Vol. 11 No. 1, pp. 111–130 March 2024

Canadian Food Studies La Revue canadienne des études sur l'alimentation

Original Research Article

Industrial meat in Canada, growth promoters, and the struggle over international food standards

Elizabeth Ann Smythe*

Concordia University; ORCID: 0000-0002-0714-7908

Abstract

This article focuses on differing national regulations and standards regarding how meat for human consumption is produced and what is permissible in that production process. Attempts to harmonize these regulations at the global level to facilitate international trade have proven to be challenging. Such harmonization of regulations is especially important to countries exporting meat, such as Canada. The conflict at the global level reflects a range of differing trade interests and values about what meat is and how it should be produced. One area of disagreement is over the extent to which methods of growth promotion in animals using technology, particularly drugs, is acceptable and safe in terms of human consumption. Canada has taken the position that they are acceptable and safe. Using two case studies of regulations related to the most recent set of beta agonist drugs, ractopamine and zilpaterol, fed to livestock to promote growth, I examine the underlying sources of these conflicts and the extent to which they reflect the interests of various actors and the forms of power they may employ to try to shape global standards at the Codex Alimentarius and the view of what is acceptable meat.

Keywords: Meat production; growth promoters; drugs; international trade; standards; Codex Alimentarius

*Corresponding author: elizabeth.smythe@concordia.ab.ca

DOI: 10.15353/cfs-rcea.v10i3.632
ISSN: 2292-3071

Résumé

Cet article porte sur les différentes réglementations et normes nationales relatives à la production de viande destinée à la consommation humaine et sur ce qui est autorisé dans le cadre de ce processus de production. Les tentatives d'harmonisation de ces réglementations au niveau mondial pour faciliter le commerce international se sont avérées difficiles. Cette harmonisation est particulièrement importante pour les pays exportateurs de viande, comme le Canada. Le différend au niveau mondial repose sur un ensemble de valeurs et d'intérêts commerciaux divergents autour de ce qu'est la viande et de la manière dont elle devrait être produite. L'un des éléments de désaccord concerne les méthodes de stimulation de la croissance des animaux à l'aide de technologies, en particulier de médicaments, et à quel point elles sont acceptables et sûres pour la consommation humaine. Le Canada a adopté la position selon laquelle ces méthodes sont acceptables et sûres. À l'aide de deux études de cas portant sur les réglementations relatives à la série la plus récente de médicaments bêta-agonistes, la ractopamine et le zilpatérol, utilisés dans l'alimentation du bétail pour favoriser la croissance, j'examine les sources sous-jacentes de ces conflits et la mesure dans laquelle ils reflètent les intérêts de divers acteurs ainsi que les formes de pouvoir que ceux-ci peuvent utiliser pour tenter de façonner les normes mondiales du Codex Alimentarius et la vision de ce qu'est une viande acceptable.

Introduction

The past three decades have seen major growth in trade in food and agricultural products. Along with this trend there has been increasing pressure on states, through trade agreements, to harmonize national and sub-national regulations around the production and safety of food products. Such national regulations have increasingly been seen to be potential non-tariff barriers to trade, (De Ville & Silles-Brugge, 2015) unless they can be justified based on sound science or evidence-based international standards. Strictures on national regulations that might impact trade are embodied in two World Trade Organization (WTO) agreements (discussed below). The WTO agreements on Sanitary and Phytosanitary (SPSA) measures and Technical Barriers to Trade (TBTA) cover most aspects of regulations that relate to food. They have been the source of a disproportionate number of trade disputes related to food.

In the case of food products, the negotiations over the establishment of international standards take place at the Codex Alimenatarius. Founded in 1963 as a joint body of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) its mandate is to develop and harmonize food standards both "protecting consumer health and promoting fair practices in the food trade" (Codex Alimentarius, home, para 1, 2023). With the creation of the WTO and its agreements on restricting barriers to trade, the standards created at Codex took on increased significance for states. However, the effort to establish such standards and to have states adopt and adhere to them has proven increasingly difficult in a number of areas related to food

production, most notably in the use of genetically modified organisms (GMOs) and the use of growth promoters in the production of red meat. Conflicts were often based on different views of the safety of these products for human consumption.

One major area of conflict has been over the use of growth promoters in meat production using technology, particularly drugs, and whether it is acceptable and safe in terms of human consumption. Using case studies of regulations related to the most recent set of drugs fed to livestock to promote growth, beta agonists, I examine the underlying sources of conflict, how they reflect the interests of various actors and the forms of power employed to try to shape global standards.

The production of pork and beef in North America has historically involved the use of a range of growth promoters. The United States—as a major meat-exporting country—has sought, along with Canada and other meat exporting allies, to establish international standards and trade agreements that would allow imports of meat produced using growth promoters, once standards ensuring they are safe for consumers have been established based on sound science. They have thus challenged the right of importing countries or regions to limit market access of this meat based on national regulations that ban their use (Codex Alimentarius Commission [CAC], 2011).

These case studies of conflict over the use of beta agonists drugs raise questions about the intensive industrial scale of meat production and differing interpretations of scientific evidence and risks related to food safety. They also highlight a conflict over whether other criteria, beyond food safety for meat consumers, should be taken into account in the setting of international standards. I argue that governments' positions on these regulations and standards reflect the interests and relative power of key actors in the meat industry including producers, processors, and drug companies. Canada's role as a meat exporter is also relevant to understanding why Canada, along with a number of meat-exporting countries, has sought to shape standards and ensure that national regulations on growth promoters are based only on "sound science." This science, however, is to be confined to the safety of meat for human consumption and rejecting any other basis for regulation that might impact trade. Despite taking that position, along with powerful states like the United States, within the Codex, Canada has been unable to secure access to a number of export markets for meat produced using these drugs. In the case of Canadian pork producers this has led many to forego the use of these drugs altogether.

Theory and methodology

This article adopts a political economy approach to understand the forces that shape international meat standards. It focusses on the types of power and the relative power/influence of various actors. In the case of global standards these actors include states, meat producers, other industry groups, and corporations along with a range of NGOs. The conception of power and its forms is drawn from the literature of political economy, summarized in the work of Clapp and Fuchs (2009) who identify three forms of power. The first is instrumental power which involves directly "influencing the policy processes" typically "via

corporate lobbying or political campaign financing" and access to decision makers (Clapp & Fuchs, 2009, p. 8). The second structural power involves the imposition of limits on the range of choices given to actors and the predetermination of options often based on size, market share, and other resources that actors can use to influence agenda setting and the range of policy alternatives to address a policy problem. In the case of the global food system the rise of large agri-business corporations and the growing corporate concentration provide a basis of power to shape the development of national and international regulations related to food. The third form of power they identify is discursive, involving contests over the framing of policies linked to "specific fundamental norms and values" (Clapp & Fuchs, 2009, p. 10). While the assumption might be that corporate actors wield much structural and instrumental power at both the national and global level my case studies will show that where divisions exist among state actors it reflects differences related to both instrumental and discursive power of actors over these regulations and how they are framed.

This study is based on the author's observations at meetings of the main standard setting body for food, the Codex Alimentarius and its Commission (CAC) which meets each year in Geneva or Rome. In addition, reports of CAC meetings from 2012 to 2022 and of the meetings of the key Codex Committee dealing with the use of growth promoters, the Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF), from 2006 to 2022 were reviewed. Interviews and discussions with Canadian negotiators at the CAC, along with representatives of non-governmental organizations (NGOs) and other non-state actors seeking to influence standards, were also conducted. I begin, however, with a brief discussion of meat production and consumption.

Meat debates

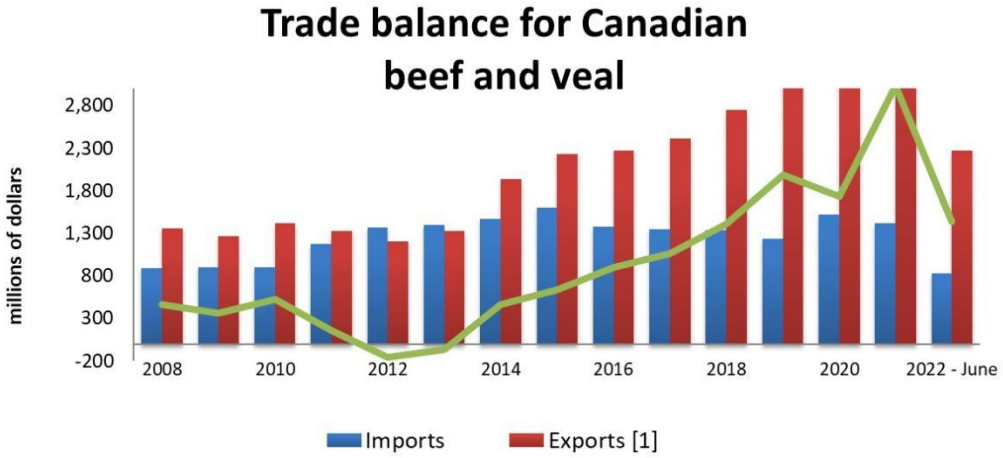
The production of meat in North America, is often characterized as following an industrial model with much emphasis on scale, efficiency, and the use of technology (Fitzgerald, 2015; Kirchelle, 2018). Critics of this system focus on aspects of production including food safety, the treatment of animals, the use of technology, and the increasing corporate concentration and market domination by a few companies (Clapp, 2016; McCrae, 2022). Hannan (2020) identifies a range of concerns about meat production including the killing of animals for food, the treatment of animals in meat production, and the meat industry's environmental footprint. An additional issue is the link between meat consumption and human health impacts related to non-communicable and chronic diseases. My focus in this article, however, will be on concerns about food safety and potential threats to human health in the consumption of meat produced using technology to promote animal growth along with the impact of these growth promoters on the welfare and suffering of livestock.

Meat in Canada: An overview

Canada is both a major food exporter and importer. The food and beverage industry represents 9 percent of manufacturing GDP and is one of the largest employers. In addition, the sector was identified by a 2017 committee advising the Minister of Finance on economic growth as a major driver of future economic growth leading the government to set robust growth targets in the sector of 31 percent by 2025. A major challenge to achieving that goal, however, was identified as the threat of barriers to foreign market access (Asare, 2022). An important element of that growth and those threats involved meat production.

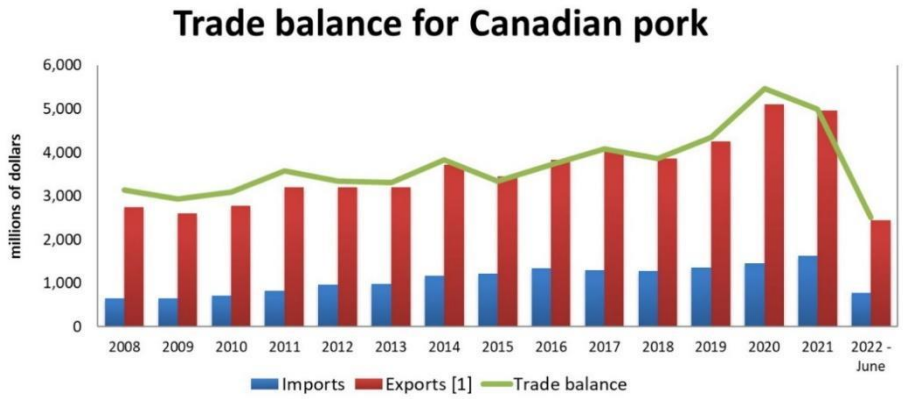
Beef and pork are the most significant meat products, in terms of volume and value of meat produced and exported (Agriculture and Agri-food Canada, 2022). As the Canadian Meat Council (CMC) notes, Canada's meat exports have grown significantly in the past fifteen years. Beef exports rose to 442000 tonnes in 2021. Exports of pork have increased from 200,000 tonnes in 1990 to over 1,151,000 tonnes, valued at 4.2 billion dollars in 2021 (CMC,2021). A vast proportion of beef exports (72 percent) go to the U.S., 11 percent to Japan, and the remaining small balance goes to a range of countries with significant growth in some Asian markets(CMC, 2021) The European Union (E.U.) is notably absent as a major market for beef.

Figure 1: Trade balance for Canadian beef and veal



As Figure 1 indicates, Canada is a net exporter of beef and veal and has become increasingly reliant on export markets over time. Canada is the third largest exporter of pork behind the U.S. and the E.U. Of the meat produced from hogs in 2021, as Figure 2 indicates, well over 50 percent is exported. Not surprisingly ensuring export market access for Canadian beef and pork has been a priority of the Canadian government.

Figure 2: Trade balance for Canadian pork



Source: Agriculture and Agri-food Canada, 2023.

Pork production, as Figure 2 indicates is even more export dependent. The bulk of pork exports went to three main markets in 2019, Japan, the U.S., and China. Once again, the E.U. does not appear as a market for Canadian pork (Canadian Pork Council, 2020).

Canada's interests and the Codex

Given Canada's position as a food exporter, it is not surprising that Canada has sought to play an active role in Codex matters since the 1990s. A government strategy for Codex was outlined in 1998 and then updated in 2008 (Health Canada, 2008). The identified goals include enhancing Canadian influence at Codex, prioritizing Codex work that advances Canada's interests, and promoting the adoption of Codex standards as the basis of national regulations, especially among the newer state members of Codex. Ultimately all are part of ensuring that Codex standards become the basis of regulatory harmonization across states to ease market access for exports. This interest in Codex is reflected in the size and activities of Canadian delegations and in participation in working groups and committees at Codex. For many years, Canada has chaired and hosted the Codex Committee on Food Labelling (CCFL), which sets food labelling standards and regulations which can potentially limit export market access. This committee has seen a number of extended conflicts over issues like labelling of food produced using GMOs (Smythe, 2009) and, more recently, front of package food labelling. In 2013, Canada also put forward a senior official as a candidate for election as Codex Commission chair though unsuccessfully (author's observation at CAC, 2013). While there is an interdepartmental committee and consultation with relevant departments, the lead on Codex is taken by Health Canada, supported by officials from the Canadian Food Inspection Agency (CFIA).

One of the major concerns also identified in the strategy was the efficiency of Codex in developing standards. These efforts to successfully develop new standards in a timely way, encourage adoption of these standards once developed and facilitate regulatory harmonization were all challenged by major conflicts over standards and regulations regarding the use of growth promoters in meat production. A brief discussion of the nature of these follows.

Growth promoters and meat

Like the U.S. before it, Canada's meat production has relied, since the 1950s, on various types of growth promoters beginning with antibiotics followed by hormones (1960s). Table 3 provides a brief summary of the types of growth promoters used in meat production and their historical development and use.

Table 3: Growth Promoters used in Meat Production in Canada/U.S.

Type of Growth Promoter	How Administered	Impact
Hormones: Six hormonal growth promoters approved in Canada for use in beef cattle: three natural—progesterone, testosterone, and estradiol-17ß; and three synthetic—trenbolone acetate (TBA), zeranol, and melengestrol acetate (MGA) The U.S. FDA standards are similar.	Usually implants behind the ear of the animal. Ear is discarded after slaughter	Approved for use in U.S. in 1956. Widely used in the U.S., Canada, and Australia. Exogenous hormones interact with endogenous hormones in the animal increasing feed efficiency and weight gain.
Antimicrobials (Antibiotics) For a list of drugs see Allen & Stanton, 2014	In the feed	Licensed for use in the U.S. in 1948 and in wide use in North America and Europe by 1950s. Low dose regular use leads to weight gain linked to changes in the microbes in the gut of animal to breakdown carbohydrates and increase feed efficiency.
Beta Adrenergic Agonists: Ractopamine hydrochloride and zilpaterol	In the feed for animals: Given near the end point of the feeding period, i.e. close to slaughter. Common names for feed with ractopamine-Paylean (pigs, Cattle and large turkeys), Zilpaterol, called Zilmax and Intervet.	Approved in U.S. in 2003 and Canada shortly after. The drug causes redirection of energy from the feed into muscle instead of fat but is only effective for three to four weeks and then the animal's body adapts to it.

Sources: Health Canada, 2012
Beef Cattle Research Council (BCRC), 2013.

Concerns related to the use of growth promoters in meat production typically focus on two areas: 1) human health and safety, and 2) animal welfare. In the case of human health, the use of antibiotics for growth promotion has come under increased criticism. Studies of antibiotic resistance in humans and its link to the use of antibiotics in the production of chicken, beef, and pork in the early 2000s led to growing concerns in the medical community and among consumers in several countries, (Spellberg et al., 2016) and many have moved to restrict use. Following U.S. action in April 2014, Health Canada (2014) announced a three-year plan to eliminate the use of antibiotics in livestock, except to treat disease.

Hormones and beta agonists remain widely used and deemed safe by regulators in Canada and the U.S. Three synthetic and three natural hormones are approved in Canada and the U.S. for use with cattle. Beta agonists are more recent and used in Canada initially in pigs and later in cattle and turkeys. (BCRC,

2015). The first product, ractopamine hydrochloride, is produced by Elanco Animal, a division of the Eli Lilly company. Under various names such as Paylean, Optaflexx, and Topmax, ractopamine it is added to animal feed (BCRC, 2015). Its effect is to speed up the heart rate and produce heavier, leaner, more muscled animals which are more profitable to producers. However, to be effective it must be fed to animals until very shortly before slaughter (BCRC, 2015). The result is that a small amount of drug residue remains in the meat. The Maximum Residue Limits (MRLs) that are deemed safe for human consumption are regulated and, in the case of Canadian beef, vary from .09 parts per million in kidneys to .01 in muscle tissue (Health Canada, 2022). A second beta agonist, zilpaterol hydrochloride, was approved for use in cattle by the U.S. Food and Drug Administration (FDA) in 2006. Produced by Merck it has been aggressively marketed in competition to ractopamine since its approval in both the U.S. and Canada under the brand names Zilmax and Intervet (Petersen, 2015) Questions have been raised about the usage of this newest form of growth promoters in meat production, at the Codex. But to understand and follow the conflict over and attempts to influence food standards in relation to these latest growth promoting drugs, a discussion of how Codex develops standards is in order.

The Codex Alimentarius

Codex work is carried out by member state delegates serving on committees which propose food standards. States with an interest in developing a new standard (often based on their own production practices and national regulations) will work with like-minded states and various stakeholders (e.g., producer groups, corporate organizations, and other non-state actors) to propose new work to be started on a standard. If approved by the committee and the full Codex draft standards will be developed in committee. Once consensus is reached the draft is forwarded to the Codex Commission (CAC) for final approval. Different types of Codex committees deal with functional (or cross commodity) issues (such as general principles, labeling, pesticide, or drug residues), commodities (such as meat), and geographic regions. Each committee has a chair whose country hosts the committee's work and meetings, that is, fund the secretariat and pay meeting costs.

Countries with strong interests in food production and trade have an incentive to lead working groups and chair committees. For example, the U.S. has chaired and hosted the Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF)—the site of many conflicts between members over the use of growth promoters in meat production (CCRVDF, 2015, 2021). Decisions of committees and the Commission are normally made by consensus, although the rules of procedure do allow for voting (Lin, 2013). As a result of a desire to be involved in Codex, given the increased harmonization of food safety standards in the EC and the importance of Codex standards to trade disputes, the European Community on behalf of the European Union (EU) pushed for an accession agreement with Codex and became a member in 2003 (Maier, 2008). The agreement amended Codex rules of procedure and established a division of competence between the twenty-seven individual members and the Community. This determines whether they speak with one voice via the Commission or several voices. Their votes, if necessary, are counted, however, as individual members (Maier, 2008).

Despite 189 member countries, the work of the Codex is dominated by key actors with material interests in food standards, resources, and technical expertise. Non-governmental groups, such as food

processors or biotechnology companies and consumer groups, may also attend, either as formally recognized observers or as part of state delegations. Observers can speak to issues following the United Nations (UN) model of NGO representation. Historically, the United States and the E.U. have dominated the work of the Codex, often in cooperation with smaller countries. The U.S. is part of the Quad group which includes Canada, Australia, and New Zealand—all food exporters. Their delegates maintain contact and meet prior to Codex meetings to coordinate their position on issues. More recently important food producing countries in South America, Brazil, and Argentina are playing a role along with some larger Asian countries. In many debates over standards patterns are evident where, for example, the food producing states of South America side with the U.S. and the Quad countries while countries dependent on E.U. market access will often side with or support the E.U., as will Norway and Switzerland (Author's observation; Smythe, 2009).

Just as there are variations in the power of state and regional actors like the E.U. based on their resources and market size, the power and influence of non-governmental actors also varies. Industry or producer associations tend to have the resources to closely monitor Codex activities and staff to attend the numerous Codex committee meetings. In a number of cases, representatives of these associations will be heavily involved in consultations with governments prior to meetings but also be present as part of state delegations. There they have opportunities to exercise instrumental power as they provide direct input into state positions. In contrast many consumer and public health advocacy organizations have fewer resources and, even though recognized as observers, are limited in the number of meetings they can attend, the number of staff they can devote to an issue and have more limited access to state delegates.

The development of new food standards at the Codex follows an eight-step process beginning with agreement to engage in "new work." Draft standards are developed and negotiated at the committee level. If there are consensus delegates can decide to approve an accelerated path through stages five through eight (CAC, 2023) At the final stage, the standard is adopted by the Codex Commission. However, adoption is not automatic. Given the increasingly complex nature of food production and the use of technologies like growth promoters, there is a growing need to set standards for human health and safety. At the same time the proliferation of national regulations, the small size of the Codex secretariat in Rome, and disagreements among delegates means that developing a standard can take many years. The process has become even slower as a result of the linking of Codex standards to international trade rules and the WTO.

The SPSA and TBTA cover most aspects of regulations that relate to food. In keeping with trade liberalization obligations of the WTO, while their right to regulate is recognized, members must notify other members of any new or changed regulations. They must avoid discrimination against foreign products or those of a single country, employ the least trade restrictive regulations possible and, in the case of food safety, base or justify regulations only on scientific grounds and, where available, relevant international standards. The standards of the Codex are referenced in the SPSA and have served as a benchmark for both agreements (World Trade Organization [WTO], 2022)

The Codex standards then can be used by states, if they conform to them, to justify national measures to protect food safety or require specific forms of labeling. This has given more weight to Codex standards which historically were seen as guidelines relying on voluntary adoption by members (Veggeland & Borland, 2005). Deviation from standards, particularly in the direction

of being more restrictive than the Codex, could mean a trade dispute and the risk of costly trade retaliation. The coercive aspect of trade dispute threats creates a strong incentive for smaller countries to adopt Codex standards and for powerful food exporting countries and their allied industries to shape Codex standards to advance their trade or corporate interests. Those interests and differing national regulations on growth promoters in meat production have been at the heart of some of the most bitter Codex and WTO disputes. Most notable was the issue of hormones. However, more recently beta agonists have become the source of disagreement, much of it centered in the CCRVDF.

Given the weight the WTO puts on scientific evidence as the basis of any justification of regulations that might restrict trade, and the Codex's mandate of food safety, technology-intensive industrial meat production has posed challenges for scientific committees that provide advice to Codex delegates. The most important is the Joint FAO/WHO Expert Committee on Food Additives (JECFA) which Codex describes as, "an international expert scientific committee administered jointly by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO). JECFA serves as an independent scientific committee which performs risk assessments and provides advice to FAO, WHO and the member countries of both organizations" (Codex Alimentarius, Codex and science, para 5 https://www.fao.org/fao-who-codexalimentarius/about-codex/science/it/2023).

Its mandate includes evaluations of residues of veterinary drugs in food and determining safe levels. The work of JECFA is demand driven responding to requests for advice that come from the Codex. With the expansion of the use of growth promoters the workload of this body has increased.

Since the 1994 WTO agreements there has been pressure for Codex to adopt and clarify procedures and practices including specifying the role of scientific advice. There has been a debate among Codex members however, on whether "other factors" unrelated to food safety could also be considered in developing standards. A 2001 statement refers "to other legitimate factors relevant for the health protection of consumers and for the promotion of fair practices in food trade" (Codex, 2013; CODEX, 2015). Delegates are divided about how to interpret this statement. Some claim that animal welfare or consumer concerns about food safety might be legitimate other factors. Others reject them and frame these concerns as disguised protectionism and irrelevant to issues of food safety. These differences are reflected in the work of the committee that took on the task of determining standards regarding veterinary drug residues in food.

The Codex committee on residues of veterinary drugs in food

By the mid-1980s it was clear that existing committees were unable to address the increased use of growth promoters in meat and milk production. Accepting the recommendations of a consultant's report and noting that the issue was "urgent and timely" the Commission agreed to establish the CCRVDF in 1986. Terms of reference are:

a) to **determine priorities for the consideration of residues** of veterinary drugs in foods
b) to recommend **maximum levels** of such substances
c) to develop codes of practice as may be required

d) to consider methods of sampling and analysis for the determination of veterinary drug residues in foods. (Codex Alimentarius, 2023, CCRVDF webpage https://www.fao.org/fao-who-codexalimentarius/committees/committee/en/?committee=CCRVDF

The list of drugs to be assessed is based on members' submissions and agreement of the committee. From the outset certain substances generated controversy. In December 1987, maximum residue levels (MRLs) for hormones were at issue. Because of opposition from the European Commission, the Codex did not finally act on hormones until June 1995 (Bevilaqua, 2006) launching the possibility for a U.S./Canada trade challenge. In the case of the bovine somatotropin (bST) hormone used to increase milk production the battle has been even more protracted. Despite being considered by the CCRVDF in 1998 consensus eluded delegates at both the committee level and at CAC (Smythe, 2014). In an effort to find a compromise, JECFA again assessed the safety of bST in milk for human consumption in 2012. However, many delegates had concerns about the impact on animals, a concern which led Canada, despite supporting standards for bST at Codex, to ban its use in Canada. A lengthy debate on a draft MRL in 2015 produced no consensus it has remained stalled at stage eight (CAC, 2015 para 49-51).

The use of beta agonists has also come before the CCRVDF, as countries like the U.S. and Canada where the drugs have been approved and are used in meat production, pushed for them to be added to the list of drugs to be assessed and for which MRLs could be set (USDA 2012). Those countries not permitting use of growth promoters have, in the first instance, opposed adding such drugs to the list for consideration. When they were unsuccessful and drugs were assessed and a standard developed, they withheld approval of it in the final stages (CCRVDF, 2021). Both ractopamine and zilpaterol have been subjects of these disputes as outlined below. But first it is useful to better understand standards and their trade impact with a closer look at food-related trade disputes and what they reflect about notions of science.

Two major disputes between E.U. and other food exporters in relation to GMOs and growth promoters had at their heart concerns about regulations and their justification especially if they impacted food exports. In the first case the E.U. moratorium on approvals of GMO crops was justified by the need to regulate in the absence of scientific certainty. The delay, however, was seen by Canada, Argentina, and the U.S., all heavily invested in GM crops, as a *de facto* trade barrier. It violated aspects of the SPS agreement in not being based on existing science (though it was limited) and causing undue delay of approvals. The 2003 dispute was resolved in favour of the complainants in 2006. Some assumed this meant the death knell of the precautionary principle in regulation (Cheyne, 2009; Cardeira et al., 2009). Even so it did not result in increased market access as a 1997 E.U. requirement to label food produced with GMOs, consumer wariness and the reluctance of large food retailers to stock food labelled to contain GMOs limited market access. Work at the Codex CCFL to determine standards for GMO food labelling initiated in 1991 by the U.S. led to a protracted eighteen-year process at Codex (Smythe, 2009). However, the U.S. and its GMO crop exporting allies failed to stop the adoption of a standard that permitted such mandatory labelling.

In the case of hormones, E.U. producers had used them in meat production, until a series of health concerns surrounding studies linking hormones use to various forms of cancer, declining male fertility and

early onset of puberty in children were raised (Tosun, 2013). This led to a public outcry, as environmental and consumer groups organized boycotts of meat produced using hormones (Tosun, 2013). New E.U. regulations in 1981 banned their use in livestock production but allowed several exemptions. Despite a study on the safety to the public which had been established by the Commission, and its recommendations supporting those exemptions, pressure from agriculture ministers of member countries and the E.U. parliament for a ban continued. In addition, a growing meat surplus, and a desire to ensure consistent standards across E.U. countries, led to a decision to expand the ban (Tosun, 2013). Desiring to not competitively disadvantage E.U. meat producers, new regulations also banned intra-European, and import trade in hormone-treated beef in 1988 setting the stage for a trade dispute (Tosun, 2013).

The bovine spongiform encephalopathy (BSE) scandal and a widespread view among the public that the E.U. Commission had failed to protect consumers led, despite pressures of trade disputes, to further tightening of restrictions on growth promoters to include beta agonists in 1996 (Tosun, 2013) From1981 to 2008 E.U. regulations on growth promoters became stricter despite counter external pressures (Tosun, 2013). The U.S. and Canada launched a dispute against the E.U. in 1995 which was successful in their claim under the SPSA that E.U. regulations were not based on scientific evidence. WTO authorized retaliation in 1999, which remained in place for a number of years, had no impact on E.U. regulations. However, the E.U. made increasing efforts to show its regulations did have a scientific basis. Recognizing the impasse, the U.S. and Canada settled with the E.U. removing trade sanctions in return for an "increase in duty free import quotas of *hormone* [emphasis added] free beef" (Tosun, 2013, p. 61). Debate has continued over the impact of hormone residues on human health and a meta-analysis of sixty years of study noted, "it cannot be concluded that exposure to relatively high amounts of exogenous hormones is a reason for these disorders. Studies dealing with these topics showed contradictory results, and thus no general conclusion can be applied. Further endocrinological and toxicological studies using animal models and human epidemiologic studies are necessary to explain the role of exogenous hormones in human health disorders" (Snoj, 2019, p. 145).

Both the case of regulation of GMOs and the use of hormones in meat production illustrate continued conflict over the science of food safety and the role of states in managing risk. They also show the challenge of securing export market access even with an international standard that supports their production processes. This is very much the case with beta agonists. In the latter case however, animal welfare also became part of the conflict.

Power and the ractopamine Battle: A pyrrhic victory?

Though ractopamine was approved by the U.S. FDA in 1999, questions arose over the data and whether evidence of its effect on pigs had been withheld from the FDA (Pacelle, 2014). Two aspects of the drug raised concerns. The first was the extent to which the drug had harmful effects on animals by increasing stress and aggression. The second related to safety and the science of risk assessment and incomplete or competing assessments.

Clearly the U.S. and the E.U. and their allies have structural power given the size of their economies, their export markets and the depth of resources and expertise they can draw on. Other actors however, with a large and growing market for imported meat, such as China, are also important. Non-state actors have influence at

the Codex as observers or as part of state delegations. Part of that influence is based on the national economic importance of their industry in terms of employment, value of exports, and contributions to GDP. In the case of Canada for example, the association Canadian Beef claims beef production contributed $21.8 billion to Canada's GDP in 2021 (Canadian Beef, 2021). The CMC points out that red meat consumption and exports supported 288,000 jobs in 2016 (CMC, 2021). In the case of national delegations, both the U.S. and Canada have included representatives of Cattlemen's associations in their delegations. In the U.S., drug companies have also been included. This access allows for the exercise of instrumental power as industry associations and producers can lobby for their interests. The number of observers at committee meetings also reflects power distributions. Health for Animals, an organization that represents "developers and manufacturers of animal health products" (Health for Animals, 2022 About, para 2) including pharmaceuticals had a total of nineteen representatives at the most recent meeting of the CCRVDF which dealt with growth promoters (CCRVDF, 2021). Both Elanco and Merck sit on its board.

Discursive power, an ability to frame issues and the competition among different frames, may not be totally under the control however, of those with instrumental and structural power. The U.S. and Canadian state delegates and meat industry associations at the CCRVDF framed the issue of MRLs as regulating based on "sound science" and evidence, especially regarding risks to human health. Other delegates, including E.U. member states and China, questioned not the existing scientific evidence to date but framed it as incomplete. The E.U. also raised the issue of concerns among E.U. consumers about the safety of food produced with these drugs, consistently reflected in annual food safety surveys (European Food Safety Authority [EFSA], 2022). The negative impact on animal welfare was also raised as an important "other factor" that should be considered.

Work on ractopamine had been initiated within CCRVDF and advanced as a result of a JECFA review of risks to humans in 2004 and 2006. However, questions were raised about the adequacy of the scientific risk assessment in relation to residue in animal organs that may be heavily consumed in some cultures and other factors that needed to be taken into account including animal welfare. Concerns were further reinforced by a 2009 negative review of JECFA's scientific analysis by the EFSA (EFSA, 2009). Final approval of the proposed MRL remained stalled. At the 2011 CAC many Codex delegations, including Canada's, became increasingly concerned about the situation of standards like bST and ractopamine being kept in limbo at stage five for years (CAC, 2011).

The attempts of the CAC chair to find a compromise failed. While adopting standards is normally by consensus and votes are rare, a vote on whether to adopt the ractopamine MRL occurred in July 2012. The U.S., Canada, and other countries permitting the use of the drug, such as Brazil, were able to win a narrow two vote victory over the delegates from the E.U., Russia, and China and others who opposed adopting the standard (CAC, 2012). However, that does not mean countries were willing to alter domestic regulation in line with it.

The approval of the standard, provided the basis for a trade challenge at the WTO, given that the E.U. refused to alter its legislation and would not adopt the Codex standard. China also made its opposition clear, as did Russia, and a number of other members. Given that the E.U. and China accounted for 70 per cent of world pork consumption there would be a trade impact. A trade challenge, however, did not emerge. The experience of the hormone dispute suggested that

even though a trade challenge could be made, and "won" against the E.U. this would not result in increased market access. In fact, in Canada, the United States, and several other meat exporters a parallel process of certified hormone free meat production destined for the E.U. market was created. A similar program was developed for ractopamine. Canadian pork producers also felt the pressure to go ractopamine-free to maintain access to markets in Russia and China. Up until recent sanctions against Russia Canadian exporters had to provide a veterinary certificate and an official guarantee from the CFIA to verify meat was ractopamine-free. The Canadian Ractopamine-Free Pork Certification Program, (Canadian Food Inspection Agency [CFIA], 2022) was developed and covers feed mills and producers and slaughter facilities (CFIA, 2022, para 1.1)

In hope of maintaining access to markets, most hog producers in western Canada have abandoned using ractopamine despite supporting Canada and the U.S. in the fight to get approval for MRLs for ractopamine at the Codex in 2012. Brazil also subsequently banned its use in order to maintain access to important export markets. As with hormones, the use of beta agonists in meat production necessitated further certification processes required to obtain an import license and qualify under E.U. quotas and various tariff rates. Even the Canada-E.U. Comprehensive Economic and Trade Agreement (CETA) implemented in 2017 did not significantly increase access for Canadian beef and pork to the E.U. unless it is certified as free of growth promoters (National Farmers Union [NFU], 2013).

Zilmax

As with ractopamine, approval in the U.S. of the use of zilpaterol and its market penetration among livestock producers necessitated an international standard for the MRL to ensure market access for meat produced using it. The U.S. proposal to add zilpaterol to the priority list of drugs for JECFA evaluation was controversial. The CCRVDF report in 2012 (CCRVDF, 2012) noted different views expressed by members, in particular, strong objections from the E.U. for inclusion of zilpaterol in the Priority List of Veterinary Drugs for JECFA evaluation. The addition of the drug was defended by the U.S., Brazil, and Canada. The U.S. argued that the drug met all criteria in the Codex Procedural Manual for placement on the priority list. Opponents argued it would face the same fate as ractopamine, which by 2012 had been stuck at stage eight of the process for years. The E.U. delegate stated that the reasons for objections were not based on science, but rather on domestic legislation, consumer preferences, and trade. Other countries added concern for animal welfare. Opponents pointed out that a consensus on a standard was highly unlikely and thus authorizing JECFA to review it and make recommendations would be a waste of its time and resources. The Committee's report noted that there had been no consensus on the inclusion of zilpaterol in the Priority List and referred the issue in March 2012 to the CAC meeting. The U.S. challenged the opposition to adding it to the list as a violation of Codex procedures leading the Commission Chair to seek a legal opinion. This resulted in zilpaterol being placed on the priority list for evaluation by JECFA. Further discussions on zilpaterol at the CCRVDF in 2015 were acrimonious (CCRVDF, 2015b). The chair of CCRVDF noted the impact of dealing with the drugs on the committee, "The experience in adopting the MRLs for ractopamine at the Commission was extraordinarily discordant. These challenges have strained our ability to work effectively as a committee. This impact has a direct and serious impact on the future ability of

CCRVDF to be able to address equally controversial matters" CCRVDF (2015a p1.).

In the case of zilpaterol a larger challenge emerged around animal welfare and the quality of the meat produced which raised concerns among meat processors and the major buyers of cattle in the U.S. In 2013 its commercial version Zilmax was linked to animal well-being at a U.S. National Cattlemen's Beef Association meeting where cases of cattle that had difficulty walking or were unable to move were described. Citing animal handling specialist Temple Grandin's concerns on August 7 Tyson Foods, with 26 percent of the U.S. beef market, suspended purchases of cattle fed Zilmax, based not on food safety but on animal welfare. Merck, the manufacturer of Zilmax announced an extensive audit of the use of Zilmax and suspended sales in the U.S. and Canada. Other processors, such as Cargill, welcomed the decision and cited a "series of extensive beef tenderness tests that created concern about potential impact to product quality" (Cargill, 2013, para 2). In November 2014 Merck returned Zilmax (with FDA approval) to the market after making adjustments to the recommended dosage. In Canada it was back on the market under new regulations. At the same time Canada had developed a beta agonist free certification program for Canadian beef necessitated again to access some export markets.

At the 2021 July virtual meeting of the CCRVDF consensus on advancing the MRLs beyond stage four again eluded the committee. Delegates favoring rapid advancement (to stage five through eight) included Canada, the U.S., Mexico, and a number of South American countries and several industry observers. E.U. members continued opposition. Efforts to agree on a compromise to advance the MRLs to stage five also failed. Thus, the MRLs remained at stage four even though the committee had accepted that "there are no public health concerns regarding the proposed MRLs and supported the JECFA scientific evaluations while recognizing that some members disagreed" (CAC, 2021, para 15). The Chair then requested that the Codex Executive Committee recommend a way forward. Their recommendation to advance the MRLs to stage five met with opposition. Concerns were raised again about the scientific evidence and its adequacy in terms of which edible tissues (liver, muscle, kidney) were tested. Some delegates argued that other tissue needed to be tested because of differences in which parts of the animal are consumed. Others questioned whether additive and cumulative effects were taken into account. Opponents challenged the use of growth promoters over all in meat production, noting national bans on use and animal welfare and consumer concerns as relevant "other factors"(CAC, 2021 para 15-19). Further efforts to find consensus failed and the issue was addressed again in the CAC meeting in November 2022 with a proviso "to ensure that all tools, including voting, are at the disposal of CAC45 to allow resolution of this issue."(CAC, 2022, p. 5) At its first face to face meeting since Covid in November 2022, after rancorous debate, CAC members voted to adopt the MRLs at stage five but in a second vote rejected a proposal to advance to stage eight, thus slowing the adoption of the MRL and ensuring further debate over the issue.

Conclusion

These case studies of the struggle to create international standards at the Codex on the use of beta agonist drugs in meat production have, like many of the conflicts around food production and trade, reflected the material interests of various actors. States, corporations, and producers try to secure market access for their products by limiting or harmonizing national regulations that might form barriers. At the heart of these conflicts is the tension between food safety regulation and trade protectionism, and the varying views about how that distinction is made, especially where the science, which in trade agreements is to be the basis of regulation, is uncertain, incomplete, or contested. Or where other issues beyond human health are concerned.

The struggles reflect the power and influence of various actors at the national and international level. Various forms of power and influence, especially structural and instrumental, provide opportunities for large state actors and key actors in the industrial production of meat opportunities for influence, especially at the national level in countries like the U.S., Canada, and others who are wedded to the industrial meat production model. However, there has been strong resistance to the adoption of these standards at Codex. Progress to gain acceptance of the use of ractopamine and zilpaterol and define safe MRLs has been slow. Even when adopted, they have been rejected by many states that refused to alter national regulations in line with the standard. This has led to industrial meat products from Canada and the U.S. being barred from major markets. Canada's position at the Codex supporting the use of beta agonists in meat production and the development of an MRL reflect its interest as a meat exporter long committed to the U.S. developed industrial model of meat production—a model largely supported and influenced by meat producers, processors, and drug companies. At the Codex Canada has sought to frame the issue as one of sound science reflected in JECFA risk assessments and to reject any other basis for standards. But the strength of opposition of the E.U. and large economies like China, despite the potential to launch trade disputes, forced both the U.S. and Canada to create a parallel growth promoter free certified system of meat production in order to access these markets.

Part of that opposition and its strength is linked to discursive power that actors can draw on. Opponents have challenged the frame of sound science, not necessarily by questioning JECFA's work *per se,* but by claiming it is incomplete or limited in scope in terms of the risk assessment. They also continued to raise issues of animal welfare and what the limits of existing scientific evidence are reflected in the publication of a report commissioned by the European Food Standards Agency in 2016 which concluded, "The number of studies investigating the impact of zilpaterol as a feed additive on animal health and welfare is limited. These limited studies indicate a potential increase in mortality, heart rate, respiration rate and agonistic behaviour in cattle, but do not enable one to conclude that the observed effects are directly linked to the administration of zilpaterol at the recommended use level in cattle" (EFSA et al., 2016, p. 14).

As the comments of the E.U. after the November 2022 CAC meeting indicated opposition to the use of growth promoters is based on a range of concerns, "The E.U. opposition to growth promoters is based on concerns about the health and welfare of animals, consumer preferences, and moral and socioeconomic concerns about the sustainability of farming practices that employ growth promoters. The One Health

approach also recognizes the interlinkages between these different aspects and the health of consumers" (CAC, 2022 Appendix 9 para 1).

The issue of food safety is not directly raised in the comments of the E.U however, the reference to consumer preferences is reflected in surveys undertaken regularly by the European Food Standards Agency (EFSA, 2022). They indicate high levels of public concern around pesticide residue and residues from growth promoters. Climate change, covid and the issue of zoonotic diseases has also reinforced an awareness reflected in the One Health approach of the WHO of the interconnectedness of humans, animals, and the environment in terms of food and health.

Conflicts over trade and meat production will continue. Ironically despite leaving the E.U., the U.K. has sought to retain E.U food safety standards and regulations as it seeks new trade agreements with the U.S. (Savage, 2020) and to join The Comprehensive and Progressive Agreement for Trans-Pacific Partnership. In both cases the U.S. and Canada have pushed for regulations allowing import of meats produced using growth promoters which has alarmed some U.K. consumers and producers. Although a Codex standard now exists for ractopamine *t*hese case studies suggest that there may be limits to globalizing the industrial meat model as we see it in North America and that the discursive frames that focus on food safety, animal welfare, and environmental sustainability have been influential in opposing them.

Acknowledgements: The author would like to thank reviewers for this article for their helpful suggestions for revision, Concordia University of Edmonton for several internal research grants which supported this research and Kinley Dyce for research assistance.

Elizabeth Smythe is an emeritus professor of political science at Concordia University of Edmonton where she taught international relations, comparative politics and Canadian public policy. Her research interests include international trade and investment agreements and international negotiations over food standards. Her publications include *Food for Thought: How trade agreements impact the prospects of a national food policy* (2018), *Canadian Food Studies* 5:3, 76-99.

References

Agriculture and Agri-Food Canada. (2022). *Canada's red meat and livestock industry at a glance*. Government of Canada. https://agriculture.canada.ca/en/sector/animal-industry/red-meat-livestock-market-information/industry-profile

Agriculture and Agri-food Canada. (2023). *Red meat trade reports.* Government of Canada. https://agriculture.canada.ca/en/sector/animal-industry/red-meat-and-livestock-market-information/trade
Allen, H. K., & Stanton, T. B. (2014). Altered egos: Antibiotic effects on food animal microbiomes. *Annual Review of Microbiology, 68*, 297-315.https://doi.org/10.1146/annurev-micro-091213-113052

Asare, F. K. (2022). *Effects of trade disputes on Canadian agri-food trade* [Unpublished master's thesis]. University of Guelph.

Beef Cattle Research Council (BCRC). (2013). *Explaining growth promotants used in feedlot cattle.* https://www.beefresearch.ca/blog/growth-promotants/
Beef Cattle Research Council (BCRC). (2015). *Hormone and other growth promotants in beef production*. https://www.beefresearch.ca/topics/hormones-other-growth-promotants-in-beef-production/

Bevilaqua, D. (2006) The Codex Alimentarius and its Influence on European and National Food Policy, *European Food and Feed Law Review* 1, 1-

Canadian Beef. (2021). *Canadian beef industry fast facts 2021.* https://canadabeef.ca/wp-content/uploads/2021/09/Canada-Beef-Fast-Fact-Sheet-2021.pdf

Canadian Food Inspection Agency (CFIA). (2022). *Annex T: Canadian ractopamine-free pork certification program (CRFPCP)*. Government of Canada. https://inspection.canada.ca/exporting-food-plants-or-animals/food-exports/food-specific-export-requirements/meat/crfpcp/eng/1434119937443/1434120400252

Canadian Meat Council (CMC). (2021). *Fact and figures*. https://cmc-cvc.com/industry/facts-figures/
Canadian Pork Council. (2020). *Foreign trade.* https://www.cpc-ccp.com/foreign-trade

Candeira, A. L., Cañellas, Recuerda, M. Á., García, E. A., Botija, F. G., Peralta, P. D., Ghisleri, L. R., Martínez-Larrañaga, M. R., & Anadón, A. (2009). GMOs and resolution of conflicts under the WTO. *European Food and Feed Law Review*, *4*, 82-294.

Cargill. (2013, February). *Cargill's view on Zilmax being pulled from the market.*http://www.cargill.com/news/cargill-view-on-zilmax-being-pulled-from-the-market/index.jsp
Cheyne, I. (2009). Precaution and international trade in food and other agricultural products. *European Food and Feed Law Review, 4*(1), 47-57.

Clapp, J & Fuchs, D Agrifood Corporations, Global Governance, and Sustainability: A Framework for Analysis, in J. Clapp & D. Fuchs (Eds.), *Corporate Power in Global Agrifood Governance,* (pp. 1-26). Cambridge, MA: MIT Press.

Clapp, J. (2016). *Food* (2nd ed.). Polity Press.
Codex Alimentarius (2022). *Codex committee on residues of veterinary drugs in foods (CCRVDF).* https://www.fao.org/fao-who-codexalimentarius/committees/committee/en/?committee=CCRVDF

Codex Alimentarius. (2023). *Home.* https://www.fao.org/fao-who-codexalimentarius/en/

Codex Alimentarius Commission (CAC). (2011). *Delegate's report of the 65th session of the codex executive committee and 34th session of the codex alimentarius commission. United States Department of Agriculture*. https://www.usda.gov/sites/default/files/documents/delegate-report-06282011.pdf

Codex Alimentarius Commission (CAC). (2021). *Codex alimentarius commission 44th session.* https://food.ec.europa.eu/system/files/2021-12/codex_cac_44_cl_2021-80e.pdf

Codex Alimentarius Commission (CAC). (2022). *Joint FAO/WHO food standards programme codex alimentarius commission, forty-fifth Session.* https://www.fao.org/fao-who-codexalimentarius/sh proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-701-45%252FFinal%2BReport%2BCAC45%252FCompiled%2BREP22_CAC.pdf

Codex Alimenatrius Commission (2023) *Procedural Manual* 28ed. Rome

Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF) (2015a). Discussion paper regarding the issues and concerns that impact the ability of the CCRVDF to efficiently perform its work (prepared by the committee chair)

Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF). (2015b). *Report of the twenty second session of the codex committee on residues of veterinary drugs in foods.* https://www.fao.org/fao-who-codexalimentarius/committees/committee/related-meetings/en/?committee=CCRVDF

Codex Committee on Residues of Veterinary Drugs in Food (CCRVDF) (2021) *Proposed Draft MRLs for Zilpaterol Hydrochloride,* February.

De Ville, F., & Siles-Brugge, G. (2015). *TTIP: The truth about the transatlantic trade and investment partnership*. Polity Press.

European Food Safety Authority (EFSA). (2009). Scientific opinion: Safety evaluation of ractopamine. Scientific opinion

of the panel on additives and products or substances used in animal feed. *The EFSA Journal 1041*, 1-52. https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/j.efsa.2009.1041

European Food Safety Authority (EFSA), Arcella, D., Baert, K., Binaglia, M., Gervelmeyer, A., Lorenzo Innocenti, M., Ribo, O., Steinkellner, H., & Verhagen, H. (2016). Review of proposed MRLs, safety evaluation of products obtained from animals treated with zilpaterol and evaluation of the effects of zilpaterol on animal health and welfare. *The EFSA Journal*, *14*(9), 4579. 10.2903/j.efsa.2016.4579

European Food Safety Authority (EFSA). (2022). *Food safety in the EU: Eurobarometer report.* https://www.efsa.europa.eu/sites/default/files/2022-09/EB97.2-food-safety-in-the-EU_report.pdf

Fitzgerald, A.J. (2015). *Animals as food: (Re)connection production, processes, consumption, and impact*. Michigan State University Press.

Health Canada. (2008). *Canada's strategic framework for participation in the joint FAO/WHO food standards program.* Government of Canada. https://www.canada.ca/en/health-canada/services/food-nutrition/international-activities/codex-alimentarius/activities/canada-strategic-framework-participation-joint-who-food-standards-program.html

Hannan, J. (2020). "Introduction" in *Meatsplaining: The Animal Agriculture Industry and the Rhetoric of Denial*. J. Hannan (Ed.) (pp. 1-30). Sydney, AUS: University of Sydney Press.

Health Canada. (2012). *Questions and answers – hormonal growth promoters.* Government of Canada. https://www.canada.ca/en/health-canada/services/drugs-health-products/veterinary-drugs/factsheets-faq/hormonal-growth-promoters.html

Health Canada. (2014, April). *Notice to stakeholders: Collaborative efforts to promote the judicious use of medically-important antimicrobial drugs in food animal production*. Government of Canada. http://www.hc-sc.gc.ca/dhp-mps/vet/antimicrob/amr-notice-ram-avis-20140410-eng.php

Health Canada. (2022, August). *List of maximum residue limits for veterinary drugs in food.* Government of Canada. https://www.canada.ca/en/health-canada/services/drugs-health-products/veterinary-drugs/maximum-residue-limits-mrls/list-maximum-residue-limits-mrls-veterinary-drugs-foods.html

Health for Animals. (2022). *About.* https://www.healthforanimals.org/

Kirchelle, C. (2018). Pharming animals: A global history of antibiotics in food production 1935-2017. Palgrave Communications, 4(1), 96. https://dx.doi.org/10.1057/s41599-018-0152-2

Lin, C. (2013). Scientification of politics or politicization of science: Reassessing the limits of international food safety lawmaking. *The Columbia Science & Technology Law Review XV, Forthcoming,* 1-40. https://doi.org/10.2139/ssrn.2227539

Maier, M. (2008, April 24-26). *The regulatory state goes global EU participation in international food standards-setting at the Codex Alimentarius*. The European Union in International Affairs, Institute for European Studies, Vrije Universiteit Brussel.

McCrae, R. (2022). *Food policy for Canada: Corporate concentration.* York University. https://foodpolicyforcanada.info.yorku.ca/backgrounder/problems/corporate-concentration/#:~:text=The%20CR4%20ration%20in%20hog,of%20fast%20food%20beef%20sales.

National Farmers Union (NFU). (2013). Fact Sheet: Will *CETA* Help Family Farmers in Canada Feb 26 https://www.nfu.ca/publications/fact-sheet-will-ceta-help-family-farmers-in-canada/

Pacelle, W. (2014). *Banned in 160 Nations: Why is ractopamine in U.S. pork?* Live Science**.** https://www.livescience.com/47032-time-for-us-to-ban-ractopamine.html

Petersen, M. (2012) As Beef Cattle Become Behemoths, Who Are Animal Scientists Serving? *Chronicle of Higher Education* April 15.

Savage, M. (2020). Cabinet unrest over U-turn on animal welfare. *The Guardian.* https://www.theguardian.com/politics/2020/jun/06/uk-accused-u-turn-animal-welfare-us-trade-talks

Shaffer, E. (2013) Smithfield Moves to Phase out Ractopamine Use. *Meat + Poultry.* May 15. https://www.meatpoultry.com/articles/8116-smithfield-moves-to-phase-out-ractopamine-usehttps://www.meatpoultry.com/articles/8116-smithfield-moves-to-phase-out-ractopamine-use

Smythe, E. (2009). In whose interests? Transparency and accountability in the global governance of food: Agri-business, the Codex Alimentarius, and the World Trade Organization. In J. Clapp & D. Fuchs (Eds.), *Corporate power in global agrifood governance* (pp 93-124). MIT Press.

Smythe, E. (2014, May 27). *Better beef? Free trade and Canadian industrial meat production*. Annual Meeting of the Canadian Association of Food Studies, Brock University, St. Catharines.

Snoj, T. (2019). Hormones in food as a potential risk for human reproductive and health disorders. *Acta Veterinaria-Beograd, 69*(2), 137-152. https://doi.org/10.2478/acve-2019-0011

Spellberg, B., Hansen, G., Kar, A., Cordova, C., Price, L., & Johnson, J. R. (2016). *Antibiotic resistance in humans and animals*. National Academy of Medicine. https://nam.edu/antibiotic-resistance-in-humans-and-animals/

Tosun, J. (2013). *Risk regulation in Europe: Assessing the application of the precautionary principle.* Springer.

US Department of Agriculture. (2012). *Report of the U.S. Delegate, Codex Committee on Residues of Veterinary Drugs in Foods, 20th Session* https://www.usda.gov/sites/default/files/documents/delegate-report-05072012.pdf

US Department of Agriculture (2021). *Report of the U.S. delegate, 25th session, codex committee on residues of veterinary drugs in foods.* https://www.usda.gov/sites/default/files/documents/delegates-report-2021-ccrvdf.pdf

Veggeland, F., & Borland, S.O. (2005). Negotiating International Food Standards: The World Trade Organization's Impact on the Codex Alimentarius Commission. *Governance, 18*(4), 675-70. https://doi.org/10.1111/j.1468-0491.2005.00297.x

World Trade Organization (WTO). (2022). *The WTO agreement on the application of sanitary and phytosanitary measures (SPS Agreement).* https://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm