How to Cite:
Ranjan, S., Himani, D., & Mukopadayay, S. (2022). A review article on: Phytochemical and pharmacological activities of carica papaya. *International Journal of Health Sciences*, *6*(S3), 11077–11088. https://doi.org/10.53730/ijhs.v6nS3.8557

A review article on: Phytochemical and pharmacological activities of carica papaya

Shashi Ranjan
Research Scholar, Dev Bhoomi Institute of Pharmacy and Research, Dehradun, (Uttarakhand), pin code-248007
*Corresponding author email: abhaykumar2k11.ak@gmail.com

Devi Himani
Assistant Professor, School of Pharmacy and Research, Dev Bhoomi Uttarakhand University, Dehradun (Uttarakhand), pin code-248007
*Corresponding author email: hiamichoudhary@gmail.com

Dr. Sayantan Mukopadayay
Associate Dean, School of Pharmacy and Research, Dev Bhoomi Uttarakhand University, Dehradun (Uttarakhand), pin code-248007

***Abstract*---**These are well-known health benefits of papaya (Carica papaya Linn.). Ayurveda, for example, recognises papaya's therapeutic value. Herbalists have used it to cure bilious fever, gonorrhoea, eczema, rheumatism and headaches. It took four decades of amazing research to identify a critical nutraceutical compound. It is antibacterial, antipyretic, insecticidal, antimicrobial, and antimolluscan. Leaves have been studied using phytoextraction of heavy metals and phytoremediation of particle pollution. Long-term research on phytoconstituents and leaf composition. Malaria, dengue fever, inflammation, and skin infections are all treated by Carica papaya. C. papaya flowers were first tested for antioxidant and antibacterial properties using TLC and UV spectroscopy. Our tests included TLC and UV-visible spectroscopy. The methanol extract had the most alkaloids, flavonoids, saponins, and tannins. N-hexane had steroids and flavonoids while chloroform had saponins and tannins. In it, there were flavonoids and phenolic compounds.

***Keywords*---**carica papaya, pharmacognosy, pharmacology, phytochemistry, ethanopharmacology.

Manuscript submitted: 18 Feb 2022, Manuscript revised: 27 April 2022, Accepted for publication: 9 June 2022

Introduction

Papaya's nutritional and medicinal properties (Carica papaya Linn.) Traditional medicine systems like Ayurveda recognise papaya's therapeutic powers. Aside from headaches, it is supposed to treat bronchitis and asthma[1]. Over 40 years of research on a crucial nutraceutical agent. Properties of Carica papaya Linn. Leaves are now analysed for heavy metals, particle pollution, and more. Phytoconstituents and leaf composition have been studied for decades. Inflammation and skin infections are treated by Carica papaya. First, TLC and UV spectroscopy were used to screen the C. papaya flowers for antioxidant and antibacterial activity[2,3]. They were analysed by TLC and UV-visible spectroscopy. The methanol extract had the most alkaloids, flavonoids, saponins, and tannins. n-hexane extracts had saponins, steroids, and flavonoids. In this extract were flavonoids, tannins, saponins, and phenols.

Fig 1. Papaya Tree

Distribution and Botanical description
Geographical distributions

The native Papaya ranges are Grenada and Colombia; the Caribbean islands of Grenada and Colombia; and the Caribbean islands of Grenada and Colombia; as well as the Caribbean islands of Guadeloupe and Dominica[6].

Taxonomy

Papaya (Caricaceae, Brassicales) is a perennial plant. In India, the plant is known as Papita, Papaya, Omakai, Pepe, and Eerankari. Mamo is the Australian name for pawpaw, whereas papaya plant is the British name for the plant. The botanical classification of C. papaya is as follows [7].

Table 1
Kingdom and their Plantae

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Brassicales
Family	Caricaceae
Genus	Carica
Species	Papaya L.

Morphological Characteristics of Papaya

Papaya is a tree-like herb that has a distinct structure than other herbs. C. papaya is often known as papaya. This plant is also known as Papye, Pawpaw, Lapaya, Tapayas, and Kapaya. Papayas, unlike trees, are herbaceous rather than woody[8]. Here are compound leaves. The palm-shaped leaves have an average diameter of 50-70 centimetres. Papaya flowers are usually dioecious. Depending on the bloom, the fruit can be shaped in many ways. Manipulation of the male bloom The corolla tube is a 2 cm cylinder. Female racemose flowers are used. The 5–30 cm long fruit is yellowish-orange in hue. The pulp of this delectable fruit is inedible[9-10].

Roots

There are distinct layers of endodermis, epidermis, and cortex in the early roots of papaya plants. These layers are dense and nonaxis[11].

Stem

From the base to the crown, the stem has a soft, hollow, and cylindrical trunk that is 30 cm in diameter. Normally, papaya trees have a single trunk and a canopy of large palmate leaves growing from the tip of the trunk, but they can have several trunks if they are damaged.

The leaves are 50-70 centimetres wide. The plant's most distinctive characteristic is a large palmate leaf with 5-9 pinnated lobes, 40-60 cm wide. The leaves spiral and cluster in mature tree branches[12]. The leaf's dorsiventrally positioned endodermis, which ranges from 30 cm to 105 cm in length, may be crucial when cavitations occur. While squishy mesophyll has 4-6 cell layers, palisade parenchyma and epidermis in the leaf have only one. The leaves are drusy and shiny (calcium oxalate crystals). The stomata on the underside of papaya leaves are anisocytic or lack secondary cells(13-15). Water, temperature, and light can change the stomatal density of 400/mm sq. The sun shines on the leaves. The leaf microscope revealed xylem and phloem but no pith. Diagram of a C. papaya leaf, ventral and dorsal views [2].


Fig 2. Leaves of Papaya

Flowers

To describe the 'trioeciousness' of C. papaya flowers is to say that distinct plants can produce either male, female or bisexual blooms. When closed, the flowers of the female papaya have a pear shape, whereas the long stalks of the male papaya support little blooms, and the tubular flowers of the bisexual papaya[(16)]. Bisexual plants are generally superior to male or female plants in terms of quality and preference. There is just one central axis through which the flowers are organised in the cluster, and they are actinomorphic, bracteolate and stationary. Ten stamens in two whorls comprise the androecium, which is epipetalous (on the petals or corolla). It has bilocular anthers that are both introrse and bilocular[(17)]. There are five petals in the corolla that are long and yellow in colour in the calyx (gamopetalous) and the five petals in the corolla that are small and joined (gamosepalous). The androecium is absent from female flowers, which only have an ovary and stigma. Male or pistillate flowers have bracteolate petals. In pistillate flowers, the androecium is missing, and the gynoecium is sessile. The ovary is superior, with an infinite number of seeds, and has a short style with a five-lobed stigma[(18-20)].


Fig 3. Flowers Papaya

Fruits

Large, oval plant fruits are sometimes referred to as "pepo-like berries" because of their melon-like shape and the presence of a seed cavity in the centre. On the main stem, fruit is borne axillary and is usually borne individually, but in clusters can also be found[21]. In addition to its flavour, colour, and scent, fruit pulp offers a wide range of chemical, nutritional, and digestive qualities Fig 4. Depending on the cultivator and climate, plant fruits take anywhere from 5 to 9 months to mature. It's green until it's ripe, turning yellow or red-orange, and the fruit flesh is yellow-orange to pinkish orange when it's mature[22]. Fruits can be oval or spherical in shape and are berries with seeds inside the fruit cavity. The unripe fruit had a thick cuticle, laticifers, epicarp parenchyma, mesocarp endocarp, and calcium oxalate crystals visible under a microscope, according to the research[23-25].

Fig 4. Papaya fruit

Seeds

Papaya plants are often propagated by the use of seeds. Oval and flat cotyledons and the endosperm of plant seeds are blackish to brownish in hue. The fruit's inside chamber is filled with a mucilaginous material that coats many black seeds. The seeds are edible, with a spicy flavor and antimicrobial characteristics that help prevent kidney failure caused by the toxin[26].

Phytochemical investigation

The analysis of C. papaya fresh flower extract in various solvents was performed using standard protocols with slight changes as follows[27].

Test for alkaloids

The plant extracts (3 ml) were infused with HCl and then steamed for a few minutes. Some Mayer regent was then added to the mixes. Turbidity is a sign that alkaloids are present[28].

Test for flavonoids

The stock solution of C. papaya extracts was diluted with sodium hydroid solution and a few drops were added (0.5 ml). The plant crude extract had a strong yellow color, which turned colorless when diluted H_2SO_4 was added, indicating the presence of a flavonoid[29].

Test for saponins

Test tube was shaken by hand for 15 minutes with stock solution from each crude extract C. papaya flowers (0.5 ml). Saponin was detected in the test tube by the creation of a foam layer at the top[30].

Test for steroids

Concentrated sulfuric acid (1 ml) was poured into the test tube through the walls after the plant extracts were dissolved in chloroform (10 ml). Fluorescent green tinged the sulfuric acid layer, which had previously been yellowish. Steroids were clearly present in this sample[31].

Test for tannins

It was mixed with distilled water and two milliliters of extract were added and swirled in. Solution of ferric chloride was added. The presence of tannins was demonstrated by the production of a green precipitate[32].

Test for phlobatannins

HCl hydrolyzed two milliliters of extract, and then the solution was heated for a few minutes. Phlobatannins are present when red precipitation forms.

Test for glycosides

Using chloroform and acetic acid, two milliliters of extracts were dissolved, followed by a few drops of sulfuric acid, and the color change from blue to green was noticed[33].

Thin layer chromatography

Chloroform: methanol (80:20) was utilized as the mobile phase in thin-layer chromatography. TLC tests were performed in a controlled environment with a temperature of RT and a relative humidity of 60%. A UV chamber (254 nm) was used for a short time to observe the varied spot positions of the compounds on the TLC plates (Merck-silica gel 60 F_{254}). Standard formulation was used to calculate the plant extract Rf value[34].

Pharmacological Studies

Table 2
Parts, Pharmacological Activities and Phyto-chemical constituents of papaya tree

Sr. No	Part of Plant	Pharmacological Activities	Phyto-chemicalconstituents
1	Roots	• Skin Infection	Carposide

2	Leaves	• Anti-Dengue activity • Anti-Malarial activity • Anti-Cancer activity • Anti-Fungal activity	Ca, K, Mg, Zn, Mn, Fe, Flavonoids
3	Fruits	• Anti-Cancer activity • Anti-Diarrheal responses • Processed foods • Source of enzyme	Papin, Chymopapin, Carotenoids enzyme, Linalool
4	Seeds	• Wound healing activity • Anti-Cancer activity • Insecticide activity	Glucosinolates, Benzyl Isothiocyanate, Papaya oil

Anti-inflammatory and immunomodulatory effects

The pulp, leaves, and seeds of papaya have anti-inflammatory and immunomodulatory effects. After eating papaya, participants' IFN-+CD4+ T cells, which are important in inflammatory responses, decreased. Papaya leaf extract significantly reduced paw oedema, cotton pellet granuloma, and formaldehyde-induced arthritis in rats. Its immunomodulatory characteristics boosted anti-tumor immunity-related cytokines (IL-12p40, IL-12p70, IFN-, and TNF-) from human cells. Similarly, when exposed to the seed extract, human blood cells demonstrated enhanced phytohemagglutinin reactivity. So the seed extract may contain immunomodulatory compounds or growth-promoting components. Some bioactive components of the seed extract can reduce cell lysis in vitro through the traditional complement-mediated hemolytic pathway[37]. This shows it may be anti-inflammatory. Papaya's flavonoids, saponins, tannins, and glycosides have been associated to anti-inflammatory benefits. Anti-inflammatory properties may be due to one or more of the identified components.

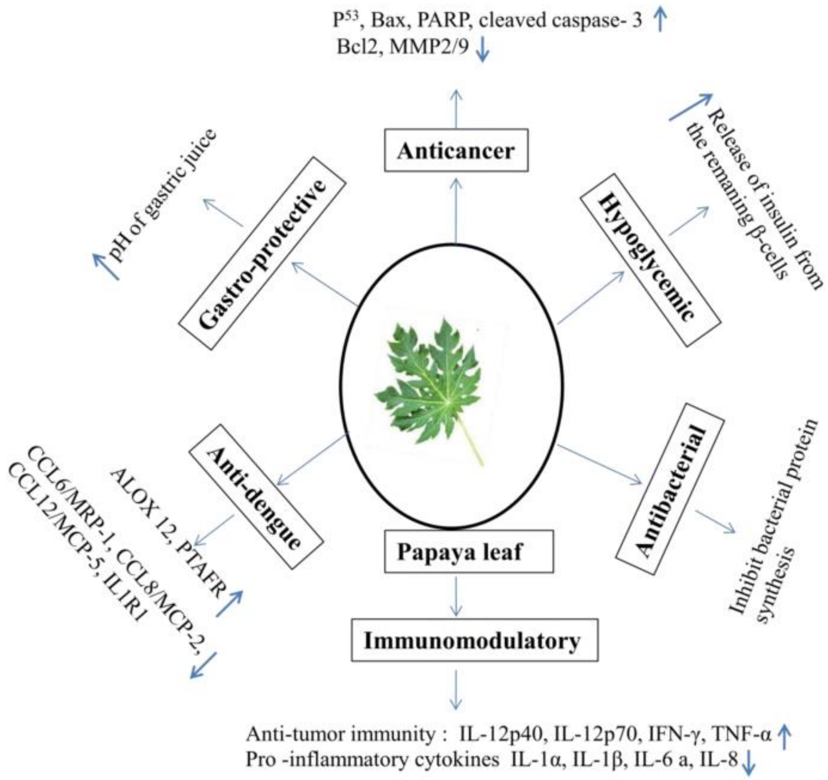

Fig 5. Show that pharmacological activity of papaya leaf

Anticancer effects

Papaya contains glucosinolates, isothiocyanates, and BITC, all of which have anti-cancer effects. BITC slows tumour growth by causing apoptosis in cancer cells. They may have anticarcinogenic qualities by stimulating phase II enzymes as glutathione S-transferases, nicotinamide ADP and quinine reductases[38]. Plant glucosinolates have been studied for their cancer-preventive effects. This can be done by plant-derived myrosinase or human gut bacteria. The anticancer properties of C. papaya leaf extract on tumour cell lines were discovered lately. In vitro, the leaf extracts significantly reduced the proliferation of solid tumour cell lines derived from cervical carcinoma, breast adenocarcinoma, prostate cancer, hepatocellular carcinoma, lung adenocarcinoma, and mesothelioma. These findings suggest that leaf extracts have anticancer properties and may one day be utilised to treat and prevent diseases like cancer and to stimulate the immune system during vaccine therapy. There is no existing scientific data on the particular chemical that shown the anti-cancer and immunological modifying advantages of papaya isothiocyanates. One study indicated that Papya leaf fractions with molecular weights under 1000 might enhance Th 1 cytokine production and slow tumour cell proliferation, thus protecting against allergies. Papaya had a high lycopene content. Lycopene induces apoptosis in human cancer cells in vitro, particularly prostate cancer cell lines, indicating chemotherapeutic potential[38].

Wound healing effects

The wound healing properties of papaya have been extensively researched in animal studies. Unripe green fruit peel extract heals epidermal wounds faster than ripe fruit peel extract in mice and rats. Skin latex was utilised to assess wound healing in mouse burn models. However, the latter notion suggested that latex has healing properties. Protease inhibitors, glutaminyl cyclase and other unknown function proteins are detected in the latex of unripe papaya fruits. Many proteolytic enzymes have been demonstrated to help debride necrotic tissues, reduce infection, promote growth, and improve scar quality. Papain, chymopapain, and leukopapain. According to traditional beliefs, papaya can effectively cure wounds[38].

Anti-ulcer effects

Papaya leaves and unripe fruits may help avoid stomach ulcers. These rats had fewer stomach ulcers than those given alcohol or the standard drugs cimetidine and indomethacin. This fruit's ability to halt digestion has been shown. By delaying gastrointestinal motility, increasing oral anti-ulcer drug absorption is useful in ulcer therapy. The unripe fruit also has antibacterial properties that may help treat or prevent stomach ulcers by killing Helicobacter pylori. Premature C. papaya preparations contain terpenoids, alkaloids, flavonoids, carbohydrate glycosides, saponins, and steroids[39]. Saponin's anti-ulcer activities include protecting the gastric lining from stomach acid by producing protective mucus. The anti-ulcer properties of the leaves and unripe fruit extracts are cytoprotective and antimotility.

Conclusion

Unlike synthetic products, which have been demonstrated to harm the body, herbal items are considered as a symbol of protection. This study found that Carica papaya leaves have numerous uses. By studying the plant's active compounds, we can learn about the plant's many biological roles. The potential of Carica papaya leaves has to be explored further. Various cutting-edge investigative techniques can be used to investigate the active compounds in Carica papaya L. leaves. C. papaya plants flourish all over the planet. They have a variety of nutrients in various parts of the plant that have been used medicinally for ages. A papaya's demonstrated pharmacological actions can treat several diseases such as anti-inflammatory, antioxidant, antibacterial, and immunomodulatory activity. Dengue fever is treatable with commercial drugs.

References

1. Bedi R: Bedi vanaspati kosh. Kitabghar publication, New Delhi; First edition 2005; 1: 440-453.
2. Pullaiah T: Encyclopaedia of world medicinal plants. Regency publication, New Delhi 2006; 1: 446-449.
3. The wealth of India, raw materials Ca-Ci: CSIR, New Delhi 1992; 3: 290. ISBN-81-85038-97-X

4. Trikamji AY: Dravyagunavigyanamuttaraardha. Sharma ayurved mandir datiya (MP) 2001; 5: 212-213.
5. Bapalal VG: Nighantu Adarsh Chaukhambhabharati Academy, Varanasi, Reprint 2007; 1: 613-616.
6. Reddy RK: Folk medicines from Chittoor district, Andhra Pradesh, India, used in the treatment of Jaundice. International Journal of Crude Drug Research 1988; 26: 137-140.
7. Raj, KPS and Patel MR: Some medicinal plants of Cambay and its immediate vicinity and their uses in Indian indigenous system of medicine. Indian drugs 1978; 15: 145-152, 160.
8. Pal SC and Srivastava SN: Preliminary notes on the ethnobotany of Singhbhum District, Bihar. Bull. Bot. Surv. India 1976; 18: 247-250.
9. Megoneitso and Rao RR: Ethnobotanical studies in Nagaland, sixty two medicinal plants used by the Angamia Naga, J. Econ. Taxon. Bot. 1983; 4(1): 167-172.
10. Ghoti H, Fibach E, Dana M, Abu Shaban M and Jeadi H: Oxidative stress contributes to hemolysis in patients with hereditary spherocytosis and can be ameliorated by fermented papaya preparation. Ann Hematol 2011; 90: 509-513.
11. Aruoma OI, Hayashi Y, Marotta F, Mantello P and Rachmilewitz E: Applications and bioefficacy of the functional food supplement fermented papaya preparation. Toxicology 2010; 278: 6-16.
12. Iweala EE, Uhegbu FO and Ogu GN: Preliminary in-vitro antisickilng properties of crude juice extracts of Persia Americana, Citrus sinensis, Carica papaya L. and Ciklavit (R). Afr J Tradit Complement Altern Med 2010; 7: 113-117.
13. Sripanidkulchai B, Wongpanich V, Laupattarakasem P, Suwansaksri J and Jirakulsomchok D: Diuretic effects of selected Thai indigenous medicinal plants in rats. J Ethnopharmacol 2001; 75: 185-190.
14. Sharma PV: Ayurved ka Vaigyanikitihasa; Chaukhambha Orientalia, Varanasi 1996; 3: 380.
15. Shaligram VL: Shaligramnighantubhushan; khemrajsrikrishnadass, Mumbai 2011; 928-929.
16. Sharma PV: Priyanighantu; Chaukhambhasurabharatiprakashan, Varanasi 2004; 193.
17. Anjum V, Ansari SH, Naquvi KJ, Arora P and Ahmad A: Development of quality standards of Carica papaya L Leaves; Scholars Research Library, Der Pharmacia Lettre 2013; 5(2): 370-376.
18. Zunjar V, Mammen D, Trivedi BM and Daniel M: Pharmacognostic, Physicochemical and Phytochemical studies on Carica papaya Linn. leaves: Pharmacognosy Journal 2011; 3(20): 5-8.
19. Awuchi, C. G., Amagwula, I. O., Priya, P., Kumar, R., Yezdani, U., & Khan, M. G. (2020). Aflatoxins in foods and feeds: A review on health implications, detection, and control. Bull Environ Pharmacol Life Sci, 9(9), 149-155.
20. Ram PN, Ram VR, Khatri TT, Vyas SJ and Dave PN: XRF analysis of Carica papaya L. leaves of semi arid region of Kachchh; International Letters of Natural Sciences 2014; 19: 15-24.
21. Vishwanath Z, Prasad DR, Mehul J, Trivedi B and Nivsarkar M: Antithrombocytopenic activity of carpaine and alkaloidal extract of Carica

papaya Linn. leaves in busulfan induced thrombocytopenic Wistar rats; journal of ethanopharmacology 2016; 181(2): 20-25.
22. Dharmarathna SLCA, Wickramasinghe S, Waduge RN, Rajapakse RPVJ and Kularatne SAM: Does Carica papaya L. leaf extract increase the platelet count? An experimental study in a murine model; Asian Pacific Journal of Tropical Biomedicine 2013; 3(9):720-724.
23. Saha, P., Kumar, R., Nyarko, R. O., Kahwa, I., & Owusu, P. (2021). Herbal secondary metabolite for gastro-protective ulcer activity with api structures. 2015; 16: 213-222
24. Suwendar PH and Ernasari GI: Analgetic activity of Papaya (Carica papaya L.) leaves extract; Procedia Chemistry 2014; 13: 147-149.
25. Otsuki N, Dang NH and Morimoto EKASC: Aqueous extract of Carica papaya L. leaves exhibits anti tumor activity and immunomodulatory effects; Journal of Ethnopharmacology 2010; 127(3): 760-767.
26. Pandey S, Walpole C, Cabot PJ, Shaw PN, Jyotsna B and Hewavitharana AK: Cancer; Biomedicine and Pharmacotherapy 2017; 89: 515-523.
27. Abidina NZ, Omara H, Empungana AJ, Kamalaldinb NA, Yahayab BH and Zubairia SI: Proliferative Activity of Saponin-Reducing Carica papaya L. Leaves Extracts on Human Lung Fibroblast Cell (IMR90). Journal Teknologi November 2016.
28. Juarez-Rojop IE: Phytochemical screening and hypoglycaemic activity of Carica papaya L. leaf in streptozotocin- induced diabetic rats; RevistaBrasileira de Farmacognosia 2014; 24(3): 341-347
29. Sahana, S., Kumar, R., Nag, S., Paul, R., Chatterjee, I., & Guha, N. (2020). A Review On Alzheimer Disease And Future Prospects.2017;77-82
30. Dinesh, M.R.; Vani, A.; Aswath, C.; Rawal, R.D. Biology of Carica papaya (Papaya). Ministry of Environment, Forest and Climate Change (MoEF&CC), 2015, pp. 1-20.
31. Milind, P.; Gurditta, G. Basketful benefits of papaya. International Research Journal of Pharmacy, 2011, 2(7), 6-12.
32. Rimberia, F.K.; Adaniya, S.; Ishimine, Y.; Etoh, T. Morphology of papaya plants derived via anther culture, Sci. Hortic., 2007, 111, 213-219.
33. Kayalvizhi, K.; Cathrine, L.; Banu, K.S. Phytochemical and antibacterial studies on the leaf extracts of female Carica papaya Linn. Int. J. PharmTech Res., 2015, 8(7), 166-170.
34. Anjum, V.; Ansari, S.H.; Naquvi, K.J.; Arora, P.; Ahmad, A. Development of quality standards of Carica papaya Linn. leaves. Sch. Res. Lib., 2013, 5(2), 370-376.
35. Kumar, Roshan, PurabiSaha, Yogendra Kumar, Soumitra Sahana, Anubhav Dubey, and Om Prakash. "A review on diabetes mellitus: type1 & type2." (2020). 12-15
36. Saini, R.; Mittal, A.; Rathi, V. Phytochemical evaluation of Carica Papaya extracts. Eur. J. Pharm. Med. Res., 2016; 3(3), 346-350.
37. Saeed, F.; Arshad, M.U.; Pasha, I.; Naz, R.; Batool, R.; Khan, A.A.; Nasir, M.A.; Shafique, B. Nutritional and phyto-therapeutic potential of Papaya (Carica papaya Linn.): An Overview. Int. J. Food Prop., 2014, 17(7), 1637-1653.
38. Osato, J.A.; Santiago, L.A.; Remo, G.M.; Cuadra, M.S.; Mori, A. Antimicrobial and antioxidant activities of unripe papaya. Life Sci., 1993, 53(17), 1383-1389.

39. Krishna, K.L.; Paridhavi, M.; Patel, J.A. Review on nutritional, medicinal and pharmacological properties of Papaya *(Carica papaya* Linn.*).* Nat. Prod. Rad., 2008, 7(4), 363-373.
40. Rinartha, K., Suryasa, W., & Kartika, L. G. S. (2018). Comparative Analysis of String Similarity on Dynamic Query Suggestions. In *2018 Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS)* (pp. 399-404). IEEE.
41. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Get vaccinated when it is your turn and follow the local guidelines. *International Journal of Health Sciences*, *5*(3), x-xv. https://doi.org/10.53730/ijhs.v5n3.2938