

Enzyme Fundamentals

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STORY AT-A-GLANCE

- › Your body secretes enzymes to catalyze biological reactions, making them vital to good health and longevity. Each organ has its own set of enzymes, and each enzyme has a different function
- › Enzymes can be broadly divided into digestive enzymes, metabolic enzymes and food-based enzymes
- › Enzymes for supplemental use can be sourced from animal, plant and microbial or fungal sources
- › There are two primary ways of using an enzyme supplement: digestively or systemically. Taken with food, it will help digest the food. Taken on an empty stomach, the enzymes will pass through your digestive system and enter your blood circulation, providing systemic benefits

Enzymes are proteins composed of individual amino acids. They are necessary to speed up many cellular functions and biological processes. Your body secretes enzymes to catalyze biological reactions, making them vital to good health and [longevity](#).¹

Each enzyme has a different function, for example, superoxide dismutase, glutathione peroxidase and catalase have antioxidant functions.² Digestive enzymes such as protease, lipase and amylase are needed for digestion and nutrient absorption and elimination,³ while molecular motor enzymes such as myosin and actin are needed for the activation of muscle contractions.⁴

The featured lecture reviews the fundamentals of what enzymes are, the main types of enzymes found in your body and in supplements, how enzymes are affected by environmental factors such as your body's pH and temperature, and why they're so important for health.

Enzymes 101

An enzyme's shape is an important key to understanding the benefits of enzyme therapy, because the shape of the protein determines its function. You could liken enzymes to specialized keys cut to fit specific locks, with the locks in this case being biochemical reactions.

Considering the tens of thousands of biochemical reactions occurring in your body at any given time, it stands to reason there are tens of thousands of enzymes. An interesting feature of enzymes is that while they catalyze biochemical reactions, they're not used up in the reaction. They merely assist and accelerate reactions.

By lowering the amount of energy needed for a reaction to occur, they allow for reactions that otherwise would not be possible, or would be too slow to keep up with your body's demands. This is also why enzyme deficiencies are thought to contribute to more rapid aging.

Types of Enzymes and Their Functions

Enzymes can be broadly divided into the following categories:⁵

- **Digestive enzymes** — These are involved in digestion, the breaking down of foods into nutrients and elimination of waste products. Digestive enzymes are extracellular, meaning they're found outside your cells. There are five primary digestive enzymes, each designed to help break down different types of food:⁶
 - **Protease** — These enzymes break down protein

- Amylase – Amylase breaks down carbohydrates, sugars and starches
 - Lipase – This enzyme breaks down fats (If you have IBS, cystic fibrosis, celiac disease, no gallbladder or gallbladder dysfunction and/or obesity, you may benefit from higher levels of lipase. Also, be aware that fluoridated water may decrease lipase and protease production⁷)
 - Lactase – This one breaks down milk sugar (lactose) in dairy products
 - Sucrase – Sucrase breaks down sucrose sugars
- **Metabolic enzymes**⁸ – These are involved in energy production and detoxification. Metabolic enzymes are intracellular, meaning inside your cells, where they help the cell carry out a variety of functions related to its reproduction and replenishment.
 - **Food-based enzymes**⁹ – These are what you find in raw, uncooked/unprocessed foods such as fruits, vegetables and fermented foods and/or supplements.

3 Main Types of Enzyme Supplements

Enzymes found in enzyme supplements used for enzyme therapy are known as hydrolases. As the name implies, they use a water molecule to cut certain bonds along the amino acid chain. Supplemental enzymes can be divided into three basic types:

1. Protease or proteolytic enzymes, which hydrolyze (break down) proteins into amino acids
2. Lipases, which break down lipids (fats) into fatty acids
3. Carbohydrases, which hydrolyze carbohydrates into simpler sugars

Enzymes for supplemental use can be sourced from animal, plant and microbial sources. Pancreatic enzymes, for example, which include all three types (protease, lipase and carbohydrase), are typically obtained from the pancreas of cows or pigs.

Proteolytic enzymes such as bromelain and papain are obtained from pineapple and papaya respectively. Enzymes can also be sourced from microbial or fungal sources. This group is the largest, as microbes and fungi can produce hundreds of different types of enzymes.

Digestive Versus Systemic Use of Enzymes

There are two primary ways of using an enzyme supplement: digestive or systemic, and the difference between them relates to timing. Taken with food, a digestive enzyme will help break down the food into smaller components.

When taken on an empty stomach, the enzymes will pass through your digestive system and enter your blood circulation, and when absorbed systemically, they serve as powerful proteases, dissolving things like fibrin and decreasing inflammation.

That said, whether you're using enzymes digestively or systemically, enzyme therapy will improve assimilation and elimination of components. In other words, the enzymes will break things down to their smallest constituent parts, making both assimilation of necessary components, and elimination of components your body does not need, easier.

As explained in a report¹⁰ by nutraceutical researcher Jon Barron, director of the Baseline Health Foundation, proteolytic enzymes taken for systemic benefit, meaning on an empty stomach, can help eliminate pathogens, allergens and rogue cells by destroying and digesting their protein-based shield. Systemically, proteolytic enzymes also have the ability to interfere with enzyme production caused by certain cancers, thereby slowing down the cancer's growth.

Systemic Use of Proteolytic Enzymes Combats Inflammation

In your gut, proteases or proteolytic enzymes, which break down dietary protein and protein-based foreign bodies, function as digestive aids. In your blood, however, they act as blood cleansers that combat inflammation and rebalance your immune system by:¹¹

1. Breaking down foreign proteins in your blood that cause inflammation
2. Facilitating the removal of inflammatory proteins via your blood stream and lymphatic system
3. Reducing edema in inflamed region
4. Significantly increasing the potency of macrophages and killer cells
5. Removing fibrin that prolongs inflammation. Fibrin is a clotting material that restricts blood flow, found both in your blood stream and connective tissue such as your muscles. Cancer cells also hide under a cloak of fibrin to escape detection.¹²

Once the cancer cells are "uncloaked," they can be spotted and attacked by your immune system. It is also thought that fibrin makes cancer cells clump together, which increases the chance for metastases.

Fibrin accumulation is also responsible for scar tissue in damaged muscle or at a surgical site. If the buildup is excessive, which can easily occur if your blood flow is poor due to low enzymatic activity, then the scar tissue may lead to chronic problems.

Excess fibrin in your blood may also raise your risk for a heart attack and/or stroke. Symptoms of excess fibrin include: chronic fatigue, poor healing ability, inflammation, pain and **high blood pressure**

How Enzymes Are Measured

Enzymes are measured¹³ in units called food chemical codex (FCC units) of some type of assay, such as hemoglobin unit tyrosine base (HUT). The FCC unit is essentially a measure of the enzyme's functionality – how well it functions under a specific assay or test.

The example given in the lecture is protease having a measure of 50,000 HUT, which means the protease can break down 50,000 bonds of red blood cells under certain

laboratory conditions.

This is important to look for when shopping for an enzyme, as the FCC units are a guarantee of a certain level of activity. Simply knowing the weight or mass of an enzyme doesn't tell you anything about its functionality, as its activity could theoretically be zero.

Factors That Affect Enzyme Activity

As noted in the video presentation, environmental factors such as the pH level and temperature inside your body can affect the activity of enzymes. As your temperature rises, enzyme activity will typically increase. If the temperature gets too high, however, the enzyme will break down.

The reason for this is because the positive and negative charges of the amino acid bonds that give the enzyme its shape cause it to vibrate. As the temperature increases, this vibration speeds up, making the enzyme work harder. This is essentially what happens when you have a fever. As your temperature rises, your enzymes start going into overdrive to heal your body.

At a certain vibrational rate, however, it's simply vibrating too quickly to remain stable, causing it to break apart. This is not a concern for most supplements though, as most remain viable up to 120 degrees Fahrenheit, and the inside of your body will never get that high. Improper storage, on the other hand, could inactivate the enzymes in the supplement if it gets too hot.

As you'd expect, with lower temperature, enzymatic activity decreases. Many will store their enzyme supplement in the refrigerator or freezer for this reason, but this actually isn't a good idea. The reason? Because taking the bottle in and out of the fridge or freezer could introduce moisture, and this moisture (water) will activate the enzymes.

The best place to store your enzyme supplement is in a relatively cool, dry area such as a kitchen cabinet or pantry. Properly stored, an enzyme supplement will typically retain full potency for up to a year.

The other factor that affects enzyme activity is your body's pH (acidity versus alkalinity), which changes throughout your digestive tract. As a result, a particular enzyme will be most active or effective in a particular part of your digestive tract, and less active in others.

For this reason, high-quality supplements will contain enzymes with a wide range of pH tolerance, thereby allowing the supplement to perform optimally all the way through your gastrointestinal tract.

Why Use Enzyme Supplementation?

As mentioned, your body naturally produces enzymes. So, why would you ever need an enzyme supplement? While it's true your body continually produces enzymes, certain factors can limit this capacity:

- **Aging** – Loss of enzyme activity is part of the aging process.
- **Genetics** – The blueprints in your DNA instruct your cells on which enzymes to make and how much, so genetic anomalies can affect your body's ability to produce certain enzymes. One example is lactose intolerance – the limited ability to hydrolyze or break down lactose, the sugar found in milk, due to an insufficiency of lactase, the enzyme that breaks down lactose.
- **Lifestyle choices** – Examples of choices that affect your enzyme capacity include the types of foods you choose to eat (whole food versus junk food, for example, or a vegan versus carnivore diet), the amount of food you eat (too much or too little) and whether or not you choose to fast or smoke.

While aging is inevitable and genetics cannot be altered, you still have a great degree of influence over your enzymes via your lifestyle choices. The healthier your lifestyle, the better your enzymatic activity will be, even without assistance from a supplement.

For example, eating plenty of fresh, raw and/or fermented foods will supply your body with healthy enzymes. Sprouts are a particularly excellent source of live enzymes.

Fasting has also been shown to conserve enzymes. If you do not eat, you will not produce digestive enzymes, allowing metabolic enzyme production and activity to proliferate instead. A supplement can still be valuable, however, to counteract genetics, aging and a less than ideal lifestyle.

How Digestive Enzymes Impact Digestion

When you swallow a food, it first enters the upper portion of your stomach. Here, any enzymes inherent in the food itself start to activate, helping to break the food down. As you might expect, the more the food can be broken down here in the first stage of your gastrointestinal tract, the less labor intensive the digestive process will be later on.

The pH in this upper stomach portion typically ranges from 4 to 6, i.e., slightly acidic. As food enters your stomach, proton pumps lining the lower pyloric part of your stomach starts pumping in hydrochloric acid, and it does this in proportion to the amount of food that you eat. The more food you put in, the more hydrochloric acid is being pumped in to help break down and liquefy that food.

Importantly, hydrochloric acid does not actually help you digest your food. Rather, it activates an enzyme called pepsin, a proteolytic enzyme that helps digest protein. In this lower section of your stomach, the pH ranges from 2 to 4.

As the food is liquefied, it starts dripping into the duodenum, the upper part of your small intestine, triggering your pancreas to secrete alkaline bicarbonates, thereby neutralizing the acidity. The pH of your small intestine typically ranges from 8 to 9.

Pancreatic enzymes are also released, which continue the process of breaking the food down into even smaller constituent parts. In summary, digestion can occur in three areas – your upper stomach, lower stomach and small intestine – and your food choices can significantly influence where and how well digestion occurs in these areas.

Enzyme supplements can also influence digestion in each of these areas, and help optimize assimilation and elimination of the foods you eat. As mentioned, for optimal benefit, you want a supplement capable of working in a wide range of pH levels, as your

stomach and small intestine ranges from 2 on the acidic side to about 9 on the alkaline side.

More often than not, taking a blend of enzymes is also beneficial, as no single enzyme can perform all the necessary functions throughout your digestive tract. As noted in the featured lecture, "the better the blend, the better the breakdown of the substrate" into single, di- and tri-chain amino acids.

Summary of What to Look for in an Enzyme Supplement

In summary, factors you want to look for when buying an enzyme supplement are:

- Blends of enzymes rather than single enzymes
- Enzymes that work across a wide range of pH levels
- FCC measurements rather than just weight, as this guarantees potency (higher FCC units indicating higher enzyme activity)

Contraindications for Proteolytic Enzymes

While proteolytic enzymes are well-tolerated and safe for long-term use in most people, there are exceptions. If any of the following scenarios apply to you, you should not take proteolytic enzymes:¹⁴

You're on prescription blood thinners such as Coumadin, Heparin or Plavix

You're having surgery within two weeks (as they can increase surgical bleeding)

You have a stomach ulcer

You're pregnant or lactating

You're currently taking antibiotics

You've had an allergic reaction to pineapple or papaya

If you're currently taking a nonsteroidal anti-inflammatory drug for pain and want to add a systemic enzyme, be sure to take them at least one hour apart from each other.

Systemic enzymes are in many ways preferable to painkillers since they effectively lower inflammation and support your body's innate ability to heal itself, while pain medication simply masks the symptoms while raising your risk for addiction and death.

Sources and References

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- ¹² [The Healthy Back Institute, 3 Ways Proteolytic Enzymes Fight Viruses](#)
- ¹⁴ [The Healthy Back Institute, What Are Systemic Proteolytic Enzymes?](#)