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WATER BALANCE OF FEMALE NEW ZEALAND WHITE DOES DURING PREGNANCY AND LACTATION IN CHINA

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ABSTRACT

Measurements of water balance were made on 16 New Zealand White does housed in individual metabolism cages at 4 levels of food intake (190-260 g/day) during pregnancy and lactation. Metabolic water and evaporative water loss were calculated. During pregnancy dietary treatment did not influence free water consumption (>300g/day) nor total water intake. Water balance was high and always positive. Ratio of free water to food intake increased from 1.35 for does given 260 g food/day to 1.78 for does receiving 190 g food/day.

Mean daily water intake was on average 135 g higher during lactation than pregnancy. Ratio of water drunk to food intake increased from 1.9 at an intake of 260 g/day to 2.3 at 210 g/day during lactation. At intakes of 260 and 230 g/day does were in approximately zero water balance but balance was highly negative at the two lowest intakes (210, 190g/day) possibly due to errors in calculating metabolic and evaporative water.

Milk production of does (each with 4 kits) was highest on the highest food intake (85 g/day) but production was similar (70-73 g/day) at the lower intakes. Kits supplemented with fresh alfalfa at 16 days of age were heavier at weaning (42 days) than those supplemented at 35 days on all diets except those kits with does on the lowest food intake (190 g/day). It was concluded that access to drinking water was necessary particularly when does were given dry food and during pregnancy and lactation if a reasonable level of reproduction and weaner growth are expected.

INTRODUCTION

Contrary to practical recommendations (Cheeke et al. 1982) in some parts of China rabbits are often not given any free water or given limited access to water during the summer. Fresh or wilted herbage is commonly fed during summer and it is often considered unnecessary therefore to provide free water. However during winter, conserved forage is normally given with some concentrate feed. This contains only small amounts of water.

During pregnancy but particularly during lactation, does have a comparatively high water demand. Restricting water intake of the doe may limit reproduction and/or kit growth.

This paper reports on measurements of water balance of does during pregnancy and lactation at the Loess Plateau Research Station, Qingyang Prefecture in Gansu Province, China.

MATERIALS AND METHODS

Sixteen New Zealand White pregnant does were allocated to four dietary food allowances : 260g/day, 230g/day, 210g/day and 190g/day. Does were naturally mated in early spring of 1989 and body weights recorded. After birth all litters were adjusted to 4 kits per doe.

Does were housed in individual metabolism cages and food and water intakes were recorded daily. Urine and faeces were collected daily for 7 days three times during pregnancy and three times during lactation at intervals of 6-7 days. Kits were housed separately and allowed to suckle their mother for a short period twice daily. Milk yield was determined by the increase in kit bodyweight before and after suckling. Kits were weaned at 42 days of age. Two litters from does on each dietary treatment were given alfalfa ad libitum at 16 days of age or at 35 days of age. Intake was not measured. Water balance of the does was calculated from water intake (in food, drink and metabolic) minus water output (urine, faeces, milk and evaporative). Metabolic water was calculated to be 0.5 g/g food consumed and evaporative water loss was taken to be 45% of total water output (Jin et al. 1990).

Plastic water bottles, fitted with nipples and a stainless steel ball, were used to measure free water intake.

Dry matter of the food and faeces was determined by drying at 105°C for 24 hours.

RESULTS

The ingredient and nutrient composition of the does' diet during pregnancy and lactation are given in Table 1.

Typical average values for water content of urine, faeces and milk were 96, 49 and 70% respectively. However water in faeces varied considerably and individual values for each balance period were used to calculate water output.

Data for water balance of rabbits during pregnancy are given in Table 2. Neither water consumption nor total water intake differed ($P>0.05$) due to dietary treatment. Water drunk was always more than 300g/day. Water voided in faeces was higher ($P<0.05$) for those does on the highest food intake but was similar on the other three intakes. Dry matter digestibility declined with decreasing food intake.

Water balance was always positive and varied from 120g/day for does receiving 260g food/day to 34g/day for does receiving 190g/day. Ratio of water consumed to food intake was 1.35 for does given 260g food/day; this increased to 1.78 for does receiving 190g/day.

Data for water balance of lactating does are given in Table 3. Except at the lowest food intake, does lost bodyweight during the 6 week lactation period. Water consumption was also lowest on this treatment. Mean daily water consumption was, on average, 135g higher during lactation compared to pregnancy. Differences were largest for does on the higher food intakes and ratios of food intake to water consumed were lowest. In contrast to pregnancy, rabbits were in approximately zero water balance at food intakes of 260 g and 230g/day, but balance was highly

Table 3 Water balance of 4 lactating does at 4 different food intakes

	Food intake (%) of ad libitum)				
	100%	90%	80%	70%	LSD (P<0.05)
Food (g/d)	260	230	210	190	
Weight (kg)	2.7	2.9	2.9	2.6	0.4
Gain (g/d)	-3.2	-2.2	-5.1	1.2	5.2
Water intake (g/doe/day)					
Water in food	25.5	22.5	20.6	18.6	
Water drunk	487.8	465.2	476.5	424.2	26.1
Total	513.3	487.7	497.1	442.8	22.8
Metabolic water	132.6	117.3	107.1	96.9	
Total water (in)	645.9	605.0	604.2	539.7	25.7
Water output (g/doe/day)					
Water in faeces	124.1	106.3	98.3	86.8	6.3
Water in urine	172.0	178.4	231.1	194.1	16.9
Water in milk	58.7	50.6	48.6	48.7	6.1
Total	354.8	335.3	378.0	329.6	17.6
Evaporative water	290.3	274.3	309.2	269.7	
Total water (out)	645.0	609.7	687.2	599.3	33.3
Water difference[1]	158.5	151.8	119.1	113.2	20.6
Water balance	0.8	-5.3	-83.0	-59.5	28.8
Drink (g): food (g)	1.88	2.02	2.27	2.23	0.18
DM digestibility (%)	63.9	65.4	64.8	65.9	2.8
Milk production (g/d)	84.5	72.7	69.9	70.1	8.7
Litter gain (g/d)	75.0	63.7	62.6	59.0	10.3

[1]Water in food and drink less water in urine, faeces and milk

negative at the two lowest intakes. However in all cases, water difference (balance not corrected for evaporative water) was positive.

Milk production was at least 10g/day more for does on the highest food allowance (84.5g/day) and similar at other intakes (69.9-72.7g/day). Consequently litter weight gain was also greatest (75g/day) at the highest food intake. Unlike during pregnancy, apparent dry matter digestibility was similar at the four different food intakes.

When data were examined for the effects of supplementation of kits with fresh alfalfa at either 16 or 35 days, mean litter weight gain at weaning was greater (P<0.05) for kits supplemented at 16 days of age.

DISCUSSION

Over the periods of pregnancy and lactation there are a number of possible sources of error in calculating water balance. A mean value of 45% of total water output for evaporative water loss is based on data with considerable individual rabbit variation (Jin et al. 1990). During pregnancy, does will be retaining water in the products of conceptus as well as in any maternal tissue gain. There may be some variation in the water content of urine. The use of a constant (0.51g of metabolic water per g of food consumed) assumes that all of the food is oxidized to yield energy, carbon dioxide and water. This is not the case during pregnancy and particularly during lactation. Finally the chemical composition of milk varies during the course of lactation, hence its water content (Cheeke et al. 1982). A single value of 69.5% for water in milk was used here in all calculations.

In a previous study of effects of temperature and diet on the water balance of growing rabbits (Jin et al. 1990), we found consistent positive balances ranging from 6.7 to 35.9 g/day. Despite some discrepancies, it is clear that rabbits do have a substantial requirement for free water when given a concentrate diet. A daily water intake of >300g during pregnancy and >450g during lactation would equate to at least 460g of herbage (65% water) during pregnancy and 690g during lactation. Such fresh herbage is available for only about 6 months of the year in the Qingyang Prefecture. During the remainder of the year conserved forage and some concentrate are given to rabbits. These would not provide sufficient water to meet the needs of pregnant and lactating rabbits and would likely reduce food intake as a consequence (Thwaites 1989).

It should be noted that intake of free water observed here was much higher than reported for growing rabbits weighing from 1.7 to 2.0 kg (Jin et al. 1990). Thwaites (1989) observed free water intakes of 58-74 ml/kg liveweight for growing female rabbits weighing 2.5-3.0 kg. However the ratios of free water : feed consumed found here (Tables 2 and 3) are well within the range of 1.56 - 2.38 recorded for growing rabbits held at 20 and 30^{o}C (Jin et al. 1990) hence water consumption appears to have been measured accurately. These food : water ratios were higher in lactation than during pregnancy at the corresponding food intakes, in part reflecting the high loss of water in milk.

It is possible that fresh herbage, depending on its nutritive value and water content, could provide the pregnant and lactating doe with sufficient water. However given the limited milk production and kit growth observed here and frequently found on rabbit farms in China, does offered dry herbage and some concentrate food would unequivocally need additional water if a reasonable level of production is anticipated. Early supplementation of kits with fresh herbage clearly improved their bodyweight at weaning and this practice should be implemented to help to reduce the trauma of weaning and its adverse consequences.

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Table 1. Ingredient and nutrient content of diets during pregnancy (preg) and lactation (lact)

Ingredient	Composition (%)		Nutrient component	Composition (%)	
	Preg	Lact		Preg	Lact
Corn	5.0	5.0	Dry matter	87.5	87.3
Bran	35.0	35.0	Crude protein	15.9	17.3
Linseed cake	12.0	18.5	Crude fibre	18.6	17.2
Alfalfa meal	46.5	40.0	Digestible energy (MJ/kg)	9.43	9.77
Bone meal	1.0	1.0			
Salt	0.5	0.5			

Table 2. Water balance of 4 pregnant does at 4 different food intakes

	Food intake (% of ad libitum)				
	100%	90%	80%	70%	LSD ($P<0.05$)
Food (g/d)	260	230	210	190	
Weight (kg)	2.9	2.8	3.0	3.0	0.5
Gain (g/d)	16.2	16.3	9.7	9.2	7.7
Water intake (g/doe per day)					
Water in food	28.9	25.5	23.3	21.1	
Water drunk	328.7	312.6	325.8	338.3	29.5
Total	357.5	338.2	349.1	359.4	29.5
Metabolic water	132.6	117.3	107.1	96.9	
Total water (in)	409.1	455.5	456.2	456.9	29.5
Water output (g/doe per day)					
Water in faeces	80.1	74.8	75.4	73.2	7.1
Water in urine	123.5	134.1	130.9	159.3	17.4
Total	203.7	208.9	206.3	232.4	21.4
Evaporative water	166.6	170.9	168.8	190.1	
Total water (out)	370.3	379.9	375.5	422.5	38.8
Water difference[1]	153.8	129.3	142.8	127.0	22.4
Water balance	119.8	75.6	81.1	33.7	29.7
Drink(g):food(g)	1.35	1.36	1.55	1.78	0.17
DM digestibility (%)	76.5	74.6	70.6	67.6	3.9

[1]Water in food and drink less water in urine and faeces