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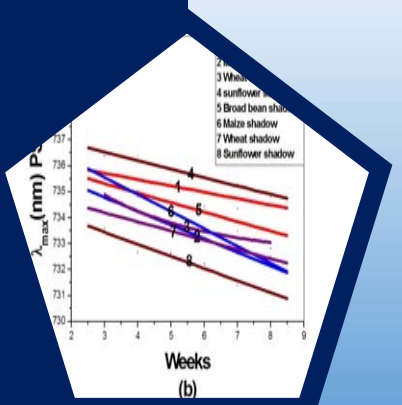

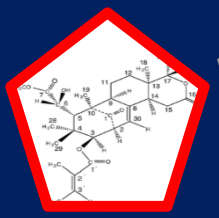

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Formulation Of Solid/Liquid Perfumes Of Essential Oils From Different Medicinal Plants

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ABSTRACT

Medicinal plants have played an important role in nearly every country. The plant extracts such as essential oils used since ancient based on their medicinal properties, industrial applications and as well as flavors and perfumes. This study aimed to extract essential oils from three medicinal plants namely; orange peels (*Citrus tangerine*), lemongrass (*Cymbopogon citratus*) and lime leave (*Cymbopogon citratus*). Then to analyse their chemical composition and finally to formulate perfumes from the essential oils. Microwave assisted hydrodistillation (MAHD) using Clevenger-type apparatus was used to obtain the oils. The chemical composition of the essential oils was analyzed by GC-MS. The yields were: 0.27%, 0.19% and 0.18% for lemongrass, lime and tangerine oil, respectively. Based on the results obtained, citral (39.76%) was the main compound in lemongrass oil, while limonene (92.22%) was the major component for tangerine oil. Nerol (17.87%) was the dominant component in lime oil. Fourteen products of solid perfumes were formulated from the three extracted essential oils using two solvents namely; ethanol and 2-propanol. The short survey was conducted on twenty-five respondents on the formulated products. The percentage of respondents choosing ethanol solvent was 56%, while those choosing 2-propanol solvent was just 44% only. Through the results from survey, it have been concluded that ethanol is the most preferred solvent in product formulations as compared to 2- Propanol. Thus, 2-propanol is not

recommended as solvent based on this research. In future, may warrant research on other solvents in order to compare with ethanol.

Keywords: Citrus tangerine, Citrus aurantifolia, Cymbopogon citratus, Essential Oils, MAHD, Solid Perfumes.

مستخلص

تلعب النباتات الطبية دوراً هاماً في كثير من البلاد. المستخلصات النباتية مثل الزيوت العطرية (الطيارة) قد استخدمت منذ القدم استناداً إلى خصائصها الطبية وتطبيقاتها الصناعية إضافة إلى إستخدامها كمنكهات أو فى صناعة العطور. هدفت هذه الدراسة إلى إستخلاص الزيوت العطرية من ثلاثة نباتات طبية ؛ وهى قشور البرتقال (**Citrus tangerine**) ، حشيشة الليمون (**Cymbopogon citratus**) و أوراق الليمون (**Citrus aurantifolia**). ومن ثم تحليل تركيبها الكيميائية وأخيرا لصياغة وتركيب عطور صلبه من الزيوت العطرية (الطيارة) . تم استخلاص الزيوت العطرية بطريقة التقطير المائى المدعوم بالميكروويف(**MAHD**) . تم تحليل التركيب الكيميائي للزيوت العطرية (الطيارة) بواسطة تحليل كروماتوغرافيا الغاز - مطياف الكتلة) (**GC-MS**. كانت ا نسب الزيوت هى: 0.27 ٪ ، 0.19 ٪ و 0.18 ٪ لزيت حشيشة اليمون والليمون واليوسفي ، على التوالي. وبناءاً على النتائج التي تم الحصول عليها ، كان السترال (39.76٪) هو المركب الرئيسي في زيت حشيشة الليمون ، بينما كان الليمونين (92.22٪) العنصر الرئيسي لزيت اليوسفي. كان نيرول (17.87٪) العنصر المسيطر في زيت الليمون. وقد تم صياغة أربعة عشر منتجا كعطور صلبة من الزيوت العطرية الثلاث باستخدام مذيبين هما ؛ الإيثانول و 2- بروبانول. قد تم إجراء مسح استطلاعى على خمسة وعشرين من المستجيبين على المنتجات المصاغة. كانت النسبة المئوية للمستجيبين الذين اختاروا مذيب الإيثانول 56 ٪ ، في حين أن أولئك الذين اختاروا مذيب 2 - بروبانول كان 44 ٪ فقط. من خلال نتائج المسح ، تم استنتاج أن الإيثانول هو المذيب الأكثر تفضيلاً في تركيبات المنتج مقارنة بـ 2- البروبانول. وبالتالي ، لا ينصح 2 - بروبانول كمذيب أو حامل عطرى على أساس هذا البحث. في المستقبل ، قد يتطلب مزيد من الأبحاث على مذيبات أخرى من أجل المقارنة مع الإيثانول.

الكلمات المفتاحية: البرتقال؛ حشيشة الليمون؛ الليمون؛ الزيوت العطرية (الطيارة) ؛ **MAHD** ؛ عطور صلبة.

1. INTRODUCTION

Medicinal plants have played an important role in nearly every country including Asia, Africa, Europe and the America. Normally the plant extracts such as essential oils are used since ancient based on their medicinal properties as well as flavors and perfumes (Fandohan et al., 2008). The orange peels (*Citrus tangerine*) and lime leaves (*Citrus aurantifolia*) came from the same genus *citrus* which are one of the medicinal plants. *Citrus* fruits have high production over 80 million tons per year and it is one of the most important horticultural crops. Their essential oils have important economic value although the fruits are mainly used for dessert. The usage of *citrus* essential oils is commonly as aroma flavor in food products, perfumery and cosmetic, and also flavoring agents to mask the unpleasant taste of drugs (Bourgou et al., 2012). *Citrus* essential oils have also several biological activities such as antimicrobial, antioxidant and anxiolytic activities (Hosni et al., 2010).

Lime *(C. aurantifolia*) is a polyembryonic species with greenish yellow, smooth surfaced, thin- skinned fruits. The volatile oil present was widely used as a flavoring agent in beverage and food products. In perfumery, lime volatile oils have been used as a base for many compositions which having higher market value than other citrus species such as grapefruit or tangerine volatile oils (Patil et al., 2009).

Lemongrass (*Cymbopogon citratus*) came from the genus of *cymbopogon* represents an important genus of about 120 species that are

cultivated on large scale and grows in tropical and subtropical area in the world. It possesses strong lemony odor due to its high content of the aldehyde citral. Lemongrass is a plant that contains 1 to 2% essential oil on a dry basis with widely variation of the chemical composition as a function of genetic diversity, habitat and agronomic treatment of the culture. *C. citratus* is commonly used for treatment of nervous and gastrointestinal disturbances, and as analgesic, anti-inflammatory, and diuretic (Hanaa et al., 2012). Medicinal plants from the genus of *citrus* and *cymbopogon* not only played roles in pharmaceutical industry but also in cosmetic product such as perfumes. Essential oils are composed of lipophilic substances, containing the volatile aroma components of the vegetal matter, which are also involved in the defense mechanisms of the plants. Nevertheless, components present in traces are also important, since all of them are responsible for the characteristic natural odor and flavor. Thus, it is important that the extraction procedure applied to recover essential oils from plant matrix can maintain the natural proportion of its original components (Fornari et al., 2012). The extracted oils not only contribute in flavoring ingredients but also as in the formulation of perfume industry (Rezzoug and Louka, 2009).

Perfume oils are not natural existing fragrances since it have artificial substances. This is because pure essential oils are very expensive but it has high effective uses as few drops of essential oils are necessary to achieve the desired effects. Essential oils are called the “notes” of the perfume and it is divided into three different notes which are base note, middle notes and top

notes. The base notes are the area whereby the smells will last longest on the skin. The top notes are the most volatile and disperse region. The middle notes are between the base notes and the top notes.

Due to the high cost of the essential oils, thus fewer amounts of oils are being extracted from the part of plants. Mostly essential oils are used in aromatherapy purpose which uses volatile plant material for altering an individual's mood and cognitive function. Therefore, the aims of this study were to extract essential oils from orange peels, lemongrass and lime leaves. Then to analyse their chemical composition and finally to formulate perfumes from each essential oil alone or in synergistic combinations to increase the efficiency and reducing amount of oil in the products.

2. MATERIALS AND METHODS

2.1 Plant Materials

The lemongrass (*C. citratus*) was bought from the wet market. Orange peels were bought from hypermarket Giant, Kuantan. Lime was collected from the plant garden located in Indera Mahkota, Kuantan.

2.2 Extraction of Essential Oils using Microwave Assisted Hydrodistillation

The essential oils were obtained by microwave assisted hydrodistillation **(**MAHD**)** in laboratory scale with controlled temperature and pressure. The plant materials of 100 g was subjected into a 2 L round-bottom flask then connected to the condenser tube and lastly attached to

Clevenger- type apparatus. Little amount of hexane (5 mL) is added into it to trap essential oils which extracted from the plant sample. The pressure was set to 300 W throughout the extraction processes. Two distinct phases should be obtained which is an organic phase (extracted oil) and an aqueous phase containing small part of oil. The duration of extraction is two hours and the percentage of essential oils is calculated based on the formula below (Mandana et al., 2011).

$$\text{Essential oils yield (\%)} = W_1 / W_2 \text{ X } 100$$

Where, W_1 = Net weight of oils (g)

W_2 = Total weight of fresh leaves (g)

The solvent removed from the oils and it was purged with nitrogen gas until the vials temperature same with room temperature. The organic layers (essential oils) are combined and labeled as "total oils". Then filter and the extracted oils are then dried over anhydrous sodium sulphate. The essential oils were kept in sealed vials until further studies.

2.3 GC-MS Analysis of Essential Oils

The GC–MS analyses was perform on a gas chromatograph HP 6890 (II) interfaced with a HP 5973 mass spectrometer (Agilent Technologies, Palo Alto, Ca, USA). A HP-5MS capillary column (30 m × 0.25 mm, 0.25 μm film thickness). The column temperature was programmed to increase from 60 to 325 °C at a rate of 5 °C/min. Helium acts as carrier gas with a flow rate of

1.2 mL/min. The quantitative analyses were based on the percentage of peak area of particular component. The injector and detector temperature are 250 °C and 265 °C respectively. The oven temperature was programmed between 60-340 °C at the rate of 4 °C/min. The column temperature is varying from time to time. Firstly, keep at 50 °C for 5 min then it was increased to 180 °C at a rate of 3 °C/min, and finally to 250 °C. The final temperature was maintained for 5 min. The oil constituents identified on the basis of their retention indices and mass spectral fragmentation by referring to those recorded in NIST library.

2.4 Products Formulation

The ingredients for the perfume formulation were essential oils, carrier oils, petroleum jelly or known as vaseline and solvent. The solvents used were ethanol and 2-propanol. Essential oils were orange peels, lemongrass and lime leaves oils. The solidifying agent used was 3 g of vaseline. The procedure to make perfume is first the vaseline was melted using 2 mL of ethanol with a little heat and when the content of the beaker is slightly warm, essential oils are added based on the sequences. Before the essential oils were added into the melted vaseline, the essential oil was homogenized with carrier oils using magnetic stirrer. The base note of essential oils should be added first followed by middle note and finally top note. The order in which the mixing process is significantly important as it will create different fragrance. As the mixture of essential oils and melted vaseline was homogenized, the liquid now was poured into a dark sealed

bottle and keep it away from heat and light. Then stored in a bottle and cooled to solidify. The process is repeated using different solvents and different mixing of the ingredients. The ratio of essential oils in all the product formulations was 1:1. Table 1, illustrated the way of mixing of different essential oils and solvents with vaseline at the same time.

Table 1: Formulation of perfume products by mixing of essential oils (125 µL each oil) and solvents with Vaseline

Solvent used	
Vaseline + Ethanol	**Vaseline + 2-propanol**
Orange peels	Orange peels
Lemongrass	Lemongrass
Lime	Lime
Orange peels + Lime	Orange peels + Lime
Orange peels + Lemongrass	Orange peels + Lemongrass
Lime + Lemongrass	Lime + Lemongrass
Orange peels + Lemongrass + Lime	Orange peels + Lemongrass + Lime

The percentage of essential oils in the formulated product was calculated in the following way:

$$\% \text{ (v/w) of essential oils in solid perfume} = \frac{Volume\ of\ essential\ oils\ used}{weight\ of\ vaseline\ used}$$

The same formula was applied in determining the percentage of essential oils or solvent contents in the formulated product. A survey was then conducted on 25 respondents which including male and female respondents

and the survey was about the comparison between the two different solvents used in the formulation.

3. RESULTS AND DISCUSSION

3.1 Yield of Essential Oil

MAHD and liquid-liquid extraction methods were performed at the controlled temperature and pressure in order to obtain the higher percentage yield of essential oils. The essential oils yield was calculated based on the net weight of oils (g). The yields were: 0.18, 0.19 and 0.27%, for *C. tangerine, C. aurantifolia* and *C. citratus,* respectively. Previous studies showed that the highest yield of *C. tangerine* was 2.95% (Sultana et al., 2012).. For *C. citratus* and *C. tangerine*, they showed a very pleasant and sweet smell as compared to *C. aurantifolia* which displayed unpleasant aroma. This is mainly because the major chemical constituents that present in each oil was different and that particular chemical components played very important roles in the production of aromas. As a result, the yield of essential oil extraction does not determine its qualitative analysis as the wt % of the yield is quantitative analysis.

3.2 The Chemical constituents of The Essential Oils

The essential oils from the three medicinal plants basically are the mixture of multi-components that containing different chemical constituents. Through GC-MS, the study of the chemical composition of the essential oils was determined by percentage area that being detected. There are 47 compounds being identified for all the three plants and tabulated in Table 2.

Different chemical constituents were present in different plants, but some compound present in all the three analysed essential oils.

Table 2: Constituents identified in the essential oils

Chemical components	**Retention time**	**Relative area (%)**		
		C. aurantifolia	***C. tangerine***	***C.citratus***
Sabinen	7.278	-	0.83	-
β-myrcene	7.885	1.32	-	4.70
Limonene	9.224	8.04	92.22	-
Ocimene	10.025	0.67	-	0.82
1-Octanol	10.929	-	1.13	-
Linalool	12.113	1.19	1.85	0.99
Alloocimene	13.367	0.30	-	1.91
4-Carvomenthenol	15.403	-	0.40	-
Citronellal	14.437	-	-	0.43
α-terpineol	15.982	0.25	0.42	-
Decanal	16.714	0.42	0.33	-
Citronellol	17.709	-	0.80	0.85
Nerol	17.801	17.87	-	-
Neral	18.247	1.05	-	26.71
Geraniol	18.968	13.03	-	4.12
Citral	19.552	1.57	-	39.76
Decyl chloroformate	19.626	-	0.30	-
Citronellyl acetate	23.128	0.17	-	-
Neryl acetate	23.597	0.56	-	-
Geranyl acetate	24.416	1.37	-	0.68
Elemene	24.673	3.35	-	-
Tetradecanal	25.411	0.55	-	-
Caryophyllene	25.732	-	-	0.48
Isocaryophyllene	25.749	6.11	-	-
Germacrene B	26.041	0.27	-	-
β-Ionone	28.484	0.94	-	-

Cadina-3,9-diene	28.678	-	-	0.19
Valencene	28.724	-	0.50	-
α-Selinene	28.787	0.57	-	-
δ-Cadinene	29.960	-	-	0.37
Nerolidol	31.557	0.38	-	-
Spathulenol	31.980	0.32	-	-
Caryophyllene oxide	32.180	3.01	-	-
Selina-6-en-4-ol	33.548	-	-	4.80
T- muurolol	34.412	-	-	0.59
α-Cadinol	34.870	-	-	1.30
α- Bisabolol	36.043	0.63	-	-
Heneicosane	36.958	0.28	-	-
Heptadecane	44.168	0.38	-	-
Isophytol	44.940	0.22	-	-
n-Hexadecanoic acid	45.484	0.91	-	-
Cyclohexadecane	49.112	0.30	-	-
Phytol	50.004	2.28	-	-
Heptacosane	51.927	0.21	-	-
Henicosyl formate	55.280	1.29	-	-
Hentriacontane	57.786	0.14	-	-
Total		**69.95%**	**98.78%**	**88.70%**

Table 2, revealed the identification of the chemical constituents of the three medicinal plants, which are *C. aurantifolia, C. tangerine* and *C. citratus*. The total percentages of the oils were 69.95%, 98.78% and 88.70%, respectively. As shown in Table 2, orange peels showed the most abundant chemical constituents as compared to the other two oils. This indicated that

the orange peels contained highest number of active ingredients. The active ingredients revealed the aromas of the particular plants. In this research, active ingredients were targeted because it holds important roles in producing either pungent or sweet aromas of the oils. The compounds obtained in all the three oils are in agreement with the results from previous studies. Citral was the major compound in *C. citratus* oil which showed the highest relative area of 39.76% from the overall constituents. Kumar (2010) reported that the two main chemical constituent in the *C. citratus* oil were citral and linalool. Meanwhile, Moncada et al. (2014) conveyed that the two main constituents in *C. citratus* plant were citral and myrcene.

Citral is a pale yellow liquid with strong lemon odour. Chemically, citral is a mixture of two aldehydes that having the same molecular formula but different structures (isomers). In current study, the major chemical constituents present in the lemongrass were citral, neral, myrcene, geraniol and selina-6-en-4-ol. The other minor constituents such as linalool, citronellol, citronnelal and geranyl acetate also present in the oil sample, but in the small amounts. The chemical compound, neral is the second major constituent and it covered about 26.71% from the total constituents. These two compounds, citral and neral representing about ≈ 66% of the total oil extracts. Comparing these results with those in the literature, it displayed some different in the major constituents of the *C. citratus* essential oil. The reasons behind might be due to the difference in geographic origin of the lemongrass and the weather which leads to the humidity of the soil changes

from time to time. The nutrients absorb by the lemongrass plant from the soil might alter the chemical constituents present later on.

For the *C. tangerine* essential oil, the major constituent was limonene and represent about 92.22% from the total oil content. This compound is one of the active ingredient that contributing to the sweet smell of orange generally. This is supported by the results obtained from the previous studies. Abyaneh et al. (2009) and Nuñeza et al. (2013) reported that limonene compound was the major ingredient in *C. tangerine* oil. Based on literature review, limonene stands about 96.62% from the total chemical constituents. Previously reported that, myrcene was the second major constituent for orange peels essential oils. The second major constituent for current study was linalool, which occupied area of 1.85%. Both limonene and linalool were present in *C. tangerine* oil. Linalool compound basically is a colorless liquid with soft and sweet odour. One of the minor constituents that detected in current study from *C. tangerine* oil was citronellol, which stands about 0.80%. Again based on previous researcher, there is no citronellol in their results obtained but there was citral present (Abyaneh et al., 2009; Nuñeza et al., 2013). However, it was in low percentage as compared to limonene which surrounds the whole constituents.

As in *C. aurantifolia*, there are many compounds acting as active ingredient, but the area percentages of each component is not as high as compared to lemongrass and citrus peels oils. The main component present was nerol which carried the percentage of 17.87% from the overall

constituents. However, there was no nerol component present in previous studies. The major compounds present in current study were nerol and geraniol, which covered the concentration of 17.87% and 13.03%, respectively. Geraniol can be extracted from the petals of various roses (Antonious and Korchar, 2003). Previous study reported that geraniol is an aliphatic alcohol in the essential oil of various plants. Geraniol compound used to repel insects as one of its function. It also used in perfumery industries. The color of geraniol is colorless but the oil extracted from lime was yellowish green, the color appeared might due to nerol since nerol contributes higher relative area compared to geraniol compound.

Previously, studies showed the major component in lime oil was limonene which carries 85.5%. Specifically, there is one compound that exists in all studied plants which is linalool. This compound can be obviously perceived that it is more common than other chemical constituents. Although the relative area of this component was low but it was one of the active ingredient for all the three medicinal plants. Thus, its medicinal value should be concerned in which might contribute to flavoring and perfumery industries.

3.3 Perfume (Solid) Products Formulation

Solid perfume is a solid cream which gives the cream base comes from a type of wax. The wax can be paraffin wax, beeswax and vaseline. These wax acts as solidifying agent which will form solid after cooled down. Generally the wax was initially melted. Once melted, a scent or several scents

were added until the cream base reaches the desired consistency. Solid perfume is mainly depends on the essence of the essential oils. Essential oils extracted from natural sources are very expensive and the economic value of essential oils increases because the yields of the oils are very little. Thus, it has high values as compared to other oils. Through the formulation process, fourteen products have been formulated using the three types of essential oils with two solvents namely; ethanol and 2- propanol. These two variables make this formulation possible for the whole research.

The amount of essential oils used in each product was the same, but the difference is just the way of mixing between the pure essential oils. Fixed amount of essential oils have been used because by fixing the oil amount, comparison between the two solvents only can be conducted. Although carrier oil was involve directly in this formulation, but it was not the active ingredient in the solid perfume. Thus the percentage of carrier oils was not concerned as much as the active ingredients. The active ingredients in the solid perfumes were essential oils and solvents only. The main concern in making the solid perfumes was the percentage of active ingredient (essential oils) in solid perfumes. The percentage calculated was in (v/w%), because the weight of the solidifying agent, vaseline was fixed. The amount of essential oils was fixed as stated earlier which 0.125 mL and the weight of vaseline used was 3 g for all product formulations. It was separated into three parts of formulations. For the first part is the formulation of the pure oil from each,

without the mixing with other essential oils. In these formulations, every pure essential oils products having 4.17% of essential oils in the solid perfumes. For the pure products, the fragrance of the product is the original essence without any side fragrance other than the smell of the pure oil. By using the same formula, the percentage of essential oils in mixing can be calculated as well. For the second part of formulation, it involved the mixing between two different essential oils (0.125 mL for each). In these formulations the products containing 8.33% of essential oil from the total constituents. For third part of formulation, it involved the mixing of three different essential oils (0.125 mL each) in the products.

Third part of formulation of products contains 12.5% essential oils in the product. The concentration of essential oils from first part to third part of formulations getting increases because the essential oils involved were getting more. For both second and third parts of formulation the essence of the products were altered slightly due to the mixing of the essential oils. This formulation have another active ingredient which is the solvent used in the product formulation. Ethanol and 2- propanol were used in altering the essence of the essential oils in the products. The same formula was applicable to determine the percentage of solvents in the product.

$$\% \text{ (v/w) of ethanol in solid perfume} = \frac{Volume\ of\ solvent\ used}{Weight\ of\ vaseline\ used} \text{ x } 100\%$$

$$= \frac{2mL}{3g} \text{ x } 100\% = 66.67\ \%$$

The percentage of ethanol in solid perfume was 66.67% as calculated. The same calculation is applied to 2- propanol solvent. Based on the calculations shown, the essential oils which act as one of the active ingredient show lower percentage as compared to the solvent used in the product formulation. The concentration of essential oils is lower because high concentration of essential oils might causes irritation to skin. Thus, it has to be in low percentage as compared to the solvent used. The solvent, ethanol is a colourless liquid with a pleasant smell, while 2- propanol is also a colourless liquid with pungent smell. However, the aroma of the essential oils was not destroyed by the solvents used. The solvent is used to compare the essence of the products that have been formulated. Figure 1, displayed the formulated product of essential oils from three medicinal plants. It also includes the formulation with different solvents.

Figure 1: Formulated products from essential oils and different solvents

Survey on the formulated products

A survey was conducted on the students of University Malaysia Pahang on the formulated products. The total of 25 students had been selected as respondents towards the products. The respondents involved were in multi-races and different gender as well. The purpose of the survey is to determine the solvents that majorities preferred in the sense of fragrance. The survey is very important in the determination of the market of these products. The total of 14 formulated products had been tested on the students. The survey result was tabulated in Table 3.

Table 3: Survey on the formulated product

Solvent used in product formulation	Students involved in survey		Total students
	Male student	Female student	
Ethanol	4	10	14
2- propanol	6	5	11
Total			25

As displayed in Table 3, the analysis of data was separated into two parts in which the result from the male and also the female students, between the two solvents used. From the survey, male students preferred the products formulated with 2-propanol while female students choose ethanol solvent as the priorities. Figure 2 shows the results obtained from the number of student choosing the preferred solvents.

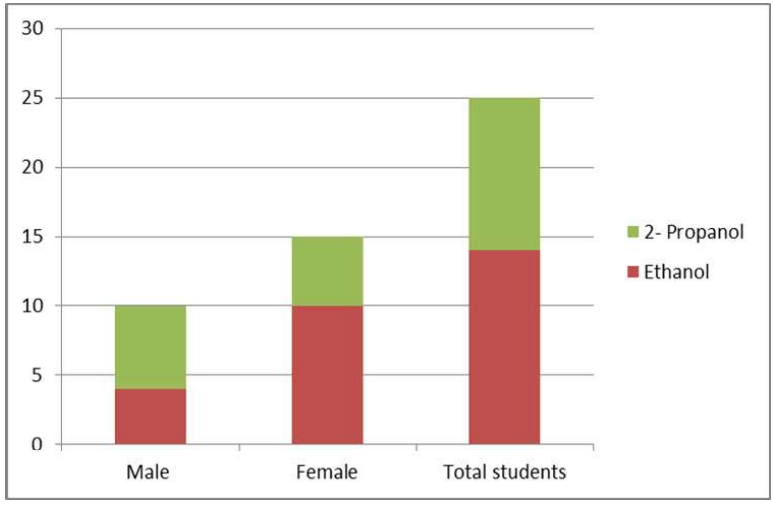

Figure 2: Survey from the formulated product

However, the percentage of students choosing ethanol solvent was higher than that of 2- propanol. The reason might due to the original smell of 2-propanol which is pungent essence as compared to ethanol having pleasant essence. The difference between the choice between male and female were because female generally have more sensitive smell receptors than male. Thus they act differently in choosing the preferred solvent used in the formulations. The percentage of the respondents towards this survey was shown in Figure 3. Majority of them choose ethanol as preferred choice in solvent in the formulation of 14 products in total. About 56% of respondents choose ethanol while only 44% of respondents preferred 2-propanol as solvent.

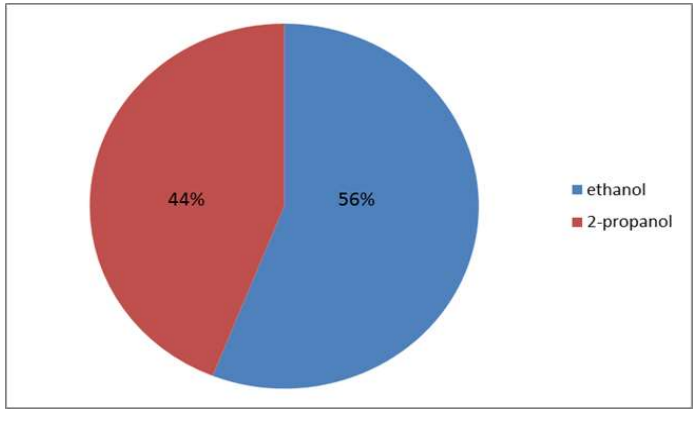

Figure 3: Comparison of percentage of respondents in choosing solvents

4. CONCLUSION

In conclusion, the yields of the essential oils were higher in *C. citratus* (0.27%) followed by *C. aurantifolia* (0.19%) and *C. tangerine* (0.18%). The chemical components from the extraction are identified using GC-MS. The totals of 47 chemical constituents were determined through the three essential oils. From GC-MS data sheet, the major component that giving out the essence of the plants were citral in lemongrass, limonene in tangerine oil and nerol in lime essential oils. Maybe different method of extraction will produce different types of compounds in terms of quality and quantity, hence may use different methods to compare the results. Based on the active compounds in oils the product formulation was carried out using different way of mixing and formulation. The percentage of active ingredients in the solid perfumes varied from first part of formulation to third parts of formulation. The first part of formulation (pure oil) showed 4.17% of essential oils in the solid perfume while for second and third parts of formulation; showed 8.33% and 12.5% of essential oils, respectively. The same calculation goes to the solvent percentage in the solid perfume which occupied about 66.67% from the total constituents. A short survey on 25 respondents was then conducted on the product formulation and the result was promising.

Conflicts of interest

The authors declare no conflicts of interest.

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