Inhalation of Orange Peel Aroma: Study on the Effects of Exotic Oils on Blood Pressure Changes

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Abstract

Oranges are a fruit that is in great demand by the public. Oranges have a sweet taste and distinctive aroma. Orange peel debris is one of the problems that is of concern to the government. This is because there are still many people who do not use it and just throw it away. This is because many people still don't know that orange peel waste contains the active substance d-lemonene. The d-lemonene compound is a compound that has a fragrant and refreshing aroma, so it can provide a calming feeling to those who inhale it. Therefore, this study aims to see the effect of the fragrant aroma of raw orange peel extract on changes in blood pressure. The extraction method used is steam distillation in order to maximize the yield obtained. After obtaining the raw extract, it was characterized using Gas Chromatography Mass Spectrometry (GC-MS) to determine the skin content. The research results showed that the yield of orange peel extract calculated based on the volume of extraction results divided by the sample weight in grams was 20% (v/w). Based on the results of Gas Chromatography Mass Spectrometry (GC-MS) characterization, it shows that the sample contains the compound d-lemonene. The effectiveness test showed a decrease in blood pressure in respondents who had high blood pressure and an increase in pressure in respondents who had low blood pressure. The reason is that the d-lemonene compound contained in orange peel can provide a calming sensation. This can happen because the d-lemonene compound is able to inhibit neuroinflammation and nitrite levels in the hippocampus and relieve anxiety through DAergic and GABAergic nerve activity mediated by A2A receptors.

Keywords: Blood Pressure, Essencial Oil, Orange Peel

INTRODUCTION

Many people in Indonesia have high blood pressure, but some have low blood pressure. The prevalence of hypertension in Indonesia has increased based on interviews (ever diagnosed and taking hypertension medication) from 25.8% in 2013 to 34.1% in 2018 (Subantara et al., 2022). Hypertension is abnormally high blood pressure measured at different times. It is known that nine out of ten people with hypertension cannot be identified as the cause of the disease. There are three important factors that aggravate hypertension, namely low patient compliance with non-pharmacological or pharmacological treatments, therapeutic/doctoral inertia, and a lack of health care systems in their approach to chronic diseases (Burnier et al., 2021; Williams et al., 2018). This is why hypertension is also called a silent killer (Sawicka et al., 2011). Its becsiause a person can have hypertension for years without realizing it until severe damage to vital organs occurs (Putra, 2022; Siwi et al., 2020). Management of hypertension can be done pharmacologically and non-pharmacologically. Non-pharmacological methods such as aromatherapy aim to lower blood pressure (Fadlilah et al., 2020; Roswita et al., 2022).

One of the aromatherapies that can be used is an extract from orange peel (Citrus sinensis). Orange peel is an organic waste whose utilization has not been maximized, even though the extract in orange peel has various benefits (Kohli et al., 2024; Marfu'ah et al., 2020; Zaki et al., 2024).The aroma derived from orange peel extract can stimulate the thalamus, which provides a calming effect and reduces the vasoconstriction activity of blood vessels, thereby lowering blood pressure (Fadlilah et al., 2020; Kaswindiarti et al., 2021; Lorigooini et al., 2021). Orange is one of the fruits found in Indonesia, and has the scientific name Citrus sinensis. The chemical content in sweet orange peel is saponins, tannins, flavonoids, and triterpenoids (Kaswindiarti et al., 2021; Song et al., 2021; Udayani et al., 2023). Sweet orange peel has a distinctive aromatic odor and bitter taste, It contains 90% volatile oil and contains limonin, hesperidine glucoside, isohesperinda, aurantiamarina, and resin (Baroroh et al., 2021). Flavone compounds in oranges include limonene, lonalol, linalil, and terpinol, which function as sedatives (Chiu et al., 2024; Pagliaro et al., 2023). Limonene in natural plant essential oils is mainly dominated by D-limonene, which is widely found in orange skins and other fruits as a plant biomarker of volatile organic compounds with a content of up to 80% or more(Araújo-Filho et al., 2020; Chen et al., 2019; Eddin et al., 2021). So it is suitable for people who have high or low blood pressure. Many people do not realize that they have high blood pressure or low blood pressure (Roswita et al., 2022).

Previous research shows that aromatherapy can reduce blood pressure in hypertensive patients (de Sousa et al., 2023; Hien et al., 2022). The effect of giving aromatherapy to hypertensive patients and obtained data on the average decrease in blood pressure from 121.04 to 113.02 (Sulyanti et al., 2019). Systolic blood pressure before the administration of lemon peel extract aromatherapy (Citrus limon) was 148 mmHg, and the average diastolic blood pressure before aromatherapy was 91 mmHg. The average systolic blood pressure after aromatherapy was 141 mmHg, and the average diastolic blood pressure after aromatherapy was 87 mmHg (Putri et al., 2020). Data on the decrease in blood pressure of hypertensive patients from 150/100 mmHg to 120/80 mmHg by administering rose aromatherapy (Mahendra et al., 2021). According to this data, we are interested in seeing the effectiveness of aromatherapy from orange peel extract (Citrus sinensis) by inhalation through the administration of inhalers and diffusers on changes in blood pressure (Nakamura et al., 2023; Vora et al., 2024).

METHODS

This research uses an experimental research design with a pre-experimental design that uses a pretest-posttest design for respondents. Experimental research was carried out by making essential oils.Orange peels were washed using running water, then cut into 2 cm cubes. Then it is dried under the sun until the water content is reduced. Furthermore, the dried orange peel (simplisia) was extracted using the maceration method. The solvent used is ethanol p.a using a ratio of 1:5 for 3 days. The orange peel essential oil obtained was then added to anhydrous Na2SO4 and filtered with a Buchner funnel until essential oil was obtained. Then it was evaporated with a rotary evaporator to get a concentrated extract. The extract was analyzed by GC-MS to see the compounds contained in the extraction results.

The effectiveness test was carried out in the TLM Department in September 2023. EC approval (ethical clearance) was obtained with number 01.75.183/KEPK/POLTEKKES KEMENKES MEDAN 2023. The essential oil obtained was then tested for effectiveness. Respondents were selected randomly, involving 30 respondents. The administration of aromatherapy was carried out for 10 minutes by measuring blood pressure before and after treatment. (Adetuyi et al., 2024; Patterson et al., 2021).

RESULTS

Based on the results of the research that has been done, orange peel extract is made using the steam distillation method. Orange peel samples are dried first using an oven and pureed, then distilled using ethanol p.a solvent with distilled water in a ratio of 1:5 until a crude extract is obtained . After obtaining the crude extract, it was then characterized using GC-MS. Figure 1 is a chromatogram of the crude extract of orange peel.

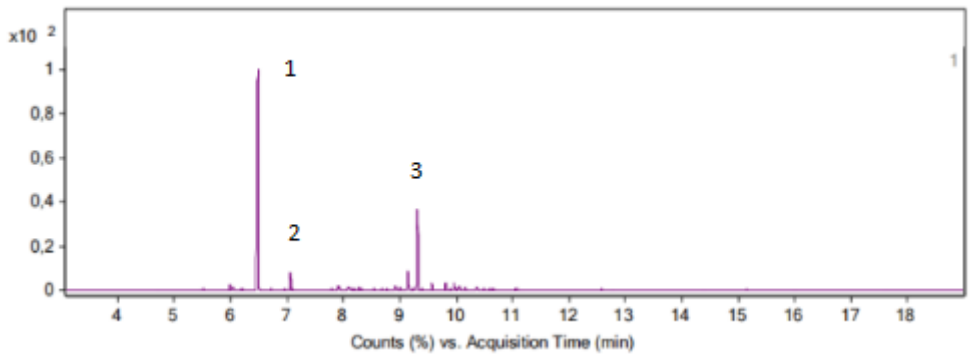

Figure 1. GC-MS result

There are three peaks that indicate the presence of three kinds of compounds in the crude extract of orange peel. Chromatogram 1 has a retention time (Rf = 6.482 minutes;

chromatogram 2 has an Rf = 7.060 minutes; and chromatogram 3 shows a retention time of 9.313 minutes.

Blood pressure measurements were taken on 30 respondents for the inhaler and 30 respondents for the diffuser. The results of blood pressure measurements are shown in Table 1.

Table 1. Blood Pressure Analysis Results

No	Description	Inheller (pretest) (mmHg)		Inheller (posttest) (mmHg)		Diffuser (pretest) (mmHg)		Diffuser (posttest) (mmHg)	
		S	D	S	D	S	D	S	D
1	Lowest score	93	60	85	66	75	61	84	64
2	Highest score	135	109	120	91	140	95	116	86
3	Mean	119,9	79,9	103,7	75,5	110.3	78,8	100,8	73,2
4	Median	122,5	80	104	75,5	109,5	78	100	73
5	Standard deviation	12,55	9,18	8,45	4,99	15.1	8,47	8	5,4

Description:
- S (Systolic)
- D (Diastolic)

Based on Table 1, the systolic blood pressure (S) with treatment using an inheller, which was 135 down, changed to 120 mmHg. The same results were shown with the use of a diffuser; the respondent with the highest blood pressure decreased from 140 to 116 mmHg. Likewise, diastolic blood pressure, both in the use of inhalers and diffusers, also decreased.

Table 2. Normality and Homogeneity Test Results

		TDS-G-D	TDD-G-D	TDS-G-I	TDD-G-I
Normality Test	Test Statistic	0.109	0.085	0.095	0.099
	Asymp. Sig. (2-tailed)	0.072	0.200	0.200	0.200
Homogeneity	F hitung	5.562	6.570	4.508	4.969
Test	P (sig)	0.022	0.013	0.038	0.030

Description:
- TDS_G_D (Combined Systolic Blood Pressure Using a Diffuser)
- TDD_G_D (Combined Diastolic Blood Pressure Using a Diffuser)
- TDS_G_I (Combined Systolic Blood Pressure Using an Inheller)
- TDD_G_I (Combined Diastolic Blood Pressure Using an Inheller)

Based on the results of the normality test and homogeneity test, it is known that the blood pressure measurement data both before and after treatment are normal and heterogeneous. According to table 1, obtained from measuring blood pressure with the use of

inhellers, as many as two respondents experienced an increase in blood pressure. The increase in blood pressure from 95/60 mmHg to 97/76 mmHg and 96/64 mmHg to 99/68 mmHg.

DISCUSSION

The mass spectrum is shown in the form of peaks recorded in the recorder in bar graph form. The fragments of compound 1 were arranged such that the peaks were organized by increasing m/e from left to right in the spectrum. The peak intensity is proportional to the relative abundance of the fragments, which depends on their relative stability. The highest peak is called the base peak and is assigned an intensity value of 100%. According to the literature study, the base peak of the crude extract shows the same retention time as the base peak of the D-Limonene compound (Erba et al., 2020).

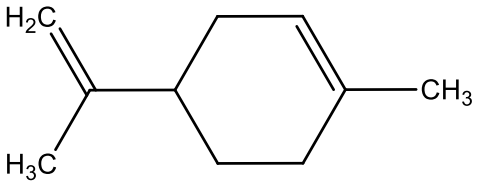

Figure 2. d-lemonene structure

The compound D-limonene is the main component of the aromatic scent and characteristic of orange peel. This shows that it is true that the characterized compound is an orange peel extract (97%) (Chiu et al., 2024). D-limonene has a structure as shown in Figure 2, which has three methyl groups. After being characterized and proven to contain d-limonene, further tests were carried out to determine its effectiveness on blood pressure. Essential oil is then packaged in an inhaler and diffuser with added distilled water (Dehghan et al., 2022a). Blood pressure measurements were carried out on 30 respondents for the inheller and 30 respondents for the diffuser, which are presented in Table 1 for the inheller and Table 2 for the diffuser.

Based on table 1, it is known that there are changes in blood pressure, both increase and decrease. This can be seen in respondents 008 and 009 respectively who experienced a decrease in blood pressure from 135/81 mmHg to 117/81 mmHg and 134/109 mmHg to 104/91 mmHg (inheller). This is in line with research conducted which showed a decrease in blood pressure from 138/85 mmHg to 123/75 mmHg (Soraya et al., 2014). This suggests that aromatherapy can provide a sense of calm by inhibiting neuroinflammation and nitrite levels in the hippocampus and relieve anxiety through A2A receptor-mediated DAergic and GABAergic neuronal activity, both of which have been shown in animal studies (Lorigooini et al., 2021; Song et al., 2021). So it can be seen that essential oil has a d-limonene compound that is proven

to be able to become aromatherapy or has an odor that can relax respondents (Dehghan et al., 2022b). The same research results were also shown in research conducted that aromatherapy from sweet orange peel could relieve anxiety, thereby making respondents relax (Goes et al., 2012). Similar results were also shown that research which showed that extracts from orange flowers were able to have a calming effect on premenstrual syndrome (Heydari et al., 2018). However, the effect of essential oil on blood pressure can be seen from the decrease in blood pressure in respondents who have high blood pressure and an increase in respondents who have low blood pressure.

The same thing happened when a diffuser was used. Especially shown in respondent 001, namely 140/85 mmHg to 112/77 mmHg, and in respondent 004 137/76 mmHg to 94/74 mmHg. This is in line with the study, which showed that there was a decrease in blood pressure from 135/92 mmHg to 119/77 mmHg by using orange aromatherapy inhaled in a diffuser (Carlsson et al., 2021). This may be because the aroma produced by essential oils can stimulate the nasal nerves and brains of respondents so that they become calmer. When inhaling essential oil vapor, the aroma will enter the nasal cavity and stimulate the nervous system in the brain, which plays a role in regulating emotions.

CONCLUSIONS

The essential oil obtained from distillation h]as a yield of 4%. The GC-MS characterization results proved that the distillate contained the compound d-limonene (chromatogram 1). The essential oil produced has a characteristically sweet and soothing citrus aroma. The effectiveness test shows that essential oil from orange peel is able to provide a relaxing effect and has the ability to lower and raise blood pressure in respondents.

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