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Haematological Indicators Affected by the Subacute Ruminal Acidosis in Dairy Cows

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Abstract: In the period covering between March 2010 and March 2011 a study was launched to examine closely the impact that the Subacute Ruminal Acidosis (SARA) upon the haematological indicators of dairy cows notable for high yields. In a total of 60 cows split into 3 groups (2 experimental groups and 1 control group) researchers followed closely the progress of ruminal pH for 3 months ensuing the calving period. The study was supposed to keep account of the haematological indicators as well. Based on the blood samples collected we succeeded in determining through the standard methods the haematological profile indicators for total White Blood Cells (WBC), Red Blood Cells (RBC), Haemoglobin (HB), Haematocrit (HCT), Mean Corpuscular Volume (MCV), Corpuscular Haemoglobin (MCH), ratio of Red blood cells to white blood cells (RDV) and Total Blood Platelets (BPLT). By virtue of the blood testing we managed to establish the neutrophils, lymphocytes, monocytes, eosinophils and basophils indicators. The data obtained upon statistical processing revealed that the presence of SARA in cows produces deviations from the norm of several haematological indicators. The biggest impact of all appears to be in the case of total amount of White Cells (WBC) in Haematocrite (HCT), the number of leukocytes, lymphocytes and basophils ($p<0.05$). Based on the results obtained researchers are inclined to believe that these changes in the haematologic indicators can be exploited to control the rumen function in cattle.

Key words: Ruminal fluids, rumenocentesis, pH, haematological profile, leukocyte formula, Albania

INTRODUCTION

Subacute Ruminal Acidosis (SARA) poses a major problem in dairy cattle farms today held to be capable of doing irreparable economic harm both in a direct and indirect manner. In prompting the pathology a number of factors are at works which are closely connected with the feeding and breeding circumstances. The SARA condition goes undetected since, it cannot be detected by means of the specific clinical indications and what is thought to be detected instead appears to be the secondary signs which scratch the surface and become noticeable a number of weeks or months afterwards. The establishment of a correct diagnosis of SARA is very intricate and depends on the control of food and feed intake as well as on the analysis of ruminal pH content. The most appropriate techniques to secure the collection of the ruminal fluid is rumenocentesis but that one turns out to be hard since, it is met with severe objection by the animal owners. The current studies are geared towards finding other methods for indirect diagnosis of SARA in cows. In this respect the study is intended to deal with new research and testing methods in controlling the SARA situation indirectly by setting up the parameter values affected by this condition with reference to, among others the haematological indicators.

MATERIALS AND METHODS

In the period March 2010-March 2011, the focus of the study was the impact of SARA condition upon the haematological indicators in dairy cows with high milk yields. The study was administered across 5 dairy cow farms which have an average production from 6000-8000 L of milk year^{-1}. In each of the farms researchers randomly picked 12 cows which were well into the first lactation phase (35±30 days of lactation). They showed no clinical signs of diseases presence. Instead they enjoyed a good body condition. From the cows researchers collected the rumen samples as well as blood which were had from the jugular vein. Rumenocentesis was chosen to be the best possible technique applied to get hold of the ruminal fluid (Duffield *et al*., 2004; Garrett *et al*., 1999; Nordlund and Garret, 1994).

The ruminal fluid sampling was collected 4-6 h after the consumption of feed rations with 20 mL syringe. Researchers proceeded straight with the measurement of pH with the portable pH gauge. Blood samples were collected from the same cow by puncturing the jugular vein. Blood then was preserved in tubes containing heparin. About the same time 3 blood samples were laid out. From the samples of blood available were able to determine the total White Cell (WBC), Red Cells (RBC),

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Haemoglobin (HB), Haematocrit (HCT), the Mean Corpuscular Volume (MCV), Corpuscular Haemoglobin (MCH), the ratio of Red cells to White blood cells (RDW) as well as the total Platelets (PLT) by means of standard methods. The haematological profile was established within 2 h of sampling. Researchers defined by the blood samples the leukocyte formula (neutrophils, lymphocytes, monocytes, eosinophils and basophils).

Based on the results obtained from ruminal pH the animals in the study were divided into 3 groups: group A, animals with an average pH rumine of 5.8-6.2 (or the control groups comprising healthy animals). Group B, animals with the average rumine pH at intervals between 5.6 and 5.8 (or the first group of experiments with animals at risk from SARA) and group C, animals with rumine pH <5.6 (or second experimental group of animals affected by SARA). The data were collected and processed statistically by applying the analysis of variance to verify the effects on the group and to evaluate statistically the significant differences between the three groups at the focus of the study.

RESULTS AND DISCUSSION

By clustering together the data secured for purposes of the pH rumen content researchers found out that the distribution of cows across the control and experimental groups was of slight consequences. The biggest number of cows (23 head or 38.3%) were found to be within the rate for pH values of rumen content. This certainly represented the control group. On the other hand, for comparison and contrast purposes in the experimental groups the animals appeared to come within lower values of ruminal pH (Table 1). In each group there were cows falling under different lactation period. The three groups were homogeneous in terms of the average days of lactation (32±14, 38±25 and 34±19, respectively) and all animals showed no external clinical signs of the disease presence. The haematological indicators of animals according to groups based on pH values of ruumen content as shown in Table 2 and 3. From the data it seems that the amount of Red Blood Cells (RBC), Haemoglobin (HGB), the ratio of Red cells to White ones (RDW), Total Blood Platelets (BPLT), Mean Corpuscular Volume (MCV), Corpuscular Haemoglobin (MCH), monocytes and eosinophils did not exhibit any significant differences between animals under the experimental groups compared with the indicators of rate ratios and the value indicators of those under the control group.

The total white cells seems to experience the biggest growth especially in the second set of experiments (±8:09 5:58±1:56 vs. 1:57 in the control group).

Whereas the haematocrit value goes down in the experimental group of cows (7.29±2.71 vs. 29.57±2.8) in the control group. The changes in other indicators do not show any significant value. The number of eritorcites hardly changes.

In the study changes produced by the level of rumen pH content are observed in leukocyte formula. The number of neutrophils increases (4.2±0.8 vs. 0.88± 3:35) in the blood of cows under the experimental group, in the same way as does the number of lymphocytes (2.98±2.66±0.95 versus 1:01). A far as noticeable increase goes for number of basophils (0.2±0.01 vs. 12:04±0:03). The number of monocytes and eosinophils remains within influenced quotas.

The associations and the dependence of the relevant factors with correlative links have been expressed in the graphs of linear regression.

Between the rumen pH contents and the total of white cells there is a correlative linkage (Fig. 1) of a negative type (r = −0.485). Weak correlative linkages but of a otherwise positive type were found between rumen pH content (r = 0.299) and haematocrite.

Table 1: Mean values of ruminal pH and average days of lactation in cows falling under the control and experimental groups

Groups	No. of heads	Percentage	Days of lactations	Ruminal pH
A-Control	23	38.3	32±14	6.08±0.28
B-I[re] exp. animals exposed to SARA	16	26.6	38±25	5.77±0.27
C-II[te] exp. animals affected by SARA	21	35.0	34±19	5.56±0.19

Table 2: Mean values of haematological parameters in cows by group, group A (normal), group B (exposed) and group C (affected by acidosis)

Indicators	Nominal values	Groups A	B	C
WBC (10^3 μL^{-1})	4.0-12.00	5.66±1.35	5.69±2.33	7.16±1.18*†
RBC (10^6 μL^{-1})	5.0-10.00	6.17±0.42	6.33±0.56	6.35±0.34
HGB (g dL^{-1})	8.0-15.00	9.89±0.46	9.97±0.81	10.22±0.62
HCT (%)	24.0-46.00	29.93±2.56	29.78±2.34	29.57±2.77
MCV (fL)	40.0-60.00	48.56±3.36	49.29±3.24	49.35±2.41*†
MCH (pg)	11.0-17.00	16.88±1.33	16.92±1.25	16.94±1.63*†
RDW (%)	16.7-23.30	21.11±1.27	20.81±1.62	20.37±1.39
PLT (10^3 μL^{-1})	100.0-800.0	603.2±87.40	632.6±65.90	628.8±91.10

*: Significant differences against group A ($p<0.05$), †: Against group B ($p<0.05$); reference values basen on Radostits *et al.* (2005)

Table 3: Mean value of indicators of leukocite formula in cows by groups grup A (normal), grup B (exposed) grup C (affected by acidosis)

Indicators (10^3 μL^{-1})	Nominal value	Groups A	B	C
Neutrofile	0.6-4.00	3.42±0.27	3.81±1.16	4.18±0.35
Limphocite	2.5-7.50	2.67±1.12	2.58±0.19	2.86±1.14
Monocite	0.02-0.9	0.84±0.21	0.86±0.33*	0.78±0.22
Eozinophile	0.0-0.24	0.06±0.12	0.05±0.13	0.01±0.02
Bazophile	0.0-0.20	0.03±0.02	0.09±0.03	0.20±0.01

*: Significant changes against group A ($p<0.05$), refernece values based on Radostits *et al.* (2005)

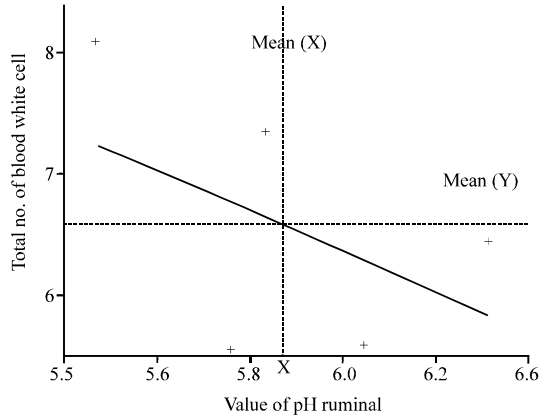

Fig. 1: Connestion rumen pH and the total of Blood White cells (WBR); r = −0.485; WBR = 17.6 + (−1.85×pH ruminal)

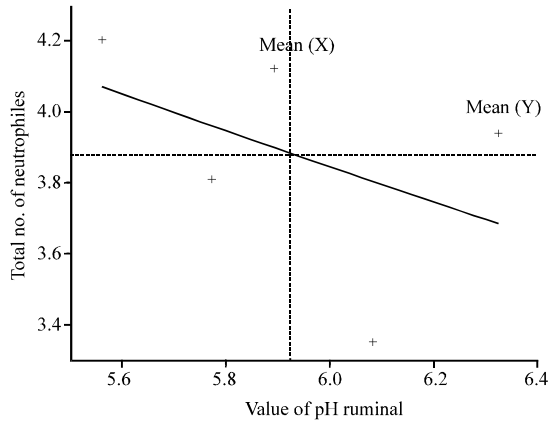

Fig. 2: Connection between rumen pH and the number of neutrophiles; r = −0.443; Neutrophiles = 6.90 + (−0.51×pH ruminal)

Indicators of leukocyte formula seem more influenced by the rumen pH content. The number of leukocytes increases with the reduction of ruminal pH. The link between these two factors is strong tending to have a negative type (r = −0.443) (Fig. 2).

The number of lymphocytes and basophils appears to be influenced by the rumen pH content. With the reduction of the value of rumen content there appears to be an increases in the number of lymphocytes and basophils.

The link between these two factors is strong and of a negative character (Fig. 3). Animals pertaining to the three groups under the experiment being nearly homogeneous between them for the average values of days in lactation (32±14, 38±25 and 34±19, respectively) along with all of animals indicated that there is a marked absence of external clinical signs of the presence of disease. The changes of values in haematological

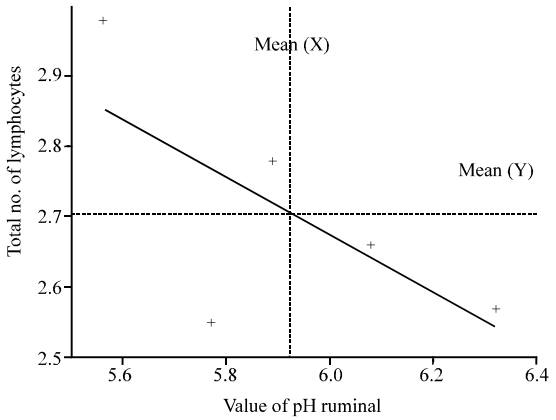

Fig. 3: Relationship between rumen pH and the number of lymphocytes; r = −0.675; Limphocite = 5.14 + (−0.41×ruminal pH)

parameters and in indicators of leukocyte formula between individuals of groups show a connection to the different values of luminal pH. Such a claim is also made by Meglia *et al.* (2001).

The results of the study show that the variations in rumen pH content affect values of haematological indicators where the latter can be useful for the diagnosis of SARA in dairy cows. The same conclusionshave also been reached by the researcher Gozho *et al.* (2007). In the study the presence of SARA impacted the levels of white cells in haematocrite in the amount of neutrophils, lymphocytes and basophils. In dairy cows in the course of SARA (with the exclusion of animals under the control group where the ruminal pH values were >5.8) the largest changes were observed in the increase of the number of white blood cells. White blood cells were significantly higher in animals nder group C. The increase in the amount of white cells is mainly owning to the increase of neutrophils and basophils. This indicator is to a lesser extent linked with the increase in the number of basophils seen in cows with low rumen pH content. According to Meglia *et al.* (2001), the phenomenon of the increase in white blood cells is easily detected by an increase in the levels of cortisol which is realized in many different events in the period around calving time.

The calculations of erythrocytes are index showed that the values obtained in the case of Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin (MCH) although, they were within the norms in this study they showed a slight increase. Such a phenomenon is also reported by other researchers (Meglia *et al.*, 2001; Morgante *et al.*, 2004, 2007). Although, there is no significant change in the level of Red Blood Cells (RBC) and Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Volume (MCV), researchers think that the

slight increase in the values of these indicators observed in dairy cows with a low a ruminal pH is a compensation-related response against the slow reduction of Haematocrite (HCT).

CONCLUSION

In the period prior to calving in cows suffering from the condition of subacute ruminal acidosis the changes in some haematological parameters are present. The indicators that are affected by the reduced values of pH in the rumen content in cows are the total white cells, haematocrite, neutrophils, lymphocytes and basophils. The most significant increase is observed in the case of total white cells, the number of neutrophils and lymphocytes while the values of Haematocrite (HCT) go down. The amount of Red Blood Cells (RBC), Haemoglobin (HGB), Total Platelets (PLT), Mean Corpuscular Volume (MCV), monocytes and eosinophils are not affected by the reduced values of rumen pH content in cows. The haematological indicators can be used for indirect diagnosis of subacute ruminal acidosis in dairy cows.

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