Effects of Dietary Calcium and Phosphorus Levels on Nutrient Digestion and Metabolism and Plasma Physiological and Biochemical Indices in Lactating Yili Mares: Postprint

Authors: Yu Quanping, XianDong Wang, Fang Meiyan, Yong Chen

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Abstract

This experiment aimed to investigate the effects of dietary calcium and phosphorus levels on body weight, chest circumference, apparent digestibility and metabolism of nutrients, and plasma physiological and biochemical indices in lactating Yili mares, to provide a reference for determining appropriate calcium and phosphorus requirements during lactation. Twenty-five Yili mares in their second lactation month, with similar age (11–14 years), body weight [(371$±$21) kg], and parity (4–6), were selected and randomly divided into five groups, with five mares per group. During the third lactation month, the calcium feeding levels for groups I, II, III, IV, and V were 45.03, 48.50, 51.96, 55.43, and 58.89 g/d, respectively, and the phosphorus feeding levels were 30.05, 32.03, 34.01, 35.99, and 37.97 g/d, respectively; during the fourth and fifth lactation months, the calcium feeding levels for groups I, II, III, IV, and V were 43.60, 46.42, 49.25, 52.07, and 54.92 g/d, respectively, and the phosphorus feeding levels were 27.63, 29.24, 30.86, 32.47, and 34.12 g/d, respectively. The experiment lasted for 90 days, with each 30-day period constituting one experimental cycle. The results showed that dietary calcium and phosphorus levels had no significant effect on mare body weight and chest circumference ($P>0.05$). Dietary calcium and phosphorus levels had no significant effect on apparent digestibility of dry matter, organic matter, and neutral detergent fiber ($P>0.05$). Group V exhibited the highest apparent digestibility of crude protein, which was 12.26%, 12.37%, and 18.28% higher than that of groups II, III, and IV, respectively ($P<0.05$); Group I exhibited the highest apparent digestibility of gross energy, which was 8.32%, 7.19%, and 11.24% higher than that of groups II, III, and IV, respectively ($P<0.05$); Groups I and III exhibited calcium apparent digestibility 17.74% and 14.49% higher than that of group IV, respectively ($P<0.05$); Group III exhibited the highest phosphorus apparent digestibility, which was

35.39% higher than that of group II (P<0.05). Dietary calcium and phosphorus levels had no significant effect on nitrogen and calcium metabolism in mares (P>0.05). The metabolizable energy of group I was 7.95% and 11.33% higher than that of groups II and IV, respectively (P<0.05); the energy deposition rate of group I was 9.30%, 8.50%, and 12.10% higher than that of groups II, III, and IV, respectively (P<0.05); phosphorus deposition in groups I, III, and V was significantly higher than that in group II (P<0.05), with group III being the highest among all groups, 42.59% higher than group II; phosphorus deposition rate in groups I and III was significantly higher than that in groups II and IV (P<0.05), with group I being the highest among all groups, 49.67% and 46.32% higher than groups II and IV, respectively; phosphorus utilization rate in groups I, III, and V was significantly higher than that in group II (P<0.05), 17.74%, 18.80%, and 16.79% higher than group II, respectively. Dietary calcium and phosphorus levels had no significant effect on plasma ionic calcium, phosphorus, calcitonin, osteocalcin, placental lactogen, pituitary prolactin, estradiol, progesterone, and estrone levels (P>0.05). Plasma parathyroid hormone level in group III was significantly higher than that in groups IV and V (P<0.05), increased by 70.61% and 47.58%, respectively. It was concluded that the diet of group I (calcium and phosphorus feeding levels of 45.03 and 30.05 g/d in the third lactation month, and 43.60 and 27.63 g/d in the fourth and fifth lactation months, respectively) could meet the calcium and phosphorus requirements of Yili mares during lactation. Appropriate dietary calcium and phosphorus levels help maintain higher levels of energy and calcium apparent digestibility as well as energy and phosphorus deposition and utilization.

Full Text

Effects of Dietary Calcium and Phosphorus Levels on Nutrient Digestion and Metabolism, Plasma Physiological-Biochemical Indices of Yili Mares during Lactation Period

YU Quanping, WANG Xiandong, FANG Meiyan, CHEN Yong*

College of Animal Science, Xinjiang Agricultural University, Urumqi 830052

Abstract

In order to provide references for confirming calcium (Ca) and phosphorus (P) requirements for Yili mares during lactation, the effects of dietary Ca and P levels on body weight, heart girth, nutrient apparent digestibility, metabolism, and plasma physiological-biochemical indices were examined. Twenty-five Yili mares at the end of their 2nd lactation month with similar age (11 to 14 years old), body weight [(371$±$21) kg] and parity (4 to 6 parities) were selected and allocated to five groups of 5 animals each. In the 3rd lactation month, the Ca intake levels of mares in Groups 1, 2, 3, 4 and 5 were 45.03, 48.50, 51.96, 55.43 and 58.89 g/d, and the P intake levels were 30.05, 32.03, 34.01, 35.99 and

37.97 g/d, respectively. In the 4th and 5th lactation months, the Ca intake levels of mares in Groups 1, 2, 3, 4 and 5 were 43.60, 46.42, 49.25, 52.07 and 54.92 g/d, and the P intake levels were 27.63, 29.24, 30.86, 32.47 and 34.12 g/d, respectively. The trial lasted for 90 days, with each 30-day period constituting a test cycle.

The results showed that dietary Ca and P levels had no significant effects on body weight, heart girth, or the apparent digestibility of dry matter (DM), organic matter (OM) and neutral detergent fiber (NDF) ($P>0.05$). The apparent digestibility of crude protein (CP) in Group 5 was the highest, increasing by 12.26%, 12.37% and 18.28% ($P<0.05$) compared with Groups 2, 3 and 4, respectively. The apparent digestibility of gross energy (GE) in Group 1 was the highest, increasing by 8.32%, 7.19% and 11.24% ($P<0.05$) compared with Groups 2, 3 and 4, respectively. The apparent digestibility of Ca in Groups 1 and 3 was higher than that in Group 4, increasing by 17.74% and 14.49% ($P<0.05$), respectively. The apparent digestibility of P in Group 3 was the highest, increasing by 35.39% ($P<0.05$) compared with Group 2.

Dietary Ca and P levels had no significant effects on nitrogen and Ca metabolism ($P>0.05$). The metabolic energy (ME) in Group 1 was higher than that in Groups 2 and 4, increasing by 7.95% and 11.33% ($P<0.05$), respectively. The energy retention rate in Group 1 was higher than that in Groups 2, 3 and 4, increasing by 9.30%, 8.50% and 12.10% ($P<0.05$), respectively. The P retention in Groups 1, 3 and 5 was significantly higher than that in Group 2 ($P<0.05$), with Group 3 being the highest among all groups, increasing by 42.59% ($P<0.05$) compared with Group 2. The P retention rate in Groups 1 and 3 was significantly higher than that in Groups 2 and 4, with Group 1 being the highest among all groups, increasing by 49.67% and 46.32% ($P<0.05$) compared with Groups 2 and 4, respectively. The P utilization rate in Groups 1, 3 and 5 was significantly higher than that in Group 2 ($P<0.05$), increasing by 17.74%, 18.80% and 16.79% compared with Group 2, respectively.

The levels of plasma ionized calcium (Ca2+), P, calcitonin, bone gla protein, placental prolactin, pituitary prolactin, estradiol, progesterone and estrone showed no significant differences ($P>0.05$) when mares were fed different dietary Ca and P levels. However, the level of plasma parathyroid hormone in Group 3 was significantly higher than that in Groups 4 and 5, with increases of 70.61% and 47.58% ($P<0.05$), respectively.

In conclusion, Diet 1 (with Ca and P intake levels of 45.03 and 30.05 g/d in the 3rd lactation month, and 43.60 and 27.63 g/d in the 4th and 5th lactation months, respectively) can meet the Ca and P requirements of Yili mares during the lactation period. Suitable dietary Ca and P levels are beneficial for maintaining higher apparent digestibility of gross energy and Ca, as well as retention and utilization of P and energy.

Keywords: Yili mare; calcium; phosphorus; digestion; metabolism; hormones

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Note: Figure translations are in progress. See original paper for figures.