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Research paper

Design, Formulation and Optimization of Peel-Off Face Mask Gel for the Symptomatic Treatment of Rosacea

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ABSTRACT

The aim of this research work was to design formulate and optimization peel off face mask for the treatment of Rosacea. Among the 4 different types of rosacea, this research work aims to develop a user-friendly symptomatic treatment for the types which affect the facial skin. The peel off mask was formulated using 4%, 6%, 8%, 10% and 12% polyvinyl alcohol (PVA) as a gelling agent and the main ingredient was chamomile oil. Evaluation of peel off mask included physical characteristics (organoleptic properties, homogeneity, viscosity, spreadability, film drying time), chemical characteristics (pH value), stability and antimicrobial activity. The variation in PVA affects the pH value, viscosity and film drying time significantly. Stability test showed that all peel off mask show no significant changes at room temperature with and without exposure to sunlight and at low temperature. The peel off mask containing chamomile oil using 10% PVA has the inhibitory effect against bacteria (S. aureus, E. coli) and fungi (C. albicans) as compared with the positive controls (clindamycin gel, gentamycin and clotrimazole gel). Variation in the concentration of PVA in the formula affected the physical, chemical characteristic and antimicrobial activity of the chamomile oil peel off gel face mask significantly. The preparation using 10% PVA was found to be the best formula with optimal results and better antimicrobial action.

Keywords: *Chamomile oil; Peel Off face mask; Rosacea; PVA; Antibacterial activity; Optimization; Spreadability; Stability*

Introduction

Skin is the largest organ in the body and covers the body's entire external surface. It is made up of three layers, the epidermis, dermis, and the hypodermis, all three of which vary significantly in their anatomy and function. The skin's structure is made up of an intricate network which serves as the body's initial barrier against pathogens, UV light, and chemicals, and mechanical injury. It also regulates temperature and the amount of water released into the environment [1,2]

In the recent years, essential oils have gained massive acceptance due to their applications in number of pharmaceutical and skin care because of their potential in inhibiting the growth and propagations of a wide range of microorganisms such as bacteria, fungi and virus. Facial cosmetics keep skin moist and remove sebum from the skin to maintain proper skin health. The use of suitable cosmetics according to the facial skin type results in healthy skin. Facial masks are the most prevalent cosmetic products utilized for skin rejuvenation. Facial masks are divided into four groups: (a) sheet masks (b) peel-off masks (c) rinse-off masks and (d) hydrogels [1].

Some essential oils are used to formulate the peel off face mask. Peel-off facial masks are known for their unique characteristics inherent to the use of film-forming polymers that, after complete drying, create a

very cohesive plastic layer allowing for the manual removal of the product without leaving any residue. Moreover, it also provides slight moisturizing action and enhances the effect of the active compounds on the epithelium, especially as a result of the occlusive effect caused by the plastic polymeric layer. Peel off masks are a type of physical exfoliant, which means they remove the top layer of skin to slough away dead skin cells. This makes skin feel smooth & look glowy [2,3].

Figure 1: Peel-off face mask.

Peel off masks work by gently removing the outermost layer of your skin to relieve dullness and dead skin. This produces a smoother skin texture and can also help balance out pigmentation. Peel off masks can assist in fading fine lines and cleansing out pores. This can eliminate acne-causing dirt and bacteria. Peel off masks are often vitamin, plant – based, or fruit extract based, and formulated with charcoal, anti-oxidants and botanicals. Peel off masks offered in several forms that can serve varying needs of skin [4-6].

Peel-off facial masks are known for their unique characteristics inherent to the use of film-forming polymers that, after complete drying, create a very cohesive plastic layer allowing for the manual removal of the product without leaving any residue. In addition, the firming action of these formulations leads to a sensation of clean skin. Moreover, it also provides slight moisturizing action and enhances the effect of the active compounds on the epithelium, especially as a result of the occlusive effect caused by the plastic polymeric layer [7].

Although formulations containing geological compounds still have remarkable commercial appeal, the high technological quality of current dermo cosmetics generates the need for more complex and elaborate products in order to ensure their commercial viability, safety, and efficacy. Accordingly, the association of geoproducts with active plant compounds may be an interesting alternative to add value to the final product. Peel off masks offered in several forms that can serve varying needs of skin. Peel off facial mask based on polyvinyl alcohol are formulation that after application and drying form an occlusive film over the face. Peel off mask available in gel form and dry form. Peel off face mask gel is one of the popular forms of topical application used to enhance the quality of facial skin. The skin face mask is easily removed as an elastic membrane. It is useful to recover and treat the facial skin and can be used to minimize pores [7-9].

Figure 2: Instruction for the use of mask.

Peel-off masks work by penetrating deep into your pores and gently removing the dead cells in the outermost layer of your skin, along with any impurities sitting over it. Removing dirt, bacteria, debris, and overall impurity is essential to have balanced, toned, healthier skin. This is where peel-off masks shine. These masks spread across your face evenly, covering all the area most affected by exposure to the environment, including UV light and pollution. Many peel-off masks have different types of ingredients that work to provide you with vitamins and minerals necessary for balanced, supple skin [10,11]. For instance, peel-off masks can have ingredients such as activated charcoal, botanicals, fruit extracts, and natural vitamins.

One of the most significant benefits of using peel-off masks is they can frequently be used along with other skincare routines without overlapping. For instance, you

can scrub your face and combine exfoliation with a nourishing, pore-clearing peel-off mask to maximize your overall results.

Figure 3: Rosacea skin condition.

Everyone loves to feel and look younger, which is a significant benefit you can get by incorporating a peel-off mask into your daily, weekly, or bi- weekly routine. Nobody likes to have their skin be excessively shiny. This can happen due to excess oil production. Shiny skin can affect your skin tone and complexion. However, you can prevent excessive oil production by using a peel- off mask. Your skin will look firmer, smoother [11].

Rosacea is a chronic relapsing inflammatory skin disease with a high prevalence among adults of Northern European heritage with fair skin. Symptoms present in various combinations and severity, often fluctuating between periods of exacerbation and remission. There are 4 types of rosacea. This research work aims to treat the types of rosacea that predominantly affect the facial skin [8,10].

Chamomile has been used in herbal remedies for thousands of years, known in ancient Egypt, Greece, and Rome. The chamomile drug is included in the pharmacopoeia of 26 countries. It is an ingredient of several traditional, unani, and homeopathy medicinal preparations. The oil isolated from chamomile flowers contains essential oil (0.2-1.5%)- chamazulene, alpha-bisabolol, bisabolol oxides A, B and C, bisabolone oxide; Flavonoids- luteolol, apigenol, quercitol; Coumarins- umbelliferone, herniarin; Uronic mucilage (10%); Sesquiterpene lactones (bitter principles): matricine, matricarina, chamazulene precursor and mineral salts (8 to 10%). This oil has been used in drinks, tea, aroma therapy, cosmetics, etc. due to its antiseptic, anti-inflammatory and other pharmacological actions [11-16].

Materials and Methods

Preparation Of Chamomile Oil Based Peel-Off Face Mask Gel:

The formulation of a peel-off mask gel of chamomile oil was made according to the formula presented in Table 1.

Table 1: Formulation of peel-off gel face mask.

Ingredients	**Formulation Code**				
	P1	**P2**	**P3**	**P4**	**P5**
Chamomile oil	3%	3%	3%	3%	3%
Polyvinyl alcohol	4	6	8	10	12
Polyethylene glycol 400 (PEG400)	2%	2%	2%	2%	2%
Tocopherol acetate	400 mg	400 mg	400 mg	400 mg	400 mg
Propylene glycol	2%	2%	2%	2%	2%
Ethyl alcohol	1%	1%	1%	1%	1%
Olive oil	2.5%	2.5%	2.5%	2.5%	2.5%
Glycerin	2%	2%	2%	2%	2%
Triethanolamine	1%	1%	1%	1%	1%
Methyl paraben	0.1%	0.1%	0.1%	0.1%	0.1%
Tween 80	1%	1%	1%	1%	1%

Disodium EDTA	0.02%	0.02%	0.02%	0.02%	0.02%
Orange oil	0.1%	0.1%	0.1%	0.1%	0.1%
Tomato red colour	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.
Distilled water q.s.	100%	100%	100%	100%	100%

Procedure

i. PVA was dispersed in ¾th of the distilled water in a water bath at a temperature of 80-900C. (mixture 1).
ii. PEG 400 was dissolved in small quantity of water (mixture 2).
iii. Methyl paraben and disodium EDTA was dispersed into propylene glycol and glycerin then stirred until homogenous.
iv. This solution was then mixed with Tween 80, olive oil and triethanolamine along with small amount of water (20%) (mixture 3).
v. Tocopherol acetate was dispersed into chamomile oil (mixture 4).
vi. Then mixture 3 was combined with mixture 2 homogenously and added again into mixture 1.
vii. Finally, orange oil and tomato red colour was mixed with mixture 1 and poured with mixture 4 homogenously until gel type consistency gets produced.

Physicochemical Evaluation of Chamomile Oil Peel-Off Face Mask Gel

The physicochemical evaluation tests performed were as follows:

a. Organoleptic characteristics:

Organoleptic properties were characterized on the basis of parameters as colour, odour and consistency by visual inspection. The uniformity in distribution of colorant was also evaluated by spreading on a glass slide.

b. Homogeneity test:

The homogeneity test was observed by applying the gel on transparent glass. The developed formulations were tested for homogeneity by visual inspection after the gel had been filled in the container. They were tested for their appearance and presence of any aggregates.

c. Determination of pH value:

1.0 g gel was accurately weighed and dispersed in 100 ml purified water. The pH of the dispersion was measured using Auto digital pH meter Labtronics LT-11, which was calibrated before use with standard buffer solution. The measurements of pH were done in triplicate and average values were calculated.

d. Viscosity:

Viscosity was measured by using Brookfield DV- II+ Pro Viscometer using spindle for the analysis id SSA31/13R.

e. Spreadability of gel:

To determine the spreadability of gel formulation, 0.5 g of gel was placed within a circle of 1 cm diameter pre-marked on a glass plate of 20 × 20 cm, over which a second glass plate was placed. A weight of 500 g was allowed to rest on the upper glass plate for 5 min. The increase in the diameter due to gel spreading was noted. Mean of 3 readings was taken.

f. Film drying time:

A modified in-vitro drying time evaluation technique was developed in order to estimate the time taken for the formulations to dry completely. Approximately 2.0 g of each formulation was spread over a glass plate of 60×60 mm forming a uniform mask layer of 55.5 mg/cm^2 with a thickness of approximately 2.0 mm. The glass plate was submitted to a heated environment in the water bath (37.0 ± 2.0°C) in order to simulate skin temperature. The formulations were monitored every 5 min, and the experiment only finished after the surface of the mask had dried completely. The results were expressed as the mean of three measurements.

The formulation was also applied onto the skin of hands of 3 healthy volunteers to confirm the results obtained from in-vitro test.

g. Stability test:

Duplicate samples of the optimized formulation were stored in opaque polyethylene bottles and submitted to the following storage conditions in order to evaluate the preliminary physicochemical stability:

i. Low temperature (5.0 ± 1.0°C),

ii. Room temperature with exposure to sunlight (22.0 ± 5.0°C), and
iii. Room temperature protected from sunlight (22.0 ± 2.0°C).

Each sample was analyzed weekly for 28 days according to the following parameters: organoleptic characteristics, applicability, film-forming performance, drying time and pH.

h. Antimicrobial activity evaluation of chamomile oil peel-off face mask gel:

Antimicrobial activity of chamomile oil peel-off mask gel was tested using Agar well diffusion method The test microbes selected for this study were E. coli (gram-negative), S. Aureus (gram-positive) and C. albicans. Nutrient agar medium was used for E. coli and S. aureus while, potato dextrose agar was used for C. albicans. Sterilized culture medium was poured into sterile petri plates and allowed to solidify. Lawn culture of test organism was prepared on the surface of agar. Cork borer was used to make cavities in the agar after solidification. Each cavity was labelled with the batch code. Then, the gel was poured using micropipette. Clindamycin phosphate gel USP 1%, and clotrimazole gel were used as positive control, while the negative control contained peel-off face mask gel without chamomile oil. These petri dishes were incubated in BOD incubator at 37^0C for 24-48 hours.

Results and Discussion

Physicochemical Evaluation Of Chamomile Oil Peel-Off Gel Face Mask

a. Organoleptic characteristics:

Organoleptic test was carried out to evaluate the preparation using the parameters colour, odour and consistency of the preparation. It was observed that as the concentration of PVA increases, the colour of the formulation changed from being transparent to milky white. After the addition of colorant, the formulations were evaluated for uniformity of colour dispersion by spreading on a glass slide. No uneven distribution was seen. These formulations also had a characteristic smell of chamomile oil with a fragrance of orange oil. Batch P1 showed less semi-solid consistency due to lower concentration of PVA. As the concentration of PVA increase the semi-solid consistency increased as seen in batch P5. The formulations were soft and smooth on application to skin and without grittiness. It was also observed that these formulations showed increase in thickness i.e., viscosity on increasing the concentration of PVA. The gel also had a glossy shine.

Chamomile oil has a fresh calming aroma that helps to balance emotions and relaxes mood. It is widely used in aromatherapy due to its wide range of therapeutic benefits.

Figure 5: Chamomile oil peel off face gel mask.

b. Homogeneity test:

Absence of grittiness in the formulations indicated that homogeneity was achieved. No phase separation was observed between chamomile oil and peel-off mask gel base on storage at room temperature and refrigerator conditions. No aggregates or gritty particles were observed.

c. Determination of pH:

The pH value should be in the range of skin pH (i.e, below 5.5) to avoid any irritation to the skin. PVA is a water-soluble synthetic polymer that has a pH value of 5.0 – 8.0. The variation of PVA concentration in the chamomile oil peel-off mask gel will affect the pH value of formulation. As the concentration of PVA increases, the pH value of the preparation was found to decrease. The pH of peel-off mask gel formulations was found to be in the range between 5.1-6.3. Optimum pH value was observed for batches P3 and P4.

Table 4: pH value (Mean value of 3 readings)

FORMULATION CODE	pH
P1	6.3
P2	6.29
P3	5.1
P4	5.4
P5	5.91

d. Viscosity:

As the concentration of PVA increases, the viscosity of preparation also increases. Viscosity in the peel-off mask gel is influenced by an increase in gelling agent concentration. PVA has greater flexibility, tensile strength and hardness. This causes greater binding and retention of the fluid by the gelling agent, thus, the viscosity of the preparation increases.

The result shown in table 3 clearly prove that as the concentration of PVA increase, viscosity also increase. Extreme viscosity may cause difficulty in spreading property on skin.

Table.no.5: Viscosity value (Mean value of 3 readings)

FORMULATION CODE	VISCOSITY (cps)
P1	231.7
P2	320.9
P3	463.7
P4	569.8
P5	710.1

e. Spreadability:

One of the criteria for a topical formulation to meet the ideal qualities is that it should possess good spreadability. It is the term expressed to denote the extent of area to which a gel readily spreads on application to skin or affected part. The therapeutic efficacy of a formulation also depends upon its spreading value. The rate of spreading depends on the rate and time of shear produced upon application and also depends on the viscosity of the formulation. In the topical preparation, spreadability is inversely proportional to its viscosity. It was concluded that the increase in PVA concentration affected the gel spreadability. A good peel-off mask gel has a dispersion ability of 5 – 7 cm according to literature review.

The extent of spreading ability of the formulated peel off mask gel formulations is shown in Table 4. The results indicate that batches P2, P3 and P4 have optimum spreading ability on skin.

Table 6: Spreadability value (Mean value of 3 readings)

FORMULATION CODE	SPREADABILITY (cm)
P1	7.6
P2	6.9
P3	6.8
P4	5.6
P5	4

f. Film drying time:

Film drying time test was carried out to find out how long the peel-off mask gel preparation will take to dry on the surface of the skin and form a film. Ideally, the peel-off mask gel should dry between 15 – 30 min. As shown in table 7 the results of drying time indicate that high concentration of PVA in the formula will cause the gel layer to dry in a short time period as compared to P1 and P2 which contain low concentration of PVA. Ethyl alcohol also helps in decreasing the drying time.

The optimum drying time was observed for the batches P4 and P5. Three healthy volunteers who applied the formulations on the skin of hand commented that the formulation with high concentration of PVA (i.e., P4 and P5) were easy to peel off as compared to the batches which contained low concentration of PVA (i.e., P1, P2 and P3). Also, the peeled mask showed signs of cracking and tearing during peeling in case of batches P1, P2 and P3 due to low film integrity. However, these issues were not observed in batches P4 and P5 as they have high film integrity.

Table 7: Film drying time (Mean value of 3 readings)

FORMULATION CODE	FILM DRYING TIME (min)
P1	16
P2	12
P3	10
P4	07
P5	06

Figure 6: Peeling of chamomile oil peel off gel mask optimized batch P4 after drying.

Olive oil and Tween 80 maintain the stability and structure of the gel without influencing the activity of chamomile oil.

g. Stability evaluation:

Physicochemical parameters were evaluated weekly in order to verify signs of instability in the formulations under different conditions. It was verified that the optimized formulations stored at room temperature protected from sunlight (22±2°C) and at low temperature (5± 1°C) did not show signs of instability in any of the parameters evaluated. Nevertheless, the storage at room temperature with exposure to sunlight (22±5°C) led to a small decrease in the applicability of the formulations and an increase in the drying time. Exposure to sunlight leads to higher variations in temperature, which may accelerate the evaporation of the water from the formulations, thereby increasing the drying time and concentrating the formulation. Due to the concentrated state, the formulation had greater viscosity, inducing a decrease in its applicability.

h. Antimicrobial activity evaluation of chamomile oil peel-off face mask gel:

The results of the antimicrobial activity showed that the chamomile oil peel-off gel mask can inhibit the growth of gram- positive bacteria (S.aureus), gram-negative bacteria (E. coli) and fungi (C. albicans). The positive controls used were clindamycin gel, gentamycin gel and clotrimazole gel respectively. A blank control with no chamomile oil and 10% PVA was used as blank solution.

M. chamomilla belongs to a major category of cultivated medicinal plants. It contains a large group of therapeutically interesting and active chemical constituents. Sesquiterpenes, flavonoids, coumarins, and polyacetylenes are considered as the most important constituents of the chamomile essential oil. Eleven bioactive phenolic compounds, such as herniarin and umbelliferone (coumarin), chlorogenic acid and caffeic acid (phenylpropanoids), apigenin, apigenin-7-O-glucoside, luteolin and luteolin-7-O-glucoside (flavones), quercetin and rutin (flavonols), and naringenin (flavanone) are found in chamomile extract. α-bisabolol and cyclic ethers are antimicrobial, umbelliferone is fungistatic, whereas chamazulene and α-bisabolol are antiseptic. The principal components of the essential oil extracted from the flowers are (E)-β-farnesene (4.9–8.1%), terpene alcohol (farnesol), chamazulene (2.3–10.9%), α-bisabolol (4.8–11.3%), α-bisabolol oxides A (25.5–28.7%) and α-bisabolol oxides B (12.2–30.9%), which are known for their anti-inflammatory, antiseptic and spasmolytic properties.

The zone of inhibition obtained for batch P4 is shown in Figure 7.

Figure 7: Zone of inhibition obtained from the optimized batch P4 containing 10% PVA and 3% of chamomile oil

Conclusion

This study was aimed to formulate a peel-off face mask in gel consistency. The effect of concentration of polyvinyl alcohol on the viscosity, drying time, spreadability and consistency was also studied. The formulation containing 10% of PVA was chosen as the optimized batch. The batch P4 also shows short drying time, agreeable viscosity, easy spreadability, high film integrity and antimicrobial activity. The results of stability study also support this fact. The results also demonstrated that variation in concentration of PVA affects physicochemical characteristics and antimicrobial activity of chamomile oil gel peel-off mask, significantly. The optimized batch also showed antimicrobial activity against gram-positive bacteria, gram-negative bacteria and fungi as compared to the positive control. Polyethylene glycol 400 helps to relieve drying of skin. Propylene glycol acts as an emollient. It forms an oily layer on skin and prevents water loss. Also, it maintains the viscosity and spread ability of formulation. Ethyl alcohol reduces the film drying time on skin. Glycerin supports the formulation by acting as a humectant and skin protectant. Tocopherol acetate plays a major role of antioxidant and promotes skin healing. It also acts as moisturizer. Olive oil acts as penetration enhancer, thus, helps in easy penetration of the oil through skin. Triethanolamine is a commonly used ingredient in cosmetic products as a pH adjusting agent, emulsion stabilizer and surfactant. Finally, it was concluded that chamomile oil can be used as an effective ingredient in preparation of anti- acne formulations and can also be used for treatment of Rosacea. Peel-off face masks provide a user-friendly approach, irrespective of sex of the patient for treatment of skin diseases.

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Conflict of Interest

The author declares no conflict of interest.

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