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Liveweight of individually fed beef cows receiving snow or liquid water

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In the 1979 Annual Feeders' Day Report, information was presented showing that after a short adaptation period pregnant beef cows will consume snow in amounts equivalent to the water intake of cows receiving liquid water. Unanswered at that stage was the question of the energy cost to the animal of melting the snow and warming it to body temperature. Furthermore there were queries raised as to possible behavioural problems that could be encountered in animals consuming snow. This and the following 2 reports attempt to shed further light on the consequences of relying on snow as a source of water. The present report examines liveweights, body temperatures and total water turnovers in pregnant beef cows. Trials were conducted at 2 locations, The University Farm in Edmonton and at The University Ranch at Kinsella, Alberta.

Materials and methods

Experiment I

Eight cows used in last year's snow studies at The University Farm were used. They were predominantly of Charolais and Angus breeding (beef synthetic), were 4 to 5 years of age at the start of the study and each had successfully raised a calf on pasture during the summer of 1979. The cattle were bred to a cross-bred bull during July and August, 1979, and were 5 to 8 months pregnant during the trial.

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Table 1. Composition of feeds offered the cows at The University Farm (Experiment I) and at The University Ranch (Experiment II).

	Experiment I		*Experiment II*	
	Brome grass hay	*Barley grain*	*Timothy hay*	*Barley grain*
Dry matter, %	89.2	88.3	92.6	88.3
Protein, %	12.1	11.6	12.6	11.6
Acid detergent fibre, %	32.1		39.0	

The cows were kept in a field as a single group. From the end of November, 1979, they were brought into individual feeders daily and were offered a ration of 3.5 kg of brome grass hay and 3.5 kg of barley grain (Table 1). The daily feeding period was from 0800 h to 1000 h and each cow was given access to liquid water for approximately 15 minutes immediately following the feeding period. With the onset of winter and the availability of snow on the ground (December 21, 1979), water was denied to 4 of the 8 cows and all cows were given access to a snow covered field when not in the feeding stalls.

At 4 weekly intervals the cows were weighed and body temperatures measured. Total water intake was measured by use of injections of tritium labelled water. Urine samples were taken for estimation of total water turnover and urine osmolality.

Experiment II

Thirty-two pregnant cows from The University Ranch breeding herd and of Hereford, beef synthetic and dairy synthetic strains were used in the study at The University Ranch. The cows were aged 3.5, 4.5 and 5.5 years. During the previous summer the cows had all raised a calf and were judged to be pregnant before selection for the experiment.

From November 28, 1979, the experimental cows were individually fed in adjacent stalls. The ration was 3.5 kg of timothy hay and 3.5 kg of barley grain (Table 1), and was offered between 0800 h and 0930 h daily. Prior to imposition of the liquid water and snow treatments all cows had continuous access to liquid water.

On January 9, 1980, (after the first snow fall that remained on the ground) the cows were allocated to treatment groups which were balanced for breed and age of cow. The treatments were:

1. Continuous access was allowed to liquid water from a heated water bowl (*continuous water*).
2. Access to liquid water from a heated water bowl was restricted to a 15 minute period immediately following feeding (*restricted water*).
3. Access to liquid water was denied and the cows had to rely on snow for their source of water (*snow*).

From the time of imposition of water and snow treatments until the termination of the experiment on March 19, 1980, the cows were kept in 3 small fields adjacent to the feeding stalls. There was permanent snow cover on the ground throughout this period. Surrounding trees and a porosity fence provided the cows some shelter from wind. No bedding or other protection from inclement weather was provided.

The cows were weighed at weekly intervals from December 28, 1979, until the end of the trial. In addition, at the start and end of the treatment period subcutanous fat depth was measured at the 12th to 13th rib of each cow by means of an ultrasonic probe.

Results and discussion

A summary of the meteorological records at both experimental sites is contained in Table 2. Throughout the trial all animals consumed the rations offered although there were occasions when the daily ration was not consumed in the limited feeding period. This feed was left in the trough and was consumed by the cow at a subsequent feeding. On no occasion did feed remain for more than 3 consecutive days. Some behavioural observations relating to cows in the

Table 2. Mean minimal and maximal air temperatures (°C) at The University Farm (Experiment I) and The University Ranch (Experiment II) during the winter of 1979-1980.

	Experiment I			*Experiment II*	
	Mean Min.	*Mean Max.*		*Mean Min.*	*Mean Max.*
Nov 29 – Dec 20	−15.1	−7.0			
Dec 21 – Jan 17	−16.6	−8.9	Dec	−13.2	−3.4
Jan 18 – Feb 13	−14.9	−2.8	Jan	−21.1	−11.2
Feb 14 – Mar 12	−12.0	−4.0	Feb	−14.9	−3.7
Mar 13 – Apr 10	−6.2	+4.4	Mar	−12.6	−1.6

Table 3. Liveweight, urine osmolality and rectal temperature in the cows receiving *water* or *snow* at The University Farm; Experiment I (1979-1980).

		Nov. 29	*Dec. 21*[1]	*Jan. 18*	*Feb. 14*	*Mar. 13*[2]	*Apr. 10*
Liveweight	*water*	481	472	491	492	505	519
(kg)	*snow*	489	479	490	489	501	521
Urine osmolality	*water*	1004	965	829	904	983	883
(mOsm/kg)	*snow*	1063	950	870	996	943	861
Rectal temperature	*water*	38.0	38.1	37.6	38.2	38.2	38.4
(°C)	*snow*	38.4	37.8	37.5	37.7	38.0	38.4

1. Water denied to 'snow' group after Dec. 21, 1979.
2. After Mar. 13 liquid water was occasionally available to 'snow' group from melting snow in field.

Table 4. Liquid water intake, water (TOH) turnover and TOH half-life in the cows receiving *water* or *snow* at The University Farm; Experiment I (1979-1980).

		Nov. 29 – Dec. 20[1]	*Dec. 21 – Jan. 17*	*Jan. 18 – Feb. 13*	*Feb. 14 – Mar. 12*	*Mar. 13 – Apr. 10*[2]
Water intake	*water*	14.7	11.0	7.4	8.1	8.5
(kg)	*snow*	15.6	*	*	*	*
TOH turnover	*water*	24.3	23.0	17.1	22.9	21.5
(kg)	*snow*	26.9	20.7	16.8	22.3	23.3
$TOH_{half\text{-}life}$	*water*	10.1	10.3	14.4	11.0	12.0
(days)	*snow*	9.1	11.7	15.0	10.7	10.9

1. Water denied to 'snow' group after Dec. 21.
2. Liquid water was occasionally available after Mar. 13 from melting snow in field.
*Access denied.

Table 5. Liveweight and subcutaneous fat depth in individually fed cows with continuous access to liquid water *(continuous)*, once-a-day access to water *(restricted)* and access only to field snow *(snow)*, Experiment II.

	Continuous	*Restricted*	*Snow*
No. of cows	10	10	11
Liveweight (kg)			
Jan 9, 1980	472.7	473.2	477.7
Mar 19, 1980	508.6	516.6	520.6
Liveweight change (kg)	+36.3	+43.4	+42.9
Fat depth (mm)			
Jan 9, 1980	4.0	4.2	4.3
Mar 19, 1980	1.8	2.5	2.8
Fat depth change (mm)	−2.2	−1.7	−1.5

present trials are contained in the following Feeders' Day Report.

Experiment I

A summary of results is contained in Tables 3 and 4. During the early part of the winter and prior to imposition of treatment all cows lost some liveweight. Thereafter all cows gained liveweight. It is evident from the data in Table 3 that there were no detrimental effects on the cow weights by denying them access to liquid water and forcing them to consume snow as their primary source of water. Furthermore, the rectal temperatures, urine osmolality and total water turnovers were not different for the 2 treatment groups and were within the normal range of values expected for pregnant beef cows over-wintered in Alberta. The differences between the total water turnover and the amount of water drunk by the cows on the liquid water treatment can be explained in part by the water from food (Table 4). However, the differences were also due to the fact that some of the cows given access to water also consumed snow. Snow consumption by cows with access to water was observed on several occasions. In fact, 3 of the cows occasionally refused to drink liquid water when offered and apparently obtained their water needs from snow in the field.

Experiment II

Despite the fact that cows consumed all the feed offered, they lost weight at an average rate of .56 kg/day during the first part of the winter. Similar losses in liveweight were also observed in Experiment I and are not uncommon for pregnant beef cows during the first part of the winter. During the first week of the treatment period, the cows receiving continuous and restricted water gained 14.4 kg and 6.6 kg, respectively, while the cows on the snow treatment lost 7.7 kg. The liveweight loss in the snow treatment is presumably due to an initial decrease in water intake resulting in a decreased rumen fluid volume. Throughout the 105 days on treatment all groups of cows gained weight and the average gains were similar for all treatments (Table 5). Subcutaneous fat cover decreased in all treatments (Table 5), and there was no significant treatment effect. The losses in subcutaneous fat occurred despite the increase in liveweight during the same period. An explanation of this phenomenon is presented in the report on page 55.

One cow aborted 2 feti during the trial and results from her are not included in the data presented.

Observations on behavioural aspects of these cows is discussed in the following paper. It should be noted that some of the cows on the restricted water treatment were observed eating snow, as did the cows on the water treatment in experiment I.

Conclusions

From these 2 experiments on individually fed pregnant beef cows, it is evident that denying the cows access to liquid water and forcing them to consume snow as their water source did not cause a significant difference in their liveweight over the winter period. As the cows within each experiment received the same amounts of ration and were kept under similar conditions, it may be concluded that there was not a significant increase in their feed requirements to maintain liveweight due to the ingestion of snow. Furthermore, the body temperature, urine osmolalities and total water turnover also indicate that there was no major strain on the cows to maintain body temperature or body hydration.