ENERGY AND WATER KINETICS IN SHEEP ACCLIMATED TO COLD NEUTRAL AND HOT ENVIRONMENTS

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Introduction

The thermal environment is known to markedly influence the energy and water needs and balances in livestock (NRC, 1981).

The present trial was to evaluate energy and water balances in sheep held in a cold, neutral or hot thermal environment but where other components of the environment, including diet, where held as constant as possible.

Materials and Methods

Fifteen mature ewes, 45 to 50 kg at the start of the trial, were divided into three groups randomly and housed in individual metabolism crates in controlled temperature rooms (0, 20, or 40°C) and were lit continuously with fluorescent lights. A diet of 1,000 g of pelleted feed was offered once daily at 1, 4:30 hour. The feed contained 79% rolled barley, 18% soybean meal, 1% limestone, 2% perma pell (pellet binder), and 0.002% of vitamin A, D and E mix (approximately equal to the maintenance requirement for the sheep in the cold treatment). Drinking water and a mineralized salt block was available *ad libitum*. The sheep were shorn at approximately six weekly intervals and were weight biweekly.

After five months of acclimation, a series of measurements were made of material, heat and water balance in each sheep. The respiratory gaseous exchange of each animal was also measured by an open-circuit system.

Results and Discussion

The diet had a moisture content of 13.7%, 17.5% crude protein and 15.3 MJ/kg of dry

TABLE 1. EFFECT OF THERMAL ACCLIMATION ON THE MATERIAL AND ENERGY BALANCE IN SHEEP

Acclimation temperature (°C)		0	20	40
No of animals		5	5	4*
Actual temperature during measurements		2.2	22.8	38.5
Final body weight (kg)		50.1	66.0	70.2
Average daily weight gain (g/d)		9.6	65.9	72.0
Dry matter intake (g/d)		863	863	863
Dry matter digestibility (%)		82.3	81.6	81.7
Energy intake (MJ/d)	Intake energy	16.07	16.07	16.07
	Digestible energy	13.35	13.19	13.23
Energy output (MJ/d)	Fecal	2.72	2.88	2.84
	Urine	1.17	1.18	1.45
	Sensible	8.88	4.63	1.63
	Evaporative	2.23	5.55	10.36
Retained energy (MJ/d)	Tissue gain	0.19	1.32	1.44

*One sheep was removed due to accident of broken leg.

matter. In the cold environment 80% of the heat loss was via sensible (conduction, convection and radiation) routes while the sheep in the hot environment lost 86% of their daily heat production via evaporation of moisture (table 1). The increased energy requirements of the sheep in the cold environment was associated with physiological acclimation and an increased basal and resting metabolism. The sheep in the present study acclimated to the cold and showed minimal discomfort and no shivering after the first few weeks of exposure.

Table 2 shows that water consumed with feed and that which arose from metabolic process within the animal represented 13% of the water available to the sheep in the cold but only 5% for the sheep in the hot environment. Average daily urine output was directly related to ambient temperature as was evaporative water loss. Fecal water output was inversely related to ambient temperature. The sheep in the hot environment evaporated almost five times as much water as did the sheep in the cold environment. This higher evaporative water loss of the animals in the hot environment was associated with their higher respiratory rates, table 2, and, as indicated in table 1, represented the major route of heat loss from these animals.

TABLE 2. EFFECT OF THARMAL ACCLIMATION ON WATER KINETICS IN SHEEP

Acclimation temperature (°C)		0	20	40
No of animals		5	5	4
Water intake (kg/d)	Drink	2.62	4.81	7.28
	Feed	0.14	0.14	0.14
	Metabolic	0.25	0.25	0.25
Water output (kg/d)	Fecal	0.17	0.12	0.09
	Urine	2.00	2.97	3.68
	Evaporative	0.83	2.06	3.85
Retained water (kg/d)	Tissue	0.01	0.05	0.05
Respiratory rate per minute		15.2	29.7	116.1

(Key Words: Sheep, Temperature, Kinetics)

Literature Cited

NRC. 1981. National Research Council: Effect of environment on nutrient requirements of domestic animals. National Academy Press, Washington, DC.