

Introduction the
enzyme will also
remain active.

[Parts of the World, Asia](#)



Bromelain is an enzyme that digests proteins, also called a proteolytic enzyme. It is found in pineapple. The name bromelain refers to either stem bromelain or fruit bromelain, depending on which part of the pineapple it is found in. Stem bromelain is most commonly used as it is inexpensive because no fruit is being wasted whereas using fruit bromelain would be a waste of food.

Pineapple has been used for medical reasons since the 1800's in Asia and South and Central America. Bromelain itself was first isolated by a Venezuelan chemist, Vicente Macano, in 1891 when he fermented pineapple fruit. It was originally named " bromelin" after the pineapple family, Bromeliaceae, but later changed to bromelain.

The pancreas consists of two types of portions; an endocrine portion and an exocrine portion. Exocrine tissues produce digestive enzymes which mix with sodium bicarbonate to form pancreatic " juice". This juice moves from the pancreatic duct, through the hepatic duct and into the duodenum where it breaks down carbohydrates, proteins and fats (Roxas, 2008).

Exocrine pancreatic insufficiency (EPI) is the inability to properly digest food due to a lack of digestive enzymes made by the pancreas. EPI is common in people with cystic fibrosis and Shwachman-Diamond syndrome. Bromelain has been said to help those whose pancreas does not produce sufficient enzymes, as it aids digestion by breaking down large and complex protein molecules into smaller peptide units or amino acids. Bromelain is an enzyme so certain factors affect it. Too high temperatures can denature the enzyme, while temperatures that are too cold can cause it to become inactive. The

optimum temperature for bromelain is 35-45 °C, however it is still stable at temperatures as high as has 60 °C and its powder form can even be stored at temperatures as low as 8°C without becoming inactive. This means that bromelain will remain active inside the human body (approximately 37?).

Bromelain's optimum pH is 4.5-9.5, but it is stable at pH 3-6. Pancreatic juices perform digestion in the duodenum, which has a pH of approximately pH 8, therefore the enzyme will also remain active. Bromelain is found in pineapple, as mentioned, but it is also available as a supplement in the form of a powder or a capsule.

Bromelain supplements are often used to treat digestive issues such as heartburn and symptoms of irritable bowel syndrome. It is also used to help people with exocrine pancreatic insufficiency digest their food. This research will focus on whether bromelain from pineapple or bromelain supplements are more effective at digesting protein to determine which is better treatment for patients suffering from exocrine pancreatic insufficiency. An experiment will be conducted in which cooked meat, gelatin and eggs will be exposed to fresh pineapple juice and bromelain supplements. The time taken for the proteins to be digested will be recorded. Aim: to determine whether fruit bromelain from fresh pineapple juice or bromelain supplements are more effective at digesting protein to find the better treatment option for exocrine pancreatic insufficiency. Hypothesis: fruit bromelain from fresh pineapple juice is more effective at digesting protein and is better for treatment of exocrine pancreatic insufficiency.

Method Label 6 test tubes A, B, C, D and E Place 10ml of Woolworths Drakensburg ph 8 water into each test tube to simulate the alkalinity of the duodenum Cut 5 pieces of cooked steak each 0, 5cm² Place one in each test tube Add the powder of one 400mg bromelain capsule to 100ml of water and stir until dissolved Juice one cup of fresh pineapple Place 5ml of the bromelain solution into test tube A and B Place 5ml of the pineapple juice into test tube C and D Test tube E is the control Heat test tube A to 37° to simulate body temperature Heat test tube C to 40° to simulate body temperature during a fever Leave test tubes B, D and E at room temperature Take results every twenty minutes on the condition of the steak Record how long it takes for the steak to break down and become mushy in each test tube Literature

Review Bromelain is an enzyme that digests protein. It has many uses, including to treat digestive disorders. Exocrine pancreatic insufficiency (EPI) is a disorder which causes the pancreas does not make digestive enzymes. Bromelain is used as treatment for EPI due to its ability to digest protein. Bromelain is available as a supplement in a powder or capsule form.

It is also found in fresh pineapple. This literature review will focus on bromelain as a treatment for exocrine pancreatic insufficiency. The pancreas is made up of endocrine tissue and exocrine tissue. The exocrine tissue produces digestive enzymes which mix with sodium bicarbonate to form pancreatic "juice". which travels through the pancreatic duct and the hepatic duct to the duodenum, where it breaks down food. (Pruimboom, 2014).

Cystic fibrosis, Shwachman-Diamond syndrome and chronic pancreatitis can cause EPI. EPI occurs when the exocrine tissues of the pancreas do not produce digestive enzymes, therefore the pancreatic juice does not digest food. Symptoms include weight loss, steatorrhea and abdominal pain. The most common treatment option is pancreatic-enzyme replacement therapy (PERT), however bromelain is also used successfully to treat EPI (Kelly, 2001, Gelecek 2012). Pancrex V forte is a pancreatic enzyme tablet that has enteric coating used to treat Chronic Pancreatic Insufficiency. Nutrizym is another medication that has a core of pancreatic extract with enteric coating and a bromelain shell and is used to treat the same illness. An experiment was conducted in which Pancrex V forte and Nutrizym were compared, as well as Nutrizym core, which is the pancreatin and coating without the bromelain shell. Twelve patients were in the trial for three months and were each given each of the medications for a month, in a random order.

Protein digestion and fat absorption were assessed. Nutrizym was notably more effective than both Pancrex V forte and Nutrizym core in both. Gelatin contains hydroxyproline which is absorbed after digestion. The gelatin tolerance test is not affected by food intake, therefore it is an effective test to use. The gelatin tolerance test is done by measuring the amount of hydroxyproline in patients' urine to assess protein digestion. For the first four hours of the test, hydroxyproline excretion levels were higher on Nutrizym than Pancrex, although they were lower from hours four to six and similar after a total of eight hours (figure 2). This suggests that protein digestion in patients started and finished earlier while on Nutrizym than while taking

Pancrex V forte and Nutrizym core. It has been concluded that the bromelain in Nutrizym is the reason for the improved protein digestion.

Fat absorption was also improved on Nutrizym. The daily fat intake was higher on Nutrizym core than on Nutrizym, demonstrating that Nutrizym is more effective at controlling the excessive eating that is a symptom of pancreatic insufficiency. The daily fat output was lower on Nutrizym than on both Nutrizym core and Pancrex (figure 1). This means that the daily fat absorption was 13.

1% higher on Nutrizym than on Pancrex, which shows that Nutrizym is extremely beneficial in improving fat absorption, most likely due to the bromelain. Five patients who usually complain of abdominal pain (most likely due to cystic fibrosis) had no occurrence of this while on Nutrizym. In this experiment, synthetic bromelain was extremely effective.

Although it was published in the British Medical Journal, this experiment was not done in recent years therefore there may be further technological or medicinal advances which could possibly invalidate it (Knill-Jones, 1970). Medications containing bromelain appear to be more effective than medications without it in the treatment of EPI. PH affects enzyme activity, and the pH of the gastrointestinal tract varies greatly. If an enzyme is in a pH to high or low for its optimum pH, it will denature and no longer be able to do what it is supposed to. An experiment was conducted to determine if bromelain is able to break down protein in the gastrointestinal (GI) tract of mice. The results demonstrated that oral bromelain retains its proteolytic activity (ability to break down proteins) throughout the GI tract of mice. This

supports the hypothesis that oral bromelain would be a potential treatment option for inflammation and other issues in the human GI tract (Hale, 2004) and that bromelain is able to function in a wide pH range therefore is a valid treatment option for human digestive disorders. Bromelain is an extremely effective and widely used enzyme.

It has many beneficial uses including debridement after burns, anticoagulant, absorbing antibiotics into the body and anti-inflammatory. It has very few side effects, besides for the fact that pineapple may cause an allergic reaction, so it is generally safe to use. Besides for being a digestive aid, it is often marketed and sold as an anti-inflammatory (WebMD, 2009). The anti-inflammatory effect of bromelain is helpful in treating digestive disorders such as ulcerative colitis and inflammatory bowel disease (Hale et al, 2005). IBD is a leading cause of EPI, so the treatment of IBD through bromelain may prevent EPI (Davis, 2016).

Research has shown that bromelain may be just as effective as NSAIDs at treating injuries and arthritis and is much more affordable and has fewer risks and side effects. Studies have shown that bromelain was successful in treating acute knee pain in otherwise healthy patients (Walker et al, 2002) and that it has potential in becoming a treatment for osteoarthritis after further research is completed (Brien et al, 2004) A study at the College of Medicine, University of Lagos in Nigeria was performed on rats to determine if oral commercial bromelain tablets or fresh pineapple juice is more effective at healing an achilles injury. The experiment tested a completely different factor to the one in this review, however it is still relevant to discuss

as a comparison between bromelain from a pineapple and commercial bromelain and to see which is more an effective treatment. Twenty four male rats of the same age were randomly divided into three groups and an achilles injury was induced to each rat on the exact same tendon, on the same limb. Group one was the control and no treatment was given. Group two was given oral bromelain tablets at a dosage of 7? mg/kg of body weight daily. Group three was given fresh diluted pineapple juice at a dosage of 30? mg/kg of body weight. The treatment was given for exactly two weeks after the injury and on the fifteenth day, the rats were killed and their tendons were cut out to be examined.

The results showed that the bromelain group significantly increased the number of tendon cells (tenocytes) from the control group. The pineapple juice also showed an increase in tenocytes compared to the control however it was not very significant. Both group two and three showed well-aligned collagen fibres, although the tendons that were treated with bromelain tablets showed mature tendon cells (figure 3) and the ones that were treated with pineapple showed tendon cells that were still maturing and showed slight inflammation (figure 4).

Both of the treated injuries healed better than the untreated injury which had random collagen fibres and immature tendon cells (figure 5). In this study, commercial bromelain was more effective than fresh pineapple juice (Aiyegbusi, et al. 2010).

Steatorrhea is the presence of extra fat in faeces. It is the most common symptom of Exocrine Pancreatic Insufficiency and it is used to diagnose EPI.

Steatorrhea occurs because individuals affected by EPI do not absorb enough fat. This has dangerous side effects such as weight loss and fatigue.

Due to not absorbing enough fat or protein, also known as malabsorption, patients are at high risk for anaemia or malnutrition (Pezzilli, 2013). A study has shown that bromelain, in combination with ox bile and pancreatin, is effective at lowering the amount of fat in stool of patients with pancreatic steatorrhea. This helps relieve symptoms such as pain, stool frequency and gas.

Bromelain helps to break down food and increases fat absorption from the food, therefore there will be more fat absorbed as nutrients, for energy and to help with weight gain (Balakrishnan et al, 1981). Bromelain is an enzyme with many beneficial functions. Research has demonstrated that bromelain is a worthy treatment option for EPI due to its wide pH activity range to function in the digestive system, its anti-inflammatory action to prevent and treat EPI and it increases absorption of fats and protein more than the same medication without bromelain. Bromelain also has much fewer side effects than other drugs yet it can achieve the same results.

It is easy to obtain and can be taken without high risk. Bromelain comes in different forms, both natural and synthetic. Both forms of the enzyme are effective but research has shown powder (synthetic) bromelain to work more effectively in some cases. Overall, bromelain appears to be an effective treatment option for EPI, its symptoms and the diseases that can cause it.