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Comparison of Beta-hydroxybutyrate Levels in the First Three Weeks After Calving in Four Healthy Different Breeds of Cows

Hüseyin CİHAN[1]*, Sevim KASAP[1], Sezgin ŞENTÜRK[1]

1 Bursa Uludag University, Faculty of Veterinary Medicine, Department of Internal Medicine, Gorukle Campus, Bursa – TURKIYE

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Abstract

The objective of this study was to determine the differences between the healthy Holstein-Friesian, Jersey, Simmental, and Aberdeen Angus breeds Beta-hydroxybutyrate (BHBA) levels at the first three weeks after calving. The blood samples were collected for analysis between 10-20 days postpartum. In this study, 80 animals were used in different regions in total. BHBA was analyzed by Ketosite®(Ketosite®, Stanbio Labrotory Inc., Boerne, TX USA). Milk fat and protein levels were immediately measured by an electronic milk analyzer (Milkoscan FT1 FOSS Industries, Denmark). Statistical analyses of the study were performed using Sigma Plot 12 (Systat Software Inc., San Lose, CA). The means of BHBA levels were compared by One Way Anova. As in Holstein cows, blood BHBA levels increased in the early lactation period and also in other breeds. The results of this study presented that serum BHBA levels were significantly higher in Holstein-Friestein cows than in Simmental and Aberdeen Angus cows.

Keywords: BHBA, milk fat/ protein ratio, cow breeds

Introduction

Blood concentrations of beta-hydroxybutyrate have been used as an indicator of negative energy balance and ketosis. [1] Excessive ketone production occurs in the liver in response to high-level fat mobilization. The circulating ketones are acetone, acetoacetate, and beta-hydroxybutyrate (BHBA). [2,3] They are found in all body fluids, including urine, blood, and milk. [2] The predominant ketone in cows is BHBA, the gold standard for ketone testing. [4] Fortunately, there are cowside tests for milk, urine, and blood. [5]

Holstein-Friesian is a large, black and white cow breed and, on average, weighs 580 kg, known as the highest-yielding cow in the world today. [6,7] Simmental breed is the second important breed, following the group of Holstein Friesian cattle. Cows of the Holstein-Friesian breed produce, on average, 29.10 kg, and those of the Simmental breed produce 25.99 kg of milk. Jerseys, smaller in size and weighing only about 400 kg, are becoming popular because of their high fertility and high milk fat content. [8] Jersey cows produce an average of 3400 kg of milk per lactation. Aberdeen Angus is a breed commonly used in beef production. They have the typical barrelled-shaped body, small heads, and short legs. Cows of the Aberdeen Angus breed produced 13,14 kg/day of milk. [8]

Milk fat and protein levels and the ratio between the two are often used to monitor energy balance in postpartum cows. [9]

The presented study aims to compare the levels of BHBA in four different breeds of healthy cattle (Holstein-Friesian,

* Corresponding author: Hüseyin Cihan, Bursa Uludag University, Faculty of Veterinary Medicine, Animal Teaching Hospital, Department of Internal Medicine, Görükle Campus, 16059, Nilüfer, BURSA – TURKIYE, E-mail: hcihan@uludag.edu.tr, Phone: +90 224 2940813

Jersey, Simmental, and Aberdeen Angus); thus, this study can shed light on subsequent studies.

Material and Method

All procedures in the study complied with the international and Turkish guidelines for the care and use of animals. The Local Ethical Committee approved the study design for Animal Experiments of Bursa Uludag University (No:2014/09).

A total of 80 cows were used to measure serum BHBA levels. Twenty (n=20) milking animals were used for each breed of Holstein-Friesian cows, Simmental, Jersey, and Aberdeen Angus.

Holstein-Friesian cattle used in this study were located in Bandırma and Balıkesir cities of Turkiye. In contrast, Simmentals were located in Bayburt; Jerseys were in Biga and Çanakkale, and Aberdeen Angus cows were in Yenişehir-Bursa. All animals in this study were 26 to 28 months of age and lived in barns with approximately the same conditions.

As a management principle, the herds were essentially typical ranching beef herds with no supplementary feeding. And all animals in the study group are subjected to a complete nutritional ration by the relevant veterinarians.
The blood samples were collected between 10-20 days after calving by puncture of the jugular vein from 4 to 6 h after milking. The blood samples were allowed to clot spontaneously at room temperature. Then the serum was centrifuged at 3000 rpm for 15 minutes and preserved at -20 C until analyzed. BHBA was analyzed by Ketosite®(Ketosite®, Stanbio Labrotory Inc., Boerne, TX USA).

Milk samples were collected automatically by a milking machine 14 days after calving, and milk fat and protein levels were immediately measured by an electronic milk analyzer (Milkoscan FT1 FOSS Industries, Denmark).
Statistical analyses of the study were performed using Sigma Plot 12 (Systat Software Inc., San Lose, CA). The means of BHBA levels were compared by One Way Anova.

Results

The results of this study are presented in Table 1. Serum BHBA levels were significantly higher in Holstein-Friesian cows than in Simmental cows and Aberdeen Angus cows. Although there were no statistically significant differences between Holstein-Friestein cows and Jersey; Jersey cows' values of BHBA were detected as lower than Holsteın-Friestein cows.

Table1. Comparison of BHBA, Milk fat/ protein ratio, and milk production in the first 3 weeks after calving in this study.

Breeds	Holsteın-Friesians (n:20)	Simmental (n:20)	Jersey (n:20)	Angus (n:20)
BHBA mmol/l (mean)	0,72 ± 0,03 ^{A}	0,50 ± 0,04 ^{B}	0,59 ± 0,04	0,54 ± 0,02 ^{B}
Milk fat/ protein ratio	1,21 ± 0,02^{A}	1,26 ±0,03 ^{B}	1,32 ± 0,02 ^{B}	----
Milk production first 3 weeks after calving	27,4 ±0,03 ^{A}	17,4 ± 0,04 ^{B}	14,1 ±0,02 ^{B}	----

^{A,B} . There is a statistically significant difference (P<0,05) between values with different letters in the same line.

Discussion

During the periparturient period and at the beginning of lactation, a sudden increase in the requirement for nutrients and energy needed for fetus development and production of milk and colostrum is observed. [10,11] Energy deficiency and/or decreased feed intake during the periparturient period result in increased lipolysis of deposited fat and release of NEFA to the blood. [12,13] An excessive increase in NEFA concentration leads to the accumulation of triglycerides (TG) in the liver and a significant increase in ketonic compound production. [12] Ketonic compounds are acetone, acetoacetate, and beta-hydroxybutyrate (BHBA). [2] This study aims to observe BHBA levels in four different breeds of dairy cows: Holstein-Friesian, Simmental, Jersey, and Aberdeen Angus. The milk yield of the cow depends on the breed. Holstein-Friesian is the largest of all dairy breeds. All cattle breeds use abundant water and lower nutrients when producing milk. Studies have shown the Jersey cow to be more efficient than the Holstein in converting feed to milk. Furthermore, Jersey cows have the highest milk fat content and protein among all breeds and are also the second most popular breed after Holstein. [8]

Milk composition also varies among different breeds. The milk of the Jersey cow has the highest milk fat content, and Jersey scores are much higher than Holstein's. Whereas the milk fat content of Holstein is only 3.7%, it is around 4.7% in the milk of a jersey cow. [7]

Cows with serum BHBA levels ≥ 1.400 μmol/L are three times more predisposed to displaced abomasum and clinical ketosis. [14] Metabolic disorders in high-yielding cows of the Simmental breed may also occur in the perinatal period; however, this is lower than in the case of Holstein-Friesian breeds. [10]

Jersey cows' values of BHBA were detected to be lower than Holstein-Friesian cows. The possible cause may be that Jersey cows had a lower milk yield than Holstein-Friesian cows.

Holstein-Friesian cows, whiches milk yield is higher than the other breeds are genetically dairy cows. Therefore negative energy balance is more common in Holstein-Friesian cows. Although jersey cows are not similar to Holstein cows in milk yield, they have higher milk fat than Holstein. Aberdeen Angus cows and Simmental cows are at the forefront of beef properties. Therefore these two breeds have a lower incidence of negative energy balance on account of BHBA levels which are lower than Holstein-Friesians and Jersey cows.

The reference values of BHBA levels are between 0,2 -0,8 mmol/L. [15] But in this study, BHBA values had statistically significant differences between breeds. However, breeds are important to evaluate the value of BHB, which is the gold standard for determining the negative energy balance.

Conclusion

It was concluded that Holstein-Friesian cows are more predisposed to negative energy balance and metabolic disorders than Jersey, Simmental, and Aberdeen Angus cows. However, more detailed studies are needed on this subject.

References

1. Hejel P, Zechner G, Csorba C, Könyves L. Survey of ketolactia, determining the main predisposing management factors and consequences in Hungarian dairy herds by using a cow-side milk test. Vet Rec Open. 2018; 17:5(1):e000253.
2. Krempaský M, Maskaľová I, Bujňák L, Vajda V. Ketone bodies in blood of dairy cows: Prevalence and monitoring of subclinical ketosis. Acta Vet Brno. 2014; 83 (4): 411-416.
3. Şahal M, Deniz A, Vural R, Küplülü Ş, Polat İM, Çolakoğlu EÇ, Öcal N, Macun HC, Pekcan M, Ocak M. Evaluation of the Effect of Different Doses of Butaphosphan and Cyanocobalamin Combination in Dairy Cattle with Subclinical Ketosis. Kafkas Univ Vet Fak Derg. 2017; 23 (3): 349-356.
4. Robichaud JD, Dubuc J, Lefebvre D, Descôteaux L. Accuracy of milk ketone bodies from flow-injection analysis for the diagnosis of hyperketonemia in dairy cows. J Dairy Sci. 2014; 97 (6):3364-70.
5. Duffield TF, Leslie KE, Sandals D, Lissemore K, McBride KBW, Lumsden JHL, Dick P, Bagg R. Effect of prepartum administration of monensin in a controlled-release capsule on milk production and milk components in early lactation. J Dairy Sci, 1999; 82 (2): 272-279.
6. Pipino1 D, Piccardi M, Lembeye F, Villalobos NL, Vázquez MI. Comparative Study of Lactation Curves and Milk Quality in Holstein versus Swedish Red and White-Holstein Cross Cows. Sustain Agric Res. 2019; 8 (1): 11-20.
7. Campos MS, Wilcox CJ, Head HH, Webb DW, Hayen J. Effects on Production of Milking Three Times Daily on First Lactation Holsteins and Jerseys in Florida. J Dairy Sci.1994; 77 (3): 770-773.
8. Ganther V, Potonık K, Jovanovac S. Test day records as a for subclinical ketosis detection. Acta Vet Beograd. 2009; 59 (3): 85-191.
9. Vlcek M, Žıtny J, Kasarda R. Changes of fat-to-protein ratio from start to the midlactation and the impact on milk yield. J Cent Eur Agr. 2016; 17 (4): 1194-1203.
10. Butler ST, Pelton SH, Butler WR. Energy balance, metabolic status, and the first postpartum ovarian follicle wave in cows administered propylene glycol. J Dairy Sci. 2006; 89 (8): 2938-2951.
11. Studer VA, Grummer RR, Bertics SJ, Reynolds CK. Effect of prepartum propylene glycol administration on periparturient fatty liver in dairy cows. J Dairy Sci. 1999; 76 (10): 2931-2939.
12. Grummer RR. Nutritional and management strategies for the prevention of fatty liver in dairy cattle. Vet J. 2008; 176 (1): 10-20.
13. Hayirli A, Grummer RR, Nordheim EV, Crump PM. Models for predicting dry matter intake of Holsteins during the prefresh transition period. J Dairy Sci. 2003; 86 (5): 1771-1779.
14. Oetzel GR. Monitoring and testing dairy herds for metabolic disease. Vet Clin North Am Food Anim Pract. 2004; 20 (3): 651-674.
15. Oetzel GR. Herd-Based Biological Testing for Metabolic Disorders. Proc. Amer. Assoc. Bovine Pract. Conf. 2001.