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Drinking water temperature affects consumption of water during cold weather in ponies

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Abstract

Two within-subjects cross-over trials were conducted to compare ad libitum consumption of warm drinking water with ambient near-freezing drinking water during cold weather. In Trial 1, eight ponies consumed a mean of 41% more water when provided continuously heated water than when provided ambient near-freezing water ($P< 0.01$). Similarly, in Trial 2, six ponies consumed a mean of 38% more water when provided buckets filled with hot water twice daily than when provided ambient near-freezing water ($P< 0.05$). Overall for both trials, 14 ponies drank a mean of 40% more warm than ambient near-freezing water. This difference was highly significant ($P< 0.0005$). Videotape procedures were used to evaluate drinking behaviour. During both trials, most drinking occurred within 3 h after feeding. There were no qualitative differences in drinking behaviour observed in either trial.

Keywords: Drinking water; Water consumption; Horses; Colic

1. Introduction

It is a common belief that cattle and horses drink less water as the temperature of drinking water approaches freezing, and that they will drink more if the water provided is warmer. There are apparently no published data confirming this assumption for horses. In cattle, it has been reported that milk production increases

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when warm water is provided in winter, with no reference as to whether more water is consumed when warm rather than ambient cold water is provided (Grzegorzak et al., 1976). In studies of cattle in summer, there are reports that cattle, given a choice, clearly prefer ambient warm water over chilled (Wilks et al., 1990) and consume more water when ambient warm rather than chilled water is provided (Lanham et al., 1986; Milam et al., 1986; Stermer et al., 1986; Baker et al., 1988) . The studies reported here were conducted to compare cold weather water consumption rates and drinking behaviour of ponies given ambient near-freezing water or warm water.

2. Materials and methods

Two within-subjects cross-over trials were conducted to compare ad libitum consumption of near-freezing and warmer drinking water during cold weather.

2.1. Animals

Fourteen pony stallions (ranging in age from 2 to 2 1 years and weighing 165-275 kg) were used. Prior to the trials, the ponies had been kept at pasture with supplemental hay. During the trials, the ponies were stabled together in a barn in individual tie-stalls (approximately 1 m x 3 m). They were maintained on mixed grass-alfalfa hay fed twice daily (07:00 and 16:00 h), approximately 5 kg total per pony per day. All ponies remained healthy throughout the trials, with normal appetite and stools.

2.2. Ambient environmental temperatures

The trials were conducted during January 1994 with daily temperatures ranging from -20 to 5 °C and with ambient air temperature inside the barn ranging from -7 to 5 °C.

2.3. Water

All water was obtained from the same tap source. For 60 days preceding the trials, the subject ponies had free access to water from the same tap source either continuously (primary water source) or intermittently (secondary water source with a stream as primary water source). During the trials, water was continuously available in 20-l plastic flat-back water buckets (Fortex, San Juan, PR 00936). Buckets were refilled with water twice daily (07 : 00 and 16 : 00 h) to 16 l. At no time were the buckets empty. To ensure that water temperatures were near freezing for ponies receiving cold water, water was drawn and allowed to reach ambient temperature before being used to refill the buckets at feed time.

2.4. General design

For each trial (1 and 2), an equal number of ponies was randomly assigned to be offered warm or cold water for a period of 5 consecutive days, during which volume of water consumed was measured twice daily. The first 24 h were only for acclimation to the condition. Volumes of water consumed were compared between conditions for the subsequent 4 trial days. Also for each trial, after the first 5 day period, each pony was switched to the alternate drinking water condition and the 5 day (1 day acclimation plus 4 days trial) pattern repeated.

2.5. Trial 1

Trial 1 evaluated consumption by eight ponies of continuously heated (HEATED) versus ambient near-freezing (COLD) drinking water. COLD water buckets were initially tilled and allowed to cool to ambient temperature. The temperature of COLD water remaining in the buckets was measured just prior to refill and ranged from 0 to 1 °C. HEATED water was kept warm using commercially available bucket heaters (1000 W, Model W-499; Farm Innovators, Inc., Hilton Head, SC, USA) that were continuously present in the water buckets. HEATED water temperature measures ranged from 5 to 60 ° C and averaged 19 ° C. Water remaining in the buckets at refill time was not discarded. HEATED buckets were refilled with warm water and COLD buckets were refilled with ambient temperature cold water. The total volume of water consumed for each of the eight ponies for each condition was compared using paired t-test procedures.

2.6. Trial 2

Trial 2 compared consumption of water by six ponies when buckets were filled twice daily with hot tap water (HOT) or cold (COLD) water. COLD water conditions were as described in Trial 1, with the exception that water remaining in buckets at refill time was discarded and buckets were refilled. HOT buckets were emptied and refilled twice daily with 46-49°C tap water. The temperature of HOT water remaining in the buckets just prior to refill ranged from 0 to 10 °C, with an average of 2°C. The total volume of water consumed for each of the six ponies for each condition was compared using paired t-test procedures.

2.7. Drinking behaviour

To evaluate drinking behaviour, one 9 h (07:00 - l6:00 h) videotaped sample of behaviour was obtained for a subset of four subjects (two COLD and two HEATED or HOT) on Day 3 or Day 4 of each trial. Videotaping commenced immediately after morning refilling of water buckets and ended just before evening refilling. Tapes were viewed by an experienced technician who was blind to the assignment of water conditions. Behavioural measures included the time of

day and duration of each drink, as well as a qualitative assessment of the associated behaviour.

3. Results

Water consumption results are summarized in Table 1. In Trial 1, the eight ponies consumed a mean of 4 1% more water when provided continuously heated water than when provided ambient near-freezing water ($P < 0.0$ 1). Similarly, in Trial 2, the six ponies consumed a mean of 38% more water when provided buckets filled with hot water twice daily than when provided ambient near-freezing water ($P < 0.05$). Overall for both trials, the 14 ponies drank a mean of 40% more warm than ambient near-freezing water. This difference was highly significant ($P < 0.0005$). Twelve of the 14 ponies drank 3-110% more HOT or HEATED than COLD water.

During both trials, most drinks (70% of drinks, representing 82% of the total drinking time) occurred within 3 h after feeding and water refill. The proportion of drinks as well as the proportion of total drinking duration occurring within the 3 h were similar for COLD and HEATED or HOT water conditions (z test of

Table 1
Total volume (1) of water consumed in 4 day trial

	Animal	HEATED	COLD	HEATED as % of COLD	P[a]
Trial 1	1	39.5	25	158	
	2	38	32	119	
	3	35	25	140	
	4	27	21.5	98	
	5	29	20	145	
	6	30	31	97	
	7	34	16.5	210	
	8	49	30	163	
	Avg. (SE)	35.2(2.5)	25.9(1.9)	141(13)	0.01
	Animal	HOT	COLD	HOT as % of COLD	P
Trial 2	9	52	33	158	
	10	38	37	103	
	11	42	35.5	118	
	12	42.5	31	137	
	13	51.5	25.15	200	
	14	45	40	112	
	Avg. (SE)	45.2(2.3)	33.7(2.0)	138(15)	0.03
	Avg(SE)	39.5(2.2)	29.2(1.7)	140(9)	0.0004

a P values refer to HEATED and/or HOT versus COLD, paired t-test procedures.

differences between proportions, P> 0.05). Under the ambient conditions of this trial, HOT water had cooled to approximately 2 1 dC at 3 h after refill.

No qualitative difference in drinking behaviour was observed between drinking water conditions. At the time of the video sample, animals had had 3 or 4 days experience with the water condition. No behavioural indication of preference or aversion to any of the water conditions was evident.

4. Discussion

Under cold weather conditions, on average ponies drank approximately 40% more warm water than ambient near-freezing water, regardless of whether the water was continually heated or whether buckets were filled with hot tap water twice daily. Only two of 14 ponies studied did not drink more warm than ambient near-freezing water. This study design did not address whether the phenomenon is due to an increased consumption of warm water or a decreased consumption of cold water, or both.

A commonly suggested maintenance requirement for water for horses is 30 ml kg- l day- l (Spier et al., 1990), which would suggest a mean requirement of approximately 6 1 day- l for ponies. The subjects in this study consumed a daily mean of 9.9 1 day-' when warm water was provided and 7.3 1 when cold water was provided. Compared with estimated maintenance requirements, these values are 20% higher for cold water and 62% higher for warm water.

In this study, most drinking occurred within 3 h after feeding and water refill. Hot water, which was 46-49 dCat the time it was provided twice daily (at feed time), was in the range of 20-35 dCduring the time most drinks occurred.

It was found that providing hot water twice daily with feeding was a simpler method for providing warm water to individually stalled ponies than using commercially available bucket heaters. The particular bucket heaters used require electrical outlets with ground fault interrupter circuitry within 2 m of each bucket and careful monitoring to ensure safe operation. In addition, all of the four units used resulted in water temperatures varying far below and above the manufacturer's specifications (to reach and maintain 37.8 d C within 20 min) .

These findings may have practical clinical application. For example, traditional belief holds that decreased water consumption is associated with impaction colic. Anecdotal observations suggest that older horses may be particularly more likely to drink less cold water in winter, possibly in association with dental problems. While the ponies in this study ranged from 2 to 21 years of age, there were too few animals in the aged category to evaluate this factor. Nonetheless, the present findings suggest that if an objective is to encourage consumption of water during cold weather as one means to help prevent impaction colic, provision of either continuously heated water or hot water twice daily with feeding would be an effective strategy for most horses.

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