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Acta Agriculturae Scandinavica, Section A — Animal Science

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/saga20

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To cite this article: Knut Egil Bøe, Ingjerd Dønnem, Cecilie Blakstad Løkken & Stine Grønmo Kischel (2021) The preference for water nipples vs. water bowls in pregnant ewes, Acta Agriculturae Scandinavica, Section A — Animal Science, 70:2, 107-112, DOI: 10.1080/09064702.2021.1886321

To link to this article: https://doi.org/10.1080/09064702.2021.1886321

Published online: 23 Feb 2021.

ACTA AGRICULTURAE SCANDINAVICA, SECTION A — ANIMAL SCIENCE
2021, VOL. 70, NO. 2, 107–112
https://doi.org/10.1080/09064702.2021.1886321

The preference for water nipples vs. water bowls in pregnant ewes

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ABSTRACT

This study included 6 groups of 6 pregnant ewes with a change-over design. In period 1 group 1, 2 and 3 had access to the water nipples and group 4, 5 and 6 had access to water bowls and vice versa in period 2. In period 3 all six groups had access to both types of water dispensers. The ewes' water intake was significantly higher when drinking only from water nipples (3.27 ± 0.29 l/ewe and day) than only from water bowls (2.04 ± 0.22 l/ewe and day) ($F = 78.28$, $P < 0.001$). The water wastage for nipples was 36% of water usage and negligible for bowls. When offered both dispensers the ewes` water intake tended to be higher from water nipples ($t = 0.69$, $P < 0.10$), and there seemed to be no specific preference for water nipples or bowls in ewes.

ARTICLE HISTORY
Received 16 June 2020
Accepted 2 February 2021

KEYWORDS
Dry ewes; water dispensers; preferences

Introduction

Dry matter intake, environmental temperature, advancing pregnancy and lactation are important factors for the need for water in sheep (Forbes, 1968). Long term water deprivation is shown to lead to body weight loss in ewes up to 26% (More & Sahni, 1978). It is however interesting to notice that in lactating ewes with free access to water and with the same management and feeding regime, the variation between individuals in daily water intake (FWI) was surprisingly large (CV = 27.6%), and that there also was a large variation from day to day within individuals (Kischel et al., 2017).

When sheep and goats are kept indoors drinking water can be provided either by water nipples or water bowls. In freestall housing for dairy cows, water troughs are also commonly used (Teixeira et al., 2006). The fact that water nipples are simpler and cheaper than water bowls is advantageous, but the high water wastage from water nipples (piglets: 56%, Torrey et al., 2008, growing-finishing pigs: 26%, Li et al., 2005, dairy goats: 30%, Bøe et al., 2011) is disadvantageous.

The provision of water from different types of dispensers might have an effect on both water intake, feed intake and daily weight gain. Torrey et al. (2008) did not find any effect on water intake, feed intake and daily gain in weaned piglets when providing water from nipples or bowls, whereas Bøe & Kjelvik (2011) found that water intake and feed intake in weaned piglets day 7–13 after weaning was higher for piglets provided water from nipples. For dairy calves Hepola et al. (2008) found no effect on water intake, feed intake or daily gain when providing drinking water from a bucket or a nipple. Providing water to dairy goats either from nipples or bowls did not have an effect on water intake (Bøe et al., 2011).

Another important issue is the animals' own preference for different types of water dispensers. Torrey and Widowski (2006) found that weaned piglets preferred a bite nipple drinker to push-lever bowl drinker, but do not mention anything about individual variation. In dairy goats the preference for type of water dispenser seem to vary both between groups and between individuals (Bøe et al., 2011). In an experiment with dry dairy goats, 3 of 6 groups preferred to drink from a nipple rather than from a bowl, whereas 1 group preferred the bowl and 2 groups showed no preference. Further, in the same experiment testing lactating goats, none of the 6 groups showed any preference for nipple or bowl. To our knowledge, there are no data on the preference for different types of water dispensers in sheep.

The aim of the present study was to examine the water intake and water wastage when pregnant ewes had access to drinking water from either water nipples or water bowls and the ewes' preference for drinking from nipples or bowls when having access to both nipples and bowls. We predicted that the ewes would prefer to drink from the nipples because of improved water quality.

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Materials and methods

The experiment were performed in January and February in 2014 at the sheep facilitiy at the Norwegian University for Life Sciences. The experiment was performed according to Norwegian regulations concerning animal use in experiments.

Experimental design

Thirty-six pregnant ewes were randomly allotted into six groups with six ewes in each group and allocatedto one of the six experimental pens 10 days before the experiment started in order to get accustomed to both types of water dispensers and the experimental pens. In experimental period 1 (7 days) group 1, 2 and 3 had only access to the water nipples and group 4, 5 and 6 had only access to water bowls. In experimental period 2 (7 days) group 1, 2 and 3 had only access to the water bowls and group 4, 5 and 6 had only access to water nipples. In experimental period 3 (7 days) all the six groups had access to both types of water dispensers.

Housing and water equipment

The experiment was conducted in an insulated, mechanically ventilated room with a mean air temperature of 6.2°C (range 4.3–7.9°C). Before the experiment started, the ewes had been kept in the same room, in pens with expanded metal flooring and with drinking water supplied in water bowls. During the experiment each group of six ewes were kept in expanded metal flooring pens measuring 2.15×3.25 m, providing 1.16 m^2 per ewe.

One float water bowl (CF7, art no. 972 824 90 DeLaval®) and one nipple drinker (Lund Nipple drinker no. 7, Lund Maskinfabrik A/S) was installed in each pen 0.55 and 0.66 m above floor level on the back wall of the pens, respectively. The flowrate for each water dispenser was tested both before and after the experiment, and for the nipple drinkers the mean flowrate was 2.4 l/min (range 2.3–2.7 l/min) and for the water bowls 2.7 l/min (range 2.0–4.0 l/min). If the stockperson observed that there was hay or manure in the water bowl, the bowl was cleaned, and the polluted water was emptied in the wastewater containers below the bowl.

Animals and feeding

A total of 36 pregnant ewes of the Norwegian White Sheep breed from the University herd were selected so that each group of six ewes had three ewes in first pregnancy, two ewes in second pregnancy and one ewe in third pregnancy. At the start of the experiment, the mean number of days in pregnancy was 40.8 + 1.8, and there were only minor differences between groups. When the ewes only had access to water nipples two ewes were not observed drinking by the stockpersons during the daily husbandry practices. Because of that one ewe was removed from the experiment in experimental period 1 after 6 days and another ewe was removed after 4 days in experimental period 2. The remaining 34 ewes had a mean body weight of 87.3 ± 11.1 kg at the start of the experiment and 87.9 ± 11.6 kg at the end of the experiment.

Grass hay (680 g DM/kg) was offered for ad libitum intake twice daily at 08:00 and 14:00. Feed intake was recorded by weighing the feed leftovers and the new feed on an electronic balance both at the morning and afternoon feeding for the three last days of each experimental period. The ewes were supplied a mineral and vitamin mixture, a mixture containing vitamin E, selenium and biotin and had free access to salt lick (all Felleskjøpet, Norway).

Water usage, water wastage and water intake

The water supply pipeline of each water dispenser was connected to a water meter (Altaïr N°C05 A4). A small container with a top made of metal grids was located under each water dispenser in order to collect possible water wastage (Figure 1). Every morning at 08:00 for the last four days of each experimental period the water usage was recorded by reading the water meters and the water wastage in the containers were weighed on an electronic balance. The water intake of the group was then calculated as water usage minus water wastage.

All the water meters were calibrated both before and after the experimental period.

Water quality

Water samples were collected from each water dispenser the last day in experimental period 1 and 2 and poured into sterilized and sealed plastic bottles. In addition, a water sample was collected from a sterilized water faucet in the animal room (control). The samples were analysed for heterotrophy germs at 22°C (CFU/ml, method: NS-EN ISO 6222), coliform bacteria (cfu/100 ml, method: ISO 9308-1), turbidity (FNU, method: NS EN ISO 7027-2) and *Escherichia coli* (CFU/100 ml, method: NS-EN ISO 9308-1) at a certified laboratory.

Figure 1. The picture shows the set-up with the water nipple (left) and the water bowl (right) on the pen wall in experimental period 3. A bucket with a top made of metal grids is located under each water dispenser to collect possible water wastage.

Behavioral observations

In order to obtain individual data, all the pens were videorecorded for the three last 24 h periods (72 h in total) in experimental period 3 by video cameraes (FosCam Outdoor HD, model F19805W) suspended right over the water dispensers and connected to a computer using the video program Blue Iris 3. All the ewes were marked on the neck/back in order identify the individual animal. The duration of each drinking bout for each ewe was scored from the video tapes using the Solomon Coder and then summarized for each 24 h period using the following ethogram:

- Drinking from the water nipple (the ewe has the upper lip over the water nipple)
- Drinking from the water bowl (the ewe has her mouth over the water bowl)
- Secondary drinking (drinking the wastewater from another ewe drinking from the water nipple before it comes down into the bucket)

Statistical analysis

This current study was a small study and hence a simple descriptive approach was chosen when presenting the results. The effect of treatment (water nipple and water bowl) on water usage, water wastage, water intake and feed intake (dry matter intake of hay) was tested using a one-way analysis of variance (in Excel). The mean ± SE for water usage, water intake and wastage over the four observation days for each group and the mean ± SE for feed intake over the three sampling days for each group was used as statistical unit. A paired t-test (in Excel) was used to test if the

Table 1. Water usage, water wastage and water intake (mean ± se, minimum and maximum in brackets) and dry matter intake of hay (mean ± se) when providing drinking water from water bowls or water nipples.

	Water nipple	Water bowl	F	*P*
Number of ewes in each treatment	34	36		
Water usage (l/ewe and day)	5.10 ± 0.26 (4.05 - 5.77)	2.05 ± 0.22 (1.26 - 2.88)	80.40	< 0.001
Water wastage (l/ewe and day)	1.83 ± 0.20 (1.16 - 2.48)	0.02 ± 0.01 (0.00 - 0.07)	78.28	< 0.001
Proportion water wastage (% of water usage)	36.1	0.7		
Water intake (l/ewe and day)	3.27 ± 0.29 (2.57 - 4.50)	2.04 ± 0.22 (1.25 - 2.87)	11.21	<0.01
CV water intake (%)	8.9	10.9		
Dry matter intake of hay (kg/ewe and day)	1.59 ± 0.03	1.67 ± 0.05	4.96	> 0.1

Note: One-way ANOVA was used to test differences between treatments. Proportion of water wastage and CV water intake (mean of 6 groups) is also calculated.

water intake was higher from water nipples than from water bowls in period 3.

Results

Water consumption and water wastage when access to either nipple or bowl (Period 1 and 2)

Water usage was more than twice when water was provided from water nipples compared to when water was provided from water bowls (Table 1). Water wastage from water bowls was almost negligible (0.7% of water usage) whereas mean water wastage from water nipples was 36.1% of water usage. The water intake was significantly higher when the ewes had access to the water nipple than when the ewes had access to the water bowl (Table 1).

However, the difference between groups within treatments were large (see Table 1). When providing water in water bowls, the water intake was more than double for the group with the highest intake (2.87 l/ewe and day) compared to the group with the lowest intake (1.25 l/ewe and day). Even if the water intake was generally higher when providing water in water nipples, the variation between groups (CV) was proportionally less (see Table 1). The highest and lowest intake of water were 4.50 and 2.57 l/ewe and day when providing water in water nipples.

In addition to the variation in water intake between groups, there were also variation within groups between observation days. When having access to water nipples, the differencebetween the day with the lowest and the day with the highest water intake was minimum 0.45 l per ewe and maximum 1.46 l per ewe. When having access to water bowls, the difference between the day with the lowest and the day with the highest water intake was minimum 0.45 l per ewe and maximum 1.62 l per ewe. This is equivalent to 23.4% of the water intake when using water nipples and 43.3% of the water intake when using water bowls.

There was no difference between the groups in daily hay intake (see Table 1).

Water consumption and water wastage when access to both nipple and bowl (period 3)

The water intake tended to be higher from water nipples than water bowls ($t = 0.69$, $P < 0.10$) when the ewes had access to both types of water dispensers (Table 2), but there were large differences between the groups. Four groups had a numerical higher intake from water nipples (> 60% of water intake) than from water bowl. One of these four groups had as much as 92.3% of the water intake from water nipple. The two last groups had a numercial higher water intake (76.4% and 82.5% of water intake) than from water nipples.

Individual preferences (behavioral observations)

Mean total drinking time (sum of drinking from bowl and nipple per ewe) was 258.5 ± 32.1 sec/24 h ranging from 57.7 sec/24 h to 903.6 sec/24 h.

When both dispensers were offered, three of the ewes did not drink from the water bowl, but only from the water nipple and two other ewes did not drink from the nipple drinker, but only from the water bowl over the 72 h observation period. Of the other 29, 8 ewes did not drink from the water nipple for 1 or 2 days, whereas 7 ewes did not drink from the water bowl for 1 or 2 days.

Twelve of the 34 ewes showed a clear preference (> 70% of the time spent drinking) for water nipples whereas 14 ewes showed a clear preference for water bowls (Table 3). Eight ewes showed no specific preference. Except from group 3, where all the ewes preferred to drink from the water bowl, all the other groups had some ewes preferring the water nipple and some ewes preferring the water bowl.

Six ewes were observed to be secondary drinkers, and three of these ewes 3–30% of their drinking time as secondary drinkers. Apart from this, they preferred to drink from the water bowl.

Water quality

The water quality was better in the water nipples compared to the water bowls (see Table 4).

Table 2. Water intake (mean over the four lasts days) from water nipples and water bowls in experimental period 3.

Group	Water nipple (l/ewe and day)	Water bowl (l/ewe and day)	Total (l/ewe and day)	Proportion from water nipple (% of water intake)
1	0.5	1.5	2.0	23.6
2	1.9	0.8	2.7	71.2
3	0.5	2.2	2.7	17.5
4	1.6	0.6	2.2	71.7
5	2.7	0.2	2.9	92.8
6	1.8	1.1	2.9	62.4
Mean	1.5	1.1	2.6	58.3

Table 3. Individual preferences (> 70% of the time spent drinking) for drinking from water nipples and water bowls.

Group	Preference for water nipple (number of ewes)	Preference for water bowls (number of ewes)	No preference (number of ewes)
1	1	3	2
2	4	1	1
3	0	4	1
4	3	2	1
5	4	1	0
6	0	3	3
Total	12	14	8

Table 4. Water quality when using water bowls and water nipples.

Period	Test	Pen						Control
		1	2	3	4	5	6	
1	Heterotrophy germs at 22°C (cfu/ml)	60	70	140	>300	>300	>300	<1
1	Coliform bacteria (cfu/100 ml)	<1	<1	<1				
1	Turbidity (FNU)	0.1	0.1	0.1	0.77	4.1	1.9	<0.1
2	Heterotrophy germs at 22 °C (cfu/ml)	>300	>300	>300	>300	>300	>300	
2	Coliform bacteria (cfu/100 ml)				<1	<1	<1	
2	Turbidity (FNU)	5.6	2.6	3.4	0.27	0.54	0.33	

Note: The shadows marks the results for the water nipples.

Discussion

The water wastage was almost negligible from water bowls, which is in agreement with other studies in piglets (Phillips & Phillips, 1999, Torrey et al., 2008) and in goats (Bøe et al., 2011). However, in piglets the water wastage from bowls can be significant although less than for nipples (Bøe and Kjelvik, 2011). For the water nipples the water wastage was more than 36% of water usage, which is comparable to studies on dairy goats (Bøe et al, 2011), growing-finishing pigs (Li et al., 2005) and piglets (Torrey et al., 2008; Bøe and Kjelvik, 2011). One reason for the high water wastage can be that the water in the nipple is provided faster than the ewes actually can swallow, and that the surplus water then will be water wastage. Li et al. (2005) found that water wastage from water nipples increased with increased flow rate in growing-finishing pigs and that also the height of the nipple affected the water wastage. In a housing system with totally slatted floor pens this high water wastage will probably not be a problem, but in pens with solid flooring/straw bedding the waste water would make the bedding surface wet, and this is of course disadvantageous.

Interestingly, the actual water intake was significantly higher when water was provided from nipples than from bowls. This is also shown in previous studies on piglets (Torrey et al., 2008; Bøe & Kjelvik, 2011) but not for dairy goats (Bøe et al., 2011) or dairy calves (Hepola et al., 2008). One possible explanation is that the water flows directly into the ewes' mouth and water is ingested faster than natural drinking speed. Another explanation is that they experienced that the water in some way was 'better' from the nipples. The water quality analysis confirm that the water quality was better from the water nipples. Phillips and Phillips (1999) found that piglets at weaning consumed significantly less water from uncleaned water bowls compared to water bowls that were routinely cleaned.

The differences in water intake between the groups in experimental period 1 and 2 were large, especially between groups within treatments, and the relative differences (CV) between groups seemed to be highest on drinking bowls. It is difficult to explain these differences between the groups. Other studies of water intake have mainly presented means and looked at how factors like feed type and intake and temperature affect water intake (eg. Forbes, 1968). In the present study the intake of hay was numerically higher in the water bowl treatment, even if the intake of water was significantly lower. Interestingly, data presented by Kischel et al. (2017) show that the daily intake of water can be very different between individuals and also between days within individuals.

Two ewes were removed from the experiment because we were not sure that they had learned to operate the nipple drinker. This may indicate that some older ewes have problems learning this task. However, in other studies with water nipples, equivalent problems have not been mentioned (ewes: Bøe et al., 2012, piglets: Torrey et al., 2008, goats: Bøe et al., 2011, calves: Hepola et al., 2008). Phillips and Phillips (1999) reported that weaned piglets, unfamiliar with nipple drinkers consumed significantly less water the first day when they were introduced to nipples, but at day four the intake was higher than from bowls. This suggest that these ewes probably were drinking when the stockpersons were not in the barn looking after the ewes.

Data from period 3, when the ewes had access to both nipples and bowls, showed that the intake of water tended to be higher from nipples than from bowls. The variation between groups were however large. Two groups had numerically higher water intake from water bowls and four groups from the water nipple. When considering the fact that the ewes drank significantly more from the water nipples than from the water bowls in period 1 and 2, this result is as expected. Also data from dairy goats (Bøe et al., 2011) showed that water intake tended to be higher from water nipples than from water bowls, and that the differences between groups are considerable.

Data from the behavioral observations of drinking behavior in period 3 showed that some ewes never drank from the water nipple and some ewes never drank from the water bowl. Further, 12 of the 34 ewes showed a clear preference (< 70% of the time spent

drinking) for water nipples whereas 14 ewes showed a clear preference for the water bowl and eight ewes showed no specific preference. Hence, there seem to be no specific preference for either water nipples or water bowls in ewes, which is in agreement with results from dairy goats (Bøe et al., 2011). The data for individual preferences must however be interpreted with some caution. The data are based on observations of drinking behavior and not actual intake of water. In the behavioral observations we scored for drinking when the ewe's mouth was in contact with the nipple or bowl, but the video pictures are not so detailed that we know when water was actually ingested. Another important factor to consider would be the speed of drinking, and also drinking speed would probably vary between individuals.

Because the ewes did not show any preference for either water nipples or water bowls, we cannot recommend one over the other. However, water nipples can be recommended due to better water quality, and water bowls can be recommended due to low water wastage.

We conclude that the water intake in ewes were significantly higher when ewes had access only to water nipples than when ewes only had access to water bowls. The water wastage from water bowls was almost negligible whereas mean water wastage from water nipples was36.1% of water usage. When having access to both water nipples and water bowls, water intake only tended to be higher from water nipples but there seem to be no specific preference for either water nipples or water bowls in ewes.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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