β-Hydroxy-β-methylbutyrate (HMB) Supplementation for Canines

What is HMB?

β-Hydroxy-β-methylbutyrate (HMB), a metabolite of the amino acid leucine, improves protein balance and muscle performance. Studies in humans have repeatedly demonstrated that supplemental HMB improves muscle performance, decreases recovery time from exercise, and improves body composition by increasing lean body mass and decreasing fat mass with exercise.[1] Other studies have demonstrated that HMB improves nitrogen balance and attenuates muscle loss due to cachexia,[2,3] sarcopenia,[4,5] and trauma[6].

HMB increases protein retention in muscles:

Muscle is the primary protein storage compartment in the body and the amount of protein in muscle is dependent upon the rate of protein synthesis compared with the rate of protein breakdown. HMB improves protein metabolism in animal models of cachexia,[7,8] and in humans with diseases causing cachexia.[2, 3] HMB also reverses the slow loss of muscle protein associated with the sarcopenic processes in aging humans by improving net retention of protein[4] and increasing muscle mass, even without exercise.[5] When HMB is combined with exercise in elderly humans, fat mass is also decreased.[9]

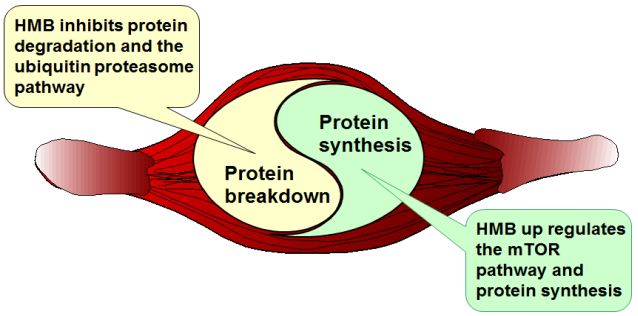

Figure 1. HMB stimulates protein synthesis (mTOR) while decreasing protein breakdown (ubiquitin proteolytic pathway).

One mechanism whereby HMB preserves lean tissue is through inhibition of the ubiquitin-proteasome pathway, a primary proteolytic pathway which is upregulated in cachexia.[7] HMB also simultaneously increases mammalian target of rapamycin (mTOR) activity and the initiation of protein synthesis,[7,10,11] and these two effects combined result in more muscle protein (Figure 1). Targeted nutritional support can upregulate mTOR activity and stimulate protein synthesis in muscle cells, and recently multiple mechanisms have been proposed and identified for nutrient regulation of mTOR activity.[12,13] Similar to the amino acid leucine, HMB stimulates mTOR increasing muscle protein synthesis, but HMB also simultaneously decreases muscle protein breakdown resulting in an increase in LBM.[11] This increase in net protein balance could be of particular importance in helping aging canines and/or canines on a protein limited or a limited feed intake diet maintain muscle mass.

HMB supplementation may improve body condition and muscle function in canines:

Canines, similar to humans, lose muscle and lean body mass (LBM) as a result of sarcopenic and/or cachexic processes.[14] Cachexia is the loss of muscle due to inflammatory processes, and a significant loss of LBM can occur before significant weight loss is observed. In canines, cardiac cachexia is a significant cause of morbidity and mortality.[14] Sarcopenic muscle loss is a more gradual loss of LBM associated with the aging canine, which many times is accompanied by an increase in fat mass such that total body weight remains unchanged or may even increase.[14] In the US, 55% of all canines (and 53% of felines) are estimated to be overweight as a result of over consumption of energy relative to expenditure.[15] The obese condition conceals loss of muscle, and similar to humans, obesity in canines results in metabolic syndromes such as insulin resistance and osteoarthritis. The results lead to further decreases in mobility, exercise, and quality of life and exacerbation of the obesity problem.[16] Lacking body composition analysis, the strategy should be to maximize protein synthesis while minimizing fat and weight gains in older animals through proper dietary nutrient intake. Additionally, body weight reduction in overweight canines can reduce causative factors of metabolic syndrome such as insulin resistance and inflammatory adipokines.[17]

HMB supplementation improves performance in canines:

HMB has been reported to improve aerobic metabolism in muscle by increasing the maximal oxygen consumption (VO_2max), time to onset of blood lactate accumulation (OBLA), and respiratory compensation point (RCP),[18,19] and decrease muscle damage shortening recovery time.[20,21]

In Training and Racing Greyhounds: Greyhounds were randomized and assigned to either control or 1 gram HMB/day for 12 weeks. After two weeks of supplementation, the HMB-supplemented group had an improvement in race finish, with the average placing improving from 4.6 prior to 3.8 after supplementation while there was little change in the control group. After 12 weeks of supplementation, the HMB-supplemented group was 0.66 seconds faster than the control group (Figure 2) and the HMB-supplemented greyhounds had increased earnings for their owners. Blood was sampled by the track veterinarian and blood chemistry and hematology was measured during the study. HMB supplementation resulted in no significant changes in blood parameters versus the control-supplemented greyhounds.

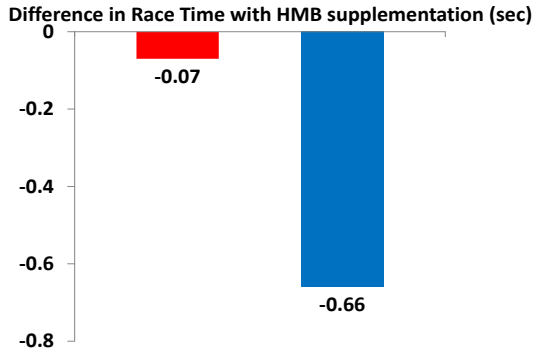

Figure 2. Difference in mean race times between the HMB-supplemented Greyhounds compared to control-supplemented Greyhounds – one month prior to supplementation, and then again during the last month of supplementation.

In Endurance Competition: The Iditarod is one of the most grueling endurance competitions held for both canine and human competitors. Sled dogs were assigned to either a control group or a group receiving 1 gram HMB/day. The dogs were fed HMB for at least 2 weeks prior to the start and continuously during the race. After the Iditarod race, blood was sampled by the overseeing veterinarian. HMB supplementation resulted in measurable decreases in serum creatine phosphokinase (CK, -14.8%) and lactate dehydrogenase (LDH, -25.4%) activities (Figure 3). Extreme exertion of muscles causes muscle damage which results in increases in serum CK and LDH, two enzymes in muscle which leak out of damaged muscle tissues and can be measured in the blood.[22] Thus, less muscle damage means a shorter recovery period for the muscle after an extreme workout.

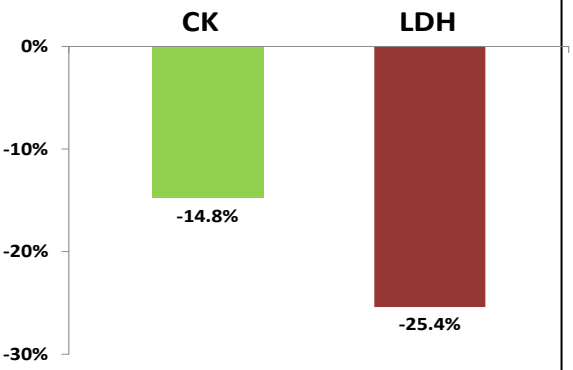

Figure 3. The effect of HMB supplementation on creatine phosphokinase (CK) and lactate dehydrogenase (LDH), blood markers of muscle damage, in sled dogs 24 hours post Iditarod race finish (% difference of the HMB group compared to control group).

Why supplement HMB:

Supplementing the diet with HMB will assure adequate levels of tissue and muscle HMB for optimal protein metabolism. Maintaining muscle mass in canines is vital to their overall health and well-being. While small amounts of HMB are naturally occurring in feeds of plant and animal origin, much of the HMB found in the body is through *de novo* synthesis from leucine. It is clear that HMB plays a role in the nutritional signaling of protein metabolism, and that during strenuous physical activity, and in older and overweight canines, dietary and *de novo* synthesis of HMB may not be adequate to support optimal muscle maintenance and muscle performance.

Conclusion:
Supplementing HMB to the diet of canines improves performance and decreases muscle damage in canine athletes. More importantly HMB may help preserve lean muscle mass and body condition in older canines. The improvement in muscle mass and function would allow older canines more mobility and an improved quality of life.

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