
Research on metabolic status in periparturient cows

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Abstract

In the experiment, hematological and blood biochemical parameters were determined in a batch of 5 cows in the last week of gestation (Group 1) and 5 cows in the first week after calving (Group 2). Cows are clinically healthy and come from a farm where the milk production per fed animal is about 30 liters/day, cows being milked 3 times per day. Hematologic parameters were found within physiological limits, but in both groups the monocytes were found to be low, and in group 1, mild lymphopenia was detected. Investigated blood biochemical parameters allowed to assert that in cows in the last week of gestation, bilirubin was found to be significantly increased when recently-bred cows were within normal limits. In both lots, LDH was found to be significantly increased. Metabolic status also determined the protein fractions by means of electrophoresis: 10 samples were analyzed (Group 3 consisting of 5 cows in the last week of gestation and Group 4 consisting of 5 cows in the first week after calving). The values of the protein fractions were within the physiological limits and the Albumin/Globulin Ratio was found within physiological limits in group 3 and lower in group 4, which confirms gamma globulin reactivation immediately after calving.

Key words: metabolism, parturition, protein fractions, immunoglobulins.

Introduction

It is known that a lot of changes occur in the dairy cow during the transition period (21 days before parturition and 21 days after parturition). In this study we tried to obtain a more detailed table of the metabolic status of the periparturient cows closer to the moment of parturition (7 days before parturition and 7 days after parturition) (5, 9). Dairy cattle, like many other species, often consume less feed in the week prior to parturition (Grummer et al., 2004), and it can take up to a week post-calving before dry matter intake (DMI) exceeds what the cow was consuming in late gestation (6). The fatty liver present at one day after calving is negatively correlated with feed intake one day prepartum (3).

Metabolic disorders are a key problem in the transition period of dairy cows and often appear before the onset of further health problems. Problems derive from the difficulty of the animals to adapt to large variations and disturbances occurring outside and inside the organism. (4) Oxidative stress is also known to be an important factor of the metabolic dysfunctions during this period. (Miller et al., 1993; Sordillo and Aitken, 2009). A lack of success in solving these issues may be due to predominant approaches in farm management and agricultural science. Instead, a successful adaptation of animals to their living conditions should be seen as an important end in itself. Both farm management and agricultural sciences should support animals in their ability to cope with nutritional and metabolic challenges by employing a functional and result driven approach (9). Techniques of modern hematology and biochemistry promise to further our understanding of the mechanisms of metabolic adaptation during the periparturient period, and to quantify the effects of nutrition and environment during pre- and postpartum periods on hepatic glucose and lipid metabolism (1,2,7).

Another important aspect of the blood and its constituents is the fact that is very dependable on the medium (temperature, way of collecting, stress of collecting the blood) for evaluating

physiological changes in the physical and health status of an animal (Egbe-Nwiyi et al., 2000; Žvorc et al., 2006; Njidda et al., 2014).

Materials and methods

In this paper we aim to achieve a metabolic monitoring of the main biomacromolecules (proteins, lipids, carbohydrates) and enzyme and mineral status to prevent possible dismetabolites, which once detected could be rectified so that even the worst period of gestation, the transition period provides optimal comfort for completing gestation and obtaining healthy newborns.

To complete the research, we chose as location a cow farm near the capital, with a tradition of raising dairy cows. At present, the farm hosts 574 cows, of which 309 cows, 65 heifers, 172 calves over 6 weeks, 18 calves above 6 weeks and 10 other categories. Cows are kept in free standing on straw bedding. As experimental protocol, we made 4 groups, each one consisting of 5 cows, as follows:

Group 1: 5 cows in the last week of gestation and Group 2: 5 cows in the first week after calving, from which we collected blood samples in order to compare the biochemical and haematological blood parameters between the 2 groups;

Group 3 and group 4 with a similar consistency, but in this case, we collected blood samples for determination of the protein fractions using a technique of electrophoresis; all paraclinical examinations were performed in our discipline laboratory.

Results and discussion

As presenting in the table below, the hematological exam in cows during the gestation week reveal a monocytopenia present in all cows from group A and also a lymphocytopenia present at four of the cows from this group. The other parameters were found within physiological limits.

Table 1. The Results of the Hematological Exam at Cows in the Last Week of Gestation (Group1)

PARAMETER	U/M	Physiolog. limits	Cow 71055	Cow 27829	Cow 53538	Cow 65317	Cow 8126
WBC	10 ⁻⁹ /mm ³	4-12	7,72	6,60	8,75	13,22	8,82
LYM	10 ⁻⁹ /mm ³	2,5-7,5	2,56	3,64	3,76	5,61	3,30
MON	10 ⁻⁹ /mm ³	0-1	0,08	0,06	0	0,12	0,13
NEU	10 ⁻⁹ /mm ³	0,6-7,6	4,88	2,01	4,75	7,18	5,19
EOS	10 ⁻⁹ /mm ³	0,1-1	0,19	0,10	0,16	0,30	0,20
BAS	10 ⁻⁹ /mm ³	0-0,5	0	0	0,01	0,01	0,01
LYM	%	45-75	33,2	55,1	42,9	42,4	37,4
MON	%	2-7	1,0	0,9	0,9	0,9	1,5
NEU	%	15-65	63,3	42,5	54,3	54,3	58,8
EOS	%	1-8	2,5	1,5	1,9	2,3	2,2
BAS	%	0-3	0,1	0	0,1	0,1	0,1
RBC	10 ⁻¹² /mm ³	5-10	6,65	6,96	7,34	8,18	7,29
HGB	g/dl	8-15	10,8	9,6	11,3	11,9	11,5
HCT	%	24-46	33,43	29,44	33,51	37,55	34,59
MCV	fl	40-60	50	42	46	46	48
MCH	pg	11-17	16,2	13,8	15,3	14,5	15,7
MCHC	g/dl	30-36	32,2	32,6	33,6	31,7	33,1
PLT	10 ⁻⁹ /mm ³	100-800	250	362	392	340	425

Monocytopenia is known to appear as a result of aplastic anemy, pancytopenia and also after using medication like: prednisolon, alprazolam, triazolam, but in this case we will strictly corelate it with the advanced stage of getation. Monocytes are the largest cells in the blood; are released into the blood and after a short while in circulation, migrate into different tissues, incidentally or specifically, in response to various chemotactic factors. In tissues, in response to different soluble factors, they differentiate into tissue macrophages with characteristic morphological and functional qualities, a process that has been called "activation" and which is reversible ("deactivation"). The cells of the phagocytic mononuclear system are very primitive phylogenetic, and no animal can live without them. They perform a wide variety of important functions in the body, including removal of foreign particles and senescent cells, dead or altered, regulation of other cell functions, processing and presentation of antigens in immune reactions, participation in various inflammatory reactions, destruction of bacteria and tumor cells.

Table 2. The Results of the Hematological Exam at cows in the first week after calving (Group 2)

PARAMETER	U/M	Physiolog. limits	78178	80501	23747	8096	8181
WBC	10 ⁻⁹ /mm ³	4-12	10,43	8,44	8,72	9,54	9,43
LYM	10 ⁻⁹ /mm ³	2,5-7,5	4,59	3,09	2,92	5,42	5,37
MON	10 ⁻⁹ /mm ³	0-1	0,11	0,04	0,85	0,09	0,16
NEU	10 ⁻⁹ /mm ³	0,6-7,6	5,41	4,02	4,64	3,70	3,69
EOS	10 ⁻⁹ /mm ³	0,1-1	0,32	0,47	0,30	0,32	0,21
BAS	10 ⁻⁹ /mm ³	0-0,5	0,01	0,01	0,01	0,01	0,01
LYM	%	45-75	44	46,1	33,5	56,8	57,0
MON	%	2-7	1,0	0,5	9,7	0,9	1,7
NEU	%	15-65	51,9	47,7	53,2	38,7	39,1
EOS	%	1-8	3,1	5,6	3,5	3,4	2,2
BAS	%	0-3	0,1	0,1	0,1	0,1	0,1
RBC	10 ⁻¹² /mm ³	5-10	7,3	5,51	6,39	6,65	8,00
HGB	g/dl	8-15	11,2	9,0	10,7	9,7	11,3
HCT	%	24-46	35,65	28,36	32,14	30,91	34,57
MCV	fl	40-60	49	51	50	46	43
MCH	pg	11-17	15,4	16,4	16,8	14,6	14,2
MCHC	g/dl	30-36	31,5	31,9	33,3	31,4	32,7
PLT	10 ⁻⁹ /mm ³	100-800	242	257	294	379	297

Regarding Group 2, the results of hematological exam are very similar to those from group 1, the values are very little semnificative modified according to the physiological vallues.

At the biochemical examination of the blood, it was noticed an increasing of Lactat Dehydrogenase (LDH) and Total Bilirubin (T-bil), which is directly corelated with the fiziological status of the cows from Group 1. There are also variations of he other parameters: T-Cho, Creatinine and Uric acid.

Table 3. The Results of the Biochemical Exam at Cows in the Last Week of Gestation (Group 1)

Parameter	U/M	Physiolog. limits	71055	27829	53538	65317	8126
T- Pro	g/dl	5,8-8,5	6,9	6,5	7,1	6,8	6,3
Albumin	g/dl	2,5-3,7	2,9	2,7	2,7	3,3	3,5
Globulin	g/dl	3,3-4,8	4,0	3,8	4,4	3,5	2,8
BUN	mg/dl	10-25	10	11	9	11	13
UA	mg/dl	1,0-2,1	0,9	0,8	1,0	1,1	0,9
Cre	mg/dl	0,4-1,0	1,4	1,0	1,0	1,2	1,1
T-Cho	mg/dl	70-280	59	50	75	85	71
GOT	IU/l	78-132	88	89	68	91	92
LDH	IU/l	692	1445	1348	1422	1654	1637
T-Bil	mg/dl	0-0,3	1,0	0,6	0,4	0,7	0,5
GPT	IU/l	0-82	8	7	9	12	7
ALP	IU/l	0-80	118	113	110	135	69

Table 4. The Results of the Biochemical Exam at cows in the first week after calving (Group 2)

Parameter	U/M	Physiolog. limits	78178	80501	23747	8096	8181
T- Pro	g/dl	5,8-8,5	6,4	6,6	6,2	7,1	5,4
Albumin	g/dl	2,5-3,7	3,2	3,4	3,3	3,3	3,2
Globulin	g/dl	3,3-4,8	3,2	3,2	2,9	3,8	2,2
BUN	mg/dl	10-25	9	13	13	7	9
UA	mg/dl	1,0-2,1	0,9	0,7	0,7	0,8	0,7
Crea	mg/dl	0,4-1,0	1,1	1,2	1,5	1,0	1,2
T-Cho	mg/dl	70-280	98	66	98	92	77
GOT	IU/l	78-132	113	51	48	42	76
LDH	IU/l	692-1445	2343	1973	1561	1588	2256
T-Bil	mg/dl	0-0,3	0,5	0,3	0,4	0,3	0,3
GPT	IU/l	0-82	10	7	7	7	10

At the biochemical examination of the blood collected from group B, it is noticed that the values of LDH and T-Bil continue to be increased and also, Creatinine reveals an increasing. Uric Acid seems to be decreased at all the cows from this group.

Table 5. Determination of protein fractions by electrophoresis in Group 3

Fraction	U/M	Physiolog. limits	8181	8096	23746	78178	80501
Total Protein	g/dl	5,8-8,5	5,40	7,10	6,20	6,40	6,60
Albumin	g/dl	1,3-2,47	1,81	1,47	1,51	1,87	1,84
α_1	g/dl	0,19-0,78	0,27	0,30	0,37	0,31	0,33
α_2	g/dl	0,19-0,78	0,50	0,63	0,63	0,67	0,62
β_1	g/dl	0,32-0,84	0,80	0,95	0,79	0,93	0,77
β_2	gd/l	0,32-0,84	0,49	0,61	0,61	0,53	0,47
γ	g/dl	1,75-2,72	1,54	3,14	2,30	2,09	2,56
Alb/Glob	/	0,45-1,31	0,50	0,26	0,32	0,41	0,39

Determination of protein fractions reveals insignificant changes according to the physiological limits for the cows in the last week of gestation. The decrease Albumin/Globulin ratio is associated with the physiological status of the cows.

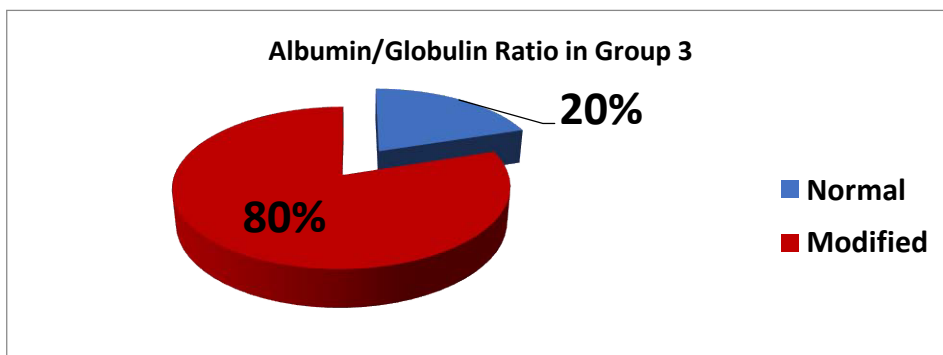


Fig. 1 Distribution of Albumin/Globulin Ratio in Group 3

Table 6. Determination of protein fractions by electrophoresis in Group 4

Fraction	U/M	Physiolog. limits	27189	53538	65317	71055	8126
Total Protein	g/dl	5,8-8,5	6,50	7,10	6,80	6,90	6,30
Albumin	g/dl	1,3-2,47	1,93	2,08	2,20	2,62	2,76
α_1	g/dl	0,19-0,78	0,42	0,35	0,10	0,41	0,30
α_2	g/dl	0,19-0,78	0,60	0,79	0,78	0,49	0,40
β_1	g/dl	0,32-0,84	1,00	0,75	0,97	0,69	0,64
β_2	gd/l	0,32-0,84	0,34	0,57	0,76	0,52	0,35
γ	g/dl	1,75-2,72	2,21	2,57	1,99	2,17	1,86
Alb/Glob	/	0,45-1,31	0,42	0,41	0,48	0,61	0,78

At one week after calving, the results of the electrophoresis reveals very unsemnificative changes according to the physiological limits, as follows: 2 of the cows from this group had a decreased Albumin/Globulin Ratio and other two cows had an increased value of the albumin vallue. This fact might be associated with the feed intake and also with some interferences.

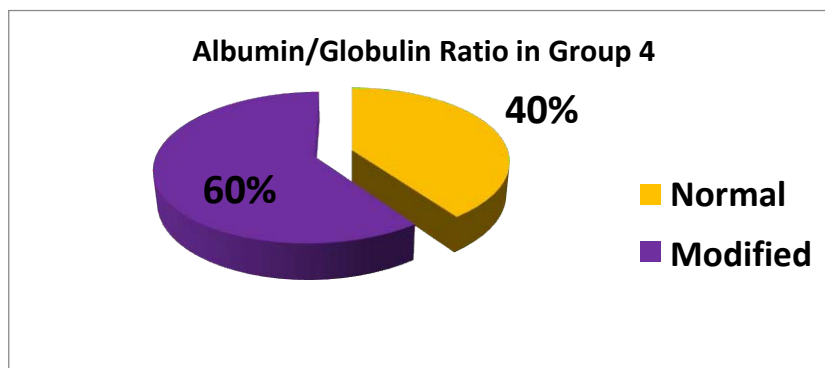


Fig. 2 Distribution of Albumin/Globulin Ratio in Group 4

Conclusions

Clinically, all the cows taken in our study are clinically healthy, but at a routine blood exam reveals a lot of changes in their metabolic status, as follows: monocytopenia, lymphocitopenia and increased values of Total Bilirubin and Lactat Dehydrogenasys in the first two groups of cows.

There are no major differences between the cows one week prior parturition and the cows after parturition, due to the period taken into account for this study, but regarding albumin/ globulin ratio it was noticed that in the cows before parturition is more significant modified than in the cows after parturition, which confirms gamma globulin reactivation immediately after calving.

By correlating the results obtained, it can be argued that routine explorations are an important tool in the diagnostic of some problems with the management of the farm and also, of the animals like: alimentary disorders, deficiency of food intake, oxidative stress.

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