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A Review : On Phytochemical Profile And Therapeutic Uses Of Annona Squamosa Plant

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ABSTRACT: -

Review Annona Squamosa (Apple Custom Apple or Sugar Apple) emphasizes plant chemical wealth and various treatments. The plants harvested in the West Indian Islands and South America contain biological compounds such as antibacterial, antioxidant, and alkaloids, flavonoids, and terpenoids, known for their anti -inflammatory characteristics. Traditionally, some of the plants containing seeds, fruits, and leaves were used to treat the disease, especially when synthetic antibiotics were used. Major treatments include anti -diabetic, antitumor, and hook activities. This test emphasizes the need for detailed research to fully use the potential of drugs A Square Mosa.

Introduction

Humans have studied medicinal plants since ancient times and have discovered numerous healing plants that treat various illnesses (Verpoorte, 1998).**[1]** Annona squamosa (L.) is a small evergreen tree of the Annobaceae family used in traditional medicine, especially for the treatment of diseases treated with synthetic antibacterial agents (Iwu et al., 1999).**[2]** Annona squamosa, known as custard apple, sugar apple or sweet apple in English, is also called sharifa in Hindi, sitaphalam in Telugu and has French names like soursolier and stony.The plant is rich in bioactive compounds (alkaloids, flavonoids and terpenoids) that have antibacterial, antioxidant and anti-inflammatory properties making it valuable in traditional medicine. Known therapeutic possibilities include antidiabetic, anticancer, and wound healing uses, although further research is needed to fully realize its medical potential **[3]** The seeds, fruits and leaves of *Annona squamosa* are effective as an insecticide, fish poison and a powerful eye irritant, while the root is used as a powerful laxative and to treat acute dysentery**.[4]** Studies on Anona squamosa have identified bioactive compounds in its fruit pod and seed oil extracts, including unsaturated fatty acids and acetogenins, whose antibacterial properties were confirmed by GC-MS analysis**.[5]** Anona squamosa is a tropical fruit cultivated worldwide, growing in harsh climate areas like West Indies, America, Brazil etc. Known by various regional names such as sharifa in Hindi, sitappalam in Tamil, sitaphala in Kannada and sita phalamu in Telugu, it is prized for its persistence and wide range of medicinal uses**.[6]** Anona squamata stands out among the fruit trees of the Annonaceae
family for its hardiness and wide distribution, it grows well in a variety of climatic conditions and is highly valued worldwide for its medicinal properties**.[7]**

TAXONOMY

Anona squamosa belongs to the kingdom Plantae Division: phylum Magnoliophyta class : Magnoliopsida.

Fig.1: Annona squamosa fruit and leaves Annona squamosa is a member of the genus Annona species :Annona squamosa family :Annonaceae, order :Magnoliales**.[8]**

GENERAL INFORMATION:-

Originally from the West Indies and South America, Annona squamosa is a member of the Annonaceae family and is frequently grown in Thailand and India. Known for its fruit and aesthetic value, it is also known as sharifa in Hindi, sitaphalam in Telugu, corossolier and cailleux in French, and custard apple, sugar apple, and sweet apple in English**.[9]**
A little tropical tree, Annona squamosa (custard apple) has an open crown, elliptic leaves that alternate, fragrant yellow-green blooms, and spherical, knobby fruits. Each fruit contains 20–40 seeds, with each section of its sweet flesh bearing an oblong seed. It is highly valued for its fruit and is widely grown in tropical areas**.(9)**

Cultivation

Annona squamosa grows well in a variety of soil types and well-drained soils; a 3-10-10 NPK fertilizer increases fruit yield. Seeds are typically used for propagation, however grafting produces faster, higher-quality fruit. Pests include mealybugs, scale insects, beetles, seed borers, and fungal infections can affect it.

Etymology:

The genus name Annona is derived from the goddess of harvest in Latin America, whereas the species name squamosa is based on the Latin term for "scale," alluding to the scaly appearance of the unripe fruit

Ethnobotanical Uses:

Edible Parts: The fruit is consumed raw and is particularly popular in Brazil and India.
In Malaysia, it is often added to milk and ice cream.

Medical Uses:
Bark extracts have compounds that may provide cancer protection. In many tropical regions of America, a leaf decoction is used to treat colds and digestive or urinary issues.

Caution: The seeds contain toxic compounds; a solution made from ground seeds mixed with water can cause blindness if it comes into contact with the eyes **(10)**

Table 1. Nutritional Profile of A. squamosa(11)

Nutrition	Amount
Water	**180gm**
Protein	**5.6gm**
Ash	**1.6gm**
Total calories	**233**
Calories from fat	**6.5**
Calories from protein	**18**
Calories from carbohydrates	**225**
Total fat	**720gm**
Omega-6 fatty acid	**90gm**
Total carbohydrates	**49gm**

Phytochemical Profiling:

The chemical tests were conducted on hexane, chloroform, ethyl acetate, and methanolic extracts of A. squamosa using standard procedures to identify bioactive secondary metabolites (12) Several bioactive compounds were found in the four extracts after a preliminary phytochemical analysis. Alkaloids, terpenoids, flavonoids, and tannins were among the substances that were consistently found in all extracts. Only the major compounds are highlighted here because of their prominence, although moderate to low levels of reducing sugars, saponins, quinones, and anthraquinones were also observed. The strong reactions in the tests for tannins, flavonoids, terpenoids, and alkaloids indicate that the extracts are rich in phytochemicals with possible therapeutic benefits. (13,14,15)
Phytochemical screening of A. squamosa extracts—hexane, chloroform, ethyl acetate, and methanol—revealed the strong presence of key bioactive secondary metabolites. Tannins, flavonoids, terpenoids, and alkaloids were prominently detected across these extracts, highlighting their abundance. Tests showed weaker or no significant presence of reducing sugars, saponins, quinones, and anthraquinones. The notable presence of these metabolites, especially in the methanolic and ethyl acetate extracts, underscores their potential therapeutic properties. quinones, and anthraquinones. The notable

presence of these metabolites, especially in the methanolic and ethyl acetate extracts, underscores their potential therapeutic properties.The phytochemical profile of extracts from A. squamosa reveals a wide variety of bioactive substances with possible therapeutic uses. Among the important classes of compounds found are: Along with other alkaloids like dopamine, salsolinol, and liriodenine, notable alkaloids include benzoxyquinazoline, samoquasine A, and roemerolidine. Strongly represented by substances with anti-inflammatory and antioxidant qualities, flavonoids include kaempferol, isoquercitrin, rutin, and quercetin. - Entkaurene Diterpenoids: The bioactivity of the extracts is attributed to compounds such as annomosin A and annosquamosin variants (A-F). Quercetin-3-glucoside, a flavonoid glycoside, was found in high concentration. Natural Oils: a diverse range of essential oils with antimicrobial and aromatic qualities, such as germacrene, β-elemene, α- and β-pinene, and sabinene. Other bioactive substances that add to A. squamosa's varied medicinal potential include glucopyranoside, annonacin, squamocin variations, and coumarinoligans like annotemoyin.(12,16)

Phytochemical Tests

1. **1.Test for Alkaloids:**

To 2 ml of plant extract, 2 ml of concentrated hydrochloric acid was added, followed by a few drops of Mayer's reagent. The appearance of a green color indicates the presence of alkaloids.

2. **2.Test for Carbohydrates:**

To 2 ml of plant extract, 1 ml of Molisch's reagent and a few drops of concentrated sulfuric acid were added. The formation of a purple color indicates the presence of carbohydrates.

3. **3.Test for Tannins:**

To 1 ml of plant extract, 2 ml of 5% ferric chloride was added. The formation of a greenishblack color indicates the presence of tannins.

4. **4.Test for Saponins:**

To 2 ml of plant extract, 2 ml of distilled water was added and shaken in a graduated cylinder for 15 minutes. The formation of a 1 cm layer of foam indicates the presence of saponins.

5. **Test for Flavonoids:**

Five ml of dilute ammonia solution was added to a portion of the aqueous filtrate of the plant extract, followed by concentrated sulfuric acid. The appearance of a yellow color indicates the presence of flavonoids.

6. **Test for Anthocyanin and Betacyanin:**

To 2 ml of plant extract, 1 ml of 2N sodium hydroxide was added and heated for 5 minutes at 100ºC. The formation of a yellow color indicates the presence of betacyanin.

7. **Test for Quinones:**

To 1 ml of extract, 1 ml of concentrated sulfuric acid was added. The formation of a red color indicates the presence of quinones.

8. **Test for Glycosides:**

To 2 ml of plant extract, 3 ml of chloroform and 10% ammonia solution were added. The appearance of a pink color indicates the presence of glycosides.

9. **Test for Cardiac Glycosides:**

To 0.5 ml of extract, 2 ml of glacial acetic acid and a few drops of 5% ferric chloride were added. This was layered with 1 ml of concentrated sulfuric acid. The formation of a brown ring at the interface indicates the presence of cardiac glycosides.

10. **Test for Terpenoids:**

To 0.5 ml of extract, 2 ml of chloroform was added, followed by careful addition of concentrated sulfuric acid. The formation of a red-brown color at the interface indicates the presence of terpenoids.

11. **Test for Triterpenoids:**

To 1.5 ml of extract, 1 ml of Liebermann–Burchard reagent (acetic anhydride + concentrated sulfuric acid) was added. The appearance of a blue-green color indicates the presence of triterpenoids.

12. **Test for Phenols:**

To 1 ml of extract, 2 ml of distilled water and a few drops of 10% ferric chloride were added.
The formation of a green color indicates the presence of phenols.

13. **Test for Coumarins:**

To 1 ml of extract, 1 ml of 10% sodium hydroxide was added. The appearance of a yellow color indicates the presence of coumarins.

14. **Test for Steroids:**

To 2 ml of extract, 5 ml of chloroform was added and filtered. To the filtrate, 2 ml of acetic anhydride and 2 ml of sulfuric acid were added. A color change from violet to blue or green indicates the presence of steroids.

15. **Test for Acids:**

To 1 ml of extract, sodium bicarbonate solution was added. The formation of effervescence indicates the presence of acids **(12).**

Table 2: QUALITATIVE PHYTOCHEMICAL ANALYSIS OF *Annona squamosa* LEAF

Name of phytochemical	the Petroleum ether extract	Chloroform extract	Ethanolic extract	Aqueous extract
Alkaloid test	+	+	++	+
Carbohydrate test	_	_	++	+

Saponin test	_	_	_	+
Flavonoid test	_	_	++	_
Anthocyanin and Betacyanin test	_	_	+	_
Quinones	_	+	++	_
Glycosides test	_	_	+	_
Cardiac glycosides test	_	_	_	_
Terpenoids test	_	_	++	_
Triterpenoids	_	_	++	_
Phenols	+	_	+	_
Coumarins	_	_	+	_
Acids	_	_	_	_
Steroids	+	_	+	_
Tannins	_	_	++	_

The ethanolic extract was found to have the highest concentration of major phytochemicals among the four leaf extracts of A. squamos (petroleum ether, chloroform, ethanol, and water). Its high concentration of phenolic compounds, flavonoids, and tannins suggests that these bioactive ingredients have a great deal of potential for use in medicine**.(17)**

THERAPEUTIC USES:

A variety of medicinal benefits are displayed by Annona squamosa: leaves have antidiabetic and anti-hyperthyroid effects, seeds have anti-fertility qualities, and fruits help with blood enrichment.**[18]**

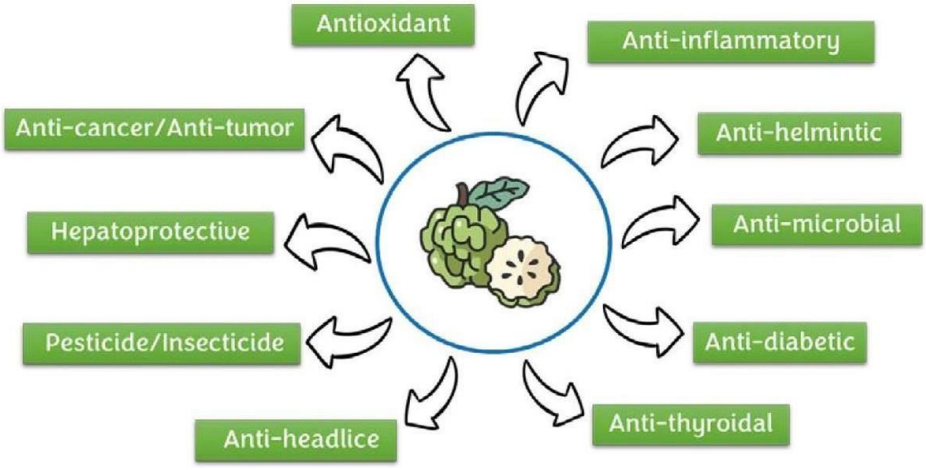

Fig.2: Therapeutic uses in digramaticaly

Antibacterial Activity

Studies Annona muricata show that the methanol and ethanol extracts of leaves have antibacterial properties against Staphylococcus aureus, probably from flavonoids, alkaloids and steroids. On the contrary, the water extracts of the peel did not show antibacterial effects, with MIC values between 25-50 µg/ml.**[19,20,21**] The methanol extract of Anona squamosa leaves showed strong antibacterial activity, especially against gram-positive bacteria, inhibiting most of the test strains except Salmonella typhimurium.The methanol extract produced the largest zone of inhibition, followed by petroleum ether and aqueous extract, with the aqueous extract showing the lowest activity**(22)**

Anti-tumor Activity

alloxan-induced diabetic rats, Annona squamosa pulp improved health outcomes, especially at higher doses (5.0 and 10.0 g/kg).Treated rats had better liver and heart health and reduced levels of SGOT, SGPT, ALKP, and serum bilirubin compared to the control group. The treatment also improved protein utilization (PER, DC, BV, NPU) and had a positive effect on FBG, cholesterol, triglyceride and total protein levels.**[23]**

Antidiabetic Activity

Annona squamosa pulp administered at doses of 2.5, 5.0, and 10.0 g/kg showed significant health benefits in alloxan-induced diabetic rats. Treated rats showed improved protein efficiency (PER, DC, BV, NPU) and reduced fasting blood glucose, total cholesterol, and triglycerides. The pulp had a positive effect on markers of liver and heart function, reducing serum SGOT, SGPT, ALKP, and bilirubin levels compared to the control group. Urinary protein and glucose levels were also positively affected, indicating an improvement in overall metabolic health**.[24]**

In rats with alloxan-induced diabetes, *Annona squamosa* fruit pulp at doses of 2.5, 5.0 and
10.0 g/kg showed significant health benefits.Treated rats had improved protein efficiency (PER, DC, BV, NPU) and decreased fasting blood glucose, total cholesterol and triglycerides.Dental pulp had a positive effect on markers of liver and heart function, lowering SGOT, SGPT, ALKP and serum bilirubin levels compared to controls.There was also a positive effect on urinary protein
and blood glucose levels, indicating improved overall metabolic health.**[25]**

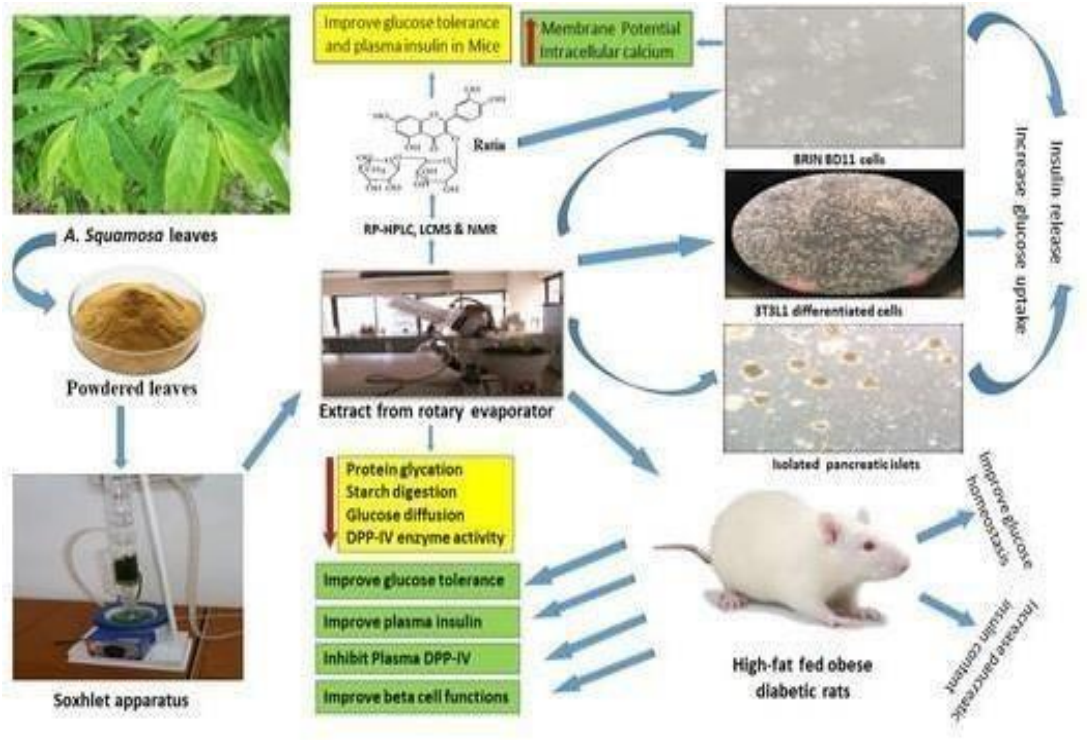

Fig.3: Antidiabetic Activity

Anticancerous Activity

Annona squamosa has traditionally been used to treat cancer, skin disorders and insect bites - the seeds are toxic and used against lice, while the leaves have liverprotective and immunomodulatory effects**.[26]**

Antimicrobial Activity

Ethanol extracts derived from Annona squamosa foliage exhibited antibacterial properties ag ainst E. coli and P. aeruginosa in vitro. At a concentration of 50 µL the extract suppressed E. coli (11 mm inhibition zone) but failed to affect P. aeruginosa. When increased to 100 µL, the inhibition zones expanded to 17 mm for E. coli and 15 mm for P. aeruginosa, attributed to se condary metabolites such as essential oils, phenolic compounds, alkaloids, terpenoids, and f lavonoids.**[27]**

Antioxidant Activity

Annona coriacea seed extract exhibited moderate levels of antioxidant activity(31.53% in DP PH, 51.59% in βcarotene assays), whereas its pulp displayed lesser effectiveness. The bark, leaves, and stem of Annona muricata also showed antioxidant properties, with EC50 values measuring 90, 290, and 116 mg/g, respectively. Ethanolic extracts derived from A. squamos a leaves revealed robust antioxidant activity (75.12% in DPPH, 34.69% nitric oxide, 10.29% superoxide tests) at a concentration of 100 µg/mL**.[28,29,30]**

Antiulcer Activity

The synthetic molecule 1-(4-β-D-glucopyranosyloxyphenyl)-2-(β-D-

glucopyranosyloxy)ethane, extracted from Annona squamosa branches, displayed significan t antiulcer properties. It decreased stomach acidity, pepsin concentrations, and H(+)/K(+)AT Pase activity, diminished plasma gastrin, and elevated mucin levels, showcasing cytoprotecti ve effects across various ulcer models. **[31]**

Anti-infertility Activity

Annona squamosa leaf extract showed antifertility effects in animal studies, significantly reducing testicular weight and sperm counts. Ethanol extract administration led to lower sperm concentration and increased abnormalities, such as bent tails, headless, and doubleheaded sperm**.[32,33]**

Other Activities

sperm.nd inThe seeds of A. squamosa have a number of pharmacological qualities, such as antihelminthic, anticancer, antioxidant, wound-healing, and insect-repelling effects. They contain cyclohexapeptides, polyphenols, alkaloids, and acetogenins, among other bioactive substances. Traditional applications include lice removal and skin exfoliation. Significant therapeutic potential is suggested by recent studies that also demonstrate the seed extract's ability to effectively inhibit the growth of Spodoptera litura larvae and its antiparasitic activity against nematodes and earthworms in livestock**.[34]**

Conclusion: -

Annona squamosa is a versatile medicinal plant with a rich history and wide therapeutic potential. Different parts of the plant, including the seeds, fruits and leaves, contain bioactive compounds such as alkaloids, flavonoids and terpenoids that contribute antibacterial, anti-inflammatory and antioxidant properties. The plant shows promise in treating diseases such as cancer, diabetes, and cardiovascular disorders, and also has insecticidal and fish poison uses. Traditional medicinal applications of Annona squamosa suggest it as a natural alternative to synthetic antimicrobials, highlighting the need for further research to support its sustainable use in modern medicine.

REFERENCES

1. Verpoorte R. Chemodiversity and the biological role of Secondary metabolites, some thoughts for selecting plant material for drug development. Proc Phytochem Soc, Europe, Kluwer Publishers. 1998; 43:11-24.
2. MW, Duncan AR, Okunjio CO. New antimicrobials of plant origin. Alexandria, VA: ASHS Press 1999, 457462
3. Popenoe W. The Cherimoya. California Avocado Society Year Book. Vol. 54. 1970. p. 133-9.
4. Mukhlesur Rahman M, Shahnaj Parvin, Ekramul Haque M, Ekramul Islam M, Mohammad A.
5. Mosaddik b. Antimicrobial and cytotoxic constituents from the seeds of *Annona squamosa*. Fitoterapia 76 :2005, 48
6. Chen Y, Chen Y, Shi Y, Ma C, Wang X, Li Y, *et al*. Antitumor activity of Annona squamosa seed oil. J Ethnopharmacol 2016; 193:362–367. doi:10.1016/j.jep.2016.08.036.
7. 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.
8. 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
9. 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.
10. Baumer 1995,Burkhill (vol 1) 1985, GTZ/ ICRAF 1990, Vogt 1995+ [Hamza(1990)].
11. Kaleem, M., Medha, P., Ahmed, Q. U., Asif, M., & Bano, B. (2008). Beneficial effects of Annona squamosa extract in streptozotocin-induced diabetic rats. *Singapore medical journal*, *49*(10), 800.
12. Md. Shakeeb Alam[1], Praveen Verma[1]*, Suman Bodh[1], Ab Waheed Wani[1] and Sanjeev Kumar[1], the remarkable nutritional value, phytochemical composition, and biological properties of *Annona squamosa* L. African journal of biological sciences Volume 6, Issue 12, 2024
13. Varadharajan, V., Janarthanan, U. K., & Krishnamurthy, V. (2012). Physicochemical, phytochemical screening and profiling of secondary metabolites of Annona squamosa leaf extract. *World Journal of pharmaceutical research*, *1*(4), 1143-1164
14. Trease GE, Evans WC. Pharmacognsy, 11th edition Brailliae Tiridal Can. Macmill and Publishers.1989.
15. Trease GE, Evans WC. Textbook of Pharmacognosy. 12th Edition (Balliere, Tindall, London. 1983; pp 57-59: pp 343-383
16. Sofowora A. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books, Ibadan. 1931
17. . Eva M, Gonzalez-Trujano (2006) Anticonvulsant effect of *A.diversifolia* and *Palmitone epilepsia*, Blackwell Publishers. 47(11):1810–1817.
18. Chandraiah. G ,THE PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF *ANNONA SQUAMOSA* L.
19. S. Dash et al, Anonaine an Alkaloid from the Leaves of Custard Apple (Annona squamosa): A Comprehensive Review on its Phytochemicals and Pharmacological Activities. Asian Journal of Chemistry, 2020. 32(8): 1824-1836.
20. Viera, G.H.F.; Mourão, J.A.; Ângelo, Â.M.; Costa, R.A.; Vieira, R.H.S.d.F. Antibacterial effect (in vitro) of *Moringa oleifera* and *Annona muricata* against Gram positive and Gram-negative bacteria. *Rev. Inst. Med. Trop* **2010**, *52*, 129–132. [CrossRef]
21. Bento, E.B.; Matias, E.F.; Brito Jr, F.E.; Oliveira, D.R.; Coutinho, H.D.; Costa, J.G.; Kerntopf, M.R.; Menezes, I.R. Association between food and drugs: Antimicrobial and synergistic activity of *Annona muricata* L. *Int. J. Food Prop.* **2013**, *16*, 738–744. (CrossRef)

22. Shanker, K.S.; Kanjilal, S.; Rao, B.; Kishore, K.H.; Misra, S.; Prasad, R. Isolation and antimicrobial evaluation of isomeric hydroxy ketones in leaf cuticular waxes of *Annona squamosa*. *Phytochem. Anal.* **2007**, *18*, 7–12. [CrossRef] [PubMed]
23. Padhi, L. P., Panda, S. K., Satapathy, S. N., & Dutta, S. K. (2011). In vitro evaluation of antibacterial potential of Annona squamosa L. and Annona reticulata L. from Similipal Biosphere Reserve, Orissa, India. *Journal of agricultural Technology*, *7*(1), 133-142.
24. Ranjan R, Sahai M. Coumarinolignans from the seeds of *Annona Squamosa* E-Journal of Chemistry 2009; 6(2):518-522.
25. Gupta, R. K., Kesari, A. N., Watal, G., Murthy, P. S., Chandra, R., & Tandon, V. (2005). Nutritional and hypoglycemic effect of fruit pulp of Annona squamosa in normal healthy and alloxaninduced diabetic rabbits. *Annals of nutrition and Metabolism*, *49*(6), 407-413.
26. Kaleem, M., Medha, P., Ahmed, Q. U., Asif, M., & Bano, B. (2008). Beneficial effects of Annona squamosa extract in streptozotocin-induced diabetic rats. *Singapore medical journal*, *49*(10), 800
27. Soni VK, Pathak M, Yadav DK. Immunomodulatory constituents from *Annona squamosa* twigs provoke differential immune response in BALB/c mice. Curr Sci. 2013;104(9):1224-1230.
28. K NS, R S, Kumar NS. Phytochemical analysis and antimicrobial activities of *Annona squamosa* (L) leaf extracts. J Pharmacogn Phytochem. 2016;5(4):128-131
29. Benites, R.; Formagio, A.; Argandoña, E.; Volobuff, C.; Trevizan, L.; Vieira, M.; Silva, M. Contents of constituents and antioxidant activity of seed and pulp extracts of *Annona coriacea* and *Annona sylvatica*. *Braz. J. Biol.* **2015**, *75*, 685–691. [CrossRef] [PubMed]
30. Essama, S.R.; Nyegue, M.; Foe, C.N.; Silihe, K.K.; Tamo, S.B.; Etoa, F. Antibacterial and antioxidant activities of hydro-ethanol extracts of barks, leaves and stems of *Annona muricata*. *Am. J. Pharmacol. Sci* **2015**, *3*, 126–131.
31. Baskar, R.; Rajeswari, V.; Kumar, T.S. In vitro antioxidant studies in leaves of *Annona* species. *Indian J. Exp. Biol.* **2007**, *45*, 480–485. [PubMed]
32. Yadav DK, Singh N, Anti-ulcer constituents of Annona squamosa twigs, Epub 2011 Feb
Kushwaha VB, Singh P. Effect of Ethanolic Extract of Different Parts of Plant (*Annona Squamosa*) on the Fertility of Male Rats. Biomed J Sci Tech Res. 2017;1(5):1319-1324.
33. Hidayati NLD, Nopianti T, Rahayuningsih N, Dewi Y, Suryani Y. Antifertility activities of ethanol extract of sugar apple leaves (*Annona squamosa* L.) in the reproductive system: spermatogenesis and sperm quality study. Pharmaciana. 2018;8(2):339-348.
34. Kumar, M., Changan, S., Tomar, M., Prajapati, U., Saurabh, V., Hasan, M., Sasi, M., Maheshwari,
C., Singh, S., Dhumal, S. et al. 2021. Custard Apple (*Annona squamosa* L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Biological Activities. *Biomolecules*, 11, 614.