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Guava leaf-based herbal hand sanitizer: A study on formulation and efficacy

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Abstract
The primary objective of this investigation is to create herbal hand sanitizers using alcohol. The objective is to use *Psidium guajava* leaf extract to make and evaluate a herbal hand sanitizer. Its effectiveness demonstrates the advantages of using herbal hand sanitizer. Alcohol-based herbal hand sanitizers have the benefit of having no negative side effects. Natural herbal hand sanitizers are economical, efficient, and safe for the environment. By using hand sanitizer, adverse effects, including dermatitis, itching, and irritation, can be avoided. Active substances with antibacterial, anti-inflammatory, and antimicrobial qualities include flavonoids, tannins, and phenolics found in guava leaves. The biological properties of guava leaf extracts, such as their anticancer, antidiabetic, antioxidant, antidiarrheal, antibacterial, lipid-lowering, and hepatoprotective properties, have been investigated. The dispersion method was used to formulate the sanitizer. Glycerine, Carbopol 940, guava leaf extract, and ethyl alcohol were among the excipients utilized. Physical testing was conducted, such as homogeneity, spreadability, adhesiveness, pH, organoleptic (shape, smell, and color), and product irritation tests. The formulations had pH values between 5 and 6. A hand sanitizer made with guava leaf extract offers a pleasant scent and a more skin-friendly, eco-friendly alternative to alcohol-based synthetic sanitizers. Its lack of harmful chemicals like TEA and parabens makes it a safe and natural option for effective hand hygiene.

Keywords: Herbal hand sanitizer, *Psidium guajava*, leaf extract, paraben free skin-friendly

1. Introduction
Eighty percent of people use plant extracts and their active ingredients for their basic medical requirements, according to the World Health Organization (WHO), (Ekor, 2013) [1]. Due to their active chemical phytoconstituents, these straightforward therapeutic formulations often yield positive effects (Park and Pezzutto, 2002) [2]. The demand for antimicrobial hand washing solutions has increased in response to the global COVID-19 epidemic (Foddai, ACG *et al.*, 2016) [3]. The tropical fruit tree known as the guava (*Psidium guajava*) grows mostly in tropical and subtropical regions throughout several nations. It is indigenous to tropical America, mostly from northern South America to southern Mexico. It is a compact tree or evergreen shrub that is a member of the Myrtaceae family. Guava leaves, pulp, and seeds are utilized to boost platelets in dengue fever patients and treat several gastrointestinal and respiratory conditions. (Laily *et al*. (2015) [4]. Guava leaves are utilized extensively for their antidiabetic, antispasmodic, cough-sedative, anti-inflammatory, antidiarrheic, antihypertensive, and anti-obesity effects (Chen HY, Yen GC).

1.1 Aim and Objective
- Collection of plant material (leaves).
- Extraction of plant extract in ethanol.
- Preliminary phytochemical screening.
- Quantitative analysis of bioactive compounds.
- Formulation of Herbal Hand Sanitizer.
- Organoleptic test for hand sanitizer

Fig 1: *Psidium guajava* leaves

2. Materials and Methodology

A. Collection of plants

The leaves of the *Psidium guajava* plant are gathered in the Indian Haryana hamlet of Jamalpur. The month of February is when the fresh guava leaves are picked. In his pioneering book "Species Plantarum" published in 1753, Swedish botanist Carl Linnaeus botanically verified and named the guava plant, *Psidium guajava L*. Since Carl Linnaeus was the first to fully describe and categorise the species, the "L." in the name stands for Linnaeus. After being carefully cleaned with tap water, all newly harvested leaves were shade-dried at room temperature, ground into a powder, and stored in airtight containers for later use.

B. Preparation of plant extract

50g of fresh guava leaves were gathered, cleaned under running water to get rid of dust, allowed to dry at room temperature in the shade for three to four days, and then crushed into a fine powder. A three-to four-day maceration procedure with 95% ethanol produced the dry powder. In a 250 ml flask, 10 g of powder was mixed with 100 ml of ethanol and agitated. Aluminium foil was then placed over the flask. To stop it from evaporating, it was shaken on a platform shaker for three days at room temperature. After the extract was filtered using Whatman filter paper to eliminate any particles that could not be extracted, the filtrate was collected. After evaporation at room temperature, the filtrates were weighed and redissolved in ethanol to achieve a final concentration of 1 mg/ml for each extract.

C. Quantitative evaluation of the main phytochemical components

The total content of flavonoids (Bohm and Kocipai-Abyazan, 1974)

10 g of the plant material was repeatedly macerated with 100 millilitres of 80% methanol in water, and the mixture was then allowed to stand for an hour at room temperature or in a water bath that was heated to 35 degrees Celsius. After that, Whatman filter paper was used to filter the mixture. A dry residue was prepared by evaporating the filtrate over a water bath; this residue was then weighed to ascertain its consistent weight.

2.1 Total Alkaloid Content

Guava leaf powder (5 g) was extracted using 200 mL of 10% acetic acid in ethanol by allowing the mixture to stand for four hours. The extract was filtered and concentrated to one-fourth of its original volume using a water bath. Ammonium hydroxide was then added drop wise to the concentrate to induce precipitation. The resulting precipitate was allowed to settle, washed with dilute ammonium hydroxide, filtered, dried, and weighed until a constant mass was achieved.

2.2 Total Phenols Content

With minor adjustments, the Folin-Ciocalteu colorimetric test, which is based on an oxidation-reduction process and was described by Singleton *et al*. (1965), was used to measure the total phenolic content in guava leaf extract. Gallic acid standard solutions at concentrations of 10, 20, 30, 40, and 50 µg/mL were made from a 1 mg/mL stock solution in ethanol to generate a calibration curve. One millilitre of guava leaf extract (1 mg/mL) and one millilitre of Folin-Ciocalteu reagent were added to a test tube for the sample analysis. One millilitre of a 10% sodium carbonate (Na_2CO_3) solution was then added to the mixture after it had been left to incubate in the dark for five minutes. After that, the reaction mixture was allowed to stand for half an hour at room temperature. The control was a blank sample that included no extract. At 750 nm, the absorbance was determined using a UV-Vis spectrophotometer.

Next, the following formula was used to determine the guava leaf extract's total phenolic content: $C\ c \times V/M$

Where,

- C = Total phenolic content (mg GAE/g dry extract)
- c = Concentration of Gallic acid determined from the calibration curve (mg/mL)
- V = Volume of extract used (mL)
- M = Weight of dry extract (g)

The result was expressed as milligrams of Gallic Acid Equivalents (GAE) per gram of dry guava leaf extract.

C. Preparation of herbal hand sanitizer

With continuous stirring, a predetermined amount of Carbopol 934 was added to the required volume of distilled water. Give it two to four hours to hydrate (overnight is best for maximum swelling). Mix the hydrated Carbopol gel well after adding the glycerol. Gently stir the guava leaf extract into the gel base. While continuously mixing the gel, gradually add the necessary quantity of ethanol. Add enough distilled water to reach the required volume and stir well. Finally, let the gel settle for 12 to 24 hours in order to eliminate air bubbles and get the right consistency. If the pH of the sanitiser is not optimal (5.5-6.8), we may also use NaOH or KOH instead of synthetic amines like TEA.

Carbopol 934 mixed into distilled water.
↓
Add glycerol/ glycerine to the carbopol gel
↓
Add ethanol with continuous mixing
↓
Add distilled water up to the desired volume
↓
At last pH was balanced in the formulated sanitizer

3. Results and Discussion

3.1 Quantitative Phytochemical Screening

Total Flavonoid and Total Alkaloid Content

The total yield of dry residue is

Table 1: Yield of TFC and TAC

Phytoconstituent	Yield
Flavonoid	1.49 gm
Alkaloid	1.67 gm

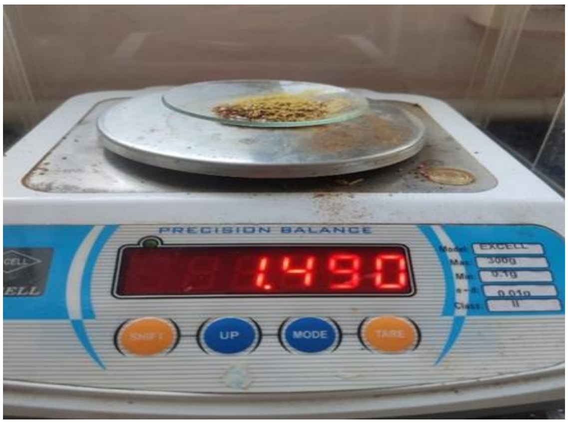

Fig 2: Total Flavonoid Content

3.2 Total Phenolic Compound

The total phenolic content of *Psidium guajava* ranges from 0.42±0.2.

Table 2: Total phenolic content data readings

S. No	Concentration	Absorbance at 750nm
1.	0.2	0.17
2.	0.4	0.29
3.	0.6	0.86
4.	0.8	1.27
5.	1.0	1.83

Fig 3: Total Phenolic Content

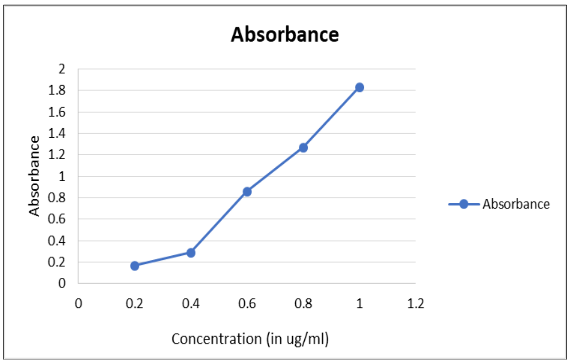

Fig 4: Graphical Representation of TPC

3.3 Formulation of herbal hand sanitiser

Table 3: Formulation of Hand Sanitiser (F1, F2 & F3

S. No	Ingredients	F1	F2	F3
1.	Guava leaves extract	2 ml	5 ml	7.5 ml
2.	Carbopol	2 gm	2.5 gm	3 gm
3.	Glycerine	1.5 ml	1.75 ml	2 ml
4.	Ethanol	1.5 ml	5 ml	7.5 ml
5.	Distilled Water	5 ml	7 ml	10 ml

3.4 Evaluation of physical parameters of hand sanitiser

The produced hand sanitiser's physical parameters were determined. The parameters, colour, pH, odour, appearance, etc. all were determined.

Table 4: Physical parameters of hand sanitiser

S. No	Parameters	F1	F2	F3
1	Colour	Light green	Green	Green
2	pH	6.8-7	7	6-7
3	Clarity	Opaque	Opaque	Opaque
4	Spread ability	Good	Easily spread	Easily spread
5	Irritancy test	No irritancy	No irritancy	No irritancy

Fig 5: Formulated hand sanitiser

4. Conclusion

The plant-based herbal hand sanitiser formulated with *Psidium guajava* (guava) leaf extract proved more effective than commercial alternatives. Guava leaves, known for treating various ailments, contain bioactive compounds such as flavonoids, tannins, saponins and alkaloids, which contribute to antimicrobial, antioxidant, and anti-inflammatory activities. Quantitative analysis confirmed high levels of flavonoids and phenolics, supporting the extract's antibacterial potential. The exclusion of synthetic preservatives (parabens) and neutralisers (TEA) did not compromise the formulation's stability or effectiveness. The final product was safe, skin-friendly, quick-drying, and visually appealing, making it suitable for regular use.

Using *Psidium guajava* (guava) leaf extract as the main active component and carbopol as the gelling agent, the current research concentrated on creating and testing a herbal hand sanitiser. The formulation addressed customer concerns about the safety and possible adverse effects of chemical additions in personal care products by purposefully excluding neutralising agents like triethanolamine (TEA) and synthetic preservatives like parabens.

4.1 Future prospective

This study opens up several opportunities for further research and development. In the future, more detailed studies can be done to test the long-term effectiveness and safety of guava leaf-based hand sanitizers. Clinical trials involving more people can help confirm its ability to kill different types of germs and ensure it is safe for daily use. There is also potential to improve the formulation by testing different natural ingredients that can work well with guava leaf extract, such as other herbal extracts or essential oils. These combinations may increase the sanitizer's ability to fight bacteria and viruses. This can also help promote the use of traditional medicinal plants and support the development of sustainable products.

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