

RESEARCH MONOGRAPH . COMPOUND PROFILE

Acetyl-L-Carnitine (ALCAR)

An acetylated form of L-carnitine with improved CNS penetration, studied for cognitive impairment, neuropathy, and depression.

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ABSTRACT

Acetyl-L-Carnitine (ALCAR; CAS 3040-38-8; molecular formula $C_9H_{17}NO_4$; molecular weight 203.24) is an acetylated form of L-carnitine that crosses the blood-brain barrier more efficiently than carnitine itself. Inside cells, ALCAR is hydrolyzed to acetyl-CoA and L-carnitine, both of which contribute to mitochondrial fatty acid oxidation and energy metabolism. The compound has been studied in cognitive impairment, diabetic peripheral neuropathy, depression (modest efficacy in mild-to-moderate depression), and male fertility. The compound is sold as a dietary supplement. Doses are typically 500 mg to 3 grams per day.

1. Compound Identification

Acetyl-L-Carnitine (ALCAR) is described as acetylated carnitine / mitochondrial cofactor. An acetylated form of L-carnitine with improved CNS penetration, studied for cognitive impairment, neuropathy, and depression.

1.1 Class summary

Acetylated carnitine / mitochondrial cofactor

1.2 Subtitle

An acetylated form of L-carnitine with improved CNS penetration, studied for cognitive impairment, neuropathy, and depression.

2. Abstract

Acetyl-L-Carnitine (ALCAR; CAS 3040-38-8; molecular formula $C_9H_{17}NO_4$; molecular weight 203.24) is an acetylated form of L-carnitine that crosses the blood-brain barrier more efficiently than carnitine itself. Inside cells, ALCAR is hydrolyzed to acetyl-CoA and L-carnitine, both of which contribute to mitochondrial fatty acid oxidation and energy metabolism. The compound has been studied in cognitive impairment, diabetic peripheral neuropathy, depression (modest efficacy in mild-to-moderate depression), and male fertility. The compound is sold as a dietary supplement. Doses are typically 500 mg to 3 grams per day.

3. Mechanism of Action

Acetylated carnitine with improved BBB penetration. Hydrolyzed centrally to acetyl-CoA and L-carnitine; mitochondrial fatty acid oxidation cofactor.

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

500 mg to 3 grams per day.

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. Veronese N, et al. Acetyl-L-carnitine supplementation and the treatment of depressive symptoms: a systematic review and meta-analysis. Psychosom Med 2018.

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