# Sports Injuries & Proteolytic Enzymes

*By Luke R. Bucci, Ph.D. And John Stiles, M.S.*

Proteolytic enzymes have been used since the dawn of written history. Papyrus scrolls from ancient Egypt detail the external application of mashed maggot heads to speed wound healing. Similar external and oral use of fresh pineapple and papaya juices by Caribbean and South Pacific islanders was noted by 17th century European explorers.

As technology and the healing arts advanced, the active components of these folk medicines (proteolytic enzymes) were discovered, isolated, characterized, tested, and marketed. During the 1960's proteolytic enzymes were in widespread use as prescription and non-prescription items for digestive aides and reduction of traumatic inflammation.

Several reasons caused proteolytic enzymes to fall out of favor as a- first-line treatment for inflammation. First, proteolytic enzymes were plentiful and inexpensive, meaning lower profits than pharmaceutical companies were accustomed to reaping. Second, proteolytic enzymes are natural substances and thus nonpatentable as pharmaceuticals.

Third, the concept of intact, active protein molecules crossing the intestinal barrier went against current dogma, although this dogma was exhaustively refuted. Fourth, development of corticosteroids and non-steroidal anti-inflammatory drugs (NSAIDS) was more attractive to the pharmaceutical industry.

These drugs rapidly replaced enzymes. Although effective in reducing pain and inflammation, these drugs do not alter the course of the underlying condition (1). Indeed, they can even suppress healing and cause numerous side effects. Even the 'safest' NSAID (ibuprofen) causes side effects in up to 16% of users (2).

The newer, more potent NSAIDs such as Feldene, Oraflex, Orudis, and Suprol have been implicated with severe side effects, including hundreds of deaths (3,4).

**Safety of Proteolytic Enzymes**

In contrast , examination of over a dozen proteolytic enzyme preparations from the Physician's Desk Reference lists only possible allergic reactions to the source of the enzymes and perhaps slight potentiation of anticoagulant drugs as adverse side effect (1,2). Numerous clinical trials with thousands of subjects have all stressed lack of observed adverse reactions. Thus, oral proteolytic enzymes have been proven to be safe and well-tolerated by over 30 years of clinical experience.

**Source of Proteolytic Enzymes**

Proteolytic enzymes in supplements are usually derived from pork or beef (pancreatin, trypsin/chymotrypsin) or plant (bromelain, papain) sources (5). The characteristics of the more common enzymes are listed in Table 1.

**Uses of Proteolytic Enzymes**

Proteolytic enzymes have been used for numerous medical applications, but only the use of oral preparations are presented in Table 2. Sports injuries are not included and will be discussed in a later section. References cited are all human studies, mostly with double- blind protocols.

As can be seen, a large variety of conditions have been reported to respond favorably to proteolytic enzyme supplementation. Importantly, proteolytic enzymes have been shown to exert anti-inflammatory effects in animal models and human trial. As inflammation is commonly encountered by chiropractors and can interfere with manipulations, proteolytic enzymes are a safe and logical adjunct to chiropractic.

**Favorable results were obtained in every study, with all reporting significant improvements in reduction of pain, swelling, edema, recovery time, period of disability, time of return to normal activities and leg-raise stiffness (for low back pain).**

**Typically 50-90% of subjects supplemented with proteolytic enzymes showed marked improvements, compared to 0-28% for control subjects. The amount of time needed to resolve injuries was halved in most subjects with supplements.**

**Mode of Action**

Exactly how proteolytic enzymes exert anti- inflammatory effects is not yet agreed upon by researchers. Several theories exist, each with supportive evidence. Obviously, a combination of several different modes of action and possibly some unforeseen modes account for the observed results.

One theory hypothesizes that exogenously administered proteolytic enzymes activate intrinsic proteases such as plasmin and kallikreins (6). These enzymes play a normal role in the inflammatory process (7,8). Another rationale is that proteins in edematous fluids are depolymerized, with a resulting increase of excess fluid by the circulation (6).

The inhibition of formation of proinflammatory Prostaglandins also appears to be caused by orally administered proteolytic enzymes and plasmin, probably owing to formation of regulatory peptides from degradation of fibrinogen (8).

Since formation of anti-inflammatory prostanglandins is not affected, proteolytic enzymes supplementation can be thought of as re-balancing the prostaglandin synthetic pathways by normalizing the needs for intrinsic proteases. It is also possible that erogenous proteolytic enzymes could act on cell membrane surface proteins to modify the phosphodiesterase system, leading to a reduction of inflammation (9).

Another line of evidence points out the increase in protease inhibitors. after oral proteolytic enzyme supplementation (5). In subjects with inflammation a shift to normal levels of inhibitors was seen at the same time clinical benefits were seen (5). Regardless of the confusion over how proteolytic enzymes work, the fact remains they are effective.

**Absorption**

In order to exert their effects, proteolytic enzymes must be absorbed intact and in active form from the gastrointestinal tract into the circulation in sufficient quantity. This concept is opposite from the current widely held dogma that intact proteins are completely broken down by the gut. This dogma is totally untrue, but still persists. Ample evidence has documented the absorption when given orally of all commonly used proteolytic enzymes in active form in humans (10-16). Amounts absorbed ranged from less than 1% to 40% of the total dose.

Since enzymes are catalysts, even a tiny amount can have huge effects. In addition, the consensus of 30 years of research in

animals and humans proves that proteolytic enzymes must be absorbed, because results were seen. Thus, significant amounts of active trypsin, chymotrypsin, bromelain, and papain are absorbed after oral administration.

**Treating Sports Injuries**

Participants in physical activates will eventually become injured, an event superseded in certainty only by death and taxes. While effectiveness of proteolytic enzymes in animal studies is dramatic and reproducible, studies with humans are wrought with technical difficulties not encountered in animal studies.

Few objective measurements for edema and inflammation are trustworthy or available, and so subjective parameters such as pain and discomfort must be monitored. Also, no two people are alike, unlike inbred laboratory animals that are bred for uniformity. Even with the obvious difficulties of working with humans, effects of proteolytic enzymes have been both dramatic and safe.

Rather than list the results of each study (which would resemble a book), the results presented have been synopsized from six studies on athletes (17-22) and eight studies on injuries common to athletes (S,6,9,23,24).

Eight studies had double-blind protocols. Trypsin/ chymotrypsin tablets were used in six studies, bromelain in four, papain in two, streptokinase/ streptodornase in one, and an unspecified mixture of enzymes in one study. Athletes were mainly from football and soccer teams. Over 1,500 subjects were studied. Injuries studied were mostly minor (bruises, sprains, strains, hematomas, lacerations, abrasions) but some were severe (low back pain, fractures, minor surgery).

Favorable results were obtained in every study, with all reporting significant improvements in reduction of pain, swelling, edema, recovery time, period of disability, time of return to normal activities and leg-raise stiffness (for low back pain). Typically 50-90% of subjects supplemented with proteolytic enzymes showed marked improvements, compared to 0-28% for control subjects. The amount of time needed to resolve injuries was halved in most subjects with supplements.

Several patterns important to attaining success emerged from these studies. First and foremost, the best results were obtained when proteolytic enzyme supplementation was started less than 24 hours after occurrence of the injury, preferably immediately. Second, enteric-coated tablets taken on an empty stomach are essential items.

Third, prophylactic supplementation clearly reduced the number of minor nagging injuries and soreness after workouts or events. Fourth, response was quicker for bruises and swelling when compared to sprains and fractures.

The types of enzymes used did not seem to make a difference - all produced satisfactory results. Only one mixture was tested, but the composition was not stated (19). However, animal research indicates that a combination of enzymes is more effective than equivalent activities or single enzymes (25).

Thus, an advantage is conferred to preparations containing multiple proteolytic enzymes, if total activity is high. Also, animal studies support the premise that addition of nutrients that play important roles in connective tissue metabolism, such as vitamin C and bioflavoniods, can further augment the effects of proteolytic enzymes (26). Chrondroitin sulfates and manganese are other nutrients with important properties for connective tissue (27).

Dosage varied depending on the particular tablet used. All studies administered the enzymes on a empty stomach, 2-4 times daily, usually 1/2-1 hour before meals. Most products were enteric-coated to resist degradation by pepsin in the stomach and allow deposition of the enzymes in the small intestine, where they are absorbed.

Another athletic-related injury, especially in the southern United States, is sunburn (ultraviolet radiation-induced burns). Proteolytic enzyme supplementation was shown to reduce skin temperatures significantly by objective measurements in one double-blind study (28).

**Chiropractic Clinical Experience**

Winston Greene, D. C., of the Downtown Chiropractic Clinic in Houston, Texas, regularly uses proteolytic enzymes in his practice. He states: “Proteolytic enzyme supplementation allows me to reduce the pain and swelling of inflamed backs, necks, and joints overnight. I can now successfully manipulate some patients 1-2 days after injury when without enzymes I couldn't touch them for 3-4 days.”

Dr. Greene finds that proteolytic enzymes aid in treatment for “acute trauma such as whiplash, sprained ankles and knees, just about any injury where swelling and redness occurs." Dr. Greene concludes: “if I were only to use one nutritional supplement, it would be proteolytic enzymes because of their versatility. Patients respond very well and are appreciative.”

**Choosing a Proteolytic Enzyme Supplement**

Many proteolytic enzyme products are available. Potential allergies and religious considerations can be circumvented by choosing products from either plant of animal sources. Since many different descriptions of potencies are used, it is almost impossible to compare products or even convert from one type of units or weights to another.

Until a central testing facility uses the same method for determining total proteolytic activity, and test every batch of every product, no one will really know which products are superior. One way to avoid the nightmare of comparing label claims and prices is to examine the company promoting the product. If a company manufactures its own products in-house, possesses a quality control program with capable scientists in a well equipped laboratory, and has demonstrated longevity in the industry with a reputation for consistent high quality, then one can be reasonably certain of obtaining a successful product.

**Conclusions**

In summary, the use of proteolytic enzyme supplementation has been well documented over a 30-year period to speed healing and recovery of traumatic injuries, especially athletic injuries. Proteolytic enzymes are safe, readily available, and not expensive. Oral proteolytic enzymes can supplement the body's endogenous enzymes, correcting localized deficiencies at critical times, thereby normalizing the inflammatory process. While proteolytic enzymes may not have a new, high-tech image, they will remain an important adjunct to chiropractic.

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**Table 1 Proteolytic Enzyme Characteristics**

| Enzyme | Source | Optimum pH Range | Amino Acid Specificity |
|---|---|---|---|
| Pancreatin | Animal / Pancreas | neutral | broad |
| Trypsin | Animal / Pancreas | neutral | lysine, arginine pref. |
| Chymotrypsin | Animal / Pancreas | neutral | carboxyl groups pref. |
| Bromelain | Pineapple stem | broad | basic amino acids leucine, glycine |
| Papain | Papaya latex | neutral | basic amino acids leucine, glycine |
| Pepsin | Animal Stomach | acid | aromatic amino acids |
| Sutilatin | Bacteria | neutral | broad |
| Brimolase | Fungi | neutral | arginine, leucine, glutamate pref. |
| Ficin | Fig tree sap | acid-neutral | broad |

**Table 2 Successful Medical Applications of Proteolytic Enzymes**

| Application | References |
|---|---|
| Digestive Aids | DiMagno. 1977: Karani, 1971 |
| Replacement of digestive enzyme deficiencies | Graham, 1977: Goodchild, 1974 |
| Low back pain and disc herniation | Gaspargy, 1971: Gibson, 1975 |
| Reduction of food allergy symptoms | Philpott, 1975 |
| Arthritis (pain and swelling reduction) | Cohen, 1964 |
| Reduction of platelet aggregation in stroke and infarct survivors | Heinicke, 1972 |
| Sputum liquefaction | Bruce, 1962: Bourgois, 1964 |
| Reduction of middle ear effusions | Gessert. 1960 |
| Acute and chronic sinusitis | Hine,C3 1966: Ryan, 1967 |
| Potentiation of antibiotics | Seneca, 1965: Bulwa, 1969 |
| Potentiation of tetracycline in acne | Stankler, 1976: Liddell, 1978 |
| Vein thrombosis and thrombophlebitis | Seligman, 1962: Gray, 1969 |
| Dental surgery (reduction of pain and swelling) | Assman, 1965 |
| Post-surgical trauma and recovery | Lund, 1969: Vallis, 1969 |
| Varicose vein stripping | Rinisten, 1971 |
| Vermifuge (kills intestinal worms) | Weise, 1950 |

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