# STUDY OF JAMBU ESSENTIAL OIL (*Acmella oleracea*) BY GAS CHROMATOGRAPHY WITH MASS SPECTROMETER (GC-MS)

Sâmia K. G. de Sá[1]*, Valcilene [1], Leandra[1], Anderson M. Pereira[2] & Leiliane S. S. de Souza[2]

[1] *Postgraduate Program in Environmental Sciences and Sustainability of the Amazon, Federal University of Amazonas, Manaus, Brazil.*
[2] *Faculty of Agricultural Sciences, Federal University of Amazonas, Manaus, Brazil.*
** Corresponding author's email address: samiagomes88@gmail.com*

## ABSTRACT

Essential oils are volatile compounds extracted from aromatic plants. They have antibacterial, antifungal and antioxidant properties. They are used in the pharmaceutical industry and in medical applications. Oil characterization, which is done using gas chromatography and mass spectrometry, is necessary because volatile aromatic compounds play a significant role in determining the flavor of foods. The extraction of essential oil from the vegetable occurred through the hydrodistillation process in a Clevenger apparatus. The effect of time and water/biomass mass ratio was evaluated, using an extraction time of 2.5h, with volume changes being observed every 30 minutes, using a mass ratio of 20%. The essential oil was characterized using gas chromatography with mass spectrometer (GC-MS) techniques. The essential oil extraction yield was 0.71%. GC/MS identified 30 constituents with a similarity index above 90, corresponding to 89.29% of its composition, with Lemnalol, Mirtenal, *Trans*-Pinocarveol having the greatest presence. The extraction method showed low yield, further studies are needed to increase yield. The profile of jambu essential oil showed potential antioxidant, anti-inflammatory, antimicrobial and analgesic activity due to its components with such properties.

**Keywords:** Bioproduct, Vegetable, Hydrodistillation

## 1 INTRODUCTION

Essential oils are volatile compounds extracted from aromatic plants that contain pathogen-inhibiting agents such as Escherichia coli, Salmonella and Staphylococcus aureus. Furthermore, its antibacterial, antifungal, antioxidant properties, anti-inflammatory and anti-cancer biological activities make it possible to use it in medicine as a drug originating from nature, standing out from treatments with components of synthetic origin[1,2]. Extraction can be carried out from the parts where its chemical constituents are arranged: branches, seeds, fruits, roots, buds, flowers, leaves, stems, wood and bark, of aromatic plants[3]. By linking biodegradability and low environmental impact with their properties, the applications of essential oils take on broad directions. They are used in the pharmaceutical industry, in medical applications, in cosmetics and aromatherapy and as natural alternatives to biocides for domestic use[4].

Oil characterization is necessary because volatile aromatic compounds play a significant role in determining the flavor of foods, exerting a direct influence on the overall evaluation of these foods[5]. This procedure is carried out using gas chromatography with mass spectrometer (GC-MS), where retention time and mass spectra differentiate the volatile constituents, allowing the composition of the essential oil to be determined. Despite the long sample preparation time, the technique makes it possible to detect even small amounts of a compound, due to its high sensitivity[4].

## 2 MATERIAL & METHODS

### 2.1 ACQUISITION OF RAW MATERIALS

The jambu leaves were obtained at the Product Fair, located in the east of the city of Manaus. Leaf and stem separation was carried out, followed by cleaning and sanitization. The parts were reduced and frozen in plastic bags, immediately frozen and kept at -18 ºC until the experiments were carried out.

### 2.2 EXTRACT FROM JAMBU ESSENTIAL OIL

The procedure was developed at the Separation Processes Laboratory (LABPROS), at the Faculty of Agricultural Sciences, on the Manaus campus of the Federal University of Amazonas. The essential oil determination in the vegetable occurred through the hydrodistillation process, using the Clevenger equipment. The extractor design is calculated to operate in a closed system, being designed based on hydrodynamic calculations to maintain system balance. throughout the extraction procedure. The extraction of the essential oil was based on the work of Reis1, who studied the enzymatic extraction of ginger essential oil.

## 3 RESULTS & DISCUSSION

### 3.1 EXTRACTION AND PHYSICAL PROPERTIES OF JAMBU ESSENTIAL OIL

The hydrodistillation of the leaves and stem of *Acmella oleracea* provided slightly viscous oil, yellowish and a highlighted characteristic aroma of the leaves. The essential oil extraction yield was 0.71%.

3.2 GAS CHROMATOGRAPHY AND MASS SPECTOMETRY (GC-MS)

Through GC/MS analysis, 30 constituents were identified with a similarity index above 90, as seen in Figure 1. The highlighted constituents correspond to 89.29% of its composition. Lemnalol (14.6%) stands out, Myrtenal (13.03%), *Trans*-Pinocarveol (11.21%), as they have a greater presence in the sample.

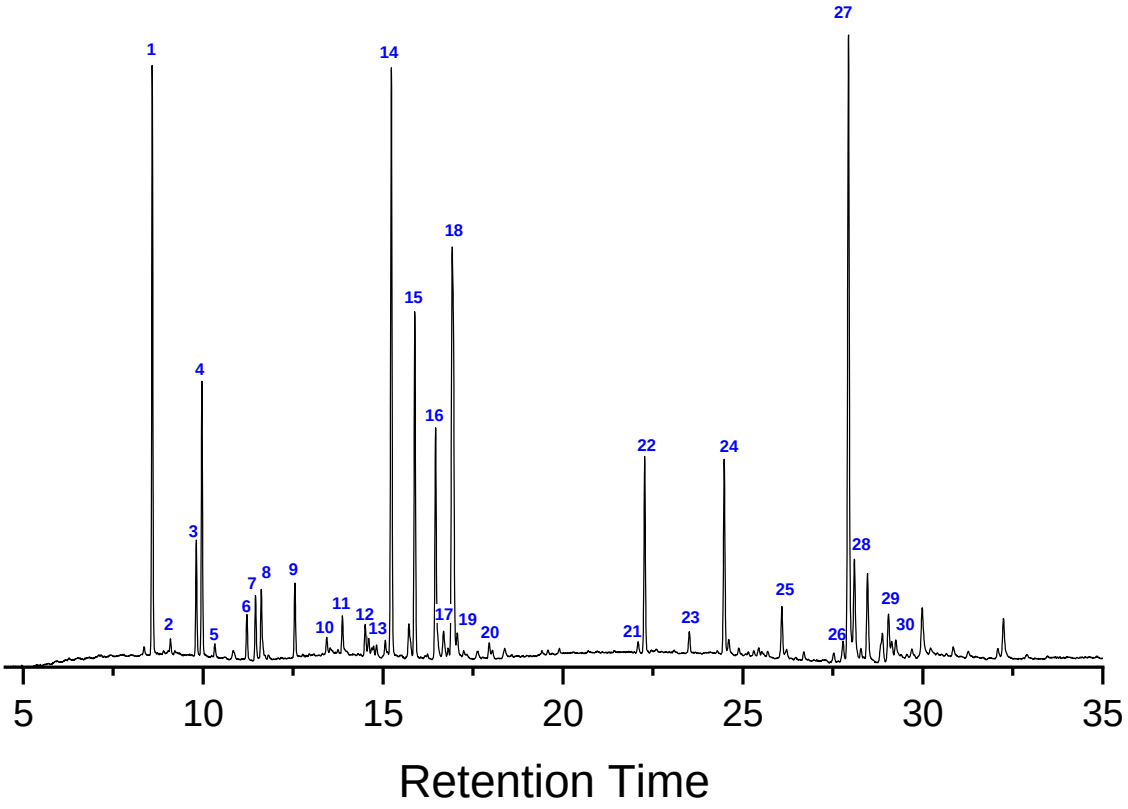


**Figure 1:** Chromatographic profile of *Acmella oleracea* essential oil.

The identified components point to the potential of jambu essential oil for antioxidant, anti-inflammatory, antimicrobial and analgesic activity due to its components with such properties. As is the case with Lemnalol, which demonstrates anti-inflammatory and antitumor activities. This compound inhibits the expression of the pro-inflammatory protein inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2). In his study, Tai[6], obtained data that exhibited significant antinociceptive effects in models of carrageenan-induced inflammation, chronic constriction injury neuropathy, and monosodium urate-induced gouty arthritis in rats. Jean[9], complements the information, highlighting the report that lemnalol exhibits antitumor activity in several cancer cell lines.

The second major component identified is common in essential oils from many plant species. The insertion of essential oil containing myrtenal helps in aromatherapy for upper respiratory tract infections as it has bronchodilating, anti-inflammatory, anti-aggregant, anti-hemolytic (*in vitro*) and antibacterial effects. In addition to presenting antidiabetic, antioxidant, antitumor, analgesic and neuroprotective potential, such activities enhance the favorable impact on various systems and organs[10]. Another prominent component was *Trans*-Pinocarveol, which is an α, β-unsaturated alcohol, which has reactivity and chemical structure favorable for transformation into a wide range of products with applications in fine chemicals. It is effective against coughs and can be included in the treatment of respiratory tract diseases [11,12].

Some of the components identified are quite common and essential oils, such as: Limonene (D-limonene), Myrcene, Caryophyllene. We can find them in the compositions of other essential oils, such as Piedmont peppermint[13], lavender[14], guava (*Psidium guajava* L.)[2] and Negramina, (*Siparuna guianensis*)[3].

D-limonene is a multifunctional compound found in abundance in citrus plants. It has antioxidant, anti-inflammatory, anticancer, antidiabetic, gastroprotective, and many other properties. Myrcene is a significant terpene commonly present in cannabis. The literature indicates that it has anti-inflammatory, analgesic, antibiotic, sedative and antimutagenic properties. While β-caryophyllene, a bicyclic sesquiterpene, has been associated with improving periodontal health, acting to reduce inflammation caused by lipopolysaccharide[3,15,5].

In addition to these, some less common components in essential oils were identified, such as 10,10-Dimethyl-2,6-dimethylenebicyclo [7.2.0] undecan-5.beta.-ol. In one study, this component was detected in clove essential oil (*Syzygium aromaticum*) and rosemary (*Rosmarinus officinali*). Another less common item is 1,2,4-Metheno-1H-indene, octahydro-1,7a-dimethyl-5-(1-methylethyl)-, [1S-(1.alpha.,2.alpha. ,3a.beta.,4.alpha.,5.alpha.,7a.beta., which was also identified in another study carried out on essence oil extracted from the blue stem of the old world 'WW-B.Dahl' (*Bothriochloa bladhii*) [13,17].

## 4 CONCLUSION

The hydrodistillation method was presented as a possible means of extracting essential oil, however, with the low value of its result (0.71%), further studies on obtaining jambu essential oil are necessary, aiming at the application of methods or insertion of pre-treatments in the process to increase yield and reduce extraction time. Through GC/MS analysis, it was possible to identify 89.29% of the total composition of the studied material. Thus, the profile of jambu essential oil showed potential antioxidant, anti-inflammatory, antimicrobial, antitumor, antinociceptive, anti-aggregant, analgesic and neuroprotective activity, due to its components with such properties.

## REFERENCES


[1] REIS, N.S.R., SANTANA, N.B., TAVARES, I. M. C., LESSA, O. A., SANTOS, L.R., PEREIRA, N. E., SOARES, G. A., OLIVEIRA, R. A., OLIVEIRA, J. R., FRANCO. M. 2020. Enzyme extraction by lab-scale hydrodistillation of ginger essential oil (*Zingiber officinale* Roscoe): Chromatographic and micromorphological analyses. Industrial Crops and Products,146

[2] TRINDADE, J. K. M., TRINDADE, I. T. M., ABEGG, M. A., CORRÊA, G. M., CARMO, D. F. M. 2021. Perfil químico e atividade antimicrobiana do óleo essencial de variedades de *Psidium guajava* L (Myrtaceae). Research, Society and Development, v. 10, n. 10, e211101018794

[3] SANTOS, R.M., NOGUEIRA, K. L., CHAPLA, V. M. 2023. Composição Química e Atividade Antioxidante de Óleos Essenciais das Folhas da *Schinus terebinthifolius* e *Siparuna guianensis*. Revista Virtual Química, 15(2), 295-300

[4] KAMPASAKALI, E., NAKAS, A., MERTZANIDIS, KOKKINI, S., ASSIMOPOULOU, A., CHRISTOFILOS, D. 2023. μ-Raman Determination of Essential Oils' Constituents from Distillates and Leaf Glands of Origanum. Molecules, 28(3), 1221

[5] WANG, C-X., WANG, L., LI, C., HU. C., ZHAO, S. 2020. Anti-proliferation activities of three bioactive components purified by high-speed counter-current chromatography in essential oil from ginger. European Food Research and Technology, 246:795–805

[6] ANDRADE, D. F., MAZZEI, J. L., D'AVILA,, L. A. 2011. Separation of Acylglycerols from Biodiesel by High Performance Liquid Chromatography and Solid-Phase Extraction. Revista Virtual de Química. 3 (6), 452-466

[7] HOUËL, E., RODRIGUES, A.M., JAHN-OYAC, A., BESSIÈRE, J.M., EPARVIER, V., DEHARO, E., STIEN, D. 2013. *In vitro* antidermatophytic activity of *Otacanthus azureus* (Linden) Ronse essential oil alone and in combination with azoles. J Appl Microbiol. 24219626.

[8] TAI, B., WEN, Z., CHEN, P., YANG, H., DUH C., CHEN, P., HSU. C. 2019. Lemnalol Modulates the Electrophysiological Characteristics and Calcium Homeostasis of Atrial Myocytes. Mar. Drugs, 17(11), 619

[9] JEAN, Y., CHEN, W., DUH, C., HUANG, S., HSU, C., LIN, C., SUNG, C., CHEN, I., WEN, Z., 2008. Inducible nitric oxide synthase and cyclooxygenase-2 participate in anti-inflammatory and analgesic effects of the natural marine compound lemnalol from Formosan soft coral *Lemnalia cervicorni*. European Journal of Pharmacology 578, 323–331

[10] DRAGOMANOVA, S., ANDOVA, V., VOLVHO, K., SALAKHUTDINOV, N., KALFIN, R., TANCHEVA, L. 2023. Therapeutic Potential of Myrtenal and Its Derivatives—A Review. Life, 13(10), 2086

[11] PAVELA, R., FERRATI, M., SPINOZZI, E., MAGGI, F., PETRELLI, R., RKOTOSAONA, R., RICCIARDI, R., BENELLI, G. 2022. The Essential Oil from the Resurrection Plant *Myrothamnus moschatus* Is Effective against Arthropods of Agricultural and Medical Interest. Pharmaceuticals, 15(12), 1511

[12] SÁNCHEZ-VELANDIA, J. E., VALDIVIESO, L. M., MARTINEZ, F., MEJÍA, S. M., VILLA, A. L., WÄRNA, J., MURZIN. 2023. Synthesis of *trans*-pinocarveol from oxidation of β-pinene using multifunctional heterogeneous catalysts. Molecular Catalysis 541, 113104

[13] GABETTI, E. SGORBINI, B., STILO, F., BICCHI, C., RUBILO, P., CHIALVA, F., REICHENBACH, S. E., BONGIOVANNI, V., CORDERO, C., CAVALLERO, A. 2021. Chemical fingerprinting strategies based on comprehensive two-dimensional gas chromatography combined with gas chromatography-olfactometry to capture the unique signature of *Piemonte peppermint* essential oil (Mentha x piperita var Italo-Mitcham). Journal of Chromatography A 1645, 462101

[14] VIGILIOU, C., ZISI, C., KONTOGIANNOPOULOS, K. N., NAKAS, A., IAKOAKIS, A., VRSAMIS, V., GIKA, H. G., ASSIMOPOULOU., A. N. 2021. Headspace gas chromatography-mass spectrometry in the analysis of lavender's essential oil: Optimization by response surface methodology. Journal of Chromatography B 1179, 122852

[15] UMNAHANANT, P., ZAFAR, A., KANKALA, V., CHICKOS, J. 2019. Vapor pressure and vaporization enthalpy studies of (+)-longifolene, (-)-isolongifolene and b-myrcene by correlation gas chromatography. The Journal of Chemical Thermodynamics 131, 583–591

[16] AINANE, A., KHAMMOUR, F., CHARAF, S., ELABBOUBI, M., ELKOUALI, M., TLBI, M., BENHIMA, R., CHERROUD, S., AINANE, T. 2019. Chemical composition and insecticidal activity of five essential oils: *Cedrus atlantica*, *Citrus limonum*, *Rosmarinus officinalis*, *Syzygium aromaticum* and *Eucalyptus globules*. Materials Today: Proceedings 13, 474–485

[17] BHANDARI, K.B., WEST, C.P., KLEIN, D., SUBBIAH, S., SUROWIEC., K. 2019. Essential oil composition of 'WW-B.Dahl' old world bluestem (*Bothriochloa bladhii)* grown in the Texas High Plains. Industrial Crops & Products 133, 1–9


## ACKNOWLEDGEMENTS


To FAPEAM (Fundação de Amparo à Pesquisa do Amazonas) for financial assistance (granting a postgraduate scholarship).