

Comprehensive Medication Analysis: lactoferrin

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Analysis Confidence: 0.75

Evidence Quality: moderate

Analysis Cost: \$0.3407

Duration: 463.5s

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Overview

Drug Classification

Drug Class:

Lactoferrin is classified as an iron-binding glycoprotein and immunomodulatory agent. Therapeutically, it functions as a nutritional supplement, antimicrobial protein, and immunomodulator. It belongs to the transferrin family of iron-binding proteins.

Mechanism of Action

Lactoferrin exerts multiple mechanisms at the molecular level: (1) Iron sequestration - binds ferric iron (Fe^{3+}) with high affinity ($K_d \sim 10^{-20} \text{ M}$), depriving pathogens of essential iron for growth; (2) Direct antimicrobial activity - binds to lipopolysaccharides (LPS) on bacterial cell walls causing membrane disruption and increased permeability; (3) Antiviral effects - binds to heparan sulfate proteoglycans and viral particles, blocking cellular entry of viruses; (4) Immunomodulation - interacts with immune cells via specific receptors (LRP1, intelectin-1), modulating cytokine production (decreases IL-6, TNF- α , increases IL-10); (5) Anti-inflammatory action - inhibits NF- κ B pathway activation and reduces oxidative stress; (6) Promotes beneficial gut microbiota by selective antimicrobial activity favoring bifidobacteria growth.

Pharmacology

Absorption

Oral bioavailability of intact lactoferrin is low (approximately 1-5% in adults) due to gastric acid degradation and proteolytic digestion in the gastrointestinal tract. In neonates and infants, absorption is higher (up to 60%) due to presence of specific lactoferrin receptors in the intestinal

epithelium and lower gastric acidity. Peak plasma concentrations are not well-established due to limited systemic absorption. Most biological effects occur locally in the gastrointestinal tract. Enteric-coated formulations may improve stability.

Distribution & Metabolism

Orally administered lactoferrin undergoes extensive proteolytic degradation in the gastrointestinal tract by pepsin, trypsin, and other digestive enzymes, producing bioactive peptides (lactoferricin, lactoferrampin). These peptides retain some antimicrobial and immunomodulatory properties. Metabolism does not involve hepatic cytochrome P450 enzymes. Small amounts of intact lactoferrin that are absorbed may be metabolized by tissue proteases or recycled via receptor-mediated endocytosis.

Elimination

Primary route of elimination is through fecal excretion of unabsorbed protein and peptide fragments following gastrointestinal degradation. Minimal renal excretion occurs due to low systemic absorption. Any absorbed lactoferrin or peptides are likely eliminated through normal protein catabolism pathways and renal filtration of small peptides.

Half-Life:

The elimination half-life of orally administered lactoferrin has not been precisely determined due to extensive gastrointestinal degradation and minimal systemic absorption. Endogenous plasma lactoferrin has an estimated half-life of approximately 10-20 minutes. Gastrointestinal transit time (2-4 hours in small intestine) is more relevant for oral supplementation effects.

Clinical Use

Approved Indications

1. No FDA-approved therapeutic indications. Lactoferrin is available as a dietary supplement and food ingredient (Generally Recognized as Safe - GRAS status)
2. Used as a component in infant formulas to approximate human milk composition
3. Approved as a food additive in various countries for nutritional fortification

Off-Label Uses

1. Prevention and treatment of necrotizing enterocolitis in preterm infants
2. Reduction of late-onset sepsis in neonates
3. Treatment of iron deficiency anemia (as iron carrier)
4. Management of inflammatory bowel disease symptoms
5. Prevention of common cold and upper respiratory infections
6. Adjunctive treatment for Helicobacter pylori eradication
7. Management of dry eye syndrome (topical ophthalmic use)
8. Support for immune function in immunocompromised patients
9. Treatment of acne vulgaris (topical)
10. Prevention of antibiotic-associated diarrhea
11. Management of chronic hepatitis C
12. Adjunctive cancer therapy support

Standard Dosing

As a dietary supplement: 100-300 mg orally once or twice daily. For neonatal sepsis prevention: 100-200 mg orally once or twice daily. For iron deficiency: 100 mg twice daily with meals. For immune support: 250-500

mg daily. For gastrointestinal conditions: 200-400 mg twice daily. Dosing varies widely based on indication and product formulation. Optimal dosing has not been established through rigorous clinical trials for most applications.

Dose Adjustments

Renal Impairment:

No specific dose adjustment required. Due to minimal systemic absorption and renal elimination, lactoferrin supplementation does not require modification in renal impairment. Use with standard dosing.

Hepatic Impairment:

No specific dose adjustment required. Lactoferrin does not undergo hepatic metabolism via cytochrome P450 enzymes. Use with standard dosing in hepatic impairment.

Pediatric:

Neonates and infants: 100-200 mg daily divided into 1-2 doses. Children: 100-250 mg daily. Pediatric dosing should be based on clinical indication and body weight when used off-label.

Geriatric:

No specific adjustment required. Standard adult dosing may be used. Consider starting at lower end of dosing range.

Pregnancy Lactation:

Pregnancy Category: Not assigned (dietary supplement). Generally considered safe as it is a natural component of human milk. Lactation: Safe and compatible with breastfeeding as lactoferrin is naturally present in breast milk at high concentrations.

Interactions

Drug-Drug Interactions

Fluoroquinolone antibiotics (ciprofloxacin, levofloxacin, moxifloxacin) (MODERATE)

Mechanism:

Lactoferrin contains iron which can chelate with fluoroquinolones, forming insoluble complexes that reduce gastrointestinal absorption of the antibiotic

Clinical Effect:

Decreased fluoroquinolone bioavailability by up to 50-90%, potentially resulting in subtherapeutic antibiotic levels and treatment failure

Management:

Administer fluoroquinolones at least 2 hours before or 6 hours after lactoferrin administration. Monitor clinical response to antibiotic therapy.

Time Separation:

2 hours before or 6 hours after

Evidence Level:

moderate

Tetracycline antibiotics (doxycycline, minocycline, tetracycline) (MODERATE)

Mechanism:

Iron content in lactoferrin chelates with tetracyclines, forming poorly absorbable complexes in the gastrointestinal tract

Clinical Effect:

Reduced tetracycline absorption and serum concentrations, potentially compromising antimicrobial efficacy

Management:

Separate administration by at least 2-3 hours. Administer tetracyclines on an empty stomach when possible. Monitor therapeutic response.

Time Separation:

2-3 hours

Evidence Level:

moderate

Levothyroxine (MODERATE)

Mechanism:

Iron in lactoferrin binds to levothyroxine in the gastrointestinal tract, forming complexes that reduce thyroid hormone absorption

Clinical Effect:

Decreased levothyroxine absorption leading to reduced thyroid hormone levels and potential hypothyroid symptoms or loss of thyroid control

Management:

Administer levothyroxine at least 4 hours before lactoferrin. Monitor TSH levels and adjust levothyroxine dose as needed.

Time Separation:

4 hours

Evidence Level:

moderate

Bisphosphonates (alendronate, risedronate, ibandronate) (MODERATE)

Mechanism:

Polyvalent cations including iron in lactoferrin chelate with bisphosphonates, significantly reducing bisphosphonate absorption

Clinical Effect:

Markedly decreased bisphosphonate bioavailability (up to 60% reduction), potentially reducing bone mineral density benefits

Management:

Administer bisphosphonates at least 2 hours before lactoferrin on an empty stomach with plain water only. Maintain strict timing protocols.

Time Separation:

2 hours before

Evidence Level:

moderate

Levodopa/Carbidopa (MODERATE)

Mechanism:

Iron content may chelate with levodopa or compete for absorption sites in the small intestine

Clinical Effect:

Reduced levodopa absorption and decreased plasma concentrations, potentially worsening Parkinsonian symptoms or causing motor fluctuations

Management:

Separate administration by at least 2 hours. Monitor for changes in motor control and Parkinson's symptom management.

Time Separation:

2 hours

Evidence Level:

moderate

Antacids (calcium carbonate, magnesium hydroxide, aluminum hydroxide) (MINOR)

Mechanism:

Antacids may alter gastric pH and potentially affect lactoferrin stability or iron release from the protein

Clinical Effect:

Possible minor reduction in lactoferrin or iron bioavailability, though clinical significance is uncertain

Management:

Consider separating administration by 1-2 hours if optimal lactoferrin absorption is desired. Generally well-tolerated with concurrent use.

Time Separation:

1-2 hours

Evidence Level:

low

Proton pump inhibitors (omeprazole, pantoprazole, esomeprazole) (MINOR)

Mechanism:

Reduced gastric acidity may decrease iron release from lactoferrin and alter iron absorption

Clinical Effect:

Potentially decreased iron bioavailability from lactoferrin, though lactoferrin has multiple functions beyond iron delivery

Management:

No specific separation required. Monitor iron status if lactoferrin is being used primarily for iron supplementation.

Evidence Level:

low

H2 receptor antagonists (ranitidine, famotidine) (MINOR)**Mechanism:**

Elevated gastric pH may reduce iron solubility and absorption from lactoferrin

Clinical Effect:

Minor potential reduction in iron absorption, though overall clinical impact is likely minimal

Management:

No routine separation required. Consider monitoring iron parameters if using lactoferrin for iron supplementation.

Evidence Level:

low

Zinc supplements (MINOR)**Mechanism:**

Competitive inhibition at intestinal absorption sites between iron and zinc

Clinical Effect:

Potential minor reduction in absorption of either mineral when taken simultaneously in high doses

Management:

Consider separating high-dose zinc from lactoferrin by 1-2 hours if both are being used for mineral supplementation.

Time Separation:

1-2 hours

Evidence Level:

low

Calcium supplements (MINOR)

Mechanism:

Calcium may compete with iron for intestinal absorption pathways

Clinical Effect:

Possible minor decrease in iron absorption when high-dose calcium is co-administered

Management:

If using lactoferrin primarily for iron supplementation, consider separating from high-dose calcium supplements by 1-2 hours.

Time Separation:

1-2 hours

Evidence Level:

low

Food & Lifestyle Interactions

No significant food interactions identified.

Safety Profile

Adverse Effects

Recommendations

What TO DO: Evidence-Based Recommendations

Monitoring Requirements

Analysis Completed:

2025-12-16T23:06:14.570538

Reasoning Steps: 4

Cost Analysis

Total Cost:

\$0.3407

Total Duration: 463.5s

Phase Breakdown

- **Phase 1: Pharmacology Analysis:** \$0.0254 (7.5%) - 37.5s
- **Phase 2: Interaction Analysis:** \$0.1402 (41.2%) - 193.4s

- **Phase 3: Safety Profile Assessment:** \$0.0626 (18.4%) - 77.8s
 - **Phase 4: Recommendation Synthesis:** \$0.0624 (18.3%) - 96.4s
 - **Phase 5: Monitoring Requirements:** \$0.0501 (14.7%) - 58.4s
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IMPORTANT DISCLAIMER:

This analysis is for educational and research purposes only.
It does not constitute medical advice. Always consult qualified healthcare professionals for medication decisions, dosing, and management of health conditions.

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