

RESEARCH MONOGRAPH . COMPOUND PROFILE

Insulin (Research)

The pancreatic peptide hormone insulin; the foundational glucose-regulatory hormone and a research probe for metabolic and anabolic biology.

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COMPOUND CLASS	Peptide hormone (51-amino-acid disulfide-linked dipeptide)

ABSTRACT

Insulin (CAS 9004-10-8; A-chain 21 amino acids, B-chain 30 amino acids; total molecular weight approximately 5808 Da for human insulin) is the pancreatic peptide hormone discovered by Banting and Best in 1921 (Nobel Prize 1923) and synthesized as recombinant human insulin (Humulin) in 1982 by Genentech, the first FDA-approved recombinant pharmaceutical.

Pharmacologically, insulin binds the insulin receptor (IR) and the IGF-1 receptor (IGF-1R) with substantially higher affinity for IR. Receptor binding triggers tyrosine kinase activation of IRS-1/2 and downstream PI3K-Akt signaling, regulating glucose uptake (GLUT4 translocation), glycogen synthesis, lipogenesis, and protein synthesis. Modern formulations include rapid-acting analogs (lispro, aspart, glulisine), regular insulin, intermediate (NPH), long-acting (glargine, detemir, degludec), and ultra-long-acting (degludec). Approved indications: type 1 diabetes (essential), type 2 diabetes (when oral agents fail). The principal safety risk is hypoglycemia, severe enough to cause neuronal injury or death; insulin is among the leading drug-related causes of medical emergency department visits. Recreational anabolic use has been documented but is associated with high acute mortality. Used as the canonical metabolic hormone in academic biology.

1. Compound Identification

Insulin (Research) is described as peptide hormone (51-amino-acid disulfide-linked dipeptide). The pancreatic peptide hormone insulin; the foundational glucose-regulatory hormone and a research probe for metabolic and anabolic biology.

1.1 Class summary

Peptide hormone (51-amino-acid disulfide-linked dipeptide)

1.2 Subtitle

The pancreatic peptide hormone insulin; the foundational glucose-regulatory hormone and a research probe for metabolic and anabolic biology.

2. Abstract

Insulin (CAS 9004-10-8; A-chain 21 amino acids, B-chain 30 amino acids; total molecular weight approximately 5808 Da for human insulin) is the pancreatic peptide hormone discovered by Banting and Best in 1921 (Nobel Prize 1923) and synthesized as recombinant human insulin (Humulin) in 1982 by Genentech, the first FDA-approved recombinant pharmaceutical. Pharmacologically, insulin binds the insulin receptor (IR) and the IGF-1 receptor (IGF-1R) with substantially higher affinity for IR. Receptor binding triggers tyrosine kinase activation of IRS-1/2 and downstream PI3K-Akt signaling, regulating glucose uptake (GLUT4 translocation), glycogen synthesis, lipogenesis, and protein synthesis. Modern formulations include rapid-acting analogs (lispro, aspart, glulisine), regular insulin, intermediate (NPH), long-acting (glargine, detemir, degludec), and ultra-long-acting (degludec). Approved indications: type 1 diabetes (essential), type 2 diabetes (when oral agents fail). The principal safety risk is hypoglycemia, severe enough to cause neuronal injury or death; insulin is among the leading drug-related causes of medical emergency department visits. Recreational anabolic use has been documented but is associated with high acute mortality. Used as the canonical metabolic hormone in academic biology.

3. Mechanism of Action

Insulin receptor agonist; tyrosine kinase activation, PI3K-Akt signaling, GLUT4 translocation, glycogen and lipid synthesis, protein synthesis.

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

Clinical individualized; basal-bolus typically 0.5 to 1 IU/kg/day total. Recreational use is high-risk.

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. Banting FG, Best CH. The internal secretion of the pancreas. J Lab Clin Med 1922.
2. Saltiel AR, Kahn CR. Insulin signalling and the regulation of glucose and lipid metabolism. Nature 2001.
3. Owens DR, et al. Insulin analogues: structure, properties, and clinical use. Diabetes Metab Res Rev 2001.

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