Deviation of Biochemical Variables in Dairy Cows with Reproductive Disorders - Data Analysis

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Summary

The aim of the study was to evaluate the results of biochemical profiles of cows from farms with reproductive disorders. The results of blood examinations collected from 205 dairy cows, which originated from 72 Slovenian farms, were analysed. In blood samples total serum protein (TSP), albumin (Alb), urea, calcium (Ca), inorganic phosphate (iP), sodium (Na), potassium (K), chlorine (Cl) and beta-carotene concentration were measured. Data were compared with normal reference values for cattle. The results were evaluated regarding the normal values for cattle. The descriptive statistics and percentage of cows deviating from normal values for investigated variables were calculated. The mean values of investigated variables were inside reference intervals for cattle. The results of biochemical examination show deviation from reference interval in 52.3% of cows for TSP, 70.8% for urea, 39.8% for iP, 27.5% for Na, 36.2% for K, 1.1% for Cl, 37.6% for beta carotene and 6.8% for Ca.

The results of biochemical investigations revealed the greatest deviations in concentrations of TSP, urea, Na, K and carotene which can be affected by different factors (nutrition, health status, stage of lactation and season). Taking into account all of these factors may be blood biochemistry a useful tool also in identifying deficiencies in the diet.

Key words

cattle, blood, biochemistry, fertility

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Aim

Reproductive performance of cows affects the overall milk yield, longevity of the cow and number of replacements needed to maintain a constant herd size what all affect the profitability. Many dairy farms face with poor fertility of cows. The most important events concerning reproduction occur while the cow is at its peak production and experiences severe metabolic stress (Opsomer et al. 2006). The blood examinations like clinical chemistry profile are a valuable diagnostic tool for the evaluation of nutritional, metabolic and health status of cattle. There are some blood metabolites which are related to the nutritional status of the cattle, they represent animal response to the nutrition (Barton et al. 1996, Whitaker 1997, Macrae et al. 2006, de Ondarza et al. 2009). Well balanced diet is important for good fertility. Blood variables related to protein supply include total serum proteins and urea. Urea level, in relation to nutrition varies according to protein content, protein degradability, non-protein nitrogen and energy of the diet (Park et al. 2002, Russell et al. 2007). Phosphorus has no direct mechanism of regulation, although calcium-regulating hormones directly affect its blood concentration. Calcium and phosphorus have important bone reserves, while the magnesium reserve is low and has no primary hormonal response for the compensation (Martens and Schweigel 2000, Larsen et al. 2001). Beta-carotene serves as the major precursor of vitamin A and also functions separately as an antioxidant with possible positive influence on fertility (Chew 1993, de Ondarza et al. 2009).

The present study intended to establish a connection between the relevant blood variables and potentially valuable background information about the cows from farms with reproductive disorders. For this purpose we analysed the results of biochemical analyses of blood samples of cows from herds with reproductive disorders sent to our clinical laboratory.

Materials and methods

In the present study the results of biochemical analyses of blood samples from cows (n=205), which were sent to our clinical laboratory due to fertility problems (delayed cyclicity, ovarian cysts) in the herd, were analysed. The cows were of various parity and stage of lactation and the samples were taken in different seasons. The cows originated from different farms (n= 72) in Slovenia with different productivity.

In blood serum samples biochemical variables; total serum protein (TSP), albumin (Alb), urea, calcium (Ca), inorganic phosphate (iP), sodium (Na), potassium (K) and chlorine (Cl) were measured with the biochemical analyser RX Daytona (Randox Laboratories Ltd, Crumlin; UK). Beta-carotene concentration was measured photometrically by using the Yudkin method (Yudkin, 1941).

The data were processed using the statistical program SPSS (Ver 20.0). For the investigated variables the data were checked for normality and descriptive statistics were calculated. The individual data were compared to the reference intervals and the percentage of cows (samples) deviating from normal values for the investigated variables were calculated.

Results and discussion

Mean values of investigated variables were inside reference intervals for cows used in the Clinical laboratory, Clinic for ruminants, Veterinary faculty Ljubljana (table 1), though the results of many single samples deviated from them (table 2) what is more relevant for interpretation. Due to the relatively small number of cows, factors like parity, stage of lactation, season were not assessed in the study.

Table 1. Descriptive statistics of biochemical variables

Variable	n	Mean	SD	Min.	Max.
TSP (g/L)	185	73.72	7.60	58.0	101.0
Alb (g/L)	42	33.35	2.50	27.5	38.0
Urea (mmol/L)	193	3.59	1.69	0.11	8.78
Ca (mmol/L)	191	2.48	0.17	1.71	2.89
iP (mmol/L)	203	2.18	0.36	0.92	3.44
Na (mmol/L)	185	141.39	3.58	131	150
K (mmol/L)	185	5.44	1.00	3.17	9.63
Cl (mmol/L)	183	100.17	3.65	91	110
Carotene (mg/L)	162	5.36	2.78	0.63	13.80

Table 2. Percentage of cows (samples) deviating from the reference values (Jazbec 1990, Whitaker 2004)

Variable	n	Below ref. value (%)	Above ref. value (%)	Reference range
TSP (g/L)	185	32.9	19.4	70.0–80.0
Alb (g/L)	42	0 (9.5)	0	27.0-38.0 (>30.0)
Urea (mmol/L)	193	56.9	13.9	3.60–5.50
Ca (mmol/L)	191	6.8	0	2.25–2.99
iP (mmol/L)	203	3.4	36.4	1.61–2.25
Na (mmol/L)	185	27.5	0	140–155
K (mmol/L)	185	5.4	30.8	4.2–5.8
Cl (mmol/L)	183	0	1.1	90.0–108.8
Carotene (mg/L)	162	37.6	0	>4.0

By checking the results of the biochemical examination it was established that the concentration of TSP and urea were below the reference values at 32.9% and 56.9% of cows respectively (table 2). The concentration of TSP in cows is associated with proteins (amino-acid supply) available in the diet (Whitaker 1997). The urea concentration in blood and milk is influenced by protein content and protein / energy ratio in the diet (Oltner and Wiktorsson 1983). The results in investigated cows indicate insufficient protein supply (diet, low appetite, etc.) and/or failure to provide a balanced diet which could affect the fertility. In 19.4% of cows the concentration of TSP was above reference value, which may be associated with the animal's health status; globulins are increased by inflammation which can contribute to the increase in TSP concentration (Whitaker 1997).

Deviations were observed also in the mineral status; in 36.4% of cows the concentration of iP was above and in 3.4% below the normal value. Less prominent were deviations of Ca concentration where in 6.8% of cows the values were below reference range. The concentration of K was in 30.8% of cows above and in 5.4% below the reference value (table 2). Hyperkalaemia could be caused by potassium excess in the diet; it could be established also in acidosis (Carlson 2002). In 27.5% of cows the concentration of Na was below reference range indicating a lack of Na in the diet of investigated cows. By samples taken in the summer months it may be associated with increased loss due to sweating. In relation to nutrition the observed deviations in mineral status could be attributed to the inappropriate content of minerals in the diet and/or to unsuitable ratio between them. Periparturient period, age of animals and acidosis can also have an influence on the concentration of Ca and iP (Jazbec 1990, Herdt 2000). Observed deviations can negatively influence on production, fertility, and health of cows.

In 37.6% of cows the concentration of beta-carotene was below the normal value (table 2). Ruminants receive beta-carotene predominately with green forage (grass) but in grass silage and in hay the content of beta-carotene can decline significantly especially when mistakes were made during the preparation (Jazbec 1990). Deficit of beta-carotene may have a negative influence on fertility of cows (Rakes et al. 1985; Dirksen et al. 2006).

Conclusions

In reviewing the results of biochemical investigations the greatest deviations were observed in concentrations of TSP, urea, Na, K and carotene which can be affected by diet, health status, stage of lactation and season. Taking into account all of these factors may be blood biochemistry a useful tool also in identifying deficiencies in the diet.

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