



## Lamb hemoglobinuria due to nutritional hypophosphatemia

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**A** young indigenous lamb was referred in spring to our teaching hospital 20 h after sudden onset of passing red urine. The lamb had been housed like a pet in a dry, open yard after early weaning. Its body condition was excellent. According to the owner, the feed was fresh, lush alfalfa only, with free access to water.

The body temperature was 39.5°C, heart rate 84 beats/min, and respiratory rate 35 breaths/min. The lamb was still eating and ruminating. Feces were normal. Urine was transparent and red, without any discomfort to the animal when being voided. The mucous membranes were pale but not icteric. On blood analysis, the packed cell volume (PCV) was 0.24 L/L, leukocytes  $9 \times 10^9/L$  (neutrophils 31%, lymphocytes 68%, and eosinophils 1%). Plasma and serum were deep red. The urine did not produce any sediment and remained red after centrifugation.

In the absence of any signs of infection or toxemia, the constant availability of water, no history of copper excess in the diet, and the consumption of lush alfalfa only, the lamb was tentatively diagnosed as being hemoglobinuric due to hypophosphatemia. Because of the emergency condition of the hemoglobinuria, 2.0 mL of a phosphorus compound was administered, IV, and the lamb was hospitalized without the administration of any other drugs. Prior to the single injection of phosphorus, the inorganic phosphorus concentration in serum was 1.5 mmol/L; 15 h after the injection, the lamb voided normal colored urine. Subsequently, the color of the serum changed to normal and the serum concentration of inorganic phosphorus increased to a 2.3 mmol/L; that of calcium was 2.5 mmol/L. The lamb was discharged with advice to the owner to feed a ration including high quality alfalfa hay, barley grain, and wheat straw.

Three months later, the lamb's bodyweight had increased, its urine was normal, and there were no signs of anemia in the mucous membranes. Additionally, the PCV, serum inorganic phosphorus concentration, and serum calcium concentration measured 0.36 L/L, 3.1 mmol/L, and 2.8 mmol/L, respectively.

The normal range of phosphorus in sheep is 1.6 to 2.4 mmol/L. Age-related differences exist with young animals having much higher values than adults, with values for neonates commonly up to 2.3 to 2.9 mmol/L (3), so at the time of the phosphorus injection, the lamb was obviously hypophosphatemic. The improved serum phosphorus concentration after 3 mo of improved nutrition suggested that the lamb had suffered from nutritional hypophosphatemia.

Hypophosphatemia in postparturient hemoglobinuria, linked to phosphorus deficiency (4), is one of the most important causes of intravascular hemolysis in adult high-production dairy cows (2). Copper and/or selenium deficiencies, phytotoxins of cruciferous plants, saponins of sugar beet and alfalfa, low energy diets, windy cold climates, and sudden consumption of large quantities of cold water have been encountered as possible contributing factors in the occurrence of postparturient hemoglobinuria in dairy cows (2–7), but postparturient hemoglobinuria has not been reported in ewes. Perhaps the low level of milk production in the ewe, selective grazing, and natural resistance to phosphorus deficiency (2) accounts for the stability of ovine red blood cells against hypophosphatemic hemolysis.

In this case, the consumption of large amounts of lush alfalfa, which characteristically has a high Ca/P ratio (4), a high saponins content, low calciferol and high carotene concentrations, and low bioavailable copper (2), probably played a role in providing the predisposing factors for the development of hypophosphatemia-associated hemolysis in the presence of suppressed antioxidant mechanisms in the red blood cells. Also, the rapid growth of the lamb and soft texture of the lush alfalfa, leading to poor blood-saliva-intestine cycling of phosphorus, probably resulted in incomplete saving of the element, and contributed in the pathogenesis of disorder.

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