

POMELO (CITRUS MAXIMA) PEEL IS RICH IN FLAVONOIDS/ESSENTIAL OILS AND MAKE A COMPELLING NATURAL ANTIFUNGAL AND COSMETIC APPLICATIONS: A SOURCE FOR ANTI-DANDRUFF SHAMPOO DEVELOPMENT

Akash Mumu¹, Niraj Kumar², Sonu Kumar³, Randhir Kumar Gupta^{4*}

Department of Pharmaceutical Sciences, Jharkhand Rai University, Raja Ulatu, Namkum, Ranchi, Jharkhand-834010.



***Corresponding Author: Randhir Kumar Gupta**

Department of Pharmaceutical Sciences, Jharkhand Rai University, Raja Ulatu, Namkum, Ranchi, Jharkhand-834010. DOI: <https://doi.org/10.5281/zenodo.22686935>

How to cite this Article: Akash Mumu¹, Niraj Kumar², Sonu Kumar³, Randhir Kumar Gupta^{4*} (2026). Pomelo (Citrus maxima) peel is rich in flavonoids/essential oils and make a compelling natural Antifungal and Cosmetic applications: A source for Anti-dandruff Shampoo Development. European Journal of Pharmaceutical and Medical Research, 13(9), 406-413. This work is licensed under Creative Commons Attribution 4.0 International license.



Article Received on 15/08/2026

Article Revised on 05/09/2026

Article Published on 10/09/2026

ABSTRACT

Citrus maxima fruit is the largest citrus fruit belonging to the family Rutaceae, native to south-east Asian countries. They are also known as shaddock and pummelo. It had big round-shaped edible fruits with pink or white flesh. It is a favourite addition to many Asian festival meals. It consists of pharmacological and medicinal properties. It useful in the treatment of diseases like microbial diseases, diabetes, oxidativestress, hepatic damage, algeria, inflammation and as depressant in CNS etc. They are rich in various sources like vitamins, minerals, phytoconstituents such as coumarins, benzenoids, steroids and citrus acid. It citrus maxima has been recommended in traditional herbal medicine as anti-diabetic agent in management of diabetes. It has been used as a folk medicine in several countries as antifungal, antimicrobial, antioxidants, larvicidal, hepatoprotective, anti-cancer, antiplatelet, antidiabetic and anti-inflammatory. In addition to this, fruits of pomelo are also reported to be used in industries dedicated to perfume, cosmetics, food and pharmaceuticals as flavouring or fragrancesenhancing agents. Antifungal activity of pomelo peel are rich in composition of bioactive compounds like; DLimonene, flavonoids that can be effectively incorporated into shampoo for treating conditions like dandruff. Candida albicans and Malassezia furfur that can be inhibit the growth of common fungi.

KEYWORD: antimicrobial, antioxidants, anti-cancer, antidiabetic and antifungal.

1. INTRODUCTION

As we know that India is well known for its ayurvedic medicines from centuries from such plant, one of these is citrus maxima. Citrus maxima (pomelo) belonging to the family Rutaceae and is characterized by its large, spherical to pear-shaped Fruits, think rind and sweet to slightly tangy pulp. It is a perennial free commonly known as Pomelo, Bhagate, Papanus, Pummela etc. The plant citrus grandis (pomelo), popularly known as Chakota in India. It grown in tropical, sub tropical and temperate region. The fruits is predominantly cultivated in southeast Asian nations such as Thailand, Malaysia,

Indonesia, Japan, India, China and many other Asian countries. It grown in temperatures 25-32°C and rainfall 1500-2500mm, within a 3-4 months dry season. The fruit like all citrus fruits, is filled with juicy sacs (vesicles), shaped like tear drops. It has big round-shaped edible fruits with pink or white flesh. The peel and pulp can be easily separated from each other. The pulp is generally pink or white in colour and coarse with large juice sacks which includes approximately 160 genera and 1700 species and has been widely used in herbal medicine.

1.1 Local names

Table 1: Some common names of Citrus maxima.

Language	Common name
Nepali	Bhogate

Hindi	Sadaphal, Batawi nimbu, Cakotra
English	Pummelo, shaddock, pumelo
Sanskrit	Madhukarkati
Italian	Pompelmo
French	Pamplemousse
Portuguese	Jamboa
Spanish	Pamelmusa
Polish	Pompela
Indonesian	Jeruk Besar, Jerukbali

1.2 Taxonomical classification

Table 2: Taxonomical classification of Citrus maxima.

Kingdom	Plantae
Phylum	Tracheophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales
Family	Rutaceae
Subfamily	Aurantioideae
Genus	Citrus
Species	Maxima

2. BOTANICAL DESCRIPTION OF THE FRUIT

The Pomelo is the biggest fruit among the Citrus family. The fruits ranges from nearly round to oblate or pear shaped; 10-30 cm wide; the peel, clinging, easily removed, greenish yellow or pale yellow, minutely hairy, dotted with tiny green glands.

Pomelo peel is the largest and the thickest of all Citrus fruits weighing up to 30% of the fresh fruit's weight. Pulp Varies from greenish yellow or pale yellow to pink

or red and it is divided into 11 to 18 segments .The flavour of this fruits of pulp varies from mildly sweet and bland to subacid or rather acidic ,and sometimes with a hint of bitterness .The segments of the pomelo are covered with a tough skin called the lamella ,it contain few seeds (yellowish white seeds).The flavedo are present in the rind of the fruits is green with oil glands appearing as spots all over the fruits peel and the albedo is white with a spongy texture.

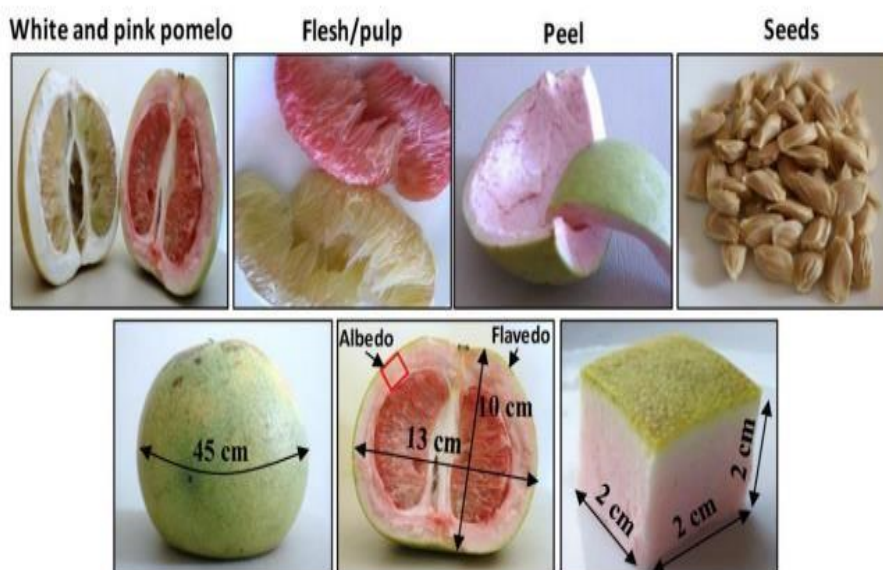


Fig. 1: Anatomy of typical Pomelo fruit.

3. Nutritive value of the fruits

Pomelo fruits is rich in powerful antioxidants like vitamin c .It also contains protein and fiber ,which can aid digestion and help for a longer periods of time after eating.

3.1 Macronutrients

Table 3: Proximate composition Per 100 g of Edible Portion (Fruit juice) of Citrus maxima.

Proximate Composition	Value / 100g
Moisture	84.82-94.1 g
Energy	38 kcal
Protein	0.76 g
Fat	0.04 g
Carbohydrates	9.62 g
Dietary Fibre	1 g

3.2 Vitamins

Table 4: Vitamin composition per 100 g of Edible Portion (Fruit juice) of Citrus maxima.

Vitamins	Value/ 100g
Vitamin A	20 I.U.
Thiamine (B1)	0.034 mg
Riboflavin (B2)	0.02 mg
Niacin (B3)	0.22-0.3 mg
Ascorbic acid	61 mg
Vitamin B6	0.036 mg

3.3 Minerals

Table 5: Mineral composition per 100 g of Edible Portion (Fruit juice) of Citrus maxima.

Minerals	Value / 100g
Sodium	1 mg
Phosphorus	17 mg
Iron	0.11 mg
Magnesium	6 mg
Manganese	0.017 mg
Potassium	216 mg
Zinc	0.08 mg
Calcium	21-30 mg

4. Phytochemical Constituents

Every plant species is known to possess specific metabolites characterized as primary or secondary depending upon their synthesis, production and function. Golden yellow or red to pink coloured appearance of pulp as well as peel of Pomelo is attributed to presence of secondary metabolites carotenoids. The peel as well as pulp of citrus fruit has been reported to contain more than 115 different carotenoids. On a comparative account juice of pulp of redfleshed pomelo possesses about 7 times high β -carotene, lycopene compared to peels of the fruits. Beside common primary metabolites (common to all plant species) such as cellulose, hemicellulose, lipids, and sugars many secondary metabolites are also present. Flavonoids are an important class of secondary

metabolites found to be present in pomelo. Flavonoids reported to be present in species include hesperidin, neohesperidin, naringenin, naringin, and rutin. Several studies conducted have studied qualitative as well as quantitative properties of different metabolites and phytocompounds synthesized in Citrus maxima. It analyzed Vitamin C through the technique of 2,6-dichlorophenolindophenol and reported the plant to be rich in synthesis and production of vitamin C. Besides a prominent source of ascorbic acid, Citrus grandis also contains other economically valued metabolites with nutritive value, health-benefiting effects, etc. such as carotenoids, limonoids, acridone alkaloids, flavonoids, minerals, oils, Vitamin B complex. In addition to this, studies have reported the fruit juice to contain Benzenoid

such as Diphenylamine; Flavonoids such as diosmin, hespeidin, luteolin, naringin, narirutin, neodiosmin, neoeriocitrin, neohesperidin, neoponcirin, quercetin, rhoifolin and sinensetin. Triterpenes such as limonin, deoxylimonin, nomilin and obacunone were found in seeds, fruit pulp and juice. Miscellaneous compounds such as ascorbic acid and citric acid were also found in the fruit juice.

5. Medicinal Uses

We studies that Citrus maxima fruit juice and peel are very nutritive and have good medicinal properties. The Pomelo pulp and peels are used as appetizer, stomach- tonic, cardiac stimulant in cardiovascular conditions and also in coughs. The fruit-juice has potential in enhancing weight loss and promoting cholesterol reduction. The Pomelo peel extracts were isolated and were evaluated to have hypolipidemic, hypoglycaemic, antioxidative, antimicrobial, anti-inflammatory and anti-cancerous properties. Pomelo fruits are also reportedly used in diseases like leprosy and asthma. They have been proven helpful in the management of hiccup, mental aberration and epilepsy. In addition, the rinds have been found effective as antiasthmatic, sedative, brain tonic, and in relief of headaches and eye troubles. Rinds are also reported to be the most used parts in traditional medicine for treatment of vomiting and diarrhoea. The seeds are utilized against dyspepsia, coughs and lumbago and its fruit is also used in the treatment of cancer and gastrointestinal disorders.

6. Function and Description of Ingredients

1. Pomelo peel extract

Common name: Pummelo

Biological name: Citrus maxima

Family: Rutaceae

Function: Pomelo peel extract plays an important role in shampoo formulation due to its natural bioactive compounds. It is rich in flavonoids and essential oils, that help cleanse the scalp and control excess oil production. The extract has antimicrobial properties that can reduce dandruff-causing microorganisms, promoting a healthier scalp environment. And presence of vitamin C content supports hair strength and shine by improving collagen formation. Pomelo peel also acts as a natural fragrance agent, enhancing the sensory appeal of shampoo. Additionally, it helps in soothing scalp irritation and may support hair growth, making it a useful herbal ingredient in cosmetic formulations.

2. Shoe black plant

Common name: Hibiscus flower

Biological name: Hibiscus rosa sinensis L.

Family: Malvaceae

Parts used : Flowers

Function:

In shampoo formulation, extracts from this plant are valued for their antimicrobial, antifungal, and astringent properties, which help reduce dandruff and maintain a clean, healthy scalp. Its bioactive compounds assist in

controlling excess oil secretion and soothing scalp irritation. The plant also contains antioxidants that may protect hair follicles from oxidative stress, supporting stronger and healthier hair growth. Additionally, it can contribute mild conditioning effects, improving hair texture and manageability. Because of its natural cleansing and protective qualities, it is often used in herbal or polyherbal shampoos.

3. Curry leaves

Common name: Sweet neem leaves

Biological name: Murrayakoenigii

Family: Rutaceae

Parts used: leaves

Function: Curry leaves, from *Murraya koenigii*, are widely used in herbal shampoo formulations due to their strong hair and scalp benefits. They are rich in antioxidants, amino acids, and essential nutrients that help nourish hair roots and support healthy growth. Their antimicrobial and antifungal properties help reduce dandruff and prevent scalp infections. Curry leaves also help strengthen hair shafts, reducing breakage and premature hair fall. They may improve hair pigmentation, helping delay premature greying. In shampoo, they act as a natural conditioning and soothing agent, leaving hair soft, shiny, and healthy while maintaining overall scalp balance and cleanliness.

4. Aloe vera Gel

Common name: Gwar Patha or Ghrit kumari

Biological name: Aloe barbadensis miller

Family: Asphodelaceae

Parts used: Leaves

Function: Aloe vera gel from Aloe vera is widely used in shampoo formulations for its strong moisturizing, soothing, and conditioning properties. It contains vitamins, enzymes, amino acids, and polysaccharides that help nourish the scalp and strengthen hair strands. Its anti-inflammatory and antimicrobial effects reduce scalp irritation, dandruff, and itching, promoting a healthy scalp environment. Aloe vera also helps balance scalp oil production, making it suitable for both dry and oily hair types. In shampoos, it acts as a natural conditioner, improving hair softness, shine, and manageability while supporting hair growth and reducing breakage.

• Function of other ingredients

• Ingredients

Sodium Lauryl Sulphate (SLS): It is used as a surfactant and as a foaming agents.

Sodium Chloride: It is used as thickener.

Lemon juice: It is used as a preservative

Acacia gum: It is used to increase viscosity

Rose oil: It is used for fragrance

MATERIALS AND METHODOLOGY

- 1) Collection of Herbs: The required herbs are collected from the local market and some of them are collected from the area of college.

2) **Extraction of Herbs:** Extraction of pomelo peel: 20gm of powdered material dissolves in the 200ml of ethanol in Soxhlet apparatus. Ethanol is used as solvent to the round bottom flask. Heat the solvent using the heating mantle for 180-210min at 78°C. Once the solvent starts boiling, the vapour will pass through the condenser.

The condensed solvent will drip into the Soxhlet apparatus and extract the desired compound will then drip back into the RBF.

Repeat the extraction process for several minutes. After the extraction process, collect the extract from RBF and cool at room temperature.

3) **Decoction of curry leaves:** Weigh 10 gm of curry leaves then first wash with the distilled water then washed curry leaves add in 100 ml of distilled water then put on a water bath for 30 min. After 30 min filter the solution we get filtered solution of curry leaves.

4) **Extraction of aloe vera:** Clean the leaves of aloe vera. Slice or split the aloe vera leaves, then extract the pulp that resembles gel. Put the pulp in the blender and blend for minimum of one min.

Table 6: Herbal Ingredients.

Herbal Ingredient	Quantity
Plant	10%
Pomelo peel extract	6%
Shoe black plant	6%
Reetha	6%
Curry leaves	6%
Aloe vera	5%

Table 7: Composition of Herbal Shampoo for (200ml).

Herbal Extract	120ml
SIS (Sodium Lauryl Sulphate)	10ml
NaCl	10ml
Acacia Gum	10ml
Lemon Juice	10ml
Rose Water	q.s
Distilled water	q.s

7. Formulation of Herbal Shampoo

Weighed all the ingredients according to the formula.

- Take a beaker add pomelo peel extract, hibiscus powder extract, curry leaves extract and aloe vera gel in given amount mix well with the help of magnetic stirrer.
- Add acacia gum and sodium chloride in beaker.
- Then add reetha powdered solution into the firstly prepared solution.
- Add lemon juice and rose water it works as Preservatives and perfume.
- And then Mix well the above solution using magnetic stirrer for several mins.
- Store the solution in the container and label on it.

8. Evaluation OF Herbal Shampoo:

1. Physical Appearance/ Visual Inspection: The formulation was tested for clarity, color, odor, foaming ability. Based on the physical appearance the test was carried out.

2. Determination of pH: A shampoo solution was constituted in distilled water and the pH of the solution was measured by using calibration pH meter. The shampoo formulation pH was 5.5, falling between the range 4 to 6 that advised for shampoo. The formulation has an acid-balanced pH that is almost skin-friendly.

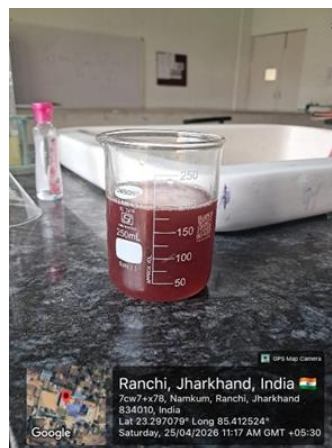


Fig. 2: Extraction of herbal ingredients.



Fig 3: Determination of pH.

3. Foaming ability and Foaming stability: The herbal shampoo solution's capacity to foam was assessed using the cylinder shake method. After adding the sample of herbal shampoo solution, the cylinder was gradually shaken by hand for ten minutes. Following a brief period of shaking, the volume of foam was measured every minute for approximately five minutes. This indicates that the foam produced by the shampoo is stable and has higher foam properties, which could be attributed to the presence of a foaming agent.

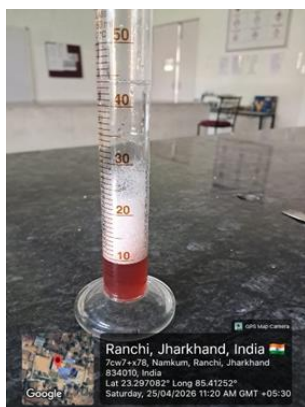


Fig. 4: Foaming ability and stability.

4. Viscosity: By using Ostwald Viscometer we determine the viscosity of the shampoo. Aloe vera gel was incorporated into the formulation to enhance thickness, a viscosity of 285 cp indicates that the shampoo achieves an ideal balance between being too thick and too watery. This viscosity level ensures that the shampoo is easy to apply and rinse out.



Fig. 5: Viscosity test.

5. Dirt dispersion: About 1% of shampoo solution taken in a Test tube and 1 drop of India ink is added. The test Tube is stoppered and shaken for about 10 mins. The amount of ink present in the foam is indicated as None, light, moderate, or heavy.

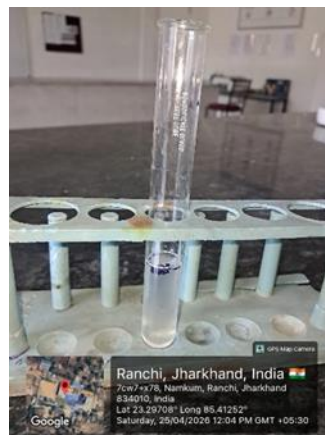


Fig. 6: Dirt dispersion test.

6. Surface tension: Measurements were carried out with a 10% shampoo dilution in distilled water at room temperature. Thoroughly clean the stalagmometer using chronic acid and purified water because surface tension is highly affected with grease or other lubricants and after cleaning determine the surface tension.



Fig. 7: Surface tension test.

7. Antifungal activity

The antifungal activity of the formulated herbal shampoo containing pomelo peel extract was evaluated using the agar well diffusion method. A suitable fungal strain (such as *Candida albicans* or *Aspergillus niger*) was cultured on potato dextrose agar (PDA) plates under sterile conditions. Three Petri plates containing the fungal culture medium were prepared. Wells were carefully made in each plate using a sterile cork borer. A total of six samples were tested. The pomelo peel extract was introduced into the wells in increasing concentrations as follows:

- Sample 2: 1 mL
- Sample 4: 2 mL
- Sample 6: 3 mL

Sample 8: 4 mL

In addition, 2 mL of a standard antifungal agent was used as the positive control (PC), and 2 mL of distilled water was used as the negative control (NC). All plates were incubated at an appropriate temperature (25-30°) for 24-48 hours. After incubation, the antifungal activity was evaluated by measuring the zone of inhibition around each well. A clear zone around the well indicates effective antifungal activity. An increase in the zone of inhibition with higher concentration of pomelo peel extract suggests better antifungal activity of the formulation.



Antifungal activity test.

9. CONCLUSION

The above review we can be concluded that citrus maxima shows various health benefits. The fruits, flowers, leaves, essential oils and juices of citrus species are utilized to prepare various forms of food products. Along with their nutritional values, in the health industry, different parts of the plants of the citrus genus have been used as supplements or remedies to prevent or control diseases. This review focused on the pharmacological activities of Citrus medica, Citrus aurantium and Citrus maxima. The above mentioned citrus species produce secondary metabolites including flavonoids, alkaloids, limonoids, coumarins, carotenoids, phenolic acids and essential oils and their importance is due to their active properties. These characteristics include anti-oxidant, anti-diabetic, anti-inflammatory, anti-microbial, anti-alzheimer, anti-obesity, anti-depressant as well as hepatoprotective activity. Besides of the above health benefits citrus maxima juice gain less popularity due to presence of bitterness compound like naringin content. By reducing its bitterness marketability can be enhance so that anyone From can get its health benefits.

REFERENCES

1. Abhilasha Shourie (2014) Ultrasonication assisted extraction of Phenolic antioxidants from Citrus

- maxima leaves and their GC-MS profile. International Journal of Pharma and Bio Sciences, 5(3): 38-48.
2. R. Susandarini, S. Subandiyah, Rugayah, B. S. Daryono, and L. H. Nugroho.
3. "Assessment of taxonomic affinity of Indonesian pummelo (citrus maxima (Burm.) Merr.) based on morphological characters," American Journal of Agricultural and Biological Science, 2013; 8.
4. R. Susandarini, S. Subandiyah, Rugayah, B. S. Daryono, and L. H. Nugroho.
5. "Assessment of taxonomic affinity of Indonesian pummelo (citrus maxima (Burm.) Merr.) based on morphological characters," American Journal of Agricultural and Biological Science, 2013; 8.
6. Hadjiakhoondi A, Baligh N. Practical guidance of medicinal plants. Islamic Azad University Scientific Publication Center, Tehran., 2005; 5-20.
7. Aswini Kharjul, Mangesh Kharjul et al. PHARMACOGNOSTIC INVESTIGATION
8. ON LEAVES OF CITRUS MAXIMA (BURM.) MERR. (RUTACEAE). IJPSR., 2012; 3(12): 1000-1005.
9. Sawant T, Panhekar D. A Brief Review on Recent Advances of Citrus maxima (Chakota). Int J Recent Sci Res., 2017; 8(8): 19400-16.
10. Morton JF. Fruits of Warm Climates: Pummelo. 1st ed. Miami (FL): Web publications, 1987; 147-51.
11. Liu, Y., Ren, C., Cao, Y., Wang, Y., Duan, W., Xie, L., Sun, C., & Li, X. (2017). Characterization and purification of bergamottin from Citrus grandis (L.) Osbeck cv. Yongjiazaoxiangyou and its antiproliferative activity and effect on glucose consumption in HepG2 cells. Molecules, 22(7): 1227.
12. Xu, C. J., Fraser, P. D., Wang, W. J., & Bramley, P. M. (2006). Differences in the carotenoid content of ordinary citrus and lycopene-accumulating mutants. Journal of Agricultural and Food Chemistry, 54(15): 5474-5481.
13. Tocmo, R., Pena-Fronteras, J., Calumba, K. F., Mendoza, M., & Johnson, J. J. (2020). Valorization of pomelo (Citrus grandis Osbeck) peel: A review of current utilization, phytochemistry, bioactivities, and mechanisms of action. Comprehensive reviews in food science and food safety, 19(4): 1969-2012.
14. Ali, M., Rumpa, N. E. N., Paul, S., Hossen, M., Tanvir, E. M., Hossan, T., Saha, M., Alam, N., Karim, N., Khalil, M.I., & Gan, S. H. (2019). Antioxidant potential, subacute toxicity, and beneficiary effects of methanolic extract of pomelo (Citrus grandis L. Osbeck) in long evan rats. Journal of toxicology, 2529569.
15. Shao, S. Y., Xu, W. J., Tao, J., Zhang, J. H., Zhou, X. R., Yuan, G., Yang, Y., Zhang, H. Y., Xu, Q., Deng, X. X., Hu, S. H., Zhang, M.X., Liu, Z. L & Yu, X. F. (2017). Glycemic index, glycemic load, and glycemic response to pomelo in patients with type 2 diabetes. Current Medical Science, 37(5): 711-718.

16. Tsai, H. L., Chang, S. K., & Chang, S. J. (2007). Antioxidant content and free radical scavenging ability of fresh red pummelo [*Citrus grandis* (L.) Osbeck] juice and freeze-dried products. *Journal of agricultural and food chemistry*, 55(8): 2867-2872.
17. He, J. Z., Shao, P., Liu, J. H., & Ru, Q. M. (2012). Supercritical carbon dioxide extraction of flavonoids from pomelo (*Citrus grandis* (L.) Osbeck) peel and their antioxidant activity. *International journal of molecular sciences*, 13(10): 13065-13078.
18. Abudayeh, Z. H., Al Khalifa, I. I., Mohammed, S. M., & Ahmad, A. A. (2019). Phytochemical content and antioxidant activities of pomelo peel extract. *Pharmacognosy Research*, 11(3): 244-247.
19. Shi, M., Liu, X., Zhang, H., He, Z., Yang, H., Chen, J., Feng, J., Yang, W., Jiang, Y., Yao, J. L., Deng, C. H., & Xu, J. (2020). The IAA- and ABA-responsive transcription factor CgMYB58 upregulates lignin biosynthesis and triggers juice sac granulation in pummelo. *Horticulture research*, 7, 139.
20. Thavanapong N, Wetwitayaklung P, Charoenteeraboon J. Comparison of Essential Oils Compositions of *Citrus maxima* Merr. Peel Obtained by Cold Press and Vacuum Steam Distillation Methods and of Its Peel and Flower Extract Obtained by Supercritical Carbon Dioxide Extraction Method and Their Antimicrobial Activity. *J Essent Oil Res.*, 2010; 22(1): 71-7.
21. Nwanneka PA, Chiamaka HA. Nutrient, phytochemical, and antinutrient composition of *Citrus maxima* fruit juice and peel extract. *Food Sci Nutr.*, 2018; 6(3): 653-8.
22. Sidana J, Saini V, Dahiya S, Nain P, Bala S. A Review on Citrus - "The Boon of Nature". *Int J Pharma Sci Rev Res.*, 2013; 18(2): 20-7.
23. Tocmo R, Pena-Fronteras J, Calumba KF, Mendoza M, Johnson JJ. Valorization of pomelo (*Citrus grandis* Osbeck) peel: A review of current utilization, phytochemistry, bioactivities, and mechanisms of action. *Compr Rev Food Sci Food Saf.*, 2020; 19(4): 144.
24. Vijayalakshmi P, Radha R. An overview: *Citrus maxima*. *J Phytopharmacol.*, 2015; 4(5): 263-7.
25. Ahmad AA, Khalifa IIA, Abudayeh ZH. The Role of Pomelo Peel Extract for Experimentally Induced Wound in Diabetic Rats. *Pharmacog J.*, 2018; 10(5): 885-91.
26. Nadakarni AK. *Indian Material Medica*. 3rd ed. Bombay: Popular Book Depot., 1954; 45-9.
27. Bhandurge P, Rajarajeshwari N, Alagawadi K, Agrawal S. Antidiabetic and hyperlipaemic effects of *Citrus maxima* linn fruits on alloxan-induced diabetic rats. *Int J Drug Dev Res.*, 2010; 2(2): 273-8.
28. J. Yang, S.-Y. Lee, S.-K. Jang, K.-J. Kim, and M.-J. Park, *Pharmaceutics* 2023; 15: 1595.
29. Shivananda, A., Muralidhara, R. D., Jayaveera, K. N. (2013). Anticancer Activity of Extracts of Various Fractions of *Citrus maxima* (J.Burm.) Merr. on HeLa Cell Line. *Journal of Pharmacy and Chemistry*, 7(1): 3-7.
30. KunduSen, S., Gupta, M., Mazumder, U. K., Haldar, P., Panda, S., & Bhattacharya, S. (2011). Exploration of anti-inflammatory potential of *Citrus limetta* Risso and *Citrus maxima* (J. Burm.) Merr. *Pharmacologyonline*, 7: 702-709.
31. M. Alamholo and M. Shojaemehr, *Journal of Kermanshah University of Medical Sciences*, 2020; 24: 1.
32. Tsai, H. L., Chang, S. K., & Chang, S. J. (2007). Antioxidant content and free radical scavenging ability of fresh red pummelo [*Citrus grandis* (L.) Osbeck] juice and freeze-dried products. *Journal of agricultural and food chemistry*, 55(8): 2867-2872.
33. Abirami, A., Nagarani, G., & Siddhuraju, P. (2014). In vitro antioxidant, anti-diabetic, cholinesterase and tyrosinase inhibitory potential of fresh juice from *Citrus hystrix* and *C. maxima* fruits. *Food Science and Human Wellness*, 3(1): 16-25.
34. Dulay RMR, Castro MEGD, Antibacterial antioxidant activities of three citrus leaves extracts. *Der Pharmacia Lettre*, 2016; 8(13): 167-170.