

OVINE KETOSIS II. THE EFFECT OF PREGNANCY ON THE BLOOD
KETONE BODY LEVELS OF WELL-FED EWES*

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INTRODUCTION

The effect of starvation on the ketone body levels of pregnant ewes has been studied extensively in the past in connection with pregnancy disease. In contrast, the effect of pregnancy *per se* on this component has received but scant attention and the only reference in the literature is to an experiment conducted by Kronfeld (1956) who found a significant increase in the ketone body levels of his animals during the last month of pregnancy. However, there are objections to this work, namely:—

- (a) The number of pregnant animals used was small (five) and, in addition, their conception dates extended over a period of four months.
- (b) The pregnant animals were not controlled by non-pregnant ones during the experiment.
- (c) The reported mean ketone body levels of the experimental animals prior to conception were abnormally high (5.0 mg. per cent) and in definite disagreement with accepted normal values (2.0 mg. per cent) [Procos, 1961 b; Goetsch, 1957; Clarke & Malan, 1956; Williams & Christian, 1959; Reid, 1960].

In view of the above it was decided to find what effect pregnancy has on the ketone body levels of adequately fed ewes whose conception dates were close enough to permit statistical comparison.

EXPERIMENTAL

The experiment lasted approximately six months (March to August, 1960).

Animals

Twenty-four mature, good-conditioned Merino ewes were used initially. Each lot of 12 animals was kept in an open camp and had free access to a sheltered stable. Eighteen of these animals were then served by two rams over a twelve day period. After nine weeks, nine of these ewes, selected for the closeness of their conception dates (within three days), were subjected to laparotomy to verify that they were indeed pregnant. Three non-pregnant ewes which were to be used as controls were treated in a similar way. Following the operation all these animals were kept separately in one camp.

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Diets

Each animal received a diet consisting of 1,000 gm. lucerne hay and 300 gm. concentrates daily. In addition to the above the animals received an adequate supply of green lucerne for a period of one week while recovering from their operations. Water was available at all times.

Sampling

Samples of jugular blood (1.5 ml.) were withdrawn at 8 a.m. Sampling was started in the fourteenth week of pregnancy. All animals were sampled twice weekly except in the last week of pregnancy when three samples were taken. In all, 45 determinations were performed on the control and 132 on the pregnant animals.

Analytical

Total ketone bodies were determined by the method developed in these laboratories (Procos, 1961a).

RESULTS

The length of the gestation period was on an average 150 days with a range of 148 to 153 days. Throughout this period none of the pregnant ewes showed any clinical signs of pregnancy disease. All the animals gave birth uneventfully to single healthy lambs with the exception of ewe No. 9 of which the lamb was born dead.

The range of ketone body values obtained was 1.08 to 3.88 and 1.49 to 3.11 mg. per cent for pregnant and non-pregnant ewes respectively, both well within the normal range. Despite small individual variations, the ketone body levels of the pregnant animals did not at any stage show any marked differences from those of the controls (Table 1). This was confirmed by a statistical analysis (t-test). The ketone body levels of both groups of animals showed a tendency to increase towards the latter part of the experiment (129 to 149th day of gestation). During this period,

TABLE 1.—Ketone body levels (mg. per cent) in the blood of pregnant and non-pregnant ewes

Dates of Sampling	Days Pregnant (Mean)	Temperature Drops °C	Controls				Pregnant											
			Sheep Numbers															
			2	4	6	5	7	8	9	10	15	20	21	24				
1960																		
28 June....	98	20.7	2.26	2.26	2.30	1.76	1.98	1.98	2.35	1.89	1.89	2.35	1.98	2.39				
5 July....	105	17.1	1.85	2.16	1.98	1.44	1.26	2.12	2.12	1.71	1.08	2.21	1.80	2.71				
8 July....	108	15.2	1.85	1.71	1.85	1.49	1.53	1.67	1.71	1.58	1.40	2.16	1.89	2.80				
13 July....	113	15.0	2.26	2.16	1.62	1.89	2.16	2.30	2.03	1.89	1.80	2.03	2.26	2.35				
15 July....	115	17.0	1.94	1.80	1.67	1.80	1.26	1.89	2.12	1.80	1.58	2.03	2.44	2.35				
19 July....	119	22.5	2.12	1.89	1.98	1.58	1.44	1.80	1.76	1.94	1.76	2.16	1.76	2.57				
26 July....	126	17.5	1.49	2.93	2.16	1.44	1.71	2.16	1.71	1.62	1.62	1.80	1.85	2.16				
29 July....	129	25.2	2.12	2.35	1.67	2.53	2.62	2.35	2.48	2.16	1.80	2.48	2.44	3.16				
2 August...	132	20.4	2.26	2.16	1.94	2.35	1.80	2.07	2.30	2.03	2.30	2.26	2.26	3.16				
5 August...	135	17.5	2.16	2.03	1.49	1.94	2.12	2.03	2.07	1.67	1.58	2.48	1.94	2.16				
9 August...	139	24.5	2.26	1.98	1.49	1.94	2.07	1.94	2.30	1.94	1.94	2.26	2.26	2.93				
12 August...	142	24.5	2.48	2.44	2.35	3.16	3.29	2.39	2.98	2.48	1.98	1.89	2.39	3.83				
15 August...	145	22.0	3.11	3.02	2.80	3.25	3.83	2.57	3.02	2.20	1.94	2.62	2.84	3.43				
17 August...	147	7.4	2.35	2.39	2.03	3.38	3.38	2.07	3.70	2.16	1.94	2.70	2.44	3.25				
19 August...	149	10.5	1.94	2.16	1.89	*	3.88	2.16	2.93	*	1.98	*	2.03	3.52				

* Lambled.

however, there were more large temperature drops† than in the first part of the experiment and it has been shown (Procos, 1961b) that such large drops result in higher ketone body levels in the blood. At temperature drops less than 20° C the mean ketone body level of the non-pregnant ewes was 2.0 mg. per cent while that of the pregnant ones was 2.08 mg. per cent. In contrast at drops greater than 20° C the values were 2.25 and 2.34 mg. per cent respectively. Statistical analysis (t-test) showed that the higher temperature drops resulted in significantly higher ketone body levels. There was, however, no significant difference between the response of the two groups of animals (12.5 per cent increase in both cases).

DISCUSSION

From the above results it is clear that in monotocous ewes pregnancy does not constitute a factor leading to increased ketone body levels when the amount of food available to the animal is sufficient to meet the additional requirements for nutrition of the foetus. Similar results were obtained for humans by Gray (1938). In view of the close relationship which exists between ketone bodies and blood sugar the results are also in full agreement with those of Kennedy, Anderson, Bechdel & Shigley (1939) and Reid (1950), who showed that the blood sugar levels of adequately fed, monotocous ewes and cows fell within the normal range.

In contrast to these results, Kronfeld (1956), also working with monotocous ewes, found higher ketone body levels during pregnancy. This, however, appears to be the result of the slight ketonemia exhibited by his experimental animals before conception (mean 5 mg. per cent, range 1 to 9 mg. per cent). This author also found a fall in blood sugar levels during the latter part of the pregnancy period.

The effect of temperature drops on the ketone body levels of sheep, observed by the author previously (Procos, 1961b) was again evident in both pregnant and non-pregnant animals. In this instance, however, despite the high temperature drops encountered, the increase in ketone body levels was small. This was probably due to the availability of shelter, which the animals used frequently, particularly during the night. The fact that there was no significant difference between pregnant and non-pregnant animals, in the degree of response to drops in temperature indicates that the former were able to cope with the additional small stress so imposed as well as the controls.

In the present experiment no twins were obtained so that it was not possible to study the effect of multiple pregnancy on the ketone body levels. This would be of interest in view of the findings by Reid (1960) that polytocous ewes respond differently to starvation and stress.

SUMMARY

The ketone body levels of adequately fed, monotocous Merino ewes were found to remain unaltered throughout the gestation period.

The ketone body levels of both pregnant and non-pregnant animals were affected to the same degree by drops in temperature. However, owing to the availability of shelter the effect was less pronounced than in previous experiments during which the animals were kept in open camps.

† Temperature drop is a term adopted by us (Procos, 1961b) to denote the drop in temperature from the maximum of the previous afternoon to the minimum in the early hours of the morning on which sampling took place.

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