تأثير حقن جلوكونات الماغنسيوم فى النعاج المريضة تجريبيا بنقص الماغنسيوم على مستوى المركبات العضويه وغير العضوية فى اللبن

ع ٠ ى ٠ أسماعيل

درس تأثير حقن ٥٠ سم^{3} من محلول ١٥٪ جلوكونات الماغنسيوم فى وريد النعاج المصابة بنقص الماغنسيوم تجريبيا ٠ وقد لوحظ أن حقن المادة المذكورة قد تسبب فى زيادة مستوى الماغنسيوم فى بلازما الدم من ٨٨, مجم٪ الى ٢,٤٨ ـ ٢,٧١ مجم ٪ فى خلال ساعه الى ساعة ونصف من الحقن ٠ كما وجد أن حقن المركب المذكور ليس له تأثير على مستوى الماغنسيوم فى اللبن ٠

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THE EFFECT OF INTRAVENOUS INJECTION OF MAGNESIUM GLUCONATE INTO EXPERIMENTALLY HYPOMAGNESAEMIC EWES ON ORGANIC AND INORGAIC CONSTITUENTS OF THEIR MILK

(With 3 Tables)

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SUMMARY

Two lactating Merino ewes, about 5 years old were used to investigate the effect of I.V. injection of magnesium gluconate into experimentally hypomagnesaemic ewe on the organic and inorganic constituents in her milk. During the control period, the animals received a Mg-deficient ration (0.045 Mg%) plus 3 grams of MgO. After that, the MgO-supplement was removed to induce hypomagnesaemia. After the Mg-concentration in blood decreased below 1 mg/100 ml, 50 ml of 25% solution of magnesium gluconate were i.v. injected. During the control period, the Mg- and Ca-levels in blood plasma averaged 2.44 and 10.1 mg/100 ml respectively. During the same period, the milk analysis revealed the following average values: Mg, 20.4; Ca, 198.9 mg/100 ml., fat 7.3; lactose, 4.8 g/100 ml.

On the Mg-deficient ration, the Mg-level in blood plasma decreased to 0.88 mg/100 ml within 6 days. Neither the hypomagnesaemia nor the injection of magnesium did influence the Mg-concentration in the milk. The fat content of the milk could not be increased by the magnesium injection. The Mg-concentration in blood plasma has been increased following the injection to a normal level (2.71-2.48 mg/100 ml) which lasted only for about 1½ hours.

INTRODUCTION

The origin of milk fat has been extensively reviewed(JONES, 1969; STORRY, 1970; PATTON and JENSEN, 1974). It is accepted that the precursors of ruminant milk fat in the blood are acetate, B-hydroxybutyrate, glucose, and triglycerides carried by the chylomicrons and very low density lipoproteins. The uptake of blood triglycerides for milk fat synthesis is dependent upon the action of lipoprotein lipase associated with the capillary endothelium of the mammary gland (SCHOEFL and FRENCH, 1968; SCOW et al., 1972; MENDELSON et al., 1977). When milk fat is depressed by restricting roughage,dietary magnesium oxide seems to inhibit fat deposition by decreasing adipose lipoprotein lipase and glyceride synthesis, while increasing the activity of this enzyme in the mammary tissue (EMERY, 1973, 1976). On the basis of this suggestion, one would expect a relatively rapid response in the milk fat percentage as a result of the action exerted by magnesium on the lipoprotein lipase in the mammary gland. This suspicion profunded the basis for the present work, in which the effect of intravenous injection of magensium gluconate principally on the milk fat percentage in lactating ewes was investigated. In order to attain the greatest possible response in the milk fat content,arising from the action of magnesium,an experimentally conducted hypomagnesaemia in lactating ewes was induced prior to the magnesium treatment.

MATERIAL AND METHODS

The experiment was carried out using two 5 year-old lactating Merino ewes at the beginning of the 7th week after lambing. The animals were kept indoors throughout the experimental period. A magnesium deficient ration containing only 0.045Mg% and 14.2% crude fiber was formulated. The ration was semisynthetic and consisted of the following ingredients: ground oats, dried beet pulp, starch, wood pulp, ground hay, soybean protein, sugar, oil, molasses, vitamins and a mineral-mixture. The chemical analysis of the ration revealed the average composition presented in Table 1.

Table 1. Average composition of the ration.

Nutritive Substance			
	%		%
Moisture content	12.50	Ca	0.94
Dry matter	87.50	Mg	0.045
Crude protein	13.24	P	0.58
Ether extract	4.00	Na	0.66
Crude fibre	14.20	K	0.87
Ash	6.61		
NFE	48.57		

From this ration, each ewe received 1500 g per day divided into two meals. On this basis, each ewe was supplied with 150 g digestible protein and 900 starch units.

During a control period lasting for 2 weeks; the ration plus 3 grams of powdered MgO were fed for each ewe. The control period was succeeded with an experimental period, in which the Mg-supplement was removed to induce hypomagnesaemia. After the magnesium level in plasma was depressed below 1 mg/100 ml, the lactating ewes were injected intravenously with 50 ml of 15%

magnesium gluconate solution to observe the change in the milk fat content brough about by the magnesium supplementation.

Blood samples were taken immediately before the morning's meal from the jugular vein once a day during the control and the period of hypomagnesaemia induction.On the day of magnesium gluconate injection, blood samples were collected at hourly intervals between 8 a.m. and 8 p.m. EDTA was used as an anticoagulant and the plasma was separated by centrifugation of the blood samples at 3000 r.p.m.for 15 minutes.Plasma magnesium and calcium were determined by the atomic absorption technique.

Milk saples were collected by hand milking ensuring an evacuation of the udder as complete as possible. Milk samples were collected at 2-hours interval began at 8 a.m. till 8 p.m. on one day during the control period, on the day where the level of blood magnesium was lowest, and lastly on the day of magnesium injection. The milk fat content was determined using the method of STAHLHUTKLIPP (1974). The method of HOFFMANN (1937) modified by STHLHUT-KLIPP (1976) was followed for the determination of the lactose content. By the atomic absorption technique, magnesium and calcium were determined in the milk plasma after the precipitation of milk proteins by trichloroacetic acid as described by ISMAIL (1977).

RESULTS

1) Blood analysis:

The estimated magnesium and calcium concentrations in the blood plasma of the ewes during the period of the experiment are presented in Table 2.

2) Milk analysis:

The magnesium and calcium concentrations as well as the fat, and lactose contents in the milk of the ewes throughout the experiment are shown in Table 3.

Table 2. The magnesium and calcium concentrations in the blood plasma of the ewes (mg/100 ml) throughout the experiment.

Time of blood sampling	Control period		A day before the Mg-treatment		After the Mg-injection	
	Magnesium	Calcium	Magnesium	Calcium	Magnesium	Calcium
8 a.m.	2.44	10.1	0.88	8.6	0.93	9.0
10					0.95 Mg-injection	8.8
10.30					2.71	9.1
11					2.48	9.7
12					2.01	9.9
1 p.m.					1.88	10.6
2					1.77	10.0
3					1.88	10.4
4					1.43	9.7
5					1.46	10.1
6					1.49	9.8
7					1.45	9.7
8					1.43	9.9
Average					1.80 n=11	9.9 n=11

Table 3. The magnesium, calcium, fat, and lactose contents in the milk of the ewes during the experiment.
(Ca, Mg mg/100 ml; Fat, Lactose g/100 ml).

Time of milk sampling	Control period				A day before the Mg-treatment				After the Mg-injection			
	Mg	Ca	Fat	lactose	Mg	Ca	Fat	lactose	Mg	Ca	Fat	lactose
8 a.m.	18.5	203.5	8.4	4.73	21.0	198.5	8.2	4.85	21.9	196.0	8.4	4.66
10	19.1	206.5	7.9	4.82	21.3	200.0	8.1	4.85	21.8	197.5	8.1	4.83
12	20.0	201.0	6.4	4.78	21.4	206.0	7.8	4.43	22.0	Mg-injection 210.0	8.3	4.86
2 p.m.	20.1	197.5	6.9	4.74	21.6	204.5	7.6	5.05	22.8	206.0	7.6	4.85
4	20.4	195.0	7.4	4.80	21.6	201.0	7.7	5.05	24.3	196.5	7.8	4.85
6	22.4	197.0	6.5	4.89	23.0	206.5	8.6	5.02	23.3	201.5	9.0	4.94
8	22.1	191.6	7.4	4.86	22.0	209.0	9.5	5.01	23.4	211.0	8.5	5.00
Average	20.4	198.9	7.3	4.80	21.7	203.6	8.2	4.97	23.2	205.0	8.2	4.9
n =	7	7	7	7	7	7	7	7	5	5	5	5

DISCUSSION

1) Blood analysis:

During the control period, the Mg-concentration in the ewes blood plasma averaged 2.44 mg/100 ml, a normal value which showed an adequate supply of magnesium during this peirod (DLUNT,1975). After the ewes were maintained for 6 days on the Mg-deficient diet, the Mg-concentration in plasma decreased to an average value of 0.88 mg/100 ml. Similar low Mg-levels in plasma of ewes were also reported by other workers during the induction of experimental hypomagnesaemia carried out on sheep maintained on Mg-deficient rations (L'ESTRANGE et al., 1967; ISMAIL, 1977). The intravenous injection of magnesium gluconate did raised very rapidly and sharply the magnesium level in plasma to an average of 2.71 mg/100 ml estimated half an hour after the injection. After that, the level of magnesium in plasma began to decrease gradually and reached a value of 1.43 mg/100 ml after 10 hours from the time of injection. This result is in agreement with those obtained by FISCHER (1968) in the cow.

During the induction of hypomagnesaemia the calcium level in the ewes plasma showed a slight decrease.

Similar decrease in the calcium concentration in blood during hypomagnesaemia was also reported in other investigations carried out on sheep (BAKER et al., 1976; ISMAIL, 1977).

2) Milk analysis:

a) Magnesium and calcium concentrations:

Neither the experimental hypomagnesaemia nor the i.v. injection of magnesium gluconate did result in any significant

alteration in the Mg-and Ca-concentrations in the milk of the ewes.

Such undependecny of the magnesium and calcium concentrations in the milk from the level of the corresponding elements in the blood was noticed also in many cases of hypomagnesaemia and hypocalcaemia in lactating ewes (L'ESTRANGE and AXFORD, 1966) as well as in the dairy cow (MEYER, 1962, SCHROTER and SEIDEL, 1966).

b) Fat content:

During the control period, the fat content in the milk of the ewes averaged 7.3 g/100 ml; a level which lies within the normal range given by other investigators working with the milk of apparently normal ewes of many breeds (ASHTON et al., 1964; CORBETT, 1968).

Concerning the period of hypomagnesaemia, the fat content averaged 8.2 g/100 ml. Although the hypomagnesaemic ewes were intravenously injected with 7.5 g of magnesium glucenate at one time, the milk fat content stayed unchanged and averaged 8.2 g/100 ml. Therefore, the increase in the milk fat content from 7.3 g/100 at the beginning of the experiment to 8.2 g/100 ml toward the end can be attributed to the effect of the stage of lactation on the milk fat content (ASHTON et al., 1964; SCHAKERNEGEAD, 1973).

It is well evidenced that during a period of unadequate magnesium supply,the animal is erged to utilize the mobilizable portion of the magnesium in its bone stores in a try to maintain the blood level of the element as constant as possible. This process continues for a time until the bone stores of magnesium are drawn off after which the clinical signs of hypomagnesaemia begin to develop (KANEKO and CORNELIUS, 1970;

AIKAWA, 1971). On this basis, the magnesium injected was probably partly directed to build up again mainly the exhausted bone reserves of magnesium and partly excreted outside the animal's body (SMITH, 1959). This suggestion might be proved by the gradual decrease in the blood magnesium concentration from 2.71 mg/100 ml following the magnesium gluconate injection to 1.43 mg/100 ml about 10 hours thereafter (see Table 1).

In other words, the Mg-concentration has been increased following the injection to anormal level (2.71-2.48 mg/100 ml) which lasted only for about 1½ hour. This duration and the amount of magnesium supplied to the mammary tissue were probably not quite enough to stimulate lipoprotein lipase in the mammary gland with a subsequent increase in the milk fat percentage. The suboptimal crude fibre content of the ration fed to the ewes not as low as used by EMERY (1973, 1976), who could correct the milk fat depression of dairy cows receiving restricted roughage diets by the addition of MgO to their ration.

c) Lactose content:

Neither the hypomagnesaemia nor the magnesium injection did influence the milk lactose content, as shown by the levels 4.97 and 4.90 g/100 ml estimated during the period of Mg-deprivation and after the i.v. injection of magnesium gluconate respectively.

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