rather than an entire industry that built on lean protein creation. Despite individual opinions, broader consideration of market trends illustrates that processor-led demand for leanness, embracing uniformity and economies of scale, resounds throughout the entire North American hog market (Ufkes, 1995, 1998). As one Iowa hog farmer put it: "We are being told that consumers are constantly demanding high quality pork that is consistently lean. Unfortunately, the pork being produced by the industrial units meets the packing plants' qualifications for lean pork, but does not meet the consumers' desire for high quality meat… consumer demand is not driving the hog industry today" (Braun & Braun, 1998, p. 53).

Some US-based producers go on to claim that producers are being penalized for higher quality, fattier hogs, and that "the poorer quality meat being produced by the industrial producers exacts a premium price at the packing plant, but then is sold at discounts or is made into sausages because much of it is of such low quality" (Braun & Braun, 1998, p. 54). Processors do indeed see "fat profits in lean meat" (Ufkes, 1998, p. 241) as processed pork, which can be used in a variety of commodity meats like hot dogs, deli meats, and sausages, and serves as cheap protein filler that can be corrected via processing for increased palatability. Sugar, fat, seasonings, cheaper added-oils like canola and palm, and flavour enhancers like smoke, maple, and hickory flavouring can all be included during further-processing (Winson, 2013). Though research into

breeding, feed ratios, and feed components has generated hogs with less backfat, it also led to the breeding out of intramuscular fat, which gives cooked meats both flavour and juiciness.

## High capital investments: New proteins, same conglomerates

North American animal protein companies are recognizing shifts in consumer demands and see success in marketing entirely plant-based and alternative proteins. This shift in focus by large animal-based companies is not an approach based on conscientiousness but is instead a move to capitalize on trends in the mass consumption of generic protein (iPES, 2022). In keeping with my framework of substitutionism and appropriationism, such high capital investments and decoupling places of production and consumption are apparent in protein creation conglomerates, even as they pivot to alternatives to pork protein. Howard and colleagues' recent report titled the "Politics of Protein" notes how rhetoric of an alternative protein transition serves to further reinforce corporate concentration of transnational conglomerates (iPES, 2022).

The purchase of Field Roast Grain Meats (a plant-based meat and cheese company) by Maple Leaf Foods is one illustration of this industrial shift. In December of 2017, Field Roast announced its acquisition for US$120 million (Maple Leaf Foods, 2018a), which followed Maple Leaf's previous acquisition of Lightlife Foods, another plant-based protein company acquired in early 2017 for US$140 million (The Canadian Press, 2017). Maple Leaf now positions itself as "the most sustainable protein company on earth" (Maple Leaf Foods, 2018b, para.1).

To accommodate their growing portfolio of plant-based protein options, Maple Leaf developed a new, independent subsidiary called Green Leaf Foods (Green Leaf Foods, 2022). There is no mention of Maple Leaf Foods anywhere on the Green Leaf Foods, Lightlight, or Field Roast Grain Meat's company websites. These mergers provide opportunities for increasing retail shelf space, brand recognition, and distribution channels for plant-based products, and distancing them from Maple Leaf's well-recognized, animal-based brands is likely to support their success. While not contained within any of Maple Leaf Foods' current product lines, the company has also provided venture capital financing to Entomo Farms, a large cricket protein producer and farm in North America (Entomo Farms, 2018).

Similar ventures are also happening outside of Canada. Tyson Foods, one of the largest hog and chicken operators in the continental US, joined Cargill, the largest beef producer, in purchasing Memphis Meats, a cellular meat venture by billionaire philanthropist Richard Branson (Tyson Foods, 2018). Tyson has also taken a stake in Beyond Meat, a plant-based protein company (Tyson Foods, 2016, 2017). Cargill has also invested in plant-based protein creation with the 2018 purchase of PURIS, the largest pea protein producer in North America (Cargill, 2018).

Taking a step back, these animal-based protein companies are themselves tightly consolidated. JBS, based in Brazil, is currently the largest meat company in the world (Schneider & Sharma, 2014). JBS acquired pork company Swift & Company in 2007 and Cargill's pork business in 2015 (Schneider & Sharma, 2014). Tyson Foods is currently the second largest meat company after JBS (Schneider & Sharma, 2014; Howard, 2019). Tyson acquired Iowa Beef Processors in 2001, and now owns stakes in both Beyond Meat

and Memphis Meats (Barboza & Sorkin, 2001; Howard, 2019). WH Group, previously named Shuanghui Group, is based in China and acquired Smithfield in 2013, then the largest hog processor in the US (Schneider & Sharma, 2014).

Acquisitions, mergers, and increasing consolidation are a cornerstone of agribusiness (Howard, 2016; iPES, 2022). Aptly referring to such concentration of power within transnational food companies as "Big Protein," Howard and colleagues note that food supply chains must be restructured to strengthen truly alternate options (iPES Food, 2022). Agricultural inputs like seeds, fertilizers, and genetic patents have also become incredibly concentrated, due to a series of mergers during the 1990s and 2000s. For example, as of 2016, there were just six input companies dominating agricultural seed (Clapp, 2017), and even further mergers now leave three mega-corporations: Bayer-Monsanto, Dow-Dupont, and ChemChina-Syngenta. As the alternate protein trend continues, it appears that the concentration of power over agricultural inputs will be still largely controlled by the very few. If the standards of leaning and grading of hog bodies plays out in the alternative-protein market as well, these massive corporations hold enormous power to shape industry research and development across multiple protein-creation sectors.

## Conclusion

Though the rationalized processes and demands of industrial efficiency, leaned hog flesh has become a device for reinforcing the value of protein within the hog commodity chain. Using the framework of substitutionism and appropriationism presented by Goodman and colleagues (1987) and Scrinis' (2008) concept of nutritionism, this article has argued that hog farming is in the business of *producing protein,* rather than *making meat,* and can supplant other forms of generic protein inputs to the human body with aims of capitalizing on the mass consumption of siloed macronutrients.

Even as North American eaters grapple with the risks of overconsumption to individual and collective health, contemporary dietary advice about eating macronutrients in isolation from one another has served to distance and deskill us (Scrinis 2008). Protein consumption is central to this discourse, yet eaters remain highly removed from all the ways those proteins are grown within animal bodies. As new industries emerge, particularly those producing lab-grown proteins, consumers and producers alike should embrace opportunities to increase transparency and reveal what has for too long operated in unseen spaces and processes (Pachirat, 2011).

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