

学校编码: 10384

分类号_____密级_____

学号: 200426007

UDC _____

厦 门 大 学

硕 士 学 位 论 文

福建九龙江口红树植物秋茄各组分单宁含量及盐度对
根单宁生产的效应

**Tannin contents of different parts of *Kandelia candel*, and salinity
effect on tannin production of roots in the Jiulong River Estuary,
Fujian, China**

指导教师姓名: 林 益 明 教授

专业名称: 植 物 学

论文提交日期: 2007 年 5 月 17 日

论文答辩时间: 2007 年 6 月 14 日

学位授予日期: 2007 年 月 日

答辩委员会主席: 李振基 教授

评 阅 人: 黎中宝 教授、丁振华 教授

2007 年 6 月

厦门大学博硕士学位论文摘要库

厦门大学学位论文原创性声明

兹提交的学位论文，是本人在导师指导下独立完成的研究成果。本人在论文写作中参考的其他个人或集体的研究成果，均在文中以明确方式标明。本人依法享有和承担由此论文产生的权利和责任。

声明人（签名）：
.

年 月 日

厦门大学博硕士学位论文摘要库

目 录

摘 要	1
ABSTRACT	3
1 前 言	5
1.1 植物单宁概念	5
1.2 植物单宁性质	5
1.3 植物单宁的生理作用	6
1.4 植物单宁合成的影响因素	7
1.5 植物单宁的定量分析	8
1.6 植物单宁细胞的观察	9
1.7 红树植物单宁研究进展	9
1.8 本文研究的目的意义	11
2. 材料与amp;方法	13
2.1 实验材料	13
2.1.1 主要实验器材	13
2.1.2 实验试剂	13
2.2 实验方法	14
2.2.1 样品采集及培养	14
2.2.1.1 样品采集	14
2.2.1.2 培养	14
2.2.2 生长发育指标测定	15
2.2.3 单宁的定量	15
2.2.3.1 总多酚的定量	15
2.2.3.2 缩合单宁的定量	15
2.2.4 单宁细胞的观察	16
2.2.5 统计分析	17

3. 结果与讨论	18
3.1 秋茄各组分的单宁含量变化.....	18
3.1.1 秋茄各组分的总酚含量变化.....	18
3.1.2 秋茄各组分的缩合单宁含量变化.....	19
3.1.3 讨论.....	22
3.2 不同盐度下秋茄根的生长指标变化.....	23
3.2.1 不同盐度下秋茄的出根率变化.....	23
3.2.1.1 秋茄在不同盐度下同一时期的出根率变化.....	23
3.2.1.2 秋茄在同一盐度下不同时期的出根率变化.....	23
3.2.2 不同盐度下秋茄的出根数变化.....	24
3.2.2.1 秋茄在不同盐度下同一时期的出根数变化.....	24
3.2.2.2 秋茄在同一盐度下不同时期的出根数变化.....	24
3.2.3 不同盐度下秋茄的根生物量变化.....	24
3.2.3.1 秋茄在不同盐度下同一时期的根生物量变化.....	25
3.2.3.2 秋茄在同一盐度下不同时期的根生物量变化.....	25
3.2.4 不同盐度下秋茄的根长变化.....	25
3.2.4.1 秋茄在不同盐度下同一时期的根长变化.....	25
3.2.4.2 秋茄在同一盐度下不同时期的根长变化.....	26
3.2.5 讨论.....	26
3.3 不同盐度下秋茄根的单宁含量变化	26
3.3.1 不同盐度下秋茄根的总酚含量变化.....	26
3.3.1.1 秋茄根在不同盐度下同一时期的总酚含量变化.....	26
3.3.1.2 秋茄根在同一盐度下不同时期的总酚含量变化.....	30
3.3.2 不同盐度下秋茄根的缩合单宁含量变化.....	30
3.3.2.1 秋茄根在不同盐度下同一时期的缩合单宁含量变化.....	30
3.3.2.2 秋茄根在同一盐度下不同时期的缩合单宁含量变化.....	34
3.3.3 讨论.....	38

3.4 在 15%盐度下秋茄根各部位的单宁含量变化.....	38
3.4.1 在15%盐度下秋茄根各部位的总酚含量含变化.....	39
3.4.1.1 在 15%盐度下秋茄根不同部位在同一时期的总酚含变化....	39
3.4.1.2 在 15%盐度下秋茄根不同部位在不同时期的总酚含量变化.	39
3.4.2 在15%盐度下秋茄根各部位的缩合单宁含量变化.....	39
3.4.2.1 秋茄在 15%盐度下根不同部位在同一时期的缩合单宁含量变	
化.....	39
3.4.2.2 秋茄在 15%盐度下根同一部位在不同时期的缩合单宁含量变	
化.....	40
3.4.3 讨论.....	40
3.5 在 15%盐度下秋茄根的单宁含量变化.....	41
3.5.1 在15%盐度下秋茄根的总酚含量变化.....	41
3.5.2 在15%盐度下秋茄根的缩合单宁含量变化.....	41
3.5.3 讨论.....	42
3.6 在不同盐度下秋茄根单宁细胞的分布.....	43
3.6.1 在不同盐度下秋茄根单宁细胞的分布.....	43
3.6.2 讨论.....	48
4 总结.....	49
参考文献.....	52
附表.....	58
附录.....	62
致谢.....	63

厦门大学博硕士学位论文摘要库

CONTENTS

Abstract(In Chinese)	1
Abstract(In English)	3
1. Introduction	5
1.1 Conception of vegetable tannins.....	5
1.2 Characteristics of vegetable tannins.....	5
1.3 Physiological function of vegetable tannins.....	7
1.4 Factors affecting vegetable tannin synthesis.....	6
1.5 Quantificational analysis of vegetable tannins.....	8
1.6 Observation of vegetable tannin cells.....	9
1.7 Review of studies on tannins of mangroves.....	9
1.8 Significance of this study.....	11
2. Materials and methods	13
2.1 Materials	13
2.1.1 Apparatus.....	13
2.1.2 Reagents.....	13
2.2 Methods	14
2.2.1 Sample collection and culture.....	14
2.2.1.1 Sample collection.....	14
2.2.1.2 Sample culture.....	14
2.2.2 Indexs of growth of <i>K.candel</i> roots.....	15
2.2.3 Measurement of tannins.....	15
2.3.2.1 Measurement of total phenolics.....	15
2.3.2.2 Measurement of condensed tannins.....	15
2.2.4 Observation of tannin cells.....	16
2.2.5 Statistics.....	17
3. Results and discussion	18

3.1 Changes of tannin contents in differrent parts of <i>K. candel</i>	18
3.1.1 Changes of total phenolics content in differrent parts of <i>K. candel</i>	18
3.1.2 Changes of condensed tannins in differrent parts of <i>K. candel</i>	19
3.1.3 Discussion.....	22
3.2 Changes of growth indexes of roots of <i>K. candel</i> in different salinity	23
3.2.1 Changes of ratio of roots of <i>K. candel</i>	23
3.2.1.1 Changes of ratio of roots of <i>K. candel</i> in different salinity at same period.....	23
3.2.1.2 Changes of ratio of roots of <i>K. candel</i> in same salinity at different periods.....	23
3.2.2 Changes of number of roots of <i>K. candel</i> in different salinity.....	24
3.2.2.1 Changes of number of roots of <i>K. candel</i> in different salinity at same period.....	24
3.2.2.2 Changes of number of roots of <i>K. candel</i> in same salinity at diffe- rent periods.....	24
3.2.3 Changes of biomass of roots of <i>K. candel</i> in different salinity.....	24
3.2.3.1 Changes of biomass of roots of <i>K. candel</i> in different salinity at same period.....	25
3.2.3.2 Changes of biomass of roots of <i>K. candel</i> in same salinity at diffe- rent periods.....	25
3.2.4 Changes of length of roots of <i>K. candel</i> in different salinity.....	25
3.2.4.1 Changes of length of roots of <i>K. candel</i> in different salinit y at same period.....	25
3.2.4.2 Changes of length of roots of <i>K. candel</i> in same salinity at different periods.....	26
3.2.5 Dissscussion.....	26
3.3 Changes of tannin contents of roots of <i>K. candel</i> in different salinity	26

3.3.1 Changes of total phenolics content of roots of <i>K. candel</i> in different salinity	26
3.3.1.1 Changes of total phenolics content of roots of <i>K. candel</i> in different salinity at same period	26
3.3.1.2 Changes of total phenolics content of roots of <i>K. candel</i> in same salinity at different periods	30
3.3.2 Changes of condensed tannin contents of roots of <i>K. candel</i> in different salinity	30
3.3.2.1 Changes of condensed tannin contents of roots of <i>K. candel</i> in different salinity at same period	30
3.3.2.2 Changes of condensed tannin contents of roots of <i>K. candel</i> in same salinity at different periods	34
3.3.3 Discussion	38
3.4 Changes of tannin contents in different parts of roots of <i>K. candel</i> in a salinity of 15‰	38
3.4.1 Changes of total phenolics content in different parts of roots of <i>K. candel</i> in the salinity of 15‰	39
3.4.1.1 Changes of total phenolics content in different parts of roots of <i>K. candel</i> at same period in the salinity of 15‰	39
3.4.1.2 Changes of total phenolics content in same part of roots of <i>K. candel</i> at different periods in the salinity of 15‰	39
3.4.2 Changes of condensed tannin contents in parts of roots of <i>K. candel</i> in the salinity of 15‰	39
3.4.2.1 Changes of condensed tannin contents in different parts of roots of <i>K. candel</i> at same period in the salinity of 15‰	39
3.4.2.2 Changes of condensed tannin contents in same part of roots of <i>K. candel</i> at different periods in the salinity of 15‰	40

3.4.3 Discussion.....	40
3.5 Changes of tannin contents of roots of <i>K. candel</i> in the salinity of 15‰.....	41
3.5.1 Changes of total phenolics content of roots of <i>K. candel</i> in the salinity of 15‰.....	41
3.5.2 Changes of condensed tainnin contents of roots of <i>K. candel</i> in the salinity of 15‰.....	41
3.5.3 Discussion.....	42
3.6 Distribution of tannin cells in roots of <i>K. candel</i> cultured in different salinity.....	43
3.6.1 Distribution of tannin cells in roots of <i>K. candel</i> in different salinity.....	43
3.6.2 Discussion.....	48
4. Conclusions	49
References	52
Tables	58
Appendix.....	62
Acknowledgements	63

摘 要

2005年秋季采集福建九龙江口红树林自然保护区的秋茄 (*Kandelia. candel*), 测定秋茄幼叶、成熟叶、老叶、茎皮、茎材、幼根皮、幼根材、老根皮、老根材等九个组分的总酚、可溶性缩合单宁、结合态缩合单宁、总缩合单宁含量; 对不同盐度 (0‰-40‰) 培养下秋茄根生长发育指标和各种单宁含量进行测定; 制作石蜡切片观察不同盐度下单宁细胞在根中的分布。探讨单宁对红树植物生态适应的意义, 研究表明:

(1) 秋茄以单宁酸为标准 and 以纯化单宁为标准测定的总酚含量具有显著的相关性, 以纯化单宁为标准的总酚含量大约是以单宁酸为标准的总酚含量的两倍。

(2) 秋茄各组分总酚含量在 $102.64 \pm 1.42 \sim 365.72 \pm 50.45 \text{ mg} \cdot \text{g}^{-1}$ 之间波动, 其中茎皮总酚含量最高, 茎材总酚含量最低, 幼根皮总酚含量高于幼根材总酚含量。皮比材总酚含量高可能是由于皮比材面对更为复杂的环境, 高总酚含量可以起到保护作用。老根皮与老根材之间没有显著性差异。老叶总酚含量高于成熟叶和幼叶。总缩合单宁与可溶性缩合单宁含量变化趋势相似, 其中可溶性缩合单宁含量显著高于结合态缩合单宁。

(3) 不同盐度下培养 60~135 d, 秋茄根生长表现出低盐促进高盐抑制。

(4) 不同盐度下培养 60~135 d, 总酚含量在同一盐度条件下随培养时间增加先波动, 而后有升高的趋势, 其中总酚最高含量出现在高盐度, 说明一定的高盐度胁迫可以促进总酚的合成; 总缩合单宁与可溶性缩合单宁含量变化趋势相似, 其中可溶性缩合单宁含量显著高于结合态缩合单宁。在 15‰ 盐度培养 75~135 d, 秋茄根不同部位的总酚、可溶性缩合单宁、结合态缩合单宁和总缩合单宁含量有相似的变化趋势: 由根尖往远离根尖的部位呈下降趋势。

(5) 15‰ 盐度下培养 15~135 d, 秋茄根总酚含量在培养 15~90 d 总酚含量呈下降趋势 ($198.71 \pm 12.60 \sim 37.42 \pm 1.13 \text{ mg} \cdot \text{g}^{-1}$), 培养 90-135 d 呈上升趋势 ($56.47 \pm 2.76 \sim 75.23 \pm 5.65 \text{ mg} \cdot \text{g}^{-1}$)。总缩合单宁与可溶性缩合单宁含量变化趋势相似, 其中可溶性缩合单宁含量显著高于结合态缩合单宁。

(6) 对不同盐度培养下秋茄根做纵向石蜡切片, 在显微镜下观察, 结果表明不

同盐度下单宁细胞在根中的分布有相似的规律：富含单宁的区域主要在根的表层细胞，越靠近根尖单宁细胞分布范围越广，秋茄根单宁细胞在根尖处分布范围于高盐度（20‰以上）下比低盐度下更广。

关键词： 红树植物；秋茄；根；生长；单宁；盐度

厦门大学博硕士论文摘要库

ABSTRACT

Total phenolics (TP), extractable condensed tannins (ECT), bound condensed tannins (BCT), and total condensed tannins (TCT) contents in the different parts of *Kandelia candel* (young leaves, mature leaves, old leaves, bark of stems, timber of stems, bark of young roots, timber of young roots, bark of old roots, timber of old roots) were determined in the Jiulong River Estuary, Fujian, China in Autumn, 2005. Seedlings of *K. candel* were cultured under various saline conditions (0‰~40‰) in greenhouse for determining indexes of growth and tannin contents of roots and for watching distributions of tannin cells of roots of *K. candel* by making parafin slice. The results showed as follows:

1. There was a significant linear correlation between total phenolics for the two different standards for *K. candel*. The results showed that about twice as much total phenolics content when the purified tannins standard was used rather than the tannic acid standard.

2. TP content of different parts of *K. candel* ranged from 102.64 ± 1.42 to $365.72 \pm 50.45 \text{ mg}\cdot\text{g}^{-1}$ with the highest in bark of stems and the lowest in timber of stems. TP content was higher in bark of young roots than timber of young roots. High TP content in bark are demanded to provide defense in complex environment. Not significant difference was found between bark and timber of old roots. TP content was higher in old leaves than young and mature leaves. ECT and TCT contents followed the similar pattern. ECT content was significantly higher than BCT content.

3. At different salinity culture, the growth of roots of *K. candel* was promoted in low salinity and was restrained in high salinity.

4. During the period of different salinity culture (from 60 to 135 d), TP content fluctuated with increasing salinity, with the highest TP content occurring in high salinity. ECT and TCT contents fluctuated under different salinity conditions with a consistent pattern. ECT contents were significantly higher than BCT contents. At culture salinity of

Degree papers are in the "[Xiamen University Electronic Theses and Dissertations Database](#)". Full texts are available in the following ways:

1. If your library is a CALIS member libraries, please log on <http://etd.calis.edu.cn/> and submit requests online, or consult the interlibrary loan department in your library.
2. For users of non-CALIS member libraries, please mail to etd@xmu.edu.cn for delivery details.

厦门大学博硕士论文摘要库