

A Preliminary Study of Chemical Compounds for *Cymbopogon Nardus* Oil Species by Means of Z-score Technique

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Abstract: Essential oils of *Cymbopogon nardus* were distilled and their chemical composition examined. *C. nardus* oil famously known as volatile and aromatic citronella oil that extracted from the grass of *C. nardus* species and its grown for the commercial essential oils. These essential oils get more beneficial and getting high demand in the market especially for therapeutic industries, biological properties and also for commercial such as perfume, soap, food flavouring and repellent product. The aim of this research was to evaluate the oil chemical compound of *C. nardus* essential oil based on GC-MS data that obtained from *C. nardus* species by using Z-score technique. The work involved of selecting *C. nardus* oil samples that cultivated from Melaka and Pahang. The input was the abundances (%) of *C. nardus* oil compounds and the output was the analysis of chemical compounds for *C. nardus* oil. The input and output data were pre-processed as follow; data transformation by using Z-score technique. The result shows that the significant chemical compound that found in *C. nardus* species by using Z-score technique include citronellol and geraniol.

Keyword: *C. nardus*, citronella, *Cymbopogon*, Z-score technique, essential oils.

INTRODUCTION

Essential oils from plants is also alternative bioactive compounds with antifungal properties beyond to the presence of secondary metabolites like tannins, terpenes, alkaloids and flavonoids, etc. [1, 2]. The *Cymbopogon*'s genus of the *Poaceae* family has been investigated for its pharmacological potential. *Cymbopogon nardus* plant popularly referred to as citronella [3, 4] which is grass cultivated that found in subtropical and tropical regions of Asia, Africa, and America, including Brazil [5]. In Malaysia, it can be easily found at Pahang and Melaka. *Cymbopogon nardus* oils

are aromatic oily liquid compounds formed by aromatic plants as secondary metabolites [6]. The essential oils of the leaves of *Cymbopogon nardus* is often employed in perfumes, the assembly of cosmetics and as a repellent. The key chemical constituents for *Cymbopogon nardus* are geraniol, citral, citronellal, and citronellol [6, 7]. Studies have demonstrated that these oils have been traditionally used as mosquito repellent, household fumigant or fragrance agent in food commodities, soaps and cosmetics [6, 8], the antiviral [9], antibacterial [10] and antifungal activities [8] of this oil. These essential oils could be a complex mixture of monoterpene and sesquiterpene hydrocarbons respectively and their oxygenated derivatives like alcohols, aldehydes, and ketones, phenylpropanoids and other minor compounds [11]. Citronella essential oils also called volatile oils [6] or ethereal oils [3] as they need a high degree of evaporation when exposed to air at room temperature which are this feature confers the strong odour to plants, both to draw in pollinators and to repel insects and herbivores [12]. These oils are important in several areas of science, especially in combatting pathogenic or opportunistic microorganisms [13, 14]. The presence of terpenes, united of the chemical compounds in essential oils contributes to the complex constitution with the action against microorganisms being directly associated with this characteristic [15]. *Cymbopogon nardus* essential oil may induce the fluctuation of external oxygen level [4]. In this research, the chemical compounds of *Cymbopogon nardus* essential oils were extracted by gas chromatography-mass spectrometry (GC-MS) and Z-score technique were proposed to analyse the significant chemical components from the extraction. The findings obtained by all the experiments were evaluated and discussed before the conclusion was made.

MATERIAL AND METHOD

Plant Material

10 fresh sample of *C.nardus* plants were cultivated from selected plantation such as Kuala Krau, Pahang and MARDI, Linggi, Melaka. All the specimens were identified by Forest Research Institute Malaysia (FRIM), Kepong, Selangor. Firstly, the samples were cut into small pieces before go through with hydro-distillation process for 6 to 8 hours to extract the oil. After that, the *C.nardus* essential oil were stored in the amber vial for analysis purposes.

GC-MS Analysis

These essential oils were obtained by hydro-distillation process and analysed by gas chromatography-mass spectrometry (GC-MS). At first, these *C.nardus* essential oils

were mix with the dichloromethane (DCM) solvent. After that, the fiber was immediately inserted into the GC injector of GC/MS for 5 minutes. GC-MS analysis was performed using Agilent Technologies 7890A/5975C Series MSD with HP-5MS column (30m x 0.25mm ID x 0.25µm film thickness). Helium was used as the carrier gas. The oven temperature is programmed from 60°C to 230°C at 3°C/min and finally held at 230°C for 1 minute. The identification of chemical compounds was identified by matching them to the mass spectral library (HPCH2205.L; Wiley7Nist05a.L; NIST05a.L).

Z-score Technique

Z-score is a technique which is to review the mean and standard deviations of data [16, 17]. This technique is preferred to standardize the data, to rearrange or to classify the data and to categorize the data into a selected group [18, 19].

$$\text{The formula: } Z = \frac{x - \mu}{\sigma}$$

Where x is an individual value, μ is mean of population and σ is standard deviation of population.

RESULTS AND DISCUSSION

Figure 1 shows the graph of raw data for *C.nardus* species that extracted from GC-MS machine. The overall number of compounds are 68 and the total number of samples are 10. After that, all the compounds were initialized by using the Z-score technique. By using this method, all data were standardized based on mean and standard deviation. Figure 2 shows a part of data transformation include positive and negative value for each compound. At this stage, only positive compounds were selected. Then, the result that appears are going to be used as a guide within the selection for significant compounds as shown in Table 1.

Table 1 shows the summary of selective compounds that classified into a group that have positive values. From this table, camphene hydrate and pulegone compound have the highest number of positive value readings which are 6 samples out of 10. This has made these compounds as the higher selective compounds. Table 2 shows the strongest compounds that have positive number compared with the previous literature review [20, 21]. From this table, it can be seen that the selected significant compounds are citronellol and geraniol. Citronellal, geranial and neral compound was excluded because all the sample shown the value of negative after applying Z-score technique.

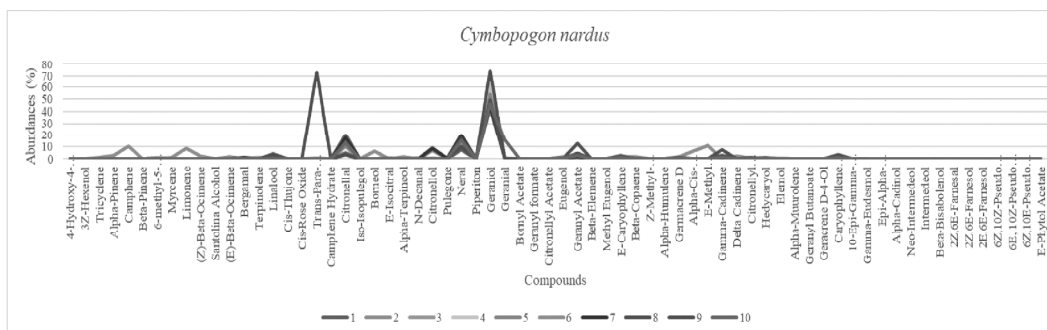


Figure 1 : Graphical observation of raw data for *C. nardus* species

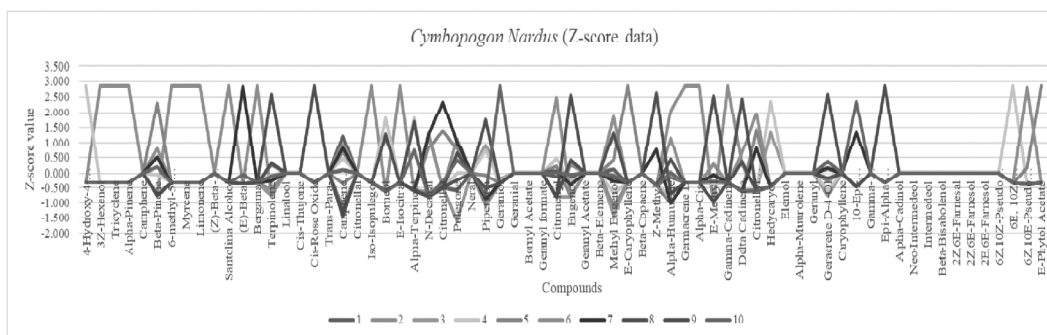


Figure 2 : Graphical observation for data transformation using Z-score technique

Table 1 : Summary of selective compounds based on Z-score value

<i>The compounds</i>	<i>Total samples that have positive values</i>
Camphene Hydrate	6
Pulegone	6
Citronellyl Acetate	5
Beta-Pinene	4
N-Decanal	4
Piperiton	4
Methyl Eugenol	4
Alpha-Humulene	4
Delta Cadinene	4
Germacrene D-4-OI	4

contd. table 1

<i>The compounds</i>	<i>Total samples that have positive values</i>
Terpinolene	3
Borneol	3
Alpha-Terpineol	3
Eugenol	3
E-Methyl Isoeugenol	3
Citronellyl Butanoate	3
Citronellol	2
Z-Methyl-Isoeugenol	2
Hedycaryol	2
10-Epi-Gamma-Eudesmol	2
6Z,10E-Pseudo Phytol	2
4-Hydroxy-4-Methyl-2-Pentanone	1
3Z-Hexenol	1
Tricyclene	1
Alpha-Pinene	1
6-methyl-5-Hepten-2-one	1
Myrcene	1
Limonene	1
Santolina Alcohol	1
(E)-Beta-Ocimene	1
Bergamal	1
Cis-Rose Oxide	1
Iso-Isopulegol	1
E-Isocitral	1
Geraniol	1
E-Caryophyllene	1
Germacrene D	1
Alpha-Cis-Bergamotene	1
Gamma-Cadinene	1
Epi-Alpha-Murrolol	1
6E, 10Z-Pseudo Phytol	1
E-Phytol Acetate	1
Camphene	0

contd. table 1

<i>The compounds</i>	<i>Total samples that have positive values</i>
(Z)-Beta-Ocimene	0
Linalool	0
Cis-Thujone	0
Trans-Para-Mentha-2,8-Dien-1-Ol	0
Citronellal	0
Neral	0
Geranial	0
Bornyl Acetate	0
Geranyl formate	0
Geranyl Acetate	0
Beta-Elemene	0
Beta-Copaene	0
Elemol	0
Alpha-Muurolene	0
Geranyl Butanoate	0
Caryophyllene Oxide	0
Gamma-Eudesmol	0
Alpha-Cadinol	0
Neo-Intermedeol	0
Intermedeol	0
Beta-Bisabolenol	0
2Z,6E-Farnesal	0
2Z,6E-Farnesol	0
2E,6E-Farnesol	0
6Z,10Z-Pseudo Phytol	0

Table 2
The selected significant compounds for *C. nardus* species

<i>Based on literature review</i>	<i>Based on Z-score technique</i>
Citronellal	Citronellol
Geranial	Geraniol
Geraniol	-
Citronellol	-
Neral	-

Figure 3 shows the pattern of abundances for *C. nardus* species. From this figure, the pattern of the abundances can be seen clearly. The highest peak belongs to geraniol compound, followed by citronellal and neral compound. The highest peak of geraniol compounds is 74.054% belongs to the number sample 8 and followed by sample number 3 which is 64.874% and sample number 1 which is 64.818%. For citronellal compound, the highest peak is belonging to sample number 1 and sample number 3 with the value of abundances are 20.517% and 18.841%. For neral dataset, the maximum value of abundances which is 20.223% belongs to the peak number of 6 and sample number 7 with the value of abundances are 19.652%. For geranial compound, it can be seen that the highest peak is 15.468% belongs to samples number 10. Most the value of abundances for geranial compound is 0.000% The highest peak for citronellol is 9.001% belong to the sample 6, followed sample 7 with the value of abundances 8.789% and sample number 3 with the value of abundances are 8.650%.

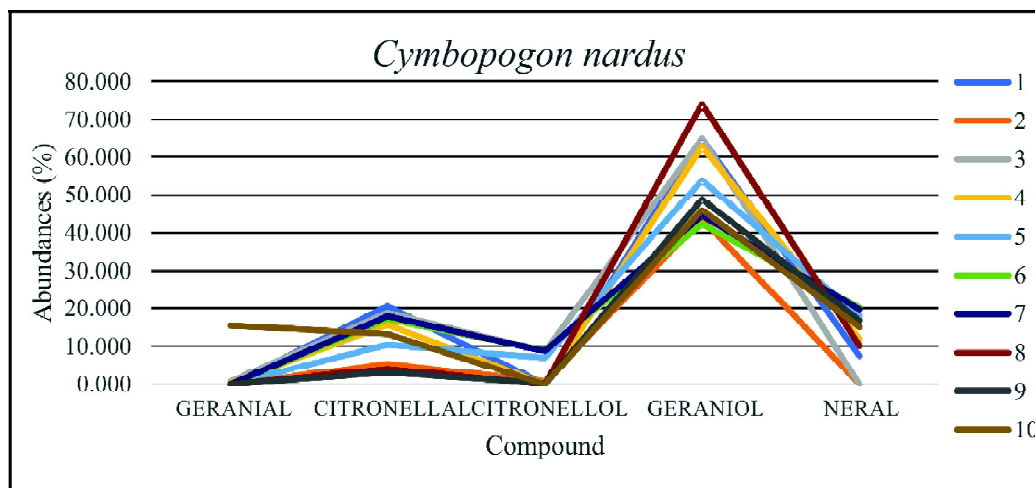


Figure 3 : The abundances for *C.nardus* species based on literature review

CONCLUSION

The study has been carried out to investigate the chemical compounds of the *C. nardus* oils species based on GC / GC-MS data. GC-MS data is a reliable technique in extracting the chemical compounds. From this result, a unique and consistent 68 chemical compounds pattern of the *C. nardus* oil species was revealed. Five strongest compounds were selected based on the literature review to be the benchmark in this

study, where they had the highest readability over the other compounds. The five compounds are citronellal, geranial, geraniol, citronellol and neral. Furthermore, Z-score technique was performed and it was found out 2 of the 68 compounds have been listed as the most significant compounds including citronellol and geraniol.

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