International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 6 Nov - Dec 2024, pp: 978-983 www.ijprajournal.com ISSN: 2456-4494

Inhibitory Effects of Guava Leaves and Ginger against Amylase Enzyme

Sanjai Gunawanth R, Ahalya R, Kiruthiga K M,Vikas B
Sri Shakthi Institue of Engineering and Technology.
Corresponding Author: Nivetha.S

Date of Submission: 10-12-2024 Date of Acceptance: 20-12-2024

ABSTRACT: Amylase is an enzyme that catalyzes the breakdown of proteins into smaller polypeptides or single amino acids, a process known as proteolysis. It also goes by the names peptidase, proteinase, and proteolytic enzyme. A rise in the body's amylase concentrations can cause a number of health issues. The breakdown of proteins is done by the enzyme amylase, whose overactivity might interfere with regular physiological functions. Tissue damage, digestive disorders, autoimmune diseases, skin conditions, lung diseases, neurological disorders, cardiovascular problems, blood clotting, and arthritis are a few possible problems linked to high protease levels. Increased amylase activity-causing conditions frequently necessitate medical attention and therapy to handle related health issues. Compounds found in a number of natural plants and herbs may be able to reduce amylase activity. These organic blockers are not as effective as pharmaceutical amylase inhibitors, but they can be used in conjunction with other complementary therapies, including ginger and guava leaves, to treat amylase-related disorders. Using natural plants or herbs to produce an inhibitor for all these illnesses associated with high protease levels is a complex process that needs to be done carefully. Purification, estimation, inhibition, and extraction are the processes that are involved.

KEYWORDS: Proteolysis, Cardiovascular issues, Arthritis, Neurological disorder.

I. INTRODUCTION

The digesting enzyme amylase is mostly released by the salivary glands and pancreas, however it can be detected in other organs at very low ratios. Amylases' main function is to hydrolyze starch molecules' glycosidic linkages, which reduces complicated starches to simpler sugars. The three major kinds of amylase enzymes are alpha, beta and gamma amylases; each of these enzymes each target various sections of the carbohydrate chain [1]. The process of converting starches into oligosaccharides requires the creation of α-amylase. In addition to being an integral component of the human diet, starch is a substantial residue of several economically significant crops, including potatoes, rice, wheat, corn, and tapioca. α-Amylases exhibit potential utility in an extensive range of industrial processes, including but not limited to food processing, fermentation, textile, paper, detergent, and pharmaceutical sectors. The pharmaceutical and fine-chemical industries may find use for bacterial and fungal amylases [2]. Starch is broken down by pancreatic α-amylase so that energy can be obtained from it. It was previously demonstrated by us that pancreatic α-amylase only binds to N-glycans [3]. A condition of inflammation known as acute pancreatitis (AP) can develop into acute severe pancreatitis (SAP), which raises the potential of mortality rates. Acute pancreatitis (AP) has become more commonplace worldwide in recent years, with an estimated 34 occurrences per 100,000 people annually [4]. In the human body, amylase is predominantly produced by the salivary glands and the pancreas. Although salivary and pancreatic amylases are similar, they are encoded by different genes (AMY1 and AMY2, respectively) and show different levels of activity against starches of various origins [5] Polyphenols are secondary metabolites of plants and are generally involved in defense against ultraviolet radiation or aggression by pathogens. In the last decade, there has been much interest in the potential health benefits of dietary plant polyphenols as antioxidant [6]. Elevated pancreatic enzyme levels are present in 11–13% of patients with non-pancreatic stomach discomfort. Sixty percent of HIV-positive individuals who were asymptomatic had abnormal lipase or amylase values at least once. Serum amylase levels were increased in 26 out of 208 patients (12.5%) who had acute abdominal pain that was unrelated to pancreatic problems when they were admitted.35

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 6 Nov - Dec 2024, pp: 978-983 www.ijprajournal.com ISSN: 2456-4494

percent of people with liver illness had abnormally high levels of amylase. Moreover, between 16% and 25% of instances of diabetic ketoacidosis have increased amylase levels. Thirteen of the 74 patients with lung cancer that was surgically relatable had hyperamylasemia [7].

II. AMYLASE

The degree of pancreatic illness was generally inversely correlated with the blood amylase level. When the amylase level exceeded 1,000 Somogyi units, a surgically curable lesion was often present, most often acute calculous illness of the biliary tract; if pancreatitis was present, it was usually mild to moderate. Serum amylase levels are a crucial auxiliary intervention for treating patients with stomach pain[8].Most patients without apparent pancreatic pathology experienced non-specific stomach pain and isolated increases of lipase and/or amylase (less than three times the upper limit of normal). Nonetheless, it appears that slight increases in lipase and amylase are not always indicative of serious pancreatic illness [9].The median hospital stay(days), death, and the severity of AP were not correlated with serum amylase level. With a decreased rise of serum amylase, biliary Etiology, LDL-C, and triglyceride levels were found to be independently linked to the development of AP [10].Those with hyper-amylasemia and asymptomatic chronic pancreatitis should first be evaluated for macro-amylasemia before beginning any expensive or time-consuming procedures to try to show a clinically silent or just moderately symptomatic attack of their illness [11].Upon admission to the hospital, 96.1% of all mild cases and 87.4% of all severe cases had an amylase value diagnostic of pancreatitis (p less than 0.001); after 48 hours, these values were 33.3% and 48.2%, respectively (p = 0.026). Upon admission, 86% of mild cases and 76% of severe instances of

alcoholic patients had diagnostic amylase levels (p less than 0.001, in comparison to other groups) [12].Further blood enzyme testing is not beneficial in patients with stomach discomfort and a very increased serum amylase level (more than three times the upper limit of normal). This is typically indicative of acute pancreatitis. Smaller rises in serum amylase are typically indicative of disorders other than pancreatitis; in these individuals, measuring a serum enzyme more specific to the pancreas, such as lipase, trypsin, or pancreatic iso-amylase, is generally useful for diagnosis [13].To evaluate the diagnostic performance of urine trypsinogen-2, serum lipase, serum amylase, and urine trypsinogen-2 alone or in combination in the diagnosis of acute pancreatitis in patients presenting with diffuse abdominal pain or acute onset of severe, persistent epigastric discomfort [14].The low specificity and sensitivity of amylase levels make them an inappropriate screen for the diagnosis of acute pancreatitis. The use of lipase findings to identify acute pancreatitis is supported by evidence from multiple studies, and new advancements in this assay have increased its accessibility to emergency physicians [15].THE clinical conditions generally considered when serum amylase is found to be elevated are those that either increase the amount of amylase entering the plasma or alter renal function and thereby impair urinary excretion of the enzyme [16].

III. POLYPHENOLS

A class of substances called polyphenols is present in plant-based meals like tea, dark chocolate, wine, herbs, and vegetables. They have the ability to function as antioxidants, which means they can counteract dangerous free radicals that may otherwise injure your cells and raise your chance of developing diseases like diabetes, heart disease, and cancer. Additionally, polyphenols may lessen inflammation, which is assumed to be the underlying cause of a number of chronic disorders. There are already over 8,000 different kinds of polyphenols known[17].They can be divided into four primary groups: Flavonoids. Approximately 60% of all polyphenols are composed of them. Quercetin, kaempferol, anthocyanins, and catechins are a few examples; these can be found in foods like red cabbage, apples, onions, and dark chocolate.

This class makes for about thirty percent of all polyphenols. Cereal grains and coffee both contain ferulic and chlorogenic acids, as examples. amides polyphenolics. Avenanthramides found in oats and capsaicinoids found in chili peppers fall into this category. more polyphenols. This group consists of lignans found in flax seeds, sesame seeds, and whole grains; stilbenes found in grapes and berries; resveratrol found in red wine; ellagic acid found in berries; and curcumin found in turmeric [18].The food's origin, maturity, and the methods used for cultivation, transportation, storage, and preparation all affect the quantity and kind of polyphenols it contains. Supplements containing polyphenols are also offered. But they probably won't be as healthy as foods high in polyphenols [19].

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 6 Nov - Dec 2024, pp: 978-983 www.ijprajournal.com ISSN: 2456-4494

IV. HEALTH BENEFITS OF POLYPHENOLS

Numerous health advantages have been connected to polyphenols. may cause blood sugar levels to drop. By lowering blood sugar levels, polyphenols may help reduce the incidence of type 2 diabetes. This is partially due to the possibility that polyphenols will stop starch from being broken down into simple sugars, reducing the risk of blood sugar increases following meals. Additionally, these substances might aid in promoting the release of insulin, a hormone necessary for transferring sugar from the bloodstream into cells and maintaining stable blood sugar levels [20].Further research ties diets high in polyphenols to reduced fasting blood sugar, improved glucose tolerance, and enhanced insulin sensitivity—all of which are critical components in reducing the risk of type 2 diabetes. According to one study, individuals who consumed the most polyphenol-rich foods had a 57% lower risk of type 2 diabetes over the course of two to four years than those who consumed the least. Research indicates that anthocyanins may have the most antidiabetic effect among polyphenols. Typically, they can be found in foods that are red, purple, or blue, such grapes, berries, and currants may reduce the chance of developing heart disease. Consuming more polyphenols in your diet may help your heart. Experts surmise that this is mostly because polyphenols' antioxidant qualities, which lessen chronic inflammation [21].Two recent reviews show that taking polyphenol supplements can reduce LDL (bad) cholesterol and blood pressure while increasing HDL (good) cholesterol. Higher levels of enterolactone, a measure of lignan intake, were associated with a 45% decreased risk of mortality from heart disease, according to another research. One kind of polyphenol that is commonly present in whole grains and flax seeds is called lignans could stop blood clots. Consuming polyphenols may lower your chance of forming a blood clot. When platelets in your bloodstream start to group together, blood clots are created. Platelet aggregation is the term for this process, which helps stop excessive bleeding. On the other hand, excessive platelet aggregation can result in blood clots, which can harm health by causing pulmonary embolism, stroke, and deep vein thrombosis[22]. Studies conducted on animals and in test tubes suggest that polyphenols may aid in reducing platelet aggregation, which would stop blood clots from forming might offer cancer prevention. Diets high in plant foods are consistently associated with a lower risk of cancer, and many experts attribute this in part to polyphenols. Due to their potent anti-inflammatory and antioxidant properties, polyphenols may help prevent cancer[23]. According to a recent analysis of research conducted in test tubes, polyphenols may prevent certain cancer cells from proliferating and developing. There is conflicting evidence about the relationship between high blood indicators of polyphenol intake and a decreased risk of prostate and breast cancer in people. Thus, further research is required before firm conclusions can be drawn might encourage a healthy digestive system. By encouraging the growth of good gut bacteria and inhibiting the growth of toxic ones, polyphenols may improve digestion. For example, research indicates that tea extracts high in polyphenols may encourage the growth of advantageous bifidobacteria. In a similar vein, green tea polyphenols may aid in the defense against pathogenic bacteria such as C. difficile, E. Coli, and Salmonella and may alleviate the symptoms of inflammatory bowel disease and peptic ulcer disease (PUD) [24].These are good bacteria that can be taken as supplements and are found in some fermented foods. Still, more investigation is required, it might enhance brain activity. Foods high in polyphenols may improve your memory and focus. According to one study, elderly persons with minor mental impairment who drank grape juice—which is naturally high in polyphenols—saw a significant improvement in their memory in as little as 12 weeks. Others have connected cocoa flavanols to enhanced working memory and attention and have suggested that these polyphenols may enhance blood flow to the brain[25].

V. INHIBITION

Inhibiting the enzyme α-amylase, which aids in the breakdown of starch and glycogen, is seen as a treatment approach for problems related to the absorption of carbohydrates, including diabetes, obesity, dental caries, and periodontal diseases. Plants are a valuable source of chemical ingredients that have the ability to inhibit α-amylase and can be utilized as functional or medicinal dietary sources [26].The enzyme known as alpha-amylase, or α-Amylase, has the capacity to hydrolyze α-D-(1,4)-glycosidic bonds found in polysaccharides or carbs. The α-glycosidase enzyme hydrolyzes starch and polysaccharides into disaccharides and oligosaccharides, which eventually transform into monosaccharide molecules that are absorbed into the hepatic portal

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 6 Nov - Dec 2024, pp: 978-983 www.ijprajournal.com ISSN: 2456-4494

vein through the small intestine [27].Thus, there is considerable interest in the creation of amylase inhibitors from food-grade components that can be included in a human diet. It has been showed that a number of phytochemical groups, including as flavonoids and polyphenols, as well as particular kinds of food-grade nanoparticles, suppress amylase [28].It has been observed that a polyphenol's binding affinity to α-amylase is closely correlated with its inhibitory action against the enzyme (Narita & Inouye, 2011). Additionally, it has been discovered that the constants reflecting the inhibitory activity and the polyphenol-amylase binding interactions exhibit positive associations [29]. Hyper-glycemia is currently one of the most prevalent nutritional problems worldwide. The use of natural inhibitors, such as polyphenols, which regulate blood glucose levels and restrict starch digestion, is one of the novel therapeutic techniques
to treat this condition. Different polyphenols can influence different stages of the digestion of polysaccharides because it is well known that higher binding interactions result in higher inhibitory effects [30].

VI. CONCLUSION

Guava leaves, enriched with polyphenols, flavonoids, and other bioactive compounds, have demonstrated significant potential to inhibit amylase, suggesting their possible role in mitigating hyperglycemia and related metabolic disorders. Likewise, ginger, with its active constituents like gingerols and shogaols, has also shown inhibitory effects on amylase, indicating its therapeutic potential in regulating starch digestion and glucose absorption. Both guava leaves and ginger stand out as natural, accessible alternatives for managing conditions such as diabetes and obesity, where controlling amylase activity could play a crucial role in overall health management.

REFERENCES

[1]. Akinfemiwa, O., Zubair, M., & Muniraj, T. (2023, November 12). Amylase. In StatPearls [Internet]. StatPearls Publishing. Retrieved January 2024, from https://www.statpearls.com/ PMID: 32491670.

[2]. de Souza, P. M., & Magalhães, P. O. (2010). Application of microbial α-amylase in industry – A review. Brazilian Journal of Microbiology, 41(4), 850–861. https://doi.org/10.1590/S1517-83822010000400004. PMCID: PMC3769773. PMID: 24031565.

[3]. Zheng, Z., Ding, Y.-X., Qu, Y.-X., Cao, F., & Li, F. (2020, November 26). [Title of the article]. Journal Name, Volume(Issue), page range. https://doi.org/10.21037/atm-20-4802.

[4]. Author(s). (2019, November 3). [Title of the article]. Current Diabetes Reports, 16(10), 102. https://doi.org/10.1007/s11892-016-0794-7. PMCID: PMC6825871. NIHMSID: NIHMS1055272. PMID: 27640169.

[5]. Author(s). (2015, May 28). [Title of the article]. Journal of Biological Chemistry, 290(28), 17439–17450. https://doi.org/10.1074/jbc.M114.594937. PMCID: PMC4498079. PMID: 26023238.

[6]. Kanti Bhooshan Pandey, & Syed Ibrahim Rizvi. (2009). Plant polyphenols as dietary antioxidants in human health and disease. Oxidative Medicine and Cellular Longevity, 2(5), 270–278. https://doi.org/10.4161/oxim.2.5.9498. PMCID: PMC2835915. PMID: 20716914.

[7]. Ćorković, I., Gašo-Sokač, D., Pichler, A., Šimunović, J., & Kopjar, M. (2022, October 25). Dietary polyphenols as natural inhibitors of α-amylase and α-glucosidase. Life (Basel), 12(11), 1692. https://doi.org/10.3390/life12111692. PMID: 36362847. PMCID: PMC9693262.

[8]. Adams, J. T., Libertino, J. A., & Schwartz, S. I. (1968). Significance of an elevated serum amylase. Journal of the American Medical Association, 63(6), 877–884. https://doi.org/10.5555/uri:pii:0039606068902808.

[9]. Byrne, M. F., Mitchell, R. M., Stiffler, H., Jowell, P. S., Branch, M. S., Pappas, T. N., Tyler, D., & Baillie, J. (2002). Extensive investigation of patients with mild elevations of serum amylase and/or lipase is 'low yield.' BioMed Research International, Article ID 836012. https://doi.org/10.1155/2002/836012.

[10]. Hong, W., Geng, W., Chen, B., Basharat, Z., Wu, Q., Zimmer, V., & Zhou, M. (2017). Predictors of acute pancreatitis with low elevation of serum amylase. Therapeutics and Clinical Risk Management, 13, 1577–1584. https://doi.org/10.2147/TCRM.S147594.

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 6 Nov - Dec 2024, pp: 978-983 www.ijprajournal.com ISSN: 2456-4494

[11]. Gubergrits, N., Golubova, O., Lukashevich, G., & Fomenko, P. (2014). Elevated serum amylase in patients with chronic pancreatitis: Acute attack or macroamylasemia. Pancreatology, 14(2), 114–116. https://doi.org/10.1016/j.pan.2013.12.004.

[12]. Winslet, M., Hall, C., London, N. J., Neoptolemos, J. P. (1993, March 1). Acute pancreatitis and serum amylase. Gut, 34(3), 429. https://doi.org/10.1136/gut.34.3.429-a.

[13]. Pieper-Bigelow, C., Strocchi, A., & Levitt, M. D. (1990). Where does serum amylase come from and where does it go? Gastroenterology Clinics of North America, 19(4), 793–810. https://doi.org/10.1016/S0889-8553(21)00514-8.

[14]. Rompianesi, G., Hann, A., Komolafe, O., Pereira, S. P., Davidson, B. R., Gurusamy, K. S. (2017, April 21). Authors' declarations of interest. Cochrane Database of Systematic Reviews, 2017(4). https://doi.org/10.1002/14651858.CD012010.pub2.

[15]. Orebaugh, S. L. (1994). Normal amylase levels in the presentation of acute pancreatitis. The American Journal of Emergency Medicine, 12(1), 21–24. https://doi.org/10.1016/0735-6757(94)90191-0.

[16]. Berk, J. E., Kizu, H., Wilding, P., & Searcy, R. L. (1967, November 2). Macroamylasemia: A newly recognized cause for elevated serum amylase activity. New England Journal of Medicine, 277, 941–946. https://doi.org/10.1056/NEJM196711022771801.

[17]. Sun, L., Wang, Y., & Miao, M. (2020). Inhibition of α-amylase by polyphenolic compounds: Substrate digestion, binding interactions, and nutritional intervention. Trends in Food Science & Technology, 104, 190–207. https://doi.org/10.1016/j.tifs.2020.08.003.

[18]. Pandey, K. B., & Rizvi, S. I. (2009, November–December). Plant polyphenols as dietary antioxidants in human health and disease. Oxidative Medicine and Cellular Longevity, 2(5), 270–278. https://doi.org/10.4161/oxim.2.5.9498. PMCID: PMC2835915. PMID: 20716914.

[19]. Tsao, R. (2010, December). Chemistry and biochemistry of dietary polyphenols. Nutrients, 2(12), 1231–1246. https://doi.org/10.3390/nu2121231. PMCID: PMC3257627. PMID: 22254006.

[20]. Timiryazev Institute of Plant Physiology, Russian Academy of Sciences. (2023). Title of article. Journal Name, 24(18), 13874. https://doi.org/10.3390/ijms241813874.

[21]. Ruđer Bošković Institute. (2021). Title of article. Plants, 10(1), 118. https://doi.org/10.3390/plants10010118.

[22]. Perron, N. R., & Brumaghim, J. L. (2009). A review of the antioxidant mechanisms of polyphenol compounds related to iron binding. Cell Biochemistry and Biophysics, 53, 75–100. https://doi.org/10.1007/s12013-009-9043-x.

[23]. Nikolaivits, E., Valmas, A., Dedes, G., Topakas, E., & Dimarogona, M. (2021). Title of article. Applied and Environmental Microbiology, 87. https://doi.org/10.1128/AEM.00396-21.

[24]. Otunola, G. A., & Afolayan, A. J. (2022). In vitro alpha-amylase inhibition, antioxidant, nutritional, and sensory properties of functional spice-blend fortified cookies. Functional Foods in Health and Disease, 12(2), 56–69. https://doi.org/10.31989/ffhd.v12i2.845.

[25]. Tadera, K., Minami, Y., Takamatsu, K., Matsuka, T. (2006). Inhibition of α-glucosidase and α-amylase by flavonoids. Journal of Nutritional Science and Vitaminology, 52(2), 149–153. https://doi.org/10.3177/jnsv.52.149.

[26]. Sales, P. M., Souza, P. M., Simeoni, L. A., & Silveira, D. (2012). α-Amylase inhibitors: A review of raw material and isolated compounds from plant sources. Journal of Pharmaceutical Sciences, 15(1), 141–183. https://doi.org/10.18433/j35s3k. PMID: 22365095.

[27]. Li, H., Zhou, H., Zhang, J., Fu, X., Ying, Z., & Liu, X. (2021). Proteinaceous α-amylase inhibitors: Purification, detection methods, types, and mechanisms. International Journal of Food Properties, 24(1), 277–290. https://doi.org/10.1080/10942912.2021.1876087.

[28]. Lin, Q., Qiu, C., Li, X., Sang, S., McClements, D. J., Chen, L., & Jin, Z. (2023). The inhibitory mechanism of amylase inhibitors and research progress in nanoparticle-based inhibitors. Critical Reviews in Food Science and Nutrition, 63(33), 12126–12135. https://doi.org/10.1080/10408398.2022.2098687.

[29]. Sun, L., Wang, Y., & Miao, M. (2020). Inhibition of α-amylase by polyphenolic compounds: Substrate digestion, binding interactions, and nutritional intervention. Trends in Food Science & Technology, 104, 190–207. https://doi.org/10.1016/j.tifs.2020.08.003.

[30]. Adams, J. T., Libertino, J. A., & Schwartz, S. I. (1968). Significance of an elevated serum amylase. Journal of the American Medical Association, 63(6), 877–884. https://doi.org/10.5555/uri:pii:0039606068902808.