Bone mineral content kinetics in sows across three consecutive lactations as a function of dietary phosphorus during lactation

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Recent data indicate that sows mobilize bone mineral reserves during lactation to meet their calcium (Ca) and phosphorus (P) requirements and subsequently restore these reserves during the following gestation. The mobilization of these reserves is further increased when dietary Ca and P supply is reduced. However, the resilience in bone mobilization-restoration of sows subjected to a low-P lactation diet over consecutive cycles, remains unknown. The objective of the present study was to address this question. A total of 28 primiparous Swiss Large White sows from the Agroscope herd were selected and assigned to four lactation diets formulated to meet the recommended nutrient requirements except for digestible P and Ca: 100 met 100% of the requirement, without exogenous phytase (9.0 g Ca, 3.0 g digestible P/kg, and a 3:1 Ca/digestible P ratio; 8 sows); 50 met 50% of the requirement, without exogenous phytase (4.5 g Ca, 1.5 g digestible P/kg, and a 3:1 Ca/digestible P ratio; 8 sows); 100+FTU (6 sows) and 50+FTU (6 sows) where 100 and 50, were respectively, supplemented with an exogenous phytase (750 FTU/kg, Quantum® Blue 5G, AB Vista, Marlborough, United Kingdom). Sows were fed ad libitum during the lactation. The gestation diet was formulated to cover nutritional requirements and did not contain exogenous phytase. Feed allowance was set at 2.8 kg/day during the first 80 days of gestation and increased to 3.0 kg/day thereafter. Sows were scanned by dual-energy X-ray absorptiometry (DXA) for bone mineral content (BMC, g) and fat tissue mass (kg) over three consecutive lactations (Lact1, Lact2, Lact3) at 2 (d2) and 24 days (d24) postpartum, and during the second gestation (Gest2) at day 40 (d40). The BMC was analyzed using a mixed model including stage (time point of measurement), lactation diet, and their interaction, with a Corsymm residual covariance structure. The mobilized BMC (BMCd24 – BMCd2) within lactation was analyzed using a mixed model including lactation number, lactation diet, and their interaction. In both models, the sow was included as a random effect. A linear correlation between mobilized BMC and fat tissue was performed across the diets 100+FTU, 100, and 50+FTU. On d24 of Lact1, BMC tended to be lower in 50 than in 100+FTU ($P = 0.054$), and on d24 of Lact2 and Lact3, it was lower than in both 100 and 100+FTU ($P < 0.05$). BMC did not differ between treatments at the other stages. The mobilized amount of BMC during lactation did not differ between treatments across lactations. These results confirm that sows fed a low-P diet during lactation mobilized more BMC, and showed that the mobilized BMC was restored over two consecutive gestations. The sow therefore appears to be resilient to a low dietary P supply over several consecutive cycles. The mobilized BMC was linearly associated with the mobilized fat tissue mass ($R^2 = 0.72$, $P < 0.001$). These findings show that during a period of higher metabolic intensity sows mobilize energy from fat tissue and minerals from bone to meet the nutrient demand for milk production. This relationship provides new perspectives for estimating mineral mobilization.