



Review Article

A short review on a Nutritional Fruit : Guava

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Abstract

Guava (*Psidium guajava* Linn.) commonly known for its food and nutritional values throughout the world. A number of chemicals isolated from plants like quercetin, guaijaverin, isoflavonoids, gallic acid, catechin, epicatechin, rutin, naringenin, kaempferol flavonoids and galactose-specific lecithins have shown promising activity. Toxicity studies in mice and other animal models as well as controlled human studies show leaf, seed, pulp, skin and fruits different extract in different concentration are helps to prevent cancer, regulating blood pressure, and treating diarrhea. Much of the traditional uses have been validated by scientific research. The plant has been extensively studied in terms of pharmacological activity of its major components and the results show antioxidant, antipyretic, antifungal, antimicrobial, hypotensive, analgesic & anti-inflammatory effect

Keywords: *Psidium Guajava*, Antidiabetic, Antibacterial, Hepatoprotective, Contractile.

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Citation: G. M. Masud Parvez et al. (2018), A short review on a Nutritional Fruit : Guava. *Opn Acc Tox & Res.*1;1, 1-8

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Received: July 17, 2018

Accepted: July 27, 2018

Published: December 03, 2018

Introduction

Guava is of numerous trees and shrubs of the genus *Psidium* (family Myrtaceae) native to tropical America. The term “guava” appears to derive from Arawak *guayabo* “guava tree”, via the Spanish *guayaba*. It has been adapted in many European and Asian languages, having a similar form. The common types of guava include apple guava, yellow-fruited cherry guava, strawberry guava, and red apple guava. It is

mostly eaten raw (ripe or semi-ripe) or consumed in the form of juice, jams, and jellies. The common guava has a fruit with a yellow skin and white, yellow, or pink flesh. [1] Guavas are known for their sweet and tangy flavor and many uses, but there’s much more to this fruit than meets the eye. Many consider it a “magical” fruit because of its array of nutrients and medicinal uses. [2] *P. guajava* has a rich ethno-medicinal history. Different parts of the plant are used in various indigenous systems of medicine, primarily for the treatment of gastrointestinal disorders [3]. Some of the ethno-medicinal uses includes the crushing of the leaves and the application of the liquids coming out from them on wounds, cuts, ulcers, boils, skin and soft tissue infectious site, rheumatic places. [4]

Guava’s believed to have originated from Mexico or Central America. It is now very popular in Asian countries and is also increasingly available in American countries, particularly after its health benefits have been revealed. The most guava producing countries are India, China, Thailand, Pakistan, Mexico, Indonesia, Brazil, Bangladesh, Philippines, and Nigeria. Globally, India, Pakistan and Brazil had been the principal producers of commercial *Guava* cultivars. Bangladesh is 8th highest *guava* producing countries. In Bangladesh the annual production is 1,048,850 MT in 2017-18. [5]

Common Names [6]

Guava is known as various names in various regions of the world. The common names of *Psidium guajava* include.

Arabic	guwâfah
Bengali	Piara
Brazil	araca
Cambodia	trapaeksruk
Chinese	fan shiliu
English	apple guava
French	gouyave
Germany	Guavenbaum
India	amarood; jamba
Portuguese	goiaba
Spanish	guayaba
Thailand	farang
Philippines	bayabas

Taxonomical Classification ^[7]

The taxonomical classification of the plant is

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Sub-Class	Rosidae
Order	Myrtales
Family	Myrtaceae
Genus	Psidium
Species	Psidium guajava

Plant Description ^[8]

Psidium guajava is a shrub or small tree usually growing 1-6 m tall, but occasionally reaching 10 m in height. The older stems are covered in a smooth, light reddish-brown, bark that peels off in flakes. This sometimes gives the trunks a mottled appearance, because the newly revealed bark is somewhat greenish-brown in colour. Younger stems are greenish in colour, hairy (pubescent), and somewhat four-angled (quadrangular).

The simple leaves are oppositely arranged along the stems and are borne on short stalks (petioles) 4-10 mm long. The leaf blades (7-15 cm long and 3-7 cm wide) are somewhat oval in shape (ovate-elliptic or oblong-elliptic) with rounded or pointed tips (obtuse or acute apices) and rounded (obtuse) bases. They have hairy (pubescent) undersides (especially when young), entire margins, and are generally dull green in colour. Each leaf has a prominent central vein (midrib) and 10-20

pairs of side veins (lateral veins) that are also relatively obvious. The flowers are usually borne singly in the upper leaf forks (axils). These flowers are about 25 mm across and are borne on a hairy stalk (pubescent peduncle) 1-2.5 cm long. Each flower has four or five green sepals (6-15 mm long) that are fused together at the base and four or five white petals (10-20 mm long). They also have large numbers (200-250) of small white stamens (6-10 mm long) and a style (6-12 mm long) topped with a stigma.

The fruit is either rounded (globose), egg-shaped (ovoid) or pear-shaped (pyriform) and turns from green to yellowish in colour as it matures. These berries (2.5-10 cm long) are crowned with the remains of the persistent sepals (calyx lobes) and have a juicy pink, white or yellowish coloured pulp containing numerous seeds. The seeds are yellowish in colour and kidney-shaped (reniform). Both planted and wild trees are used for fruit which aids their spread.



Figure 1: Guava fruits

Various Species [9]

Guava belongs to genus Psidium and various species are

Psidium amplexicaule	Psidium friedrichsthalium	Psidium incanescens
Psidium araoRaddi	Psidium galapageium	Psidium montanum
Psidium aracaRaddi	Psidium guajava	Psidium pedicellatum
Psidium australeCambess	Psidium guineense	Psidium robustum
Psidium cinereum	Psidium harrisianum	Psidium rostratum
Psidium dumetorum	Psidium havanense	Psidium sartorianum
Psidium firmum	Psidium spathulatum	Psidium sintenisii

Ethnomedicinal Uses

Psidium guajava fruit (Guava) is an ethnomedicine. It has special importance in the traditional system of medicine. In Ayurveda, it is considered as an important herbal medicine for dysentery and diarrhea. In Traditional Chinese Medicine system, it is used to treat many diseases. It has been used since ages to improve the health of humans

Plant part	Compound	Ethnomedicinal Use	Reference
leaves	Phenolic compounds, isoflavonoids, gallic acid, catechin, epicatechin, rutin, naringenin, kaempferol	Hepatoprotection, antioxidant, anti-inflammatory, anti-spasmodic, anti-cancer, antimicrobial anti hyperglycemic, analgesic activity	[10- 16]
Pulp	Ascorbic acid, carotecoids (lycopene, β -carotene, β -cryptoxanthin)	Antioxidant, anti-hyperglycemic, Anti-neoplastic	[17- 20]
Seed	Glycosids, Carotenoids, phenolic compounds	Antimicrobial activity	[21-22]
Skin	Phenolic compounds	Improvement of food absorption	[23-24]
Bark	Phenolic compounds	Strong antibacterial activity, stomachache and anti-diarrhoeal activity	[10, 25]

Table 1: Ethnomedicinal use of guava

Nutritional Status ^[9]

Guava is an extremely good source of vitamin, minerals, protein, fat etc which is well known as a booster for vision health. The food value per 100g guava is presented in the following table.

Name	Content
Calories	77-86g
Moisture	2.8-5.5g
Crude fiber	0.9-1.0g
Protein	0.1-0.5
Fat	0.43-0.7mg
Ash	9.5-10mg
Carbohydrate	9.1-17mg
Calcium	17.8-30mg
Phosphorous	0.30-0.70mg
Iron	200-400 I.U
Carotene	0.046mg
Thiamine	0.03-0.04mg
Riboflavin	0.6-1.068mg
Niacin	40 I.U.
Vitamin B3	35 I.U
Vitamin G4	36-50mg

Table 2: Food value of guava

Pharmacological Effect

Various part of the plant/fruit has been used for different pharmacological activity and different solvents are use to extract the sample. Various concentrations of the extracts are used for various activities.

Pharmacological Effect	Extract	Conc.	Pharmacological Activity	Ref.
Antioxidant activity	water	0.63 g/L	Respectively showed effects on scavenging hydroxyl radicals and inhibiting lipid peroxidation.	[26]
	65% Ethanol	0.47 g/L		
	95% Ethanol	0.58 g/L		
Treatment of cough	Water	2 and 5 g/kg	Decreased frequency of cough by 35% and 54%, as compared to the control, within 10 min after injection of the extract.	[27]
Anti-diabetic activity	Water	250mg/kg	Showed statistically significant hypoglycaemic activity.	[28]
	Methanol	0.2-1.0 ml	There was a dose-dependent increase in percentage inhibitory activity against alpha- amylase enzyme. At a concentration of 0.2 ml of plant extract showed a percentage inhibition 27.8% and for 1.0 ml plant extract showed inhibition of 96.3%	[29]
Antibacterial activity	Water	10.0, 5.0 & 0.16 mg/ml	Showed antibacterial activity against <i>S. suis</i> , <i>P. multocida</i> , <i>E. coli</i> and <i>S. typhimurium</i> .	[30]
	75% Methanol	5.0 & 0.16 mg/ml		
	Acetone	20.0 & 0.31 mg/ml		

Hepatoprotective Activity	Water	250 and 500mg/kg	Significantly reduced the elevated serum levels of aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase and bilirubin.	[31]
Anti-diarrhoeal Activity	Water	50-400 mg/kg	Significant protection of rats and mice against castor oil-induced diarrhoea, inhibited intestinal transit, and delayed gastric emptying.	[32]
		1 mg/kg	Significant antimotility effect, and caused dose-related inhibition of castor oil-induced enteropooling in the animals.	
		10 mg/kg	Significant delayed the onset of castor oil-induced diarrhoea.	
Contractile effect	Water	0.25-2 mg/ml	Psidium guajava significantly contracted aorta rings. The effect of P. guajavawas to a large extent mediated by activation of alpha-adrenoceptor and to a lesser extent by acting via calcium ion channel.	[33]
Anti-hypotensive effect	Water	50-800 mg/kg	Reductions in systemic arterial blood pressures and heart rates of hypertensive were examined in normal and diabetic rats	[34]
Analgesic & anti-inflammatory Activity	Water	50-800 mg/kg	P. guajava leaf aqueous extract produced dose-dependent and significant ($p < 0.05-0.001$) inhibition of fresh egg albumin-induced acute inflammation (edema) in rats.	[35]
Anticancer activity	Acetone	250 μ g/ml	Showed 35.5% inhibition against growth of HT-29 cells.	[36]
	Water	1.5 mg/day	A Psidium guajava leaf has been shown to possess anti-prostate cancer activity. It diminished both the prostate specific antigen (PSA) serum levels and tumor size in a xenograft mouse tumor model.	[37]
	Essential oil	0.019-4.962 mg/ml	Psidium guajava was highly effective in reducing the growth of human mouth Epidermal carcinoma (KB) and murine leukemia (P388) cell lines.	[38]
Anti-hypertensive effect.	Water and ethanol	0.5 g/kg body weight	Final systolic blood pressure values from the beginning and the end of the experimental Spontaneous Hypertensive Rats in 0.5 and 2.0 mg/ml were 231-179 mmHg and 246-169mm Hg. These results were significantly lower when the beginning until the end of the experiment.	[39]
		2.0 g/kg body weight		
Antifungal activity	Hexane	50mg/ml	It showed the best antifungal activity against Trichophyton rubrum, Trichophyton tonsurans, Sporotrix schenckii, Microsporum canis, Cryptococcus neoformans, Candida parapsilosis, and Candida albicans.	[40]
	Acetone		Only showed the activity against Cryptococcus neoformans, Candida parapsilosis, and Candida albicans	
	Methanol		Only showed the activity against Cryptococcus neoformans, Candida parapsilosis, and Candida albicans.	
Anti-proliferative activity	Water	29.0 \pm 0.4 μ g/ml	P. guajava extracts exhibited equivalently potent antiproliferative activity towards KB cells with IC50 values.	[41]
Antipyretic activity	Water	200 mg/kg	The extract and aspirin produced comparable antipyretic effects up to 60 min.	[42]

Treatment of plaque	Methanol	2mg/ml, 4mg/ml	The active flavonoid compound, quercetin-3-O-alpha-l-arabinopyranoside (guajaverin) isolated from <i>Psidium guajava</i> demonstrated high potential antiplaque agent by inhibiting the growth of the <i>Strep. Mutans</i> .	[48]
Spermato protective activity	Ethanol	250 mg/ kg/d and 500 mg/ kg/d	The extracts of the leaves of <i>Psidium guajava</i> Linn. possess beneficial effects on sperm production and quality, and may thus improve the sperm parameters of infertile males with oligospermia and nonobstructive azoospermia.	[49]
Spasmolytic effect	Methanol	-	The spasmolytic activity of the <i>Psidium guajava</i> leaf is mainly due to the aglycone quercetin, present in the leaf and in the extract mainly in the form of five flavonols, and whose effect is produced when these products are hydrolyzed by gastrointestinal fluid.	[50]
Immuno modulatory activity	-	55 microg/ ml	Extracts derived from <i>Psidium guajava</i> revealed immunomodulatory activities.	[51]
Anti-malarial activity	Acqueous	10-20 microgra/ml	The leaves are used as an ingredient in the preparation of fever "teas". They are also used as a part of the pot herb used in steam treatment for malaria. The stem bark extract contained anthraquinones, flavonoids, seccoirridoids and terpenoids and was found to be effective for the treatment and/or prophylaxis of malaria.	[52]

Table 3: Pharmacological potential of guava

Discussion

This fruit is one of the most important sources of medicines. It is popularly known as guava and has been used traditionally as a medicinal plant throughout the world for a number of ailments. The aim of this review is to present some chemical compounds in *P. guajava* and their pharmacological effects.

Guava has a good amount of lycopene that is carotenoid phytonutrient. Lycopene has anti-tumor properties and protects from prostate cancer^[43]. Guava is rich in dietary fiber, which can reduce the sugar levels in the body and help diabetes patients take control of their health^[44]. People suffering from chronic pain can use the fruit and derive benefit from its anti-inflammatory properties. Guavas contain a mineral known as folate. It helps promote fertility in humans^[45]. Guava is rich in magnesium which acts as a nervous relaxant^[46]. It helps to relax muscles and nerves of the body. Guava has a capacity to shrink and contract any open tissues in your body. This has anti-bacterial properties that can flush out the harmful toxins and bacteria from your body. Guava juice is an effective remedy to treat dengue fever. It is recommended to drink the guava juice at least three times in a day for effective results. Pink guavas contain twice the amount of lycopene present in tomatoes. Lycopene is an antioxidant that protects our skin from being damaged by UV rays and environmental pollution^[47].

Conclusion

In conclusion, these results show that guava (*Psidium guajava*) has Antioxidant, Anti-diabetic, Antibacterial, Anti-diarrhoeal, Anti-hypotensive, Analgesic & anta inflammatory, Anticancer, Anti-hypertensive, Antifungal, Antipyretic and high nutritional value. The whole fruit of this plant is edible. The fruit can be eaten raw or even cooked. Fruits are sliced and used as salads or desserts. Beverages are also prepared from the pulp of the fruit. Many varieties of delicacies

such as jam, guava paste, and guava cheese are produced from the fruit. The leaves are also edible and have medicinal properties. This vital fruits should be cultivated more to meet the nutritional requirements at cheaper value.

Reference

- 1.The Editors of Encyclopaedia Britannica. Guava. Encyclopadia Britannica. Accessed on: 25/07/2017. (<https://www.britannica.com/plant/guava>).
- 2.Guava: The Most Powerful Antioxidant Food (!) for Your Immune System. Dr. Axe. Accessed on: July 25, 2017. (<https://draxe.com/guava/>).
- 3.Begum S, Hassan SI, Siddiqui BS. Two new triterpenoids from the fresh leaves of *Psidium guajava*. *Planta Med.* 2002; 68:1149-1152.
- 4.Aliyu BS. Some ethno-medicinal plants of the Savannah Regions of West Africa Description and phytochemicals. Triumph publishing company. 2006; 1:135-152.
- 5.Top 10 largest guava producing countries in the world. The Daily Records. Archived on 26/03/2018. Accessed on: 25/07/2017. (<http://www.thedailyrecords.com/2018-2019-2020-2021/world-famous-top-10-list/world/largest-guava-producing-countries-world-fruits-states/6566/>).
- 6.Invasive Species Compendium. Cookies on Invasive Species Compendium. Accessed on: 27/07/2017. (www.cabi.org/isc/datasheet/45141).
- 7.Classification for Kingdom Plantae Down to Genus *Psidium* L. Natural resources conservation service. Accessed on: 27/07/2017. (plants.usda.gov/java/ClassificationServlet?source=display&classid=PSIDI).
- 8.*Psidium guajava* (Guava). Bio-NET-EAFRINET. Accessed on: 15/08/

2017. ([https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Psidium_guajava_\(Guava\).htm](https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Psidium_guajava_(Guava).htm)).
9. Guava: Wikis. The full wiki. Accessed on: 15/08/ 2017. (www.thefullwiki.org/Guava).
10. Ryu NH, Park KR, Kim SM, Yun HM, Nam D, Lee SG et al. A Hexane Fraction of Guava Leaves (*Psidium guajava* L.) Induces Anticancer Activity by Suppressing AKT/Mammalian Target of Rapamycin/Ribosomal p70 S6 Kinase in Human Prostate Cancer Cells. *J Med Food*. 2012; 15(3): 231-241.
11. Metwally AM, Omar AA, Harraz FM, Sohafy SME. Phytochemical investigation and antimicrobial activity of *Psidium guajava* L leaves. *Pharmacogn Mag*. 2010; 6(23): 212-218.
12. Roy CK and Kamath JV, Asad M. Hepatoprotective activity of *Psidium guajava* Linn leaf extract. *Indian J Exp Biol*. 2006; 44(4): 305-311.
13. Ojewole JA. Anti-Inflammatory and analgesic effect of *Psidium guajava* Linn (Myrtaceae) leaf aqueous extracts in rats and mice. *Methods Find Exp Clin Pharmacol*. 2006; 28(7): 441-446.
14. Nair R, Chanda S. In-vitro antimicrobial activity of *Psidium guajava* L leaf extracts against clinically important pathogenic microbial strains. *Braz J Microbiol*. 2007; 38(3): 452-458.
15. Peng CC, Peng CH, Chen KC, Hsieh CL, Peng RY. The Aqueous Soluble Polyphenolic Fraction of *Psidium guajava* Leaves Exhibits Potent Anti-Angiogenesis and Anti-Migration Actions on DU145 Cells. *Evid Based Complement Alternat Med*. 2011; 2011: 219069.
16. Chen KC, Peng CC, Chiu WT, Cheng YT, Huang GT, Hsieh CL et al. Action mechanism and signal pathways of *Psidium guajava* L aqueous extract in killing prostate cancer LNCaP cells. *Nutr Cancer*. 2010; 62(2): 260-270.
17. Huang CS, Yin MC, Chiu LC. Antihyperglycemic and antioxidative potential of *Psidium guajava* fruit in streptozotocin-induced diabetic rats. *Food Chem Toxicol*. 2011; 49: 2189-2195.
18. Bontempo P, Doto A, Miceli M, Mita L, Benedetti R, Nebbioso A et al. *Psidium guajava* L. anti-neoplastic effects: induction of apoptosis and cell differentiation. *Cell Prolif*. 2012; 45(1): 22-31.
19. Oliveira DS, Lobato AL, Ribeiro SM, Santana AM, Chaves JB, Pinheiro SHM. Carotenoids and Vitamin C during Handling and Distribution of Guava (*Psidium guajava* L.), Mango (*Mangifera indica* L.), and Papaya (*Carica papaya* L.) at Commercial Restaurants. *J Agric Food Chem*. 2010; 58(10): 6166-6172.
20. Thuaytong W, Anprung P. Bioactive compounds and prebiotic activity in Thailand-grown red and white guava fruit (*Psidium guajava* L). *Food Sci Technol Int*. 2011; 17(3): 205-212.
21. Pelegrini PB, Murad AM, Silva LP, Dos Santos RC, Costa FT, Tagliari PD et al. Identification of a novel storage glycine-rich peptide from guava (*Psidium guajava*) seeds with activity against Gram-negative bacteria. *Peptides*. 2008; 29(8): 1271-1279.
22. Vargas CHI, Varela LIR, Ferreira SRS, Alfonso. Extraction of phenolic fraction from guava seeds (*Psidium guajava* L) using supercritical carbon dioxide and co-solvents. *J Supercrit Fluids*. 2010; 51: 319-324.
23. Nascimento RJ, Araújo CR, Melo EA. Antioxidant from agri-industrial wastes of the guava fruits (*Psidium guajava* L). *Alim Nutr*. 2010; 21: 209-216.
24. Guo C, Yang J, Wei J, Li Y, Xu J, Jiang Y. Antioxidant activities of peel, pulp and seed fractions of common fruits as determined by FRAP assay. *Nutr Res*. 2003; 23(12): 1719-1726.
25. Rahim N, Gomes DJ, Watanabe H, Rahman SR, Chomvarin C, Endtz HP et al. Antibacterial activity of *Psidium guajava* leaf and bark against multidrug-resistant *Vibrio cholerae*: implication for cholera control. *Jpn J Infect Dis*. 2010; 63: 271-274.
26. Wang B, Jiao S, Liu H, Hong J. Study on antioxidative activities of *Psidium guajava* Linn leaves extracts. *Wei Sheng Yan Jiu*. 2007; 36(3): 298-300.
27. Joseph B, Priya RM. Review on nutrition, Medicinal and Pharmacological Properties of guava (*psidium guajava* linn.). *International Journal of Pharma and Bio Sciences*. 2011; 2(1): 53-69.
28. Mukhtar HM, Ansari SH, Bhat ZA, Naved T, Singh P. Antidiabetic activity of an ethanol extract obtained from the stem bark of *Psidium guajava* (Myrtaceae). *Pharmazie*. 2006; 61(8): 725-727.
29. Manikandan R, Anand VA, Muthumani D. Phytochemical and in vitro anti-diabetic activity of methanolic extract of *Psidium guajava* leaves. *Int J Curr Microbiol App Sci*. 2013; 2(2): 15-19.
30. Puntawong S, Okonogi S, Pringproa K. In Vitro Antibacterial Activity of *Psidium guajava* Linn. Leaf Extracts against Pathogenic Bacteria in Pigs. *CMU J Nat Sci*. 2012; 11(2): 127-134.
31. Roy CK, Kamath JV, Asad M. Hepatoprotective activity of *Psidium guajava* L leaf extract. *Indian J Exp Biol*. 2006; 44(4): 305-311.
32. Ojewole JA, Awe EO, Chiwororo WDH. Antidiarrhoeal activity of *Psidium guajava* Linn. (Myrtaceae) leaf aqueous extract in rodents. *J Smooth Muscle Res*. 2008; 44(6): 195-207.
33. Olatunji-Bello II, Odusanya AJ, Raji I, Ladipo CO. Contractile effect of the aqueous extract of *Psidium guajava* leaves on aortic rings in rat. *Fitoterapia*. 2007; 78(3): 241-243.
34. Ojewole J.A. Hypoglycemic and hypotensive effects of *Psidium guajava* L. (Myrtaceae) leaf aqueous extract. *Methods Find Exp Clin Pharmacol*. 2005; 27(10): 689-695.
35. Ojewole J.A. Antiinflammatory and analgesic effects of *Psidium guajava* Linn. organisms. *Am J Chin Med*. 2005; 33(2): 197-204.
36. Lee SB, Park HR. Anticancer activity of guava (*Psidium guajava* L.) Branch extracts against HT-29 human colon cancer cells. *Journal of Medicinal Plants Research*. 2010; 4(10): 891-896.
37. Chen KC, Peng CC, Chiu WT, Cheng YT, Huang GT, Hsieh CL et al., Action mechanism and signal pathways of *Psidium guajava* L. Aqueous extract in killing prostate cancer LNCaP cells. *Nutr Cancer*. 2010; 62(2): 260- 270.
38. Joseph B, Priya RM. Bio-active compounds in essential oil and its effects of antimicrobial, cytotoxic activity from the *Psidium guajava* L. Leaf. *Journal of Advanced Biotech*. 2010; 9(10): 10-14.
39. Gutiérrez RM, Mitchell S, Solis RV. *Psidium guajava*: A review of its traditional uses, phytochemistry and pharmacology. *Journal of Ethnopharmacol*. 2008; 117(1): 1-27.
40. Abdelrahim SI, Almagboul AZ, Omer MEA. Antimicrobial activity of *Psidium guajava* L, *Fitoterapia*. 2002; 73(7-8):713- 715.
41. Fathilah AR, Sujata R, Norhanom AW, Adenan MI. Antiproliferative activity of aqueous extract of Piper betle L. and *Psidium guajava* L. on KB and HeLa cell lines. *J Med Plants Res*. 2010; 4(11):987-990.
42. Joseph L, George M, Sharma A, Gopal N. Antipyretic and analgesic effects of the aqueous extract of the *Prosopis cineraria*. *Glob Jour of Pharmacol*. 2011; 5(2): 73-77
43. Vaidyanathan S. What are the health benefits of Guava? *Research Gate*. Accessed on: 03/07/ 2018. (www.researchgate.net/post/What_

are_the_health_benefits_of_Guava).

44. Brown MJ. 8 Health Benefits of Eating Guavas. Healthline. Accessed on: 03/07/ 2018. (<https://www.healthline.com/nutrition/8-benefits-of-guavas>).

45. Willett E. 5 Tropical Fruits to Enjoy With Your Fertility Diet. Natural Fertility info. Accessed on: 03/07 2018. (<https://natural-fertility-info.com/5-tropical-fruits-fertility-diet.html>).

46. Ahuja A. 15 Amazing Guava Benefits: Heart Healthy, Weight Loss Friendly and More. NDTV Food. Accessed on: 03/07 2018. (<https://food.ndtv.com/health/15-amazing-guava-benefits-heart-healthy-weight-loss-friendly-and-more-1244242>).

47. Naaz S. 31 Amazing Benefits Of Guava (Amrood) For Skin, Hair, And Health. StyleCraze. Accessed on: 03/07 2018. (<http://www.stylecraze.com/articles/amazing-benefits-of-guava-for-skin-hair-and-health/#gref>).

48. Prabu Gr, Gnanamani A, Sadulla S. Guajaverin – a plant flavonoid as potential antiplaque agent against *Streptococcus mutans*. *J Appl*

Microbiol 2006. 101(2):487-495.

49. Akinola OB, Oladosu OS, Dosumu OO. Ethanol extract of the leaves of *Psidium guajava* Linn enhances sperm output in healthy Wistar rats. *Afr J Med Med Sci*. 2007;36(2):137-140.

50. Lozoya X, Meckes M, Abou-Zaid M, Tortoriello J, Nozzolillo C, Arnason JT. Quercetin glycosides in *Psidium guajava* L. leaves and determination of a spasmolytic principle. *Arch Med Res*. 1994 25(1):11-15.

51. Kaileh M, Vanden Berghe W, Boone E, Essawi T, Haegeman G. Screening of indigenous Palestinian medicinal plants for potential anti-inflammatory and cytotoxic activity. *J Ethnopharmacol*. 2007; 113(3):510-516.

52. Nundkumar N, Ojewole JA. Studies on the antiplasmodial properties of some South African medicinal plants used as antimalarial remedies in Zulu folk medicine. *Methods Find Exp Clin Pharmacol*. 2002; 24(7):397-401.