·综述·

药用鼠尾草传统应用调查与研究进展△

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［摘要］ 本文通过系统查阅近期的国内外药用鼠尾草相关文献，从其传统应用、化学成分及药理作用方面进行综述。现代化学研究表明药用鼠尾草含有丰富的挥发油、黄酮类、酚类、酚酸及其衍生物等活性成分，药理活性研究表明其具有抗氧化、抗菌、抗炎和镇痛及抗癌等活性。因此，对药用鼠尾草进行系统深入的整理研究，可为其综合开发利用提供参考。

［关键词］ 药用鼠尾草；化学成分；药理作用

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Research Progress on Chemical Constituents of *Salvia officinalis* and Its Pharmacological Effects

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［**Abstract**］ The research advances in *Salvia officinalis* were systematically discussed from several aspects including the traditional application, chemical constituents and pharmacological effects. The modern phytochemical research has shown that *S. officinalis* is rich in essential oil, flavonoid, phenols and the other chemical constituents. The pharmacological research has also proved that *S. officinalis* has multiple bioactivities, such as antioxidant, antibacterial, anti-inflammatory and analgesic, anticancer, and so on. Therefore the systemic in-depth research on *S. officinalis* could provide reference for development and utilization of it.

［**Keywords**］ *Salvia officinalis*; chemical constituents; pharmacological effects

药用鼠尾草 *Salvia officinalis* Linn.，为唇形科 Labiatae 鼠尾草属 *Salvia* 的一种芳香性植物，又名撒尔维亚，多年生草本。原产于欧洲南部与地中海沿岸地区，我国仅有栽培。药用鼠尾草的属名“*Salvia*”来自拉丁名“salvare”，意为“治疗”，种名“officinalis”，意为“药用的”，可见其药用价值甚高[1]。由于其具有广谱的药用功效，被称为万能药，经常被作为各种疾病治疗的传统中药材，包括解痉、抗菌、抗炎和神经疾病治疗，叶的浸液可作咽喉炎的嗽剂[2]。药用鼠尾草全株含香精油或挥发油，药用鼠尾草精油可用于食品工业、香料、香水和药物制剂；作为食用调香剂，用于肉类食品炖卤、煲汤或香肠、罐头食品、奶制品的调味剂；药用鼠尾草叶药茶可用于缓解盗汗，治疗神经过敏、震颤和抑郁[3]。国外对药用鼠尾草的化学成分及其药理作用进行了大量的研究工作，而国内在这方面的研究较少。现将国外对药用鼠尾草化学成分及药理作用的相关研究结果进行总结，为今后的进一步研究开发和综合利用提供参考。

1　传统应用

自古以来，产地民间常将药用鼠尾草叶和花奉为传统的神圣良药，不仅可以治疗多种疾病，还可作为保健食品食用，将药用鼠尾草叶加入三明治，或药用鼠尾草精油可以帮助消化，起到健胃的作用[1,3]。药用鼠尾草的最佳药效之一是防止出汗过多。此外，用其煎剂漱口，可止牙痛[4-5]。药用鼠尾

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草精油亦可用作食品调香剂，用于肉、香肠、鱼、汤类、罐头食品等的调味料，花可凉拌食用[6]。然而，由于地域性及民族文化的差异，使得药用鼠尾草的功效以及应用在不同的地域有所不相同，因此我们对药用鼠尾草的传统应用进行文献调研，为其进一步开发奠定基础。

表 1　药用鼠尾草的传统应用情况

应用地域	功效及应用	使用方法	文献
约旦	健胃、消食	0.1 ~ 0.3 g 药用鼠尾草精油	[3]
克罗地亚	滋补、兴奋剂、驱风剂，防腐剂；治疗口腔感染、炎症，例如口腔炎、齿龈炎、咽炎等。	药用鼠尾草干燥叶、精油或油树脂	[4-5]
利比亚，巴西	伤口治疗，皮肤和头发护理，香水，化妆品。	药用鼠尾草精油	[6-7]
地中海地区	提高记忆力，治疗阿尔茨海默病、抗氧化、抗菌、降血糖和抗肝癌。	药用鼠尾草精油、茶叶	[8]
地中海地区	食品调香剂，用于肉、香肠、鱼、汤类、罐头食品等的调味料。	药用鼠尾草花、叶和精油	[9]

2　化学成分

截至目前，国内外已报道的药用鼠尾草化学成分有 200 多个，主要为挥发油、黄酮类和酚类、酚酸及其衍生物；其他成分有糖和氨基酸等。

2.1 黄酮及其苷类

黄酮类化合物(flavonoids)是一类存在于自然界的、具有 2-苯基色原酮结构的化合物。至今已从药用鼠尾草中分离并检测得到 26 个黄酮类化合物，包括 24 个具有二氢黄酮母核，2 个具有黄酮烷母核，其母核结构见图 1，化合物见表 2[10-17]。

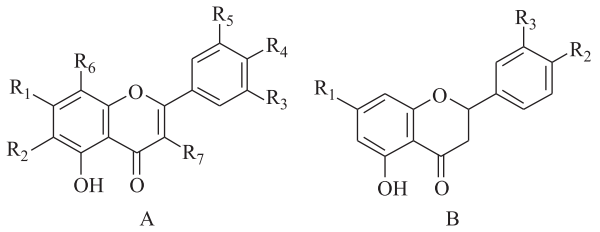

图 1　药用鼠尾草中黄酮类化合物母核结构

表 2　药用鼠尾草中的黄酮类成分

编号	化合物名称	母核	R_1	R_2	R_3	R_4	R_5	R_6	R_7
1	luteolin 7-*O*-*β*-D-glucoside	A	OGlu	H	OH	OH	H	H	H
2	luteolin 7-*O*-*β*-D-glucuronide	A	OGlucu	H	OH	OH	H	H	H
3	luteolin 3′-*O*-*β*-D-glucuronide	A	OH	H	OGlucu	OH	H	H	H
4	6-hydroxyluteolin 7-*O*-*β*-D-glucoside	A	OGlu	OH	OH	OH	H	H	H
5	6-hydroxyluteolin 7-*O*-*β*-D-glucuronide	A	OGlucu	OH	OH	OH	H	H	H
6	6，8-di-C-*β*-D-glucosylapigenin	A	OH	Glu	H	OH	H	Glu	H
7	Hispidulin	A	OH	OCH_3	H	OH	H	H	H
8	Cirsimaritin	A	OCH_3	OCH_3	H	H	OH	H	H
9	5-hydroxy-7，4′-dimethoxy flavone	A	OCH_3	OH	H	OCH_3	H	H	H
10	salvigenin	A	OCH_3	OCH_3	H	OCH_3	H	H	H
11	luteolin	A	OH	H	H	OH	OH	H	H
12	eupafolin	A	OH	OCH_3	H	OH	OH	H	H
13	Apigenin	A	OH	H	H	OH	H	H	H
14	Xanthomicrol	A	OCH_3	OCH_3	H	OH	H	OCH_3	H
15	5，3′4′-Trihydroxy-7-methoxyflavone	A	OCH_3	H	H	OH	OH	H	H
16	5，4′-Dihydroxy-6，7，3′-trimethoxyflavone	A	OCH_3	OCH_3	H	OH	OCH_3	H	H
17	5，4′-Dihydroxy-6，7，8，3′-tetramethoxyflavone	A	OCH_3	OCH_3	H	OH	OCH_3	OCH_3	H
18	Eupatoline								
19	Eupaline								
20	Patuletin	A	OH	OCH_3	H	OH	OH	H	OH

续表 2

编号	化合物名称	母核	R_1	R_2	R_3	R_4	R_5	R_6	R_7
21	Patulitrin	A	OGlu	OCH_3	H	OH	OH	H	OH
22	Isorhamnetin-3-*O*-Glc	A	OH	H	H	OH	OCH_3	H	OGlu
23	Isorhamnetin-3-*O*-Rha-Glc	A	OH	H	H	OH	OCH_3	H	OGlu-Rha
24	Isorhamnetin-3-*O*-Rha-Rha-Glc	A	OH	H	H	OH	OCH_3	H	OGlu-Rha-Rha
25	kaempferol	A	OH	H	H	OH	H	H	OH
26	quercetin	A	OH	H	H	OH	OH	H	OH
27	quercetin 4′-glucoside	A	OH	H	H	OGlu	OH	H	OH
28	Hesperetin	B	OH	OCH_3	OH	—	—	—	—
29	Genkwanin	B	OCH_3	OH	H	—	—	—	—

2.2 挥发油

药用鼠尾草全株挥发油含量较高，达 1.2% 左右。目前，主要利用气相色谱技术及气相色谱-质谱联用技术[18]，从隔绝空气干燥的药用鼠尾草的地上部分、叶、种子、茎、花及精油中鉴定了 150 多种精油，其中 1，8-Cineole，Borneol，β-Thujone，α-Humulene，β-Caryophyllene，β-Pinene，Caryophyllene oxide，α-Pinene，Camphene，Camphor 的含量相对较高[2-9,19-42]。

2.3 酚类、酚酸及其衍生物

Marie-Elisabeth Cuvelier 等利用柱层析和高效液相色谱法分离纯化得到 30 多个酚类和酚酸类化合物，主要有以下两类：一是咖啡酸及其衍生物，包括咖啡酸单体如：caffeic acid，3-(3，4-dihydroxyphenyl)lactic acid，safficinolide，3-*O*-caffeoylquinic acid，5-*O*-caffeoylquinic acid，chlorogenic acid，ferulic acid，cinnamic acid[11,43]；咖啡酸二聚体如：rosmarinic acid，7，8-dihydroxy-2-(3，4-dihydroxyphenyl)-1，2-dihydronaphthalene-1，3-dicarboxylic acid[11,44]；咖啡酸三聚体如：salvianolic acid K，salvianolic acid I，sagecoumarin，3-monoester[45]；咖啡酸四聚体如：salvianolic acid L，sagerinic acid[45]；以及咖啡酸糖苷如：6-*O*-caffeoyl-β-D-fructofuranosyl-(2→1)-α-D-glucopyranoside，1-*O*-caffeoyl-β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside，trans-p-coumaric acid 4-*O*-(2′-*O*-β-D-apiofuranosyl)-β-D-glucopyranoside，cis-p-coumaric acid 4-*O*-(2′-*O*-β-D-apiofuranosyl)-β-D-glucopyranoside，6-*O*-(E)-Feruloyl-(α and β)-glucopyranoside[10,46-47]。二是一些其他小分子酚酸类化合物如 Gallic acid，1-*O*-p-hydroxybenzoyl-β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside，4-hydroxyacetophenone 4-*O*-(6′-β-D-apiofuranosyl)-β-D-glucopyranoside，carnosol，12-*O*-methyl carnosol，isorosmanol，methyl carnosate，12-*O*-methyl carnosic acid，rosmadial，carnosic acid，rosmanol，epirosmanol，epirosmanol methyl ether，epiisorosmanol ethyl ether，galdosol，columbaridione，atuntzensin A 等[10-12,16,46,48-50]。

2.4 其他成分

Peter Capek[51]用离子交换色谱法和斐林试剂沉淀法，从药用鼠尾草地上部分的水提液检出一葡甘露聚糖，它是由 D-葡萄糖:D-甘露糖(1.0:1.3)组成。除以上成分外，药用鼠尾草叶子中还含有多种氨基酸，主要有天冬氨酸、谷氨酸、丝氨酸、甘氨酸和苏氨酸等 15 种氨基酸[52-53]。

3　药理作用

3.1 抗氧化活性

鼠尾草属植物被称为天然的抗氧化剂。Lakhal H 等[27]通过硫氰酸铁法验证巴特纳地区药用鼠尾草精油的抗氧化活性，结果显示，其精油具有良好的抗氧化作用，并呈现剂量依赖性，其中，4 $mg\cdot mL^{-1}$ 精油的抑制率最高(55.46%)。Mingfu Wang 等[46]利用 DPPH 和 $ABTS^+$ 法对日本东京地区药用鼠尾草提取物的抗氧化活性进行了检测，发现抗氧化活性最好的化合物是 rosmarinic acid 和 luteolin 7-*O*-β-D-glucoside。

I. Grzegorczyk 等[54]对罗兹地区药用鼠尾草的芽、毛状根、未分化细胞和愈伤组织和体外再生植株的幼苗和根进行抗氧化作用研究。再生植株毛状根和根的甲醇提取物具有较强抗氧化活性，而未分化细胞和愈伤组织抗氧化活性相对较低。Khakpour Shahrzad 等[55]检测伊朗卡拉季地区药用鼠尾草醇提取物的抗氧化作用，腹腔注射 28 d，异烟肼所致肝毒性大鼠的天冬氨酸转氨酶、丙氨酸转移酶和碱性

磷酸盐活力增加，而醇提取物给药组的肝毒性大鼠的酶活性减低。这证实了该提取物对异烟肼所致肝损伤具有保护作用，而且浓度为 250 mg·kg^{-1}的效果最佳。巴西圣马利亚药用鼠尾草叶子水溶性成分也具有较强的抗氧化活性[56]。

3.2 抗菌活性

巴西地区药用鼠尾草精油对蜡样芽孢杆菌、巨大芽孢杆菌、枯草芽孢杆菌、嗜水气单胞菌、嗜水气单胞菌和产酸克雷伯菌均有显著的抑菌和杀菌活性[7]。Eugenia Pinto 等[57]对葡萄牙地区药用鼠尾草精油对抗念珠菌、皮肤癣菌和其他丝状真菌的最低抑菌浓度(MIC)和最低致死浓度(MLC)进行评价。此精油含有 20.5% Camphor 和 10.4% *cis*-Thujone，对皮肤癣菌株具有较强杀菌活性，而且 MLC 值为 0.63 μL·mL^{-1}。伊朗地区药用鼠尾草精油也对金黄色葡萄球菌和白色念珠菌具有较高的抗菌活性[25]。而阿尔及利亚地区药用鼠尾草提取物中的黄酮类化合物能够清除真菌菌株的自由基，具有抗真菌作用[27]。

Ileana C. Farcasanu 等[58]研究罗马尼亚地区药用鼠尾草叶子不同浓度乙醇提取物对酵母细胞的抗菌作用，发现 90% 乙醇提取物具有最强抗菌作用，酵母细胞的代谢和结构更容易损伤，并呈现剂量依赖性。日本冈山地区药用鼠尾草提取液降低了耐万古霉素肠球菌氨基糖苷的最低抑菌浓度，具有明显的抗菌活性，其有效活性成分为 carnosol 和 carnosic acid[59]。喀土穆苏丹药用鼠尾草花的水提物和甲醇提取物具有抗菌活性，尤其是对耐抗生素的铜绿假单胞菌。同时，也可以杀死鳃足虫，其 LC_{50} 分别为 55.1 ppm 和 55.6 ppm，而且 70% 甲醇提取物比水提物抗菌活性更强[60]。

Dragana Stanojevic 等[61]研究塞尔维亚地区药用鼠尾草水提物与防腐剂苯甲酸钠、山梨酸钾和亚硝酸钠的协同作用，主要是通过棋盘法进行评估，结果证实，水提物与上述 3 种防腐剂均表现出协同作用，表明它可作为食品天然防腐剂使用。Tularat Sookto 等[62]采用同样的方法，证实了泰国药用鼠尾草精油对白色念珠菌具有较高的抗菌活性。约旦地区药用鼠尾草精油对皮肤癣菌具有抗菌活性，还能够明显抑制巨噬细胞内 NO 的产生，而且不影响细胞活力，MIC 值为 0.64 μL·mL^{-1}。这些发现表明它适用于护肤的化妆品和药品[63]。

3.3 抗炎镇痛作用

阿尔巴尼亚南部和北部的药用鼠尾草精油对小鼠巨噬细胞抗炎实验表明，两者均可显著($P < 0.05$)减少 RAW 264.7 细胞产生一氧化氮(NO)和核因子 kappa B(NF-κB)[29]。de Melo 等[64]采用急性炎症和白细胞迁移实验模型探讨巴西地区药用鼠尾草醇提取物和精油的炎症应答的干预效应。在角叉菜胶诱导的胸膜炎实验中，醇提取物不能减少胸膜渗出物的体积和白细胞转移，但是对巴豆油诱导小鼠耳肿胀产生了显著的局部抗炎效果。精油能够明显抑制由酪蛋白诱导的白细胞趋化，也可以减少精索筋膜的旋转、粘连和白细胞转移。数据表明，精油具有抗炎活性。巴西地区药用鼠尾草醇提取物具有显著的镇痛、抗炎活性，其镇痛作用的主要活性成分包含 carnosol、ursolic acid 和 oleanolic acid[65]。Ali Namvaran Abbas Abad 等[66]以吗啡作为对照，研究维也纳地区药用鼠尾草提取物对长春新碱诱导的小鼠周围神经病变的影响，结果表明药用鼠尾草提取物可能用于长春新碱诱导外周神经性疼痛的治疗。Valeria Dal Pra 等[67]研究埃雷欣药用鼠尾草的叶子甲醇提取物的抗炎活性，数据表明，25 μg·kg^{-1}甲醇提取物能够抑制血液循环中的白细胞转移到病变部位，具有显著抗炎活性。

3.4 细胞毒性和抗肿瘤

Andrej Jedina'k 等[13]发现从乌克兰地区药用鼠尾草中分离得到的 β-ursolic acid 能够抑制尿激酶活性(IC_{50} = 12 μM)和组织蛋白酶 B 活性(IC_{50} = 10 μM)，表明存在潜在的抗癌活性。Cristovao F. Lima 等[68]评价葡萄牙地区药用鼠尾草的水和甲醇提取物对 HepG2 细胞生长具有抑制作用。Dragana Šmidling 等[69]利用人羊膜上皮细胞-水泡性口炎病毒体外模型，研究贝尔格莱德地区野生和栽培药用鼠尾草中萜类化合物的细胞毒性和细胞内、细胞外抗毒活性。结果显示，萜类化合物的细胞毒性与其提取方法有关，CO_2 压力为 300 bars，温度为 60 ℃(149/3)时，蒸馏得到的栽培药用鼠尾草提取物，毒性最强；而在 CO_2 压力为 500 bars，温度为 100 ℃(144/5)时，其毒性最低，并且在细胞内水平具有抗病毒活性。

有研究[70]采用燃料排斥试验和 MTT 法检测药用鼠尾草的细胞毒性和对细胞增殖的抑制作用，50 ~ 800 μg·mL^{-1}甲醇提取物能够抑制 KG-1A，U937 和 Raji 细胞的增殖，并呈现剂量和时间依赖性，细胞增殖率 > 80%($P < 0.01$)，IC_{50} 值分别为 214.377、229.312、239.692 μg·mL^{-1}。但是甲醇提取物对正常细胞株没有明显的细胞毒作用。

3.5 降血糖作用

Valiyari S 等[71]给正常大鼠和链脲菌素诱导的糖尿病大鼠，口服药用鼠尾草提取物和格列本脲，以血糖、甘油三酯、总胆固醇、尿素、尿酸、肌酐、天门冬氨酸氨基转移酶(AST)、谷丙转氨酶(ALT)水平作为评价指标。口服 0.2 $g\cdot kg^{-1}$ 和 0.4 $g\cdot kg^{-1}$ 药用鼠尾草提取物 14 天，糖尿病大鼠的上述指标均显著降低，其血浆胰岛素增加，而正常大鼠没有变化。

Maryam Eidi 等[72]给由链脲霉素诱导的糖尿病大鼠腹腔注射药用鼠尾草甲醇提取物(100，250，400 和 500 $mg\cdot kg^{-1}$)和精油(0.042，0.125，0.2 和 0.4 $mL\cdot kg^{-1}$)，分别用水和葵花油作为空白对照。结果显示，药用鼠尾草精油没有改变大鼠的血糖，注射 3 h 甲醇提取物能显著降低糖尿病大鼠的血糖，而对胰岛素释放没有影响。甲醇提取物 LD_{50} 值为 4000 $mg\cdot kg^{-1}$。同时，对正常大鼠的血糖和胰岛素都没有影响。研究表明[73]，药用鼠尾草叶的提取物能够预防高脂饮食大鼠的胰岛素升高和炎症反应。但是，药用鼠尾草水和醇提取物对链脲佐菌素诱导的糖尿病大鼠不具有降糖作用[74]。

3.6 利尿作用

Upendra Bhadoriya 等[75]以氢氯噻嗪(10 $mg\cdot kg^{-1}$)为阳性对照，研究药用鼠尾草叶子甲醇提取物(50 和 100 $mg\cdot kg^{-1}$)的利尿作用，通过测定尿量和钠钾排泄量进行分析。数据表明，和对照组相比，甲醇提取物具有显著利尿作用，为民间将其作为利尿剂提供定量依据。

3.7 其他药理作用

Búrbara Mayer 等[76]利用酒精性胃损伤模型评价药用鼠尾草水醇提取物的胃肠活动，表现出良好的活性，ID_{50} 8.40(54.8 ~ 128.9) $mg\cdot kg^{-1}$。水醇提取物能够减少醋酸溃疡和胃分泌的总酸度，而且在体外实验中，能抑制 H^+,K^+-ATP 酶活性。经过研究发现 carnosol 可能是保护胃黏膜的主要活性成分。而且，药用鼠尾草乙醇提取物可以抑制人脐静脉内皮细胞毛细管形成和大鼠三维胶原基质主动脉血管再生，而其正己烷馏分的抑制效应最强，并且均呈现剂量依赖性。因此，可以治疗或预防与血管生成相关的疾病[77]。药用鼠尾草精油也能够抑制胆碱酯酶，改善健康青年人的情绪和认识性能[78]，提高成年雄性大鼠的记忆效应[79-80]。

4　讨论

药用鼠尾草具有广谱药用功效，且活性很高，在医药及香料上有重要用途，是天然的抗氧化剂，其挥发油尚可用作化妆品的香料。目前，国内对药用鼠尾草的研究甚少，而国外对其化学成分及药理作用研究较多。从现有的文献调研中发现，药用鼠尾草中化学成分丰富。其中，主要集中在药用鼠尾草地上部分挥发油成分的分离鉴定。大多数产地药用鼠尾草挥发油组成和含量较为相似，尤其是葡萄牙、阿尔及利亚、突尼斯和伊朗地区。而且挥发油成分具有较好的药理活性，具有显著的抗氧化、抗菌等活性。另外，药用鼠尾草自然资源丰富，在地中海、利比亚、巴西、日本以及葡萄牙等地都有分布，发掘利用的潜力很大。但是，其他成分的药理活性研究较少，药用鼠尾草的毒理研究也比较缺乏，同时，也没有对药用鼠尾草进行质量控制研究，值得深入研究。这将有利于发掘新药资源，并且对药用鼠尾草的开发和综合利用具有重要的现实意义。

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