

---

---

# **The Animal Industry in a Changing Society - How Must We Adapt?**

John Webb

Maple Leaf Foods Inc., 30 St Clair Avenue West, Toronto, ON, M4V 3A2

---

---

## **Abstract**

In this digital age consumers are much more aware of key issues in agriculture, sustainability, food and health. Eating patterns are moving away from family meals towards a need for speed and convenience. Shifting demographics means an aging population with greater ethnic diversity in origins and tastes. Biofuels, water shortage and designer bacteria threaten the pattern of livestock farming. Our animals are becoming just one small part of a vast and complex food industry. Producers must respond through *innovation* based on an understanding of consumer needs. Prime targets will be alternative feedstuffs, effluent management, processing, packaging and consumers' kitchens. Clear messages must go back to the consumer that meat is healthy and is produced with due regard for the animals and the environment. The value chain must work in unison to embrace new technology, and ensure clear research priorities for science that will underwrite the competitive position of the industry.

## **Introduction**

The last 50 years have seen outstanding success in the technology of livestock production. Advances in nutrition, genetics and health have resulted in large improvements in growth rate, feed efficiency, yield, and animal welfare. Meat is wholesome, nutritious and cheap. But the reality is that our everyday care of livestock goes largely unnoticed, and our misfortunes are very public. Farming is no longer at the root of society, and meat no longer a focal point of family life. Livestock have become just one small part of a complex food industry. So how are consumers changing, how can we provide what they need, and how can we use our farming heritage to make them feel good about meat? From a food industry perspective, here is a look at some of the changes, and how we might respond.

## **Eating Habits**

Rigid family meal times are being replaced by snacking, 'grazing' and eating on-the-run.. For the under-45's, meals are less likely to consist of the traditional meat and two vegetables. Some 55% of households now have only one or two persons. Eating out at restaurants or "fast-food" continues to increase. By 2017 some 22% of Canadians will be visible ethnic minorities, mainly Asian.

The industry needs to provide convenience. Food must be quick and easy to prepare. It can be ready to eat, ready to heat, or ready to BBQ. There must be mini-meals for grazing, and food on-the-go for snacking. Portion sizes need to range widely from full meal to snack.

## **Diet and Health**

In Canada some 35% of the population are overweight and 24% are obese. For children under 17 years, 18% are overweight and 8% are obese. Two million Canadians or 1 in 16 have been diagnosed with diabetes, with the incidence projected to grow at 6% per year. Cardiovascular disease is now the number one cause of death. The current preoccupation with sodium reduction needs to be accompanied by a program of weight control.

Industry must provide the consumer with healthy choices for controlling both energy intake and food composition. Portion sizes may need to be reduced, requiring a lower slaughter weight or a smaller genotype. Lean meat and omega-3 are seen as hugely positive, along with whole grains, high fibre, pre/probiotics, beta-glucans and anti-oxidants. Every opportunity must be taken to reduce sodium, nitrites, fat, gluten and preservatives.

## **Healthy Aging**

Some 14% of Canadians are over 65 years of age and this proportion is increasing. Without healthy food, the bill for medical care can be expected to sky-rocket. As people get older, a key limiting factor for nutritional health is the ability to consume sufficient protein. This is often compounded by swallowing difficulties, and fading ability to appreciate taste. Mobility and mental acuity may can limit the ability to prepare meals.

Meat is an ideal source of protein, providing all eight of the essential amino acids. The challenge is always to present it in the right form. A meat sandwich can deliver an ideal balance of protein and carbohydrate, but it must be small, tasty, and easy to swallow. A very soft sausage is also ideal, but it does not need to be in the form of a large wiener that is difficult to cut or bite – it could be in the form of bite-size portions that are ready to heat. Packaging must be easy to open and store in the fridge.

## **Processed Meat**

A 2007 report from the World Cancer Research Fund linked processed meat to colorectal cancer (WCRF, [www.dietandcancerreport.org](http://www.dietandcancerreport.org)). A more recent study suggested that processed meat significantly increased the risk of cardiovascular disease (Micha et al., 2010). These meta-analyses combining published studies are very open to confounding of meat intake with lifestyle. For example, a recent re-analysis of studies on colorectal cancer suggested that the cancer risk from eating processed meat is much smaller than previously suggested (Alexander et al., 2010).

The animal industry must be quick to engage experts to defend itself against conclusions based on questionable science. Confounding can arise when people with very high meat intake have a generally more unhealthy lifestyle, possibly involving more fatty foods, greater alcohol intake, less fruit and vegetables, and less exercise. The message must be that meat, processed or not, is perfectly healthy as part of healthy lifestyle including plenty of exercise and fruit and vegetables.

## **Food Safety**

A series of recent recalls including the 2008 Maple Leaf Foods listeriosis tragedy has raised awareness of the critical importance of microbiological safety in large-scale operations. The meat industry is vigorously responding by every possible means. For *Listeria monocytogenes*, addition of lactate/diacetate can prevent growth in ready-to-eat meat, and is now approved in Canada.

The industry must be seen to continue to develop its culture of food safety. Scientific understanding of the organisms needs to be increased in order to pro-actively mitigate the risks. The question arises for example of whether *Listeria* is becoming more adept at persisting in the meat plant environment. It can form polymer sheet biofilms that are difficult to detect and remove. New technology is badly needed to kill the bacteria after the meat is sealed in the package. Irradiation is deemed unacceptable, and high pressure treatment though successful is expensive.

## **Allergies**

The prevalence of food allergies in Canada is now running at 3%, with some 1.7% of children and 0.7% of adults showing peanut allergy. Perhaps not too surprisingly, latest research suggests that eating minute quantities of peanuts can actually induce tolerance and reverse the allergy. Fortunately, most of the allergies so far are to tree nuts, shellfish and gluten, leaving meat relatively unaffected. However, there are allergies to chicken meat, and egg allergens can contaminate poultry meat during processing.

Since allergies are caused by protein, the livestock industry must be watchful for new allergies, and aware of the regulatory environment. Modern assays can detect parts per billion of allergens. Labelling regulations may dictate “may contain” allergen statements for very small amounts. Research is needed on how tolerance is induced and undermined, and on the concept of threshold doses needed to trigger a reaction. Many people can tolerate low concentrations of an allergen, which might even be beneficial.

## **Zoonoses**

Livestock are sometimes seen as a reservoir of infection for humans. Thus the recent ‘triple reassortment’ H1N1 influenza containing recombinant DNA from strains found in pigs, poultry and humans was automatically (and misguidedly) dubbed “swine flu”. In this case transmission appeared to occur in both directions: human to pig and vice versa. Some diseases present in animals are also ubiquitous in the environment. Good examples are MRSA (Methicilin Resistant *S. aureus*) and *L. mono*, which both cause serious disease in the immune compromised.

Clearly education is required that elimination of say *L. mono* from farm animals does not eliminate the food safety risk, since contamination occurs from the environment in the interval between cooking and packaging. For direct transmission like flu or MRSA, education and good practice will prevent farm workers from acting as vectors to family and friends who are immune

compromised. The balance here is to let it be known that the animal industry is acting responsibly without causing alarm.

### **Spongiform Encephalopathies**

This is the family of prion protein diseases in humans and animals that are fatal and untreatable. They include BSE, Scrapie, Creutzfeldt-Jakob and Chronic Wasting Disease. These misfolded proteins can arise spontaneously, and then be transmitted through ingested central nervous system tissue. This is possibly one of the most alarming conditions of our time, since it is poorly understood, can replicate the condition in normal proteins, is unlike any other “pathogen”, and is difficult or impossible to eradicate.

Research is urgently needed to understand and control this condition, in case for example there should be new more vigorous prion variants, or an increase in spontaneous occurrence. The apparent relationship with neurodegenerative disorders such as Alzheimers in humans should help increase the scale of research. Recognizing market sensitivities, the animal industry needs a test with which to ascertain prevalence, enable elimination, and provide evidence of freedom. An ideal solution might be a “vaccine” that would provide antibodies against the misfolded forms of prion.

### **Antibiotic Resistance**

Livestock producers are sometimes blamed for creating antibiotic resistance in humans. Whilst there is no question that resistant organisms are selected by the use of veterinary antimicrobials, scientific opinion on the consequences is divided. One point of view is that resistant organisms such as *Salmonella* are indeed transmitted to humans, and even that the animals provide a fertile haven for new recombinants as in flu (Nolbak, 2004). The counterview is that resistant bacterial infections in humans are rarely food-borne, and are therefore not acquired from livestock (Wassenaar, 2005).

Short term, a certain amount of education of the public may be of value. Longer term, it is naïve to think that the need for therapeutic antibiotics can be eliminated altogether. Alternatives to antibiotics are needed, and bioactive peptides might be the answer, both as antimicrobials and as growth promoters. With the help of the new generation of genetic markers, breeding programs can look for ways to improve immune responsiveness. The feed industry is already addressing ingredients that promote immunity.

### **Animal Welfare**

Like it or not, the media and lobby groups continue to direct attention to modern farming methods. Books such as “The Omnivore’s Dilemma” (Pollan, 2006) and TV programs such as “Food Inc” (Director Robert Kenner, 2008) present a negative face of the livestock industry. Sow stalls in UK were outlawed as the results of a private member’s bill in parliament, while castration and farrowing crates are coming under scrutiny.

Industry must address the public relations aspects of welfare on the grounds that perception is reality. The international livestock community must ensure that research is available so that regulatory decisions are fact-based. With the benefit of hindsight, every effort must be made to prevent any descent into the “commodity trap” of low margins so that husbandry can be optimized from the animal’s viewpoint. Thus pricing might be viewed as a key to high standards in the industry.

## **Sustainability**

The key issues are water and energy, along with N and P pollution. Grain-fed beef production in the USA requires 100,000 litres of water per kg food, and broiler chickens 3,500 litres. Compare that to soybeans at 2,000 litres per kg and potatoes at 500 litres (Pimentel et al., 1997). It is much more efficient to eat plant material directly than put it through animals. As hydrocarbons are used up, so carbohydrates are being grown to capture and store the sun’s energy. But these take up land and water that could grow food for animals and people. Consumers increasingly feel a responsibility to “do the right thing” for the environment – bringing their own bags, and eating locally (*locovores*) to save food miles. In the quest for freshness and convenience, the food industry produces a huge volume of packaging, much of which is still not either recyclable or biodegradable.

Here it is important to separate the issues that are short versus long term. Short-term, reducing the amount of packaging per kg food must be a high priority, along with recyclability and biodegradability. Livestock products already have the huge advantage that they can be produced locally year-round. Longer-term, the animal industry must encourage research on crops that can thrive on less water in arid areas, and in a wider range of temperatures and soils. The search for alternative feed sources such as pulses and potatoes must continue.

## **Global Warming**

“Global warming, climate change, greenhouse gas emissions” ... these are constantly in the news. Animals are cited as a significant source. For example a cow emits 100 to 500 litres of methane per day, produced by bacteria in the rumen.

The historic announcement earlier this year of the first “man-made” bacteria using artificial DNA (Venter, 2010) offers the possibility of designer bacteria that can capture CO<sub>2</sub>, methane and other gases from the atmosphere and turn them into ideal carbohydrates and proteins for animal feeding. These feed ingredients could be produced locally, perhaps even on the farm, without wasteful transport. For ruminants, designer bacteria could be introduced into the rumen that would prevent formation of the greenhouse gases at source.

## **Genetic Manipulation**

It is a large step from GM plants to genetically altered animals. Canada’s “Enviropig” is a classic example of what is possible using this technology (Forsberg et al., 2003). Here a gene construct consisting of a phytase gene from *E.coli* and a promoter gene from a mouse has been introduced into the pig. Expression of this gene is targeted to the salivary gland, so that

phosphates are broken down and emissions into the environment reduced. GM livestock are not banned in Canada – they can be approved on a case by case basis. As yet none is approved.

In the long-term, GM technology could be very useful for example to utilize novel feedstuffs, improve human health properties of meat, or immune responsiveness of the livestock. Current thinking in the Canadian food industry is that the public is not ready for GM meat. This could change quickly in the event of a health benefit for consumers, for example in reducing the risk of heart disease or diabetes. In licensing GM products in Canada, very careful consideration will need to be given not only to safety but to international trade in countries where GM is not approved.

## **Cloning**

Cloning is the production of identical copies of an individual animal. It involves extraction of DNA from a somatic cell, and micro-injection of that DNA into the nucleus of a fertilized egg from which its own DNA has been removed – a process known as *nuclear transfer*. The transferred DNA must first be returned from its differentiated state into its embryonic or *pluripotent* state. It is not GM in the sense that the DNA sequence is unaltered, but gene expression has to be changed in order to switch all the genes back on. This appears to have led to lower viability and shorter life-span for some clones.

Cloning of market hogs for example would be prohibitively expensive. Cloning of the very best boars at nucleus level can increase rates of genetic improvement, but will also raise inbreeding levels leading to a loss of genetic variation. Cloning of terminal sires can increase genetic merit, but contrary to popular belief will only reduce variation in the slaughter generation by 6-10%. As yet cloned meat is not approved in Canada. Health Canada is conducting a risk analysis of the science, and also examining international trade implications of cloned meat.

## **Genomics**

*Single nucleotide polymorphisms* (SNPs) provide a very large number of genetic markers. They are digital in that there is naturally occurring variation in a single unit of the DNA code, such that for example AACT becomes AAGT. These SNPs act as markers for the presence or absence of useful genes. As many as 500,000 SNPs can now be placed on a single chip. The SNPs can greatly increase the genetic variation available for selection in traits that are difficult to measure such as milk yield or meat quality.

The dairy industry in Canada has been quick to exploit this technology in its progeny testing program, with SNP chips involving several thousand SNPs following studies at Genome Alberta (Strauss, 2010). The pig industry is collecting DNA samples across a wide population with a view to tackling traits such as meat quality and immune function. Genomics provides an opportunity for the Canadian industry to *differentiate* on consumer traits such as fatty acid and amino acid profiles, as well as animal health and welfare traits such as physical soundness.

## **Trans Fats**

There is a misguided view that trans fats from meat are more harmful than those from hydrogenated vegetable oil? In cattle trans fats are produced by fermentation in the rumen. Based on scientific opinion to date, it appears there is no difference between animal and industrial trans in elevating cholesterol (Pfeuffer and Schrezenmeir, 2006).

The industry should ensure that the public is aware of the low proportion of trans fats consumed from meat. In fact pork is free from trans fats. While there is a move to regulate industrial trans fat, elimination of animal trans fat is not considered worthwhile due its presence in dairy products and the very small amount consumed. Fatty acid composition can be changed by both genetics and nutrition.

## **Omega-3**

Omega-3 fatty acids promote cardiovascular health. Flax has a very high concentration of alpha-linolenic acid (C18:3 *n*-3), which is believed to prevent or even reverse atherosclerosis – blockage of the arteries. There are also claims that alpha-linolenic acid can improve brain health and slow down the progress of neurodegenerative disorders such as Alzheimers. The human body cannot synthesize C18:3, but once present it can synthesize these into longer chain fatty acids such as EPA and DHA that are believed to be good for health.

Omega-3 eggs are well established. Given that fish, especially salmon, and flax are rich in Omega-3, delivery via meat may not be a priority. It is reasonably easy to create fatter and/or heavily marbled omega-3 pork by changing the fatty acid composition of the diet. Longterm genetics offers a real opportunity for shifting fatty acid profile. For leaner cuts, the challenge is that omega-3 is present in the fat rather than muscle. Various proprietary solutions to create water-soluble omega-3 are being developed, for example in micro-encapsulated form for orange juice.

## **How Must We Adapt?**

**Understand the Customer** The first step is to understand the changes in society. Who is the customer and what will delight them? For the individual business, what are the opportunities, and what is our approach to risk? Is the business a primary risk-taker, an early adopter, or a fast-follower? Big picture, the industry needs to provide great-tasting and safe food that is healthy, easy to prepare, and with the proviso that it is good for the environment, and that the animals are well cared for.

**Innovate** Easy to say and much more difficult to bring to life, innovation requires a change of mindset or culture, and a freedom to generate ideas. Technology is only one small part of innovation – it is simply a new way of doing things. Good examples of technical innovation are the Blackberry (RIM), iPod (Apple), PCR genetic testing, and the Dash-8 and CRJ aircraft from Bombardier. What made them successful was that they filled an identified need, and they continue to delight the customer. Maple Leaf Foods spent four years developing a highly innovative SNP and web-based DNA traceability system for pork that was never used. It has

been likened to the Concord airliner – great technology, not so good business model. The Open Innovation concept lowers the financial risk by trawling existing knowhow and solutions from outside the organizations, and a number of companies now provide this service.

**Communicate** There must be a clear message to the consumer and the food industry. The message that meat is nutritious and safe as part of a balanced lifestyle needs to be loud and clear. A good starting point would be Canada’s Food Guide. Animal products provide many essential nutrients. The message of caring for our animals needs to be out there. How can the livestock industry improve its “brand” or public face? Should there be a “livestock information centre” handling media and consumer relations in a very open and factual way? Could there be better scientific and medical expert spokespersons on hot topics such as health risks, animal welfare and the environment? Could there be a famous figure who would champion the industry?

**Exploit the Value Chain** While the consumer is the end customer, all the downstream value-chain partners are customers for some form of *service*.

Genetics→ Feed→ Producer→ Processor→ Retail/Food Service→ Consumer

The service includes packaging, traceability, extended shelf-life, food safety, and sustainability. All offer an opportunity to add value and to share risk. There will also be intersections with other value chains such as biofuels that offer opportunities to work together.

**Embrace New Technology** New technology that can appear as a threat may in fact offer a greater opportunity. For example designer bacteria might produce synthetic protein in place of meat, but they could also produce carbohydrate for animal feed using CO<sub>2</sub> drawn from the atmosphere. Smart ovens might read the code on a pack and cook meat to perfection. The digital age of smart phones and web access offers a huge possibility that the perfect meal could be freshly prepared for pick-up or at home using this technology. All the signs are that wet chemistry will give way to quantum physics, where detection and possibly treatment of pathogens is done by non-invasive energy waves in real time.

**Be Prepared for Emergencies** Recent history of the livestock industry indicates that the unexpected will happen. In the wake of BSE, H1N1 and foot and mouth, the industry must be organized to act quickly. There may be crop failures, trade barriers, intrusions into the feed supply, water shortages, or new pathogens. This will require resources, but being able to act quickly will remove risk and create a huge competitive advantage.

**Get the Right Research** There must be a science base that will underwrite the competitive position of the industry. Hence it is important to identify and communicate to government and academia the priorities for fundamental research. For the meat and meals food companies today, top priorities are salt reduction, food-borne pathogens, biodegradable packaging, taste, and health and wellness. For livestock, microbiology must be high on the list, with more fundamental knowledge needed of bacteria and viruses. They are the greatest threat in a changing world due to their fast rate of evolution and adaptation. Alternative feedstuffs and waste disposal will feature strongly, along with the science behind GM livestock.

**Higher Goals** Repositioning the livestock industry in a changing society will require some higher goals and values. Would it be too great a stretch to aim to “Make meat and livestock products the healthiest and most sought-after food on the planet”? The greater understanding of the functionality of the human genome in the next ten years will unravel the science of human health and nutritional needs to an unimaginable degree. The industry should start to think now about how to turn this into its greatest opportunity by meeting those needs.

## References

- Alexandera D.D., Millerb, A.J., Colleen A., Cushinga, C.A. and Lowec, K.A. (2010) Processed meat and colorectal cancer: a quantitative review of prospective epidemiologic studies. *European Journal of Cancer Prevention*. 00:000–000 (web pre-publication).
- Forsberg, C.W., Phillips, J.P., Golovan, S.P., Fan, M.Z., Meidinger, R.G., Ajakaiye A., Hilborn D., and Hacker R.R. (2003). The Enviropig physiology, performance, and contribution to nutrient management, advances in a regulated environment: The leading edge of change in the pork industry. *Journal of Animal Science* 81 (14 Suppl 2): E68–E77.
- Micha, R., Wallace, S.K. and Mozaffarian D. (2010) Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus. a systematic review and meta-analysis. *Circulation* 121:2271-2283.
- Mølbak K. (2004) Spread of resistant bacteria and resistance genes from animals to humans - the public health consequences. *J Vet Med B Infect Dis Vet Public Health* 51(8- 9):364-9.
- Pfeuffer M. and Schrezenmeir, J. (2006) Impact of trans fatty acids of ruminant origin compared with those from partially hydrogenated vegetable oils on CHD risk. *International Dairy Journal* 16: 1383–1388.
- Pimentel, D., Houser, J., Preiss, E., White, O., Fang, H., Mesnick, L., Barsky, T., Tariche, S., Schreck, J. and Alpert, S. (1997) Water resources: agriculture, the environment, and society. *BioScience* 47: 97-106.
- Pollan, M. (2006) *The Omnivore’s Dilemma*. Penguin. 450 pp.
- Strauss, S. (2010) Biotech breeding goes bovine. *Nature Biotechnology* 28: 540–543.
- Wassenaar T.M. (2004) Use of antimicrobial agents in veterinary medicine and implications for human health. *Crit Rev Microbiol*. 31(3):155-69.
- World Cancer Research Fund and American Institute for Cancer Research (2007) *Food, nutrition, physical activity, and the prevention of cancer: a global perspective*. Washington DC: AICR.
- World Cancer Research Fund and American Institute for Cancer Research (2009) *Policy and action for cancer prevention. Food, nutrition, and physical activity: a global perspective*. Washington DC: AICR.