ສ່ວນປະກອບເຄມີຂອງນ້ຳມັນຫອມລະເຫີຍຈາກຂີ້ໝົ້ນເຫຼືອງເກັບກູ້ຢູ່ ສປປ ລາວ ກໍລະນີສຶກສາ ຂອງເມືອງບາຈຽງຈະເລີນສຸກ ແຂວງຈຳປາສັກ

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ພາກວິຊາເຄມີສາດ, ຄະນະວິທະຍາສາດທຳມະຊາດ, ມະຫາວິທະຍາໄລຈຳປາສັກ

ບົດຄັດຫຍໍ້

ການຄົ້ນຄວ້າ-ວິໄຈຄັ້ງນີ້ມີຈຸດປະສົງເພື່ອກຳນົດສ່ວນປະກອບທາງເຄມີຂອງນ້ຳມັນຫອມລະເຫີຍຈາກຂີ້ໝົ້ນເຫຼືອງ(*Curcuma Longa* Linn Rhizome) ທີ່ສະກັດດ້ວຍອາຍນ້ຳໃນໄລຍະເວລາທີ່ແຕກຕ່າງກັນ 3 ຊົ່ວໂມງ 5 ຊົ່ວໂມງ 7 ຊົ່ວໂມງ ແລະ 9 ຊົ່ວໂມງ, ນຳໄປວິເຄາະດ້ວຍເຄື່ອງມືແກັສໂຄຣມາໂທກຣາຟີ (Gas chromatography) ແລະ ແມສສເປັກໂຕຣເມທຣີ (Mass spectrometry) (GC/MS), ຈາກຜົນການວິເຄາະພົບວ່າ ທາດທີ່ລະບຸໄດ້ມີ 30 ຊະນິດ, ໃນນັ້ນທາດທີ່ມີເປີເຊັນຫຼາຍກວ່າໝູ່ແມ່ນ ຊິງກິເບີຣີນ zingiberene 23.%, ອາຣ໌ເທີຣ໌ເມີໂຣນ ar-turmerone 17.45%, ຢູຄາລິຟຕອລ 16%, ທາດເລົ່ານີ້ລ້ວນແຕ່ມີຄຸນລັກສະນະທາງດ້ານຊີວະພາບສູງ.

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Chemical Composition of Essential oil from *Curcuma Longa* Linn Rhizome Collected in Lao PDR case study of Ba Chiang District, Champasack Province

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Abstract

This research aim to determine the chemical composition of essential oil of *Curcuma Longa* Linn rhizome extracted by steam distillation in different periods: (3, 5, 7 and 9 hours) analyzed by Gas chromatography and Mass spectrometry GC/MS.This results showed that the identified 30substances, the substances with a high percentage are Zingiberene 23%, Ar-turmerone 17.45%, Eucalyptol 16%, these substances are a strong biological activity.

Key words: *Curcuma longa* Linn, extraction, determine, essential oil, chemical composition

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1. Introduction

The turmeric (curcuma longa Linn.) plants, a perennial herb belonging to the ginger family (Zingiberaceae) is cultivated extensively in southeast tropical Asia such as: Viet Nam, Laos, Thai Land, India, China etc. (Soni Himesh et al, 2011).Turmeric is rich in Curcuminoids which vary in chemical structure, physico-chemical characteristics. Curcumin, demethoxy curcumin and bisdemethoxy curcumin these three compounds are present in turmeric commonly these three compounds called as curcuminoids (Naresh et al, 2021). Curcumin is a major chemical composition of turmeric, turmeric contrains about 2-5% curcumin alone (Gokhul et al, 2015), which has long been known as a plant-based active ingredient, it plays an important role in the food, cosmetic and pharmaceutical industries. Turmeric is one of the very popular plants that were used nearly 4000 years ago, derived from the Ayer Veda culture in India (S. N. Garg et al, 1999), (Bharat B. Aggarwal et al, 2007) it is added to most dishes whether it is meat or vegetables. Today, turmeric is a valuable source of high economic value. Therefore, the research on extraction, determination of the chemical composition and the compound's formulation extracted from turmeric is extremely important and necessary. Many researches in countries around the world have shown that curcumin has high biological activity such as protect the liver, pain relief, anti-cancer, anti-ulcer, anti-fungal, anti-bacterial, antioxidant, anti- inflammatory etc. (Viet Nam Academy of Science and Technology, 2008), (Pham Thiep et al, 2000). This study investigate extraction essential oil of Curcuma longa Linn by steam distillation method and determination chemical compositions of essential oil from Curcuma longa Linn.by GC-MS

2. Materials and Methods

Materials

Curcuma longa Linn. Local variety colected from the 6 villages of Bachieng District such as: Lomsack neua, Lomsack Tai, Huayleusy, Pheerlat, Nongkok and Nongboknoi. The first time on 07-10.02.2021 at Lom sack neua, Lom sack Tai, Huayleusy and second time on 24-27.02.2021 at Phialat, Nongkok, and Nongboknoi. We collected fresh samples in black plastic avoid from sunlight recording field data.These local variety of *Curcuma longa* Linn was selected. Fresh rhizome of *Curcuma longa* Linn. We used 3Kg of *Curcuma longa* Linn. rhizomes for extracted by 1000mL steam distillation set, 1000mL heating mantle, mortar with pestle for crushed samples, 500mL and 250mL beakers, 1000mL measuring cylinder. The experiment was carried out at Agriculture and food industrial product quality testing center and the faculty of natural science. The experiment covered a period of 8 months from March 2021 to October 2022.

Chemical

Distilled water (H_2O) is used for extracted, sodium sulfate (Na_2SO_4) is used as a moisture free agent for steam distillated oil from *Curcuma longa* Linn. Rhizome, Hexane (C_6H_{14}) we used for injected into the GC inlet maintaining column flow rate. All chemical used were of reagent grade (supplied by Khonsavanh company) and used as supplied.

Preparation of materials

The fresh rhizome of *Curcuma longa* Linn. was cleaned by normal water, washed under flowing tap water, the purpose of washing rhizome is to remove the dust and pollution externally stick on the surface of rhizome. After complete washing of each rhizome and left to dry at a room temperature, it is cut or sliced into fine size having size up to 1mm or crushed by mortar with pestle until become homogenized, the purpose of cutting

rhizome into small size is to increase the surface area for better extraction for steam distillation process.

Method of extraction

We weigh materials approximately 200g of each batch, after weighing this measured quantity of material. We insert this crushed rhizome into 1000mL of round bottom flask and adding 600mL of water in the same container. The essential oil of curcuma longa Linn was extracted by steam distillation method by 1000mL of steam distillation set at different times (3 hours, 5 hours, 7 hours and 9 hours) at 200°C. We observed the changes takes place in the process of

Steam distillation. For steam distillation process, we need continuous cool water supply to condenser for condensation of the steam or vapour of rhizome and water mixture. After condensation process, all condensate is come to the beaker then it sends to separating funnel. The essential oil and water layer was separated completely and drawn off slowly after that we collected in the test tube and dried over by sodium sulfate (Na_2SO_4) and we get the pure essential oil, stored it at 4°C for GC-MS analysis & further use

Quantitative analysis of essential oil by GC-MS

The chemical constituents in the essential oil were separated using a Shimadzu gas chromatograph (GC2010) with Rtx-5 MS column (25 m × 0.25 mm× 0.25 μm). 1 μl of the essential oil was diluted with spectroscopic grade hexane (10:1) was injected into the GC inlet maintaining column flow rate of 1 mL/ min and purge flow 3 mL/min after fixing the split ratio at 120. The initial column oven temperature was set at 40°C and the injection temperature was 250°C. The qualitative analysis of the essential oil was further continued in a Shimadzu GCMS-QP2010 plus. During the analysis, the ion source temperature and the interface temperature was set at 200°C and 250°C respectively. Detector scanning start time was 4 minutes, end time was 68 minutes and scan speed was 666 with scanning range of m/z 40.00-350.00. (Madan Raj Bhatta et al, 2018)

3. Results and Discussion

Extracted essential oil of curcuma longa Linn by steam distillation method

The results of the experiment to extracted essential oil of *curcuma longa* Linn. by steam distillation method in different time periods: 3 hours, 5 hours,7 hours and 9 hours, the extraction of essential oil of *curcuma longa* Linn. Using the same quantify of *curcuma longa* Linn. (200gm), the same temperature (200°C), we got essential oil with different quantify. After that removing the moisture in the essential oil using 2gm of sodium sulfate (Na_2SO_4) into the essential oil, Sodium sulfate (Na_2SO_4) will absorb H_2O and bind together in a lump below the essential oil, notice that the essential oil is brighter and the quantify has changed, which has a detailed analysis of the experimental results (see table 1)

Comparing of quantify of essential oil from *curcuma longa* Linn extracted with steam distillation method

Extracted essential oil from *curcuma longa* L. with steam distillation in different periods. Noticed that: 200 g of *curcuma longa* L. in different time periods have the quantify of essential oil from curcuma longa Linn.: 3 hours with a volume 2.066 mL, 5 hours with a volume 3.166 mL, 7 hours with a volume

4.266 mL and 9 hours with volume 4.253mL. we used for a period of 7 hours has more oil, followed by 9 hours, 5 hours and less than 3 hours. The essential oil has a light yellow color, the smell and quantify of essential oil obtained from *curcuma longa* Linn by steam distillation method in different time periods had different quantify: 7 hours >9 hours > 5 hours > 3 hours.

The Chemical composition of essential oil of Curcuma longa Linn *by GC-MS*

The identification results of the chemical composition of essential oil of *Curcuma longa* Linn in Laos by GC-MS have identified 30 constituents, of which the major constituents of zingiberene are (22.98%), ar-turmerone with (17.45%), Eucalyptol with (15.99%) the remaining constituents accounted for 11.16% - 0.04%, (see table 2)

Among the identified components are compounds with high pharmacological activity and strong biological activity such as ar-turmerone, caryophyllene, eucalyptol, isoborneol, camphene, borneol.

Comparing the chemical composition of Bachieng essential oil of curcuma longa Linn. With Kailali (Nepal) essential oil of curcuma longa Linn.

There are 30 constituents in Bachieng essential oil of *curcuma longa* Linn have identified, higher than Kailali (Nepal) essential oil of *curcuma longa* Linn. With 22 constituents. There are 9 constituents available in all two types of *curcuma longa* Linn essential oil. The constituent with highest percentage is zingiberene (22.98%), higher than 9 times compared with percentage of zingiberene (7.16%) in Kailali (Nepal) essential oil of *Curcuma longa* Linn (see table 3)

The difference in percentage content, quantify and content of constituent identification in the Bachieng essential oil of *curcuma longa* Linn´s rhizome with other countries has proved that quality of plant essential oils depends entirely on natural conditions in which the plants survival and develop

4. Conclusion

By steam distillation method,we observed that the extracted essential oil of *curcuma longa* Linn in different periods which the extraction process can be concluded that: the quantify of *curcuma longa* Linn using for each extraction is 200 g, for 3 hours, the average essential oil is 2.066 mL(1.030%); for 5 hours, the average essential oil is 3.166 mL (1.578%), for 7 hours,the average oil is 4.266 mL (2.126%) and for 9 hours the average oil is 4.253mL (2.121%).Show that the oil obtained from the extraction in different periods of time will not decrease much, so the appropriate time for extracting essential oil of *curcuma longa* Linn is 7 hours.

By gas chromatography mass spectrometry (GC-MS) have been identified in Bachieng essential oil of *curcuma longa* Linn of which 30 constituents are found. Thereby comparing the chemical composition of Bachieng essential oil with other countries, the percentage of constituents in general is not much different only varies the number of constituents

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Table 1. The results of extracted essential oil from *curcuma longa* Linn by steam distillation method

No	Time (h)	(x̄)Weight of *curcuma longa* L. (g)	(x̄) quantify of essential oil (mL)	(x̄) quantify of essential oil (mL) after removing the moisture	(x̄) quantify of essential oil (%)
1	3	200.583	2.233	2.066	1.030
2	5	200.489	3.366	3.166	1.578
3	7	200.672	4.366	4.266	2.126
4	9	200. 453	4.352	4.253	2.121

Table 2.The result of Chemical composition of essential oil from *Curcuma longa* Linn.by GC-MS

	Retention time (RT)	Constituents	Percentage content (%)
1	4.879	α–pinene	0.24
2	5.128	Camphene	0.07
3	5.426	β -phellandrene	0.04
4	5.532	β -pinene	0.14
5	5.611	β-Myrcene	0.19
6	5.928	α –phellandrene	0.13
7	6.091	4-Carene	0.13
8	6.472	Eucalyptol	15.99
9	6.701	γ-Terpinene	0.08
10	7.161	Terpinolene	2.44
11	7.202	p-Cymenene	0.08
12	8.190	camphor	0.19
13	8.458	Isoborneol	0.13
14	8.605	Borneol	0.09
15	8.735	1-Terpinenol	0.25
16	9.010	α-Terpineol	0.62
17	9.646	cis-Carveol	0.05
18	11.822	delta-Elememe	0.06
19	13.096	β-Elemene	0.17
20	13.955	Caryophylene	1.08
21	14.942	α –Caryophylene	4.43
22	15.386	α-Curcumene	2.07
23	16.070	zingiberene	22.98

24	16.252	β-Bisabolene	2.19
25	16.789	β-Sesquiphellandrene	11.26
26	17.544	γ- Elemene	0.38
27	20.587	Ar – turmerone	17.45
28	20.687	Turmerone	6.07
29	21.348	Curlone	3.53
30	21.580	Curdione	0.04

Table 3. The result of comparing the chemical composition of Bachieng essential oil of *curcuma longa* Linn with Kailali (Nepal) essential oil of *curcuma longa* Linn.

No	Name of chemical constituents	Percentage content (%)	
		C longa L. Bch	C longa L. Kailali
1	α–pinene	0.24	-
2	Camphene	0.07	-
3	β -phellandrene	0.04	-
4	β -pinene	0.14	-
5	β-Myrcene	0.19	-
6	α –phellandrene	0.13	-
7	4-Carene	0.13	-
8	Eucalyptol	15.99	2.30
9	γ-Terpinene	0.08	-
10	Terpinolene	2.44	9.54
11	p-Cymene	0.08	0.55
12	Camphor	0.19	-
13	Isoborneol	0.13	-
14	Borneol	0.09	-
15	1-Terpinenol	0.25	-
16	α-Terpineol	0.62	-
17	cis-Carveol	0.05	-
18	delta-Elememe	0.06	-
19	β-Elemene	0.17	-
20	Caryophylene	1.08	9.11
21	α –Caryophylene	4.43	-
22	α-Curcumene	**2.07**	**5.93**
23	Zingiberene	22.98	8.18
24	β-Bisabolene	2.19	2.04
25	β -Sesquiphellandrene	11.26	9.27
26	γ- Elemene	0.38	-
27	Ar – turmerone	17.45	15.48

28	Turmerone	6.07	-
29	Curlone	3.53	-
30	Curdione	0.04	-
31	α–Terpinene	-	0.49
32	p-Cymene-8-ol	-	0.85
33	α -Humulene	-	2.02
34	E- Nerolidol	-	0.45
35	Ar- Tumerol	-	0.56
36	Caryophyllene oxide	-	1.32
37	3,4-Dimethylbenzyl isothiocyanate	-	1.38
38	Fokienol	-	0.45
39	α -Bisabolol	-	0.56
40	Cedren-13-ol,8_	-	0.57
41	Benzenesulfonamide,N-(2,6-dimethylphenyl)-4-methoxy-3-tetrazol-1-yl-	-	8.73
42	Zinc,bis[2-(1;1-dimethyl-2-propenyl)-3,3-dimethylcyclopropyl]-,[1.alpha.(1R*,2	-	0.61
43	6. β.Bicyclo[4.3.0]nonane,5.beta.-ioamethyl-1.beta.-isopropenyl-4.alpha.,5.alpha	-	0.62