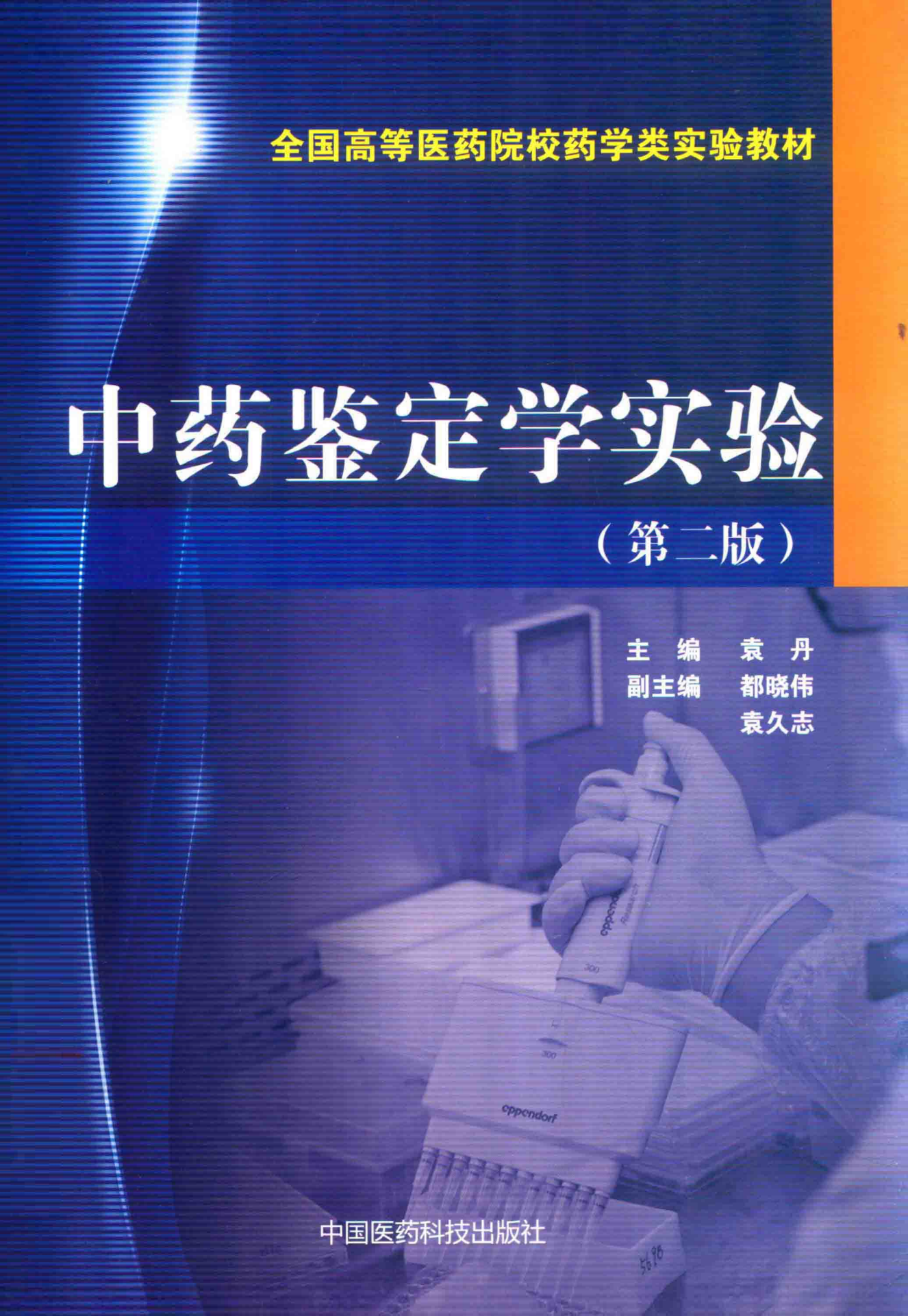
全国高等医药院校药学类实验教材

中药鉴定学实验

（第二版）

主　编　袁　丹
副主编　都晓伟
袁久志



中国医药科技出版社

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内 容 提 要

本书为全国高等医药院校药学类实验教材之一。全书分为三章，第一章为基础实验，收载实验18个，主要包括中药显微实验技术和根及根茎类、茎木类、皮类、叶类、花类、果实及种子类、全草类、动物类和矿物类等不同类别中药的基原鉴别、性状鉴别、显微鉴别和理化鉴别。第二章为现代实验技术，收载实验4个，主要包括红外光谱、HPLC色谱、凝胶电泳和聚合酶链式反应（PCR）分子生物技术等在中药鉴定学中的应用。第三章为综合性实验，收载2个实验，包括未知中药粉末的显微和理化鉴别及中药材质量标准的制订。附录收载了本书有关实验药材的中英文名称、拉丁名及基原植（动）物拉丁学名对照表和常用显微鉴别试剂等。为适应教育国际化的要求，增加了英文对照内容，以便于学生在阅读英文文献、撰写英文论文时参考。书末附有部分中药的彩色插图。本书可供高等医药院校中药学、药学和制药学等相关专业使用。

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第二版前言

本书是全国高等医药院校中药学、药学和制药学等相关专业本科的实验教材。

本书依据高等医药院校中药鉴定学教学大纲，在《中药鉴定学实验》教材基础上改编而成，分为三章：第一章为基础实验，收载中药鉴定学基础实验18个，以培养基本实验技能和方法为目的，主要内容包括中药显微实验技术和根及根茎类、茎木类、皮类、叶类、花类、果实及种子类、全草类、动物类和矿物类等不同类别中药的基原鉴别、性状鉴别、显微鉴别和理化鉴别。值得一提的是，本书在基础实验篇的实验中，引入了中药数码显微鉴定及数码成像技术，力图使实验教学内容与现今中药材鉴定的科研和常规鉴定工作接轨，学以致用。第二章为现代实验技术，收载现代中药鉴定的新技术和新方法实验4个，使学生了解中药鉴定学前沿技术方法，以引导学习兴趣和激发创新意识为目的，主要内容包括红外光谱、HPLC色谱、凝胶电泳和聚合酶链式反应（PCR）分子生物技术等在中药鉴定学中的应用。第三章为综合性实验，收载未知中药粉末的显微和理化鉴别方法及中药材质量标准的制定等2个实验，以培养综合分析和自主实验能力为目的。另有附录收载了本书有关实验药材的中英文名称、拉丁名及基源植（动）物拉丁学名对照表和常用显微鉴别试剂等，书末附有部分中药的彩色插图。

本书的特点是内容全面，重点突出，图文并茂，兼具一定的广度和深度，适用范围广，同时有英文对照内容，便于学生掌握专业英语词汇，提高阅读英文资料、撰写英文论文等国际学术交流能力，较好地体现了实验教学的系统性、科学性、前沿性和创新性。全部实验的参考学时为120学时，各院校可根据实际教学条件和教学计划选择授课。

本书是由沈阳药科大学、黑龙江中医药大学和辽宁中医药大学的中药分析鉴定学教研室教师联合编写。实验一～四、二十四由潘英妮副教授编写；实验五～八由齐文讲师编写；实验九、十七和二十三由袁久志副教授编写；实验十、十一和十二由李峰教授编写；实验十三和十四由王添敏副教授编写；实验十五、十六和十八由都晓伟教授编写；实验十九～二十一由袁丹教授编写，并负责审稿和统编全书；实验二十二由肖锋讲师编写。

在编写本书的过程中，得到了沈阳药科大学教务处的大力支持，在此表示衷心的感谢。由于时间仓促，水平有限，书中难免存在错漏之处，敬请批评指正。

编者

2014年7月

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第一章　基础实验

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实验一　显微制片与显微镜的使用

【实验目的】

掌握中药显微鉴别的基本制片技术；掌握中药显微化学鉴别的原理和方法；了解显微镜的构造，并掌握显微镜的使用方法。

【实验原理】

一、显微制片

根据鉴别对象和目的的不同，常选用徒手制片法、滑走制片法、冰冻制片法和石蜡制片法等方法来制备各种显微制片。根据制作方法和保存时间的不同，可分为临时制片、半永久性制片和永久性制片三大类。徒手制片法主要用于临时制片，操作简便、迅速、实用。滑走制片法是利用滑走切片机进行切片，适用于切制木质的根和茎等坚硬材料。冰冻制片法主要用于动物药、新鲜的植物药或幼嫩组织的切片。石蜡制片法是以石蜡作为支持剂的切片方法，主要操作步骤为：取材→固定→冲洗→脱水→透明→浸蜡→包埋→切片→粘片→脱蜡→染色→透明→封藏。

不同的鉴定材料（完整、破碎或粉末），选用的显微鉴定方法也不同。根据观察目的和对检品采取制片方法的不同，可将显微制片分为横切片或纵切片、粉末片、表面片、解离组织片、磨片等。横切片和纵切片主要用于观察药材的组织构造特征；粉末片主要用于观察组织碎片、细胞、内含物等特征；表面片主要用于观察叶、花、全草、果实和种子等的表面特征；解离组织片主要用于观察细胞的完整形态；磨片用于观察骨类、贝壳类及矿石等坚硬中药的显微特征。

二、显微化学鉴定

是指在药材的临时切片或粉末片上滴加各种化学试剂，利用显微化学反应来确定细胞壁和内含物的性质及某些有效成分在组织中的分布等。

【实验材料】

浙贝粉末，半夏粉末，洋地黄叶，松枝，桔梗根。

【仪器与试剂】

1. 仪器　生物显微镜，载玻片，盖玻片，切片刀，培养皿，镊子，滤纸条，擦

镜纸。

2. 试剂 水合氯醛试液，稀甘油试液，甘油醋酸试液，乙醇，间苯三酚试液，盐酸，苏丹Ⅲ试液，氯化锌碘试液，碘试液，硫酸，钌红试液。

【实验方法】

一、徒手制片

徒手切片是指用刀片或徒手切片器将材料切成薄片，可在显微镜下观察其组织构造和细胞特征等。

1. 取材、固定与切片 将药材经软化处理后，选取适当的部位，切成长2～3cm长的小段，用拇指、食指和中指夹住材料，下端用无名指托住，另手持刀片，自左向右移动手腕，牵曳切片，动作要轻而快，力求切片薄而完整。操作时材料的断面与刀口需经常用水润湿。对于叶片或柔软的材料，需用稍坚固而易切的胡萝卜、马铃薯或通草等将材料夹住后进行切片。

2. 徒手切片器切片 将适当长度的材料夹入切片器上，旋紧螺丝将材料固定紧，材料略露出圆盘平面，然后将切片或剃刀平放在圆盘上，自左向右拉切片，同时转动切片器下端的升降调节轮，使材料上升，以利切片。

3. 装片 将切好的薄片用毛笔小心地移入到盛有清水的培养皿中浸泡，取载玻片滴加稀甘油，用镊子或毛笔将切片移于其上，再滴加一滴稀甘油，加上盖玻片后观察。也可将薄片滴加水合氯醛液加热透化，然后再滴加稀甘油封藏。加盖玻片时应尽量避免产生气泡。

取桔梗根进行徒手切片，用乙醇装片镜检。

二、粉末制片

一般药材经粉碎、过筛（50～80目）后制片，特别坚硬的药材可用锉刀将其锉成粉末。此法是鉴别中药最常用的方法之一，主要鉴别细胞和细胞内含物的形态特征。取粉末少量，置于载玻片上，滴加1～2滴蒸馏水、稀甘油或甘油醋酸试液，加上盖玻片，置显微镜下观察，主要用于观察细胞中的不溶性物质，如淀粉粒、脂肪油滴、色素颗粒等。如要观察细胞的形态特征，则应滴加水合氯醛加热透化，除去细胞中的淀粉、油脂等，从而使细胞的形态更加清晰。为防止水合氯醛结晶析出，用水合氯醛透化后应滴加稀甘油，然后加上盖玻片，擦净溢出液，置显微镜下观察。

取浙贝母粉末，用蒸馏水装片镜检。

三、表面制片

多用于叶片、果实或草本植物茎表皮组织的观察，主要注意表皮细胞的形态、气孔的类型、毛茸的特征及着生情况等。通常用镊子夹住叶片或果实等的表面，轻轻撕取表皮层置于载玻片上，加适宜的试液制片。注意使其上表面朝上方，置显微镜下观察。

取洋地黄叶，制作表面片并镜检。

四、解离组织片

为观察细胞的完整形态，尤其是纤维、石细胞、导管、管胞等细胞彼此不易分离的组织，需利用化学试剂使组织中各细胞之间的胞间质溶解，使细胞分离。如果样品中薄壁组织占大部分，木化组织少或分散存在，可用氢氧化钾法；如果样品坚硬，木化组织较多或集成较大群束，可用硝铬酸法或氯酸钾法。在解离前，应先将样品切成宽或厚约2mm的小条或片。

1. 氢氧化钾法 置样品于试管中，加5%氢氧化钾溶液适量，加热至用玻璃棒挤压能离散为止，倾去碱液，加水洗涤后，取出少量置载玻片上，用解剖针撕开，以稀甘油装片观察。

2. 硝铬酸法 置样品于试管中，加硝铬酸试液适量，放置，至用玻璃棒挤压能离散为止，倾去酸液，加水洗涤后，照氢氧化钾法操作，装片观察。

3. 氯酸钾法 置样品于试管中，加硝酸溶液（1→2）及氯酸钾少量，缓缓加热，待产生的气泡渐少时，再及时加入氯酸钾少量，以维持气泡稳定地发生，至用玻璃棒挤压能离散为止，倾去酸液，加水洗涤后，照氢氧化钾法操作，装片观察。

取松枝用硝铬酸法制作解离组织片并镜检。

五、显微化学鉴定法

1. 细胞壁性质的鉴别

（1）木质化细胞壁 加间苯三酚试液1～2滴，稍放置，加盐酸1滴，因木化程度不同，显红色或紫红色。

（2）木栓化或角质化细胞壁 加苏丹Ⅲ试液，稍放置或微热，显橘红色至红色。

（3）纤维素细胞壁 加氯化锌碘试液，或先加碘试液湿润后，稍放置，再加硫酸溶液（33→50），显蓝色或紫色。

（4）硅质化细胞壁 加硫酸无变化。

2. 细胞内含物性质的鉴别

（1）淀粉粒 加碘试液，显蓝色或紫色；用甘油醋酸试液装片，置偏光显微镜下观察，未糊化的淀粉粒显偏光现象，已糊化的淀粉粒无偏光现象。

（2）糊粉粒 加碘试液，显棕色或黄棕色；加硝酸汞试液，显砖红色。（材料中如有多量的脂肪油，宜先用乙醚或石油醚脱脂后进行试验。）

（3）脂肪油、挥发油或树脂 加苏丹Ⅲ试液，显橘红色、红色或紫红色；加90%乙醇，脂肪油不溶解（蓖麻油及巴豆油例外），挥发油则溶解。

（4）菊糖 加10% α－萘酚乙醇溶液，再加硫酸，显紫红色并很快溶解。

（5）黏液 加钌红试液，显红色。

（6）草酸钙结晶 加稀醋酸不溶解，加稀盐酸溶解而无气泡发生；加硫酸溶液（1→2），逐渐溶解，片刻后析出针状硫酸钙结晶。

（7）碳酸钙结晶（钟乳体） 加稀盐酸溶解，同时有气泡产生。

（8）硅质 加硫酸不溶解。

用显微化学鉴定法鉴别浙贝母的淀粉粒、半夏的黏液细胞、桔梗的菊糖和松枝的木质化细胞壁。

六、显微镜的使用

1. 显微镜的构造 显微镜主要由机械部分与光学部分组成（图 1－1）。

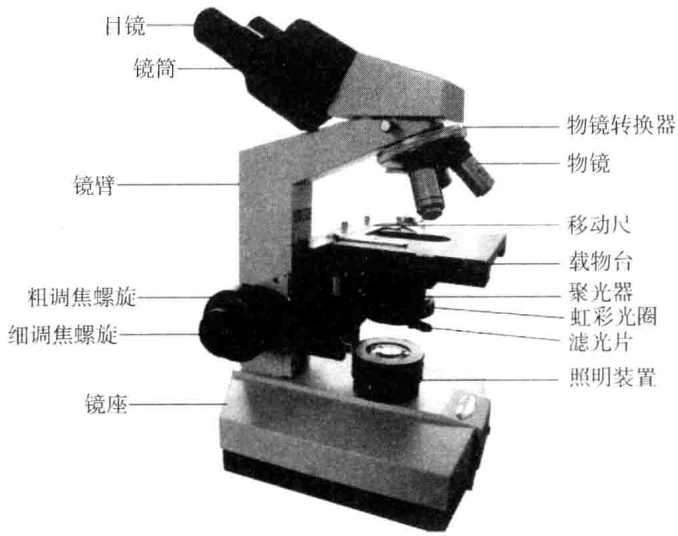

图 1－1 显微镜构造示意图

（1）机械部分 主要包括镜座、镜臂、镜筒、载物台、物镜转换盘、焦距调节装置等。

①镜座：用于保持显微镜的稳定与平衡。

②镜臂：用于支持镜筒及取放显微镜时便于握持之用。

③镜筒：为一中空的金属圆筒，用以固定物镜与目镜间的距离。现以双筒倾斜式为常见。镜筒中转折处装有棱镜，使光线转折 45°。一般镜筒长度为 160mm，也有的长为 170mm。

④载物台：用于放置载玻片之用，并有夹压片固定。装置较完善的显微镜，载物台一侧附有旋钮。可控制载玻片前后左右的移动。利用移动器上的游标尺可观察记录被检品的位置，便于再观察或重新拍照参考。

⑤物镜转换盘：具有 3～6 个螺旋口，每个螺旋口配置有不同放大倍率的物镜。通过转动转换盘，可利用不同放大倍率的物镜。

⑥焦距调节装置：通过镜筒与载物台的升降，调节物镜与标本间的距离。主要包括粗调节器和细调节器 2 个部分。外端一般是粗调节器，内端一般是微调节器。

（2）光学部分 主要由一系列的放大透镜组合而成。除了主要用于放大的透镜组外，尚有光密度调节装置、滤光片、光源装置等。

①物镜：是决定显微镜性能的最重要部分，内装有多组复式透镜。镜筒长，透镜组数多，放大率则大。一般放大率在 10 倍以下者，被称为“低倍物镜”。放大率在 40 倍以上者，被称为“高倍物镜”。为防止散射、漫射，在物镜与标本间选用香柏油或特

别浸润油作为介质进行观察时，被称为“油镜”，放大率一般在100倍。

②目镜：内装有一组放大率较小的透镜组，其作用在于将物镜所成图像作进一步的放大。就分辨力而言，目镜不能提高图像的质量。目镜表面都刻有放大率，如5×，10×，15×等3种。

③光密度调节装置

聚光器：由数片透镜组成，位于载物台下方，用于将光线集中到所要观察的标本上。聚光器的一侧，尚装有升降调节轮，供汇聚光线密度所用。在低倍镜观察时，可将最上面的一块上透镜移出光路之外，使得聚光镜的数值孔径变小。通过调节可变光阑的开放程度，从而得到透镜边框上的数字所代表的不同数值孔径，更好地发挥显微镜的观察效果。一般说来，光阑孔径开大，光量度会加强，但又会降低物镜的解像力。因此，聚光器的光阑开孔最好为物镜数值孔镜的60%～70%。

场光阑：位于光源的上方，主要功能是靠减少物镜反射光斑来控制图像的光。一般在明视野时，可将场光阑全部打开，直到在显微镜中可以看到它的整个圆形视野为止。

2. 显微镜的使用方法 使用显微镜时，应注意“两先两后”：即先低倍，后高倍；先粗调，后微调。操作时，应徐徐将物镜下降，以至几乎接近盖玻片，然后再徐徐提升，注意寻找目标。应先用低倍镜对物体进行全面观察，如再对某一特定的部分作进一步较详细的观察时，则必须先把该部分移至视野中心，再换用高倍镜进行观察。调节焦距，至成像清晰。由于物体本身具有一定的厚度与不同的透明度，故观察过程中，尚须不断轻微调节小调节器。同时应按照物体透明度的大小，将聚光器或虹彩光圈作适当的调节，以便对物体的结构获得清晰、完整的概念。

观察完毕后，必须把物镜转离光路，取下标本片，使显微镜恢复至非工作状态放回原处。

【实验报告】

1. 简述粉末片、表面片、解离组织片与徒手切片的制作过程和注意事项。
2. 使用显微镜要注意哪些事项？

Experiment 1 Microscopic Mounting and Use of Microscope

Purpose

To understand the techniques of mounting in microscopic identification of Chinese herbal medicines; To understand the methods and principles of microscopic chemical identification of TCM; To learn the structure and use of microscope.

Principle

1. Making Specimen Slides

Methods of making specimen slides should be chosen according to the nature of test object and purpose. There are four main methods including bare hand mounting, gliding mounting, cryology mounting and paraffin mounting. There are three kinds of slides including temporary

slides, semi - permanent slides and permanent slides according to the methods of mounting and conservation time. Bare hand mounting is mainly for making temporary slide. It takes the advantages of convenience, quickness and practicality. Gliding mounting is suitable for ligneous roots, stems or some other solid materials, gliding slicing machine is directly used in slicing. Cryology mounting is mainly used in slides of animal tissue, fresh and young plant tissue. Paraffin slicing is the method that acquires paraffin as an invading agent. The steps are as follows: sampling→immobilization→rinsing→dehydration→vitrification→olefin immersion→olefin embedding→slicing gluing slide pieces→ dissolvetion→dyeing→vitrification→sealing.

Different methods should be chosen according to the nature of test objects (intact, broken or powdered). Microscopical slides mainly include slide of transverse or longitudinal sections, slide of powder, slide of surface, slide of disintegrated tissue and slide of ground section. Slide of transverse or longitudinal sections is mainly used to observe tissue structure of crude drugs. Slide of powder is mainly used to observe tissue fragments, shape and ergastic substance of cells. Slide of surface is mainly used to observe the surface characteristic of leaves, flowers, herbs, fruits and seeds. Slide of disintegrated tissue is mainly used to observe the shape of intact cell. Slide of ground section is proper for hard drugs of animals or minerals.

2. Microscopic Chemical Reaction

This method is mainly for determining the properties of cell wall and ergastic substance of cell and distribution of some active component in plant tissue by adding some chemical agents on the temporary slide of plant tissue or powder of crude materials.

Materials

Powder of Fritillariae Thunbergii Bulbus and Pinelliae Rhizoma, leaf of *Rehmannia glutinosa*, branch of *Pinus massoniana*, root of *Platycodon grandiflorum*.

Apparatus and reagents

Microscope, slide glass, cover glass, blade, petri dish, tweezers, filter scrip, lens paper.

Chloral hydrate solution, dilute glycerol solution, glycerol - acetic acid solution, alcohol, solution of phloroglucinol, hydrochloric acid, Sudan Ⅲ solution, zinc chloride - iodine solution, iodine water, sulphuric acid, solution of ruthenium red.

Experimental methods

1. Bare Hand Mounting

This method is for slicing materials with razor blade or bare hand slicing machine.

(1) Sampling, fixing and slicing: Choose suitable part from the material after softening, cut it into rods of 2 ~ 3cm in length. Use thumb, forefinger and middle finger to clamp the material, support the bottom of the material with fourth finger. Hold a blade with right hand, put the blade against the material and slice smoothly from the left outward to the right inward, keep lubricating the blade with water. For leaf and other soft materials, clamp them with carrot, potato or medulla tetrapanacis before slicing.

(2) Slicing with bare hand slicing machine: Clamp the material of proper length on the machine, keep the material a bit higher than the disc pan, put the blade on the disc and slice smoothly from the left ward to the right ward, turn the hoisting wheel to rise the material at the same time.

(3) Mounting: transfer the sliced pieces with brush to petri dish full of water, drop dilute glycerol on a slide, transfer the slice on it with tweezer or brush, add a drop of dilute glycerol again and cover the cover glass. The slices can also be treated with dilute chloral hydrate solution, heat until it is transparent and mount it in dilute glycerol. Avoid producing gas bubble when cover the cover glass.

Make a slice of the root of *Platycodon grandiflorum* with the method of bare hand mounting, mount it in ethanol and examine.

2. Slide of Powder

The crude drug should be pulverized and put through sieve (50 ~ 80mesh) before mounting, solid materials should be shattered by file. Spread a small quantity of the powder on a slide, and examine after treated with distilled water, dilute glycerol or glycerol – acetic acid solution. This method is mainly for observing starch grain, fatty oil and pigment granule inside the cell. If observe the shape of cell, the slide should be treated with chloral hydrate, and heat to remove the starch and fatty oil inside the cell in order to observe clearly. After treated with chloral hydrate, add a drop of dilute glycerol to prevent chloral hydrate from crystallizing.

Make a slide of powder of Fritillariae Thunbergii Bulbus, mount in distilled water and examine.

3. Slide of Surface

After moistening and softening the materials, cut two parts of about $4mm^2$ of the observed part, place on the glass slide (one for the obverse, the other for the opposite), or tear its epidermis, add suitable test solution or heat until it is transparent, cover the cover glass and examine.

Make a slide of surface of the leaf of *Rehmannia glutinosa* and examine.

4. Slide of Disintegrated Tissue

In order to observe the shape of intact cells, such as fiber, stone cell, vessel and tracheid, which are usually in group and difficult to separate, we should use chemical agents to dissolve the middle lamella of cells. Potassium hydroxide method can be used if parenchyma makes most part of the material and with a few or scattered woody tissues; chromic – nitric acid method or potassium chlorate method can be used if the material is hard, with the presence of more woody tissues or the woody tissues grouped into larger bundles. The material should be cut into small strips of about 5mm in length, 2mm in diameter or pieces of about 1mm thick before disintegrated.

(1) Potassium hydroxide method: Place the material in a test tube, add an adequate quantity of 5% potassium hydroxide solution, and heat until the material can be disintegrated

by pressing with a glass rod. Decant the alkali solution and wash the material with water, transfer a little to a slide, tear with dissecting needle, observe using dilute glycerine asmountant and cover the cover glass.

(2) Chromic - nitric acids method: Place the material in a test tube, add an adequate quantity of chromic - nitric acid TS, and allow tostanduntil the sample can be disintegrated by pressing with a glass rod. Decant the acid solution, wash with water, and prepare a mount as method 1.

(3) Potassium chlorate method: Place the material in a test tube, add nitric acid solution (1→2) and a little potassium chlorate, heat gently until effervescence relaxes. Add a small quantity of potassium chlorate in time to maintain a light effervescence until the sample can be disintegrated by pressing with a glass rod. Decant the acid solution, wash with water and prepare a mount as method 1.

Make a slide ofdisintegrated tissue of the branch of *Pinus massoniana* in chromic - nitric acids method and examine.

5. Microscopic Chemical Identification

(1) Identification of Cell Wall

① Lignified cell wall Add 1 ~ 2 drops of phloroglucinol TS to the specimen on the slide, allow to stand for a moment, add 1 drop of hydrochloric acid, a red color or purplish - red color is produced depending on the extent of lignification.

② Suberized or cuticuarized cell wall Add Sudan III TS as above, allow to stand for a moment or warm gently, an orange - red or red color is produced.

③ Cellulose cell wall Add zinc chloride - iodine TS, or at first add iodine TS to moisten it, allow to stand for a moment, then add sulfuric acid solution (33→50), a blue or purple is produced.

④ Siliceous cell wall No change takes place on adding sulfuric acid.

(2) Identification of Cell Contents

① Starch Add iodine TS, a blue or purple color is produced; Mount in glycerol - acetic acid TS, examine under a polarizing microscope, starch granules show crossed polarized light which disappears in gelatinized granules.

② Aleurone Add iodine TS, a brown or yellowish - brown color is produced; Add mercuric nitrate TS, a brick red color is produced. (if the material is oily, it should be de - fatted with ether or petroleum ether before being tested).

③Fatty oil, volatile oil or resin Add Sudan Ⅲ TS, an orange - red, red or purplish - red colour is produced; In 90% ethanol, fatty and resin oil is insoluble, except castor oil and croton oil, while volatile oil is soluble.

④ Inulin Add a 10% solution of a - naphthol in ethanol and then add sulfuric acid, the crystals of inulin turn purplish - red and dissolve rapidly.

⑤ Mucilage Add ruthenium red TS, a red colour is produced.

⑥ Calcium oxalate crystals Insoluble in dilute acetic acid, soluble in dilute hydrochloric acid without effervescence; Dissolve gradually in sulfuric acid solution (1→2), but needle crystals of calcium sulfate appear on standing for a moment.

⑦ Calcium carbonate crystals (stalactite) Soluble in dilute hydrochloric acid with effervescence.

⑧ Silicum Insoluble in sulfuric acid.

Examine the starch grain of Fritillariae Thunbergii Bulbus, mucilage cell of PinelliaeRhizoma, inulin of Platycodonis Radix, lignified cell wall of Pinus massoniana with the method of microscopic chemical identification.

6. Use of Microscope

(1) Structure of Microscope The microscope is mainly composed of mechanical set and optical system. (Fig. 1 - 1).

① Mechanical set: usually includes base, arm, body tube, stage, nosepiece, focus knob *etc.*

Base: supports the microscope and keep it steady.

Arm: supports the body tube and used as the handle when carrying microscope.

Body tube: is an empty metal cylinder, used to fix the distance between objective and ocular.

Stage: used to place and fix the slide.

Nosepiece: holds 3 ~ 6 joints, each of them is fitted with objectives of different magnifications.

Focus knob: used to adjust the distance between objective and specimen by raising and lowering the body tube and stage, mainly includes the coarse focus knob and the fine focus knob.

② Optical system: mainly includes a set of magnifying lens, light density control, light filter, light source *etc.*

Objective: is very important to the function of microscope, and there are several sets of compound lens inside. Longer body tube and more sets of lens result in higher magnifying power. Generally low powder objective is below 10 magnifications and high powder objective is above 40 magnifications. In order to prevent scattering and diffusing, add cedar oil or other special oils between objective and specimen, thus the objective is 100 magnifications and is called "oil immersion objective".

Ocular: contains a set of lens of lower magnifying power, it can further magnify the image produced by objective, but cannot promote the quality of the image. Magnifications are carved on the surface of the ocular, such as 5 ×, 10 ×, 15 ×.

Light density control: a. Condenser: it is composed of several lens and located below the stage, used to concentrate light on the specimen under examination. These is a adjust knob on the side of microscope which can lift or lower the condenser to change the light density. b.