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FORMULATION OF SOLID PERFUME FROM LOCALLY AVAILABLE *CHRYSANTHEMUM X MORIFOLIUM* (GARDEN CHRYSANTHEMUM) AND THEOBROMA OIL

Rochele Yao S. Benan^{1*}, Shariya Mei L. Pedro², Rimson George A. Ba-oy³, Trisha Mhae L. Pilay⁴,
Christian Yoshua D. Sacramento⁵, Benjamin A. Litusquen⁶, Honey Khyllle W. Dimatulac⁷, Aubrae
Frances E. Bannawi⁸

- ¹ Saint Louis School of Pacdal, Inc.
Email: slspi.rocheleyaobenan@gmail.com
- ² Saint Louis School of Pacdal, Inc.
Email: slspi.shariyameipetro@gmail.com
- ³ Saint Louis School of Pacdal, Inc.
Email: slspi.rimsongeargebaoy@gmail.com
- ⁴ Saint Louis School of Pacdal, Inc.
Email: slspi.trishamhaep@gmail.com
- ⁵ Saint Louis School of Pacdal, Inc.
Email: slspi.christianyoshuasacramento@gmail.com
- ⁶ Saint Louis School of Pacdal, Inc.
Email: slspi.benjaminjrlitusquen@gmail.com
- ⁷ Saint Louis School of Pacdal, Inc.
Email: slspi.honeykhyllledimatulac@gmail.com
- ⁸ Saint Louis School of Pacdal, Inc.
Email: aubraefrancesb@gmail.com
- * Corresponding Author

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Abstract:

Chrysanthemums have a vast supply of cut flowers but limited use in the farming industry. This is a serious issue that every farmer experiences during harvest. As a result, a formulation of solid perfume from garden chrysanthemums may provide a remedy for this issue. This research aims to create a solid perfume from locally accessible *Chrysanthemum x morifolium* (Garden Chrysanthemum) and Theobroma oil. The researchers employed Rotary Evaporation to extract essential oils from Garden Chrysanthemum petals and formulate a solid perfume from cocoa butter, beeswax, avocado, and Garden Chrysanthemum oil at the University of Baguio. The formulated solid perfumes underwent tests for their homogenous, hardness/strength, pH, and organoleptic properties. Where the results showed that the three formulations were homogenous, the different concentrations affected the physical appearance of the solid perfume.

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Keywords:

Chrysanthemum X Morifolium, Solid Perfume, Theobroma Oil, Rotary Evaporation, Formulation

Introduction

Solid perfumes, cream perfumes, or solid colognes are perfumes that are solid rather than the liquid mix of alcohol and water or fragrance and carrier oil that is used in most perfume applications (Mroczek, 2022). According to Jones (2021), solid perfumes are typically made with natural wax, such as beeswax or shea butter, as the fragrance medium instead of water. After that, the product is gently rubbed into the skin, usually at pulse points like the neck or wrist. Seow (2021) stated that several high-end perfume brands offer their characteristic aromas in solid perfume formulations. Unlike regular perfumes and colognes, solid fragrances are compact and leak-proof because of their waxy substance. Additionally, since solid fragrances do not leave a spillage, consumers may easily reapply in public without being seen.

Solid perfumes with essential oils are gaining appeal as a natural and sustainable alternative to standard liquid perfumes (Shinde et al., 2023). According to Debadatta et al. (2024), the global solid perfume market was valued at USD 1.65 billion in 2023 and is expected to reach USD 4.7 billion by 2032, growing at an 11.1% compound annual growth rate from 2024 to 2032. The growing consumer interest in personal care and fragrance goods drives growth in the global solid perfume industry. Cosmetics and perfumery technological advancements have altered customer perceptions and use of fragrance goods. These scents, praised for their simplicity and mobility, represent a creative innovation in the fragrance industry, attracting widespread attention.

Furthermore, *Chrysanthemum morifolium* is one of the world's four great cut flowers, with significant ornamental and commercial value. Flower fragrance is a significant ornamental characteristic of chrysanthemum, particularly for tea and edible chrysanthemum, and the quality of the scent influences its commercial value (Wang et al., 2023). Chrysanthemums have long been used in the perfume industry; many perfumes are derived from these flowers, such as Serge Lutens' De Profundis, a Floral fragrance for men and women. De Profundis debuted in 2011. Christopher Sheldrak is the nose behind this fragrance (Fragrantica, 2022). Furthermore, Amouage also released a perfume in 2016 called Myths Woman, a seductive floral-green fragrance for ladies. This smell-artistic creation was created by the well-known perfumer Nathalie Lorson (CrisMS, 2024).

Cocoa butter (theobroma oil) is a pale-yellow, edible vegetable fat derived from cocoa beans with a mild chocolate flavor and aroma. It is used to produce chocolate confections, pharmaceutical ointments, and toiletries. It is valued for its melting properties, as it remains brittle at room temperature or lower but melts just below body temperature (Rogers, 2021). According to Zelman (2020), cocoa butter is an excellent choice due to its high fatty acid

content as the main component of skin creams. Fatty acids aid skin hydration. The fat in cocoa butter forms a barrier that keeps moisture in and stops the skin from drying out. Cocoa butter is also high in phytochemicals, which are natural plant compounds. These substances may improve blood flow to the skin and slow skin aging by protecting against UV ray damage. Cocoa butter smooths scars, wrinkles, and other skin imperfections. Many women believe that cocoa butter creams and lotions can be used to prevent and minimize the appearance of stretch marks during and after pregnancy. Cocoa butter has also been promoted for its ability to heal rashes caused by conditions such as eczema and dermatitis (Watson, 2017).

A previous study was conducted by Septiyanti (2021), which used jasmine oil. The results showed that the most preferred formulation based on the organoleptic test was produced with a 30% cocoa butter concentration with a preference level of 3.63. Solid perfume with 30% cocoa butter concentration had characteristics of a penetration level of 14.16 mm/sec, melting point of 90° C, pH value of 4, and IC50 201.98 µg/mL. Solid perfume products showed homogeneity and physical stability during four weeks of observation at room temperature.

As a result, the researchers will focus on using *Chrysanthemum x morifolium* oil extract as a raw material for this study. Correspondingly, in this study, the formulation of solid perfume will be optimized by using cocoa butter as the raw material and *Chrysanthemum x morifolium* (Garden Chrysanthemum). The solid form aims for ease of use and storage while increasing stability. This study will characterize solid perfume products, including an organoleptic test, homogeneity test, strength/hardness level test, and pH test.

Literature Review

Solid Perfume

Solid fragrance is a "new" product that is quite old. It dates back to ancient Egypt but has recently gained popularity. Solid perfumes, cream perfumes, or solid colognes are solid rather than the liquid mix of alcohol and water or fragrance and carrier oil used in a typical perfume application (Mroczek, 2022). According to Vicki (2023) and Mroczek (2022), solid perfumes are scents available in a solid form, usually in the shape of a paste or balm. The aroma lasts longer on the skin because of a combination of waxes, oils, and other chemicals used in its creation than conventional liquid perfumes. To name a few benefits of solid perfume, solid perfumes are alcohol-free (Singh, 2019; Connett, n.d.; Srivastava, 2021), almost zero waste (Amanvida, 2021; Connett, 2019), moisturizing, and nourishing (Singh, 2019; Nuutjob, 2023; Cobes, 2022). Additionally, solidified perfumes eliminate the possibility of spilling or leaking due to a crack in the perfume container (Singh, 2019). A handy perfume alternative is a solid perfume. Because of its creamy smoothness, this type of scent is portable (Slesarenok & Yakovleva, 2019). Moreover, there are various body parts to which you can apply solid perfume, such as the wrist, neck, pulse point, and even your hair (Mroczek, 2022). Solid perfumes are usually applied by rubbing a small amount on the body's pulse spots, such as the wrists or neck, using a finger or a cotton swab. The body's heat helps release the fragrance over time, and the perfume's solid consistency helps extend the scent's longevity (Pal et al., 2014 & Shinde et al., 2023). Cocoa butter is made from the cocoa bean, the seed of the *Theobroma* tree, primarily cultivated in South America and West Africa (Naik et al.; V., 2014). Reinhardt (2022) stated that cocoa butter has a pale yellow hue and a strong cocoa flavor and aroma. Despite the name, this fat is entirely vegan and plant-based, derived solely from the cacao bean.

Theobroma Oil/Cocoa Butter

Theobroma oil, or cocoa butter, is most commonly found in body and face lotions. It is, however, used in cooking, in both sweet and savory dishes. Cocoa butter has a cocoa flavor and aroma and is classified as a vegetable fat. Despite the name's use of the word "butter," it is vegan and contains no dairy products (Murray, 2022). Cocoa butter is used as a raw material in many cosmetic products, including cream, sunscreen, lipstick, soap, and shampoo (Ristanti et al., 2018). Cocoa butter is high in vitamin D2, a precursor to the body's active form of vitamin D. It is also high in minerals like potassium, phosphorus, iron, copper, and magnesium but low in health-promoting polyphenols (Alexis, 2022).

Cocoa butter is a rich emollient that moisturizes and nourishes even the most parched skin (think chapped hands or lips). It is solid at room temperature and melts nicely when applied. It contains fatty acids, primarily oleic (35%), stearic (34%), and palmitic (25%) fatty acids, as well as antioxidant vitamin E and polyphenols (Gasser et al., 2008 & SuperZero, 2022).

Chrysanthemum X morifolium (Garden Chrysanthemum)

Linnaeus coined the term "chrysanthemum" in 1753, combining the Greek words "chrysos" (gold) and "anthemom" (flower) to describe the golden flowers of the first chrysanthemum varieties (Boase et al., 2004). Although a wide variety of flower colors, shapes, and forms were initially developed through conventional and mutant breeding, transgenic procedures are now more commonly used, with Agrobacterium-mediated transformation being the most prevalent method of introducing foreign genes into chrysanthemums (Da Silva et al., 2013). According to Sivers (2022), Chrysanthemums were first documented as a flowering herb in China in the 15th century B.C. The earliest illustrations of chrysanthemums (around the 17th century A.D.) described them with small yellow flowers, even though chrysanthemums had been depicted on ancient Chinese pottery hundreds of years prior. Chrysanthemum oil and extract have also been used in herbal medicine for their antibacterial and antibiotic properties. According to Gaddis (2022), essential oil extracted from the chrysanthemum plant has long been used as an all-natural organic pesticide and insect repellent. The oil of the chrysanthemum flower has a pleasant scent; because of their pleasant fragrance, the dried petals of the chrysanthemum flower have been used in potpourri and to freshen linens for hundreds of years. Chrysanthemum oil can also be used in perfumes or scented candles. The scent is light and flowery without being heavy.

Methodology

Research Design

The researchers adopted a true experimental type of Quantitative Research design to extract oil and formulate a perfume from locally available Chrysanthemum. Bhandari (2022) defined quantitative research as the process of collecting and analyzing numerical data. It can find patterns and averages, make predictions, test causal relationships, and generalize results to broader populations. According to Gautam (2017), true experimental research relies on statistical analysis to prove or disprove a hypothesis, making it the most accurate form of research. Out of the types of experimental design, only true design can establish a cause-effect relationship within a group. In a true experiment, three factors need to be satisfied: there is a control group, which will not be subjected to changes, and an experimental group, which will experience the changed variables; a variable that the researcher can manipulate; and a random

distribution. The research design aims to evaluate the efficacy of using a Chrysanthemum as an alternative ingredient in perfume formulation.

Methods and Materials

The materials required to characterize scent during the formulation of perfume materials include some of the listings below, such as Tripod, Gauze Pad, Beakers, Stirrer, and Denatured Alcohol. They enable the division of the numerous parts. All of the materials in this project were of natural origin. Furthermore, the main components needed for a solid perfume are as follows with their respective prices: Beeswax (250g, Php 248), Avocado Oil (100g, Php 110), Chrysanthemum X morifolium, and Cocoa butter (250g, Php 238). Furthermore, the researchers picked about 5 kg of Garden Chrysanthemum and removed their petals. The flower petals were placed under the sun as the process of Rotary Evaporation requires dried and crisp petals; about 213.64 grams of dried petals were collected. The researchers were asked to blend the dried petals until they became powdery. The blended petals were soaked in 1 Liter of ethanol for 48 hours. After 48 hours, the researchers filtered the solution. Lastly, the university performed the process of rotary evaporation.

Garden Chrysanthemum Rotary Evaporation

Chrysanthemum x morifolium essential oil is obtained by rotary evaporation, wherein the distillation of Garden Chrysanthemum produces a yellow oil. This follows the research of Jang et al. (2021) and the study of Liu et al. (2017) that extracted essential oil from the same species, resulting in yellow-colored oil with a distinctive flower aroma. 0.78% of essential oil is obtained using the process of rotary evaporation from the 5 kg of Chrysanthemum flowers. The essential oil yielded 39 mL.

Solid Perfume Formulation

In this study, the preparation used a solid and liquid base combination, cocoa butter, beeswax, avocado oil, and the essential oil of Chrysanthemum flowers. This research used cocoa butter and beeswax as a base. Cocoa butter concentrations used were 5g (10%) for F1, 10g (20%) for F2, and 15g (30%) for F3. Formula 3 has the highest amount of cocoa butter, followed by Formula 2, and Formula 1 has the least amount of cocoa butter. According to Zelman (2020), cocoa butter is an excellent choice due to its high fatty acid content as the main component of skin creams. Fatty acids aid skin hydration. The fat in cocoa butter forms a barrier that keeps moisture in and stops the skin from drying out. Beeswax was used with concentrations of 50% (F1), 40% (F2), and 30% (F3). Formula 1 has the most beeswax, 25g of beeswax, followed by Formula 2, which has 20g of beeswax, and lastly, Formula 3 has the least amount of beeswax, 15g. Beeswax was chosen because it can increase the consistency of the preparation and dissolve in essential oils (Maysarah et al., 2020).

The researchers melted the cocoa butter at 90°C. Garden Chrysanthemum oil as a fragrance was mixed with avocado oil and then added to the wax compound. The mixture was stirred until homogeneous, then cooled and hardened at room temperature (Septiyanti et al., 2021). The composition of a solid perfume is shown below:

Table 1: Composition Of Solid Perfume

Variables	F1	F2	F3
Cocoa Butter	5g	10g	15g
Beeswax	25g	20g	15g
Avocado Oil	10g	5g	5g
Chrysanthemum Oil	10g	15g	15g

Solid Perfume Evaluation

The formulation of solid perfume and the necessary tests, such as the Organoleptic Test, Melting Temperature Test, Hardness Level Strength/Strength Test, pH Test, and Homogeneity Test, were adopted from the study of Maysarah et al. (2020).

Organoleptic Test

Stick perfume preparations were observed for several parameters, such as color, consistency, and aroma. (Hernani, 2012 cited by Maysarah, et al., 2020). The organoleptic test is a method of testing using the five human senses (Septiyanti et al., 2021).

Hardness Level Test

The solid perfume was placed horizontally and about 1.5 cm from the edge of the tin can; a load was hung to give pressure. Every 30 seconds, 10 grams was added until the preparation was broken. (Nazlinawaty et al., 2012 cited by Maysarah, 2020).

pH Test

The pH level of the formulated solid perfume will be tested by the researchers using a pH meter (Septiyanti et al., 2021). It is equipment that detects the activity of hydrogen ions in solutions or the acidity or alkalinity of a solution. In the end, the pH level, which typically ranges from 1 to 14, is used to describe the level of hydrogen ion activity. The pH scale measures acidity, with 0 being very acidic and 14 being very alkaline (Iowa State University, 2023).

This pH measurement is directly related to the ratio of hydrogen ion concentration and hydroxyl ion concentration ($[H^+]$ and $[OH^-]$, respectively). The general breakdown of pH levels is as follows: Neutral solution: $pH = 7$, Acidic solution: $pH < 7$, and Basic solution: $pH > 7$

Homogeneity Test

A homogeneity test of solid perfume will be conducted by applying the samples to a flat glass. According to Mappa et al. (2013), as cited by Maysarah et al. (2020), 0.5 g of stick perfume was taken, applied to the glass preparation, and covered with glass. Then, the naked eye was used to observe the presence of coarse grains.

Data Analysis

By the time the researchers had completed formulating the solid perfume from Garden Chrysanthemums and recorded all the relevant data, The researchers were able to determine that 39 mL of essential oil was obtained from 5 kg of the Chrysanthemums, which is 0.78% through the use of a math equation. To calculate the percentage of a number, divide it by the whole and multiply by 100, which follows:

$$(\text{Value} \div \text{Total value}) \times 100$$

After conducting the strength test of the formulated perfumes to get the mean, the researchers divided the sum of all values in a data set by the number of values.

$$\text{Mean (x)} = \Sigma x/n$$

Σx = sum of all values

n = number of values

Results and Discussion

Appearance of Solid Perfume

Table 2: Appearance Of The Solid Perfume Preparation

Appearance			
Formula	Color	Consistency	Odor
F1	Cream White	Solid	Chrysanthemum
F2	Cream White	Solid	Wax(Cocoa Butter)
F3	Cream White (slightly darker)	Solid	Wax and Chrysanthemum

Observation of the organoleptic test of color, aroma, and consistency of stick perfume preparations can be seen in Table 2. According to Lamusu et al. (2012), as cited by Maysarah et al. (2020), an organoleptic test was carried out to determine the level of liking and acceptability of the color, taste, aroma, and consistency of the preparation. The organoleptic test revealed that F1 has a cream-white color and a solid consistency, and its prominent odor is that of a chrysanthemum. Meanwhile, F2 also has a creamy white color, a solid consistency, and a prominent smell of the base used, cocoa butter. Lastly, F3 has a slightly darker cream-white color, a solid consistency, and a mixed aroma of cocoa butter and Chrysanthemum. The Organoleptic evaluation revealed the details regarding the color, odor, appearance, texture, etc, of the prepared formulation, which was pleasant, smooth, and acceptable (Septiyanti et al., 2021).

Table 3: Homogeneity Test Result

Formula	Homogeneity
F1	Homogenous
F2	Homogenous
F3	Homogenous

To avoid discomfort, a preparation must be homogenous and flat (Naibaho, 2013). The homogeneity test findings revealed that when all stick perfume compositions were put into transparent glass, there were no coarse grains. The homogeneity test revealed that F1, F2, and F3 are homogenous. This demonstrated that the preparations were made consistently (MOH RI, 1979, as cited by Maysarah et al., 2020). Because the ingredients used are soluble in essential oils, all homogeneous preparations indicated that all formula ingredients were well mixed, as there were no lumps or coarse grains in the preparations.

Table 4: Strength Test Result

Formula	Mean (g) \pm SD
F1	181.86 g
F2	120.11 g
F3	154.56 g

Table 4 discusses the strength test result. The strength test was performed to determine the strength of the preparation during the packaging, transportation, and storage processes (Risnawati et al., 2012). The results of the stick perfume strength test showed that F1 has the highest strength (181.86 g), followed by F3 (154.56), and lastly, F2 has the lowest strength (120.11). This finding was caused by the formula's varied concentrations of beeswax and cocoa butter (Sampebarra et al., 2016; Baldino & Gabriele, 2010). To the study of Sampebarra., et al. (2016) and Anisa et al. (2019), beeswax can enhance the number of solids in the preparation, resulting in a harder-formed shape. On the other hand, the inclusion of cocoa butter softened the solid perfume product. The presence of cocoa butter in the formulation was a crucial component in adjusting the texture and melting point (Septiyanti., et al., 2021; Baldino & Gabriele, 2010)

Table 5: pH Test Result

Formula	pH	
	pH Level	Basic/Acid/Neutral
F1	7.11	Neutral
F2	7.93	Basic
F3	7.28	Neutral

Table 5 showcases the result of the pH test. pH standard for topical preparation in contact with skin was about 4-8 (Padmadisastra et al., 2007, as cited by Septiyanti., et al., 2021). The pH value was expected not to be too acidic because it can irritate and not too alkaline because it can cause scaly skin (Septiyanti., et al., 2021). The resulting solid perfume was tested using a pH meter. Formula 1 has a pH level of 7.11, which is neutral; Formula 2 has a pH level of 7.93, which can be considered essential. Lastly, Formula 3 has a pH level of 7.28, which is neutral. These pH values are considered safe for topical preparation for human skin application. According to Ramlah (2017), this solid perfume contained cocoa butter, which contained fatty acids similar to the fatty acids that are present in the skin. However, the pH level of a person's skin can also influence how a perfume smells. Due to variances in skin pH levels, a fragrance may smell differently on one person than another, even if they are wearing the same perfume (Terry, 2023 & Kessler, 2020).

Tests

Organoleptic Test				Strength Test	pH Test		
	Odor	Consistency	Color	Homogeneity Test	Mean (g) ± SD	pH Level	Basic/Acidic/Neutral
F1	Chrysanthemum	Solid	Cream White	Homogenous	181.86 g	7	Neutral
F2	Wax (Cocoa Butter)	Solid	Cream White	Homogenous	120.11 g	8	Basic
F3	Wax and Chrysanthemum	Solid	Cream White (slightly darker)	Homogenous	154.56 g	7	Neutral

Table 6: Overall Results of the Tests

Table 6 is the summary of all the tests conducted for the evaluation of solid perfume. Formula 1 has a prominent scent of Chrysanthemum, a cream-white color, and a solid consistency. The researchers found that it is homogenous. It has a breaking load of 181.86 g. Lastly, its pH level is 7. The second formula has a scent of wax (cocoa butter), a solid consistency, and a cream-white color. It was also homogenous. Its breaking load resulted in 120.11 g, which is basic as its pH level is 8. The last formulation, formulation 3, has a scent of mixed cocoa butter and Chrysanthemum; it has a solid consistency and a cream-white color slightly darker than the previous formulations. It is also homogenous. It has a breaking load of 154.56 g and is neutral, with a pH value of 7.

Conclusion

Based on the research that has been done, Chrysanthemum x morifolium essential oil can be formulated into stick perfume preparation. All the tests showed that all formulae can be used as perfume. The results suggest that Formula 3 is a better formula based on each test parameter. Formula 3 has a pH level of 7, which means it is neutral and homogenous; it has a strength test of 154.56 g. Its organoleptic test showed that it has a cream-white color, a solid consistency, and a mixture of Cocoa Butter and Chrysanthemum as its odor. Furthermore, Formula 3 has a firm solidity, cream-white tint, chrysanthemum, and wax odor. This is due to the variance in the formulation. Because of its odor, it can be concluded that it has the best formula. Since Formula 3 is homogeneous, no coarse granules are visible to the human eye. Because the formulation is homogeneous, the mixture has the same appearance and qualities. It can be concluded that wearing perfume prevents irritation. In addition, formula 3 has a strength of 154.56g, as there were no standard strength test values for solid perfumes, yet the researchers cannot compare and conclude whether the data gathered is excellent. Lastly, formula 3 has a pH level of 7, which is neutral. It can be concluded that the perfume will not cause any irritation to the consumers as it has a neutral pH level.

For future studies, other researchers may establish suitable measurements/formulations to employ in order to improve the quality of the perfume and the mass production of the chrysanthemum; also, the researchers advise pursuing the method of sun-drying for chrysanthemum drying and contrasting it with the approach of utilizing an oven to dry the chrysanthemum to ascertain which method is better. Lastly, a piece of equipment such as a microscope is used to test the homogeneity of the solid perfume to obtain an accurate result.

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