**Exploring the wonders of *Annona squamosa* (custard apple)**

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**Abstract**

***Plants have been utilized extensively in traditional medicine by a range of nations since ancient times, and more research into their safety, efficacy, and quality value is needed. One of the plants that have been widely used by society in traditional medicine is Annona squamosa L. A. squamosa is commonly cultivated in tropical and subtropical regions. Based on previous research, all parts of A. squamosa including bark, leaf, and roots have proven biological activities such as antioxidant, antifungal, and anticancer, especially on the leaves. Indian people have long history used young leaves of A. squamosa for antidiabetic, besides in South China, they use seeds to decrease the cancer effect in the human body. The pharmacological activities of A. squamosa leaves are antimicrobial, antifungal, anti-inflammatory, anticancer, antiulcer, antidiabetic, antidiarrheals, antiplatelet, antioxidant, and hepatoprotective, neuroprotective, and cytoprotective. Phytochemicals in A. squamosa leaves include coumarins, tannins, cardiac glycosides, flavonoids, carbohydrates, and saponins. Meanwhile based on nutritional analysis shows that the A. squamosa leaves are water protein, lipids, Fiber Ash and Calcium.***

**Introduction**  
Today's society has a high concern for a healthier life by consuming natural ingredients. Plants are the best source for making traditional medicine because they live all around us. According to the World Health Organization, it is estimated that 80% of the world's population has used herbal ingredients as medicine for aspects of health care.4 Annona is the second largest genus in the Annonaceae family after Guatteria. A. squamosa is one of the herbal plants that can be used as medicine, also known as custard apple, and based on previous research studies it has been proven has various pharmacological effects that are good for the body.

A. squamosa has been cultivated throughout the world such as in the West Indies, America, and Brazil. Besides custard apples, A. squamosa can also be referred to as sharifa (Hindi), sitappalam (Tamil), sitaphala (Kannada), and sita phalamu (Telugu). The A. squamosa tree can grow up to 3-8 m tall, has cone-shaped fruit, has leaves consist of two colors, namely brilliant green on the top and bluish green on the underside of the leaves, also has petiole that can reach 0.7 - 1.5 cm, while the leaf shape can be oval or elliptical. A. squamosa is an important tropical fruit that can withstand harsh climatic conditions and is widely distributed among annonaceous fruits.

A. squamosa leaves contain active substances such as flavonoids, glycosides, phenolics, tannins, phytosterols, alkaloids, and saponins. These compounds show therapeutic effects such as antioxidants, anticancer, antimicrobial, antiviral, anti-melanogenic, and anti-inflammatory activities. preventing these adverse effects.

Custard apple, scientifically known as Annona squamosa, is a tropical fruit that belongs to the Annonaceae family. It is native to the West Indies but is now cultivated in many tropical and subtropical regions around the world. The fruit gets its name from its creamy, custard-like texture and sweet flavor.

Custard apple is a medium-sized fruit with a greenish-brown, rough, and bumpy exterior. It has a unique shape, typically round or heart-shaped, with a diameter ranging from 7 to 12 centimeters. The fruit is made up of multiple segments or carpels that contain soft, white or creamy flesh embedded with shiny black seeds.

**PLANT DESCRIPTION**

A. squamosa is one of the garden plant that comes from the Annonaceae family known as custard apple. A. squamosa is a small tree with thin gray bark, has flower crown that resembles a flat or round ball. A. squamosa leaves are green with a width of 3-5cm and a length of up to 15 cm, this plant dormancy can be caused by fluctuations in temperature, light, or rainfall. A. squamosa is also a type of plant with bisexual flowers with the groups of 2 to 4 and can reach a length of about 2.5 cm. One of the animals that plays a role in the pollination process of A. squamosa is the nitulid beetle. After the pollination process is carried out, tuberculous fruit is formed and has an aromatic also sweet taste. Each carpel has a smooth seed, with black or dark brown in color, and has oval shape. Trees A. squamosa can flower in spring to early summer, but in areas with permanent humidity levels, A. squamosa can flower throughout the year. The flowers are actinomorphic, protogynous, pedicillate, spirocyclic, bracteates, and bisexual. The A. squamosa flower has six petals and a degenerated sepal formation. The stems of branches A. squamosa are irregular in shape and gray in color and contains compounds

**Varieties of Custard Apple**

There are several different varieties of custard apple cultivated worldwide, including:

1. Pinks Mammoth: This variety is renowned for its large size and sweet, custard-like taste. It has a pale green exterior and a creamy, white flesh.
2. African Pride: Originating from South Africa, this variety has a reddish-brown exterior and a rich, sweet flavor. It is known for its high productivity.
3. Geffner: Geffner custard apple trees are self-pollinating, making them suitable for smaller gardens or limited spaces. The fruit has a green exterior and a pleasant flavor.

**Cultivation and Growing Conditions**

Custard apple trees thrive in warm, tropical climates. Here are some key aspects of custard apple cultivation:

1. Climate: Custard apple trees prefer a subtropical or tropical climate with temperatures between 20°C and 30°C (68°F to 86°F). They are sensitive to frost and require protection in cooler regions.
2. Soil: Well-draining soil with good fertility is essential for custard apple cultivation. The ideal pH range is between 6.0 and 7.5. Sandy loam or loamy soil is recommended.
3. Watering: Custard apple trees require regular watering, especially during dry periods. However, excessive moisture can lead to root rot, so proper drainage is crucial.
4. Sunlight: These trees thrive in full sunlight. They require at least 6 to 8 hours of direct sunlight daily for optimal growth and fruit production.

**Harvesting and Storage**

Custard apples are harvested when the skin color changes from green to a dull yellowish or brownish hue, depending on the variety. The fruit should be gently handpicked to avoid damage. Custard apples are highly perishable and best consumed soon after harvesting. They can be stored for a few days in a cool, dry place or refrigerated for slightly longer shelf life.

**Nutritional Value**

Custard apple is not only delicious but also packed with essential nutrients. It is a good source of vitamin C, dietary fiber, potassium, magnesium, and several B vitamins. The fruit is relatively low in calories and contains no cholesterol or unhealthy fats.

**Culinary Uses**

Custard apple is primarily enjoyed fresh by scooping out the flesh with a spoon. The creamy texture and sweet flavor make it a delightful treat on its own. It can also be used in smoothies, milkshakes, desserts, ice creams, and fruit salads. The pulp can be sieved to remove the seeds and incorporated into various recipes.

Overall, custard apple is a tropical fruit that offers a unique taste experience along with nutritional benefits. Its cultivation requires specific growing conditions.

**Phytochemistry**

Phytochemicals can be found in all fruit and vegetables. That’s why people should consume any kind of them because they can remove free radicals in the human body. Some forms of disease such as heart disease and cancer can be prevented by the phytochemical content in the leaves of this plant, free radical molecules react with antioxidants in the body. Food decomposition can be prevented by using the antibacterial and antioxidant components of leaf extracts.21In the leaves of A. squamosa various kinds of common phytochemical compounds can be found including coumarins, tannins, cardiac glycosides, flavonoids, carbohydrates and saponins.18 In other research, It has been found 33 annonaceous acetogenins, 19 diterpenes, 88 alkaloids and 13 cyclopeptides as the most common constituents of A. Squamosa. Four alkaloids were found in both extracts, leaves and seeds of A. squamosa, namely anonaine, asimilobine, nur nuciferine, liriodenine, corypalmine and reticuline.23 Research with essential oils according to the genus Annonaceae phytochemical compounds found including, (E)-caryophyllene, bicyclogermacrene, caryophyllene oxide, germacrene D, spathulenol, α-pinene, β-pinene, limonene and β-elemene.24 The fundamental oil extricated from A. squamosa shows fabulous antiparasitic and antimalarial movement. 0.13% base oil is produced in the Himalayan lowlands by hydrostillation strategy. The number of constituents that have been identified is around 40, from A. squamosa, the results obtained with a total oil of 88.6% in the extraction process. ASLEO GC-flame ionization discovery investigations and gas chromatography-mass spectrometry showed that the sesquiterpenoids were dominated by sesquiterpenoids (21.8% oxygenated sesquiterpenes and 63.4% hydrocarbon tarred sesquiterpenes) taken after by 1.4% oxygenated monoterpenes and 2.0% monoterpenes. A. squamosa is said to have altered the restorative effect, quantifying the antitumor, insecticidal, antiovulatory and abortive effects according to studies which mainly focus on guaranteeing the of A. squamosa constituents.leaves by GC-MS studies. About 43-54% Hydrogen peroxide can be linked by A. squamosa leaf extract so that it shows antioxidant activity.

**NUTRITIVE VALUE**

A. squamosa leaves contain sufficient concentrations of several minerals. Minerals are needed to protect human’s body because they can help to carry out various activities inside the body, such as regulating blood pressure, the immune system, blood clotting, nerve function, muscle contraction and relaxation, metabolism energy, maintenance of healthy bones and teeth, and regulate many enzymes. One of vitamins that contained in A. squamosa extract is vitamin C. Vitamin C is involved in various activities in the human body such as immune response, maintaining healthy skin, bone development, wound healing, bone development, and strengthening connective tissue. Other vitamins that functioned as co-factors in enzymes involved in oxidation-reduction reactions and carbohydrate metabolism are vitamins B1, B2, BIn a study conducted in Egypt, suggested that the highest protein content was in the leaves of A. squamosa when it compared to the fruit and seeds of A. squamosa plant. A. squamosa with a higher protein content, that is A. squamosa leaf extract, can be used in humans and also animals to increase the value of food. High amounts of protein and amino acids are found in the methanol and water extracts which from the leaves of A. squamosa. These results were proven by the Biuret test which confirmed that there were amino acids and proteins in the aqueous A. squamosa leaf extract, also the Milon test confirmed that there were amino acids and proteins in the A. squamosa methanol leaf extract.

**TRADITIONAL USE**

Herbal medicine has been widely accepted in most countries in the world, as evidenced according to WHO countries in Africa, Latin America, and Asia use herbal medicine as a complement to the primary treatment. One such plant with extensive traditional use is A. squamosa. A. squamosa tree is widely distributed in Indomalaya, the Caribbean, South America, and Australia. Commonly all parts of A.squamosa can be used by communities for thetreatment of different acute and chronic diseases such as insect bites, cancerous and skin complaints. Antibacterial and wound healing activity of the leaves of A. Squamosa. In America, India, and Thailand A. squamosa leaf is used to treat urinary tract infection and dysentery. In Indonesia leaves A. squamosa are very popular, especially since research has begun to prove that it can fight super dangerous diseases such as cancer. Even in India the leaf as traditional medicine is also crushed and applied to wounds. In addition, decoction of A. squamosa leaves or combination with other plants, its content can be absorbed by the body well as a febrifuge, cold remedy, and employed in the bath to alternative rheumatic pain in traditional American medicine.

**MEDICINAL VALUE**

Medicine using natural ingredients from medicinal plants has been used as an alternative medicine since ancient times. The use of medicinal plants as alternative medicine is considered effective and important for human health.Research on the benefits of leaves A. squamosa has been widely carried out, and research studies examining the benefits of A. squamosa leaves show that leaves A. squamosa have many health benefits related to phytochemical diversity. The compounds contained in A. squamosa leaves include phenol-based compounds such as proanthocyanidins and 18 different phenolic compounds. The biological activities of A. squamosa leaf extract includes anticancer, hepatoprotective, lipidlowering, antidiabetic, anti-obesity, antioxidant. A.squamosa leaves are also reported to have various chemical compounds that are beneficial for the body such as hydroxyl isomers of ketones and alkaloids. A. squamosa leaves have potential for vermicide action, treatment of tumors, cancer, insect bites, abscesses, and skin diseases. A. squamosa leaves that have been crushed into smaller compounds have been used to treat wounds and ulcers on the skin. Leaves A. squamosa which have been in the form of dry powder are considered as an alternative medicine for cases of slimy diarrhea and can also be used for laxatives. Leaf methanol extract A. squamosa can be a natural ingredient that is used as an alternative material that can be developed into various types of drugs that can delay or even prevent damage to body cells or in other words, A. squamosa leaf has the potential as an alternative antioxidant material. A. squamosa leaf methanol extract can be used as a dermatological anti hyperpigmentation agent and has the potential to be developed into cosmetic products that can lighten the skin.

**Antimicrobial activity**

Based on research on the antibacterial activity of the ethanol extract of A. squamosa leaves and DMSO which were tested in vitro with the agar plate method against clinical isolates of P. aeruginosa and E. coli by Neethu et al (2016), it was shown that there was a mechanism of inhibition of the growth of these two microbes due to the treatment of A. squamosa leaf ethanol extract.In this study, A. squamosa leaf ethanol extract at concentration of 25µl was shown no zone of inhibition. However, at a concentration of 50µl, there was an inhibition zone of 11 mm on isolates E. coli and no inhibition zone on isolates P. aeruginosa. and at a concentration of 100 µl, there was an inhibition zone of 17 mm on isolates E. coli and 15 mm on isolates P. aeruginosa. A. squamosa is used as an antibacterial agent because it has secondary metabolites such as essential oils, phenols, alkaloids, terpenoids, and flavonoids.

**Antifungal activity**A. squamosa leaves extract is revealed to be capable of inhibiting the growth of Fusarium oxysporum and especially Colletotrichum capsici.

**Anti-inflammatory activity**

Maintenance of urolithiasis using the ethanolic extract of A squamosa have almost the same comparison than the clinical treatment. Pain in urinary tract inflammation can be reduced by the pharmacological activity of anti-inflammatory and analgesic compounds from A. squamosa leaf extract. Smooth muscle contractions of the urinary tract have been shown to be relaxed by restoring impaired kidney function, normalizing urine and serum parameters, and restoring damaged cells. In association with the assessment of The ethanol extricate of atemoya takes off (Annona squamosa L. x Annona cherimola Mill.), There was a reduction in leukocyte relocation as a parameter of inflammatory activity. Examination of the peritoneal cavity is carried out and then a subcutaneous discussion package test is carried out so that the decrease in movement can be known. Barriers to the pathway This cyclooxygenase effect occurs because the inflammatory activity inhibits the synthesized mediators. Inflammation can occur due to involvement of the relocation of defense cells by carrageenan, IL-1β, IL-8, IL-6, plasma exudation and (TNF-α).**Anticancer activity**

Ethnic communities use all parts of A. squamosa traditionally for treatment of various diseases, such as cancer tumors, skin problems, insect bites, and any others.But there is a part of this plant that is poisonous located in the seeds which can be used to kill lice and head lice, while the leaves of A. squamosa can be used as hepatoprotective and immunomodulatory. In previous studies, a research has been carried out on A. squamosa against anti-cancer related non-alkaloidal moieties particularly the acetogenin. A research on the alkaloids section of A. squamosa yielded two benzylisoquinoline alkaloids. Isolated Alkaloids I provide excellent activity for colon cancer cells (HTC116) and also for Human Breast cancer cells (MCF-7) which is related to the activity of benzylisoquinoline alkaloids in cancer cells.

**Antiulcer activity**

A. squamosa leaves contain properties that have efficacy as Antiulcerative. Recently a study conducted on experimental animals of male albino- Wistar rats and indomethacin was used to induce ulcer presented that aqueous extract of dosage 175 mg/kg and 350 mg/kg significant reduction in free acidity, gastric volume, and ulcer index as compared with the control group. The acute oral toxicity study for aqueous extract of A. squamosa leaves has shown that the plant leaf was safe and nothing side effects were observed so, it can be used for the management of peptic ulcers

**Antioxidant activity**

Antioxidants are compounds that play a role in inhibiting or providing protection for living organisms from damage which is a manifestation of uncontrolled ROS production.Diseases such as diabetes, cancer, and inflammatory conditions are some of the diseases caused by oxidative stress. In this case, antioxidants play a role to help fight oxidative stress by scavenging free radicals. Natural antioxidants such as flavonoids as well as several phenolic compounds have been documented that have the potential to protect cells from free radicals

The results of several studies on the content of antioxidant compounds in the ethanol extract of A. squamosa leaves show that leaves A. squamosa contain flavonoids in the form of rutin and hyperoside. Rutin and hyperoside are compounds that have biological activities related to antioxidant mechanisms. A. squamosa leaf extract using chloroform solution showed strong free radical scavenging activity of IC50 308.3 mg/mL. In the other hand, their leaf extract using methanol solution showed free radical scavenging activity of IC50 342.5 mg/mL. Meanwhile, their extract with an aqueous solution showed relatively little free radical scavenging activity, namely IC50 439.6 mg/mL. The extract using ascorbic acid showed the highest free radical scavenging activity, which was IC50 35.26 mg/mL.4

**Antidiabetic activity**

The antidiabetic and antioxidant properties of A. squamosa leaf extract may be due to the presence of these phytochemicals. The induction of streptozotocin causes specific damage to islet cells and thereby increases blood glucose concentrations. It is well known that gliclazide produces hypoglycemia and is often used as the standard drug in STZ-induced models of moderate diabetes to compare the antidiabetic properties of various compounds. Administration of A. squamosa leaf extract in STZ-induced diabetic rats resulted in a significant decrease in blood glucose levels.

**Anti-infertility activity**

Animal subject that was administered by A. squamosa leaf extract showed a significant reduction of the average testicular index, this happened because of testicular weight shrinkage which indicates antifertility activity. Extract of A. squamosa leaves affects the hormonal mechanism that regulate spermatogenesis, which decrease caudal epididymal sperm counts. Administration of the ethanol extract notably showed a decrease of spermatozoa concentration and abnormalities in spermatozoa such as bent tails, spermatozoa without tils, headless spermatozoa, and spermatozoa with two heads.

**Anti platelet activity**

Anti-platelet movement: The ent-kaurane diterpenoids, which are separated from the stem of A. squamosa. are examined for anti-platelet action. The ent kaurane diterpenoids 'ent-Kaur- 16-en-19-oic acid' and '16alpha-hydro19 -al-entkauran- 17-oic acids' appeared total inhibitory impacts on rabbit platelet conglomeration at 200 M, detailed that Annona species can be misused for planning of restorative items with tall esteem.

**Hepatoprotective activity**

A. squamosa leaves have very high antioxidant activity, which have function to free radical capacity, while lipid peroxidation inhibitors have hepatoprotective function. In a study conducted by Rajeskumar *et al.* (2015), which is to evaluating the hepatoprotective function of A. squamosa leaves, using albino rats that they were given a dose of A. squamosa leaf extract (1000 mg/kg body weight) could provide effective protection on liver cells by increasing protein levels, inducing a significant decreasing in serum glutamate oxaloase transaminase, and serum glutamate pyrivate transaminase levels.

**Anti diarrhea activity**

A. squamosa leaves contain alkaloids, tannins, steroids, flavonoids, and saponins, Tannin is the properties that have astringent to treat dysentery and diarrhea.60 In detail, the compound leaves are alkaloids, 6, 7-dimethoxy-1-(α-hydroxy-4-methoxybenzyl)-2-methyl-1, 2, 3, 4-tetrahydroisoquinoline.61 An experiment showed that ethanolic extract of A. squamosa leaves was effective as an antidiarrheal.

**Neuroprotective activity**

A. squamosa leaf has many benefits. Based on a study conducted by Porwal *et al.* (2015), related to neuron protection, it was stated that sugar apple leaf extract contains anonaine can help in treating epilepsy, mood disorders, and memory problems.The results of the phytochemical test of A. squamosa leaf extract using Petroleum and Ethanolic showed that A. squamosa leaf contains phenols components. Phenols play an important role in preventing neurodegenerative disease conditions.

**Cytoprotective activity**

The increase in mucin levels in the pyloric ligation model and the alcohol-induced protection of the aspirin model are clear evidence of cytoprotective activity in A. Squamosa.

**Hypolidemic activity**

Diabetic mice were shown to had higher total cholestrol and TGs values compared to control. Therapy using aqueous and ethanolic extracts of A. squamosa leaves both lead to decrease in mean level of cholesterol, triglyceride, and LDL-cholestrol, while HDL-cholesterol was increased. This could happen due to the initiation of lipoprotein lipase enzyme and inducement of β-cells that secrete fair amount of insulin to clear triglycerides from the plasma.**Immunomodulatory activity**

A. squamosa leaf water extract has a possibility to be a strong immunostimulant with a nonspecific immune mechanism. The immunomodulatory movement of leaf extract watched in A. squamosa was showed in Clarias batrachus fish in hematological parameters. There was a critical increase within the concentration of extract (10ml) 50% and (15ml) 100%. At that point analyzed hematological parameters in fish blood and found an increase within the number of TEC, hemoglobin levels, TLC counts and the number of Differential Leukocytes. Hematological lists such as hemoglobin, blood cell counts (RBC and WBC) revealed critical changes due to the treatment of ethanol extract of A. squamosa leaves and fruit. The important increase in WBC assay in treated mice observed in this study may be due to stimulation of the immune system.

**Nephrotoxicity activity**

Histopathological examination of paracetamol inebriated kidney tissue in rats was obtained at the expense of animals after 24 hours. Examination revealed intense necrosis and degeneration of the tubular epithelium. These changes suggest cell degeneration on the side of intense tubular necrosis and are most associated with histopathological changes. Insignificant swelling or direct necrosis was observed in pretreated (200 and 400mg/kg) ethanolic extract of A. squamosa leaves and impressively (P < 0.001) reduced BUN, creatinine, and urate corrosive levels in a urate-dependent manner. at the dose, which appears the power of renal cell regeneration.

**CONCLUSION**

A. squamosa plant is a type of plant that was first known in Mexico and is now widely found in so many places around the world. A. squamosa plants grow well in the lowlands and the tropics. The leaves of A. squamosa is a type of plant that is still rarely used. A. squamosa has a lot of benefits for humans such as for health functions based on the previous studies that have shown that their leaves have high nutritive value. However, research on A. squamosa leaves needs to be further developed to be able to convince and increase the information that A. squamosa leaves have many benefits, especially in the prevention and treatment of disease.

**REFERENCES**

Al-Nemari R, Bacha AB, Al-Senaidy A. Selective cytotoxic effects of Annona Squamosa Leaves against breast cancer cells via apoptotic signaling proteins. Plants. 2020;9:1-14.

Chandel SS, Dikshit SN, Sharma HG. Collection and evaluation of custard apple (Annona squamosa L.) genotypes in Chhattisgarh plains. J Pharmacogn Phytochem. Published online 2018:149-152.

Fincan M. Extractability of phenolics from spearmint treated with pulsed electric field. J Food Eng. 2015;162:31-37.

Gajalakshmi S, Divya R, Divya Deepika V, Mythili S, Sathiavelu A. Pharmacological activities of Annona squamosa: A review. Int J Pharm Sci Rev Res. 2011;10(2):24-29.

Johns T, Windust A, Jurgens T, Mansor SM. Antimalarial alkaloids isolated from Annona squamosa. Phytopharmacology. 2011;1(3):49-53.

Kalidindi N, Thimmaiah NV, Jagadeesh NV, Nandeep R, Swetha S, Kalidindi B. Antifungal and antioxidant activities of organic and aqueous extracts of Annona squamosa Linn. leaves. J Food Drug Anal. 2015;23(4):795-802.

Khairullah AR, Solikhah TI, Ansori ANM. Review on the Pharmacological and Health Aspects of Apium Graveolens or Celery: An Update. Syst Rev Pharm. 2021;12(1):606-612.

Korah MC, Rahman J, Rajeswari R. Evaluation of diuretic efficacy and antiurolithiatic potential of ethanolic leaf extract of Annona squamosa. Ma C, Chen Y, Chen J, Li X, Chen Y. A review on Annona squamosa L.: phytochemicals and biological activities. Am J Chin Med. 2017;45(05):933-964.

Morais-Braga MFB, Carneiro JNP, Machado AJT. Phenolic composition and medicinal usage of Psidium guajava Linn.: Antifungal activity or inhibition of virulence? Saudi J Biol Sci. 2017;24(2):302-313.

Moreira SA, Alexandre EMC, Pintado M, Saraiva JA. Effect of emergent non-thermal extraction technologies on bioactive individual compounds profile from different plant materials. Food Res Int. 2019;115:177-190.

Moreira SA, Alexandre EMC, Pintado M, Saraiva JA. Ethanolic Noni (Morinda citrifolia L.) leaf extract dechlorophyllised using sedimentation process: Antioxidant, antibacterial properties and efficacy in extending the shelf‐life of striped catfish slices. Int J Food Sci Technol. 2021;56(6):2804-2819.

Nagori R, Sharma P, Purohit SD. Molecular characterization of diversity in Annona squamosa L.: A high value tropical medicinal plant. Int J Phytocosmetics Nat Ingredients. 2018;5(1):1-13.

Nguyen MT, Nguyen VT, Le VM. Assessment of preliminary phytochemical screening, polyphenol content, flavonoid content, and antioxidant activity of custard apple leaves (Annona squamosa Linn.). IOP Conf Ser Mater Sci Eng. 2020;736:062012.

Olatunde OO, Tan SL Della, Shiekh KA, Benjakul S, Nirmal NP. Ethanolic guava leaf extracts with different chlorophyll removal processes: Anti-melanosis, antibacterial properties and the impact on qualities of Pacific white shrimp during refrigerated storage. Food Chem. 2021;341:1-11.

Safira A, Savitri SL, Putri ARB. Review on the pharmacological and health aspects of Hylocereus or Pitaya: An update. J Drug Deliv. Ther. 2021;11(6):297-303.

Shukry WM, Galilah DA, Elrazek AA, Shapana HA. Mineral composition, nutritional properties, vitamins, and bioactive compounds in Annona squamosa L. grown at different sites of Egypt. Ser Bot Environ Sci. 2019;1(1):7-22.

Silva H do N, Rabêlo SV, Diniz TC. Antinociceptive and antiinflammatory activities of ethanolic extract from atemoya (Annona cherimola Mill x Annona squamosa L.). African J Pharm Pharmacol. 2017;11(18):224-232.

Solikhah TI, Solikhah GP, Susilo RJK. Aloe vera and Virgin Coconut Oil (VCO) accelerate healing process in domestic cat (Felis domesticus) suffering from scabies. Iraqi J Vet Sci. 2021;35(4):699-704.

Vanitha V, Umadevi KJ, Vijayalakshmi K. Determination of bioactive components of Annona squamosa L leaf by GC-MS analysis. Int J Pharm Sci Drug Res. 2011;3(4):309-312.

Verma RS, Joshi N, Padalia RC, Singh VR, Goswami P, Chauhan A. Characterization of the leaf essential oil composition of Annona squamosa L. from foothills of north India. Med Aromat Plants. 2016;5(5):1-5.

Vyas K, Manda H, Sharma RK, Singhal G. An update review on Annona squamosa. Int J Pharm Ther. 2012;3(2):107-118.