Chemical compositions of ethanol extract of nut grass (*Cyperus rotundus* L.) rhizomes growing in 3 different ecological zones

N Utami[1,2,*], S Susianti[2], S Bakri[3], B Kurniawan[2], M Muhartono[2], S Sutyarso[4]

[1]Master Program of Environmental Sciences, Graduate Program, Universitas Lampung
[2]Department of Medical Education, Faculty of Medicine, Universitas Lampung
[3] Department of Environmental Sciences, and Department of Forestry, Faculty of Agriculture, Universitas Lampung
[4] Department of Biology, Faculty of Mathematics and Sciences, Universitas Lampung

* nurul.utami@fk.unila.ac.id

Abstract. Nut grass (Cyperusrotundus L.) is a weed plant that is able to absorb large amounts of nutrients, is easy to grow anywhere, easy to maintain, and has high resistance to various external influences. As a plant, nut grass produces secondary metabolites that function to protect it from environmental threats, such as insect, bacteria, fungi and other types of pathogens. Many factors can determine secondary metabolites in a plant, including geographic location/ place of growth, climate and environmental conditions, and the nutritional status of the plant. This study aims to determine the chemical composition of the ethanol extract of nut grass rhizomes grown in 3 different zones. **S**ample of nutgrass rhizomes were taken from the highlands, lowlands, and coasts in Lampung Province and was extracted with ethanol solvent. Later, those extracts were analyzed by Gas Chromatography Mass Spectrometry (GCMS) and the chemical compound identified was compared to literature. In the ethanol extract of nut grass taken in the highlands, lowlands and coastal areas, 118, 42, and 87 chemical compounds were detected respectively, with different main chemical compounds in the nut grass rhizomes extract from each zone.

1. Introduction

Nut grass (Cyperus rotundus L.) is a weed that could absorb large amounts of nutrients compared to other plants. This plant has high resistance to various external influences, has high ability to survive, and has a wide distribution, so it can be found in many places. Its nature makes nut grass considered disturbing by the community, so it is often destroyed so as not to interfere with the growth of other plants [1, 2].

As a plant, nut grass produces secondary metabolites that function to protect it from environmental threats, such as insect, bacteria, fungi and other types of pathogens. The content of secondary metabolite compounds found in nut grass includes alkaloids, flavonoids, tannins, glycosides and furochromones, as well as many new sesquiterpenoid.

Many factors could determine secondary metabolites in a plant, including geographic location/ place of growth, climate and environmental conditions, and nutritional status of plants [3–5]. It is known that there are 4 chemotypes (H-, K-, M-, and O-) of nut grass essential oil that grows in various places in Asia. Each chemotype has a different substance/ content concentration. For example, type H from Japan contains α-cyperone (36.6%), β-selinene (18.5%), cyperol (7.4%) and caryophyllene (6.2%). The chemicals that dominate the composition of nut grass also differ from one country to another. In the Nigerian and Tunisian species, the most common substances found were cyperene (19.2-30.9%) and α-cyperone (4.5-25.2%). In Brazil, the species studied were found to contain α-cyperone (22.8%) and cyperotundone (12.1%) as the highest content [4]. Hence, this study was conducted to determine the chemical composition of ethanol extract of nut grass rhizomes growing in 3 different ecological zones in Lampung Province.

2. Method

The fresh rhizomes of nut grass were collected from 3 different ecological zones, namely the highlands, lowlands, and coastal. The location for sampling in the highlands was in Talang Padang, district of Tanggamus, and at the coordinate point -5.377263, 104.792544. In the lowlands, the location for collecting nut grass is in Sukarame, Bandar Lampung City at the coordinate point -5.3790486, 105.3041975. The location for sampling of nut grass in the third zone is Pasir Sakti, district of East Lampung, with the coordinate point of -5.5383300, 105.7876040.

The sample were then brought to the Botany Laboratory, Faculty of Mathematics and Sciences, Universitas Lampung for taxonomic verification and extracted with ethanol solvent, using maceration method. The extracts were then sent to the Integrated Research and Testing Laboratory (LPPT) Universitas Gadjah Mada (UGM) for GC-MS testing.

3. Results

Chromatogram of ethanol extract of nut grass rhizomes taken in the highlands showed 118 active chemical constituents. Of the 118 constituents of these chemical compounds, there are 6 main constituents, namely d-Selinene, Caryophyllene oxide, Longiverbenone, Cyperotundone, 2,5-Octadecadiynoic acid, methyl ester, and Methyl trisporate B.

Furthermore, there were 42 peaks of chemical constituents from the GCMS test results of the ethanol extract of nut grass rhizomes from the lowlands. There are 4 main chemical compounds, namely Cyperotundone, n-Hexadecanoic acid, Chlorfenapyr, and Diisooctyl phthalate.

Chromatogram of ethanol extract of nut grass rhizomes from coastal areas showed 87 chemically active compounds. The seven main chemical compounds from the ethanol extract of the nut grass tuber are α-Neoclovene, Caryophyllene oxide, Panaxjapyne A, Cyperotundone, n-Hexadecanoic acid, Oleic Acid, Methyl trisporate B. Chemical composition of ethanol extract of nut grass rhizomes shown in table 1.

Table 1. Main compounds of ethanol extract of nut grass rhizomes

Zone	No.	Peak Number	Retention Time (minute)	Chemical Compound	Area (%)
Highlands	1.	14	20.07	d-Selinene	7.62
	2.	38	24.63	Caryophyllene oxide	3.04
	3.	54	26.82	Longiverbenone	3.75
	4.	58	27.22	Cyperotundone	11.21
	5.	91	31.86	2,5-Octadecadiynoic acid, methyl ester	4.07
	6.	118	37.57	Methyl trisporate B	2.13
Lowlands	1.	13	27.21	Cyperotundone	8.83
	2.	26	23.73	n-Hexadecanoic acid	8.70
	3.	37	37.87	Chlorfenapyr	12.86
	4.	39	43.20	Diisooctyl phthalate	11.23
Coastal Area	1.	8	20.07	α-Neoclovene	2.42
	2.	27	24.63	Caryophyllene oxide	2.73
	3.	38	26.83	Panaxjapyne A	3.57
	4.	42	27.23	Cyperotundone	10.53
	5.	72	32.72	n-Hexadecanoic acid	3.82
	6.	80	36.01	Oleic acid	4.15
	7.	84	37.57	Methyl trisporate B	4.72

Main chemical compounds of ethanol extract of nut grass rhizomes was different, both in quantity and composition. Comparison of the main chemical composition of the ethanol extract of nut grass rhizomes grown in the 3 different zones is presented in table 2.
As seen in table 2, the main chemical compound contained in the ethanol extract of nut grass rhizomes from the 3 growing places differed from one another. For example, Cyperotundone compound in the ethanol extract of nut grass rhizomes from the highlands and the coastal area, was the compound with the largest percentage of area, while from the lowlands, Cyperotundone had the second largest percentage area after Chlorfenapyr. Cyperotundone is a secondary metabolite compound contained in the Cyperaceae family of plants, and is included in the sesquiterpenoides group. Apart from Cyperotundone, the chemical compound present in the three samples was n-Hexadecanoic acid, which is the most common saturated fatty acid found in animals, plants and microorganisms.

Table 2. Comparison of the main compounds in the ethanol extract of nut grass rhizomes.

No.	Chemical compound	Area (%)		
		Highlands	Lowlands	Coastal area
1.	**d-Selinene**	7.62	-	-
2.	**Caryophyllene oxide**	3.04	-	2.73
3.	**Longiverbenone**	3.75	-	-
4.	**Cyperotundone**	11.21	8.83	10.53
5.	**2,5-Octadecadiynoic acid, methyl ester**	4.07	-	2.74
6.	**Methyl trisporate B**	2.13	-	4.72
7.	**n-Hexadecanoic acid**	0.79	8.70	3.82
8.	**Chlorfenapyr**	-	12.86	0.37
9	**Diisooctyl phthalate**	-	11.23	-
10.	**α-Neoclovene**	-	-	2.42
11.	**Panaxjapyne A**	-	3.76	3.57
12.	**Oleic acid**	-	1.84	4.15

It could also be seen in table 2 that, a major compound found in one ethanol extract, might also be found in the ethanol extract of nut grass rhizomes growing in different zone, even though only in a small amount. An example is Oleic acid, which was found in the ethanol extract of nut grass rhizomes from the coastal zone as the main compound, but it was also detected in the ethanol extract of nuts grass rhizomes from the lowland zone. There were also compounds that have only been detected in the ethanol extract of nut grass rhizomes growing in one zone. For example, Longiverbenone and d-Selinene, which were only found in the ethanol extract of nut grass rhizomes growing in the highlands.
The results of this study were also in line with research conducted by Yagi et al. (2016), where it was found that the chemical composition of the essential oil of nut grass rhizomes grown in Sudan was different from those grown in other countries, such as Brazil, Nigeria, and Hawaii. Likewise, research on the chemical content of nut grass rhizomes essential oil grown in district of Tanggamus, Lampung Province, the composition was different from the essential oil from nut grass rhizomes growing in South Africa and Iran [6, 7].
The difference in height to the content of chemical compounds in plants had been proven in previous studies. Among them is research on the effect of growing and drying height on the total flavonoid sambang colok (*Iresine herbstii*), which proved that there were significant differences in total flavonoid levels in the altitude and drying treatment [8]. Another study conducted by Nurnasari and Djumali (2010) showed that altitude affects the nicotine content of tobacco produced. The difference

in altitude is followed by differences in environmental elements, such as relative humidity, rainfall, and the number of rainy days. The nicotine content of tobacco in this study was influenced by the elements of the height of the growing place of the tobacco, air temperature, and relative humidity [9] Differences in the results of this study with previous studies actually confirm that the composition of chemical compounds in a plant is influenced by genetic and environmental factors. These environmental factors include climate, geography of place to grow, abiotic stress such as salinity, and the age of the plants when they are harvested [7]. The composition of secondary metabolite/ chemical compounds might also be affected by nutrients. Soil nutrient content was inversely proportional to the amount of secondary metabolite production, but was directly proportional to the number of types of secondary metabolites produced. Many flavonoid compounds in *duku* plants were formed in areas with high Ca levels [10].

Longiverbenone and Caryophyllene oxide were found as the main chemical compounds in the ethanol extract of nut grass rhizomes growing in the highlands. These results are consistent with research conducted by Busman et al. which showed that the same main compound was detected in essential oil of nut grass rhizomes growing in the same ecological zone (district of Tanggamus). However, its main composition is not the same as this study [7]. This might be due to the precise place of grow of nut grass was at different coordinate points, even though they were still in one zone. This shows that apart from altitude, there were other environmental factors that could affect the composition of chemical compounds in a plant, one of which is nutrients. The absence of nutrient analysis in the soil where nut grass is grown is a limitation in this study.

4. Conclusion

This study shows that there were differences in the composition of chemical compounds, which were detected in the ethanol extract of nut grass rhizomes growing in 3 different ecological zones. The difference in the composition of chemical compounds in this study with previous research in the same ecological zone leads to other environmental factors that need to be investigated, such as the nutrients contained in the soil where the nut grass grows.

Acknowledgements

The authors thank Universitas Lampung for the supporting facility and funding, and also all those who have helped us in conducting this study. This research study was supported and funded by DIPA Unila Funding 2019.

References

[1] ErwinE , Joko T., and Lanang H. 2017. Efektifitas Constructed Wetlands Tipe Subsurface Flow System dengan Menggunakan Tanaman Cyperus rotundus untuk Menurunkan Kadar Fosfat dan COD pada Limbah Cair Laundry. *J. Kesehat. Masy.*, 5(1):1–6.

[2] Trimin K. 2017. Potensi Tumbuhan Liar Berkhasiat Obat di Sekitar Pekarangan Kelurahan Silaberanti Kecamatan Silaberanti. *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam.* 14(2): 89–99

[3] Dewoto H. R. 2007. Pengembangan Obat Tradisional Menjadi Fitofarmaka. *Majalah Kedokteran Indonesia*. 57(7): 205–211.

[4] Lawal O. A. and Oyedeji A. O. 2009. Chemical composition of the essential oils of cyperus rotundus L. from South Africa. *Molecules*. 14(8): 2909–2917.

[5] Sholekah F. F.. 2017. Kandungan Flavonoid dan beta Karoten Buah Karika (Carica pubescens) Daerah Dieng Wonosobo, in *Seminar Nasional Pendidikan Biologi dan Biologi* 2017, pp. 75–82.

[6] Yagi S., Babiker R., Tzanova T., and Schohn H.. 2016. Chemical composition, antiproliferative, antioxidant and antibacterial activities of essential oils from aromatic plants growing in Sudan. *Asian Pac. J. Trop. Med.* 9(8): 763–770.

[7] Busman H., Nurcahyani N., Sutyarso S., and Kanedi M.. 2018. Chemical Composition of The Essential Oils Distilled from Tuber of Rumput Teki (Cyperus rotundus Linn.) Growing in

Tanggamus. *Eur. J. Biomed. Pharm. Sci.* 5(4): 69–72.
[8] Safrina D. and Priyambodo W. J.. 2018. Pengaruh Ketinggian Tempat Tumbuh dan Pengeringan terhadap Flavonoid Total Sambang Colok (Iresine herbstii). *J. Penelit. Pascapanen Pertanian* 15(3): 147–154.
[9] Nurnasari E. and Djumali. Pengaruh Kondisi Ketinggian Tempat Terhadap Produksi dan Mutu Tembakau Temanggung. *Bul. Tanam. Tembakau, Serat Miny. Indonesia* 2(2): 45–59.
[10] Salim M., Yahya, Sitorus H., Ni'mah T., and Marini. 2016. Hubungan Kandungan Hara Tanah dengan Produksi Senyawa Metabolit Sekunder pada Tanaman Duku (Lansium domesticum Corr var Duku) dan Potensinya sebagai Larvasida. *J. Vektor Penyakit* 10(1): 11–18.