Summary

Athletes are always striving to improve their performance, and one way to gain small but significant improvements is by using ergogenic supplements. β-alanine and sodium bicarbonate are two supplements with the potential to increase performance in high-intensity exercise. In this thesis, the effect of these two supplements was explored separately and in combination in well-trained subjects. Carnosine (β-alanyl-L-histidine) is a dipeptide primarily located in the skeletal muscle. Supplementing with β-alanine increases muscle carnosine content through binding of β-alanine with histidine in a process catalysed by carnosine synthase. Increasing muscle carnosine content has been linked to exercise performance improvements, especially in high-intensity exercise. Carnosine is known to be an intracellular H⁺ buffer but has also been linked to increased Ca²⁺ sensitivity and having antioxidant properties. Ingesting sodium bicarbonate increases extracellular buffer capacity by increasing blood pH and blood HCO₃⁻ content prior to onset of exercise, increases efflux of H⁺ from the muscle cells and hereby possible delays muscle pH decrease during intense exercise. The lowering of muscle pH has been coupled to fatigue development. Therefore, co-supplementing with β-alanine and sodium bicarbonate could possibly delay fatigue during high-intensity exercise due to a double defence against acidification by increasing buffer capacity both in the muscle and in the circulation. To address whether β-alanine supplementation and sodium bicarbonate ingestion could enhance performance in a high-intensity time to exhaustion test and change intra- and extracellular buffer capacity, 18 well-trained male subjects were supplemented with β-alanine or a placebo for 8 weeks. On two post-supplementation test days, the subjects further ingested sodium bicarbonate or a placebo in a double-blinded randomised cross-over trial. In the present thesis, it is demonstrated that β-alanine supplementation increases muscle carnosine content, increases muscle buffer capacity, and attenuates muscle pH drop during high-intensity exercise. Ingestion of sodium bicarbonate increases blood HCO₃⁻ and base excess and increases muscle lactate during high-intensity exercise. When β-alanine and sodium bicarbonate is co-supplemented, high-intensity exercise capacity is increased, which is not the case when each of the supplements is supplemented individually.

Prolonged maximal isometric contraction rapidly increases intracellular H⁺ production and is thus a good model for investigating the effect of increased muscle carnosine on fatigue development. Seventeen elite kayakers were supplemented with β-alanine or a placebo for 8 weeks to investigate the effect of β-alanine supplementation on 1000 m kayak ergometer performance and fatigue development during maximal isometric contraction. It was demonstrated that the supplementation with β-alanine did not result in altered fatigue development during a prolonged maximal isometric contraction. Furthermore, β-alanine supplementation did not affect 1000 m kayak ergometer performance.
After terminating supplementing with β-alanine, the muscle carnosine level drops to baseline levels over a period of approximately 10 weeks. The mechanism behind this decrease is unknown, but a possibility could be that some of the carnosine is lost during high intensity or prolonged exercise. To address this question, arterial and venous plasma samples obtained from subjects at rest, during prolonged exercise and during high-intensity exercise were analysed for carnosine content. No A-V differences were found, and thus carnosine does not seem to be released to the circulation during exercise.