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# Transporting swine: Challenges and opportunities

Terry Whiting, DVM, MSc

Veterinary Disease Control and Epidemiology, Manitoba Agriculture and Food, Veterinary Services Branch, 545 Univ. Cres, Winnipeg MB R3T 5S6, 204-945-6750, FAX: 204-945-8062, twhiting@gov.mb.ca

## Abstract

The transportation of farm animals in Europe and the transportation of horses to slaughter in the US are emotive issues which have resulted in public awareness campaigns and, eventually, government regulation. The transportation of animals is a multi-factorial process which includes identifying animals suitable for transport, presenting for loading, providing the transportation service, unloading and lariatage at destination, and using animals further after transport to destination. Recognition of the complexity of livestock transport and the business environment in which livestock transport is carried out suggests that to understand the process in its entirety is truly a challenge. In the future, assurance of a high level of animal well-being during transport may be one of the many quality assurances demanded by the consumer. This paper explores areas of interaction between science, practice, and reality of production. It is a fact that large numbers of livestock will continue to be transported for the foreseeable future.

## Introduction: Philosophy of animal welfare science

Research into questions of animal well-being has considerably expanded in the past two decades. There have emerged at least three main schools of research (see **Table 1**). In general, scientists attempt to measure things indicating a good or poor state of animal well-being as a tool to evaluate whether one management system or practice is superior to another. The challenge, therefore, is to assess the subjective concept of “animal welfare” utilizing indicators or parameters which can be measured. What

scientists disagree on is what is and what is not a valid measure of animal welfare.

Probably the oldest school of animal welfare research uses the biological functioning approach to measure animal welfare. Parameters measured as a proxy of animal welfare in this approach are the following:

- Biochemical or physical indicators
- Factors of mortality or morbidity
- Environmental indices such as space and its utilization
- Quantification of light levels, air quality, temperature, or relative humidity
- Performance measures such as growth, production, or reproduction

Also included in biological functioning evaluation are behavior studies involving species-related normal and abnormal behavior sequences. A leading example of this scientific approach is the work of Prof. Don Broom, Cambridge University, UK. The Cambridge Veterinary School is recognized world-wide as a leader in animal welfare research with one of the largest and most influential research groups in the world. This approach to research maintains close ties with animal health and traditional veterinary and production parameters as integral to the overall evaluation of animal welfare (1-4). It is also the approach most often used in evaluating the effect of transport and abattoir management on meat quality (5-8).

The widely implemented behavioral-based research of Temple Grandin on evaluating appropriate pre-slaughter handling of cattle is structured on the biological functioning scientific approach. The behavioral measures in

Table 1: Philosophical schools of animal welfare research.

School	Investigative focus	Things measured
Cambridge (Broom)	Biological functioning; physiological, pathological, behavior changes	Lameness; disease; blood chemistry; behavioral indices
Animal perception (Duncan)	Feelings of the animal	Motivation; emotions; aversion; animal preference
Economics (Bennett)	Consumer attitude	Willingness to pay; product aversion; consumer right to know

these studies, such as frequency of vocalization, slips, and falls are objective actions of an animal under certain situations and no real evaluation of the “feelings” of the animal at the time of the measured behavior are needed to apply the investigative techniques or understand the science (9, 10).

As early as 1965, Professor Brambell of the United Kingdom proposed the following definition:

*Welfare* is a wide term that embraces both the physical and mental well-being of the animal. Any attempt to evaluate welfare therefore must take into account the feelings of animals that can be derived from their structures and function and also from their behaviour.

The “feelings” school of animal welfare has developed from this line of reasoning, led by researchers such as Dr. David Frazer at the University of British Columbia and Dr. Ian Duncan at the University of Guelph (11-15). The premise of this research approach is that it is the animal’s perception of its own situation which is the morally appropriate and scientifically correct assessment of welfare.

The simplest example of the justification for this philosophical approach in livestock production is provided by the genetic selection of broiler chickens for feed consumption and growth. Not only do the production level birds risk problems with lameness related to the rate of growth—a significant welfare concern—but the parent stock share their genetic programming for aggressive feed consumption. To maintain productivity in broiler breeder flocks, the parent stock must be subjected to severe feed restriction or they will over-consume feed and suffer from obesity and low egg production (16). These flocks are normally provided with about 25% of the feed that they would consume if provided ad libitum. Proponents of the feelings school of animal welfare use this argument to demonstrate that the physiological/pathological approach is inadequate to cover all situations. In this example, although egg production, body weight, feather condition, and other measures of production are good, the scientific evaluation may rate the welfare conditions poor as the broiler breeders are constantly subjected to the feelings of severe hunger.

To actually measure how much value an animal puts on having a thing, for instance, more feed or access to a nest box for laying hens, the experiments become quite complex and open to various interpretations. Many of the experiments involve measuring how much work an animal will do (measuring motivation) to achieve a reward or evaluating an animal’s preference for an environment, such as measuring how much cows prefer certain flooring types over others in dairy barns.

There has developed a third or fringe area of farm animal welfare research which the purists would not recognize as animal welfare research at all. I will refer to this as the

“economics” school of research. This approach is based on the premise that the actual true welfare of the animal is irrelevant to the development of public policy and regulatory/marketing demands for animal welfare certification. The thing most valuable to measure is how the public perceives the welfare of animals under varying production systems.

Bennett in the UK (17-19) and den Ouden (20-23) in the Netherlands typify this group of researchers. The economics school asserts that product development strategies can only be successful if producers adopt a consumer-oriented approach, as the consumer ultimately decides what food products are bought (24). Moreover, consumers may evaluate product attributes differently than experts (25). The extent of additional price consumers are willing to pay (WTP) for products derived from production systems deemed more animal friendly is difficult to objectively establish. Attempts have been made to estimate WTP for the elimination of battery cages for layer hens (26, 27) and alternative stunning procedures for hog slaughter (28).

Researchers in the biological functioning school can be quite critical of the “feelings” research community (29), and both groups tend to publish in different scientific journals. The European commission has as an advisory support group, The Scientific Committee on Animal Health and Animal Welfare (SCAHAW), a physiological-veterinary based group (16); the equivalent in Canada is the Expert Committee on Animal Welfare and Behaviour, a more ethnological dominated group (30). Both are in some way charged with evaluating research needs for scientific and technical questions concerning the protection of animals, notably with regard to animal husbandry, herd management, transport, and slaughter. It has been recognized that much of the animal welfare science agenda has recently been dominated by behavioral scientists who have not given sufficient weight to animal health problems that are some of the most primary and major threats to farm animal welfare (31).

There is some concern that the two more traditional animal-focused, science-based groups—the biological functioning and animal feelings groups—are being overshadowed in the political/regulatory process and decision making process of corporations purchasing meat products. The fact is that the consumer can drive public policy regardless of what current scientific knowledge may be (32).

## Transportation

All workers in swine welfare and meat quality agree that transportation is a serious stress on the animal and a cause for concern. Slaughter pigs arriving dead at the abattoir is easy to measure; however, it is an insensitive measure of poor animal welfare (7, 33, 34). Meat quality at slaugh-

ter is the result of a complex mix of genetics, animal handling, and transport. Meat quality is relatively insensitive to changes such as stocking density during transport (8). In general, when there is consistent opinion that a thing (product) is important, there is the potential to identify a profitable market share filling the need for that product. Livestock transportation is a valuable component of the meat production chain.

When consumer advocacy groups and swine production experts were compared, there was general agreement on the aspects of hog production which are perceived to be animal welfare concerns (21). Transportation accounts for about 1% of the total cost of hog production (Netherlands) but contributes about 20% to overall welfare concern in production systems. In Manitoba cost of delivery of slaughter hogs within the province was about \$2.00/pig delivered when market prices averaged \$160.00 for 2002 deliveries, comparing favorably with Dutch costs. Compared to radical changes in housing, such as access to the outdoors and group housing of sows, modification of transport conditions can result in significant overall improvement in swine welfare as perceived by the public—at low cost (22, 23). The causes for public concern for animal welfare during transportation include the following:

- General handling of animals (use of electric prods etc.)
- Using loading ramps appropriately
- Mixing unfamiliar animals during transport or prior to slaughter
- Loading from more than one farm
- Holding animals overnight prior to slaughter

Improvement in this area can be achieved relatively inexpensively by modifying education and training procedures.

Most concerns identified as welfare risks for transportation of market hogs tend to be minimized by an increase in average farm size and a streamlining of marketing processes such as just-in-time and direct delivery to the abattoir. There may be a positive relationship between farm size and transportation efficiency, with a greater proportion of the hogs delivered direct to slaughter. “Industrialization” of hog farming is not an inherent cause of decreased welfare during transportation. Transportation of hogs to market has not been the target of concern by non-profit animal welfare organizations in North America as it has been in the European Union.

## Challenges: EU animal welfare proposal to the WTO

In recent years, increasing levels of personal income in developed countries have led to a rising interest among some consumers regarding product attributes that have an ethical rather than strictly utilitarian basis. In response to this trend, there have been consistent calls for the World Trade Organization (WTO) to address new issues such as environmental and labor standards in the development of international trade rules. In response to rising consumer interest in the well-being of animals used in commercial food production, the European Union (EU) has been increasing its animal welfare standards. Humane transportation of animals and enforced regulation of transportation of live animals has been a primary effort in responding to demands from consumers in Europe. Internal regulation does nothing to inform consumers of the welfare standards that have been applied to food that is imported.

At the second special session of the WTO Committee on Agriculture in June 2000, the EU submitted a proposal on Animal Welfare and Trade in Agriculture calling for the issue of animal welfare standards to be addressed. The EU Commission is pursuing this controversial proposal from a two-fold motivation: 1) concerns expressed by EU consumers pertaining to the production methods used to rear their food, and 2) EU producers regarding the effect on their international competitiveness of regulations enforcing costly animal welfare standards. The proposal has not received widespread support among WTO members.

Satisfying European consumers’ desire to know about foreign animal welfare standards will require the labeling of imports. Labeling of imports for animal welfare purposes is not consistent with World Trade Organization obligations.

As currently constituted, the WTO is unable to adequately address the issue and cannot deal with consumer groups’ demands for protection on ethical grounds. WTO is committed to the principal of competitive advantage—the principal that countries should produce what they are good at and trade their excess for products that other countries are better at producing. The WTO does not allow self-imposed cost increases associated with social regulations to be a justification for introducing trade barriers (35). It appears that if the EU wishes to achieve its goals pertaining to the ethical issues surrounding animal welfare, it must tackle the issue head-on and raise the broad issue of ethical concerns directly. It has already suggested that the sanitary and phytosanitary agreement (SPS) be reopened to take account of consumer preferences in the context of genetically modified food (36).

It appears that there is a long process to be followed and significant time will pass prior to animal welfare becom-

ing integral to international trade in animals and animal product (35).

Although animal welfare as an international trade issue appears to be a non-starter at the moment, this does not preclude increasing pressure on national and sub-national governments to provide for enhanced regulatory control over livestock production. In the US, revision of the Animal Welfare Act in 1985 requires that laboratory non-human primates have their “psychological needs met” (37). The commercial transportation of horses to slaughter has recently come under regulation (38). Currently the American Horse Defense Fund, the nation’s premier horse protection and education nonprofit organization commended US Representative John Sweeney (R-NY), Chairman of the Congressional Horse Caucus, and US Representative John Spratt (D-SC) when they introduced the American Horse Slaughter Prevention Act (Feb 13, 2003). The Act intends to ban the trade in horsemeat and live horses for human consumption (39).

## Branding

There are several current related topics in food production that provide opportunities and challenges for livestock hauling. They are interrelated due to a common identity preservation and/or traceability component. Branding is a well-understood commercial system where product producers or marketers attempt to differentiate their product from other similar products in the marketplace. The benefit to the marketers is that they either develop a devoted clientele with a specific brand preference or they are able to charge and receive a premium for the additional quality inherent in their “brand.”

In Britain there has been a plethora of branding programs related to specific process and production methods (PPM) (organic, animal welfare, environmentally friendly) supported by large market outlets. Perhaps the most famous is the “Freedom Foods” branding program provided by the Royal Society for the Prevention of Cruelty to Animals (40). All foods bearing the Freedom Food trademark are traceable from supermarket shelf to the farm. Strict welfare standards exist for farm animal husbandry including auditing and certification of livestock premises, transportation, and abattoirs participating in the Freedom Foods program.

The cost of segregating livestock from the farm, the abattoir, and beyond is significant. By 1995 about half the swine hauling vehicles delivering hogs for slaughter in Britain were not full due to the requirements of product segregation for the various PPM labeling programs (7).

Several other initiatives currently under discussion or implementation in North America are Country of Origin Labeling (COOL), consumers’ right to know (CRTK), and PPM (35, 36). In Canada, Maple Leaf Foods introduced a

branded product in 2002, called Maple Leaf Prime Medallion(tm) Naturally, Canada’s first 100% vegetable grain fed pork fed exclusively from a proprietary NutriMedallion(tm) feed (41). This initiative followed up a similar previous launch of a specialized poultry product (NutriPrime(tm)) (42) both distinguished by the PPM of feeding no animal products to the livestock destined for this branding.

Branding and segregation of products may be more economical and possible to achieve in North American pork production where vertically integrated productions systems have been able to develop more freely than in Europe. The commitment to the European family farm method of production has limited integration in some livestock production areas such as Germany (average pig herd size 113 in 1999) (43). Traceability of livestock products is emerging as a major issue in Canada in the wake of the BSE crisis.

## Quality of the ride

Much of the public opinion regarding animal welfare is formed on the perception of the quality of the experience of the individual animal (14). The “Animal Welfare Matrix” has been proposed as a general method for evaluating farm animal welfare and has been used in evaluating housing systems in particular (37) (see **Figure 1**).

The animal welfare matrix is a general system for addressing the needs of on-farm animal welfare auditing. Animals would be expected to have good welfare if they receive a positive check in each box in reference to some objective measurement(s). If problems were identified uniformly over anatomy, physiology, behavior, and productivity, most people would agree that the production method would fail a welfare assessment. However, should the farm not qualify for an assurance that the welfare is adequate if there is a problem in just the one cell? For example, is welfare “bad” for sows in gestation crates where all other objective measurements of welfare are excellent?

The nature of transportation precludes the use of this matrix evaluative system. This is due to the following factors:

- In the relatively short duration of transportation, health is usually not affected and physiology is difficult to measure.
- Confined space in transport vehicles precludes many behavior measurements.
- Meat quality as a measure of productivity is affected by a myriad of concurrent activities around the time of transport and slaughter, leaving only measurements of fracture, DOA, bruising, or frostbite as possible

Figure 1: The animal welfare matrix: a general system of addressing the needs for on-farm animal welfare auditing.

Stage of Life	Anatomy	Physiology/Health	Behaviour	Productivity
Breeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gestation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> *	<input type="checkbox"/>
Lactating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neonatal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Growing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

objective measures of rough handling or poor transport.

Due to the inability to scientifically approach the animal to answer questions of animal welfare in transport, welfare scientists in Europe have investigated the microclimate of transportation vehicles extensively (44). Early work with broiler chickens indicates that the major problem inherent in transport is in controlling and dissipating the massive amounts of heat generated by the birds (45). A mechanical ventilation system for mobile livestock trailers is under commercial development (46).

The concept of a “thermal load” in poultry transport (44) may be of value in understanding the conditions in transporting pigs. Engineering studies of trucks in motion suggest that natural ventilation is largely from the back to the front of the vehicle, and a thermal load builds up towards the front and the top of the load. Recent measurement of weight (water) loss by cattle in transport indicated that animals in this position—top and towards the front of the vehicle—was associated with the most weight loss (47) (see **Figure 2**).

The development of controlled ventilation vehicles in Europe is a response to regulatory demands set down by the EU Commission (46). Political pressure to come up with quick “scientific” answers to essentially legislative demands has been identified as a significant risk to the

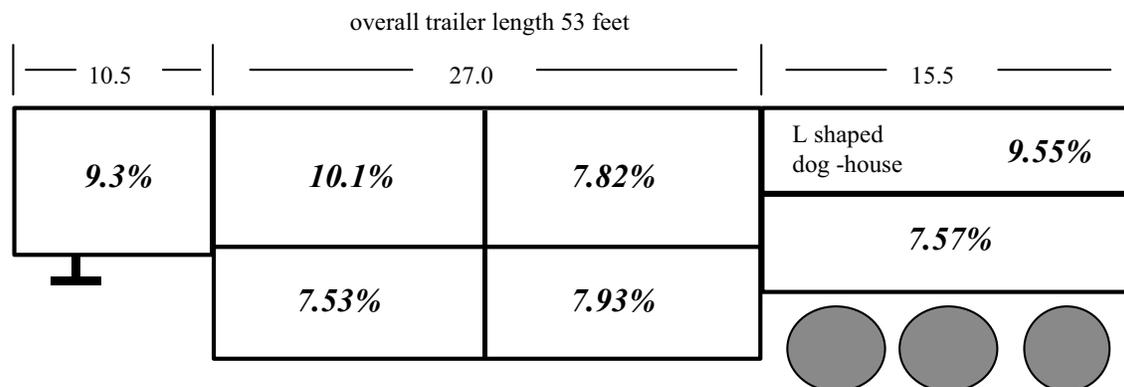
development of a good, basic scientific understanding of animal welfare (31).

### Quality assurance opportunities

The Trucker Quality Assurance<sup>SM</sup> Program (48) is an excellent driver training and certification program; however, as it has no critical control points or method of auditing, it is probably a misnomer to refer to it as a true QA program. There are many possible objective measures likely to be associated with quality of livestock transport (see **Table 2**). The measurements may not reflect true critical control points as described in HACCP approaches to quality assurance. However, as livestock transport is a free market enterprise, recording and reporting information back to the customer related to the level of service could be a useful marketing tool and method of verifying quality of service.

If the axiom is true that we manage what we measure, then there is some significant, untapped information that commercial transporters can feed back to their customers. Some problems and variability in the quality of transportation are somewhat out of the control of the transporting company, such as weather and delays in loading and unloading. Documentation of these variables may be of value to both the producer and the trucker.

Figure 2: Percentage weight loss in cattle average weight 972 lbs. transported 10 hours from Kamloops B.C. to Lacombe Alberta. Cattle in the top experienced significantly more weight loss than front compartments, suggesting location on a transport vehicle can significantly affect weight loss in cattle (47).



## Persistent challenges to better transportation

There are several ongoing challenges to humane transportation of pigs that require our attention as producers of pork for the North American market:

### Distance traveled

In the past thirty years there has been consolidation of the meat packing industry in North America. The current slaughter environment involves fewer larger and more specialized abattoirs. Between 1977 and 1996, plant numbers declined sharply as plant sizes increased. Plants that slaughtered over a million hogs annually accounted for 38% of hog slaughter in 1977; two decades later, large plants accounted for 87% of slaughter. By 1997, ten plants accounted for 40% of US hog slaughter (49). Although not well documented, it is probable that the average hog was transported further between birth and slaughter in 1997 compared to 1977.

In Manitoba there is no slaughter facility that will handle significant numbers of cull sows, and no plant will accept cull boars. Cull breeding stock from Manitoba and most of Western Canada are exported to the US for slaughter, perhaps running the risk of long transit times.

### Who pays?

Carrying new costs of production forward through the production chain to the consumer has been difficult to achieve in livestock production. It is clear that some “welfare friendly” modifications to production come at a capital cost and a loss of production (50). The swine industry is becoming more vertically integrated and these costs may be more internalized and recoverable than equivalent management changes in the beef industry.

### Cull sows and boars

As previously mentioned, cull sows and boars may have to travel some distance to slaughter and not a lot of attention has been paid to this class of pig in the humane transportation research community. Concurrently some of the major purchasers of ground pork such as the McDonalds restaurant chain have been showing increased interest in animal welfare. Producers and manufacturers of ground pork should anticipate an increasing interest from the public and the customer in the management of cull sows in the future.

### Increasingly difficult pigs to transport

Transporters have suggested that current lean pigs are more susceptible to transport stress than were older strains of pigs. There is very little direct scientific literature to support this assertion; however, animals in a population genetically selected for high production efficiency seem

Table 2: Potential objective measurements of high-value livestock transportation.

Variable measured	Method of data collection
Dead on arrival	Truck report, abattoir records
Time loading	Truck specific GIS recorder/locator
Time in transit	Truck specific GIS recorder/locator
Wait time at the abattoir	Truck specific GIS recorder/locator
Loading density per compartment	Truck report
Weather adjustment	Truck report compliance with point triggered adjustment Decrease loading density at 70° F, 70% RH Board up sides at 20° F
Consignment-specific demerits	Abattoir records, record of payment
Trailer disinfecting program	Product used, dry time allowed
Biosecurity program	Last use of trailer, pyramid dedicated equipment
Running average for any variable	Integrate with previous years' data, compare with seasonal adjusted rates for DOA

Stage of life	Anatomy	Physiology & Health	Behavior	Productivity
Breeding	√	√	√	√
Gestation	√	√		√
Lactating	√	√	√	√
Neonatal	√	√	√	√
Growing	√	√	√	√

to be more at risk for behavioral, physiological, and immunological problems (51).

## Conclusion

Humane transportation of livestock within production systems and to slaughter or salvage is a visible component of our production of human food of animal origin. Humane transport is a critical point where animals are at risk to suffer needlessly through inattention on our part. The general public can become engaged in the discussion of this issue resulting in regulatory intervention. In the overall cost of production, transportation is very small component and excellence can be achieved at low cost. In the future, our industry will need to continue to do an excellent job in transporting pigs and will be required to document the job we are doing. Some situations, such as the handling of cull sows, require further research and special attention in our marketing systems.

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