

## Introduction

While perfume has been around for thousands of years, current trends in the cosmetics industry are focused on customized products (Campanella & Palma, 2025). Customization of fragrances applies to how perfume reacts to skin and body chemistry. Increased persistence, or longevity, of perfumes is a characteristic desired by consumers (Kim et al., 2021) and refers to how long a fragrance remains noticeable after application. Research on the relationship between biological factors and perfume longevity provides insight to manufacturers and consumers on the variation of one fragrance's performance from one individual to another.

Perfume is a partly polar mixture containing a scent profile typically made up of essential oils diluted by a carrier base like denatured alcohol. The scent profile can be broken down into three notes (top, middle, base) characterized by their volatility. Sweat is a polar mixture of water and minerals like salts. Salt concentrations in sweat can vary from one individual to another, affecting interactions between body chemistry and perfume longevity. The mixture's evaporation rate, which determines longevity of perfumes, is approximately proportional to the evaporative cooling rate which is the mixture's temperature decrease over time.

The purpose of this study was to determine to what extent the longevity of perfume molecules was altered by the concentration of salt in synthetic sweat as measured by evaporative cooling rate.

## Materials and Methods

Each 50 mL sweat sample contained approximately 49.5 mL deionized water, 0.05 g of urea, and 0.05 mL of lactic acid. The amount of sodium chloride varies from 0.5 g to 2.5 g, with 0.5 g added to produce each subsequent salt concentration.

The pH of each solution was tested after the initial mixture was created. The average person's sweat has a pH between 4 and 5. To ensure that every synthetic sweat sample was as realistic as possible, the pH of the solutions with a higher concentration of sodium chloride had to be adjusted. This was accomplished by adding a sodium hydroxide solution one drop at a time and retesting the pH until it was found to be in the 4–5 range. After the pH was confirmed to be in range, 5 mL of synthetic sweat was put into a 10 mL beaker and 5 mL of perfume was added.

## Materials and Methods (continued)

Material Name	Percentage in solution (%)	Volume in solution (mL)
Denatured Alcohol (carrier)	80	40
Sweet Orange Essential Oil (top note)	3	1.5
Jasmin Essential Oil (middle note)	7	3.5
Vanilla Essential Oil (base note)	10	5

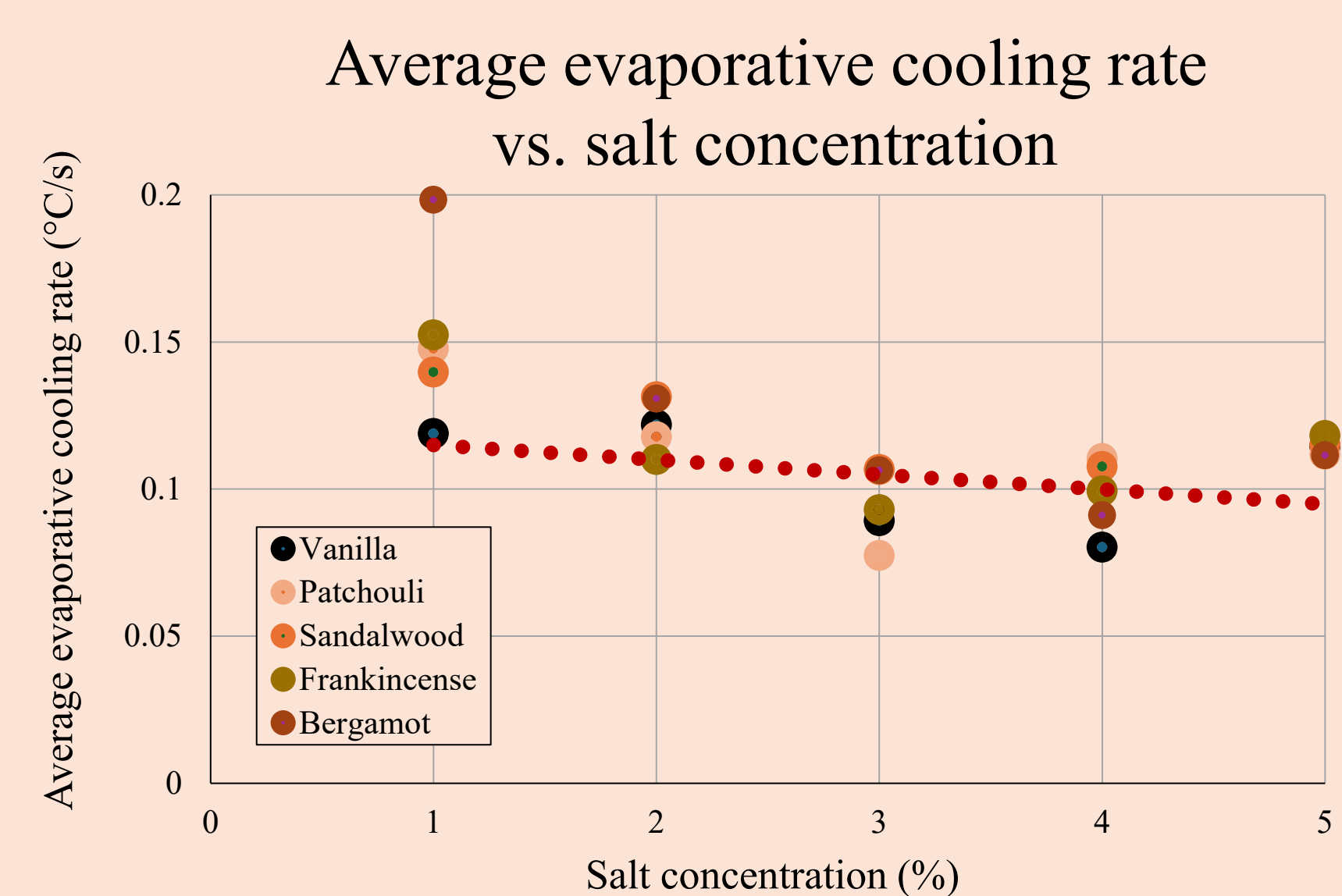
Table 1: A summary of the specific measurements for the vanilla sample. The perfumes are considered Eau de Parfum because they contain 80% of the carrier base and 20% fragrance (essential oils). The 50 mL samples varied only in the base note used. The five different base notes used were bergamot, vanilla, frankincense, sandalwood, and patchouli.



Figure 1: The experimental set up consisted of five 10 mL beakers containing perfume and sweat mixtures. A temperature probe was wrapped in circular (15 cm diameter) filter paper and held in each mixture for ten seconds. During each trial, the probe was secured by a piece of tape to minimize experimental error. A laptop was used for running Logger Pro that measured the rate of evaporative cooling. The documented rate used for data required a linear fit feature in Logger Pro to analyze the same 20–40 second interval for each trial.

A large portion of the original methodology for this project was dedicated to the inclusion of sebum (oil produced by sebaceous glands) which ended up failing due to the inconsistency of the solution when sebum was added. The mixture contained polar and nonpolar layers which was not ideal for evaporation rate testing.

## Results



Graph 1: Evaporative cooling rate is used to infer evaporation rate which is related to longevity. One data point represents the average magnitude of evaporative cooling for two trials at each salt concentration. The trendline represents the general relationship between evaporative cooling and salt concentration.

## Results (continued)

Graph 1 shows evaporative cooling rates generally decreased as salt concentration increased from 1%–3% for all solutions while an increase in the evaporative cooling rates were observed at 3%–5% for most solutions.

## Conclusion

The purpose of this study, to determine the effect of increased salinity in sweat on the evaporation rate of perfume, was fulfilled. Findings indicated that increased salinity decreased evaporative cooling rates indicating similar trends in evaporation rates.

A scientific principle that guided the experiment is called salting out (Vorholz & Maurer, 2008). When salt is added to water, the liquid molecules are given less room to vaporize into the atmosphere lowering the evaporation rate. This study focused on the extent to which salting out applies to sweat and perfume. In perfumes, using essential oils for fragrance, salting out has a different effect on the alcohol portion of the solution and not the fragrance (oil) part. Therefore, it cannot be assumed that longevity of perfume is increased due to increased salinity. The increase in evaporative cooling rate seen from 3%–5% is most likely due to inconsistent ambient room temperature between testing periods.

Future research should incorporate sebum and fragrances that are synthetic and polar. The inclusion of sebum would deepen the understanding of how body chemistry interacts with fragrance to support cosmetic innovations for personalization. Testing synthetic, polar fragrances in place of essential oils would provide results that are more descriptive of the perfume's longevity.

## References

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