

Metabolism disturbances among ruminants in the conditions of Kyrgyzstan

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Abstract. This article shows the change in metabolism of ruminants, which are bred in the highlands of Kyrgyzstan. Some of the most widespread diseases, such as ketosis, immune deficiencies of cows and ewes, as well as their newborn calves and lambs, have been studied. Experimental studies were carried out in the clinic of the Veterinary Medicine Faculty of the Kyrgyz National K.I. Scriabin Agrarian University using traditional methods used in veterinary medicine. Based on the conducted production and experimental studies, it was noted that in tested animals, namely the Kyrgyz Fine-wool breed sheep and the Alatau breed cows, metabolic pathologies in the form of ketosis and immune deficiencies are often recorded. Usually these diseases have interrelated etiopathogenetic mechanisms of development and therefore, the authors set the following goals and objectives: to study the mechanisms of development of ketosis in pregnant ewes and pregnant cows, as well as their newborn lambs and calves. And to reveal the features of changes in morpho-biochemical and immunological parameters of blood of ewes and their lambs of the Kyrgyz fine-wool breed, and cows and their calves of the Alatau breed.

Keyword: Pathology, cow, ewe, calves, lambs, blood, antenatal, ketosis, immune deficiencies.

1. Introduction

Kyrgyzstan is a mountainous country, where mountains occupy more than 95% of the total area of the republic. In this regard, the basis of the country's economy is agriculture, and animal husbandry is its priority sector. With the transfer of animal husbandry to market relations, a number of new problems have appeared for the workers of veterinary medicine. One of which is the study of metabolic diseases, especially in ruminants bred in the republic. According to our data, metabolic diseases among cows and sheep, and their young generation, on average, occupy from 3 to 46% of all internal pathologies of animals [1-6]. Individual scientists, like I.G. Sharabrin [7], note that in Russia cattle ketosis is diagnosed among 50 to 60%, and it often occurs more among calves born in the springtime, than among those born at the end of the year. Other researchers who dealt with this problem have the same opinion [8]. It should be noted that the above authors claim that all types of metabolisms are disturbed during ketosis, but there

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are no scientific works on how these changes affect the birth of future offspring. Therefore, we consider it very relevant to study metabolic disorders in mothers and their newborns, as well as their impact on future offspring, taking into account the high-altitude conditions of the country.

2. Materials and methods

Experimental production tests were carried out at the Vetka dairy farm, the Thyme farm, the Sokuluksky State Processing Plant and the scientific laboratory of the Department of Internal Animal Diseases, the Faculty of Veterinary Medicine and Biotechnology of KNAU named after K.I. Scriabin in the period from 2006 to 2020. For the tests, there were selected ewes and their newborn lambs of the Kyrgyz fine-fleeced breed, in the amount of 20 heads (10 heads of ewes and 10 heads of their lambs), and mother cows and their newborn calves of the Alatau breed in the amount of 20 heads (10 heads of cows mothers and 10 heads of their calves). For the experiment, 4 groups of animals were formed: the first experimental group included ewes (10 heads) and newborn lambs (10 heads), the second experimental group included mother cows (10 heads) and their calves (10 heads). The third was the control group, this included clinically healthy ewes and their lambs, 10 heads each, and the fourth group was the control group, and included clinically healthy cows and their calves, 10 heads of each. In the experimental and control groups of animals, morphological, biochemical and immunological blood tests were performed, where they studied for the general indicators of metabolism (total protein, sugar, reserve alkalinity, calcium, phosphorus, ketone bodies), immunological (lymphocytes, B, T-lymphocytes, phagocytic index and morphological parameters (erythrocytes, leukocytes, hemoglobin).

Hematological blood tests (morphological, biochemical and immunological) in experimental and control groups of animals were carried out according to uniform methods, adopted in veterinary medicine [9]. The obtained digital data were statically processed according to A.S. Asatiani and A.V. Pushkarev [10] on microcalculators such as " CITYCAL " CT - 3338. In the tables and in the text, the measured values are presented as the simple arithmetic ($M \pm m$) standard error of the mean value. Significance of differences ($P \leq 0.05$; $P \leq 0.01$; $P \leq 0.001$) was determined using Mr. Student's table.

3. Results

One of the main causes of ketosis among sheep some authors [11, 12, 13, 14] consider to be feeding with silage, haylage containing butyric and acetic acids. The data obtained by us under the experimental conditions showed that feeding for 20 days with corn silage and for 35 days with haylage containing butyric and acetic acids as mono-feed causes ketosis among sheep. Morphological and immunological parameters of blood in ewes and newborn lambs with ketosis are shown in Table 1.

Table 1. Morpho-biochemical and immunological parameters of blood in ewes and newborn lambs

N	Indicators	Types of diseases				P≤
		Ketosis in ewes	Control group	Ketosis in lambs	Control group	
1	Erythrocytes, in $10^{12}/l$	8.7±0.22	10.05±0.30	4.63±0.15	9.11±0.12	0.05

2	Leukocytes, in 10 ⁹ /l	5.4±0.17	7.78±0.39	11.2±0.45	8.19±0.45	0.01
3	Hemoglobin, g /l	98.0±2.0	114.0±5.6	8.8±0.31	10.09±0.22	0.05
4	Total protein, g /l	56.4±3.2	72.7±0.6	55.0±0.20	76.0±0.18	0.05
5	Sugar, mmol /l	1.30±0.08	2.6±0.2	1.87±0.04	5.24±0.0	0.01
6	Phosphorus, mmol /l	1.21±0.09	2.42±0.03	1.45±0.07	2.48±0.05	0.05
7	Calcium, mmol /l	2.42±0.05	3.14±0.05	2.02±0.03	2.75±0.00	0.05
8	Reserve alkalinity, vol%, CO ₂	24.4 ± 0.34	44.6 ± 2.7	27.0±0.03	48.2±0.04	0.05
9	Ketone bodies, mmol /l	4.64±0.53	0.25±0.50	3.70±0.02	1.06±0.02	0.001
10	Lymphocytes, %	34.08±1.2	54.08±1.27	37.3±0.64	56.4±0.12	0.001

Based on this Table 1, it can be concluded that the content of the main metabolic indicators (total protein, sugar, reserve alkalinity, calcium, phosphorus, ketone bodies) of ewes with ketosis had major changes, especially ketone bodies, they significantly increased up to 4.64±0.53 mmol/ l (P< 0.001) compared with the control group. The same happened with newborn lambs from these ewes i.e. all indicators of metabolism, including the content of ketone bodies, have change significantly (P ≤ 0.001). The most significant change was found in the morphoimmunological composition of blood in ewes with ketosis and their newborn lambs. Sick animal has a decrease in the number of erythrocytes (up to 8.7±0.22 and 4.63±0.15 in 10¹² /l, P ≤0.05), hemoglobin (up to 98.0±2.0 and 8.8 ±0.31 g/l, P ≤ 0.05), lymphocytes (up to 34.08 ± 1.2 and 37.3 ± 0.64%, P ≤ 0.001), and an increase in leukocytes in lambs with ketosis (up to 11, 2±0.45 versus 8.19±0.45 in test, P≤0.01).

It should be noted that in a daily diet of mother cows (experimental group) there are deficiencies in 21.7% of the feed unit, 41.3% of metabolic energy, 32.9% of digestible protein, 18.4% of fat, 45.2% of calcium, 14.4% of phosphorus, and fiber and carotene, in total amounted upto 4.5 and 8.4%, respectively compared with the required feeding norms for highly productive cows [15]. In addition, silage and haylage contain more butyric acid up to - 12.4%, which in turn causes a great stress on metabolic processes in pregnant cows and inevitably leads to the formation of a large number of ketone bodies. Morpho-biochemical parameters of blood in mother cows and newborn calves are shown in Table 2.

Table 2. Morpho-biochemical and immunological parameters of blood in mother cows and newborn calves

N	Indicators	Ketosis in cows (experimental group)	Control group	Ketosis in calves	Control group
1	Erythrocytes, in 10 ¹² /l	5.40±0.23	5.94±0.14	5.2±0.48	6.5±0.4

2	Leukocytes, in 10 ⁹ /l	5.4±0.175	6.93±1.99	6.2±0.62	8.0±0.3
3	Hemoglobin, g/l	9.32±1.70	9.85±0.4	94.2±0.21	120.0±2.4
4	Total protein, g/l	47.4±0.17	72.5±1.84	40.7±0.12	79.0±0.16
5	Sugar, mg%	46.5±11.2	44.8±2.0	99.8±1.23	80.9±0.0
6	Inorganic phosphorus, mg%	4.20±0.17	5.20±0.15	6.2±0.16	7.50±0.05
7	Total calcium, mg%	8.5±0.45	10.6±0.43	6.6±0.11	12.0±0.45
8	Reserve alkalinity, vol% CO ₂	19.3±4.4	48.6±0.98	42.4±0.33	53.0±1.02
9	ketone bodies, mg%	17.5±4.11	4.4±1.7	13.3±0.92	3.84±0.06
10	Lymphocytes, %	48.2±0.22	64.0±1.03	48.2±0.01	70.1±1.02
11	B-lymphocytes, %	13.2±0.12	16.6±0.21	12.04±0.04	22.3±0.82
12	T-lymphocytes, %	32.3±0.54	36.3±0.30	13.2±0.30	35.7±2.04
13	Phagocytic index, %	32.0±0.02	36.0±0.01	54.2±0.03	68.0±0.05

As shown in Table 2, the imbalance of the diet leads to a noticeable decrease in the main indicators of metabolism in mother cows and their newborn calves compared with the healthy animals data, especially the content of phosphorus 19% and 17.3%, reserve alkalinity 60.2% and 20.0 %, total protein 38.8% and 48.4%, total calcium 19.8% and 45.0%, and the amount of sugar fluctuated at a low level of homeostasis . The content of ketone bodies sharply increases not only in mother cows up to 17.5 mg%, but also in newborn calves to 13.3 ± 0.02 versus 3.84 ± 0.06 mg%, morph and immune blood parameters in experimental cows and calves compared with the control group, especially the content of erythrocytes 9.09% and 20.0%, leukocytes 22.0% and 22.5%, hemoglobin 5.3% and 21.5%, lymphocytes 24.6% and 31.2 %, B-lymphocytes 20.4% and 44.3%, T-lymphocytes 11.0% and 63.0%, and phagocytic parameters 11.1% and 20.2%.

4. Discussion.

A number of scientists tried to find the reasons for the ketosis in sheep when fed with silage and haylage, containing large amounts of acetic and butyric acids [12, 13, 14]. However, there is no specific experimental study when pregnant ewes were given corn, containing silage with butyric acid up to 10-12% for 20 days and haylage as a mono-food for 35 days, and especially their effect onto offspring. The morpho-biochemical and immunological blood parameters obtained by us in experimental ewes and newborn lambs confirm that ketone bodies pass through the placenta into the fetus and cause antenatal ketosis (toxicosis) in newborn lambs.

Many scientists who studied the ketosis in highly productive cows [7, 8, 15] indicate that inadequate feeding of pregnant cows, especially in the second half of pregnancy, disrupts the metabolism in the body, i.e. causes ketosis. However, what is the condition of mother cows and how it affects the immune system of newborn calves has not been fully studied. One of the objectives of our research is clarification of this matter. Our experimental studies, carried out on

mother cows and their newborn calves, do confirm the obtained data on ewes and their lambs that ketone bodies from the mother's blood pass into the fetal body and cause ketosis, but it was also found that these newborn calves undergo a major change in the immune system i.e. are born with pathology of immune deficiency.

5. Conclusion

In the conditions of high-mountainous Kyrgyzstan, ketosis in ewes of the Kyrgyz fine-wool breed and their newborn lambs is widespread. One of the reasons for the occurrence of ketosis in pregnant ewes is one-sided feeding with silage containing butyric acid (up to 10-12%). Ewes with ketosis are born sick with antenatal ketosis in lambs. At ketosis, the ewes and their newborn lambs have decrease of erythrocytes (up to 8.7 ± 0.22 and 4.63 ± 0.15 in $10^{12} / l$), hemoglobin (up to 98.0 ± 2.0 and $8, 8 \pm 0.31$ g/l), and the number of leukocytes in lambs increases by 27.7%. ± 0.20 g/l), sugar, respectively (up to 1.30 ± 0.08 and 1.87 ± 0.04 mmol /l), inorganic phosphorus (up to 1.21 ± 0.09 and 2.02 ± 0.03 mmol / l), total calcium (up to 24.4 ± 0.34 and 27.0 ± 0.03 vol% CO₂) and the amount of ketone bodies increases, respectively (up to 4.64 ± 0.53 and 3.70 ± 0.02 mmol / l) compared with healthy animals. In this regard, antenatal ketosis of newborn lambs can be considered as an independent nosological entity. When pregnant cows of the Alatau breed are fed with an inadequate diet, metabolism is disturbed not only in mother cows, but also in their newborn calves. They develop hypoglycemia, acidosis, hypoproteinemia, hypophosphatemia, hypocalcemia, erythropenia, leukopenia, and ketonemia. Also, there was significant decrease in the number of lymphocytes (up to $48.2 \pm 0.01\%$), B-lymphocytes (up to $12.04 \pm 0.04\%$), T-lymphocytes (up to $13.2 \pm 0.30\%$) and phagocytic index (up to $12.04 \pm 0.04\%$) of newborn calves, which means the body's immune deficiency. For the perspective, we set up a task to make a deep study of metabolic diseases in local breeds, especially newborn animals, and to develop effective methods of preventive measures.

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