



Research article

Functional properties for formulation development in mucilage of Deccan hemp (Java jute)

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Abstract: Deccan hemp is rich in mucilage and of immense value. This study was performed to examine mucilage of the plant and its functional group with the help of FT-IR Spectroscopy for preparation and development of pharmaceutical formulation. Mucilage was found to be 9.54% w/w which was off white in colour, tasteless and with a characteristic odour. Physicochemical characterization revealed that mucilage has enough moisture *i.e.* 9.34 % w/w and is of neutral pH. It was found to be soluble in hot water and insoluble in organic solvents while in cold water mucilage swelled to form a gel. FT-IR analysis of mucilage showed the presence of - as major markers that scope to be of scientific relevance particularly plant polymer based excipient and coating material in pharmaceutical products.

Keywords: Deccan hemp - Excipient - FT-IR - Spectroscopy - Mucilage - Pharmaceutical products.

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INTRODUCTION

The plant-based excipient polymer have been effectively applied in various pharmaceutical dosage forms like nanoparticles, film coating agents, matrix controlled system, suspensions, implants, buccal films and microspheres (Durso 1980, Chang & Shukla *et al.* 2003). Mucilages have been extensively used in the field of drug delivery for their easy availability, cost-effectiveness, eco-friendliness, emollient and non-irritant nature, non-toxicity, capable of many of chemical modifications, bio-degradable and compatible due to natural origin (Baveja *et al.* 1989, Kirtikar & Basu 1991). Mucilage is intracellular physiological product release without injury of the plant (Geetha *et al.* 2009). It is polysaccharide mixture having a high molecular weight (20000 and more) (Narkhede *et al.* 2010), commonly found in various organs of many higher plant species (Hadley 1997). It is an amorphous biomaterial and its composition was found to be rich in D-glucose, D-fructose, L- galactouronic acid, D-galactose, L- rhamnose, sucrose, maltose and xylose (Naveen *et al.* 2013). Mucilage acts as a membrane thickener and food reserve in the plants (Banker & Anderson 1987). They have been used as viscosity enhancers, stabilizers, disintegrants, solubilizers, emulsifiers, bioadhesives and binders (Baveja *et al.* 1988). Hence the present study was undertaken with the aim to extract, evaluate and characterize mucilage of plant for its physicochemical parameters, functional properties and application prospects. It is a good source of natural polymer with thickening and binding properties in different industrial applications. Plant material and products are compatible with environment safety and human health.

MATERIAL AND METHOD

Material

The plant with fruits was collected and authenticated by Dr. A.K.S Rawat (Scientist & HOD) at department of Pharmacognosy and Ethnopharmacology division CSIR-National Botanical Research Institute, Lucknow (voucher field booklet no 254060).

Processing and extraction

100 g of hemp fruit was cut into pieces, soaked in 1 L distilled water for 3–4 hours followed by heating at

70°C for 5–10 minute and crushed into mechanical blender which was filtered by muslin cloth after which ethanol was added into the filtrate (1:2) ratio was to precipitate mucilage and dried in hot air oven at 40–45°C. The mucilage powder obtained passed through sieve # 40 and stored in a desiccator at room temperature (Lohar *et al.* 2008).

Organoleptic evaluation

The isolated mucilage was characterized for organoleptic properties such as colour, taste, odour, and texture, fracture (Lala *et al.* 1981).

Solubility

1 g dry mucilage powder was solubilized with polarity gradient solvents and the solubility was determined (Lala *et al.* 1981).

pH

The mucilage was weighed and dissolved in water separately to obtained 1% w/v solution. The pH of solution was determined using digital pH meter (Lala *et al.* 1981).

Swelling index

The swelling index is the volume (in ml) taken up by the swelling of 1g of test material under specified conditions (Malviya *et al.* 2010).

FTIR Spectroscopy Analysis

Infrared (IR) spectroscopy was conducted using FT-IR Spectrophotometer; the spectrum was recorded in the wavelength region of 4000 to 400 cm^{-1} . The sample was mixed with KBr in ratio (1:4) and compressed into pellet with pressure of 7–8 tons in press. The pellet was then placed in the light path and the spectra was obtained at a resolution of 2 cm^{-1} from 4000 to 400 cm^{-1} for interpretation through software (Thermo Scientific S.No1630) (Harika *et al.* 2016).

RESULTS AND DISCUSSION

Table 1. Organoleptic and physicochemical characteristic of Deccan hemp mucilage.

S.N.	Properties of mucilage	Results
1	Swelling Index	9±0.52 % w/w
2	Solubility	Soluble in hot water, Insoluble in organic solvents and in cold water swell to form a gel
3	Loss on drying	9.34 % w/w
4	pH	7.2±0.2
5	Colour	Off white colour
6	Odour	Odour less
7	Taste	Taste less
8	Texture	Irregular
9	Fracture	Rough

The percentage yield of mucilage was 9.54% w/w, Organoleptic characteristics and physicochemical parameters *i.e.* solubility, moisture, pH, colour, odour, taste and texture were show in table 1. The chemical profiling of mucilage conforms the presence of six major markers through FT-IR. IR spectra at 3350 cm^{-1} indicates broad peak stretching and the presence of OH group. The IR spectra at 2850 cm^{-1} indicates C-H stretching of aliphatic hydrocarbon group and spectra at 2800 cm^{-1} indicates C-H stretching (primary aliphatic hydrocarbon group). The characteristic sharp peak at 1750–1700 cm^{-1} represents the stretching mode of the carbonyl group (carboxylic acid). The characteristic COO- peak at 1620–1635 cm^{-1} confirms the presence of -NH₂ bending (amide group), whereas the absorption band at 1050 cm^{-1} corresponds to the OH- primary aliphatic alcohol (Fig. 1; Table 2). There are some reports available demonstrating the role of present major functional groups in the plant species (Carboxylic acid exhibit hydrogen bonding with themselves especially in non-polar solvents, to increase stabilization of compounds and elevates their boiling points, Carboxylic acid participate in hydrogen bonding as both hydrogen acceptors and hydrogen donors) (<https://courses.lumenlearning.com>, <https://Chem.libretexts.org>). CH₂ group represents primary aliphatic hydrocarbon at wavelength of 2800 cm^{-1} this functional group characterizes the presence of polysaccharide. Due to the presence of an OH functional group at wavelength of 1050 cm^{-1} indicates polysaccharide nature of mucilage, which results to higher boiling points compared as to their parent alkanes. It was observed that IR spectra of Opium powder was similar to deccan hemp as investigated/found in our study (Figs. 1 & 2) the OH stretching, CH₂ stretching, amide and

aliphatic alcohol groups were found in the IR spectra of Opium and deccan hemp.

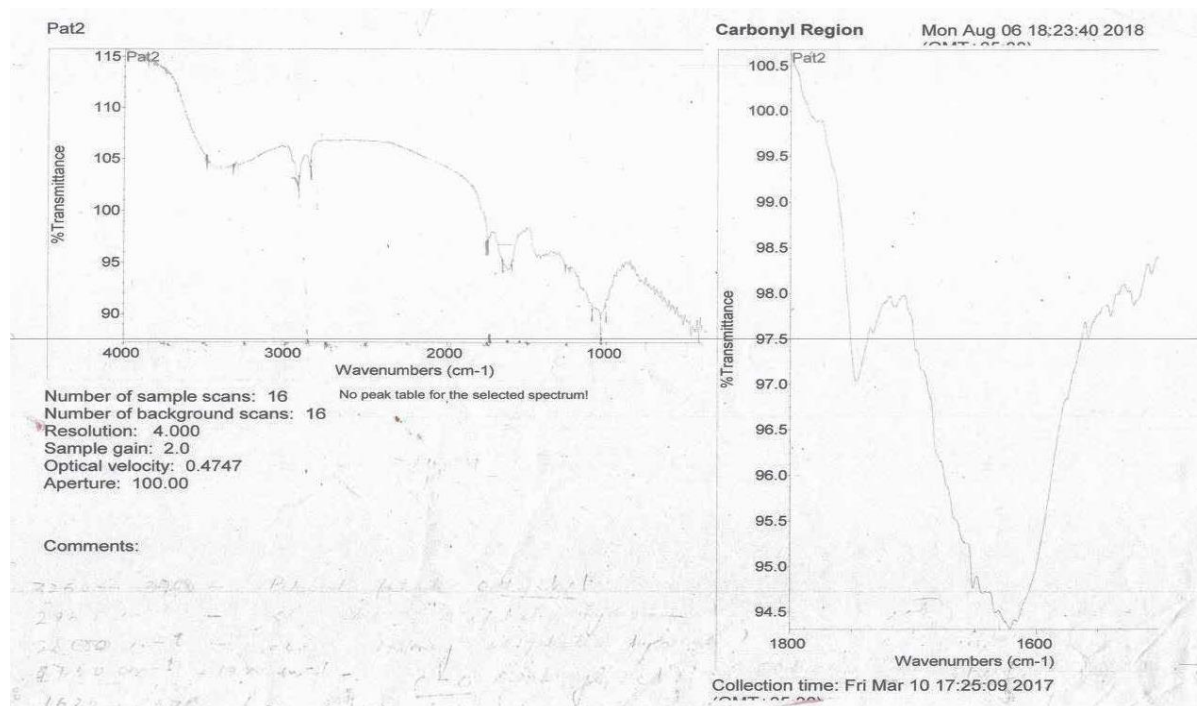


Figure 1. IR spectra of Deccan hemp mucilage at resolution from 1000 to 4000 cm^{-1} .

Table 2. Functional groups and peak value of IR spectroscopy of Deccan hemp mucilage.

S.N.	Functional Groups	Range (Wave No) cm^{-1}	Peak Value	Vibration	Intensity
1	Primary Aliphatic Alcohol	1050	1050	OH	Strong
2	Amide	1620–1590	1620–1635	-NH ₂ Bending	Broad peak
3	Carbonyl	1750–1700	1750	C=O Stretch	Strong
4	Aliphatic Hydrocarban	2962–2853	2850, 2800	C-H Stretch	Medium
5	Hydroxyl alcohol	3600–25000	3350	OH Stretch	Broad peak

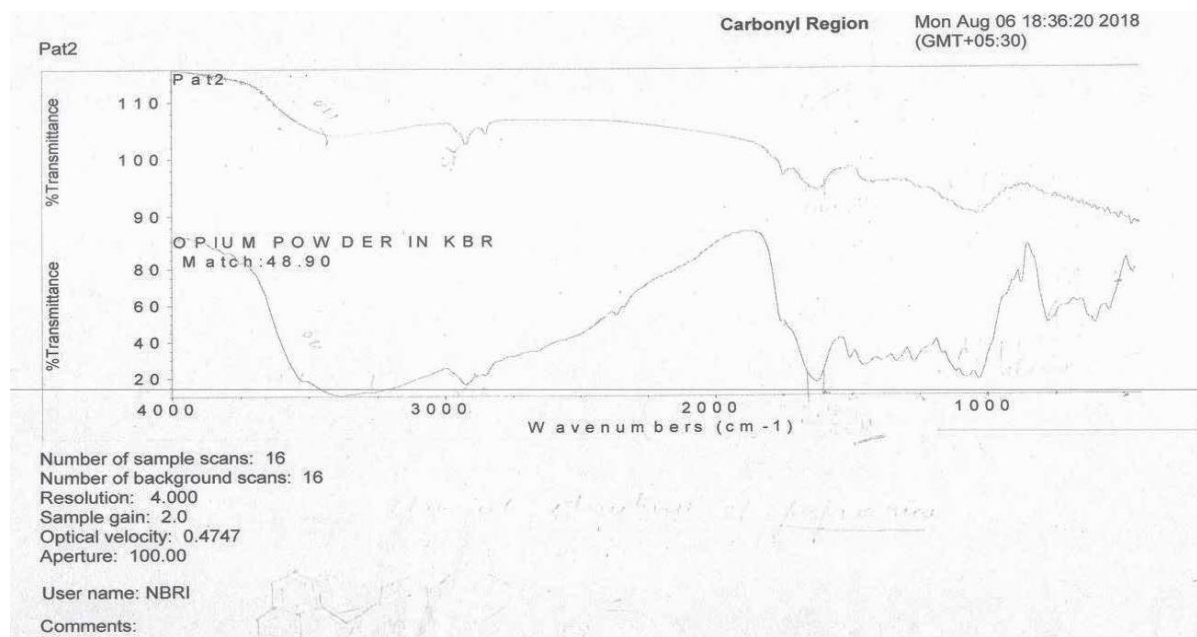


Figure 2. IR spectra of Deccan hemp mucilage and Opium powder at resolution from 1000 to 4000 cm^{-1} .

CONCLUSION

Studies infer that Deccan hemp is an economically important plant with enough mucilage content of high functional value to be used as bio-polymers in pharmaceutical formulations and coating material. The IR spectra of opium powder were found to be very similar to IR spectra of Decan hemp mucilage. Opium shows

antimicrobial, anti-inflammatory, analgesic activity etc hence on the basis of IR spectra it may be possible that Decan hemp with exhibit the similar action and provide a new way to future technologies in Novel Drug Delivery System.

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