

Bone-specific alkaline phosphatase activity in dairy cows

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Abstract Bone-specific alkaline phosphatase is considered the single most accurate marker of bone formation. In this study, 75 healthy Holstein dairy cows in their first, second, third, fourth or fifth parities underwent serum bone-specific alkaline phosphatase quantification. The results indicate that enzyme activity values have a decreasing pattern with increasing order of parity ($p < 0.05$). However, the differences between cows in second and third parity and also between cows in fourth and fifth parity were not statistically significant ($p > 0.1$). We concluded that bone-specific alkaline phosphatase measurement by heat inactivation provides a simple method to determine bone metabolic status and useful data to evaluate calcium availability in dairy cows.

Keywords Bone-specific alkaline phosphatase · Dairy cow · Heat inactivation

Introduction

Bone metabolism is a dynamic lifelong process of bone modeling (in growing individuals) and remodeling (in mature/adult individuals), which is tightly coupled absorption of old bone tissue and synthesis of new bone tissue (Frost 1990a, b). Under homeostatic equilibrium bone resorption and formation are balanced. The ability of bone to adapt to mechanical loads is brought about by continuous bone resorption and bone formation; if these processes

occur at different locations, the bone morphology is altered. Frost defined this as modeling. During the remodeling process, old bone is continuously replaced by new tissue. This ensures that the mechanical integrity of the bone is maintained but causes no global changes in morphology (Frost 1990a, b). The modeling and remodeling processes are not very different at the cellular level. They are based on the separate actions of bone resorbing cells called osteoclasts and bone forming cells called osteoblasts (Vaananen and Horton 1995). Osteoporosis is a condition of reduced bone mass and increased bone fragility obviously caused by disturbed modeling and remodeling processes (Boyce et al. 2003). The purpose of the remodeling process is essential to maintain the strength and flexibility of bones, especially in high yielding dairy cows, and also to supply calcium when demand for it is too high to be covered from food (Goff 2000). A variety of biochemical assays that reflects the activity of osteoblasts (the bone-forming cells) and osteoclasts (the bone-resorbing cells) have been developed for clinical use. They have helped increase the understanding of the bone remodeling cycle, the pathogenesis of skeletal disorders, and the response of these disorders to therapy (Singer and Eyre, 2008). Bone-specific alkaline phosphatase (BALP; ALP; EC 3.1.3.1) is considered the single most accurate marker of bone formation and is the classic marker for increased osteoblastic activity (Allen 2003). It is an ectoenzyme anchored to the plasma membrane by a phospho-glycan linkage to phosphatidylinositol and released to circulation by a phosphatidylinositol glycan hydrolase (Farley and Jorch 1983; Weiss et al. 1989). BALP is produced by osteoblasts and is required for osteoid formation and matrix mineralization (DeLaurier et al. 2002).

In dairy cows, bone metabolism must change to balance the varying demand for calcium (Ferguson and Williams

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