Papain Technical Sheet

High activity protease for digesting protein

Scientific & Technical™

Papain Technical Datasheet

1. Product Overview

Unlock the power of nature with our high-performance papain enzyme — a versatile, plant-derived protease designed to deliver consistent, efficient protein hydrolysis across a wide range of applications. Sourced from premium papaya latex and carefully purified for optimal activity, our papain offers excellent stability over broad pH (5–8) and temperature ranges, making it ideal for food processing, nutraceuticals, pharmaceuticals, cosmetics, and industrial formulations. In food applications, papain enhances meat tenderisation, improves protein digestibility, clarifies beverages, and supports production of protein hydrolysates with controlled peptide profiles. In nutraceutical and pharmaceutical formulations, it serves as a reliable digestive aid and anti-inflammatory support ingredient. Cosmetic manufacturers value its gentle yet effective exfoliating properties for enzyme-based skincare products. Our papain is available in multiple activity grades and customisable formulations (powder or liquid) to fit your specific process requirements.

2. Product Characteristics

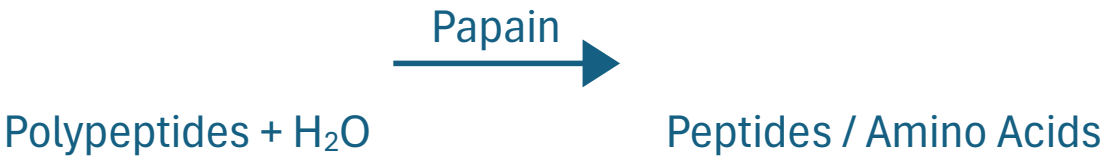
Parameter	Specification
Enzyme Class	Cysteine endopeptidase (EC 3.4.22.2)
Source	*Papaya latex*
Appearance	Brown liquid
Activity	6,000 USP / mg
Units	Where 1 U is the amount of enzyme required to release 1 µg of tyrosine (or equivalent peptides) per minute from casein
Total Protein	10-12 % w/v
Density	1.1-1.2 g per mL
Temperature Range	15–65 °C (operational)
Optimal Temperature	55–60 °C
pH Range	4.5–8.0
Optimal pH	6.5-7.0
Shelf Life	12 months (sealed and kept under recommended storage conditions)

3. Enzymatic Properties

3.1 Mechanism of Action:

Papain is a cysteine endopeptidase that hydrolyses internal peptide bonds in proteins through a thiol-dependent catalytic mechanism. Its active site contains a catalytic dyad composed of Cys25 and His159 (supported by Asn175), where the histidine residue acts as a general base to deprotonate the

thiol group of cysteine, generating a highly reactive thiolate anion. This nucleophilic thiolate attacks the carbonyl carbon of a peptide bond in the substrate, forming a covalent acyl–enzyme intermediate and releasing the amino-terminal portion of the cleaved peptide. Subsequent hydrolysis of this intermediate by a water molecule, activated by histidine, releases the carboxyl-terminal peptide fragment and regenerates the free enzyme. This two-step mechanism (acylation and deacylation) allows papain to efficiently degrade a wide range of protein substrates under mild conditions, contributing to its broad specificity and utility in food, pharmaceutical, and industrial applications.



3.2 Kinetics:

Papain follows typical Michaelis–Menten kinetics when acting on soluble protein or synthetic peptide substrates, with reaction velocity dependent on substrate concentration, enzyme concentration, pH, and temperature. The catalytic process involves rapid formation of an enzyme–substrate complex, followed by nucleophilic attack by the active-site cysteine to form a transient acyl–enzyme intermediate; under steady-state conditions, the rate-limiting step is often the deacylation (hydrolysis) of this intermediate. The enzyme is characterized by kinetic parameters such as Km (reflecting substrate affinity) and kcat (turnover number), which vary depending on the substrate used. Papain activity typically increases with temperature up to its optimum (around 60°C) and shows maximal catalytic efficiency near neutral pH. The reaction can be inhibited by thiol-reactive compounds, heavy metals, or oxidising agents, and may exhibit product inhibition at high peptide concentrations. Because papain is an endopeptidase, hydrolysis proceeds internally along the protein chain, often producing a rapid initial rate as accessible peptide bonds are cleaved, followed by a gradual decrease as substrate availability changes.

3.3 Inhibitors:

- Heavy metals (Hg^{2+}, Cu^{2+})
- Urea, Guanidine hydrochloride, SDS
- Extreme low or high pH
- High temperatures above 60 deg. C
- High chelator concentrations (EDTA)

4. Applications

4.1 Meat Tenderisation (Primary Use)

- Breaks down tough muscle proteins (actin, myosin, collagen)
- Improves tenderness in beef, pork, poultry, and game meats
- Used in:
    - Marinades
    - Tenderising powders
    - Injection brines
    - Ready-to-cook meat products

Benefit: Enhances texture, reduces cooking time, increases consumer acceptability.

4.2 Protein Hydrolysates Production

- Produces protein hydrolysates from:
  - Meat proteins
  - Fish proteins
  - Plant proteins (soy, wheat, pea)
  - Dairy proteins

Applications:

- Nutritional supplements
- Sports nutrition
- Infant formulas
- Medical nutrition products
- Flavour enhancers

Benefit: Improves digestibility and bioavailability of amino acids.

4.3 Brewing Industry (Beer Clarification)

- Breaks down haze-forming proteins
- Prevents chill haze formation in beer

Benefit: Improves clarity and shelf stability.

4.4 Dairy Processing

- Used in limited cases as a milk-clotting enzyme
- Used in protein hydrolysis for:
  - Cheese flavour development
  - Functional dairy ingredients

Benefit: Improves flavour and texture development.

4.5 Baking Industry

- Softens gluten structure
- Improves dough handling
- Used in:
  - Crackers
  - Biscuits
  - Specialty baked goods

Benefit: Produces tender texture and consistent crumb structure.

4.6 Juice Clarification

- Helps reduce protein haze in fruit juices
- Improves filtration efficiency

Benefit: Enhances clarity and stability.

4.7 Flavour Development

- Controlled protein hydrolysis generates savoury peptides
- Used in:
  - Seasonings

- Broths
- Sauces
- Processed foods

Benefit: Contributes to umami and overall flavour enhancement.

4.8 Functional Food & Nutraceutical Products

- Digestive enzyme supplements
- Protein digestion aid in functional beverages

Benefit: Supports digestive health claims.

4.9 Seafood Processing

- Softening of squid, octopus, and other tough seafood
- Production of seafood protein hydrolysates

5. Handling & Storage

5.1 Storage Conditions:

- Store at 4–25 °C in sealed containers
- Avoid direct sunlight and freezing
- Keep away from acids, oxidizing agents, and heavy metals

5.2 Stability on Storage:

- Activity loss ~1–5% per month at room temperature
- Refrigeration improves stability

5.3 Safety Information:

- Non-toxic and biodegradable
- May cause allergic reactions via inhalation or skin contact
- Use protective clothing, gloves, goggles
- Avoid aerosol formation

Refer to product MSDS for complete safety details.

6. Packaging Options

- 0.1 L, 1 L, 10 L, 25 L (1000 kg totes available upon request)

7. Quality Control Specifications

Test	Specification
Activity assay	≥ labelled activity

Test	Specification
Density (liquid)	1.1–1.2 g / mL
Moisture (powder)	≤ 8%
Microbial load	Total plate count ≤ 50,000 CFU / g
Pathogens	*Salmonella* negative, *E. coli* negative

9. Shelf Life

- **Liquid:** 12 months - store in original container, sealed, in cool conditions.

10. Disclaimer

This technical data sheet provides general information. Application testing is recommended to determine optimal use conditions.

NOTE: THIS DOCUMENT CANCELS AND SUPERSEEDS ALL OTHER EDITIONS