RESEARCH ARTICLE

Preparation and Evaluation of Polyherbal Periodontal Gel for Treatment of Periodontitis

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Received: 23rd July, 2023; Revised: 08th September, 2023; Accepted: 17th February, 2024; Available Online: 25th March, 2024

ABSTRACT

Periodontal disease is one of the most important concerns for dentists and patients. The study aimed to create a topical polyherbal gel using ethanolic extract and to evaluate polyherbal gel. Ethanolic extract of *Curcuma longa* rhizomes, chamomile powder from *Matricaria chamomilla*, and clove oil were obtained and used to prepare different formulations of polyherbal gels using hydroxypropyl methylcellulose (HPMC) and other excipients. The prepared gel formulations were studied for pH, viscosity and spreadability evaluation. The pH was observed to be in between 6 to 7 and had ideal viscosity and spreadability range. The drug content and *in-vitro* drug release profile were evaluated and plotted to identify optimized gel formulations among all prepared formulations. The optimized polyherbal formulation, F2, was applied to field emission scanning electron microscopy (FESEM). The antimicrobial evaluation showed that the prepared formulations are effective in inhibiting microbial growth and effective in periodontal care.

Keywords: Periodontitis lesions, Flora, Herbal extracts, Periodontal gel, Evaluations.

International Journal of Drug Delivery Technology (2024); DOI: 10.25258/ijddt.14.1.26

How to cite this article: Rao NGR, Rao DBS, Kulkarni PA, Dev D, Kumar GS. Preparation and Evaluation of Polyherbal Periodontal Gel for Treatment of Periodontitis. International Journal of Drug Delivery Technology. 2024;14(1):179-182.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

A large percentage of people worldwide suffer from periodontitis, a common and possibly hazardous gum ailment. This inflammatory illness can have effects on systemic health in addition to endangering oral health. It is a more severe form of gum disease that is defined by inflammation of the alveolar bone, periodontal ligament, and gums surrounding the teeth. It usually results from neglected gingivitis, a less severe type of gum disease brought on by the buildup of plaque, a sticky bacterial film, on the teeth.[1] Clinically, gingival inflammation and swelling can be linked to different degrees of periodontitis lesions. When a disease has been present for a prolonged time, the gingiva may seem clinically healthy with little swelling and inflammation. The gingival surface could be stippled and have a rigid uniformity. Nonetheless, injury to the deeper layers of tissue caused by periodontal disease may result in a gradual deterioration of the alveolar bone and periodontal ligament. The primary reason for tooth loss in adulthood is eventually the breakdown of these supporting tissues, leading to tooth loss. As of right now, long-standing infections caused by bacteria are thought to be the main trigger of periodontitis. The specific makeup of these infections varies from person to person and, to some extent, from site to site on various teeth of the same topic.[2] Presently, more than 300 species of microbes have been identified in the oral cavity; however, only 5% of these are thought to be strongly linked to periodontitis, with 1% being present in more than 90% of occasions (Slots, personal interaction). Sadly, the identification of the disease's causative agents in humans has been hampered by the complexities of the flora, the sporadic nature of disease action episodes, and the comparatively wide variations in the data collected within and between subjects. One major danger for periodontitis is tobacco consumption. It is more difficult for the body's ability to combat infection when smoking because it impairs the body's defenses and slows down the healing process.[3]

Polyherbal gels are compositions that combine different medicinal plants, extracts or powders in a gel base. When various herbal extracts blend together, the overall activity of the herbs can have synergistic effects, which increase the entire therapeutic value. Comparing the use of single herbs with

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this synergism is thought to yield a greater and more potent solution. Polyherbal gel represents a different strategy in the therapeutic and preventive management of oral and periodontal infections.[4] It has a wide range of therapeutic potencies, such as anti-inflammatory, antimicrobial, and antioxidant effects. Represent a different strategy for treating and preventing oral and periodontal infections. The drugs selected for this research were rhizomes of *Curcuma longa* for its anti-inflammatory and antioxidant properties, alcoholic extract of chamomile from flowers of *Matricaria chamomilla* for mild sedative properties and to promote relaxation, and clove oil from the dried flower buds of *Syzygium aromaticum* which exhibits strong antimicrobial properties and has been shown to be effective against various bacteria.[5]

MATERIALS AND METHODS

Rhizomes of *C. longa* were collected from a local drugstore. Chamomile extract powder was purchased from Indiamart and Clove oil was purchased from RK World Infocom Pvt Ltd. Hydroxypropyl methylcellulose (HPMC) was obtained from Central Drug House Pvt Ltd.

Extraction

The dried ethanolic extract of *C. longa* rhizomes was taken after extraction and stored in desiccators for preparation of polyherbal gel.[6]

Preparation of Polyherbal Gel Formulations

All the drugs and other excipients are measured (Table 1). HPMC gel base was prepared by hydrating it in propylene glycol. Firstly, in one beaker, water was heated and HPMC is slowly added and stirred. After the mixture cooled down, propylene glycol was mixed to it. In the second beaker, ethanolic extract of *C. longa*, chamomile powder, clove oil, and glycerine were mixed, and HPMC gel base was combined while constantly stirred.[7]

Evaluation of Polyherbal Gel

Physical evaluation

The polyherbal gel's physical appearance was visually evaluated to assess its transparency and clarity.

pH evaluation

A carefully measured 1-gram of gel was distributed throughout 100 mL of distilled water. A digital pH tester was used to determine the dispersion's pH. The pH was measured.

Viscosity evaluation

A Brookfield digital viscometer was employed to measure the dispersion viscosity and estimate the total number of spindles at 38°C and various angular velocities. The spindle number 7 was employed at 38°C with a spindle speed of 50 to 60 rpm. The formulation's viscosity measurements were computed.[8]

Spreadability

An adequate sample amount is taken between two glass slides and a weight of 1-gm is applied on the slides for 5 minutes and then observe the spreadability.[9]

Spreadability can be measured by the formula given:

$$S = M \times L/T$$

Where, S: Spreadability, M: Weight tide the upper slide, L: Length of a glass slide, T: The amount of time needed to divide the slides.[9]

Drug content

A 50 mL volumetric flask was filled to the brim along with methanol, one gram of each gel formulation was mixed, and the mixture was shaken vigorously to dissolve the active components. Following filtration through Whatman filter paper, a 10 mL methanol dilution was made by pipetting out 0.1 mL of the filtrate.[10] Spectrophotometric calculation of the active component was performed using a standard curve that was plotted at 272 nm (Figure 1).[10,11]

In-vitro drug release

A dialysis membrane measuring 7 cm in length was filled with a 1-mL gel sample. Subsequently, 50 mL of a 1:1 ethanol to water solution that had been heated to 37 ± 0.5°C and 25 strokes per minute were used for suspending the bags in a shaking water bath. Predetermined intervals were used to remove one milliliter of sample and replace it with an equivalent volume of fresh medium.[11] A fresh set of release media was substituted for the whole set every day (24 hours) throughout the release investigations, which could last up to a week. A UV spectrophotometer was used to determine the amount of tannins at 272 nm wavelength after diluting the samples.[12,13]

Table 1: Formulation of a polyherbal gel including alcoholic extract of traditional Indian herbs

Ingredients	*F1*	*F2*	*F3*	*F4*
Curcumin (mg)	500	500	500	500
Chamomile powder (mg)	200	200	200	200
Clove oil (mL)	0.75	0.75	0.75	0.75
Hydroxypropyl-methylcellulose (HPMC) (mg)	0.25	0.50	0.75	1.00
Methyl paraben (mg)	0.02	0.02	0.02	0.02
Propylene glycol (mL)	2	4	2	4
Glycerine (mL)	10	10	10	10
Distilled-water (mL)	q.s	q.s	q.s	q.s

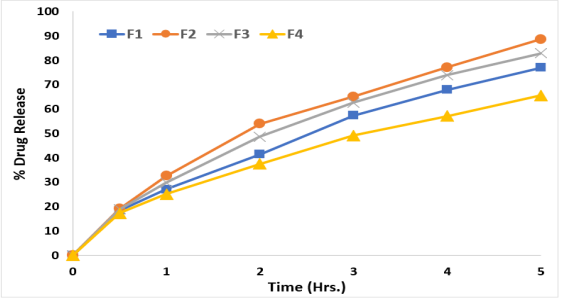

Figure 1: Drug release (%) of polyherbal gel

Field emission scanning electron microscopy

Scanning electron microscopy (SEM) offers comprehensive details regarding a formulation's surface properties. This involves the composition, size, and shape of the particles or constituents in the formulations. It is essential to comprehend the surface features in order to evaluate the product's physical attributes.[12] The Indian Institute of Technology (Kanpur) provided TESCAN (Model MIRA-3 LMH) for this evaluation. Images of the optimized formulation were captured at magnifications of 271 x and 490 x.[14,15]

Antibacterial studies

Gram-positive *Staphylococcus aureus* bacteria were collected from IIT Kanpur to serve as model. The gel's antibacterial action was tested contrary to the *S. aureus* bacterial strain. Each of the four compositions was added in an aseptic manner on the inoculated plates. The plates were allowed to incubate for a whole day at 37°C after being set at room temperature for 30 to 40 minutes. Regions of inhibition were identified by determining the clear area that developed in all gel samples. The antimicrobial effect was assessed by calculating the diameter of the zones of inhibition of microbial growth (millimeters).[16,17]

RESULTS AND DISCUSSIONS

The formulated polyherbal gel has excellent clarity and transparency, according to the observed results. The periodontal bio-adhesive gels' pH was observed to be between 6.16 and 6.47, which is well within the buccal cavity's typical pH range of 6 to 7. This implies that there won't be any discomfort from those gels. The viscosity values varied between 3214.46 and 3705.27 cps. The viscosity decreases as the amount of HPMC increases, which shows shear-thinning behavior, making it suitable for applications where it easily spreads. F2 showed excellent viscosity. Polyherbal gels were proved to spread effortlessly and smoothly within the range of 16.64 to 24.43 g-cm/second. Because of its short spreading time, F2 was thought to have excellent spreadability (Table 2). The amount of medication in the polyherbal gel suggested that the system was suitable for high trapping in the internal phase.

Table 2: Evaluation parameters of polyherbal gel

Evaluation Parameter	*F1*	*F2*	*F3*	*F4*
Consistency	Fluid	Semi Solid	Semi Solid	Semi Solid
Color	Dark-Yellow	Dark-Yellow	Dark-Yellow	Dark-Yellow
Homogeneity	Good	Very Good	Good	Good
Odor	Charac teristic	Charact eristic	Charact eristic	Charact eristic
pH	6.52	6.6	6.7	6.7
Viscosity (cps)	3705.27	3417.66	3401.09	3214.46
Spreadability (gcm/sec)	16.64	17.86	20.18	24.43
Drug content (%)	94.63	98.14	95.73	97.87

Table 3: *In-vitro* drug release of polyherbal gel

Time (hrs)	*F1*	*F2*	*F3*	*F4*
0	0	0	0	0
0.5	18.43	19.08	18.9	17.3
1	27.09	32.65	29.73	25.18
2	41.4	53.9	48.7	37.47
3	57.43	65.06	62.66	49.17
4	67.96	77.08	73.93	57.1
5	77.05	88.67	82.9	65.59

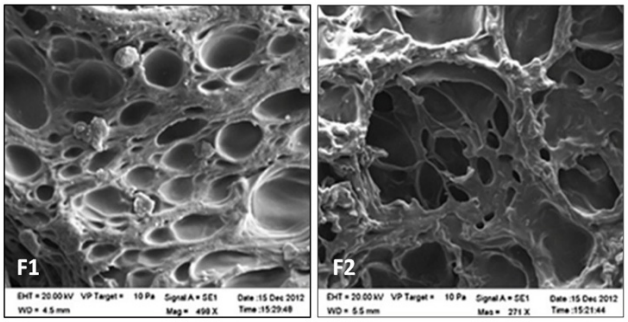

Figure 2: SEM images of polyherbal formulations

Evaluation of *In-vitro* Drug Release

In-vitro diffusion of each polyherbal formulation of 0.5% was studied. Results showed that, as the concentration of the gelling agent increases, %drug diffusion increases (Table 3). $F2_{was}$ found to have maximum drug release and F4 was found to have minimum drug release (Figure 1).

Field Emission Scanning Electron Microscopy (FESEM)

The optimized formulation's field emission scanning electron microscopy (FESEM) analysis demonstrated the gel's homogeneity and uniformity of gel matrix. It demonstrated that the herbal ingredients within the gel form no clumps or aggregates; rather, they are evenly distributed (Figure 2).

Antibacterial Studies

The antibacterial study indicated the antibacterial efficacy of the polyherbal gel. The formulation code F2 was found to be most effective against bacterial infection as it showed a better zone of inhibition in the range of 21.02 ± 0.6242 as compared to other formulations. Thus, formulation F2 exhibited maximum activity against selected strains due to the high amount of herbal extracts compared to others.

CONCLUSION

The formulation and evaluation of the polyherbal gel were completed successfully. According to the outcomes, polyherbal gel with formulation code F2 was found to be the most suitable and effective of the other formulations. All of the formulations show ideal pH and viscosity ranges. Gel formulations that were optimized ensured sustained drug release. It proved to be very successful in managing periodontitis because it inhibited the growth of specific bacteria and parasites. Furthermore, a

more comprehensive clinical trial on its efficacy and protection profile might be conducted.

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