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EFFECT OF ADAPTATION STRESS ON BLOOD INDICES OF LIMOUSINE COWS**

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Abstract: The aim of research was to assess glucose (Glu), fibrinogen (Fb) and hematocrit (Ht) in the whole blood samples, while cortisol (Cort), haptoglobin (Hp), serum amyloid A (SAA), total protein (TPt) and concentrations of protein fractions (albumins, globulins) in blood serum to monitor adaptation stress in beef cows of Limousine breed. Three groups of cows, each consisting of 8 animals shortly after parturition, were studied simultaneously after different time of adaptation to the new herd (Group I - 1 week, Group II - 3 weeks, Group III - 1 year). Group III animals were perceived as already adapted to the herd environment. Limousine cows with the shortest time of stay in the new herd characterised with elevated concentrations of Glu ($P<0.01$), Cort, SAA and β-globulin fraction while concentration of γ-globulins was significantly lowered ($P\leq0.05$). These indices may be related to adaptation stress lasting ca 1 week. The most sensitive response of animals to adaptation stress lasting 1 week was exhibited in elevated Glu values. Cows with 3 weeks elapsed time from relocation exhibited only elevated Ht and SAA values.

Key words: beef cattle**,** adaptation stress, blood indices

Introduction

Reactions of animals to stress are not uniform and therefore they are difficult to interpret. The answer to stress is related to timing of stressor and it's intensity as well as to previous experience of animals, their physiological stage and environmental effects combined with animal's genotype, age and sex. To score animal's adaptation to local environment and welfare behavioural, haematological, biochemical, physiological as well as

neurohormonal tests are performed (*Grandin* 1997; *Fazio and Ferlazzo* 2003; *Okeudo and Moss* 2005).

The aim of research was to assess chosen blood indices to monitor adaptation stress in beef cows of Limousine breed.

Materials and methods

Three groups of Limousine cows were studied after relocation (ca 1000 km) to a new environment: group I (n = 8) – cows, which entered the new herd 1 week before examination; group II (n = 8) – cows, which entered herd 3 weeks before examination and group III (n = 8) – cows with 1 year of adaptation in the new herd. All tested cows were up to 1 – 2 weeks after parturition. They were examined in cattle crush and blood samples were obtained from jugular vein. Glucose (Glu), fibrinogen (Fb) concentrations and hematocrit (Ht) were tested in the whole blood samples, while cortisol (Cort), haptoglobin (Hp), serum amyloid A (SAA), total protein (TPt) and concentrations of protein fractions (albumins, globulins) were tested in blood serum. Glucose concentration readings were obtained immediately, just after bleeding, using glucometer (Roche). Other tests were performed in laboratory: Ht and Fb using capillars (*Millar et al.* 1971), Hp guajacol method (*Jones and Mould* 1984), SAA using The Tridelta phase^{TM} range SAA test, Cort using radioimmunological method with CORTISOL RIA DSL-2100 kit, TPt using biuret method while protein fractions using paper electrophoresis. Data were analysed statistically using one way analysis of variance and significance of difference between groups were tested using Duncan test (Statistica 7.1 package).

Results of investigation and discussion

Relation was stated between glucose and cortisol in performed study. The highest concentration of Glu and Cort were found in the Group I, with the shortest time of adaptation to new environment – 1 week – Table 1. This group characterised also with the wide spread in Glu and Cort values - as animals' individual reaction to adaptation stress. The mean Glu concentration in the Group I exceeded the upper reference value for adult cattle (*Winnicka* 2002) and differed significantly ($P<0.01$) from other groups.

There are no many results comparing Cort and Glu in blood of cattle.Animals exposed to stress factors became hypoglycaemic, however

Mudroń et al. (2005) did not found relation between glucose level and cortisol in blood serum in cows before and after surgery.

Table 1. Values of blood traits (mean, SD)

Group	Hematocrit (%)	Glucose (mg/dl)	) Cortisol ($ng \cdot cm^{-3}$)	Fibrynogen (g/l)	SAA ($\mu g \cdot cm^{-3}$)
I	32,35 1,95	102,75 ^{A} 30,14	10,09 6,26	6,50 0,77	63,14 38,39
II	34,60 ^{a} 3,36	60,14 ^{B} 3,38	6,96 3,49	5,60 20,6	5,9 9,98
III	30,82 ^{b} 2,57	68,6 ^{B} 8,95	6,69 4,67	5,22 1,07	1,24 2,60
Total average	31,96 2,88	72,88 19,2	7,27 4,87	5,64 1,31	23,23 36,39

A, b - means denoted with different letters differ: capitals at P≤0,01; small letters at P≤0,05

There are no many results comparing Cort and Glu in blood of cattle. Animals exposed to stress factors became hypoglycaemic, however *Mudroń et al.* (2005) did not found relation between glucose level and cortisol in blood serum in cows before and after surgery.

The total average Cort level (7.27 $ng \cdot cm^{-3}$), found in Limousine cattle population studied, was high when compared to results obtained by others (*Madej et al.* 1992; *Hoffman et al.* 1996; *Grandin* 1997; *Poster et al.* 1999; *Mudroń et al.* 2005). *Madej et al.* (1992) suggested reference range for Cort to be 1 – 10 $ng \cdot cm^{-3}$. *Hopster et al.* (1999) stated, that 70% of tested cows in the 1-st month of lactation had the average Cort level below 3 ng/ml while other cows characterised with levels above 6 ng/ml. *Mudroń et al.* (2005) stated Cort levels ranging 8.6 – 8.2 $ng \cdot cm^{-3}$ in cows before surgery (stimulated lightly because of preparation to intervention), however 2 hours after treatment concentration peaked to 36.7 – 39.9 $ng \cdot cm^{-3}$ and lowered to 3.95 – 4.32 $ng \cdot cm^{-3}$ on the 3-rd day. High Cort level (22.5 – 57.7 $ng \cdot cm^{-3}$) in cow blood serum was stated by *Hofmann et al.* (1996) when separated previously calves were allowed to have limited access to dams. *Fazio et al* (2001, in *Fazio and Ferlazzo* 2003) found significant relation between Cort and Ht values in calves after transport. Own results are in agreement with above statement – higher levels of Cort and Ht were found in group I and II – in animals which entered new environment recently. Hematocrit values in Group II differed significantly ($P<0.05$) from the Group III values – Table 1.

Acute-phase proteins are not only good indicators of inflammatory processes of infectious and non-infectious origin but may be also used for

monitoring quality of meat animals before slaughter through the indication of sub clinical processes affecting meat quality and to score level of animals' welfare (*Conner et al.* 1989; *Tourlomoussis et al.* 2004; *Alsemgeest et al.* 1995). In ruminants highly useful seems to be fibrinogen and haptoglobin as proteins with time delayed reaction (increased values 12 – 24 hours after stimulus returning to ordinary – reference values after 8 to 14 days) and serum amyloid-A (SAA) - protein with quick reaction time (increase noted in 6 – 8 hours from stimulus and return to basic level after 24 – 48 hours).

In Limousine cows studied Fb levels were in the range of reference values in the Group III , while levels exceeding norms were stated in 12.5 and 25.0% of animals, respectively in Group I and II. Slightly increased level of Hp (0.21 and 0,22 g/l) were stated in 2 cows only in the Group I, while in other animals Hp was not detected (0 values). This result is surprising, since Hp is perceived as sensitive acute-phase protein in cattle. Probably, as stated by *Alsemgeest et al* (1995), physical stress experienced by cows was not strong enough to stimulate hepatocytes to produce Hp, but it was enough to increase SAA synthesis. High concentrations of this protein was found in the Group I, where only 1 cow had SAA below 10 ug/ml, while the maximum level reached 105.9 ug·cm^{-3}. Group II had 25.0% of cows with slightly elevated concentration of SAA, while the Group III characterised with negligible quantities of SAA or none. Values stated for Group II and III animals have to be accepted as physiological ones as found by *Tourlomoussis et al*. (2004) in healthy adult beef cattle.

Concentrations of TPt in blood plasma of tested cows were in the range of reference values (*Winnicka* 2000), while data obtained for protein fractions might indicate the effect of different adaptation level of tested groups – Table 2.

Table 2. Concentrations of total protein and protein fractions in blood (mean, SD)

Group	Total protein (g·dcm^{-3})	Albumins (g·dcm^{-3})	α- globulins (g·dcm^{-3})	β- globulins (g·dcm^{-3})	γ- globulins (g·dcm^{-3})
I	63,28 3,53	28,37 2,94	10,77 1,30	9,17 3,09	14,95^{b} 3,02
II	67,50 5,63	29,47 4,94	11,52^{a} 2,00	7,53 1,43	18,96^{a} 3,85
III	65,97 4,49	30,56 2,05	9,63^{b} 1,23	7,75 1,34	18,02 3,16
Total average	65,52 4,70	29,51 3,36	10,56 1,65	8,16 2,15	17,27 3,61

A, b - means denoted with different letters differ: capitals at P≤0,01; small letters at P≤0,05

Albumin fraction is mainly an indicator of nutritional status of animals, and is perceived as negative acute-phase protein. Albumin fraction found in the Group III was in lower range of norms (*Žvorc et al.* 2000), but in the case of beef cattle this result may be accepted as correct. Group I and II animals characterised with albumin levels below reference values what, in conjunction with previously discussed blood traits (Table 1), indicated immunological stimulation. The lowest albumin concentration was found in the Group I cows, with the shortest time of stay in the new environment. Increased α-globulin fraction, where different acute phase proteins are present, was stated in all studied groups. All tested cows were after parturition so increased concentration of this fraction has physiological basis. However, average values of this fraction in Group I and II are considered as high, and difference between group II and III proofed to be significant ($P \leq 0.05$). Fraction of γ-globulins dominated within immunoglobulins. The mean values of this fraction in Group II and III were in the normal range (16.9 – 22.0 $g \cdot dcm^{-3}$), while the Group I values were much lower. It might be the result of body reaction to many new antigens and in time these values should be normal.

Conclusion

Limousine cows after parturition with the shortest time of stay in the new herd characterised with elevated concentrations of Glu ($P<0.01$), Cort, SAA and β-globulin fraction while concentration of γ-globulins was significantly lowered ($P \leq 0.05$). These indices may be related to adaptation stress lasting ca 1 week. The most sensitive response of animals to adaptation stress lasting 1 week was exhibited in elevated Glu values. Cows with 3 weeks elapsed time from relocation exhibited only elevated Ht and SAA values.

UTICAJ ADAPTATIVNOG STRESA NA INDIKATORE KRVI KRAVA RASE LIMUZIN

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Rezime

Cilj ovog rada je bio ocena glukoze (Glu), fibrinogena (Fb) i hematokrita

(Ht) u uzorcima krvi, i kortizola (Cort), haptoglobina (Hp), serum amiloida A (SAA), ukupnog proteina (TPt) i koncentracija frakcija proteina (albumini, globulini) u krvnom serumu kako bi se pratio stres prilikom adaptacije kod tovnih krava rase limuzin. Tri grupe po 8 krava su ispitane odmah nakon teljenja i različitog vremena adaptacije na novo stado (grupa I - 1 nedelja, grupa II - 3 nedelje, grupa III - 1 godina). Životinje iz grupe III su smatrane već adaptiranim na nove uslove u stadu. Limuzin krave sa najkraćim periodom boravka u novom stadu su imale povišene koncentracije Glu ($P<0.01$), Cort, SAA i β-globulin frakcije, dok je koncentracija γ-globulina bila signifikantno smanjena ($P\leq0.05$). Ovi indikatori se mogu dovesti u vezu sa periodom adaptacije u trajanju od 1 nedelje. Povišene vrednostu Glu predstavljau dokaz najosetljivije reakcije životinja na stres od adaptacije koja je trajala nedelju dana. Krave koje su ispitivane 3 nedelje nakon promene lokacije su imale samo povećane vrednosti Ht i SAA.

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