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Short Communication

Failure of LiCl-conditioned taste aversion to prevent dogs from attacking sheep

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Abstract

Two Alaskan Husky dogs were used in a pilot study to examine the feasibility of LiCl-conditioned taste aversion as a method to prevent dogs from attacking livestock. The salt LiCl induces vomiting and diarrhoea, but is also an antidepressive drug. The dogs were fed LiCl-treated sheep baits at doses of 1–4 g LiCl per 250–900 g bait. A 4 g amount of LiCl in 500 g bait established a strong aversion against sheep meat in both dogs. Nevertheless, both dogs continued to attack sheep with an intensity even greater to that observed prior to LiCl treatment. Temporary side effects of the LiCl treatment included pronounced aggressiveness between the two dogs at feeding time, muscle stiffness and poor motor coordination. These results indicate that the method of LiCl-conditioned taste aversion to prevent dogs attacking sheep failed. © 1997 Elsevier Science B.V.

Keywords: Dog; Taste aversion conditioning techniques; LiCl; Predation

1. Introduction

Predatory attack by domestic dogs on free-ranging livestock is a problem in many areas. Hunting breeds of dogs are often trained with an electric collar to establish a conditioned aversion to sheep. Some breeds, e.g. Spitz breeds, do not readily respond to this type of treatment, which is also suspected to cause behavioural disturbances in the dog. Alternative methods are therefore necessary.

As an evolutionary adaptation, many animal species develop taste aversions against types of food that once have elicited sickness (Bolles, 1970; Revusky and Garcia, 1970;

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Treisman, 1977). Taste aversion conditioning has been studied, and is already being used in practice, as a method for reducing livestock predation. Positive results have been attained in the USA and Canada by using lithium chloride (LiCl) in sheep baits and carcasses to establish taste aversion in wolves, coyotes, and other canids (Gustavson et al., 1976; Ellins et al., 1977; Ellins and Catalano, 1980; Gustavson et al., 1982; Jelinski and Jowsey, 1983; Gustavson and Gustavson, 1985; Gustavson and Nicolaus, 1987).

In addition to inducing vomiting and diarrhoea, the salt LiCl is an antidepressive drug. It has been argued that the acute use of LiCl for establishing taste aversion has no adverse mental effects on the animal similar to those induced by the chronic use of lithium in psychiatric treatment (Gustavson, personal communication, 1994). Nevertheless, the Norwegian Committee for the Ethical Treatment of Research Animals wanted us to perform a controlled pilot study on two dogs before allowing any large-scale evaluations of the LiCl-conditioned taste aversion method on dogs.

The aim of this pilot study was to examine the feasibility of using LiCl-conditioned taste aversion to reduce predation on sheep by dogs. The LiCl doses needed to establish aversion, behavioural effects of the LiCl treatment, and the treatment's effectiveness in reducing predatory behaviour towards sheep were considered.

2. Material and methods

Two five year old Alaskan Husky males from the same litter were used, referred to as dog A and B, and weighing 21 and 22 kg respectively. The dogs were penned together during the study, as normally, except when tested at live sheep.

2.1. Dose experiment

Gustavson (personal communication, 1994) recommended a concentration of 4 g LiCl per kg bait, irrespective of the size of the dog. Small dogs eat less of the bait per unit time compared with large dogs, and since LiCl induces sickness soon after ingestion, animals will stop eating treated baits before serious poisoning can occur. The recommended dose is high enough to elicit vomiting, but still low enough to prevent the salty flavour to dominate an aversion effect. The actual dose the animal receives is the amount it eats minus the amount regurgitated and expelled in diarrhoea. Normally, LiCl makes the animal ill within 10 to 30 min.

The dogs in this study were fed sheep baits of 250–900 g containing 1–4 g of LiCl (Table 1). The baits consisted of sheep meat, fat and wool, and smelled strongly like sheep. The solid LiCl was dissolved in water and injected into the bait at eight different sites with a 20 ml syringe.

2.2. Establishing LiCl-conditioned taste aversion

The feeding programme used resembled the ones described by Gustavson and Nicolaus (1987) (Experiments 2 and 3). LiCl-injected baits were given on days 1, 2, 4

and 6, while commercial dog food was supplied on days 3, 5 and 7 (Table 1). Taste aversion was tested for on days 6 and 7. Time spent eating, amount of bait left over, the latency time between feeding initiation and vomiting, and the amount of vomit were recorded.

The daily ration of commercial dog food for these dogs was about 400 g (1580 kJ/100 g dry matter). A sheep bait of 500 g should be enough to fulfil their daily energy needs. The dogs were exercised every second day by taking them for a 5 km run in front of a bicycle. Any type of abnormal behaviour during feeding and training was registered.

2.3. Testing the dogs' response to live sheep

The dogs were tested separately on live sheep at three occasions, i.e. before LiCl treatment (base level of hunting drive, day 0) and then again on days 7 and 8 after the bait aversion had been established. Since physical contact between predator and prey may be necessary before the predator is able to associate the aversive bait with the live prey (Gustavson and Gustavson, 1985), the test was repeated on day 8.

The trials were performed under controlled conditions with a 2 m high deer fence between the sheep and dog being tested. Still, the dog was able to get in physical contact with the sheep to a restricted extent. The dog's test arena measured 35 × 15 m. Adjoining this arena and running parallel to the short side, a 2 m wide runway for three sheep was put up. At the start of the test there was a 35 m distance between the dog and sheep. The time elapsed from releasing the dog until it started to chase or attack the sheep was measured.

Table 1
Feeding programme, LiCl doses and aversion reactions in dogs A and B

Day of feeding	Type of feed	Weight (g)	LiCl/dog /day (g)	Eating time	Leftovers (g)	Time until vomiting	Vomit mass (g)
Day 1	Sheep	250 [a]	1	A: 43 s	0	–	0
				B: 47 s	0	–	0
Day 2	Sheep	500	2	A: 19 min	0	11 h	50
				B: 25 min	0	–	0
Day 3	Dogfood	200 [a]	–	A: < 30 s	0	–	0
				B: < 30 s	0	–	0
Day 4	Sheep	500	4	A: 45 min	122	125 min	300
				B: 40 min	200	130 min	200
Day 5	Dogfood	400	–	A: < 60 s	0	–	0
				B: < 60 s	0	–	0
Day 6	Sheep	900	4	A: > 60 min	840	–	0
				B: > 60 min	760	–	0
Day 7	Dogfood	400	–	A: < 30 s	0	–	0
	Turkey	50	–	B: < 30 s	0	–	0

[a] The dogs were fed about half the normal ration to ensure that they would be hungry enough to eat LiCl-treated baits the following day.

3. Results

3.1. Dose experiment and taste aversion establishment

The degree of aversion induced by various doses of LiCl is shown in Table 1. One gram of LiCl in 250 g bait did not result in regurgitation or any other signs of aversion. Two grams of LiCl in 500 g bait tended to prolong the time required to finish eating, and a small amount of vomit was produced 11 h after the meal by dog A. Four grams of LiCl in 500 g bait induced strong vomiting reactions in both dogs 2 h after eating the baits. Offering sheep baits on day 6 confirmed that the vomiting reactions on day 4 had established an aversion towards sheep meat; the dogs hardly touched the baits. This aversion was specific towards sheep meat, as indicated by their willingness to eat fresh turkey meat on day 7.

The total LiCl intake, corrected by subtracting the amount of LiCl in bait that was regurgitated but without considering the amount in faeces, was estimated to be about 5 g for dog A and 6 g for dog B.

3.2. Behavioural reactions

The dogs suffered stomach convulsions before regurgitating, as expected. The LiCl treatment also induced muscle stiffness and muscle trembling (particularly in the hind legs), with a corresponding reduction in motor coordination. In addition, the dogs showed aggressive behaviours towards each other during and after feeding; baring teeth, fighting and guarding their own food, which they had never done before. Although the muscle stiffness may have affected the dogs' capacity to run, they were still willing to exercise, and their gait seemed to be normal. They had normal faeces and drank normal amounts of water. The muscle stiffness and abnormal behaviours lasted for about a week after the strong vomiting reaction on day 4. The dogs behaved normally during the following year. When offered sheep meat again half a year after the experiment, they readily accepted it.

3.3. Testing the response to live sheep

Initial testing of the dogs with live sheep (day 0, before LiCl treatment) showed that they were extremely motivated to hunt (Table 2) and attacked within 15 s of their release. On both testing occasions after the LiCl treatment (days 7 and 8), the delay between release and attack was even shorter.

Table 2
Time elapsed between the release of a dog and its attack on the sheep

Dog	Delay between release and attack (s)		
	Day 0	Day 7	Day 8
A	8	5	4
B	14	6	5

4. Discussion

The results agreed well with the theoretical assumptions until the dogs were tested using live sheep. The dogs attacked the sheep, even though they had a strong aversion against sheep meat. The most obvious explanation for this result is that the dogs did not associate the meat with live prey. A moving prey elicits hunting behaviour, whereas a stationary piece of meat does not. The dogs' association between meat and live prey was no stronger on day 8, after having been in physical contact with the sheep the day before. Many scientists have not been able to reproduce the results of Gustavson and his colleagues (Conover et al., 1977; Burns, 1980; Bourne and Dorrance, 1982; Burns, 1983a) and methodological weaknesses are discussed by Conover et al. (1977), Ellins and Martin (1981), Burns (1983b), Gustavson and Nicolaus (1987) and others.

Contrary to our expectations, the delay between release of the dogs and their attack on the sheep was shorter after the LiCl treatment (days 7 and 8) than before (day 0). This indicates that the dogs did not associate meat and live prey, but may also reflect habituation to the test situation.

The two first doses of LiCl (1 g LiCl/250 g bait and 2/500) were offered using the concentration recommended by Gustavson (4 g/kg bait, Gustavson personal communication, 1994), but the baits were smaller. No strong vomiting reactions were attained until the recommended amount of 4 g LiCl per dog was used. However, this amount resulted in unexpected adverse behavioural and muscular reactions in the dogs, as shown by pronounced aggressiveness towards each other at feeding time, muscle stiffness, muscle trembling and poor motor coordination. We consider this observation to be the most important result of our study. Although such responses have neither been discussed nor documented in the literature, they could, nevertheless, have occurred. It is possible, that adverse reactions went unnoticed in cases where the post-treatment follow-up was less comprehensive than that carried out in the present study. Another possibility is that the repeated intake and accumulation of LiCl in the dogs might have caused the side effects. However, since the estimated accumulation per dog was only 5–6 g LiCl this seems unlikely.

5. Conclusion

Since the desired aversion response against live sheep in this pilot study failed to appear, and since the LiCl treatment had some negative mental and physiological effects on the dogs, we cannot recommend LiCl-conditioned taste aversion as a method to prevent dogs from attacking livestock. As a consequence, a larger project originally planned was abandoned. If such studies are to be made, however, it will be necessary to focus more on the mental and physiological effects of the LiCl treatment and on improving the methodology.

References

Bolles, R.C., 1970. Species-specific defence reactions and avoidance learning. Psychol. Rev., 77: 32–48.

Bourne, J. and Dorrance, M.J., 1982. A field test of lithium chloride aversion to reduce coyote predation on domestic sheep. J. Wildl. Mgmt., 46: 235–239.

Burns, R.J., 1980. Evaluation of conditioned predation aversion for controlling coyote predation. J. Wildl. Mgmt., 44: 938–942.

Burns, R.J., 1983a. Microencapsulated lithium chloride bait aversion did not stop coyote predation on sheep. J. Wildl. Mgmt., 47: 1010–1017.

Burns, R.J., 1983b. Coyote predation aversion with lithium chloride management implications and comments. Wildl. Soc. Bull., 11: 128–133.

Conover, M.R., Francik, J.G. and Miller, D.E., 1977. An experimental evaluation of aversive conditioning for controlling coyote predation. J. Wildl. Mgmt., 41: 775–779.

Ellins, S.R. and Catalano, S.M., 1980. Field application of the conditioned taste aversion paradigm to the control of coyote predation on sheep and turkeys. Behav. Neural Biol., 29: 532–536.

Ellins, S.R. and Martin, G.C., 1981. Olfactory discrimination of lithium chloride by the coyote (*Canis latrans*). Behav. Neural Biol., 31: 214–224.

Ellins, S.R., Catalano, S.M. and Schechinger, S.A., 1977. Conditioned taste aversion: a field application to coyote predation on sheep. Behav. Biol., 20: 91–95.

Gustavson, C.R. and Gustavson, J.C., 1985. Predation control using conditioned food aversion methodology: theory, practice, and implications. Experimental assessments and clinical applications of conditioned food aversions. Ann. NY Acad. Sci., 433: 348–356.

Gustavson, C.R. and Nicolaus, L.K., 1987. Taste aversion conditioning in wolves, coyotes, and other canids: retrospect and prospect. In: H. Frank (Editor), Man and Wolf. Dr. W. Junk Publishers, Dordrecht, pp. 169–203.

Gustavson, C.R., Kelly, D.J., Sweeney, M. and Garcia, J., 1976. Prey-lithium aversions, I. Coyotes and wolves. Behav. Biol., 17: 61–72.

Gustavson, C.R., Jowsey, J.R. and Milligan, D., 1982. A 3-year evaluation of taste aversion coyote control in Saskatchewan. J. Range Mgmt., 35: 57–59.

Jelinski, D.E. and Jowsey, J.R., 1983. Coyote predation on sheep, and control by aversive conditioning in Saskatchewan. J. Range Mgmt., 36: 16–19.

Revusky, S.H. and Garcia, L, 1970. Learned associations over long delays. In: G.H. Bower (Editor), Psychology of Learning and Motivation. Academic Press, New York, 4: 1–83.

Treisman, M., 1977. Motion sickness: an evolutionary hypothesis. Science, 197: 493–495.