

# Hydro-Zyme™ & HCl-Plus™

## Nutritional Support for Digestion

The stomach produces a variety of substances that promote digestion and assimilation. Gastric juice contains hydrochloric acid and pepsinogens, precursors of the family of proteolytic enzymes called pepsins. Parietal cells produce both stomach acid and intrinsic factor, a protein required to bind vitamin B12, prior to its absorption by the small intestine. The secretion of H<sup>+</sup> by parietal cells requires an ATPase (H<sup>+</sup>, K<sup>+</sup>) to pump H<sup>+</sup> out of the cell. Chloride ion is exported separately, so that the resulting product is HCl. The pump is activated by histamine stimulation of a cell surface receptor involving cyclic AMP. Drugs such as Omeprazole act by inhibiting this enzyme.

Hydrochloric acid is a strong mineral acid which functions to maintain gastric pH between 1.5 to 2.5. Acidity serves three important roles; low pH kills microorganisms in food, it activates pepsinogen, and it unfolds (denatures) proteins, making them more accessible to proteolytic degradation. The gastric lining is protected from the strong acidic environment by a thick layer of mucus.

The incidence of low stomach acid (hypochlorhydria) increases with age. Atrophic gastritis occurs in 20% to 30% of healthy, elderly, individuals, and is the most common cause of reduced gastric acid production<sup>(1)</sup>. An estimated 30-50% of people over the age of 60 are believed to produce inadequate stomach acid,<sup>(2)</sup> although, only 16% hyposecretors in healthy elderly people has been reported<sup>(3)</sup>. In extreme cases, the stomach does not produce acid (achlorhydria) and gastric pH approaches neutrality. Other causes of low gastric acid production include malnutrition and excessive use of antacids and H2 receptor antagonists.

Inadequate stomach acid is linked to maldigestion. This can promote inadequate mineral uptake, due to malabsorption of iron, calcium, zinc and others,<sup>(2)</sup> and increased risk of intestinal infections due to *Candida albicans* and parasites<sup>(1,4)</sup>. In diabetics, the prevalence of achlorhydria, together with related anemia due to vitamin B12 malabsorption, has been estimated to range from 12 to 41%<sup>(5)</sup>. Achlorhydria and hypochlorhydria have been linked to peptic ulcer disease and to *Helicobacter pylori* overgrowth<sup>(6)</sup>. Hypochlorhydria can also cause an increased bacterial colonization of the small intestine. (In addition to gastric acid, other factors that limit bacterial colonization include normal bile flow and peristalsis.) It has also been suggested that gastric acid acts as an antitumor defense, and that achlorhydria predisposes patients to gastric cancer<sup>(7)</sup>.

### Nutrients that Support the Formation of Gastric Acid

**Betaine HCl and Glutamic Acid HCl.** Betaine is trimethylglycine, a normal metabolite and a methyl donor. In the protonated form, betaine HCl gives up a proton and chloride ion in aqueous solutions, that is, hydrochloric acid.

Therefore, betaine hydrochloride represents a dietary source of hydrochloric acid<sup>(2)</sup>. (When protonated with HCl, glutamic acid yields hydrochloric acid in aqueous solutions.) Like betaine HCl, glutamic acid HCl represents a supplemental form of gastric acid.

**Ammonium Chloride.** Gastric cells require chloride as the raw material for hydrochloric acid production. Excreted chloride ion is reabsorbed by the intestine after a meal, causing a temporary, postprandial rise in serum chloride levels. Chloride represents a major anion electrolyte required to maintain optimal pH, and to maintain osmotic balance in the body.

**Vitamin B6.** The absorption of pyridoxal phosphate is positively influenced by gastric acid secretion<sup>(8)</sup>. Vitamin B6 deficiency is linked to deficiencies of trace minerals.

Pancreatin is a commercial preparation of porcine pancreas, highly enriched in pancreatic enzymes, including trypsin, chymotrypsin, carboxypeptidase, as well as amylase (starch digestion) and lipase (fat digestion). Porcine pancreatin contains these enzymes in a ratio similar to human pancreas, and the digestive enzymes of human and porcine pancreas possess similar properties. Pancreatic enzymes can be denatured by exposure to gastric acid, therefore, the pancreatin in **Hydro-Zyme™** is coated to preserve activity during transit through the gastrointestinal tract<sup>(9)</sup>.

A note on pancreatin activity measurement; measurement of proteolytic activity of pancreatin has been defined by the U.S. Pharmacopoeia, based upon the digestion of a standard protein, casein. Pancreatin 4X possesses 4 times the activity of pancreatin 1X (25 USP units of proteolytic activity per milligram). Therefore, 10 mg of pancreatin 4X per tablet of **Hydro-Zyme™** provides 1,000 USP units.

### Proteolytic Enzymes in Digestion

A wide assortment of proteolytic enzymes (proteases) is required to degrade proteins to amino acids and peptides. They are manufactured in cells as inactive precursors called zymogens, which must be activated after they have been released into the intestinal lumen. Ingested proteins first encounter proteolytic enzymes of the stomach. Pepsin refers to a closely related group of proteases produced by the gastric mucosa. The zymogen and pepsinogen, is activated both by HCl and by autocatalytic action. This enzyme exhibits maximal activity at low pH (high gastric acid). Upon leaving the stomach, chyme, (food particles mixed with gastric juice) is



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neutralized in the intestine by bicarbonate secreted by the pancreas. (The presence of acidic chyme in the duodenum triggers pancreatic secretion.) Thus, hypochlorhydria may be associated with secondary pancreatic insufficiency. After neutralization, chyme is subjected to a battery of powerful pancreatic enzymes. The exocrine pancreas produces potent proteolytic enzyme peptidases, such as trypsin and alpha chymotrypsin, as their zymogens form, trypsinogen and chymotrypsinogen, respectively. Trypsin possesses a very high degree of peptide bond specificity in cleaving bonds adjacent to arginine and lysine. Chymotrypsin has a different substrate specificity; it cleaves peptide bonds adjacent to large, non-polar amino acids, such as aromatic amino acids and methionine. Other pancreatic proteases include elastase, which break down connective tissue. Activation of pancreatic zymogens begins in the intestine to prevent their premature activation, which could damage the pancreas. Trypsin activates most of the zymogens released into the intestine. Trypsin itself is first activated from trypsinogen by the enteric enzyme, enteropeptidase.

Pancreatic exopeptidases are represented by carboxypeptidases, which cleave amino acids from the carboxyl terminus of peptides. Carboxy-peptidases are derived from the zymogens, procarboxypeptidase A and B. Additional peptidases which serve to degrade peptides, are produced by the intestinal mucosa. For example, aminopeptidases cleave off amino acids from the N terminus of peptides.

Pancreatic secretions contain a variety of other digestive enzymes, in addition to proteases. Amylase cleaves the 2 (1-4) glycoside linkages of amylose to yield maltose molecules. These di- and tri-saccharides are hydrolyzed to glucose at the intestinal brush border. Lipase hydrolyzes triglycerides to free fatty acids and monoglycerides, in the presence of a helper polypeptide called colipase, and bile salts, which serve to emulsify digested fats.

Betaine HCl and glutamic acid HCl supplements should not be chewed. They should be taken with meals. Such supplements may be inappropriate when there are ulcerative gastrointestinal conditions and when aspirin or other analgesics are being used.

#### References

1. Saltzman, JR *et al.* Bacterial overgrowth without clinical malabsorption in elderly hypochlorhydric subjects. *Gastroenterology* 1994; 106: 615-623.
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3. Hurwitz, A *et al.* Gastric acidity in older adults. *JAMA* 1997; 278: 9-662.
4. Giannella, RN *et al.* Influence of gastric acidity on bacterial and parasitic infections. *Annals Int Med* 1973; 78: 271-276.
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8. Middleton HM. Intestinal hydrolysis of pyridoxal 5-phosphate *in vitro* and *in vivo* in the rat.
9. Guarner, I *et al.* Fate of oral enzymes in pancreatic insufficiency. *Gut* 1993; 34: 708-712.

Hydro-Zyme™ is available in 90-count (#1262) and 250-count (#1263) bottles.

### Supplement Facts

Serving Size: 1 Tablet

	Amount Per Serving	% Daily Value
Vitamin B6 (as pyridoxine hydrochloride)	2 mg	100%
Betaine Hydrochloride	150 mg	*
Glutamic acid (as L-Glutamic acid hydrochloride)	50 mg	*
Ammonium Chloride	35 mg	*
Pancreatin 4X (porcine)	10 mg	*
Pepsin (1:10,000)	10 mg	*

\* Daily Value not established

**Other ingredients:** Vegetable culture †, cellulose, stearic acid (vegetable source), modified cellulose gum, silica and food glaze.

† Specially grown, biologically active vegetable culture (from organic *Pisum sativum*, *Lens esculenta* and/or *Cicer arietinum*) containing naturally associated phytochemicals including polyphenolic compounds with SOD and catalase, dehydrated at low temperature to preserve associated enzyme factors.

**This product is gluten and dairy free.**

**RECOMMENDATION:** One (1) tablet with each meal as a dietary supplement or as otherwise directed by a healthcare professional.

#### KEEP OUT OF REACH OF CHILDREN

Store in a cool, dry area.  
Sealed with an imprinted safety seal for your protection.

Product # 1262 Rev. 07/15

HCl-Plus™ is available in 90-count (#1230) bottles.

### Supplement Facts

Serving Size: 1 Tablet

	Amount Per Serving	% Daily Value
Vitamin B6 (as pyridoxine hydrochloride)	2 mg	100%
Betaine (as betaine hydrochloride)	115 mg	*
Glutamic Acid (as L-Glutamic acid hydrochloride)	50 mg	*
Ammonium Chloride	35 mg	*
Pepsin (1:10,000)	10 mg	*

\* Daily Value not established

**Other ingredients:** Vegetable culture †, cellulose, stearic acid (vegetable source), modified cellulose gum, and silica.

† Specially grown, biologically active vegetable culture containing naturally associated and/or organically bound phytochemicals including polyphenolic compounds with SOD and catalase, dehydrated at low temperature to preserve associated enzyme factors.

**This product is gluten and dairy free.**

**RECOMMENDATION:** One (1) tablet with each meal as a dietary supplement or as otherwise directed by a healthcare professional.

#### KEEP OUT OF REACH OF CHILDREN

Store in a cool, dry area.  
Sealed with an imprinted safety seal for your protection.

Product # 1230 Rev. 09/14

To place your order for **Hydro-Zyme™** and **HCl-Plus™** or for additional information please contact us below.



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These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.