# 桂郁金茎叶、生品与炮制品挥发油的比较分析

潘小姣,陈勇,韦玉燕,杨秀芬*
(广西中医学院,南宁 530001)

[摘要] **目的**:分析桂郁金茎叶、生品与炮制品的挥发油化学成分。**方法**:用水蒸气蒸馏法提取挥发油后采用气相色谱-质谱联用法(GC-MS)分析。**结果**:从桂郁金茎叶中分离得到 57 个化学成分,鉴定了 37 个;桂郁金生品中分离出 45 个化学成分,鉴定了 22 个;从桂郁金炮制品中分离出 44 个化学成分,鉴定了 32 个。**结论**:3 个样品挥发油的成分及含量均存在较大差异。

[关键词] 桂郁金; 挥发油; 气相色谱-质谱
[中图分类号] R284.1 [文献标识码] A [文章编号] 1005-9903(2011)21-0107-06

# Comparative Analysis of Volatile Oils in Stems and Leaves, Root Tubers and Its Processed Products of *Curcuma kwangsiensis*

*PAN Xiao-jiao, CHEN Yong, WEI Yu-yan, YANG Xiu-fen**
(1. *Guangxi Traditional Chinese Medical University, Nanning* 530001, *China*)

[**Abstract**] **Objective**: To analyze constituents in the volatile oils extracted from stems and leaves, root tubers and its processed products of *Curcuma kwangsiensis*. **Method**: Volatile oils of *C. kwangsiensis* were extracted through steam distillation, and the constituents were separated and identified by using GC-MS. **Result**: Thirty-seven chemical components were determined in volatile oil from stems and leaves of *curcumae kwangsiensis*, 22 chemical components were determined in volatile oil from root tubers of *C. kwangsiensis* and 32 chemical components were determined in volatile oil from its processed products. **Conclusion**: Chemical components in volatile oils were different in three samples.

[**Key words**] *Curcuma kwangsiensis*; volatile oil; GC-MS

桂郁金为姜科姜黄属植物广西莪术 *Curcuma kwangsiensis* S. G. Lee et C. F. Liang 的干燥块根,其性味辛、苦、寒,归肝、心、肺经,具有活血止痛、行气解郁、清心凉血、利胆退黄等功效,用于胸胁刺痛、胸痹心痛、经闭痛经、乳房胀痛、热病神昏、癫痫发狂、血热吐衄、黄疸尿赤等症[1]。姜科姜黄属植物均富含挥发油,现代研究表明,挥发油具有抗肿瘤、抗腹泻、抗炎、抗早孕等药理作用。目前对广西莪术挥发油的研究多集中在根茎[2-3](中药材莪术),对茎叶和块根(中药材桂郁金)目前没有挥法油方面的研究报道。本文采用气质联用方法对桂郁金茎叶、生品与炮制品中的挥发油成分进行了系统分析,并比较了它们所含挥发油成分的差异。

## 1 材料

**1.1** 药材 桂郁金茎叶、生品与炮制品均于 2010 年 12 月采购自广西钦州市灵山县陆屋镇,其中桂郁金茎叶为桂郁金干燥的地上部位,桂郁金生品为为自然阴干的块根,桂郁金炮制品为水煮至透心再烘干的块根。样品经广西中医学院何报作教授鉴定为广西莪术 *C. kwangsiensis* 的茎叶、干燥的块根生品和炮制品。

**1.2** 仪器和试剂 气相色谱-质谱联用仪 HP6890/

[收稿日期] 20110503(002)
[基金项目] 广西科技厅应用基础研究专项(桂科基 0832006)
[第一作者] 潘小姣,副教授,从事中药活性成分筛选及其质量标准研究,Tel:0771-3137585,E-mail:pxjgx@yahoo.com.cn
[通讯作者] *杨秀芬,医学博士,教授,从事中草药心血管活性的物质基础及作用机制研究,Tel:0771-2279423,E-mail:xiufenyang@163.com

HP5973(美国惠普公司);色谱柱为 HP-5MS (0.25 μm×0.25 mm×30 m)弹性石英毛细管柱;挥发油提取器;LG16-W 离心机(北京医用离心机厂),无水硫酸钠(分析纯,上海化学试剂公司)。

## 2 方法与结果

**2.1** 挥发油提取 分别称取桂郁金茎叶、生品与炮制品各 50 g,用挥发油提取器按常规方法水蒸气蒸馏提取至挥发油量不再增加,得到有浓郁香味的浅黄色油状液体,得率分别为 0.6%,0.4%,0.2%。所得挥发油分别加 1 mL 乙酸乙酯溶解,置 1.5 mL 离心管,加适量无水硫酸钠,离心(10 000 r·min$^{-1}$)10 min,备用。

**2.2** 气相色谱分析条件 HP-5MS(0.25 mm×0.25 μm×30 m)弹性石英毛细管柱;载气为氮气,流速为 1 mL·min$^{-1}$,进样量 0.5 μL,分流比 50∶1,气化室温度 250 ℃,离子流温度 230 ℃,电离方式 EI,电子能量 70 eV,扫描质量范围为 15 ~ 550。谱图采用 NIST98 和 NIST05 进行检索。桂郁金茎叶挥发油的升温程序为起始温度 70 ℃,以 15 ℃·min$^{-1}$升温至 160 ℃,保持 1 min,以0.5 ℃·min$^{-1}$升温至 170 ℃,以 10 ℃·min$^{-1}$升温至 180 ℃。桂郁金生品挥发油的升温程序为起始温度 70 ℃,以 15 ℃·min$^{-1}$升温至 160 ℃,保持 1 min,以 0.5 ℃·min$^{-1}$升温至 165 ℃,以 15 ℃·min$^{-1}$升温至 180 ℃。桂郁金炮制品挥发油的升温程序为:起始温度 70 ℃,以 15 ℃·min$^{-1}$升温至 130 ℃,保持 1 min,以 15 ℃·min$^{-1}$升温至 160 ℃,保持 1 min,以 0.5 ℃·min$^{-1}$升温至 165 ℃,以 15 ℃·min$^{-1}$升温至 180 ℃。

**2.3** 结果 桂郁金茎叶共检出 57 个成分,已鉴定成分 37 个,占挥发油总量的 69.78%,其中含量最高的 3 个化合物为(*E*,*E*)-10-(1-甲乙烯基)-3,7-环奎二烯酮(7.09%)、莪术呋喃烯(6.96%)、石竹烯氧化物(4.73%);桂郁生品共检出 45 个成分,已鉴定成分 22 个,占挥发油总量的 68.31%,其中含量最高的 3 个化合物为莪术呋喃烯(25.23 %)、吉马酮(11.13%)、β-榄香烯(6.53%);桂郁金炮制品共检出 44 个成分,已鉴定成分 32 个,占挥发油总量的 79.06%,其中含量最高的 3 个化合物为吉马酮(20.68%)、香橙烯(9.05%)、莪术呋喃烯(7.27%)。各样品挥发油成分差异较大,相同成分相对含量差异也较大。各样品挥发油中已鉴定成分及共有成分见表 1 ~ 4。

**表 1 桂郁金茎叶挥发油化学成分分析**

| No. | $t_R$/min | 桂郁金茎叶挥发油所含化学成分 | 分子式 | 相对含量/% |
|---|---|---|---|---|
| 1 | 3.48 | (1*S*)-6,6-dimethyl-2-methylene-bicyclo[3.1.1]heptane (1*S*)-(-)-β-蒎烯 | $C_{10}H_{16}$ | 0.28 |
| 2 | 3.89 | eucalyptol 桉叶素 | $C_{10}H_{18}O$ | 0.87 |
| 3 | 4.40 | 3,7-Dimethyl-1,6-octadien-3-ol 芳樟醇 | $C_{10}H_{18}O$ | 0.52 |
| 4 | 4.82 | camphor 樟脑 | $C_{10}H_{16}O$ | 2.81 |
| 5 | 5.00 | isoborneol 异龙脑 | $C_{10}H_{18}O$ | 3.61 |
| 6 | 5.25 | α-terpineol (*p*-menth-1-en-8-ol)α-松油醇 | $C_{10}H_{18}O$ | 0.82 |
| 7 | 5.57 | cis-2-Methyl-5-(1-methylethenyl)-2-cyclohexen-1-ol 顺式-2-甲基-5-(1-甲乙烯基)-2-环乙烯醇-1 | $C_{10}H_{16}O$ | 0.19 |
| 8 | 5.86 | 3,7-dimethyl-2,6-octadienal 柠檬醛 | $C_{20}H_{32}O_2$ | 0.05 |
| 9 | 6.16 | isobornyl acetate 乙酸异龙脑酯 | $C_{12}H_{20}O_2$ | 0.33 |
| 10 | 6.80 | (3*R*-trans)-4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-cyclohexene (3*R*-反式)-4-甲基-4-乙烯基-3-(1-甲乙烯基)-1-(1-甲基乙基)-环己烯 | $C_{15}H_{24}$ | 0.31 |
| 11 | 6.95 | α-cubebeneα-荜澄茄油萜 | $C_{15}H_{24}$ | 0.06 |
| 12 | 7.31 | copaene 胡椒烯 | $C_{15}H_{24}$ | 0.47 |
| 13 | 7.43 | [1*S*-(1α,2β,4β)]-1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-cyclohexane β-榄香烯 | $C_{15}H_{24}$ | 3.82 |
| 14 | 7.85 | caryophyllene 石竹烯 | $C_{14}H_{22}$ | 2.71 |
| 15 | 8.20 | (1α,4aα,8aα)-1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-naphthalene (1α,4aα,8aα)-1,2,3,4,4a,5,6,8a-八氢-7-甲基-4-亚甲基-1-(1-甲基乙基)-萘 | $C_{15}H_{24}$ | 0.72 |

续表 1

| No. | $t_R$/min | 化学成分 | 分子式 | 相对含量/% |
|---|---|---|---|---|
| 16 | 8.31 | *cis*-1,1,4,8-tetramethyl-4,7,10-cycloundecatriene 顺式-1,1,4,8-四甲基-4,7,10-环十一三烯 | $C_{15}H_{24}$ | 2.61 |
| 17 | 8.58 | (4aR-trans)-decahydro-4a-methyl-1-methylene-7-(1-methylethylidene)-naphthalene (4aR-反式)-十氢-4a-甲基-1-亚甲基-7-(1-甲基亚乙基)-萘 | $C_{15}H_{24}$ | 1.21 |
| 18 | 8.68 | germacrene D 大根香叶烯 D | $C_{15}H_{24}$ | 1.23 |
| 19 | 8.80 | trans-6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropenyl-benzofuran 莪术呋喃烯 | $C_{15}H_{20}O$ | 6.96 |
| 20 | 8.95 | [2*R*-(2$\alpha$,4a$\alpha$,8a$\beta$)]-1,2,3,4,4a,5,6,8a-Octahydro-4a,8-dimethyl-2-(1-methylethenyl)-naphthalene [2*R*-(2$\alpha$,4a$\alpha$,8a$\beta$)]-1,2,3,4,4a,5,6,8a-八氢-4a,8-二甲基-2-(1-甲乙烯基)-萘 | $C_{15}H_{24}$ | 4.36 |
| 21 | 9.29 | (1*S*-*cis*)-1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene (1S-顺式)-1,2,3,5,6,8a-六氢-4,7-双甲基-1-(1-甲基乙基)-萘 | $C_{15}H_{24}$ | 2.40 |
| 22 | 9.77 | (4a*R*-trans)-1,2,3,4,4a,5,6,8a-octahydro-4a,8-dimethyl-2-(1-methylethylidene)-naphthalene(4a*R*-反式)-1,2,3,4,4a,5,6,8a-八氢-4a,8-二甲基-2-(1-甲基亚乙基)-萘 | $C_{15}H_{24}$ | 1.29 |
| 23 | 10.04 | 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane 1-甲基-1-乙烯基-2-(1-甲乙烯基)-4-(1-甲基亚乙基)环己烷 | $C_{15}H_{24}$ | 2.15 |
| 24 | 10.34 | 1,7,7-trimethyl-2-vinylbicyclo[2.2.1]hept-2-ene 1,7,7-三甲基-2-乙烯基双环[2.2.1]庚烯-2 | $C_{12}H_{18}$ | 1.17 |
| 25 | 10.45 | caryophyllene oxide 石竹烯氧化物 | $C_{15}H_{24}O$ | 4.73 |
| 26 | 10.69 | $\gamma$-elemene $\gamma$-榄香烯 | $C_{15}H_{24}$ | 3.51 |
| 27 | 11.19 | [1a*R*-(1a$\alpha$,7$\alpha$,7a$\beta$,7b$\alpha$)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,4,7-tetramethyl-1H-cycloprop[e]azulene [1a*R*-(1a$\alpha$,7$\alpha$,7a$\beta$,7b$\alpha$)]-1a,2,3,5,6,7,7a,7b-八氢-1,1,4,7-四甲基-1H-环丙烷[e]甘菊环烃 | $C_{15}H_{24}$ | 1.05 |
| 28 | 11.52 | (1*S*-*cis*)-1,2,3,4,5,6,7,8-Octahydro-1,4-dimethyl-7-(1-methylethylidene)-azulene 愈创木烯 | $C_{15}H_{24}$ | 1.99 |
| 29 | 11.71 | 2-isopropyl-5-methyl-9-methylen-bicyclo[4.4.0]dec-1-ene 5-甲基-9-亚甲基-2-异丙基双环[4.4.0]十烯-1 | $C_{15}H_{24}$ | 2.49 |
| 30 | 12.29 | (*E*,*E*)-3,7-dimethyl-10-(1-methylethylidene)-3,7-cyclodecadien-1-one 吉马酮 | $C_{15}H_{22}O$ | 1.16 |
| 31 | 12.60 | (-)-spathulenol (-)-匙叶桉油烯醇 | $C_{15}H_{24}O$ | 0.39 |
| 32 | 13.14 | (*E*,*E*)-10-(1-methylethenyl)-3,7-cyclodecadien-1-one (*E*,*E*)-10-(1-甲乙烯基)-3,7-环奎二烯酮-1 | $C_{13}H_{18}O$ | 7.09 |
| 33 | 13.59 | 6,10-dimethyl-3-(1-methylethyl)-6-cyclodecene-1,4-dione 莪二酮 | $C_{15}H_{24}O_2$ | 3.65 |
| 34 | 13.93 | 6-isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol 6-异丙烯基-4,8a-二甲基-1,2,3,5,6,7,8,8a-八氢-萘醇-2 | $C_{15}H_{24}O$ | 1.89 |
| 35 | 18.95 | bis(2-methylpropyl) ester-1,2-benzenedicarboxylic acid 邻苯二甲酸二异丁酯 | $C_{16}H_{20}O_4$ | 0.27 |
| 36 | 19.31 | 6,10,14-Trimethyl-2-pentadecanone 植酮 | $C_{18}H_{36}O$ | 0.47 |
| 37 | 22.71 | (*E*,*E*)-6,10,14-trimethyl-5,9,13-pentadecatrien-2-one 法尼基丙酮 | $C_{18}H_{30}O$ | 0.14 |

**表 2 桂郁金生品挥发油化学成分分析结果**

| 序号 | $t_R$/min | 桂郁金生品挥发油所含化学成分 | 分子式 | 相对含量/% |
|---|---|---|---|---|
| 1 | 3.25 | camphene 莰烯 | $C_{10}H_{16}$ | 0.28 |
| 2 | 3.46 | β-pinene β-蒎烯 | $C_{10}H_{16}$ | 0.40 |
| 3 | 3.73 | 3-carene 3-蒈烯 | $C_{10}H_{16}$ | 0.35 |
| 4 | 4.38 | (+)-4-carene (+)-4-蒈烯 | $C_{10}H_{16}$ | 0.30 |
| 5 | 4.80 | camphor 樟脑 | $C_{10}H_{16}O$ | 1.23 |
| 6 | 4.98 | borneol 龙脑 | $C_{10}H_{16}O$ | 0.90 |
| 7 | 6.14 | (1S-endo)-1,7,7-trimethyl-bicyclo[2.2.1]heptan-2-ol-acetate 左旋乙酸冰片酯 | $C_{12}H_{20}O_2$ | 0.91 |
| 8 | 6.80 | (3R-trans)-4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-cyclohexene(3R-反式)-4-甲基-4-乙烯基-3-(1-甲乙烯基)-1-(1-甲乙烯基)-环己烯 | $C_{15}H_{24}$ | 0.79 |
| 9 | 7.43 | [1S-(1α,2β,4β)]-1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-cyclohexane β-榄香烯 | $C_{15}H_{24}$ | 6.53 |
| 10 | 7.84 | caryophyllene 石竹烯 | $C_{14}H_{22}$ | 2.05 |
| 11 | 8.29 | α-Caryophyllene α-石竹烯 | $C_{14}H_{22}$ | 1.50 |
| 12 | 8.81 | trans-6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropenyl-benzofuran 莪术呋喃烯 | $C_{15}H_{20}O$ | 25.23 |
| 13 | 8.95 | (4aR-trans)-decahydro-4a-methyl-1-methylene-7-(1-methylethylidene)-naphthalene(4aR-反式)-十氢-4a-甲基-1-亚甲基-7-(1-甲基亚乙基)-萘 | $C_{15}H_{24}$ | 2.01 |
| 14 | 10.04 | 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane 1-甲基-1-乙烯基-2-(1-甲乙烯基)-4-(1-甲基亚乙基)-环己烷 | $C_{15}H_{24}$ | 3.47 |
| 15 | 10.65 | β-elemenone β-榄香烯酮 | $C_{15}H_{22}O$ | 2.97 |
| 16 | 11.49 | [1S-(1α,7α,8aα)]-1,2,3,5,6,7,8,8a-Octahydro-1,8a-dimethyl-7-(1-methylethenyl)-naphthalene 佛术烯 | $C_{15}H_{24}$ | 1.15 |
| 17 | 12.00 | β-humuleneβ-蛇麻烯 | $C_{14}H_{22}$ | 2.22 |
| 18 | 12.13 | [1S-(1α,7α,8aβ)]-1,2,3,5,6,7,8,8a-Octahydro-1,4-dimethyl-7-(1-methylethenyl)-azulene [1S-(1α,7α,8aβ)]-1,2,3,5,6,7,8,8a-八氢-1,4-双甲基-7-(1-甲乙烯基)-甘菊环烃 | $C_{15}H_{24}$ | 1.58 |
| 19 | 12.41 | isoaromadendrene epoxide 异香橙烯环氧化物 | $C_{15}H_{24}O$ | 1.27 |
| 20 | 13.13 | (*E*,*E*)-3,7-dimethyl-10-(1-methylethylidene)-3,7-cyclodecadien-1-one 吉马酮 | $C_{15}H_{22}O$ | 11.13 |
| 21 | 13.49 | neocurdion 新郁金二酮 | $C_{15}H_{24}O_2$ | 0.80 |
| 22 | 13.69 | 6-isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol 6-异丙烯基-4,8a-双甲基-1,2,3,5,6,7,8,8a-八氢-萘醇-2 | $C_{15}H_{24}O$ | 1.24 |

**表 3 桂郁金炮制品挥发油化学成分分析**

| 序号 | $t_R$/min | 桂郁金生品挥发油所含化学成分 | 分子式 | 相对含量/% |
|---|---|---|---|---|
| 1 | 3.20 | 2-methyl-5-(1-methylethyl)-bicyclo[3.1.0]hex-2-ene 2-甲基-5-(1-甲基乙基)-二环[3.1.0]六烯-2 | $C_{10}H_{16}$ | 0.22 |
| 2 | 3.28 | (1R)-α-pinene (1R)-α-蒎烯 | $C_{10}H_{16}$ | 1.86 |
| 3 | 3.42 | camphene 莰烯 | $C_{10}H_{16}$ | 4.62 |
| 4 | 3.65 | β-pinene β-蒎烯 | $C_{10}H_{16}$ | 2.39 |
| 5 | 4.02 | 1-methyl-2-(1-methylethyl)-benzene 邻异丙基甲苯 | $C_{10}H_{14}$ | 0.23 |
| 6 | 4.06 | *D*-lfimonene 右旋萜二烯 | $C_{10}H_{16}$ | 1.47 |
| 7 | 4.11 | eucalyptol 桉叶素 | $C_{10}H_{18}O$ | 5.21 |
| 8 | 4.69 | 3,7-dimethyl-1,6-octadien-3-ol 芳樟醇 | $C_{10}H_{18}O$ | 0.19 |
| 9 | 5.38 | camphor 樟脑 | $C_{10}H_{16}O$ | 4.46 |

续表 3

| No. | $t_R$/min | 桂郁金生品挥发油所含化学成分 | 分子式 | 相对含量/% |
|---|---|---|---|---|
| 10 | 5.51 | borneol 龙脑 | $C_{10}H_{16}O$ | 2.56 |
| 11 | 5.60 | isoborneol 异龙脑 | $C_{10}H_{18}O$ | 0.70 |
| 12 | 5.71 | (*R*)-4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol (－)-4-萜品醇 | $C_{10}H_{18}O$ | 0.24 |
| 13 | 5.85 | α-terpineol (*p*-menth-1-en-8-ol) α-松油醇 | $C_{10}H_{18}O$ | 0.56 |
| 14 | 6.95 | (1*S*-endo)-1,7,7-trimethyl-bicyclo[2.2.1]heptan-2-ol-acetate 左旋乙酸冰片酯 | $C_{12}H_{20}O_2$ | 1.75 |
| 15 | 7.56 | (3*R*-trans)-4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-cyclohexene (3R-反式)-4-甲基-4-乙基-3-(1-甲乙烯基)-1-(1-甲基乙基)-环己烯 | $C_{15}H_{24}$ | 2.30 |
| 16 | 8.19 | [1*S*-(1α,2β,4β)]-1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-cyclohexaneβ-榄香烯 | $C_{15}H_{24}$ | 0.22 |
| 17 | 8.31 | [1a*R*-(1aα,4aα,7α,7aβ,7bα)]-decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene 香橙烯 | $C_{15}H_{24}$ | 9.05 |
| 18 | 8.80 | caryophyllene 石竹烯 | $C_{14}H_{22}$ | 0.81 |
| 19 | 8.90 | γ-elemene γ-榄香烯 | $C_{15}H_{24}$ | 0.42 |
| 20 | 9.22 | β-panasinsene β-人参烯 | | 0.29 |
| 21 | 9.35 | α-caryophyllene α-石竹烯 | $C_{14}H_{22}$ | 0.61 |
| 22 | 9.66 | [1*S*-(1α,4α,7α)]-1,2,3,4,5,6,7,8-octahydro-1,4,9,9-tetramethyl-4,7-methanoazulene [1*S*-(1α,4α,7α)]-1,2,3,4,5,6,7,8-八氢-1,4,9,9-四甲基-4,7-亚甲基奥 | $C_{15}H_{24}$ | 0.24 |
| 23 | 9.81 | [s-(*E*,*E*)]-1-methyl-5-methylene-8-(1-methylethyl)-1,6-cyclodecadiene [s-(*E*,*E*)]-1-甲基-亚甲基-8-(1-甲基乙基)-1,6-环奎二烯 | $C_{15}H_{24}$ | 1.59 |
| 24 | 9.93 | (4aR-trans)-decahydro-4a-methyl-1-methylene-7-(1-methylethenyl)-naphthalene (4aR-反式)-十氢-4a-甲基-1-亚甲基-7-(1-甲基亚乙基)-萘 | $C_{15}H_{24}$ | 0.83 |
| 25 | 10.05 | trans-6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropenyl-benzofuran 莪术呋喃烯 | $C_{15}H_{20}O$ | 7.27 |
| 26 | 11.09 | [1*R*-(1α,3α,4β)]-4-ethenyl-α,α,4-trimethyl-3-(1-methylethenyl)-cyclohexanemethanol [1*R*-(1α,3α,4β)]-4-乙烯基-α,α,4-三亚基-3-(1-甲乙烯基)-环己甲醇 | $C_{15}H_{26}O$ | 0.23 |
| 27 | 11.43 | 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane 1-甲基-1-乙烯基-2-(1-甲乙烯基)-4-(1-甲基亚乙基)-环己烷 | $C_{15}H_{24}$ | 1.67 |
| 28 | 12.11 | [1a*R*-(1aα,7α,7aα,7bα)]-1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-tetramethyl-1H-cyclopropa[a]naphthalene, [1a*R*-(1aα,7α,7aα,7bα)]-1a,2,3,5,6,7,7a,7b-八氢-1,1,7,7a-四甲基-1H-环丙烷[a]萘 | $C_{15}H_{24}$ | 2.11 |
| 29 | 12.25 | [2*R*-(2α,4aα,8aα)]-decahydro-α,α,4a-trimethyl-8-methylene-2-naphthalenemethanol α-桉叶醇 | $C_{15}H_{26}O$ | 1.59 |
| 30 | 12.49 | β-elemenone β-榄香烯酮 | $C_{15}H_{22}O$ | 1.90 |
| 31 | 14.24 | [1S-(1α,3aβ,4α,8aβ)]-decahydro-4,8,8-trimethyl-9-methylene-1,4-methanoazulene 长叶烯 | $C_{15}H_{24}$ | 0.79 |
| 32 | 15.63 | (*E*,*E*)-3,7-dimethyl-10-(1-methylethylidene)-3,7-cyclodecadien-1-one 吉马酮 | $C_{15}H_{22}O$ | 20.68 |

## 3 讨论

桂郁金茎叶和块根之间的挥发油差异较大。桂郁金每年都是在冬季茎叶枯萎后采挖地下部位,所以桂郁金产地会遗弃大量废弃茎叶。因茎叶含有丰富的挥发油,具有刺激气味不适合作为动物饲料和生活燃料,故通常是用燃烧的方法将其焚毁,这样就造成了空气污染和资源浪费。本研究表明桂郁金茎叶总挥发油含量较高(0.6%),其中樟脑、β-榄香烯、莪术呋喃烯、石竹烯、石竹烯氧化物、异龙脑等化学成分含量较高,可考虑将茎叶“变废为宝”,把其挥发油开发用于日化产品。

**表 4 3 种样品挥发油中含有相同化学成分**

| No. | 化学成分 | 相对含量/% | | |
|---|---|---|---|---|
| | | 桂郁金茎叶 | 桂郁金生品 | 桂郁金炮制品 |
| 1 | camphor 樟脑 | 2.81 | 1.23 | 4.46 |
| 2 | (3*R*-trans)-4-ethenyl-4-methyl-3-(1-methylethenyl)-1-(1-methylethyl)-cyclohexene (3*R*-反式)-4-甲基-4-乙烯基-3-(1-甲乙烯基)-1-(1-甲基乙基)-环已烯 | 0.31 | 0.79 | 2.30 |
| 3 | [1*S*-(1$\alpha$,2$\beta$,4$\beta$)]-1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-cyclohexane $\beta$-榄香烯 | 3.82 | 6.53 | 0.22 |
| 4 | (4a*R*-trans)-decahydro-4a-methyl-1-methylene-7-(1-methylethylidene)- naphthalene (4a*R*-反式)-十氢-4a-甲基-1-亚甲基-7-(1-甲基亚乙基)-萘 | 1.21 | 2.01 | 0.83 |
| 5 | trans-6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropenyl-benzofuran 莪术呋喃烯 | 6.96 | 25.23 | 7.27 |
| 6 | 1-ethenyl-1-methyl-2-(1-methylethenyl)-4-(1-methylethylidene)-cyclohexane 1-甲基-1-乙烯基-2-(1-甲乙烯基)-4-(1-甲基亚乙基)环已烷 | 2.15 | 3.47 | 1.67 |
| 7 | (*E*,*E*)-3,7-dimethyl-10-(1-methylethylidene)-3,7-cyclodecadien-1-one 吉马酮 | 1.16 | 11.13 | 20.68 |
| 8 | caryophyllene 石竹烯 | 2.71 | 2.05 | 0.81 |
| 9 | 6-isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol 6-异丙烯基-4,8a-双甲基-1,2,3,5,6,7,8,8a-八氢-萘醇-2 | 1.89 | 1.24 | – |
| 10 | eucalyptol 桉叶素 | 0.87 | – | 5.21 |
| 11 | 3,7-dimethyl-1,6-octadien-3-ol 芳樟醇 | 0.52 | – | 0.19 |
| 12 | isoborneol 异龙脑 | 3.61 | – | 0.70 |
| 13 | $\alpha$-terpineol ($p$-menth-1-en-8-ol) $\alpha$-松油醇 | 0.82 | – | 0.56 |
| 14 | $\gamma$-elemene $\gamma$-榄香烯 | 3.51 | – | 0.42 |
| 15 | camphene 莰烯 | – | 0.28 | 4.62 |
| 16 | $\beta$-pinene $\beta$-蒎烯 | – | 0.40 | 2.39 |
| 17 | borneol 龙脑 | – | 0.90 | 2.56 |
| 18 | (1*S*-endo)-1,7,7-trimethyl-bicyclo[2.2.1]heptan-2-ol-acetate 左旋乙酸冰片酯 | – | 0.91 | 1.75 |
| 19 | $\alpha$-caryophyllene $\alpha$-石竹烯 | – | 1.50 | 0.61 |
| 20 | $\beta$-elemenone $\beta$-榄香烯酮 | – | 2.97 | 1.90 |

桂郁金生品和炮制品的挥发油差异较大,可见不同的加工方法对挥发油化学成分有很大的影响。至于挥发油之间的差异是否会影响药理作用,还有待进一步研究阐明。

## [参考文献]

[1] 国家中医药管理局《中华本草》编委会. 中华本草:第24卷[M]. 上海:上海科学技术出版社,1999:637.

[2] 陆兔林,杨光明,宋坤,等. 气质联用法分析炮制对莪术挥发油成分的影响[J]. 中成药,2003,25(10):810.

[3] 陈旭,曾建红. 广西莪术挥发油指纹图谱研究[J]. 药物分析杂志,2008,28(8):1363.

[责任编辑 蔡仲德]