

A QUESTIONNAIRE STUDY ON EUTHANASIA IN FARM-RAISED MINK

HANNU T. KORHONEN, JUHANI SEPPONEN & PEKKA ESKELI

ABSTRACT: A questionnaire was formulated to collect data on euthanasia procedures and routines in farmed mink. The principle aim was to clarify the extent and functionality of the main killing methods, i.e. filtered exhaust and cylinder CO (carbon monoxide) and cylinder CO₂ (carbon dioxide). The questionnaire was sent to 397 mink farms in Finland and to 143 in the Netherlands. The final response rates were 34.3% for Finland and 24.5% for the Netherlands. The farms in the Netherlands were typically larger than those in Finland. The preferred method of euthanasia in the Netherlands is cylinder CO, which has been shown to work well in that country's farming system. In Finland, the filtered exhaust CO killing method has a long history, and farmers have grown accustomed to using this special method. The results were as follows: 20.0% of farmers listened outside the killing box, and when there was no sound, they presumed the animals were dead; 20.0% of farmers checked the state of the animals through the inspection window of the box before opening it; 80.0% of farmers waited for 5 minutes or more after the last mink was put into the box before emptying it; 45.7% farmers inspected each individual mink when emptying the box, checking for breathing and movement; and 14.3% of farmers inspected the mink at the cooling site, checking for breathing and movement. The replies to our questionnaire study suggest that farmers consider that all three euthanasia methods, cylinder CO, cylinder CO₂ and filtered exhaust CO are effective and useful ways of killing mink in farming practice.

KEY WORDS: *Mustela vison*, killing methods, social welfare, gas euthanasia, fur farming, and Finland and Netherlands' farmers.

INTRODUCTION

In 2013, new legislation will be introduced regarding the slaughter of husbandry animals in the European Union (*Regulation EC, No.1009/2009*). This legislation will also cover the killing of fur-farmed animals, and new measures regarding the euthanasia of mink and foxes will be implemented. The term "euthanasia" is originally derived from Greek. It can be considered as "a good death" (AVMA, 2007); and, thus, carries the implication of a painless, humane death. It refers to the process of killing the animal with the use of recognized, acceptable, and ethical techniques. The methods of euthanasia employed must have an immediate depressive action on the central nervous system to ensure insensitivity to pain without causing fear or suffering. The procedure must also be practical, reliable,

Hannu T. Korhonen, Juhani Sepponen and Pekka Eskeli are Principal Research Scientists and Ph.D. Docents in Applied Zoology, Animal Production Research, MTT (Agrifood Research Finland) Silmäjärventie 2, 69100 Kannus, Finland. The authors can be contacted via e-mail at: hannu.t.korhonen@mtt.fi

easy to use, relatively inexpensive, and compatible with operational practices on farm.

Opinions are, however, divided about the most acceptable way of euthanizing fur-farmed animals. Several methods and techniques have been developed and tested. These include breaking the neck, electrocution, gassing with carbon monoxide (CO), carbon dioxide (CO₂), nitrogen (N₂) or Argon (Ar), and lethal injections (Loftsgård, Braathen & Helgebostad, 1972; Finley, 1980; Loftsgård, 1980; Gierløff, 1980a and 1980b; Löliger, 1984; Lamboy, Roelofs & van Voorst, 1985; Hansen, Creutzberg & Simonsen, 1991; Cooper, Mason & Raj, 1998; Raj & Mason, 1999; EFBA, 1999; and Fitzhugh *et al.*, 2008). Neck-breaking is prohibited today. Electrocution is rarely used any more, as it is not considered a very suitable method for modern practice and, besides, it would require an alternative method for additional assurance.

The main gases currently used for euthanasia on European fur farms are carbon monoxide (CO) and carbon dioxide (CO₂). The former originates from either a petrol machine (filtered exhaust gases) or a cylinder (pure source); the latter is employed only as a pure gas from a cylinder (EFBA, 2008a and 2008b).

Due to the lack of sufficient knowledge about the type of mink euthanasia most commonly practised on commercial farms, a questionnaire was formulated to collect basic data on killing procedures and routines. The main scope of the present study was to clarify the extent and functionality of the main euthanasia methods, i.e. filtered exhaust and cylinder CO, and cylinder CO₂.

MATERIAL AND METHODS

Questionnaire for Finnish Farms. The four page questionnaire consisted of four parts with 41 questions. A copy of the questionnaire is available upon request from the authors. The questionnaire collected, *first*, general information on animals and production premises; *second*, details about the euthanasia methods used; and *third*, finally, information on the killing of animals in general and plans for the future. There was also space for general comments. The entire questionnaire was estimated to take the farmer 10-15 minutes to complete. The answer block was partly numerical, but it also had a dichotomous response block (yes/no), and a part where the respondent could write freely.

The questionnaire, together with a short cover letter explaining the purpose and scope of the study and a freepost return envelope, was sent to Finnish farmers on August 30, 2010. In an effort to improve the response rate, a reminder was sent 7-8 weeks later. The questionnaires were also handed to farmers in person at the Finnish Fur Breeders' Association's briefings in autumn 2010. The final response rate, after the reminder and information occasions, was 34.3% (sent to 397 farms, responses received from 136 farms).

To encourage participation, the cover letter pointed out that new legislation regarding the slaughter of husbandry animals was to be introduced in the EU (European Union). The legislation would include the killing of fur-farmed

animals, and new measures regarding the killing of mink would be implemented. The questionnaire had been developed to elicit the necessary practical experience and an overview of practices on farms. It was being sent to mink-breeders, who would be able to help with research by completing the form. It was stressed that all information provided would be confidential.

Questionnaire for Dutch Farmers. The questionnaire used for Finnish farmers was adapted to Dutch conditions. Since only cylinder CO is used in the Netherlands, the questions on exhaust CO (carbon monoxide) and cylinder CO₂ (carbon dioxide) were omitted from the Dutch version. In the end, the Dutch questionnaire contained 24 questions. It was translated into Dutch and delivered to farmers by the Dutch Fur Breeders' Association in September 2010. A copy of the questionnaire is available upon request from the authors. The response rate, after a reminder, was 24.5% (sent to 143 farms, response received from 35 farms).

Data Analyses. The data from Finnish farms were recorded by MTT (*Agrifood Research Finland*) at Kannus, Finland. The Dutch data were saved first by the Dutch Breeders' Association in the Netherlands, and then sent to MTT Kannus, Finland, for further processing. All data were treated by SAS (Statistical Analyses Software) 9.1 release at MTT.

RESULTS

The sizes of mink farms using filtered exhaust CO (carbon monoxide), cylinder CO₂ (carbon dioxide), and cylinder CO in Finland and in the Netherlands are given in table 1. On average, farms were much larger in the Netherlands than in Finland. Cylinder CO was used exclusively in the Netherlands.

Table 1:
 Sizes of Farms Included in the Present Study

	Finland		The Netherlands
	Exhaust CO	Cylinder CO ₂	Cylinder CO
No. of farms	118	18	35
< 7,500 pelts produced	98	11	1
7,500 – 15,000 pelts produced	8	3	7
15,000 – 30,000 pelts produced	5	1	12
> 30,000 pelts produced	0	1	13
No response	7	1	2

Finnish Farms. The data from Finland are based on responses from 136 farms (table 2). About 13.2% of these (18) used cylinder CO₂ (carbon dioxide) for euthanasia and all the others (118 farms, 86.6%) filtered exhaust CO (carbon monoxide). No Finnish farms used cylinder CO for killing mink. The farms using CO₂ were on average larger than those using exhaust CO (1,044 vs 1,834 vixens on average). There was no difference in litter size between the farms.

Table 2:
 Basic Data from Finnish Mink Farms Using Exhaust CO and Cylinder CO₂ for Euthanasia

	Exhaust CO	Cylinder CO ₂
No. of farms	118	18
No. of sheds	9.2	11.0
No. of vixens	1,044	1,834
Litter size	4.40	4.41
Pelting on own farm, %	42.2	41.2
Possibility for individual killing, %	20.9	15.4
No. of days spent on killing	15.8	16.3
Hours per day spent on killing	4.2	5.4
No. of animals in gas box	56	75
Time interval to mink input, sec.	54	28
Size of gas box: length, cm	145	158
width, cm	70	65
height, cm	70	69
volume, m ³	0.73	0.72

The killing box volume was similar with both gases. However, the number of animals placed in the killing chamber was higher with CO₂. With both gases, the killing period lasted for about 16 days. Farmers using cylinder CO₂ spent 1.2 hours per day more on the killing procedure than did farmers using filtered exhaust CO. Pelting most often occurred on the own farm, the percentage of furs pelted on the own farm being of the same order of magnitude in both gas groups (table 2).

Only 3.5% of filtered exhaust CO users reported that the CO concentration was measured (table 3). The gas was delivered into the killing box through a filter in 92.2 % of farms. Altogether 56.6% of farms cooled the gas using a kind of air cooling system with a long gas input pipe. The temperature of the gas in the killing box was measured by 14.4% of farmers during the euthanasia procedure. The average temperature in the box was reported to be 34.5 °C. The engine was kept running throughout the killing procedure on 87.9% of farms. These farms typically killed large numbers of animals in one day.

None of the farmers reported measuring the CO₂ concentration in their killing boxes. The size of the CO₂ cylinder ranged from 15 to 60 kg, the average being 30 kg. The average number of mink that could be killed by a 30 kg CO₂ cylinder was 915. Thus, 1 kg CO₂ can be used to kill, on average, 31 animals. None of the CO and CO₂ users measured CO or CO₂ concentration or gas flow in the chamber.

Only four out of a total of 18 CO₂ users answered the question concerning type of control valve. Three had an AGA (A Gas) unicontrol regulator and one a Jetcontrol 500 regulator. The pressure used was reported to be from 0.2 to 200 bar. This sounds odd and is probably incorrect. It is possible that the farmers did not understand the question.

Table 3:
 Data on Exhaust CO Killing Procedure
 N = Number of Farms Replying

Variable	N	Yes (%)	No (%)
Engine running continuously?	116	87.9	12.1
CO concentration measured?	113	3.5	96.5
Exhaust gas filtered?	115	92.2	7.8
Exhaust gas cooled?	113	56.6	43.4
Temperature of chamber known?	104	14.4	85.6

Only 68.6% of filtered exhaust CO users answered the question concerning the type of machine and engine. The most common engine was a feeding machine (75.3% of farmers; see also figure 1), the next most common was a lawn mower (12.3%) and the next a killing trolley (7.4%); the least common were a car (3.7%) and an ATV [All Terrain Vehicle] (1.3%). The fuel employed was petrol (either 95 Oct or 98 Oct, or both).

Only 3.1% of filtered exhaust CO users were interested in having a pool of killing equipment to be shared by all farmers. No CO₂ users were interested in shared use. Furthermore, only 3.9 % of filtered exhaust CO users were willing to switch from exhaust CO to CO₂ for euthanasia. None of the CO₂ users were willing to exchange CO₂ for exhaust CO. The willingness to kill mink individually was low in both groups: 20.9% in the filtered exhaust CO and 15.4% in the CO₂ group.

About 89.7% of farmers that used filtered exhaust CO reported that they had not experienced any adverse effects from CO on their health. The corresponding figure for CO₂ users was 93.3%. Altogether 96.7% of farmers were satisfied with the method they were currently using. Six filtered exhaust CO farmers reported that they had also tested cylinder CO₂ but were not satisfied and continued with filtered exhaust CO. One farmer reported strong cooling and ice formation presenting a problem with the CO₂ cylinder.

Farmers most commonly confirmed that animals were dead by the time elapsing after the last mink was put into the box. Figure 1 shows that 36.7% of filtered exhaust CO and 28.6% of CO₂ users relied on time. The next most common method was to test for motion/movement (33.0% vs 21.2%). This was followed by a combination of movement and v = voice/vocalisation (4.6% vs 21.4%), and by vocalisation alone (2.8% vs 21.4%). A combination of motion/movement, voice/vocalisation, and time was similar for both gases (11.0% vs 7.1%).

Dutch Farms. The Dutch data are based on material from 35 farms (tables 1 and 4). All farmers used cylinder CO (carbon monoxide) for mink euthanasia. About 75.0% of farmers considered that their killing method worked very well, and 25.0 % that it worked well. Almost all farmers, i.e. 97%, considered that the killing method used had no effect on their health or wellbeing.

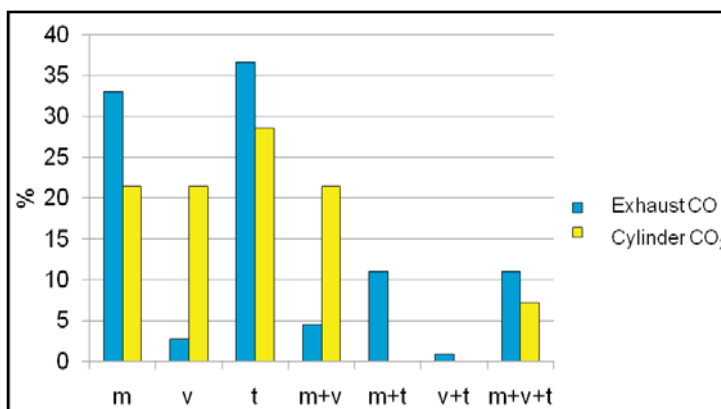


Figure 1:
 How to Confirm that the Mink are Dead
 m = movement, v = voice, t = time

Table 4:
 Basic Data from Dutch Mink Farms Using Cylinder CO for Euthanasia

	Cylinder CO
Possibility for individual killing, %	3.0
No. of animals in gas box	115
Time interval to mink input, sec.	13
Size of gas box: length, cm	128
width, cm	75
height, cm	72
volume, m ³	0.68

Altogether 87.9% of farmers reported that the animals were put into the killing box one at a time. The flow rate of the gas was as follows: 2.25 l/min before the first animal was put into the box; 1.95 l/min when the animal was put into the box; and 2.25 l/min after the last animal was put into the box. Gas filling started 121 sec. before the first animal was put into the box and continued for 271 sec. after the last animal was put into the box. The killing box was opened 355 sec. after gas input ceased. Only 15.6% of farmers took account of wind direction during the killing process. The killing box was usually opened out of doors (60.6% of farmers). The cadavers were picked up, on average, 32 sec. after the killing box had been emptied.

The size of cylinder for CO was 10 kg (85.7% of farmers) or 40 kg (12.5%). The average number of animals that could be killed using a 10 kg cylinder was 3,040; and that using a 40 kg cylinder was 8,000. Thus, 1 kg of CO can kill on average 250 animals. Only 11.4% of farmers reported being able to measure the CO concentration in the killing box. However, only one answer gave the actual

concentration, which was 99.5%. Altogether, 75.8% of farmers stored their cylinder in a locked space out of doors.

Dutch farmers were asked how they confirmed that the mink were dead. They could give two answers to the alternatives given. The results were as follows: (1) seven farmers listened outside the killing box, no sound meant death; (2) seven farmers checked through the box's inspection window before opening the box; (3) about 28 farmers waited for 5 minutes or more after the last mink was put into the box before emptying it; (4) about 16 farmers inspected each individual when emptying the box, checking for breathing and movement; (5) five farmers inspected the mink at the cooling site, checking for breathing and movement; and (6) one farmer inspected the mink at the cooling site, checking for normal cooling of the body temperature.

DISCUSSION

Mailed, self-administered questionnaires can be used to collect data on various subjects of interest. Although they are less expensive and quicker to complete than in-person interviews and give respondents time to collect some of the information requested, they also have disadvantages (Doherr *et al.*, 1998). A major one is the generally low response rate. In the present study, 136 of 397 questionnaires mailed to Finnish farmers were eventually returned, the response rate being thus 34.3%. This can be considered fairly high, providing us with enough data to draw reliable conclusions on the situation. However, most Finnish farms use filtered exhaust CO (carbon monoxide) and only a few cylinder CO₂ (carbon dioxide). Thus, the cylinder CO₂ results are based on data from only 18 farms.

In the Netherlands, 35 of 143 questionnaires mailed were returned, the response rate being thus 24.5%. This percentage is close to the reliability limit for results. The reliability of the Dutch results is, however, improved by the fact that Dutch farmers used only one killing method, i.e. cylinder CO. Thus, the expected variation among farms is probably lower than it would have been had they used several euthanasia methods.

Our initial intention was to use the same questionnaire in Finland and the Netherlands. This would have made it easier for us to compare the situation in the two countries. However, representatives of the Dutch Breeders' Association wished to adapt the questionnaire to their own situation.

The present questionnaire data are valuable in that they refer to three different euthanasia methods, namely, cylinder CO, cylinder CO₂ and filtered exhaust CO and so enable us to compare the different methods. Nevertheless, we should remember that the answers are based on farmers' personal opinions and thus reflect how they see things. According to the results, farmers consider that the euthanasia method they are currently using is good and efficient, and they are not very willing to exchange it for an alternative method. Their opinion is based on practical experience, which is a very valuable point of view. They have learned through their own practice that their method can be used to kill mink effectively.

It is clear that all three gas methods studied are workable in farm practice. If one or other of the methods had not worked in practice, farmers would already have exchanged it for a better one.

Farms in the Netherlands are typically larger than those in Finland, and the Dutch rely primarily on cylinder CO euthanasia. Practical experience has shown that this method works well in their farming system. In the Netherlands, mink are more commonly kept in halls, whereas in Finland they are still mostly kept in sheds.

In Finland, the use of filtered exhaust CO has a long history, and farmers are used to this special method. Nowadays, however, they frequently use bottle CO₂ as well. Cylinder CO is totally unknown in Finland and is not commercially available.

We had to order cylinder CO from Germany for our experiment. It presented several difficulties and was also expensive. The cost of equipment for CO in Finland is currently as follows: 10 kg cylinder € 220, valve € 515, and flow meter € 110. The cost of CO₂ equipment is: 30 kg cylinder € 60, valve € 280, and flow meter € 110. The total costs for CO₂ are thus markedly lower than those for cylinder-produced CO (Korhonen, 2010). Still, the cheapest method is engine-produced exhaust CO, the total cost of which was estimated to be less than € 150. In the Netherlands, cost for 10 liter cylinder is € 67 and that for 40 liter cylinder is € 96. The price of flowmeter is about € 300. Only flowmeter but no valve is used in the Netherlands.

From the literature, we know that CO is a toxic gas yet colourless, odourless, tasteless, and non-irritating (AVMA, 2007). It is very difficult for people and animals to detect. At concentrations of 12.5 – 75%, it is highly explosive. Symptoms of mild acute poisoning include headache, vertigo, and flu-like effects. Greater exposure can lead to significant toxicity of the central nervous system and heart, and even death (Carding, 1977; Barinaga, 1993; Piantadosi, 2002; and Gorman, Drewry & Huan, 2003). CO causes adverse effects in humans mainly by combining with haemoglobin (HbCO) in the blood. This prevents oxygen from binding with haemoglobin, thus reducing the oxygen-carrying capacity of the blood and leading to hypoxia.

According to AGA (A Gas) safety instructions, a safe exposure level in humans is 30 ppm in 8 h (AGA, 2010a). The EFBA (European Fur Breeders' Association) pointed out in their own paper that when using CO, the farmer must, for his own safety, leave the killing box open for 2 minutes before emptying it (EFBA, 2008a and 2008b). In the present study, over 60% of Dutch farmers typically opened the box in the open air after killing the animals. Furthermore, 97% of cylinder CO farmers in the Netherlands reported that they had not observed any effect on their health during the euthanasia process. This tempts us to conclude that Dutch farmers are well aware of the hazards involved in the use of pure bottle CO. In Finland, 89.7% of farmers reported that they had not observed any effect on their health. This is a slightly lower percentage than that for cylinder CO in the Netherlands. Typically, with exhaust CO, the engine is kept running for the whole day, which may partly explain the difference.

CO₂ is also a colourless and odourless gas. It is heavier than air (AVMA, 2007). At low levels, it has few toxicological effects and is typically safer to use than pure CO. According to AGA safety instructions, a safe exposure level in humans is 5000 ppm in 8 h (AGA, 2010b). Divers in particular suffer from a condition known as hypercapnia, in which there is too much CO₂ in the blood. Hypercapnia can induce increased cardiac output, elevated arterial blood pressure, and a propensity for arrhythmias (Langford, 2005). At high concentrations (> 75%), CO₂ may cause headache, confusion, lethargy, and death. In Finland, 93.3% of CO₂ farmers reported not having any health problems when using cylinder CO₂. According to the replies of the present questionnaire, exposure of farmers on CO and CO₂ seems to be slight during killing procedure.

CONCLUSION

On the basis of the present study, farmers consider that all three euthanasia methods, namely: cylinder CO (carbon monoxide), cylinder CO₂ (carbon dioxide), and filtered exhaust CO are effective and useful ways of killing mink in farming practice. In the Netherlands, cylinder CO is the only gas employed for killing mink. In Finland, on the other hand, cylinder CO is totally unknown and the most common euthanasia method is filtered exhaust CO. Also cylinder CO₂ is used in Finland. Exposure of farmers on CO and CO₂ seems to be slight during killing procedure.

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