

RESEARCH MONOGRAPH . COMPOUND PROFILE

Beta-Alanine

A non-proteinogenic beta-amino acid; the rate-limiting precursor for muscle carnosine synthesis; an ergogenic supplement that buffers exercise-induced acidosis.

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COMPOUND CLASS	Beta-amino acid / carnosine precursor

ABSTRACT

Beta-alanine (3-aminopropanoic acid; CAS 107-95-9; molecular formula $C_3H_7NO_2$; molecular weight 89.09) is a non-proteinogenic beta-amino acid produced endogenously by uracil and dihydrouracil degradation. The compound is the rate-limiting precursor for skeletal muscle carnosine (beta-alanyl-L-histidine) synthesis. Pharmacologically, supplementation over 4 to 12 weeks elevates muscle carnosine by approximately 30 to 80 percent, increasing the muscle's intracellular pH-buffering capacity during high-intensity exercise. The ergogenic effect is most pronounced for exercise durations of 1 to 4 minutes (where lactate buffering is rate-limiting); meta-analyses show approximately 2 to 3 percent improvement in such efforts. The characteristic side effect is paresthesia (tingling, particularly on face and extremities) attributed to peripheral nerve activation by free beta-alanine; sustained-release formulations and split dosing reduce this. Plasma half-life is approximately 25 minutes; the relevant pharmacokinetic compartment is muscle carnosine, which has a much longer turnover. Used as the canonical lactate-buffering ergogenic in sport science.

1. Compound Identification

Beta-Alanine is described as beta-amino acid / carnosine precursor. A non-proteinogenic beta-amino acid; the rate-limiting precursor for muscle carnosine synthesis; an ergogenic supplement that buffers exercise-induced acidosis.

1.1 Class summary

Beta-amino acid / carnosine precursor

1.2 Subtitle

A non-proteinogenic beta-amino acid; the rate-limiting precursor for muscle carnosine synthesis; an ergogenic supplement that buffers exercise-induced acidosis.

2. Abstract

Beta-alanine (3-aminopropanoic acid; CAS 107-95-9; molecular formula $C_3H_7NO_2$; molecular weight 89.09) is a non-proteinogenic beta-amino acid produced endogenously by uracil and dihydrouracil degradation. The compound is the rate-limiting precursor for skeletal muscle carnosine (beta-alanyl-L-histidine) synthesis. Pharmacologically, supplementation over 4 to 12 weeks elevates muscle carnosine by approximately 30 to 80 percent, increasing the muscle's intracellular pH-buffering capacity during high-intensity exercise. The ergogenic effect is most pronounced for exercise durations of 1 to 4 minutes (where lactate buffering is rate-limiting); meta-analyses show approximately 2 to 3 percent improvement in such efforts. The characteristic side effect is paresthesia (tingling, particularly on face and extremities) attributed to peripheral nerve activation by free beta-alanine; sustained-release formulations and split dosing reduce this. Plasma half-life is approximately 25 minutes; the relevant pharmacokinetic compartment is muscle carnosine, which has a much longer turnover. Used as the canonical lactate-buffering ergogenic in sport science.

3. Mechanism of Action

Rate-limiting carnosine synthesis precursor; supplementation expands muscle carnosine pool and intracellular pH-buffering capacity during exercise.

The mechanistic profile described above represents the consensus position from peer-reviewed literature where available; for compounds with sparse formal characterization, this section reflects vendor-grade reports and structurally-related class pharmacology and should be interpreted with appropriate caution.

4. Pharmacokinetics and Routes of Administration

Pharmacokinetic data are summarized within the abstract for compounds with formal Phase 1 records. Compounds without published human pharmacokinetic studies are noted as such; investigators should treat the absence of data as a research limitation.

5. Reported Research Dose Ranges

3.2 to 6.4 g per oral administration daily, in divided doses, for 4 to 12 weeks.

Doses are scaled from clinical use where the compound is approved as a medicine, from Phase 2/3 trials where development advanced, or from rodent dose-response data scaled by allometric assumptions where the compound has no human clinical record. Investigators should treat dose ranges from research-chemical-grade vendors as starting points for their own pharmacokinetic and tolerability characterization rather than validated dosing recommendations.

6. Sourcing and Quality Verification

Investigators should obtain analytical confirmation of identity (mass spectrometry; for peptides, additionally amino acid analysis or N-terminal sequencing) and purity (HPLC area-percent, ideally greater than 95 percent) on every lot. Vendor certificates of analysis vary in quality; third-party analytical confirmation through independent laboratories (e.g., Janoshik Analytical, Anabolic Lab) is the gold standard for research-grade peptides and small molecules.

For compounds with established pharmaceutical-grade marketing in any jurisdiction, sourcing from the marketed product (where legal and accessible) provides the highest quality assurance.

7. Reconstitution and Handling

Peptides should be reconstituted in bacteriostatic water or sterile water for injection in the volume appropriate to the desired concentration; lyophilized peptides should be allowed to come to room temperature before reconstitution to minimize precipitation. Reconstituted peptides should be stored refrigerated and used within the timeframe specified by the manufacturer (typically 14 to 30 days for bacteriostatic water reconstitutions, shorter for sterile water).

Small molecules: storage conditions vary by compound; consult the certificate of analysis for the specific product. Most are stable at room temperature in dry, dark conditions; oxidation-sensitive compounds (e.g., catecholamine precursors) require cool storage and protection from light.

8. Stack Interaction Considerations

Investigators combining this compound with other research substances should consider receptor-level interactions (additive effects at shared targets), enzyme-level interactions (CYP-mediated drug-drug interactions where applicable), and pharmacodynamic interactions (additive sedation, additive serotonergic activity, additive hemodynamic effects).

The stack interaction section in published monographs of well-characterized compounds is necessarily incomplete for any specific combination; investigators should treat novel combinations with elevated caution and titrate gradually.

9. References

1. Trexler ET, et al. International Society of Sports Nutrition position stand: beta-alanine. J Int Soc Sports Nutr 2015.
2. Hoffman J, et al. Beta-alanine and the hormonal response to exercise. Int J Sports Med 2008.
3. Saunders B, et al. Beta-alanine supplementation to improve exercise capacity and performance: a systematic review and meta-analysis. Br J Sports Med 2017.

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