

## Research Article



## Effect of Hydroxypropyl Methylcellulose (HPMC) in Release Profile of Air Fresheners Gel Prepared Using Carrageenan and HPMC

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### ABSTRACT

Air freshener is a product that is used in households by consumers, which are designed to diminish bad odours inside the room to make the room feels comfortable. The main objective of this article is to formulate the air freshener's gel using carrageenan and HPMC and evaluate its release profile. For preparations of air freshener gel, volatile oil was extracted from orange peel (*Citrus reticulata*) using Clevenger apparatus. The volatile oil was stored until it was used for gel preparation. Five formulations of gel namely F1, F2, F3, F4 and F5 were formulated using different concentrations (1%, 2%, 3%, 4% and 5%) of carrageenan and was evaluated for different parameters such as homogeneity, appearance, hedonic test, total liquid evaporation and residual gel weight. Among them, the best formulation was selected for further formulation of air freshener's gel using different concentrations (0.5%, 1%, 1.5%, 2% and 2.5%) of HPMC. After evaluation, F3 formulation (1.5% HPMC) was selected as optimised formulation, which gives the most sustained effect with better residual gel weight and total evaporation of liquid. From the experiments we can conclude that the formulated HPMC (1.5%) based gel has more sustained air freshener effects with good homogeneity and could be used for preparations of household applications.

**Keywords:** Air fresheners gel; HPMC based sustained release gel; Room fresheners gel; Sustained release air fresheners gel.

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### INTRODUCTION

Air fresheners are the product, which are designed to diminish bad smells, freshen up the air by releasing their contents into the air, and have been used in the field of environmental sanitation for decades.<sup>1</sup> Several forms of freshener are available in the market namely solid, aerosol, liquid and gel. Air freshener gel is usually placed or hung inside the room or toilet. Air fresheners are used by household people to mask the bad odour by releasing the fragrant components from the fresheners.<sup>2</sup> Air freshener is mainly made up of two components namely fragrances and solvents. Solvents usually used are either water or oil. Fresheners that use a water-based system are usually made in the form of gel.<sup>1</sup> Air freshener gel is a water-based system, contains few ingredients such as gelling agent, fragrance oil, water and used together in various combinations to ensure rigidity and stability of the solidified gel. In addition, the air freshener in gel form is easier in terms of storage and packaging.

The use of natural polymers / biopolymers as a raw material have several advantages such as good water solubility, ability to swell, does not produce toxicity and are

biocompatible. Carrageenan has good gel forming properties, abundant in nature and it is safe for the environment. Despite carrageenan being a good gelling agent and capable of entrapping and releasing fragrance, it cannot be used alone in air fresheners gel because of syneresis, a phenomenon where water is coming out from the gel matrix.<sup>3</sup> Hydroxypropyl methylcellulose (HPMC) is a well-known compound in the pharmaceutical industry due its inherent properties to either slow release or controlled release of drugs from the formulation. Since for an air fresheners gel sustained action is desired and therefore, we have made an effort to use different concentrations of HPMC along with carrageenan to formulate an air fresheners gel and evaluate its release from the gel matrix.

### MATERIALS AND METHODS

#### Materials:

Fresh oranges were collected from the local market Thuampui, Aizawl, Mizoram, India. Carrageenan is obtained from Balaji Drugs, HPMC from Himedia. All solvents and chemicals used were of analytical grade.

#### Extraction of essential oil from orange peels:

The oranges were thoroughly washed and then peeled off. The size of the peels was finely reduced by using a mixing grinder (Prestige iris 750, India) and were ready for the extraction process. The Clevenger apparatus was used for the extraction of essential oil from the fresh peels of *Citrus reticulata* by hydro-distillation.<sup>4</sup> The oil was collected in small bottles and stored until further used.



**Formulation of air freshener gel using carrageenan:**

A simple air freshener gel was formulated as per the method described by Hutagoal *et al.*, 2017 with slight modification using various concentrations of carrageenan (table 1). Carrageenan and sodium benzoate were dissolved in distilled water and the mixture was heated at a temperature of 75°C with continuous stirring until a homogeneous mixture was formed. Then the temperature was lowered to 65°C, propylene glycol, orange oil were added and stirred to achieve homogeneity. Subsequently, the mixture was then transferred into the petridish and allowed to stand at room temperature.<sup>1</sup>

**Formulation of air freshener gel using HPMC:**

Air freshener gel with HPMC was further formulated by using optimised carrageenan concentration (3%) as per the method described by Hutagoal *et al.*, 2017 with slight modification using various concentrations of HPMC (table 2). Carrageenan, sodium benzoate and HPMC were dissolved in distilled water and heated at a temperature of 75°C with continuous stirring until homogeneous mixture was formed. The temperature was then lowered to 65°C and propylene glycol was added and stirred. Finally, the orange oil was added and stirred to achieve homogeneity. Then the mixture was transferred into petridish and allowed to stand at room temperature. The resultant gel has been evaluated for the best-optimised formulation.<sup>1</sup>

**Evaluation of the formulated gel:****Homogeneity:**

To check the homogeneity the prepared gels were evaluated by visual observation and touch.

**Appearance:**

The appearance of the gel was evaluated for colour, consistency and roughness.

**Hedonic Test:**

Hedonic test is the test method used to measure the level of preference for products using the assessment form. It was conducted as per the method described by Garg *et al.*, with slight modifications.<sup>5</sup> A test was conducted to determine the level of panellist preference to air freshener gel preparation that has been made. Test was performed using 15 panellists by asking each panellist to smell air freshener gels and asked to fill the assessment form according to their preference for each formulation. The assessment criteria of air freshener gel preparation are shown in table 3. As per the National Bureau of Standards (2006) the selected participants have the following characteristics

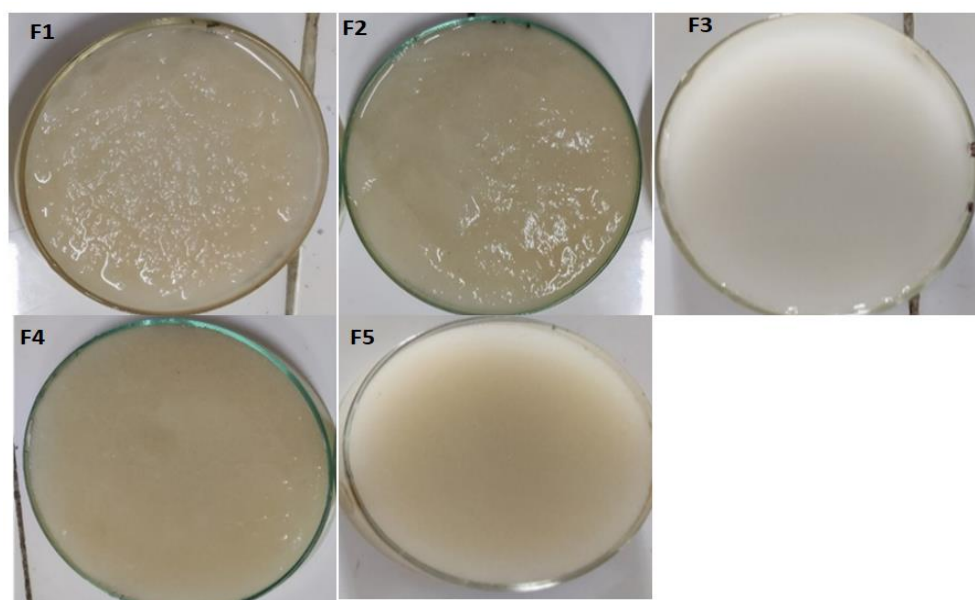
- i. Attracted by the organic test sensory and willing to participate.
- ii. Consistent in taking decisions.
- iii. They are in good health and free of illness related to sensory properties, such as chronic colds, food allergies, or diabetes.
- iv. They are non-smokers

**Total Liquid Evaporation:**

Liquid evaporation test of the gel was done by weighing the gel before each week until four weeks. Weight loss of gel in each week indicates the evaporation of liquid from the gel matrix and the reading was taken till 4 weeks. Total liquid evaporation and residual gel weight was calculated by the formula:

$$\text{Total Liquid Evaporation} = \text{Weight of gel at week1 (W1)} - \text{weight of gel at week 4(W4)}$$

$$\text{Residual Gel Weight} = \text{Weight of gel in the previous week i.e., week 1(W1)} - \text{Weight of gel at the time of weighing i.e., week 2(W2)}$$



**Figure 1:** Different formulations of gel using HPMC (F1:0.5%; F2: 1%; F3:1.5%; F4:2%, F5:2.5%)

**RESULTS**

**Extraction of volatile oil using Clevenger apparatus:**

Volatile oil extracted by using Clevenger apparatus from orange (*Citrus reticulata*) peels was 2.1ml (~1.7661g) from 180g of orange peel with 0.981% yield.

**Evaluation of HPMC based air freshener gel**

The formulated air freshener gel using carrageenan was evaluated for homogeneity, appearances to optimize the formulation. Among the five formulations, F3 was chosen and further formulated with HPMC (table 1). Similarly, five formulations were formulated using different concentrations of HPMC (table 2). HPMC based formulations were evaluated for homogeneity, appearances, Hedonic test, total liquid evaporation and residual gel weight which are closely related to the stability of the formulated gels.

**Homogeneity:**

Among the all-formulated gels using HPMC, we found F3 with better homogeneity (figure 1).

**Appearance:**

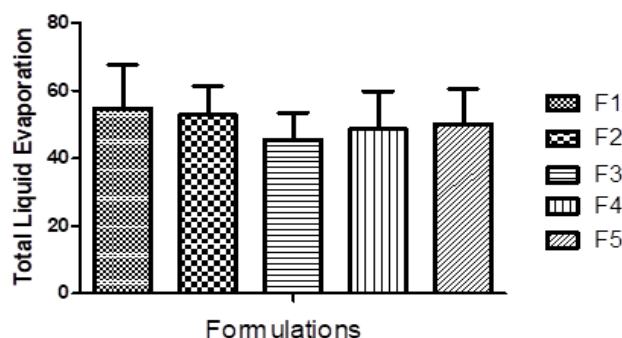
The appearance of the gel was judged by its colour, consistency and smoothness. Formulation F3 stands the good consistency (figure 1).

**Hedonic test:**

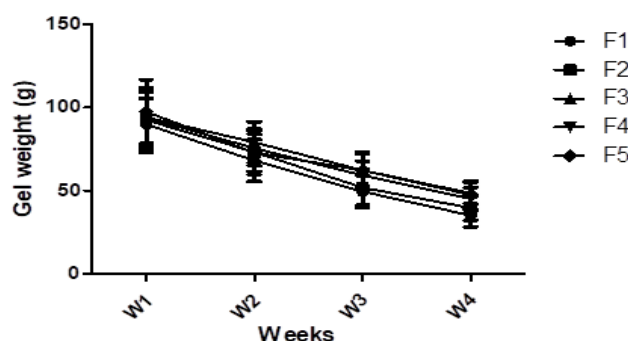
From the assessment form of the panellists, it was observed that formulation F3 was preferred and followed by F1, F3, F4 and F5 (table 4). Hedonic test results showed that F3 formulation could release the fragrance from its matrix for longer duration compare to other formulations.

**Total Liquid Evaporation and Residual Gel Weight:**

Total liquid evaporation was determined by weighing the gel air freshener formulations and calculating the weight loss for four weeks. From the study it was found that F3 formulation has the lowest total liquid evaporation followed by F4, F5, F2 and F1 (figure 2). Residual gel weight study shows F3 formulations with 1.5% HPMC have highest residual weight compared to other formulations (figure 3).



**Figure 2:** Total liquid evaporation from HPMC based formulated gels



**Figure 3:** Residual weight of HPMC based formulated gels

**Table 1:** Formulation of simple carrageenan air fresheners gel

SL NO	Components	F1	F2	F3	F4	F5
1	Citrus Oil 2%	2.00	2.00	2.00	2.00	2.00
2	Starch	2.00	2.00	2.00	2.00	2.00
3	Carrageenan	1.00	2.00	3.00	4.0	5.0
4	Sodium Benzoate 0.1%	0.10	0.10	0.10	0.10	0.10
5	Propylene Glycol 10%	10.00	10.00	10.00	10	10
6	Distilled water	q.s	q.s	q.s	q.s	q.s
7	Total (gm)	100	100	100	100	100

**Table 2:** Formulation of HPMC based air fresheners gel

SL. NO	Components	F1	F2	F3	F4	F5
1	Citrus Oil 2%	2.00	2.00	2.00	2.00	2.00
2	Starch	2.00	2.00	2.00	2.00	2.00
3	Carrageenan	3.00	3.00	3.00	3.00	3.00
4	HPMC	0.5	1.00	1.50	2.0	2.5
5	Sodium Benzoate 0.1%	0.10	0.10	0.10	0.10	0.10
6	Propylene Glycol 10%	10.00	10.00	10.00	10.00	10.00
7	Distilled water	q.s	q.s	q.s	q.s	q.s
8	Total	100	100	100	100	100



**Table 4:** Results of Hedonic test at various time intervals

SL. NO.	Time	HEDONIC TEST RESULTS				
		F1	F2	F3	F4	F5
1	W1	Fragrant	Very Fragrant	Moderate Fragrant	Moderate Fragrant	Moderate Fragrant
2	W2	Moderate Fragrant	Fragrant	Less Fragrant	Less Fragrant	No Fragrant
3	W3	Less Fragrant	No Fragrant	Moderate Fragrant	No Fragrant	No Fragrant
4	W4	No Fragrant	No Fragrant	Less Fragrant	No Fragrant	No Fragrant

**Table 3:** Assessment criteria of air freshener gel preparation

SL. NO	Criteria	Score
1.	Very Fragrant	5
2.	Fragrant	4
3.	Moderate Fragrant	3
4.	Less Fragrant	2
5.	Not Fragrant	1

## DISCUSSION

HPMC is a well renowned compound in the pharmaceutical industry due to its ability to sustain or control released properties of the drug moiety from its core.<sup>6</sup> Therefore, we used HPMC to know the effect in the release profile of fragrant from the gel matrix at different concentrations (0.5-2.5%). Among all the formulations with 1.5% HPMC was found with good appearances, homogeneity, least total liquid evaporation and highest residual weight. Although carrageenan alone can form a good gel, however, retention of the solvents is not sufficient enough especially for the formulation type like air fresheners gel. HPMC itself may not have good properties for gel formation but it can retard the evaporation of liquids from the matrix in a controlled manner. Therefore, from the first formulation, an optimised concentration of carrageenan was selected for better consistency of gel and then HPMC at different concentrations were used to prepare air fresheners gel (Table 2). The formulated gels were evaluated for the appearances, consistency, smoothness, Hedonic tests, total liquid evaporations and residual gel weight. After evaluation, it was found that F3 formulation with HPMC 1.5% shows highest consistency of the gel, no lump formation and provides longer duration of fragrance (table 4). Total liquid evaporation and residual gel weight also favours F3 formulation (figure 2 & 3). Therefore, it is evident that use of HPMC at optimum concentrations might have slowed the release of liquid from the gel matrix and thereby enhancing the time of release of the volatile components from the matrix.

## CONCLUSION

Carrageenan can be successfully formulated as a gel forming base in the preparation of air freshener since it induces gel formation at very low concentrations. However, it cannot retain the fragrance as well as liquid for a long time. In order to increase the ability to hold liquid in the matrix we used HPMC. In this study HPMC (1.5%) have shown its ability to slow release of the fragrant for a longer duration. The formulated gel with HPMC (1.5%) has shown least total liquid evaporation, highest residual gel weight. Therefore, we can conclude that use of HPMC may enhance the duration of fragrance from a gel matrix due to its ability to slow down the evaporation of the liquid. Hence, HPMC may be used in the air fresheners gel for sustained fragrant effect.

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