LOGISTICS AT TRANSPORT TO SLAUGHTER. FOOD AND ENVIRONMENT – OPTIMISED ANIMAL TRANSPORT

Wiberg, S.[1], Algers, A.[2], Algers, B.[1], Franzén, U.[3], Lindencrona, M.[3], Moen, O.[3], Ohnell, S.[3] and Waidringer, J.[3]

[1] Swedish University of Agricultural Sciences, Department of Animal Environment and Health;
[2] Swedish University of Agricultural Sciences, Department of Food Science;
[3]WSP Analys och Strategi

SUMMARY

All kinds of transportation are a potential stressor to animals. Animals exposed to stress have reduced welfare. Stress can also lead to inferior meat quality and condemned carcases, which incurs both economical and environmental losses. The transports themselves also have a negative impact on the environment. A small scale and a medium scale abattoir were compared. The transport optimization in this pilot study shows good possibilities to improve efficiency by collecting the same amount of animals in a shorter period of time with reduced distance driven.

Keywords: animal welfare; animal transport; logistics; emissions; abattoir

INTRODUCTION

There is an increasing consciousness of animal welfare in food production and societal demands on the transport system are high regarding animal welfare and environmental impact. Research show that transports can be detrimental to animals leading to reduced welfare. The transports can cause stress and injuries on the animals which also can affect the meat quality (Atkinson, 2000). The profitability in the Swedish meat industry is low and at the same time, the slaughter industry is moving in a direction toward fewer and larger abattoirs with increasing areas of service.

The work presented here was conducted as a pilot study. The aim was to investigate the possibilities to optimise transport to slaughter in small and medium scale abattoirs, to improve transport conditions for the animals with a simultaneous decrease in environmental load and transport costs.

MATERIAL AND METHODS

A small scale (SA) and a medium scale abattoir (MA) were compared. Data on animal welfare and transport routes and routines were collected in June-August 2006 through questionnaires and visits to the abattoirs. At the abattoirs distance, times, number of animals, etc. was recorded. This data was used in both an animal welfare analysis and in a transport simulation. The latter also served as basis for environmental impact calculations where a comparison between the performed and the optimised transports was made.

The SA slaughtered once a week, and data was collected for five days. A large part of the animals slaughtered at the SA were reared at the farm where the SA was situated. The transports were conducted with 10 vehicles and 9 transporters. Most transports were performed by the owners of the animals. Two vehicles belonged to the farm and were used for transportation of their animals. The total number of collections of animals studied was 23 divided in 22 rounds.

Data from the MA was collected for two weeks (10 days of slaughter). Records from 178 collections divided in 85 rounds were obtained. Of these, 101 were collections of cattle, 76 of pig and 1 of sheep. Since there is only one recorded collection of sheep no calculations were made on transport of sheep. The transports were conducted with 17 vehicles. Of the vehicles, two belonged to the abattoir, four to farmers and the rest to private hauliers.

In the questionnaire, farmers, transporters and representatives from the abattoirs were asked about the attitudes towards a number of different changes that could make the animal transport system more optimal.

RESULTS

Vehicle 1–4 each performed between 17 and 26% and together 81% of the collections. As seen in figure 1, these four vehicles transported almost all cattle to MA. Figure 1 also shows how the transports of pig were distributed among the vehicles, and that vehicle 5 and 7, despite few collections, transported a large part of the pigs, and that vehicle 3, despite many collections, transported relatively few animals.

The proportion of animals, lairaged overnight was high, especially for pigs but also for sheep at SA (fig 2).

To SA all transports but one collected animals at only one farm, as most transports were conducted by the owners themselves. Of the 85 rounds to MA, 48 (56%) consisted of one collection.

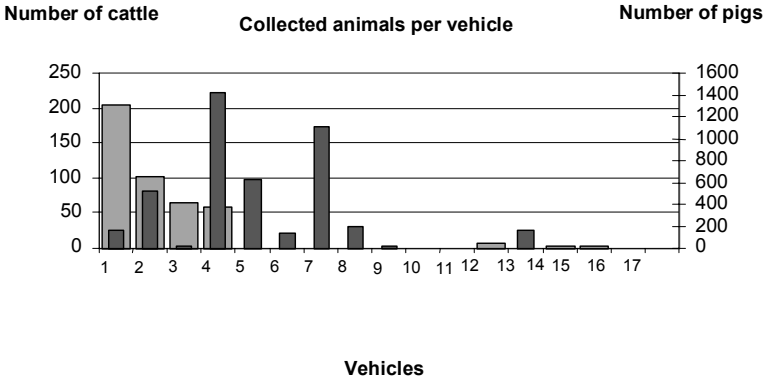

Figure 1. Animals transported to MA (Pigs=dark, cattle=light)

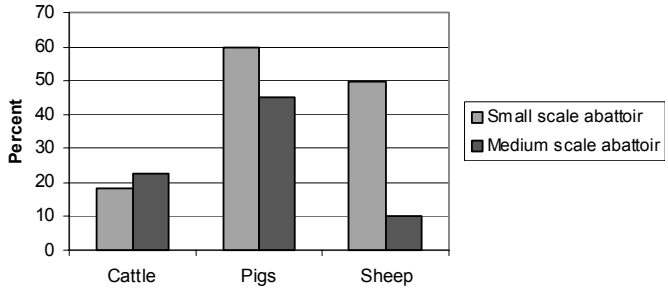

Figure 2. Animals kept in lairage overnight

The duration of handling at transport to slaughter varied considerably between abattoirs and species (table 1).

Table 1. Handling duration at transport to slaughter

	Cattle		Pigs	
	SA	MA	SA	MA
Time 1, (h:min)	00:00	00:04	00:00	00:05
Time 2, (h:min)	00:04	00:03	00:05	00:01
Time 3, (h:min)	00:01	00:05	00:02	00:05
Time 4, (h:min)	00.09	02:36	00:26	02:11

Time 1: Time from arrival of vehicle to start loading of animals; Time 2: Time for start to finished loading; Time 3: Time from finished loading to start driving; Time 4: Total travelling time

Mixing of animals was recorded on the transport and upon arrival to the abattoir. Transporters at SA answered that 50% (n=6) of the cattle, 0% (n=2) of the pig and 33% (n=9) of the sheep were mixed in the transport vehicle. The corresponding numbers for MA were 19% (n=75) and 78% (n=46) for cattle and pig, respectively. Mixing in lairage was not reported from SA, but recorded in 82% (n=22) and 100% (n=25) for cattle and pig at MA, respectively.

Group size at collection of cattle to SA were in 7 of 9 occasions 2–3 animals and in two cases 5–6 animals. Pigs were collected in groups of 3–5 animals in 4 cases and sheep <10 in 4 cases, 11–20 sheep in 3 and >20 sheep in one case. To MA, one single cattle was collected in 31% of collections. In 34% of the collections, the groups were of more than three animals. Pigs were collected in groups of 1–10 animals in 36% of the cases.

Optimised transports

The traditional way of transport planning is done with pen and paper. Since 2–3 years, there is a national digital database of all roads in Sweden, and their driving restrictions. This, in combination with GPS navigators and route optimizing computer programs, are tools that can revolutionize transport logistics.

For animal transports, there are several conditional elements that need to be considered to accomplish a good transport; e.g. legislation, overnight lairage, transport conditions, access to animal and access to vehicles and transporters. But there is also an advantage compared to many other parts of industry – a large “time window” for the collection of goods. A pig ready for

slaughter has about a five day interval where slaughter can be done before it gets too heavy. For healthy cattle, the interval is about three weeks, which is about the time the farmer accepts to wait. This means there is five days and 3 weeks, respectively, to plan the transport to slaughter. In the slaughter industry, the planning can be done during regular working hours with good planning in advance.

The optimizations in this study were done using the data from MA. At present, transports to MA are performed using 17 vehicles with different starting points; some start at the abattoir, others where the transporters live.

The first scenario, "Present" was done to recreate the performed transports as they were done in reality, deleting the five transport vehicles which only marginally contributed to the transports. Some information from the forms that were filled out at the visits to the abattoirs was used, and some basic conditions were set up, for example: Vehicles started at their present starting points and returned to the same place at the end of the day, the number of collections of animals was 178 and the time to unload and wash the vehicles was estimated to 50 min. In the second scenario, "Optimized present", a computer program was used to optimize the transports. The program could choose what day and what vehicle to use for each round. The basic conditions were, for example: Only the largest vehicles were used, the vehicles started at their present starting points and returned to the same place at the end of the day, maximum transport time of eight hours and no animals kept in lairage over night. A third optimization was done again, "New optimization". Here, the basic conditions were still maximum transport time of eight hours and no animals kept in lairage over night, but also that only five of the largest vehicles were used and that the vehicles all had the same starting and return point (the abattoir). See table 2.

Table 2. Different scenarios after optimisation

	Present	**Optimised present**	**New optimisation**	**% reduction present – new optimisation**
Vehicles, n	12	7	5	– 58%
Distance, km	14153	12167	9894	– 30%
Time, min	26720	22988	20653	– 23%
Rounds, n	85	51	58	– 32%
Time/round, min	326	390	356	+ 9%
Distance/round, km	167	239	171	+ 2%

Environmental impact

The available data on transports to the SA was too limited to do reliable calculations on emissions. For the MA, calculations on emissions have been made for the scenarios "Present" and "Optimized present".

Calculations on emissions are based on the transporters data on loading capacity, fuel consumption and driving distances. Data on emissions from vehicles of different Euro classes are collected from "nätverket för transporter och miljö" (2007).

The optimization shows large potential to reduce emissions, see table 3. The CO_2 -emissions are reduced in relation to driving distance. Thus what is effective from a commercial viewpoint also reduces the environmental impact. To decrease emissions further (NOx, HC and particles), replacement of old vehicles was shown to have the largest effect. Subsidies or legal demands are ways to speed up such replacements.

Table 3. Emissions as % reduction of scenario "Present"

	Optimised route	**Euro 2**	**Euro 3**
Distance	11%	11%	11%
HC	20%	34%	42%
NO_x	16%	4%	27%
PM	20%	40%	42%
CO_2	12%	12%	12%

Attitudes

The studies on attitudes show that it is a general belief that picking up animals earlier in the day to avoid overnight lairage is positive for animal welfare and that the use of pre loading facilities is viewed as being positive for animal welfare and labour situation. Producers of slaughter animals believe that animal welfare can be improved by the use of mobile slaughter facilities. There is a positive attitude to transporters given their own geographical region irrespective of the receiving abattoir and a negative attitude to several transporters working in the same area to increase flexibility.

DISCUSSION AND CONCLUSION

A large part of the collections of animals were done in small groups of animals. To make use of vehicles with large loading capacity and collecting small groups of animals mean more stops per round. Many stops are negative for animal welfare (Gebresenbet and Eriksson, 1998). Small groups also increase transport time and the risk of mixing animals.

It was common to mix animals in the transports and in lairage. To transport small groups of animals under conditions with good animal welfare and at the same time use the vehicle capacity, the equipment for fencing the animals in the transport needs to be flexible.

Loading is, for good animal welfare, the most crucial moment of the day of slaughter (Fraser and Broom, 1990). Loading time differs between the two abattoirs, and is for example longer for pigs for the SA. A longer loading time is positive for animal welfare, as the animals can walk at their own pace (Hemsworth, 1993). Studies have shown that animals that are mixed in the transport vehicle are exposed to stress (Bradshaw et al, 1996). A short time from arriving at the farm until start of loading is therefore beneficial for animals in transports which previously collected animals. The differences in times 1–4 (table 1) between SA and MA are due to the number of animals and the way the animals are transported. At SA, they are in most cases driven across the farm yard by their owners, and at MA, professional transporters with a tight schedule and large vehicles transport a larger number of animals.

Time from arrival at the abattoir until slaughter varied greatly because some animals were slaughtered immediately after arrival, while others were kept over night. A large part of the animals at both abattoirs are kept in lairage over night. After a well performed transport there are no advantages in keeping animals in lairage and a long time in lairage increases the risk of spreading contagious diseases (Warriss, 2003). Animals exposed to stress can benefit from around two hours in lairage, under good circumstances (Santos et al., 1997). Time in lariage is apart from that considered a factor of stress and should be avoided (Geverink et al, 1998; Santos et al., 1997).

In the optimized scenarios, mean travel distance per animal increase compared to "present". Further research is needed to analyse the effect of an increased number of stops and longer

journeys compared to long and overnight lairage on animal welfare. Further research is also needed to study the effect of flexible interiors in the transport vehicles to reduce mixing and thus the stress load on the animals.

Emissions are reduced as the distance decreases. To further reduce emissions it is the exchange of vehicles that induces the largest effects.

The conclusion from this pilot study is that transport optimisation can result in simultaneously increased animal welfare, reduced costs and reduced environmental impact. Farmer attitudes show openness to such changes.

REFERENCES

Atkinson, S. 2000. Farm Animal Transport, Welfare and Meat Quality. Thesis, Rapport 4, Department of Animal Hygiene and Health, Swedish University of Agricultural Sciences, Skara, Sweden,

Bradshaw, R.H., Parrot, R.F., Goode, J.A., Lloyd, D.M., Rodway, R.G. & Broom, D.M. 1996. Behavioural and hormonal responses of pigs during transport; effect of mixing and duration of journey. Animal Science 62: 547–554.

Fraser, D., Broom, D.M., 1990. Farm animaal behaviour and welfare. Baillière Tindall, Lomdon.

Gebresenbet, G. & Erikson, B. 1998. Effects of transport and handling on animal welfare, meat quality and environment with special emphasis on tied cows. Department of Agricultural Engineering, Swedish University of Agricultural Sciences, Uppsala, Sweden.

Geverink, N., Bradshaw, R.H., Lambooy, E., Wiegant, V.M. & Broom, D.M. 1998. Effects of simulated lairage conditions on the physiology and behaviour of pigs. The Veterinary Record 143: 241–244.

Hemsworth, P.H. 1993. Behavioural principles of pigs herding. In: Grandin, T. (ed.) Livestock Handling and Transport. CAB International, Wallingford, Oxon, UK.

Nätverket för transporter och miljö. 2007. www.ntm.a.se (20070325)

Santos, C., Almeida, J.M., Matias, E.C., Franqueza, M.J., Roseiro, C. & Sardinha, L 1997. Influence of lairage environmental conditions and resting time on meat quality in pigs. Meat Science 45, 253–262.

Warriss, P.D. 2003. Optimal lairage times and conditions for slaughter pigs: a review. Vet. Rec., 153: 170–176.