ENZYME INFORMATION SHEET

Rainrock Nutritionals

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Enzymes are proteinaceous substances of various sizes, molecular weights and shapes depending on their function. Enzymes serve as catalysts in metabolic chemical reactions. That is, they serve to speed up specific chemical reactions by reducing the activation energy for the reaction converting substrates to products. A complete explanation of enzyme kinetics and the kinetic-molecular theory is beyond the scope of this paper but a reduction in activation energy tremendously increases the rate at which these reactions occur by hundreds or thousands of times.

The functions of enzymes in metabolism are broken down into six broad categories. These categories are (Conn, Stumpf, et al, p.139, Zubay, pp.265-66):

Hydrolases- Catalyze the breakdown of complex substrates into smaller segments

Oxioreductases- Catalyze oxidation and reduction reactions

Ligases- Catalyze the combination of two smaller substrates into one large molecule

Lyases- Catalyze the splitting of double and triple bonds with the addition and/or release of chemical groups

Isomerases- Catalyze the rearrangement of chemical groups in a substrate

Transferases- Catalyze the transfer of chemical groups from one substrate to another

Of these six categories, we are most concerned in this information sheet with the first two i.e., the hydrolases and the oxioreductases. These two categories are most often used clinically as food supplements. The hydrolases include proteases that catalyze the digestion of proteins, amylases that catalyze the digestion of sugars and starches, and lipases that catalyze the digestion of fats.

The digestive properties of hydrolase enzymes make them a multi-faceted tool for clinical use. Their activity is not limited to the simple digestion of food but extends systemically. Studies on proteolytic enzymes have shown them to have excellent anti-inflammatory and micro-circulatory enhancement properties (Pizzorno and Murray, pp. 857-869, Wolf and Ransburger, pp.84-100). These properties are attributed to the fibrinolytic and thrombolytic activities of certain hydrolases. The anti-inflammatory mechanism of proteolytic enzymes is different from prescription anti-inflammatory drugs (steroids and non-steroids). Unlike drug therapies that seek to suppress natural damage response mechanism, supplemental enzymes are very similar to the enzymes found in the body. They enhance the body's natural damage repair mechanisms and controls so there are no adverse side effects to restrict the time of therapeutic use.

Inflammation is a highly complex process that is the result of cellular assault from one or more sources including chemical, physical and biological. Inflammatory conditions are known by many names. Allergy, arthritis, sunburn and other burns, sprains, strains and other athletic and soft tissue injuries, pancreatitis, hepatitis and many other '–osis' and '–itis' conditions are included in the list. Many conditions that have their origins in the inflammatory process do not come to mind as readily as some of those listed above. These include arteriosclerosis, atherosclerosis, adhesions and scarring.

Many of the conditions listed above have similar biochemistry (Crouch and McClintic, pp.461-464, Pizzorno and Murray, p. 863, Wolf and Ransburger, pp. 34-68). Once damage is done to the cells biochemical changes occur which change the permeability of the cell membranes and the surrounding capillaries leading to the formation of exudates. Swellings, redness, pain and sometimes fever follow. Leukocytes and macrophages concentrate at the site and begin to digest the damaged and dying cells (phagocytosis). Phagocytosis by mature leukocytes is accompanied by a rapid uptake of oxygen by the phagocytes and the appearance of the superoxide radical in the area around the damage site, possibly as an anti-infection response. The superoxide radical is highly toxic to many foreign bacteria (Montgomery, Dryer, et al, pg. 219). Fibrin forms as fibrinogen is exposed to the destroyed and damaged tissue and the specialized proteins released by the damaged cells. This is the beginning of the clotting process and serves to lock-up or 'fixate' toxins at the site to minimize damage to surrounding tissue. The clotting leads to a reduction of blood flow to the damaged region resulting in edema and pain. As part of the body's repair process proteolytic enzymes, most notably plasmin, are sent to the injury site to begin the process of exudate removal and fibrin breakdown, even as the fibrin forming process is just beginning. This accounts for studies showing that proteolytic enzyme supplementation immediately after an injury (or prophylactically) results in a significant reduction in both the severity and duration of inflammation (Wolf and Ransburger, pp. 84-92). Commonly, especially in older victims, excess fibrin formation occurs leading to an exaggeration of inflammation symptoms and an increased risk of necrosis and scar formation. Thus, the importance of systemic enzymes like plasmin and others serve as part of a regulatory mechanism which inhibit the effects of cellular damage on surrounding tissue becomes obvious.

Through the processes of stress, aging, poor nutrition and other factors, including severity of injury, the body's natural anti-inflammatory enzyme system often operates at a substantially reduced level leading to long term inflammation and resultant pain, edema and thrombi. Supplemental enzymes can be of great assistance in controlling the problems associated with inflammatory processes.

Plasmin-like enzymes commonly used in enzyme supplementation include trypsin, α-chymotrypsin and pepsin. The activity of these enzymes, like that of plasmin, involves cleaving polypeptide chains, usually at particular types of amino acids with differing degrees of specificity. Their great activity is due to the property of cleaving proteins at sites inside the polypeptide chains (endopeptidases), not just at the terminal end. They also work together to solubilize large proteins into short non-coaguable polypeptide chains. Other supplemental enzymes include papain, a phytoenzyme that has a less specific but potent proteolytic activity and bromelain, also a phytoenzyme, which is a potent proteolytic enzyme and has been shown to activate plasmin from plasminogen, a proenzyme. Pancreatin is an extract of pancreas containing a mixture of several proteolytic, lipolytic and amylytic enzymes. Lipolytic enzymes like lipase and pancrelipase are important in solubilizing fats to fatty acids and glycerol. Amylitic enzymes like amylase split starches into saccharides and smaller polysaccharides.

An important adjunct enzyme system in the body's damage repair mechanism includes the oxioreductase enzymes superoxide dismutase (SOD) and catalase. These two enzymes work as a team to reduce the highly destructive superoxide radical (O_2^-) to two H_2O molecules via hydrogen peroxide (H_2O_2). The superoxide radical is often sited as one of the main culprits in premature aging and reduction in cell growth rates (Pizzorno and Murray, pp. 831, Stipanuk, pp. 757, 907, Wolf and Ransburger, p. 114). The superoxide radical is certainly responsible for cell wall damage and the presence of SOD and other oxioreductase enzymes and coenzymes are necessary to prevent adjacent cell damage. A defect in SOD has been implicated in a form of Amyotrophic Lateral Sclerosis. (Blaylock, p. 122) Glutathione is an important electron-transfer link in this repair mechanism as well as enabling amino acid transport across cell membranes. Glutathione is essential in maintaining sulfhydryl bonds in the reduced state in a variety of tissues and is a potent enzyme activator.

To cut costs, some manufacturers claim that their enzymes contain glutathione because they add the three constituent amino acids, L-glutamic acid, L-cystein and L-glycine to their product. This assertion is false. Glutathione is a tripeptide. There is no indication that the three free-form amino acids that make up glutathione will be used to manufacture it in the body if supplied in this manner. Similarly, some manufacturers claim some of their trypsin activity as α-chymotrypsin, a critical but expensive peptidase, without actually adding much, or, sometimes, any. If you are not sure, ask the manufacturer if they are actually using glutathione and α-chymotrypsin.

There are other important aids to oxioreductase enzymes besides glutathione and catalase. One of the most important is α-lipoic acid. This molecule attaches to enzyme-substrate complexes. It acts as a coenzyme in the transfer of electrons and activated acyl groups from one substrate to another. The physical structure of the molecule is such that it can "swing" around in an arc and its' disulfide bond can be reduced for the electron transfer. Several of these molecules often line up and act as a shuttle to perform their transfer functions (Zubay, pp. 369-371). α-Lipoic acid doesn't just reduce the superoxide radical. It also reduces the hydroxyl radical, hypochlorous acid and oxygen singlets and chelates free copper and iron. α-Lipoic acid also has the ability to regenerate other free radical scavengers like vitamins C and E as well as SOD and catalase from their oxidized state (Blaylock, pp.245-248). Thus, an SOD-lipoic acid-catalase complex is highly important in preventing damage to cell walls and protects DNA from damage from free radicals.

Lyophilized calf thymus is included in Omnizyme and Omnizyme Forte because, according to researchers, lyophilized thymus is rich in nuclease enzymes. Nucleases are hydrolases, which cleave the phosphodiester bonds of DNA and RNA. Damaged and foreign RNA/DNA are readily digested by these enzymes. Thus, a viral invader is susceptible to the two-pronged attack of proteases on its' protein coat and nucleases on its' genetic material (Wolf and Ransburger, pp.119-133).

One of the major problems of enzyme supplementation is getting enzymes that are pH sensitive past the stomach to the duodenum where absorption takes place. In a supplement designed to enhance digestion, this can be accomplished by using a two-phase strategy. Pepsin is in its most active state at very low pH and papain is active in a very wide pH range. Therefore, no special protection is required for these two enzymes. They are quite active in the stomach. On the other hand trypsin, α-chymotrypsin, pancreatin, SOD, amylase, lipase, catalase, glutathione and other activators, enzymes and coenzymes are susceptible to deactivation or destruction by stomach acids. A method must be devised to protect them through the stomach but make them available for absorption in the duodenum. This is the reason these types of products cannot be made in capsule form. Instead, we use tablets with a special coating to protect the contents and release them at the proper time. In the case of Gestall HCl, a special coating and tablet pressing technique is used to provide the two-phase tablet mentioned earlier. Omnizyme, Omnizyme Forte and LipoSOD Complex are specially coated for protection from the highly acidic conditions of the stomach and maximized absorption and activity at the proper sites.

Rocky Fork Formulas currently carries four products that use hydrolase enzymes as their main ingredients. These are the two-phase digestive aids **Gestall HCL** and **Gestall** and the specialty enzyme mixtures **Omnizyme** and **Omnizyme Forte**. Omnizyme and Omnizyme Forte also contain oxioreductase enzymes. The ingredients of these enzymes products are listed below.

Gestall HCl

Stomach Phase

Betaine HCl	160 mg
Glutamic HCl	105 mg
Pepsin	105 mg
Papain	55 mg
Gentian Root	5 mg
Ginger Root	5 mg
Lyophilized Stomach	5 mg

Duodenal Phase

Pancreatin	105 mg
Pancrelipase	50 mg
Amylase	30 mg
Bromelain	35 mg
Ox Bile Extract	65 mg
Lyophilized Duodenum	5 mg

Gestall

Stomach Phase

L-Glycine	40 mg
Pepsin	125 mg
Papain	75 mg
Ginger root (4:1 Standardized Extract)	75 mg

Duodenal Phase

Pancreatin (4X) (equivalent to 400 mg)	100 mg
Pancrelipase	75 mg
Bromelain	50 mg
Trypsin	25 mg
Ox Bile extract	75 mg

Omnizyme

Pancreatin (4X) (Equivalent to 1250 mg)	313 mg
Papain	150 mg
Bromelain	150 mg
Trypsin	125 mg
Lipase	50 mg
Amylase	50 mg
α-Chymotrypsin	3 mg
Rutin	100 mg
Lyophilized Calf Thymus	55 mg
Catalase	200 Units
Superoxide Dismutase (SOD)	50 mcg
L-Glutathione	10 mg
Zinc Gluconate	10 mg

Omnizyme Forte

Pancreatin (4X) (Equivalent to 1250 mg)	313 mg
Papain	150 mg
Bromelain	150 mg
Trypsin	125 mg
Lipase	50 mg
Amylase	50 mg
α-Chymotrypsin	45 mg
Rutin	100 mg
Lyophilized Calf Thymus	55 mg
Catalase	200 Units
Superoxide Dismutase (SOD)	50 mcg
L-Glutathione	10 mg
Zinc Gluconate	10 mg

We also currently carry one product whose main constituents are oxioreductase enzymes, **LipoSOD Complex**.

LipoSOD Complex

Superoxide dismutase	250 mg*
Catalase	250 mg
α-Lipoic acid	25 mg

*2000 Units

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