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(RESEARCH ARTICLE)



Formulation and characterization of papaya leaf gel

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Abstract

The study was designed for ethanolic extraction of papaya leaf, phytochemical screening of the extract, formulation of papaya leaf gel by using carbopol 934 and characterization of the herbal gel. The fresh papaya leaves were collected and extracted by maceration process using ethanol as a solvent. The extract was analysed by UV spectrophotometer and IR spectroscopy for identification of phytochemical compounds. Then the phytochemical evaluation was performed and the presence of glycoside, tannins, flavonoids and saponins were observed. The herbal gel was prepared by using carbopol 934 polymer and isopropyl alcohol as penetration enhancer. pH of 6 was observed by using the pH meter. Swelling index of blank gel was 190% and the swelling index of herbal gel was 220%. In the spreadability study, the diameter of the spot was observed within 3.5-3.7 cm. The interaction study between phytochemicals and the excipients was carried out by FTIR spectroscopy.

Keywords: Papaya leaf gel; Carbopol 934; Ethanolic extraction; Dermal preparation

1. Introduction

Topical delivery is an attractive route for local and systemic dermatological diseases. It enhances absorption due to its deeper penetration to the skin. It is less toxic and more effective that reduces systemic effect. Gels are basically used as delivery systems for topical administered drug directly to the skin, eye or mucous membrane [1]. Topical delivery is defined as the application of a formulation containing drug to the skin to directly treat cutaneous disorders (eg. acne) with the intent of containing pharmacological or other effect of the drug to the surface of the skin or within [2,3,4]. Within the major group of semisolid preparations, the use of transparent gels has explained both in cosmetic and pharmaceutical preparations. In spite of many advantages of gel, a major limitation is in the delivery of hydrophobic drugs [5,6]. Gel are constituted by entrapment of large amounts of aqueous or hydroalcoholic liquid in a network of colloidal solid particles, which may be organic or inorganic polymers of natural or synthetic origin. The higher aqueous component permits greater dissolution of drugs, and permits easy migration of the drug as compared to the ointment or cream base. However, this makes gels poor vehicle for hydrophobic drugs. This limitation of gels can be overcome by making emulgel [7]. A tropical plant, *Carica papaya*, a flowering plant, having five yellow orange or cream white petals. The fruits have many seeds surrounding by a smooth yellow to orange red flash. They are mainly trees or shrubs comprising about 35 species of six genera. The young leaves *Carica papaya* contain carpine which is an alkaloid. Several minerals are reported in leaves of *Carica papaya* like calcium, magnesium, sodium, iron and some vitamins are ascorbic acid, thiamine and riboflavin. The latex is rich in chymopapain and papain. The *Carica papaya* leaf extract was investigated for its anti-inflammatory activity, anti-fungal activity and wound healing activity [8].

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2. Preparation of plant extract

At first the fresh papaya leaves were collected. Then the leaves were washed properly with water. After that the leaves were shade dried and then grinded into small particles by mechanical grinder. Then the powder was extracted by cold maceration process with help of ethanol. In this process the fine powder was placed into ethanol for 7-8 days. After that the extract was filtered by whatman filter paper and the filtrate was collected. Then the solvent was evaporated by rotary evaporator under reduced pressure [9].

3. Phytochemical evaluation of plant extract

3.1. Qualitative test for alkaloid

1 ml of 1% HCl was added to 3 ml of each extract in different test-tube. Each mixture was heated for 2 min in a water bath while stirring continuously. It was cooled and filtered. 1 ml of filtrate from above was added to 0.5 ml of Mayer's reagent. 1 ml of each filtrate from above was added to 0.5 ml of Wagner's reagent in different test tube.

3.2. Qualitative test for tannin

Ferric chloride (FeCl₃) Test: 5 g of ferric chloride was dissolved and made up to 100ml with distilled water. 0.5 ml of FeCl₃ was then added to 2 ml of the extract.

KOH Test: 1 ml of freshly prepared 10% KOH was added to 1 ml of each extract in difference test tube.

3.3. Qualitative test for flavonoid

Two drops of NaOH solution was added to 1 ml of each extract in difference test tubes. Two drops of AlCl₃ solution was added to above, followed by addition of concentrated H₂SO₄.

3.4. Qualitative test for saponin

2 ml of each of the Fehling solution A and B was added to 3 ml of the extract. The mixture was boiled for 5 min.

3.5. Qualitative test for glycoside

5 ml of distilled water was added to 2 ml of the papaya leaf extract. 2 ml of the H₂SO₄ was also added the mixture and was boiled in water bath for 15 min and allowed to cool. The mixture was neutralized with 20% KOH solution. 1 ml of equal parts of Fehling solution A and B (each) was added to the mixture and boiled for 15 min in a water bath [10].

3.6. Thin layer chromatography (TLC) of papaya leaf extract

Silica gel G was used as stationary phase and ethyl acetate and hexane were used as mobile phase. The sample was spotted by capillary tube. After completion of run the spots were identified by UV chamber. The distance travelled by solutes and mobile phase was measured. Then R_f value was calculated.

3.7. Analysis of extract by UV visible spectrophotometer

The ethanolic extract was diluted by double distilled (DD) water. Then the sample was analysed by UV visible spectrophotometer within the range of 200-800 nm.

4. Preparation of papaya leaf gel

At first the polymer was placed in water for 2 hours. Then the solvent which contains the plant extract was added to the polymer and mixed for twenty minutes. Then the dispersion was allowed to hydrate and swell for sixty minutes. Finally the pH was adjusted with 98% triethanolamine with gentle stir. After that the mixture was allowed to equilibrate for twenty four hours [11].

5. Characterization of papaya leaf gel

5.1. Determination of pH

The pH of the gels was measured using a digital pH meter. The results were the mean of triplicate readings.

5.2. Determination of swelling index

1 g of gel formulations was taken on porous aluminium foil and then placed in the petridis containing 10 ml distilled water. The samples were taken from the petridis at a different time interval and left undisturbed in a dry place for some time so that the external liquid was removed and weighed. Swelling index was calculated by the formula as following [12]

$$\text{Swelling Index (SW)\%} = [(W_t - W_0) / W_0] \times 100$$

Where (SW) % = Equilibrium percent swelling, W_t = Weight of swollen gel after time t , W_0 = Initial weight of gel at zero time.

5.3. Determination of spreadability

For determination of spreadability, 1 g of gel formulations was placed within the circle of 1 cm diameter pre-marked on a glass plate of 20 x 20 cm, on which a second glass plate was placed. A 500 g weight was allowed to rest on the upper glass plate for 5 min. The diameter due to gel spreading was noted [12].

5.4. Drug excipients interaction study

The pure carbopol 934, papaya leaf extract and papaya leaf gel were mixed separately with IR grade KBr and corresponding pellets were prepared by applying specified pressure in a hydraulic press. The pellets were scanned over a wave number range of 4000 to 400 cm^{-1} in FTIR spectroscope.

6. Results and discussion

The UV-visible spectrum of ethanolic extract of *C. papayawas* taken at the wavelength of 200-800 nm. The spectra showed the peaks at 675 nm, 428.5 nm, 305.5 nm and 241 nm with the absorption of 0.486, 0.717, 0.831, and 0.961 respectively. There was a peak at 241 nm, which indicates presence of saturated compounds with hetero atoms like S, O, N or halogens. Generally the peaks due to this transition occurs from 180 nm-250 nm. There was a peak at 305.5 nm, which indicates the presence of aldehydes or ketones containing S, O, N or halogen. The peak at 675 nm was due to the presence of chlorophyll.

In IR spectrum of carbopol 934 many peaks were observed. The peak observed at 1707 cm^{-1} which was associated with ketone or aldehyde C=O stretching. Another peak was observed at 1527 cm^{-1} which was associated with C=C stretching. The other peak was observed at 1452 cm^{-1} which was associated with CH_2 bending and CH_3 bending. Here two peaks at 1180 cm^{-1} and 1048 cm^{-1} were observed due to the C-O-C stretching and C-OH stretching. Two peaks at 2865 cm^{-1} and 2984 cm^{-1} were observed which was associated with alkane C-H stretching. The peak at 1242 cm^{-1} which was associated with alcohol C-O stretching (Figure 1).

IR spectrum of ethanolic papaya leaf extract consist several peaks. Two peaks were present at 2846 cm^{-1} and 2948 cm^{-1} due to the alkane C-H stretching. Two peaks at 1449 cm^{-1} and 1485 cm^{-1} were observed which was associated with aromatic C=C stretching. The peak at 1243 cm^{-1} was due to the alcohol C-O stretching and C-N vibrations. Three peaks at 1165 cm^{-1} , 1084 cm^{-1} and 1020 cm^{-1} were recorded which were associated with alcohol O-H bending. A peak at 1380 cm^{-1} was observed which was associated with phenols C-O stretching. Four peaks at 1506 cm^{-1} , 1558 cm^{-1} , 1550 cm^{-1} and 1541 cm^{-1} were observed due to the phenol N-H bending. Two peaks were present at 1417 cm^{-1} and 1380 cm^{-1} which were associated with phenols C-O stretching. A single peak was observed at 1713 cm^{-1} due to acid C=O stretching. A peak was present at 2334 cm^{-1} which was associated with C \equiv N stretching. A single peak was recorded at 1380 cm^{-1} which was associated with alkane C-H bending (Figure 2).

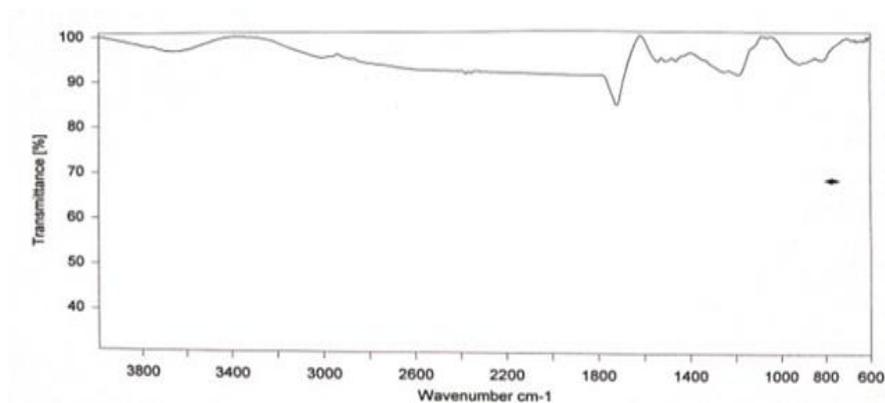


Figure 1 FTIR spectra of carbopol 934

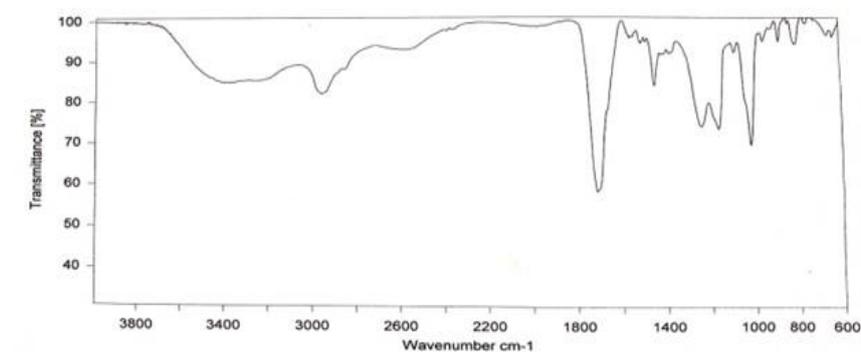


Figure 2 FTIR spectra papaya leaf extract

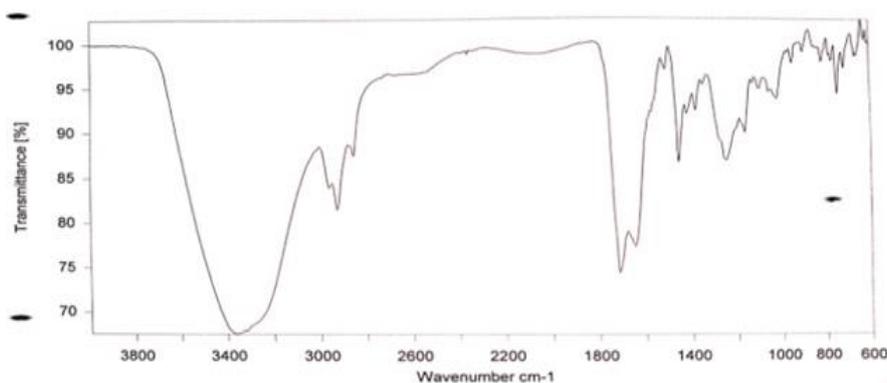


Figure 3 FTIR spectra of papaya leaf gel

In IR spectrum of papaya leaf gel contain many peaks. A single peak at 3367 cm^{-1} was observed which was associated with alcohol and water O-H stretching. Two peaks were recorded at 2925 cm^{-1} and 2853 cm^{-1} due to the alkane C-H stretching. A single peak was observed at 1712 cm^{-1} for acid C=O stretching. The peak was observed at 1643 cm^{-1} which was associated with alkene C=C stretching. Two peaks at 1451 cm^{-1} and 1415 cm^{-1} were recorded for aromatic C=C stretching. A couple of peaks were observed at 1376 cm^{-1} and 1344 cm^{-1} which were associated with phenols C-O stretching. Another peak was observed at 1245 cm^{-1} due to the alcohol C-O stretching. Four peaks were observed at 1162 cm^{-1} , 1097 cm^{-1} , 1054 cm^{-1} and 1019 cm^{-1} which were associated with alcohol O-H bending. The peak at 1505 cm^{-1} was recorded due to the N-H bending. Here some peaks were observed at 897 cm^{-1} , 813 cm^{-1} , 770 cm^{-1} , 714 cm^{-1} and 779 cm^{-1} which were associated with aromatic C-H bending (Figure 3). Hence, there was no major interactions between ethanolic extract and excipients except some minor physical interaction which might be due to hydrogen bonding and/or Vander wall forces and/or co-valent bonding.

Table 1 Phtochemical evaluation of plant extract

Material	Compound	Reagent	Color change	Observation/Confirmation
Leaf extract	1) Alkaloid	Mayer	No	-
		Wagner	No	-
	2) Tannin	FeCl ₃	Greenish Dirty	+
		KoH	white PPT	+
	3) Flavonoid	AlCl ₃ solution & Conc. H ₂ SO ₄	Deep red	+
	4) Saponin	Fehling solution	Brick red precipitate	+
	5) Glycoside	KoH solution & conc. H ₂ SO ₄ ,	Brick red precipitate	+
		Fehling solution		

pH of the papaya leaf gel was observed to be 6. Swelling index of blank gel was 190% and the swelling index of herbal gel was 220%. In the spreadability study, the diameter of the spot was observed within 3.5-3.7 cm. R_f values were 0.58 and 0.68 which indicate that two components were separated and visualised on TLC chromatogram.

7. Conclusion

The study was regarding formulation and characterisation of papaya leaf gel. The papaya leaf gel was prepared by using carbopol 934 and the characterisation of the herbal gel was carried out. Further studies are required for future aspect.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

Researchers are in a supervisory relationship under corresponding author. The authors report no other conflicts.

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