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PAPER

Risk assessment in stock calf transportation from France to Italy: the contribution of road inspections

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Abstract

In order to assess the risk associated with the transport of stock calves imported from France to Italy, information obtained from inspections carried out in Piedmont by competent authorities between 2001 and 2010 were considered. The inspections concerned 246 trucks transporting a total of 13,857 fattening calves. Based on the types of infringements recorded, several hazards related to animal welfare, such as overcrowding, tying by the horns and inappropriate mixing, were identified and characterized. The inspection of vehicles revealed hazards concerning partitions, bedding, decks, lighting, drinking and mechanical ventilation systems. A calculation was made of the incidence of these infringements and the consequent exposure of calves to such hazards and risk characterization was performed. The ranking shows overcrowding and the absence of partitions to be major risks in stock calf transportation from France to Italy. A logistic regression was adopted to evaluate the effect on the exposure to hazards of the only two variables recordable during the inspections: number of calves inside each vehicle and the travelled distance. The results showed a direct relationship between the number of calves per vehicle and exposure to absence of partitions or to overcrowding. The relationship between the travelled distance and the exposure to the absence of partition was found not significant. The information obtained from the inspections provides not only a basis for evaluating the welfare of calves during transport but also an objective contribution to the assessment of the risks related to their transportation.

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Introduction

Transport is a complex series of operations which includes handling, loading, journey, and unloading at the farm or at the abattoir. During all these practices, animals experience different stressors that might be aversive for the animals' welfare such as restraint, manipulation, sudden change, hunger, thirst, fatigue, injury and extreme thermal conditions (Gradin, 1997). The protection of animals during transport is becoming an increasing concern and there is a rising interest in using Risk Assessment (RA) methodologies for the purpose of implementing qualitative standards for transport. Risk Assessment is a scientifically based process commonly used when estimating the likelihood and consequences of an adverse event, which is referred to as a hazard. Its application is based on World Health Organization guidelines (FAO/WHO, 1999) addressing microbiological food safety issues and on World Organization for Animal Health (OIE) guidelines for assessing the risk related to the import of live animals and their products (World Organization for Animal Health, 2004a,b). The risk assessment approach is followed, whenever possible, in the provision of scientific advice on the welfare of food producing animals and on the impact of scientific assessments on the EU regulatory framework by the Animal Health and Welfare (AHAW) Panel of the European Food Safety Authority (EFSA) (Ribo *et al.*, 2009). European Food Safety Authority also supported a project to develop animal welfare risk assessment guidelines on transport (Dalla Villa *et al.*, 2009).

The goal of RA is to better identify and rank welfare risk factors and prioritize possible corrective measures (Muller-Graf *et al.*, 2008). The risk assessment procedure follows the following steps: hazard identification, hazard characterization, exposure assessment and risk characterization. As far as animal welfare is concerned, a hazard can be defined as any factor or agent which adversely affects animal well-being. During transport, hazard occurs when even one of the animal's needs is unmet or insufficiently met. These needs are not so different from those at the farm (drinking, eating, lying down and getting up, suitable environmental conditions, appropriate social contacts, etc.) even if their levels might differ due to transport stress, and they must be met when the animals are in transit according to specific timing and procedures defined by regulations. According to Dalla Villa (2009), hazard characterization (HC) of transport concerns the consequences of the exposure to one or several hazards qualitatively and quantitatively (magnitude and likelihood of the adverse effect). In this approach, the exposure to hazards is expressed by the likelihood of the animal being exposed to one or more hazards during transport. The risk characterization is obtained by relating the hazard characterization with the exposure assessment in order to identify the chance of its occurrence. There are several approaches to calculate the risk characterization which were recently reviewed by Lester *et al.* (2007). In the approach used by Dalla Villa *et al.* (2009) the calculation of risk characterization scores is based on multiplying the probability of hazard occurrence and its magnitude.

Every year, Italy imports about one million cattle from France. In 2009, 755,000 stock calves were imported for fattening, mostly weighing from 160 kg to 350 Kg (ISTAT, 2010). The journeys generally lasted longer than eight hours and must be carried out in compliance with European long transport regulations, which include inspections *on the road* of animals, vehicles and accompanying documents. At present, *on the road* inspections are the only occasion for evaluating transport conditions, because the processes of loading and unloading at farms are not monitored by the competent authorities. As a consequence, direct information about the exposure to some hazards related to transport conditions can be obtained only during road inspections. As highlighted by Reenen *et al.* (2008) and Dalla Villa *et al.* (2009), in animal transport risk assessment there is a lack of reliable indicators for assessing the exposure of the animals to the identified hazards. The aim of this study was to evaluate the contribution that information resulting from the *on the road* inspections required by European regulations can provide to the assessment of risk in relation to the long-distance transport of stock calves from France to Italy.

Materials and methods

The data were drawn from the reports of *on the road* inspections carried out at the border between France and Italy, between 2001 and 2010, by the Veterinary Office for the fulfilment of EU requirements (UVAC) of Piedmont region, in cooperation with the State Forestry Corps and the Traffic Police. During the 10-year period, 246 vehicles, mainly truck-trailer and semitrailers, transporting a total 13,857 fattening calves, were stopped and inspected on the basis of EU Council Directives 91/628/EC and 95/29/EEC and Regulations No. 1255/1997, No. 411/1998 and No. 1/2005. Detailed information on the number of vehicles and calves inspected by year is reported in Table 1.

In accordance with articles 8 and 18 of the Council Directives and articles 23, 25, 26 and 27 of Regulation No 1/2005, whenever an infringement was found, all necessary actions required to safeguard animal welfare were taken; they ranged from a fine which did not imply a stop in the journey to the transfer of the animals to other means of transport or to the closer authorized staging point. In addition, whenever a transporter failed to observe, or a means of transport failed to comply with transport regulations, notification was sent to the competent authority to grant authorization to the transporter or a certificate of approval of the means of transport pending further decisions.

The infringements recorded during the inspections were divided into three categories related to the animals being transported, the vehicle, and the accompanying documents (Table 2). With the sole exception of overcrowding, the infringements listed are verifiable by checking the animals' condition and the presence and the proper functioning of vehicle equipments. The overcrowding was assessed, for each deck of the inspected vehicle, by calculating the ratio between the space allowance (m^2) and live weight of animals (kg) loaded. The calculation of live weight was based on the date of birth reported on the indi-

Table 1. Number of vehicles inspected and calves transported according to the year of inspection.

Years of inspection°	No. of vehicles checked	No. of calves transported	No. of vehicles with infringements	No. of calves in vehicles with infringements
2001	21	1311	16	1021
2002	11	579	8	462
2003	34	1753	15	805
2004	58	3369	36	2102
2005	40	2358	9	544
2006	18	1076	5	271
2007	23	1198	4	286
2008	20	1054	3	97
2009	5	274	4	213
2010	16	885	3	176

°Legislation in force: years 2001-2006, EU Council Directives 91/628/EC and 95/29/EEC, Regulations No. 1255/1997 and No. 411/1998; years 2007-2010, Regulation No. 1/2005.

Table 2. List of infringements recorded during the inspections divided into three categories related to the animals being transported, the vehicle, and the accompanying documents.

Animals transported	Vehicles	Accompanying documents
Overcrowding	Drinking system	Veterinary certificate
Improperly tied	Partition	Journey log
Mixing different sexes or ages	Mechanical ventilation system	
	Bedding	
	Deck	
	Lighting system	

Table 3. Hazard characterization, exposure assessment and risk characterization according to the approach of Dalla Villa *et al.* (2009).

Severity score	Definition	Explanation
1	Mild	Minor changes from normality, indicative of pain, malaise, frustration, fear or anxiety.
2	Moderate	Moderate changes from normality, indicative of pain, malaise, frustration, fear or anxiety. Clear change in adrenal or behavioural reactions, such as motor responses and/or vocalisations, according to each species behavioural patterns.
3	Severe	Substantial changes from normality, indicative of pain, malaise, frustration, fear or anxiety. Strong change in adrenal or behavioural reactions, such as motor responses and/or vocalisations according to each species behavioural patterns.
4	Very severe	Extreme changes from normality, indicative of pain, malaise, frustration, fear or anxiety, usually in several measures, that could be life-threatening if persisting.
Duration score		**Levels**
1		The effect lasts up to 3 hours
2		The effect lasts between 3 and 8 hours
3		The effect lasts between 8 and24 hours
4		The effect lasts between 24 and 72 hours
5		The effect lasts more than 72 hours

Magnitude: severity/4 × duration/5; probability of occurrence is estimated quantitatively as a Pert probability distribution function, specifying minimum, most likely and maximum values (e.g. min., 5%; most likely, 15%; maximum, 25%). Risk characterization: magnitude × probability of occurrence.

vidual passport, assuming 1 kg per day of age and subtracting 40 kg as the approximate weight of birth. Overcrowding was recognized and subjected to fines when the ratio was smaller than the lowest values of the range defined by EU regulations for the corresponding weight category (Council Directive 95/29/EC Chapter VI 47. Loading Densities, B Bovine Animals, L 148; Reg. EC No 1/2005, Annex I, Chapter 7, L 3/29).

The hazard characterization was based on the seriousness of the hazards, evaluated in relation to the consequences of the unfulfilled needs and adverse effects, following the indications reported in literature (Grandin and Gallo, 2007; SCAHAW, 2002; Tarrant and Grandin, 2000) and expert groups (Reenen *et al.*, 2008; Dalla Villa *et al.*, 2009). In order to provide a quantitative estimation of exposure, the hazard frequency was calculated as the percentage of calves transported in vehicles where infringements were recognized in relation to the total number of calves inspected. Risk characterization scores were calculated using the approach described by Dalla Villa *et al.* (2009) as reported in Table 3. The hazard characterization is expressed as magnitude; the *magnitude* is obtained multiplying the *severity* of the hazard by the *duration* of its effect. The *severity* is expressed by four classes ranging from *mild* to *very severe*, while *duration* is expressed by five classes of time duration ranging from: *the effect lasts up to 3 hours* to t*he effects lasts more than 72 hours*. The magnitude is calculated by weighting severity and duration scores based on the number of their respective classes as follows: Magnitude=Severity/4 * Duration/5.

In the present study, duration was considered as *the effect lasts between 8 and 24 hours* (score=3), thus equal to 3/5. This value is based on an estimated journey duration based on the most frequently recorded travelled distances. Thus the magnitude calculated for the transport of calves varied from 1/4 *3/5 to 4/4*3/5, i.e. from 0.15 to 0.60. In the present study the risk characterization score was calculated as the product of magnitude and observed exposure. This approach also includes a quantitative assessment of the likelihood that an adverse effect can occur, ranging from 0% to 100%. In the present study this was considered as equal to 100%, supposing that all calves had the same likelihood of occurrence of an adverse effect since they were transported in very similar vehicles and route conditions. Moreover, in this approach a qualitative assessment of the uncertainty of the *magnitude* scores is also adopted. On the basis of various sources of evidence, the uncertainty could be low (solid and complete data available), *medium* (some but not complete data available) and *high* (little or no data available). In the present study, the qualitative assessment of uncertainty of the *magnitude* score was considered *medium* for the hazards identified here, due to the relevant, but not exhaustive, literature available.

Statistical analysis

The hazard-related data resulting from the inspections were transformed into dependent binary response variables; a value of 0 was associated with compliance with regulations and 1 with non-compliance or infringement, considered a hazard. A logistic regression was used to assess the influence of the number of calves inside each vehicle and distance of the journey, the only two transport conditions recordable during the inspections, on the probability of hazard exposure. The mean values (±s.d.) of the variables were 56±13 (min 10, max 93) and 813±311 km (min 410, max 2227), respectively. In detail, the logistic distribution model adopted was the following:

$$P_r\,(Y=1) = e^{(\alpha+\beta_1 x_1+\beta_2 x_2)} / 1 + e^{(\alpha+\beta_1 x_1+\beta_2 x_2)}$$

where P_r is the probability of hazard occurrence, x_1=No. of animals loaded; x_2=travelled distance (km). The data were analyzed using the SAS Proc Logistic software package (SAS,

Table 4. Frequencies of infringements observed during vehicle inspections carried out between 2001 and 2010 at the border between France and Italy.

Animals	Calves, %	Trucks, %	Vehicles	Calves, %	Trucks, %	Accompanying documents	Calves, %	Trucks, %
Overcrowding	23.8	20.3	Drinking system	8.3	8.1	Veterinary certificate irregular or incomplete	0.5	0.4
Improperly tied	0.4	2.0	Not present	0.6	0.8			
Mixing different sexes or ages	3.7	4.1	Out of order	2.1	2.0	Journey log°	39.5	34.5
			Lack of water	3.5	3.2	Plan missing	17.3	15.4
			Unusable for cattle	2.0	2.0	Resting places missing	10.2	8.9
			Partitions	22.6	21.1	Time of departure missing	7.9	7.3
			Not present	17.1	16.3	Expected duration missing	9.1	8.5
			Present but not set in place or unsuitable	5.5	4.9	Unrealistic expected duration	5.1	4.9
						Unsigned	6.8	6.1
			Mechanical ventilation system	10.2	10.6	Unstamped	1.8	1.6
						Unbound	6.8	6.9
			Not present	1.8	1.6			
			Out of order	8.4	8.9			
			Bedding	5.3	5.2			
			Not present	0.9	0.9			
			Not sufficient	4.4	4.3			
			Deck	0.8	0.8			
			Height not sufficient	0.8	0.8			
			Lighting system	1.8	1.6			
			Not present	0.5	0.4			
			Not sufficient	0.4	0.4			
			Out of order	0.5	0.4			
			Lighting present only in one part of the vehicle	0.4	0.4			

°The figures given are not the sums of each single item because several vehicles presented more than one journey log infringement.

1996). A χ^2 Wald test of the null hypothesis was carried out and P values <0.05 were accepted as significant. Hazard exposures lower than 1% were not considered in the logistic regression. A similar model was recently used to evaluate the risk of impaired pork quality (Guàrdia *et al.*, 2004) and the risk of pig mortality after transport to the slaughterhouse (Averos *et al.*, 2008).

Results and discussion

Hazard identification

A correspondence emerged between the infringements recorded during the inspections (Table 4) and the hazards in cattle transportation identified by expert focus groups (Reenen *et al.*, 2008; Dalla Villa *et al.*, 2009). Infringements such as overcrowding and incorrect tying of animals, as well as some violations regarding partitions, bedding, decks, and drinking and mechanical ventilation systems were identified as hazards. The irregularities detected in the accompanying documents showed the highest frequencies. Even if they were useful for identifying infringements related to compliance with journey and rest periods, they were not taken into account because of the impossibility of quantifying the breaches in terms of duration.

Hazard characterization

The hazards identified and their characterization, together with the unfulfilled or insufficiently satisfied needs and the adverse effects, are listed in Table 5. On the basis of the methodology suggested by Dalla Villa *et al.* (2009), the identified hazards were characterized as *moderate* (score=2) or *severe* (score=3). *Moderate* hazards are capable of causing moderate changes from normality, discomfort, health problems or pain but not intense or prolonged ones, while *severe* hazards imply substantial changes from normality and are capable of causing intense and/or prolonged discomfort, health problems or pain. On the basis of the literature on stock calf welfare during transport (Grandin and Gallo, 2007; SCAHAW, 2002; Tarrant and Grandin, 2000) and recent indications of focus groups (Reenen *et al.*, 2008, Dalla Villa *et al.*, 2009), the hazards concerning overcrowding and lack of drinking and mechanical ventilation systems were characterized as *severe*, while those concerning partitions, bedding, truck decks, tying and mixing of animals were characterized as *moderate*.

The quantification of the severity of adverse effects still remains an unresolved problem in RA (Muller-Graf *et al.*, 2008). In the present study, the scoring was based on the available literature and expert opinions, but a degree of uncertainty cannot be avoided. Moreover, it is

Table 5. Infringements and hazards identified with unfulfilled needs of animals, their adverse effects, and hazard characterization according to the approach of Dalla Villa *et al.* (2009).

Infringements - Hazard identified	Unfulfilled needs	Adverse effects	Severity	Score	Magnitude°
Animals					
Overcrowding	Adequate breathing, thermoregulation, drinking, normal posture equilibrium, lying down, getting up	Hyperthermia, dehydration, physical exertion, impact against other subjects	Severe	3/4	3/4×0.6=0.45
Improperly tied animals	Normal posture equilibrium, lying down, getting up	Physical exertion	Moderate	2/4	2/4×0.6=0.3
Mixing of animals of different sexes or ages	Appropriate social contacts	Physical exertion, impact against other subjects	Moderate	2/4	2/4×0.6=0.3
Vehicles					
Drinking system Not present Out of order Lack of water Unusable for cattle	Drinking	Dehydration	Severe	3/4	3/4×0.6=0.45
Partitions Not present or, if present, not used	Normal posture equilibrium	Physical exertion, impact against other subjects or against the internal walls	Moderate	2/4	2/4×0.60=0.3
Mechanical ventilation system Not present Out of order	Adequate breathing, thermoregulation	Difficulty in breathing, hyperthermia	Severe	3/4	3/4×0.6=0.45
Bedding Not present Not sufficient	Normal posture, adequate environmental condition	Physical exertion, impact against other subjects or against the internal walls	Moderate	2/4	2/4×0.6=0.3
Lighting system Not present Not sufficient Out of order	Normal vision, adaptation to the change of light	Fear	Mild	1/4	1/4×0.6=0.1
Decks Height not sufficient	Normal posture	Physical exertion, impact against the roof	Moderate	2/4	2/4×0.6=0.3

°Magnitude: severity × duration where duration: 3/5 = 0.6.

well known that there are interactions among hazards and cumulative effects arising from them. Due to the absence of methods for including these effects in RA, a possible solution is to categorize the hazards on the basis of other factors (Muller-Graf *et al.*, 2008). For instance, overcrowding could be judged within the context of different environmental conditions, such as below or above thermal neutrality conditions (Dalla Villa *et al.*, 2009). However, the application of RA on animal welfare, in particular on animal transport, could be considered a new field where the definition of guidelines is in progress and where new scientific knowledge might help to reduce miscalculation or misinterpretation of hazard severity and/or exposure.

Exposure assessment and risk characterization

Table 6 shows the exposure score of the hazards identified, together with the risk characterization. The highest values of the hazards exposure were represented by overcrowding (23.8%) and absence of partitions (22.6%). Despite the importance of an adequate stocking density in transit, overcrowding is practiced as an attempt to reduce the cost of transport per head. The absence of partitions is related to overcrowding since it is likely that more space is obtained on the vehicle for the transportation of a larger number of animals than permitted by removing these facilities. Exposure to a lack of mechanical ventilation or drinking systems showed a frequency of 10.2% and 8.3%, respectively. The incidence of exposure was lower in the case of hazards associated with the absence of or inadequate bedding and the mixing of animals, 5.3% and 3.7%, respectively. Exposure to the hazard of lack of lighting system, insufficient deck height, and inappropriate tying were the lowest, with a frequency of 1.9%, 0.9% and 0.4%, respectively. There are no previous data on hazard exposure of calves during transport. The estimates found in the present study fell within the ranges of exposure estimated for the same hazards in a simulated scenario regarding heifers transported over long distances (Dalla Villa *et al.*, 2009). Even if a comparison is not possible, our findings highlighted the need to obtain figures on hazard exposure based on observed data in order to reduce the uncertainty of the theoretical model applied for risk assessment in animal transportation.

The approach applied ranked overcrowding as a major risk in stock calf transportation from France to Italy. The result of RA is not a conclusive numerical estimate of the risk attributed to the hazards identified during the inspections. It suggests that reducing overcrowding should be a priority in future actions devoted to improving the transport conditions of calves imported from France to Italy. Hazard exposures based on observed data are now available thanks to *on the road* inspections which provided a figures able to improve the reliability of the RA in animal transportation and to decrease the uncertainty of the estimates.

Effect of the number of calves inside the vehicle and travelled distance

The results of the logistic regression are shown in Table 7. The number of calves loaded into a vehicle significantly influenced the hazard probability as far as overcrowding ($P<0.01$) and the absence of partitions ($P<0.05$) are concerned. The other hazards *lack of ventilation, lack of drinking system, absence of or inadequate bedding, lack of lighting system*, and *mixing* were not significantly related to the number of animals in the vehicle. Stating that the number of calves is positively related to overcrowding seems obvious, however, this could be true only if all trucks inspected had the same space allowance and all transported calves had the same weight, which is not the case in this study. The positive relationship between the risk of overcrowding and the number of animals inside the vehicle (Table 7) suggests that the loading of more calves than required by the legislation could occur more frequently when the number of animals inside a vehicle becomes so high that recognizing this infringement becomes difficult. A large number of animals inside a vehicle could be associated with the presence of lighter calves, which are more sensitive to bad journey conditions due to overcrowding. As stated earlier, the relationship between the number of animals inside the vehicle and the absence of partitions is technically related to overcrowding.

Figure 1 shows the range of probabilities for overcrowding and absence of partitions in relation to the number of calves inside each vehicle. The probability of exposure to the first two hazards reaches 60% when the number of animals loaded into the vehicle is around 90. The travelled distance shows an interesting but weak inverse relationship with exposure to the absence of partitions, which decreased with

Table 6. Exposure (in percentage) to hazards identified during the inspections and risk characterization according to the approach of Dalla Villa *et al.* (2009).

Hazards	Exposure, %	Magnitude	Risk characterization
Overcrowding	23.8	0.45	10.7
Absence of partitions	22.6	0.3	6.8
Lack of mechanical ventilation	10.2	0.45	4.6
Lack of drinking system	8.3	0.45	3.7
Absence or inadequate bedding	5.3	0.3	1.6
Mixing of animals of different sexes or ages	3.7	0.3	1.1
Lack of lighting system	1.9	0.1	0.2
Insufficient height of deck	0.9	0.3	0.3
Improperly tied animals	0.4	0.3	0.1

Risk characterization: exposure × magnitude.

Table 7. Coefficient, standard error and statistical significance of the effect of the number of calves into the vehicle and distance of journey on hazards of overcrowding and absence of partitions.

	Coefficient	SE	Wald χ^2	P value
Overcrowding				
Intercept	-3.8470	1.0987	12.2602	
No. calves/journey	0.0496	0.0155	10.1914	0.0014
Distance, km	-0.0005	0.0006	0.5534	0.4569
Absence of partitions				
Intercept	-2.1472	1.0128	4.4948	
No. calves/journey	0.0290	0.0141	4.1446	0.0418
Distance, km	-0.0011	0.0007	2.2779	0.1312

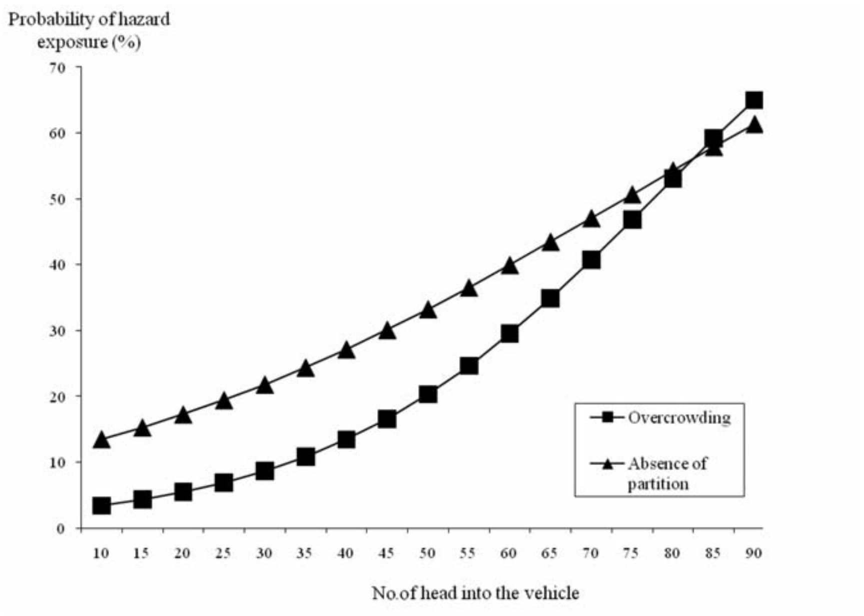

Figure 1. Relationship between the number of calves loaded in the vehicle and the probability of exposure to overcrowding and absence of partitions.

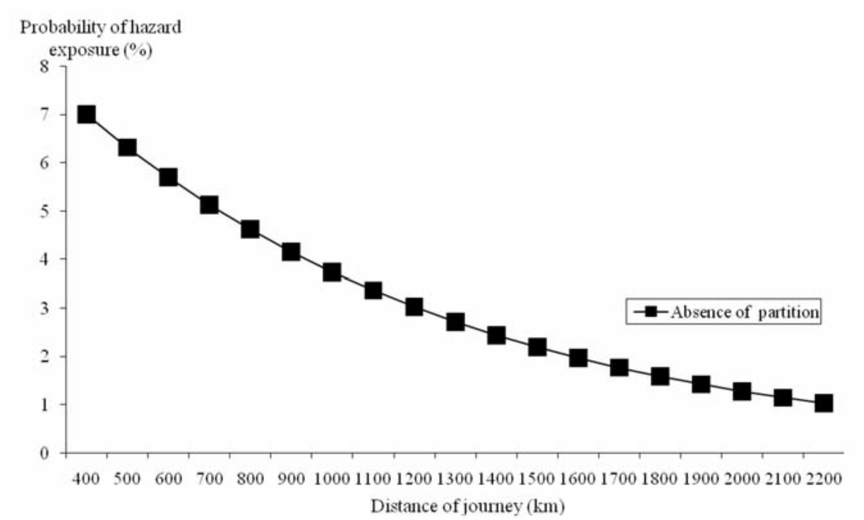

Figure 2. Relationship between the travelled distance and the probability of exposure to absence of partition.

increasing distances.

Figure 2 shows the probability of the absence of partitions in relation to variations in travelled distance; the probability is more than 7% when the distance is 500 km and it decreases to less than 2% when the distance is greater than 2000 km. This negative relationship suggests that the partitions could be less frequently used or left out of the vehicles if the journeys are short. This is probably due to a widespread belief that a shorter journey is less likely to be subjected to an inspection.

Conclusions

The results show that information collected during the *on the road* inspections represent a reliable contribution to the hazard identification, hazard exposure, and assessment of risk in the transport of stock calves. Overcrowding and the absence of partitions were found to be the major risks in stock calf transportation from France to Italy. A direct relationship emerged between the number of calves per vehicle and exposure to overcrowding or to absence of partitions. More data on transport inspections are needed in order to increase the reliability of the RA in animal transportation. The information obtained from *on the road* inspections provides not only a basis for evaluating the welfare of animals during transport but also an objective contribution to the assessment of the risks related to their transportation.

References

Averos, X., Knowles, T.G., Brown, S.N., Warriss, P.D., Gosalvez, L.F., 2008. Factors affecting the mortality of pigs being transported to slaughter. Vet. Rec. 163:386-390.

Dalla Villa, P., Marahrens, M., Velarde Calvo, A., Di Nardo, A., Kleinschmidt, N., Fuentes Alvarez, C., Truar, A., Di Fede, E., Otero, J.L., Müller-Graf, C., 2009. Project to develop animal welfare risk assessment guidelines on transport. Available from: http://www.efsa.europa.eu/it/supporting/doc/21e.pdf

EFSA, 2007. Opinion of the scientific panel on animal health and welfare on a selfmandate on the framework for EFSA AHAW risk assessments. EFSA J. 550:1-46.

European Commission, 2002. The welfare of animals during transport (details for horses, pigs, sheep and cattle). Report of the Scientific Committee on Animal Health and Animal Welfare (SCAHAW) adopted on 11 March 2002. European Commission, Health & Consumer Protection Directorate-General. Available from: http://ec.europa.eu/food/fs/sc/scah/out71_en.pdf

FAO/WHO, 1999. Codex Alimentarius Commission. Principles and guidelines for the conduct of microbiological risk assessment. Document n. CAC/GL-30. Available from: http://www.codexalimentarius.net

Grandin, T., 1997. Assessment of stress during handling and transport. J. Anim. Sci. 75:249-257.

Grandin, T., Gallo, C., 2007. Cattle transport. In: T. Grandin (ed.) Livestock Handling and Transport. 3rd ed., CAB International, Oxford, UK, pp 134-154.

Guàrdia, M.D., Estany, J., Balasch, S., Oliver, M.A., Gispert, M., Diestre, A., 2004. Risk assessment of PSE condition due to preslaughter conditions and RYR1 gene in pigs. Meat Sci. 67:471-478.

ISTAT, 2010. Foreign Trade Statistics. Italian National Institute of Statistics. Available from: http://www.coeweb.istat.it/english/default.htm

Lester, R.R., Green, L.C., Linkov, I., 2007. Site-specific applications of probabilistic health risk assessment: review of the literature since 2000. Risk Analysis 27:635-658.

Müller-Graf, C., Candiani, D., Barbieri, S., Ribó, O., Afonso, A., Aiassa, E., Have, P., Correia, S., De Massis, F., Grudnik, T., Serratosa, J., 2008. Risk assessment in animal welfare – EFSA approach. Alternatives to Animal Testing and Experimentation Journal 14:789-794.

Reenen, C.G. Van, Reimert, H.G.M., Gerritzen, M.A., Leenstra, F.R., Lambooij, E., 2008. Hazard identification and characterization of welfare aspects during transport of farm animals. Report 152. Animal Sciences Group Publ., Wageningen, The Netherland.

Ribo, O., Candiani, D., Serratosa, J., 2009. Role of European Food Safety Authority (EFSA) in providing scientific advice on the welfare of food producing animals. Ital. J. Anim. Sci. 8(Suppl.1):9-17.

SAS, 1996. User's Guide, 4th ed. SAS Inst. Inc., Cary, NC, USA.

Tarrant, V., Grandin, T., 2000. Cattle transport. In: T. Grandin (ed.) Livestock hhandling and transport. 2nd ed. CAB International, Oxford, UK, pp 151-173.

World Organisation for Animal Health, 2004a. Handbook on import risk analysis for animals and animal products. Volume 1. Introduction and qualitative risk analysis. Available from: http://www.oie.int/doc/ged/D6586.PDF

World Organisation for Animal Health, 2004b. Handbook on import risk analysis for animals and animal products. Volume 2. Quantitative risk assessment. Available from: http://www.oie.int/doc/ged/D11250.PDF