

RESEARCH MONOGRAPH . COMPOUND PROFILE

Idebenone

A short-chain synthetic ubiquinone analog approved in Europe for Leber hereditary optic neuropathy, with reduced lipophilicity and better water solubility than CoQ10.

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COMPOUND CLASS	Synthetic ubiquinone analog

ABSTRACT

Idebenone (Raxone, Catena, Sovrima; CAS 58186-27-9; molecular formula $C_{19}H_{30}O_5$; molecular weight 338.44) is a synthetic short-chain ubiquinone analog with the 10-carbon isoprenoid tail of CoQ10 replaced by a 10-carbon hydroxyalkyl chain. The structural modification substantially increases water solubility while preserving the redox-cycling quinone chemistry. The compound is approved in Europe (Raxone) for Leber hereditary optic neuropathy, a mitochondrial complex I disease producing acute optic neuropathy. Idebenone bypasses dysfunctional Complex I by directly transferring electrons from cytosolic NADH to Complex III. The compound has also been studied in Alzheimer disease (mixed results, did not advance to FDA approval), Friedreich ataxia (modest effects, no approval), and Duchenne muscular dystrophy. Doses are 900 mg per day in three divided doses for LHON.

1. Compound Identification

Idebenone is described as synthetic ubiquinone analog. A short-chain synthetic ubiquinone analog approved in Europe for Leber hereditary optic neuropathy, with reduced lipophilicity and better water solubility than CoQ10.

1.1 Class summary

Synthetic ubiquinone analog

1.2 Subtitle

A short-chain synthetic ubiquinone analog approved in Europe for Leber hereditary optic neuropathy, with reduced lipophilicity and better water solubility than CoQ10.

2. Abstract

Idebenone (Raxone, Catena, Sovrima; CAS 58186-27-9; molecular formula $C_{19}H_{30}O_5$; molecular weight 338.44) is a synthetic short-chain ubiquinone analog with the 10-carbon isoprenoid tail of CoQ10 replaced by a 10-carbon hydroxyalkyl chain. The structural modification substantially increases water solubility while preserving the redox-cycling quinone chemistry. The compound is approved in Europe (Raxone) for Leber hereditary optic neuropathy, a mitochondrial complex I disease producing acute optic neuropathy. Idebenone bypasses dysfunctional Complex I by directly transferring electrons from cytosolic NADH to Complex III. The compound has also been studied in Alzheimer disease (mixed results, did not advance to FDA approval), Friedreich ataxia (modest effects, no approval), and Duchenne muscular dystrophy. Doses are 900 mg per day in three divided doses for LHON.

3. Mechanism of Action

Synthetic ubiquinone with reduced lipophilicity. Bypasses dysfunctional Complex I in mitochondrial disease.

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

900 mg per day in three divided doses (LHON).

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. Klopstock T, et al. A randomized placebo-controlled trial of idebenone in Leber's hereditary optic neuropathy. Brain 2011.

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