

METABOLIC CHARACTERISTICS OF COWS ON FARMS WITH DIFFERENT WELFARE SCORE*

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SUMMARY: Animal welfare is an important factor influencing the productivity and health. Modern research in the area of animal welfare includes an analysis of parameters obtained from the animals themselves on farms. The aim of this study is to investigate influence metabolic characteristic of cows on farms with different welfare score. Measuring the welfare on cow farms was conducted according to the protocol of Welfare Quality® scoring system. Experiment was included 9 farms. Each of four principles of welfare was analyzed. According to the scores of welfare, farms were divided into two groups: a group of cows with low scores (score 0-50), a group of cows with high scores (score 51-100). Difference between mean value of metabolic parameters of cows originating from farm with low and high welfare scores were analyzed by a Student t-test. Cows from farm with lower welfare score according to principle of good housing showed a tendency to lower glucose and calcium concentration in mid lactation period. Cortisol concentration was higher in early ($p<0.1$) and mid lactation ($p<0.05$). Metabolic adaptation of cows in relation to welfare principle of good feeding showed that cows from farm with low scores showed: higher NEFA, BHB, bilirubine and cortisol concentration in early lactation. Metabolic changes in mid lactation showed tendency to higher BHB, and lower glucose and urea concentration. Cows from farm with lower welfare score according to principle of good health showed higher NEFA, BHB and cortisol and lower glucose concentration. The metabolic characteristics of cows depend on providing the principle of welfare on farms. Cows from farm with lower welfare scores showed higher cortisol concentration and signs of metabolic stress, such as higher NEFA, BHB and bilirubin concentration and lower concentration of glucose and urea. The most important principles, which significantly affects these characteristics, are the principles of good health and good feeding. These results show that it is possible to estimate the welfare of cows based on metabolic status, which requires further investigation.

Key words: cows, welfare, metabolic stress, cortisol.

Original scientific paper / *Originalni naučni rad*

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*This paper is part of scientific projects TR31062 and TR31095, Ministry of education and science, Serbia.

INTRODUCTION

Animal welfare is an important factor influencing the productivity and health. It is defined as the ability of animals to adapt to different environmental conditions (Hristov et al., 2007). The sustainable production and stability in animal production is depends from provide of all welfare criteria and principles as well as eliminate stressors (Belić and Cincović, 2010). Assessment of well-being can be done by analyzing environmental conditions in which the animals live. Modern research in the area of animal welfare includes an analysis of parameters obtained from the animals themselves on farms (Whay et al., 2003b). Our previous result (Cincović et al., 2012) showed that the health and productive characteristics of cows depend on providing the principle of welfare on farms. The most important principle, which significantly affects these characteristics, is the principle of good health. Milk production and reproductive characteristics depend on the principles of good nutrition, good housing and good health. Good production is determined by many factors on the farm, so ensuring a quality veterinary supervision (the principle of health) must be a priority.

The aim of this study is to investigate influence metabolic characteristic of cows on farms with different welfare score.

MATERIAL AND METHODS

Measuring the welfare on cow farms was conducted according to the protocol of Welfare Quality® scoring system. This system provides the assessment of the welfare of cows on the basis of four principles alongside the associated criteria, the principle of good housing, good nutrition principle, the principle of good health and the principle of good behavior of cows. Evaluation of farms was performed based on four principles of welfare. We used statistical software that has been formed based on standards set out in the Welfare Quality® Assessment Protocol for Cattle, 2009, ISBN/EAN978-90-78240-04-4. According to the scores of welfare, farms were divided into two groups: a group of cows with low scores (score 0-50), a group of cows with high scores (score 51-100). Score was calculated for each of the four principles. Nine dairy farm on the territory of Serbia participated in this experiment. At each farm blood was sampled from 7 cows in early and 7 cows mid lactation. Total number of cows included in experiment was 126. Metabolic status included concentration of NEFA, BHB, glucose, urea, Ca, total bilirubin and cortisol. For this purpose was used kit manufactured by Randox (UK) and ELISA kit for cortisol (Uscn Life Science). All measurements were performed on Rayto spectrophotometers.

Statistics: Difference between mean value of metabolic parameters of cows originating from farm with low and high welfare scores were analyzed by a Student t-test.

RESULTS AND DISCUSSION

Cows from farm with lower welfare score according to principle of good housing showed a tendency to lower glucose and calcium concentration in mid lactation period. Cortisol concentration was higher in early ($p < 0.1$) and mid lactation ($p < 0.05$). Results are presented in Table 1. Metabolic adaptation of cows in relation to welfare principle of good feeding showed that cows from farm with low scores showed: higher NEFA, BHB, bilirubine and cortisol concentration in early lactation. Metabolic changes in mid lactation showed tendency to higher BHB, and lower glucose and urea concentration. Results are presented in Table 2. Cows from farm with lower welfare score according to principle of good health showed higher NEFA, BHB and cortisol and lower glucose concentration. Results are presented in Table 3.

Cortisol is hormone of stress (Hristov i Bešlin, 1991). The role of this hormone is generally positive, at least immediately, improving fitness by energy mobilization (Sapolsky et al., 2000). Higher concentration of cortisol in our results agree with previous general conclusions that stressed cows had higher cortisol concentration (Mendoza et al., 2000). Level of cortisolemia is highly influenced by usual and unusual manipulation with cows (Bertoni et al., 2005). Good housing Other metabolic characteristic of cows from farm with lower welfare score are indicative for metabolic stress. Stressors and poor nutritional management causing reduction in voluntary DMI will result in large increases in NEFA. The main blood indicators of lipomobilization in ruminants are BHB, the most important and abundant ketone body, and NEFA. NEFA are preferentially and greatly accumulated as TG in the liver, primarily because of a decrease in the very low density lipoproteins synthesis by hepatocytes, and consequently bilirubine concentration increase (Cincović et al., 2011; Cincović et al., 2012a; Doković et al., 2013). Good feeding and good health principles of welfare are in relation with body condition score, lameness, skin lesion and other. Body condition score is in relation with energy balance, food energy and metabolic characteristic (suffering decreased food intake with consequently metabolic changes), and changes as lameness and skin lesion are very painful (which increases cortisol concentration), so it is clear why there are certain metabolic and hormonal adaptations in dairy cows according to welfare score. These results show that it is possible to estimate the benefit of cows based on metabolic status, which requires further investigation.

Table 1: Concentration of metabolic parameters between cows originating from farm with low and high welfare scores according to principle of good housing

Metabolic parameters	Period of lactation	Welfare score- good housing		P
		0-50 (4 farms)	51-100 (5 farms)	
NEFA mmol/l	Early	0.65±0.17	0.55±0.16	NS
	Mid	0.34±0.11	0.29±0.09	NS
BHB mmol/l	Early	0.86±0.19	0.71±0.14	NS
	Mid	0.41±0.11	0.33±0.14	NS
Glucose mmol/l	Early	2.78±0.8	2.66±0.5	NS
	Mid	3.01±0.5	3.55±0.32	<0.1
Urea mmol/l	Early	3.3±0.44	3.5±0.37	NS
	Mid	5.2±0.6	5.8±0.4	NS
Ca mmol/l	Early	2.2±0.4	2.3±0.3	NS
	Mid	2.3±0.4	2.8±0.3	<0.1
Bilirubin µmol/l	Early	8.8±1.4	8.1±1.12	NS
	Mid	5.5±0.9	5.1±1.1	NS
Cortisol ng/ml	Early	18.6±3.1	15.5±2.2	<0.1
	Mid	12.81±1.8	10.1±2.1	<0.05

Table 2: Concentration of metabolic parameters between cows originating from farm with low and high welfare scores according to principle of good feeding

Metabolites and hormone	Period of lactation	Welfare score- good feeding		p
		0-50 (4 farms)	51-100 (5 farms)	
NEFA mmol/l	Early	0.69±0.15	0.42±0.17	<0.05
	Mid	0.35±0.09	0.3±0.13	NS
BHB mmol/l	Early	0.92±0.14	0.75±0.11	<0.05
	Mid	0.66±0.11	0.54±0.12	<0.1
Glucose mmol/l	Early	2.11±0.4	2.77±0.44	<0.05
	Mid	3.22±0.33	3.56±0.39	<0.1
Urea mmol/l	Early	3.22±0.44	3.36±0.57	NS
	Mid	4.9±0.6	5.7±0.59	<0.1
Ca mmol/l	Early	2.11±0.34	2.21±0.25	NS
	Mid	2.5±0.22	2.7±0.4	NS
Bilirubin µmol/l	Early	9.97±1.61	8.51±1.32	<0.05
	Mid	5.66±1.1	5.8±0.9	NS
Cortisol ng/ml	Early	17.9±1.2	16.3±1.6	<0.1
	Mid	12.5±2.1	11.1±1.9	NS

Table3: Concentration of metabolic parameters between cows originating from farm with low and high welfare scores according to principle of good health

Metabolites and hormone	Period of lactation	Welfare score-good health		p
		0-50 (6 farms)	51-100 (3 farms)	
NEFA mmol/l	Early	0.68±0.13	0.49±0.16	<0.05
	Mid	0.46±0.09	0.31±0.11	<0.1
BHB mmol/l	Early	0.89±0.14	0.75±0.12	<0.1
	Mid	0.61±0.15	0.42±0.17	<0.05
Glucose mmol/l	Early	2.26±0.51	2.89±0.46	<0.05
	Mid	3.45±0.28	3.49±0.32	NS
Urea mmol/l	Early	3.2±0.4	3.5±0.4	NS
	Mid	5.1±0.8	5.6±0.32	NS
Ca mmol/l	Early	2.12±0.3	2.19±0.25	NS
	Mid	2.4±0.35	2.62±0.3	NS
Bilirubin µmol/l	Early	8.39±1.2	8.56±1.4	NS
	Mid	5.3±1.13	5.2±0.09	NS
Cortisol ng/ml	Early	18.9±2.3	16.5±1.9	<0.05
	Mid	12.3±2.2	10.3±2.1	<0.05

CONCLUSION

The metabolic characteristics of cows depend on providing the principle of welfare on farms. Cows from farm with lower welfare scores showed higher cortisol concentration and signs of metabolic stress, such as higher NEFA, BHB and bilirubin concentration and lower concentration of glucose and urea. The most important principles, which significantly affect these characteristics, are the principles of good health and good feeding. These results show that it is possible to estimate the benefit of cows based on metabolic status, which requires further investigation.

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METABOLIČKE KARAKTERISTIKE KRAVA NA FARMAMA SA RAZLIČITIM NIVOOM DOBROBITI

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Izvod

Dobrobit životinja je značajan faktor koji utiče na produktivnost i zdravlje. Savremena istraživanja u oblasti dobrobiti životinja podrazumevaju analizu parametara dobijenih od samih životinja na farmi. Cilj ovog rada je da se ispituju metaboličke karakteristike kod krava na farmama sa različitim nivoom dobrobiti. Merenje nivoa dobrobiti vršeno je upotrebom protokola *Welfare Quality® scoring system*. U ogled je uključeno 9 farmi. Ispitan je svaki princip dobrobiti posebno. Na osnovu skora dobrobiti farme su podeljene u dve kategorije: farme sa niskom ocenom dobrobiti (0-50) i farme sa visokom ocenom dobrobiti (51-100). Razlika u srednjoj vrednosti metabolita između krava koje potiču sa navedene dve kategorije farmi ispitana je t-testom. Kod krava na farmama sa nižim skorom dobrobiti postoji viša koncentracija kortizola i znaci metaboličkog stresa krava koji se ogledaju u povećanoj koncentraciji NEFA, BHB i bilirubina i sniženoj koncentraciji glukoze i uree. Najvažniji principi dobrobiti koji utiču na metabolički status krava su princip dobrog zdravlja i princip dobre ishrane. Dobijeni rezultati pokazuju da je moguće koristiti metaboličke parametre krava u proceni dobrobiti, što zahteva dodatna istraživanja.

Ključne reči: krave, dobrobit, metabolički stres, kortizol.

Received / *Primljen*: 08.10.2013.

Accepted / *Prihvaćen*: 05.11.2013.