Short Communication

Comparative Evaluation of Natural Polymer as Gelling Agent in Formulation of Bioadhesive Antifungal Vaginal Gel

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The objective of the present study was to extract mucilage from okra and evaluate it as a gelling agent in the vaginal gel. The okra mucilage was extracted following the established methods. The percentage yield of okra mucilage was found to be 8.0 % w/w. The Fluconazole antifungal vaginal gel was formulated using the okra mucilage as gelling agent and evaluated for compatibility study, viscosity, pH, spreadability and diffusion study. The effect of the mucilage as the gelling agent was compared with the commonly used synthetic polymers such as carbopol 940 and hydroxypropyl methyl cellulose at the concentration of 0.5 %, 1 % and 1.5 % w/w. The result of the study showed that the okra mucilage was comparable to polymer carbopol 940 and hydroxypropyl methyl cellulose K4M as gelling agent. Thus, okra mucilage (1.5 %) has the potential for being substituted as gelling agent in place of conventional gelling agent.

Key words: Okra, gelling agent, vaginal gel, diffusion, viscosity

Gels are semisolid systems containing either suspensions composed of small inorganic particles or large organic molecules interpenetrated by a liquid[1]. Gelling agent polymers possess the property of gelation that is useful in the formulation of stable systems by reducing interfacial and surface tension thereby increasing the viscosity of the liquid phase[2]. Mucilages are produced intracellularly, as a result of metabolism and may act as storage matter. These are polysaccharide macromolecules that dissolve more or less upon contact with water and form colloidal solutions[3]. Vaginal infection is the most common disease in our day-to-day life and includes bacterial vaginosis, candida infections, trichomoniasis, etc[4]. Women are more susceptible for causing infection because of substantial mucosal exposure to seminal fluids, pH change, etc[5]. Treatment of these infections is mostly done with antifungal agents as most of the infections are caused due to fungi and can be classified as systemic and topical infections. Fluconazole is a synthetic antifungal agent belonging to group of triazole and commonly used antifungal agent[6].

Among the various drug delivery systems, vaginal route offers many advantages due to its large permeation area, rich vascularisation, avoidance of first pass metabolism, reduction in the incidence and severity of gastrointestinal side effects, a decrease in hepatic side effects and relatively low enzymatic activity[5,7]. External application of gel at skin offers certain advantages like quick release of drug directly to the site of action, independency of water solubility of drug as compared to creams and ointments, better patient compliance, less interaction with food and drugs and avoiding first pass effect[8]. The large numbers of synthetic and natural polymers have been used to achieve mucoadhesion in pharmaceutical formulations. The use of natural polymers as excipients in pharmaceutical sectors is increasing day by over semi synthetic or synthetic excipients because of their easy availability, safety, non-irritancy and cost effectiveness[9]. Okra mucilage is natural plant polysaccharide from the fruits of *Abelmoschus esculentus* (Family: Malvaceae). This polysaccharide is non-toxic, as it obtained from an edible source[10]. It is an acidic polysaccharide consisting of galactose, rhamnose and galacturonic acid[11]. Okra mucilage makes viscous solution in water owing to its 1.7

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million molecular weight glycoproteins[12]. It has excellent protective colloid properties. Its vegetable derivation and rheological properties make it ideal for as combination of flavouring agent[13]. Okra mucilage has studied for its suspending, disintegrant property, floating property as well as better sustained release of the drug[14,15]. But its gelling property is not reported. This study is carried out to determine its potential utility as mucoadhesive gelling agent. The materials used for the present study were fluconazole, Hydroxypropylmethyl Cellulose (HPMC) K4M, carbomer 940, glycerin, propylene glycol, methyl paraben, propyl paraben, sodium dihydrogen phosphate, disodium hydrogen phosphate, methanol, acetic acid, Triethanolamine (TEA) and ethanol. Desiccator, Fourier Transform Infrared (FTIR) spectrophotometer, spreadability test apparatus, Brookfield viscometer, ultraviolet-visible spectrophotometer and Franz diffusion cell were employed for the present study. Okra fruits were purchased from the local market, Nagpur, Maharashtra. The plant material was identified and authenticated by Botanist, Department of Botany, R. T. M. Nagpur University, Nagpur. The specimen number given to the authenticated herbarium sheet was 10272. Mucilage was isolated from okra fruits using aqueous extraction method[3]. The isolated mucilage was characterized for swelling index, pH, loss on drying, solubility and viscosity[16]. Compatibility study was carried out using FTIR (Shimadzu Corporation Kyoto, Japan). Antifungal gel was formulated using Fluconazole (1 % w/w) which was dissolved in a hot mixture of propylene glycol (20 % w/w) and glycerin (10 % w/w) as moistening agent. Carbopol 940, HPMC K4M gel was prepared by dispersing the calculated amount of polymer (1.5 %) in calculated amount of warm water with constant stirring using magnetic stirrer at a moderate speed. Mucilage was also soaked in water with stirring at moderate speed. Then the previous mixture containing the drug was added to this. The pH of the carbopol gel was adjusted using TEA as 4.5[6]. The gel formulations were prepared (Table 1) using three different concentrations of okra mucilage i.e., 0.5 %, 1 % and 1.5 % and compared with the Carbopol 940 and HPMC K4M gel.

The gel formulation of okra mucilage (1 %) was found comparable with the Carbopol 940 gel (1.5 %) and was used for further study. Formulated gel was evaluated for spreadability, viscosity, pH and *in vitro* drug release[17,18]. The isolated okra mucilage was observed pale brown in colour. Swelling index was found 78 %, pH was found 6.54, loss on drying was found 12.3 % w/w and viscosity (centipoise (cP)) was found and 357 cP. Mucilage was found insoluble in acetone, ethanol and chloroform and slightly soluble in water. No chemical interactions were found between drug and mucilage as well as between drug, HPMC and Carbopol 940 (fig. 1a and fig. 1b). Spreadability of the gel formulation of Carbopol 940, HPMC K4M and okra polymer was observed 3.15 g cm sec^{-1}, 3.51 g cm sec^{-1} and 3.7 g cm sec^{-1} respectively. Viscosity of all the three gel formulations was found 120 000 cP, 110 000 cP and 116 000 cP respectively. pH of all the three formulations was observed 5.64, 5.34 and 5.89 respectively. Cummulative drug release (%) for okra polymer gel was found 92.34 %, for Carbopol gel it was observed as 90.49 % and for HPMC K4 gel was found as 89.053 % respectively (fig. 2).

TABLE 1: FORMULATION OF GEL CONTAINING OKRA MUCILAGE, CARBOPOL 940 AND HPMC K4M

Ingredients (% w/w)	Batches								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Fluconazole	1	1	1	1	1	1	1	1	1
Carbopol 940	0.5	1	1.5	-	-	-	-	-	-
HPMC K4M	-	-	-	0.5	1	1.5	-	-	-
Okra mucilage	-	-	-	-	-	-	0.5	1	1.5
Glycerin	10	10	10	10	10	10	10	10	10
Propylene glycol	20	20	20	20	20	20	20	20	20
Methyl paraben	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Propyl paraben	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Purified water (q. s.)	100	100	100	100	100	100	100	100	100

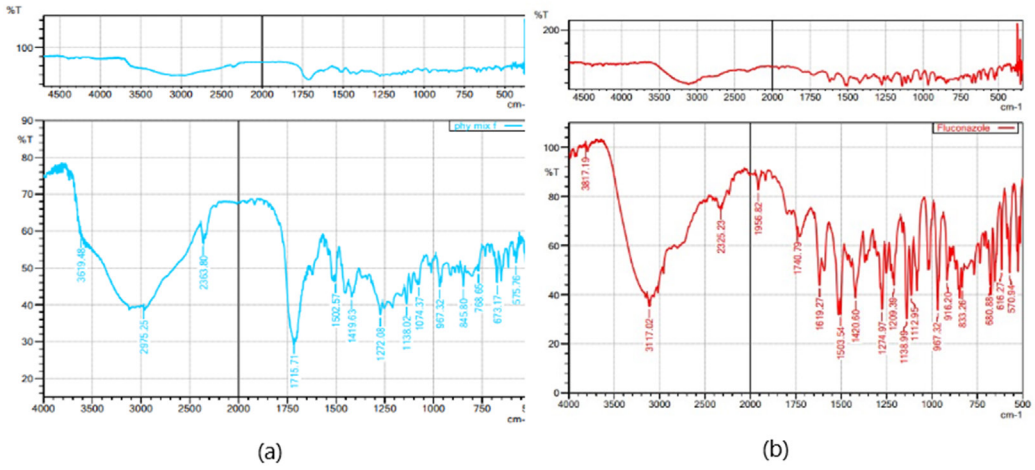

Fig. 1: FTIR spectrum of (a): Mixture of fluconazole, HPMC K4M, Carbopol 940 and mucilage and (b): Fluconazole

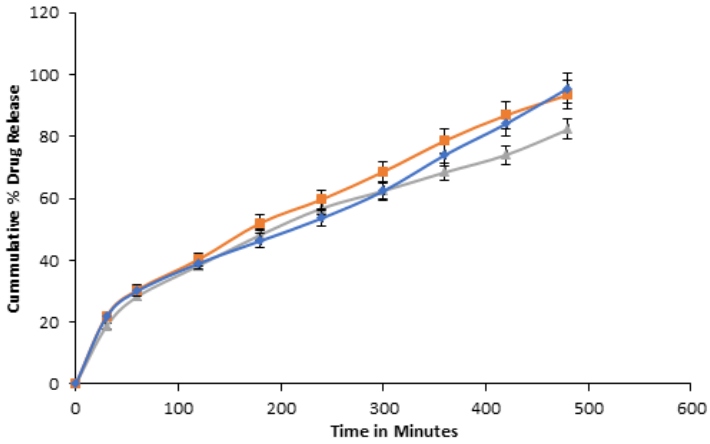

Fig. 2: Cumulative drug release (%) of okra polymer gel, HPMC K4 M gel and carbopol gel
Note: ( ): HPMC K4 gel; ( ): Carbopol gel and ( ): Okra polymer gel

The compatability studies proved the compatability between drug and polymers. Okra mucilage gel showed comparable drug release to that of HPMC K4M and carbopol 940 gel formulations. Thus, it can be concluded that, okra mucilage acted as potential gelling agent and can be alternative for bioadhesive gel preparations. Our future studies will be directed at determining bioadhesive strength, microbiological studies (antifungal activity), irritation test, stability study and *in vitro* drug release comparison with marketed formulation.

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Conflict of interests:

The authors declare that they have no competing interest.

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