J. Pijar MIPA, Vol. 18 No. 5, September 2023: 783-787 ISSN 1907-1744 (Print)
DOI: 10.29303/jpm.v18i5.5418 ISSN 2460-1500 (Online)

ACTIVE COMPOUNDS OF C*itrus hystrix* DC IN SPECIAL CUISINE OF THE SAMAWA TRIBE, WEST NUSA TENGGARA

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Received: July 21, 2023. Accepted: August 30, 2023. Published: September 30, 2023

Abstract: The people of Sumbawa are famous for their various typical Sumbawa dishes. Typical dishes popular among the people and widely known in NTB are sepat and salty chili dishes. This dish is inseparable from flavoring *Monte Sumbawa*. Additional types of food, such as anointing, are also indispensable for *Monte Sumbawa*. *Monte Sumbawa* is a type of kaffir lime *citrus hystrix* DC that grows in the Sumbawa area. Consumption*monte sumbawa* is very high in all areas of Sumbawa. This research aims to meet the community's needs and not depend on the fruiting season—innovation in essential oil distillation and packaging monte *sumbawa* in packaged products. The research method uses laboratory experiments. The content of active compounds was obtained using the GC-MS method. Based on the results of the GC-MS test, the active compound contains the major compound, linalool, with a weight percentage of 57.8%. Oil contains minor compounds such as 1-Octadecene (CAS).alpha.-Octadecene, 3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)- (4)-Ter , TRANS(.BETA.)-CARYOPHYLLENE, and GERMACRENE-D. Active compounds play an active role in supporting the health of the human body and as a detox against various cancer-causing free radicals. The product is packaged in a dropper bottle which is easy to use and can be stored for a long time. Society can use Monte anytime and no longer depend on the fruiting season.

Keyword: *Citrus hystrix* DC, *Active Compound, Special Cuisine, Samawa Tribe*

INTRODUCTION

The current trend of using compounds in essential oils to support antibiotic therapy is becoming increasingly popular. *Monte Sumbawa* is a species of kaffir lime *citrus hystrix* DC. This fruit grows a lot in various areas in the Sumbawa region, such as Pemulung Village, Bukit Permai, Moyo Island, and other areas in Sumbawa. Kaffir lime essential oil contains many active compounds that play an important role in the human body. Profile of the active compounds of essential oils*Citrus hystrix* DC includes limonene, β-pinene, terpinene-4-ol, B-pinene (47.926%), D-limonene (24.121%), citronellal (11.84%), and α-pinene (2.834%), sabinene, and citronellol [1-2]). The content of active compounds in kaffir lime extract can act as a potential anti-diabetic, anti-hyperlipidemic, and anti-obesity, as well as preventing the development of hypertension [3-5]. These substances are important when supplied to the human body.

The people of Sumbawa are famous for their various special dishes using monte *sumbawa Citrus hystrix* DC. It causes a very high need for *Monte Sumbawa*. Continuous need and condition of fruit unavailable anytime is problematic for kaffir lime users. Another problem is *Monte Sumbawa* can only be stored for a short time. The fruit is perishable, and when stored in the refrigerator, the fruit dries out. Of course, this will affect the availability of flavoring (essential oil) in the fruit *monte*.

Kaffir lime fruit spoils easily and dries up in long-term storage in the refrigerator. According to information from one of the residents of Sumbawa, people still use monte skin even though it has dried. *Monte* dry pulverized in the chili paste. A lack of essential oil will affect the taste and increase the amount of Monte used. Conditions like this could be better for the user and greatly affect the dish's taste.

Development of natural flavoring products, *Monte Sumbawa*, can overcome society's problems as users. Products can be used anytime and anywhere. Products can be stored in the refrigerator without reducing the volume of essential oils. Essential oils are packaged in glass dropper bottles that are non-reactive (do not affect taste) and easy to use. Society can use Monte in a few drops, like when squeezing monte sumbawa water.

RESEARCH METHODS

This research is laboratory experimental research. The research sample is Monte Sumbawa, used as a spice in typical dishes. Essential oils are isolated from fresh fruit and packaged in a practical packaging. Isolation and packaging procedures can be seen in the figure below [6-7].

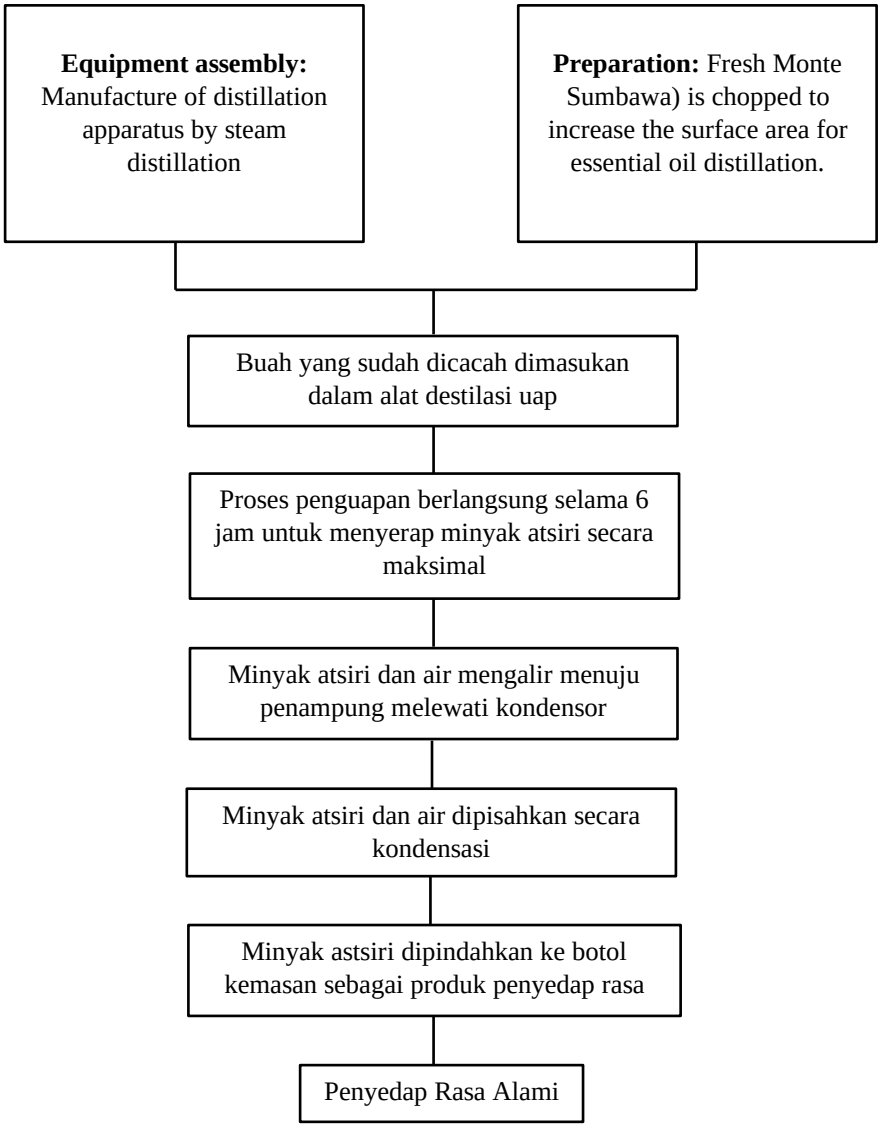


Figure 1. Process flow diagram for the isolation of Monte Sumbawa essential oil

Sample preparation

The research sample is the fresh fruit of Monte Sumbawa. The fruit is separated between the skin and the fruit flesh. The fruit's skin is chopped into a smaller surface to facilitate the evaporation of essential oils along with water vapor.

Preparation of steam distillation apparatus

The distillation process uses the steam distillation method. This method is used for volatile essential oils. The assembly of the steam distillation apparatus can be seen in Figure 1. The connections on the distillation apparatus are tight to prevent gas or steam leaks.

Figure 1. Steam distillation toolset

Essential oil distillation process

A fine sample of fresh fruit skin is put into the sample holding flask. The solvent is added to the flat flask. Heating using a hot plate. The heating process is at a high temperature of about 100^{O}C until

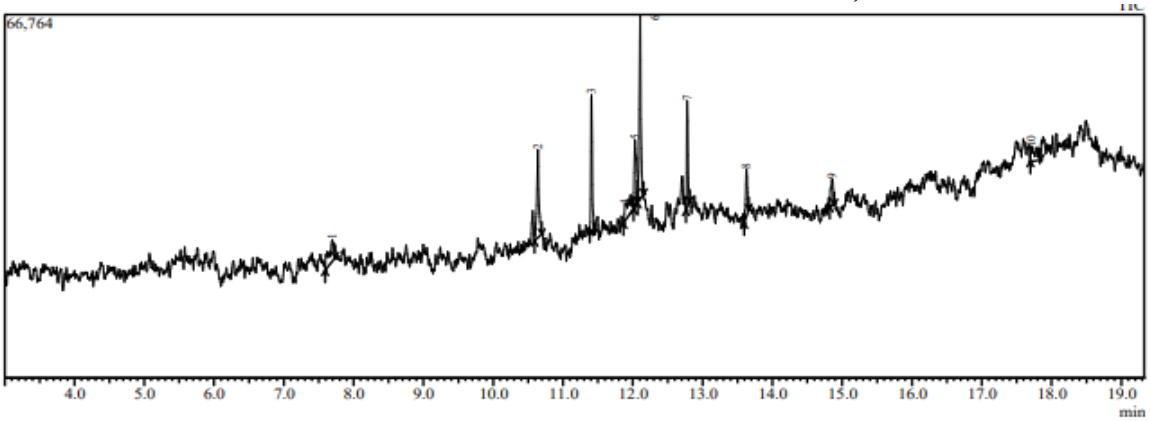
the water solvent boils. Water vapor from the flask flows into the sample tube. Hot water vapor will encourage the process of evaporation of essential oils. Evaporated oil flows with water vapor to the condenser. The water vapor and essential oils melt again and flow toward the yield reservoir. Essential oil and water vapor are separated and collected in sample bottles.

Testing the active compound content

The 2 test samples are essential oil samples and boiling water in flat flasks. The essential oil in the sample bottle is separated by 1 ml into the test bottle. The content of active compounds in essential oils was tested using the GC-MS method. Data from the test results were processed and analyzed for the percentage of dominant compound content.

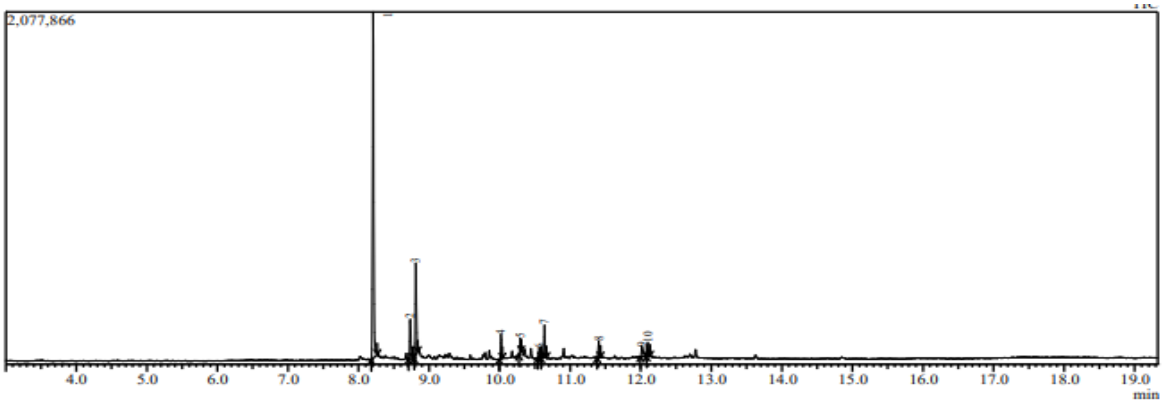
RESULTS AND DISCUSSION

Plants contain active components of secondary metabolites. Monte sumbawa contains active compounds from roots, stems, leaves, and fruit. This study examines the active compounds in the skin of the Monte Sumbawa fruit. Fresh fruit peels contain essential oils. The distinctive aroma of essential oils is often used as a distinctive aroma in the typical dishes of the Sumbawa people. Typical food is fast consumed for generations by people. This behavior supplies nutrients to the human body. Active compounds can be natural antioxidants in maintaining the human immune system. Compounds in the essential oil of Monte Sumbawa based on the results of the GC-MS test can be seen in Figure 3 and Figure 4. The active compounds of terpenoids and polyphenols that are the focus of the study are linalool, 1-Octadecene (CAS). alpha.-Octadecene, 3-Cyclohexen-1- ol, 4-methyl-1-(1-methylethyl)-(4)-Ter, TRANS(.BETA.)-CARYOPHYLLENE, and GERMACRENE-D.



Peak	Area %	Height %	Name
6	20.08	26.10	1-Octadecene (CAS) .alpha.-Octadecene
3	13.77	19.36	1-Octadecene (CAS) .alpha.-Octadecene
2	12.88	12.43	1-Hexadecene (CAS) Cetene
5	11.63	9.46	9-Octadecenoic acid (Z)- (CAS) Oleic
7	9.61	15.11	1-Octadecene (CAS) .alpha.-Octadecene

Figure 3. GC-MS test results of monte sumbawa water extract



Peak	Area %	Height %	Name
1	57.71	57.80	Linalool
3	15.51	15.40	3-Cyclohexene-1-methanol, .alpha.,.alpha.,4-trimethyl- (CAS)

2	6.68	6.58	3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)- (CAS) 4-Ter
4	3.40	4.03	TRANS(.BETA.)-CARYOPHYLLENE
5	2.06	2.41	GERMACRENE-D

Figure 4. GC-MS test results for Monte Sumbawa essential oil

Dominant Active Compounds

Linalool (2,6-dimethyl-2,7-octadien-6-ol) or monoterpene alcohol is an octa-1,6-diene compound substituted by 3,7-dimethyl and 3-hydroxy. Terpene compounds contribute to correlating their chemical composition with pharmacological effects [8]. Linalool in Monte Sumbawa essential oil is the dominant compound with a height percentage of 57.8% (figure 4). Linalool has comprehensive bioactive properties such as anti-microbial, anxiolytic, anti-stress, lung protective activity, anti-inflammatory and anti-cancer. Linalool induces apoptosis of cancer cells through oxidative stress and, at the same time, can protect normal cells [9-11]. The protective effect of linalool on the liver, kidneys, and lungs is due to its anti-inflammatory activity.

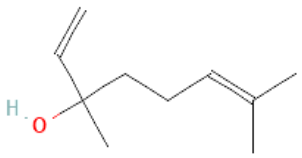


Figure 5. The structure of the linalool compound

1. Anti-microbial

Linalool interferes with the normal morphology of cells causing damage to membrane integrity. *aeruginosa* and *P. fluorescens*. This ability proves that linalool can be a food preservative by damaging cell membranes, disrupting metabolism, and interfering with cellular functions resulting in microbial cell death [12-13].

Linalool (0–2.0 mM) inhibited cell proliferation and A549 lung adenocarcinoma cell migration. The antioxidant properties of linalool increase the production of reactive oxygen species in inhibiting cell growth and depolarizing the mitochondrial membrane potential [14]. Cell damage causes leakage of intracellular components (AKP, proteins, nucleic acids, and ions). This test was carried out on the Brochothrix thermosphacta (B. thermosphacta) bacteria in the curing process of cold beef [15].

2. Antifungal (antifungal)

One of the causes of easy rot in fruit and plant pests is fungus. Fusarium oxysporum f. sp. radicis-lycopersici (Forl) is a phytopathogenic fungus that causes damage to fusarium crowns and tomato roots. Linalool inhibits mycelium growth, depletes glutathione, and reduces the activity of many antioxidant enzymes, downregulating primary metabolite biosynthetic pathways [16]. Overall, linalool significantly reduced the expression of many Forl pathogenic genes so that it can be used as a fungicide and agent of green *chemistry*.

3. Anti-Cancer

Linalool has apoptotic and antiproliferative properties by killing apoptotic cells in human breast cancer cells (MCF-7 and MDA-MB-231) and cancer cell 22Rv1 human prostate by reducing expressions of Ki-67 and PCNA [17-18].

Senaya Active Minor

Minor active compounds also have an important role in Monte Sumbawa essential oil. Minor active compounds include 1-Octadecene (CAS).alpha.-Octadecene, 3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)- (4)-Ter, TRANS(.BETA.) -CARYOPHYLLENE, and GERMACRENE-D. However, TRANS(.BETA.)-CARYOPHYLLENE and GERMACRENE-D have been widely studied because of their activity against antibacterials and larvae. TRANS(.BETA.)-CARYOPHYLLENE and GERMACRENE-D are classified as sesquiterpene compounds. This compound showed moderate anti-microbial activity against Staphylococcus aureus, Bacillus cereus, and Escherichia coli [19]. The β-germacrene-D-4-ol compound showed oviposition prevention activity in larvae *A. aegypti pada* concentrations of 5, 10, and 50 ppm [20]. GERMACRENE-D at high concentrations can be toxic to the human body. The average LC50 values (10.25–19.11 µg/mL) revealed that the oil containing a sufficiently large amount of germacrene D was highly toxic to the sample *Artemia sp.* [21].

CONCLUSION

Based on the results of the GC-MS test, it can be concluded that the primary active compound content in Monte Sumbawa essential oil is the linalool compound, with a weight percentage of 57.8%. The linalool compound can act as an anti-microbial and antifungal. Monte can be used as a preservative in food products and is safe for consumption. Natural preservatives are essential in supporting green chemistry. Consumption of linalool compounds can increase the body's resistance to various free radical radiation attacks and pathogenic bacteria that interfere with the health of the human body.

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