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The effects of glucogenic and lipogenic diets on plasma glucose and urea nitrogen concentration of Baloochi sheep

Mortezaee*, A., A.R. Vakili, M. Danesh Mesgaran & A. Hodjatpanah-montazeri

Department of Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, P. O. Box: 91775-1163, Iran

Abstract

In tropical condition, low quality feed stuff and heat stress expose ruminants such as sheep to lack of proper amounts of available energy, which may lead to a negative energy balance condition. It has been hypothesized that increasing the availability of glucogenic and lipogenic nutrients can improve energy balance and decrease the incidence of metabolic disorders associated with it. The objective of this study was to investigate the effects of glucogenic or lipogenic diets on blood glucose and blood urea nitrogen (BUN) concentration of Baloochi lambs. Three ruminaly fistulated lambs were used in a 3×3 Latin square design with 3 periods (each period of 28 days). Each period included 21 days of adaptation and 7 days of sample collection. Experimental diets were a glucogenic (concentrate: 24.0% maize, 20.4% barley, 27.0% soybean meal, 13.8 canola, 13.8 % wheat bran, 0.3% $CaCo_3$, 0.5% mineral and vitamin premix, 0.2% salt), a lipogenic (concentrate: 10.2% soybean meal, 6.7% canola meal, 29.2% wheat pulp, 24% wheat bran, 20.4% sunflower meal, 8.5% fat powder, 0.3% $CaCo_3$, 0.5% mineral and vitamin premix, 0.2% salt) or a mixture of both diets (50:50). Diets consisted of 50% chopped alfalfa hay and 50% concentrate and were fed once daily ad libitum. On day 27, blood samples were taken from jugular vein before the feeding, 2, 4 and 6 hour post feeding with heparinized syringe. Samples were centrifuged (3500 × *g* for 15 min at 4°C) and collected plasma was kept frozen at −20°C for further analysis. Blood glucose and BUN concentrations were determined by an auto-analyzer (Alcyon 300i Abbott, USA). There was no significant difference among treatments for blood glucose and BUN concentration ($P > 0.05$). However, glucose concentration was less for lambs fed lipogenic diet compared with glucogenic or mixed diet (66.1 vs. 67.91 vs. 71.47 ± 2.59, respectively). The glucogenic diet tended to increase BUN compared with lipogenic or mixed diet (39.79 vs. 38.13 vs. 36.96 ± 2.13, respectively). Present study demonstrated that glucogenic and lipogenic diets may have a potential to improve negative energy balance through affecting on some of the blood metabolites.

Keywords: glucogenic, lipogenic, blood metabolites

***Corresponding author**: Mortezaee, A.
E-mail address: a.mortezaee6482@gmail.com

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Introduction

In tropical condition, low quality feedstuff and heat stress expose ruminants such as dairy ewes and dairy cows to lack of proper amounts of available energy, which may lead to a negative energy balance condition (Van Knegsel et al., 2007; Chiofalo et al., 2005). Negative energy balance has been associated with an increase in incidence and severity of metabolic disorders, like fatty liver, ketosis (Grummer, 1993) and ruminal acidosis (Bobe et al., 2004), an increase in incidence of infectious diseases (Collard et al., 2000). Furthermore, negative energy balance leads to a decrease in reproductive performance, like delayed resumption of ovarian activity (Staples et al., 1990), diminished estrous expression (Lopez et al., 2004), attenuated follicle quality (Lucy et al., 1991), lower conception rates, and more days open (Reist et al., 2003; Reksen et al., 2002). It has been hypothesized that increasing the availability of glucogenic and lipogenic nutrients can improve energy balance and decrease the incidence of metabolic disorders associated with it. Lipogenic nutrients in ruminants originate from fermentation of fiber to acetate and butyrate, dietary fat or are derived from body reserves. Glucogenic nutrients originate from starch that has escaped rumen degradation or gluconeogenesis. The objective of this study was to investigate the effects of glucogenic or lipogenic diets on plasma glucose and urea nitrogen concentration of Baloochi sheep.

Material and Methods

Three ruminally fistulated sheep were used in a 3×3 Latin square design with 3 periods (each period of 28 days). Each period included 21 days of adaptation and 7 days of sample collection. The animals were assigned to individual metabolical cages (0.5 × 1.2 × 1 m) and had free access to salt and fresh water throughout the experiment. Experimental diets were a glucogenic (G) (concentrate: 23.8% corn, 20.2% barley, 27.0% soybean meal, 13.8% canola meal, 13.8% wheat bran, 0.3% DCP, 0.5% mineral and vitamin premix, 0.4% sodium bicarbonate, 0.2% salt), a lipogenic (L) (concentrate: 10.2% soybean meal, 6.7% canola meal, 29.2% wheat pulp, 24% wheat bran, 20.4% sunflower meal, 8.1% fat powder, 0.3% DCP, 0.5% mineral and vitamin premix, 0.4% sodium bicarbonate, 0.2% salt) and a mix (50:50, DM basis) of both diets. Diets consisted of 50% chopped alfalfa hay and 50% concentrate and were fed once

daily ad libitum. On day 27, blood samples were taken from jugular vein before the feeding, 2, 4 and 6 hours post feeding with heparinized syringe. Plasma was obtained by centrifugtion (15 min at 3500× *g*) and frozen at −20°C until analysis. Analyses for glucose and urea were performed using commercially available kits on an auto-analyzer (TARGA 3000, Italy, glucose, blood urea nitrogen, Biosystem Ltd., Spain). Data were applied to the mixed model of SAS (version 9.1; SAS Institute Inc., Cary, NC) with the following statistical model of: $Y_{ijklm} = \mu + A_i + B_j + C_k + D_l + (AD)_{il} + \varepsilon_{ijklm}$; where Y_{ijklm} was the depndent variable, μ was the overall mean, A_i was the treatment effect, B_j was the period effect, C_k was the random effect of animal within treatments, D_l was the sampling time effect, $(AD)_{il}$ was the interaction effect of treatment and sampling time and ε_{ijklm} was the residual error. The sampling time was included in the model as repeated measurement by using compound symmetry. Differences between least squares means were considered significant at ($p < 0.05$), using PDIFF in the LSMEANS statement.

Results and Discussion

Plasma glucose and urea nitrogen concentrations at pre and post feeding are shown in figures 1 and 2, respectively. There was no significant difference among treatments for plasma urea nitrogen concentration ($P > 0.05$). Sheep fed the mixture of G and L diets (50:50) tended to have higher plasma glucose (Table 1; P=0.08). This response, indicating that mixture of both diets has an efficacious glucogenic effect that favors the increase of gluconeogenesis, glycogenolysis, or both. Plasma urea nitrogen concentration is higher in glucogenic diet compared with other group, this may cause by increased absorption of ruminal ammonia, resulting in greater quantities of ammonia being detoxified in the liver to form urea. These data are supported by observations from other research (Van Knegsel et al., 2007).

Table 1. Blood metabolites in sheep receiving either glucogenic, lipogenic or both diets.

Item	Lipogenic	G:L (50:50)	Glucogenic	S.E.M	P-value
Urea-N (mg/dl)	38.13	36.96	39.79	2.13	0.11
Glucose (mg/dl)	67.10	71.47	68.91	2.59	0.08

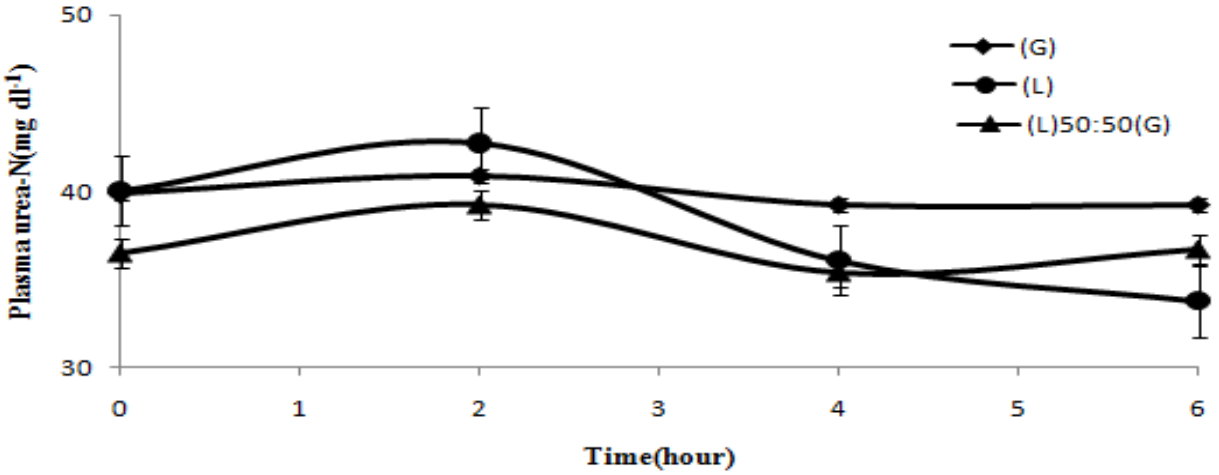

Figure 1. Plasma urea nitrogen concentration in sheep fed glucogenic (G), lipogenic (L) or mix of both diets.

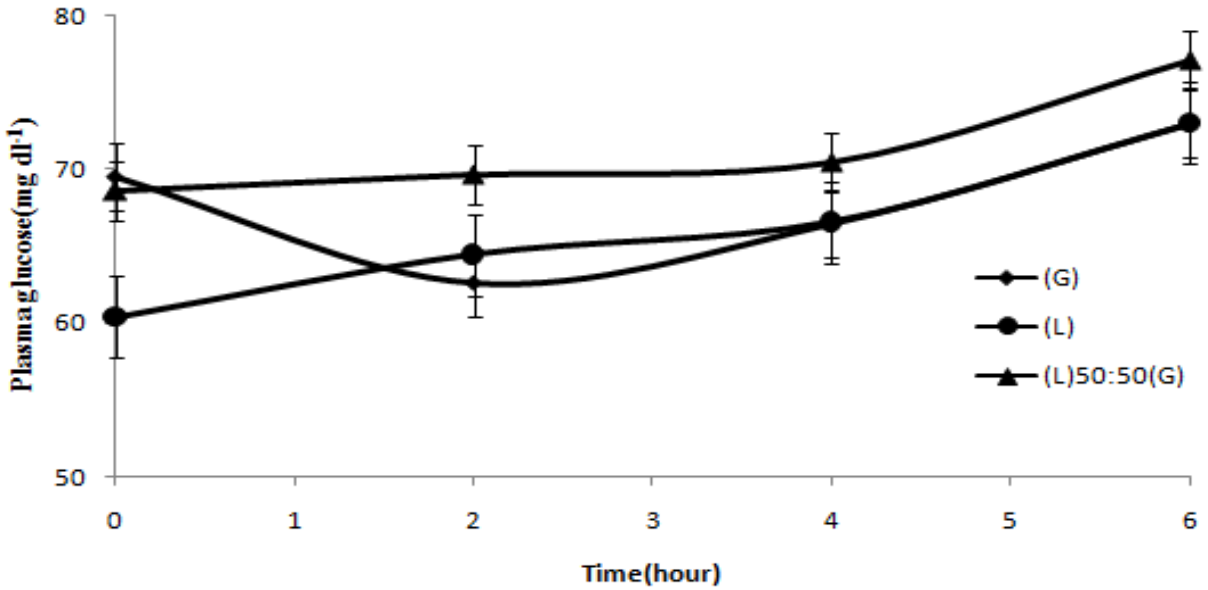

Figure 2. Plasma glucose concentration in sheep fed glucogenic (G), lipogenic (L) or mix of both diets.

Conclusion

Present study demonstrated that feeding the mixture of G and L diets (50:50) compared with each of them have a potential to improve negative energy balance through affecting on plasma glucose.

References

Bobe, G., J. W. Young, and D. C. Beitz. 2004. Invited review: pathology, etiology, prevention, and treatment of fatty liver in dairy cows. J. Dairy Sci. 87: 3105-3124.

Chiofalo, V., M. Todaro, L. Liotta, S. Margiotta, T. Manzo and G. Leto. 2005. Effect of propylene glycol on pre- and postpartum performance by dairy ewes. J. Small Rumin. Res. 58:107–114.

Collard, B. L., P. J. Boettcher, J. C. M. Dekkers, D.Petitclerc, and L. R. Schaeffer. 2000. Relationships between energy balance and health traits of dairy cattle in early lactation. J. Dairy Sci. 83:2683-2690.

Grummer, R. R. 1993. Etiology of lipid-related metabolic disorders in periparturient dairy cows. J. Dairy Sci. 76:3882–3896.

Lopez, H., L. D. Satter, and M. C. Wiltbank. 2004. Relationship between level of milk production and estrous behavior of lactating dairy cows. Anim. Reprod. Sci. 81: 209-223.

Lucy, M. C., C. R. Staples, F. M. Michel, and W. W. Thatcher. 1991. Energy balance and size and number of ovarian follicles detected by ultrasonography in early postpartum dairy cows. J. Dairy Sci. 74: 473-482.

Reist, M., Erdin, D. K., von Euw, D., Tschumperlin, K. M., Leuenberger, H., Hammon, H.M., Morel, C., Philipona, C., Zbinden, Y., Kunzi, N., and Blum, J. W. 2003.Postpartum reproductive function: association with energy, metabolic and endocrine status in high yielding dairy cows. Theriogenology. 59: 1707-1723.

Reksen, O., Grohn, Y. T., Havrevoll, O., Bolstad, T., Waldmann, A., and Ropstad, E. 2002. Relationships among milk progesterone, concentrate allocation, energy balance, milk yield and conception rate in Norwegian cattle. Anim. Reprod. Sci. 73: 169-184.

Statistical Analysis Systems (SAS), 2003. SAS User's Guide: Statistics, version 9.1 SAS Institute, Inc., Cary, NC, USA.

Van Knegsel, A. T. M., H. van den Brand, J. Dijkstra, W. M. van Straalen, R. Jorritsma, S. Tamminga and B. Kemp. 2007. Effect of glucogenic vs. lipogenic diets on energy balance, blood metabolites, and reproduction in primiparous and multiparous dairy cows in early lactation. J. Dairy Sci. 90:3397–3409.