KRMIVA

NON-ESTERIFIED FATTY ACIDS (NEFA) AND GLUCOSE RESPONSE IN AD LIBITUM FEED INTAKE IN YOUNG BREEDING BULLS

NEZASIĆENE MASNE KISELINE (NEFA) I GLUKOZA KAO POKAZATELJI HRANIDBE AD LIBITUM MLADIH RASPLODNIH BIKOVA

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ABSTRACT

Simmental bulls (n=40) randomly allocated in groups of six and kept in pens on slatted floor were tested for their weight gain between 5 and 12 months of age. The average feed consumption at 12^{th} month of life was 20.1 kg of maize silage, 3.9 kg of hay and 3.0 kg of concentrate. This provided a daily intake of up to 11.4 kg of dry matter and 118 MJ ME. The serum samples were analysed for NEFA and GLUC. At this time, the avarage (x±sd) body mass of bulls was 486±47 kg and their weight gain 1.141±198 g. The mean values for NEFA and GLUC were 144±58 µmol/L and 4.54±0.38 mmol/L respectively, ranging between 48 and 283 µmol/L for NEFA and 3.90 to 5.40 mmol/L for GLUC. There was a signifficant difference between NEFA and GLUC variation coefficients (40.4 vs. 6.2%, P<0.001). The polynomial equation was quadratic for NEFA (µmol/L) = -1905.43 + 898.77 GLUC (mmol/L) -97.16 $GLUC^2$(mmol/L), suggesting inflexion point at 4.6 mmol/L serum glucose level (R=0.957). Obviously, at the same energy intake GLUC serum levels were under strong homeostatic and homeoretic control mechanisms, while NEFA concentrations were much more sensitive to requirements for weight gain. After the GLUC concentrations increased up to 4.6 mmol/L it seems that NEFA concentrations tended fall, suggesting that the point of energy equilibrium was achieved.

INTRODUCTION

The development from a calf to the breeding bull is highly dependent on the ration fed (Chestnutt et al., 1975; Pruitt et al., 1985; Pruitt and Corah, 1986). High or low levels of energy intake affect the expression of growth capacity (Griffiths, 1978; Verde and Trenkle, 1987) and also the reproductive performance (Makarechian et al., 1984; Gauthier and Coulaud, 1986; Rice, 1987) of an animal. In addition, energy balance in young bulls undertaken performance trial is important not only for expressing of their growth capacity but also for breeding value assesment of these animals. For instance, glucose (Kalm and Feddersen, 1988) or non-esterified fatty acids and glucose (Szücs et al., 1996) may be useful as selection criteria for metabolically unstable bulls that must be excluded further breeding.

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The very early review of Averdunk, 1969 the points to the necessity of performance testing for dual-purpose and meat production bulls in Germany. Later, information on the initial organisation events and feeding systems is available in the exellent reviews of Rath, 1972. Rittmannsperger, 1972, Schwarz et al., 1972 and Werkmeister, 1982. In Slovenia, the postweaning growth testing of Simmental breeding bulls has been performed since 1963.

Because of the dual-purpose nature of the Slovenian Simmental breed the test for weight gain is conducted in unrestricted feed intake conditions. On principle, the effects of variations in nutrititional intake on productivity and metabolic response could be measured in different ways (Hutjens, 1995). We report here the study that examined the usefulness of serum levels of non-esterified fatty acids and glucose in terms of their ability to reflect the different enegy intake in postweaning growth testing.

MATERIALS AND METHODS

Forty Simmental bulls randomly allocated in groups of six and kept in pens on slatted floor were tested for their weight gain between 5 and 12 months of age. The bulls had free accsess to all of the ration components. The measured feed consumption at 12th months of life was 20.1 kg of maize silage, 3.9 kg of hay and 3.0 kg of concentrate (Table 1.). This provided an average daily intake of up to 11.4 kg of dry matter and 118 MJ metabolizable energy (ME). Vitamin-mineral mix was offered regularly.

Table 1. The average daily feed intake and nutritive value of daily ration ad libitum feeding system for 12 months old bulls kept in pens in groups of six.

Tablica 1. Prosječni sastav i hranidbena vrijednost dnevnog obroka ad libitum za bikove u dobi 12 mjeseci, držanih u boksovima po šest u skupini

Feed - Krma	Daily intake - Dnevni prirast				
	Ration Obrok (kg)	Dry matter Suha tvar (kg)	ME (MJ)	Dig. crud. protein Probavljive sirove bjelančevine	Crude fiber Sirova vlaknina
Hay - Sijeno	3.9	3.4	23.3	281	1.331
Maize silage Kukuruzna silaža	20.1	5.4	63.6	195	1.053
Concentrate - Koncentrat	3.0	2.6	31.1	585	181
Total - Ukupno	26.9	11.4	118.0	1.061	2.565

The blood samples were obtained by jugular venipuncture at the end of the performance testing, i.e. during the 12th months of life. Serum concentrations of non-esterified fatty acids (NEFA) were determined as described by Matsubara et al., 1983. Samples were incubated using coenzyme-A and acyl-coenzyme-A synthetase with ATP in phosphate buffer at 37°C for 10 minutes (Randox, Crumlin, U. K.) and measured with an automatic spectrophotometer (HyCell Diagnostics, France). Glucose (GLUC) concentrations were measured using glucose-oxydase enzymatic system with phenol and amino-4-antipyrine as a substrate at 37°C (bioMerieux, France).

Unless stated otherwise, all descriptive statistics are reported as mean and standard Deviation (x±s.d.) The normality was checked using Kolmogorov-Smirnov test. To predict the values of dependent variable (NEFA) a polynomial regression curve and appropriate coefficients were used.

RESULTS AND DISCUSSION

During the experimental period the average body mass of bulls was 486±47 kg and their weight gain 1.141±198 g. The descriptive statistics of NEFA and GLUC are presented in Table 2:

Table 2. Descriptive statistics of serum concentrations of non-esterified fatty acids (NEFA) and glucose (GLUC) in 118 MJ ME supply conditions for bulls gaining 1.141±198 g per day

Tablica 2. Statistički pokazatelji vrijednosti koncentracija nezasićenih masnih kiselina (NEFA) i glukoze (GLUC) bikova opskrbljenih s 118 MJ ME, koji su prirastali 1.141 g dnevno

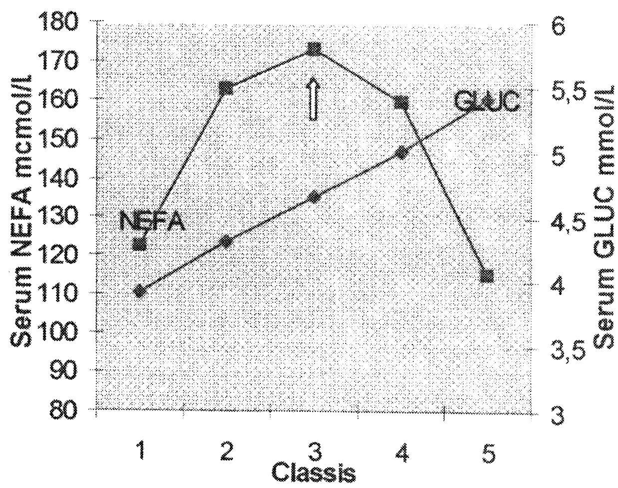
	NEFA (μmol/L)	GLUC (mmol/L)
N	40	40
Min	48.00	3.90
Max	283.00	5.40
Mean - Prosjek	144.00	4.54
Standard deviation	58.10	0.38
Skeweness	0.54	0.06
Kurtosis	3.05	2.45

Normality of distribution was confirmed for GLUC (chi-sqr= 2.48, n.s.) but not for NEFA data (this distribution was binomial, in fact, chi-sqr= 0.779, n.s.). There was a significant difference between NEFA and GLUC variation coefficients (40.4 vs. 8.3%, P<0.001) during 118 MJ ME energy supply conditions. These findings can be explained by the fact that if the energy intake meets the requirements (Rittmannsperger, 1972; Romanowski et al., 1983), the NEFA interchange between liver and fat deposits is limited and vice versa. These observations are consistent with the previous findings of Svetina et al., 1993 who report lowest NEFA variation coefficient at the end of the fattening period (12 to 15 months of age), but it appears to contradicte our previously reported results. No differences in concentrations of NEFA were detected between two groups of bulls with above- or below avarage weight gain (Vojtic and Vengust, 1994).

The regression analysis shows that polynomial equation was quadratic (R=0.957); NEFA (μmol/L) = -1905.43 + 898.77GLUC (mmol/L) -97.16GLUC^2 (mmol/L), suggesting inflexion point at 4.6 mmol/L serum glucose level (arrow below the NEFA curve in Figure 1). Obviously, at the same energy intake GLUC serum levels were under strong homeostatic and homeoretic mechanisms, while NEFA concentrations were much more sensitive to requirements for weight gain. After the GLUC concentrations increased to 4.6 mmol/L it seems that NEFA concentrations tended to fall, suggesting that the point of energy equilibrium was achieved. Although, not in total quantitative agreement, the data of Dawson et al., 1998 and Hornick et al., 1998 suggest NEFA and GLUC concentrations were inversely related to the energy intake. In addition, Orskov et al., 1999 observed that at the amount of 6.5 g glucose/kg metabolic BW infused to the fasting steers, the maximal reduction in plasma beta-hydroxy butirate concentrations was achieved. The similarity between results in this and our experiment is quite evident.

Figure 1. Relatiopship of serum concentrations of glucose (GLUC) and non-esterified fatty acids (NEFA) in 118 MJ ME supply conditions for bulls gaining 1.141 g per day. White arrow indicates the point of energy equilibrium.

Slika 1. Veza između koncentracija glukoze (GLUC) i nazasićenih masnih kiselina (NEFA) u serumu bikova opskrbljenih sa 118 MJ ME, koji su prirastali 1.141 g dnevno. Bijela strjelica pokazuje točku metaboličke ravnoteže.



The purpose of the experiment was to assess two markers of energy metabolism (NEFA and GLUC levels) and their relationship during the last month of the growth performance trial. To summerise, there is no reliable information in the literature regarding the parallelism between NEFA and GLUC concentrations in young bulls, so these results show the potential of metabolic control for assessment of energy status in growth performance trial.

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SAŽETAK

Simentalski bikovi (n= 40) držani su u boksovima po šest, na podu od rešetaka i mjeren je njihov prirast u dobi između petog i 12. mjeseca. U 12. mjesecu starosti bikovi su u prosjeku konzumirali 20.1 kg silaže kukuruza, 3.9 kg sijena i 3.0 kg koncentrata. Takav obrok je sadržavao 11.4 kg suhe tvari i 118 MJ metaboličke energije. Istovremeno utvrđivane su serumske vrijednosti nezasićenih masnih kiselina (NEFA) i glukoze (GLUC). Prosječna tjelesna masa bikova bila je ($\bar{x}$ ±sd) 486±47 kg a prirast

1.141±198 g. Nađene koncentracije NEFA i GLUC varirale su između 48 i 283 µmol/L odnosno 3.90 do 40 mmol/L seruma, dok su srednje vrijednosti bile 144±58 µmol/L i 4.54±0.38 mmol/L. Razlike između koeficijenata varijacije za NEFA (40.4%) i GLUC (6.2%) bile su znakovite (P<0.001). Tjeme regresijske jednadžbe NEFA (µmol/L) = -1905.43 + 898.77GLUC - 97.16GLUC^2(mmol/L) je u točki 4.6 mmol/L glukoze. Na istoj razini opskrbe energijom bila je koncentracija GLUC pod čvrstom kontrolom homeostatskih i homeoretskih mehanizama, dok je koncentracija NEFA osjetljivija s obzirom na energetske potrebe za prirast. Kad je koncentracija GLUC dosegla vrijednost od 4.6 mmol/L smanjila se koncentracija NEFA, što govori o uspostavljenoj energetskoj ravnoteži.

ČISTI MLIJEČNI PROIZVODI ZA MLADE ŽIVOTINJE

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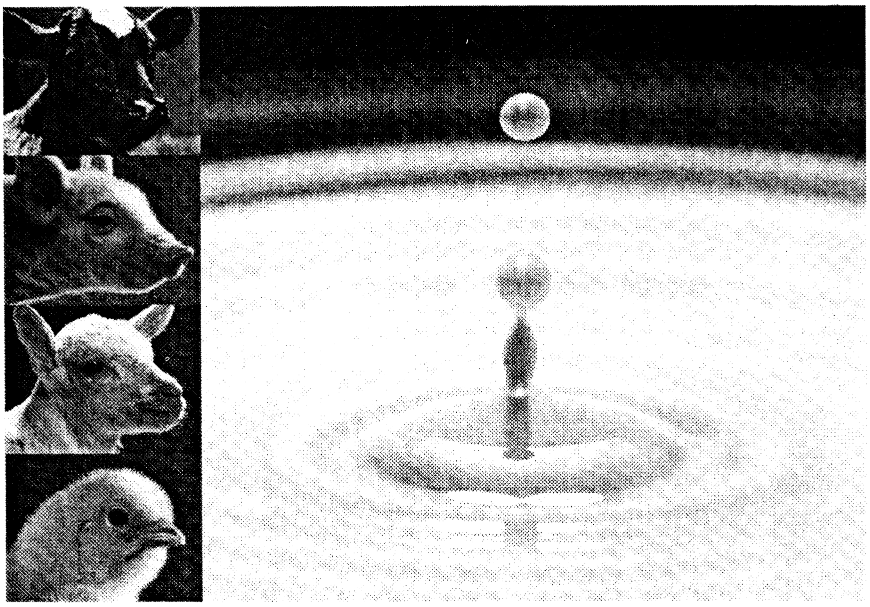
Gotovi proizvodi: zamjene za mlijeko, kao i krmne smjese za rano odbitu prasad

* Zamjene mlijeka za telad:
Kalvoquick, Kalvolac, Kalvostart, Isilac

* Zamjena mlijeka za prasad, jarad i janjad:
Porcolac, Chivalac, Halmalac

* Krmne smjese za rano odbitu prasad. Prva čvrsta hrana za mladu prasad temeljena na mliječnim proizvodima:
Porco Sweet, Porco Pre



Mliječni koncentrati: polugotovi proizvodi, temeljeni na mliječnim sirovinama, za uključivanje u hranu za mlade životinje

Serolat predstavlja lanac mliječnih koncentrata, odabranih za hrane za prasad i zamjenu mlijeka za telad. Proizvodi Serolat se sastoje od 100% mliječnih sirovina.

Prelac zamjena za obrano mlijeko u prahu, temeljena na kombinaciji mliječnih i biljnih sirovina, izvanredne kakvoće. Prelac nudi najbolji odnos cijene i kakvoće.

Avilac jedinstveni novi koncept sirovina temeljenih na mliječnim proizvodima i emulzifikatorima odabranih za hranu za perad.

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