

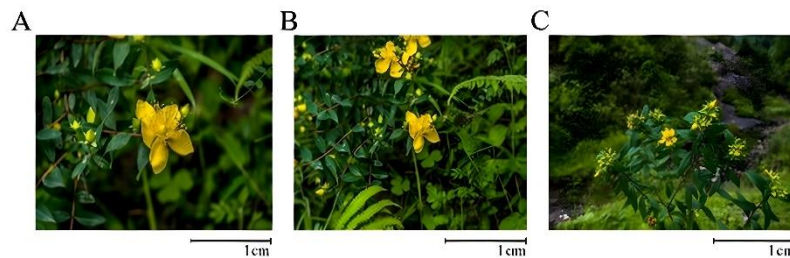
九种金丝桃属植物叶绿体全基因组：基因组结构、比较分析和系统发育关系

范照睿^{1#} 王佳敏^{2#} 童凯^{1*} 康振辉^{1*}

(1. 四川轻化工大学食品与酿酒工程学院, 宜宾 644000; 2. 兰州大学生态学院, 兰州 730000)

Complete Chloroplast Genomes of Nine *Hypericum* Species: Genome Structure, Comparative Analysis, and Phylogenetic Relationships

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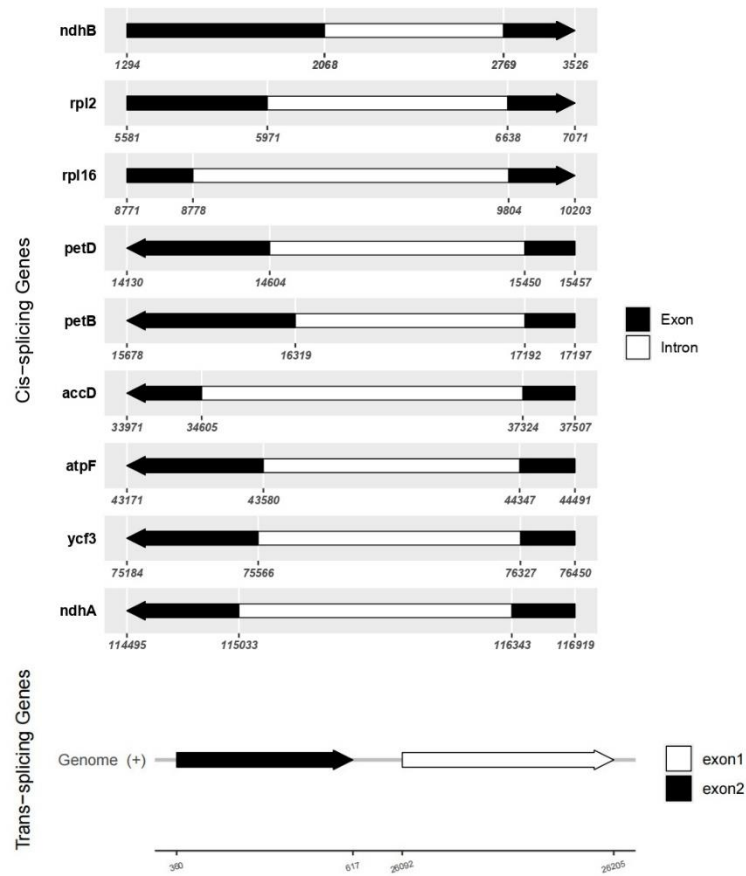


A: 植株; B: 花; C: 叶片

A: Plant. B: Flower. C: Leaf

附图 1 川滇金丝桃的形态特征

Supplementary Fig. 1 The morphological characteristics of *Hypericum forrestii*



附图 2 川滇金丝桃叶绿体顺式和反式剪接基因结构

Supplementary Fig. 2 Structures of *cis*- and *trans*-splicing genes in the *Hypericum forrestii* chloroplast genome

附表 1 9 种金丝桃属植物叶绿体全基因组的详细信息

Supplementary table 1 Summary of the complete chloroplast genomes of nine *Hypericum* species

Species	尖萼金丝桃 <i>H.Acmos epalum</i>	碟花金丝桃 <i>H.adding tonii</i>	黄海棠 <i>H.ascyr on</i>	栽秧花 <i>H.beani i</i>	川滇金丝桃 <i>H.forres tii</i>	贯叶金丝桃 <i>H.monog ynum</i>	贯叶连翘 <i>H.perfor atum</i>	柄叶金丝桃 <i>H.petiola tum</i>	元宝草 <i>H.sampso nii</i>
基因组大小 Genome size (bp)	152 654	122 570	162 286	137 652	135 991	138 972	139 725	136 105	168 150
大单拷贝区 LSC (bp)	126 934	98 190	97 542	99 212	90 710	93 123	95 109	93 709	101 233
小单拷贝区 SSC (bp)	3 044	9 574	11 052	10 988	10 425	11 079	11 084	11 088	11 141
倒位重复区 IR (bp)	11 338	7 403	26 846	13 726	17 428	17 385	16 766	15 654	27 888
总体 GC 含量 Overall GC content (%)	38	38	37	38	38	38	37	37	38
大单拷贝区 GC 含量 GC content in LSC (%)	39	36	36	37	36	36	36	36	37
小单拷贝区 GC 含量 GC content in SSC (%)	34	39	32	32	33	32	31	31	32
倒位重复区 GC 含量 GC content in IR (%)	32	53	40	46	43	43	44	44	40
基因总数 Gene number	127	112	127	113	115	119	119	116	118
蛋白编码基因数 Protein-Coding Genes	85	75	86	72	73	77	74	76	75
tRNA 基因数 tRNA Genes	33	29	34	33	34	34	37	34	35
rRNA 基因数 rRNA Genes	8	8	8	8	8	8	8	6	8
假基因数 Pseudo Genes	0	0	8	0	0	0	0	0	0

附表 2 川滇金丝桃叶绿体基因组

Supplementary table 2 Chloroplast genes of *Hypericum forrestii*

基因类别 Category for gene	基因分组 Group of genes	基因名称 Name of genes
自我复制基因 Self-replication	核糖体大亚基 Large subunit of ribosome	<i>rpl23, rpl2, rpl22, rpl16, rpl14, rpl36, rpl33, rpl20,</i>
	核糖体小亚基 Small subunit of ribosome	<i>rps12, rps7, rps3, rps8, rps11, rps18, rps2, rps14, rps4, rps15,</i>
	DNA 依赖性 RNA 聚合酶 DNA dependent RNA polymerase	<i>rpoA, rpoC2, rpoC1, rpoB,</i>
	rRNA 基因 rRNA gene	<i>rrn16S, rrn23S, rrn4.5S, rrn5S,</i>
	tRNA 基因 tRNA gene	<i>trnL-CAA, trnM-CAU, trnW-CCA, trnP-UGG, trnQ-UUG, trnS-GGA, trnG-UCC, trnR-UCU, trnC-GCA, trnD-GUC, trnY-GUA, trnE-UUC, trnT-GGU, trnS-UGA, trnG-GCC, trnT-UGU, trnF-GAA, trnL-UAA, trnV-UAC, trnH-GUG, trnV-GAC, trnI-GAU, trnA-UGC, trnR-ACG, trnN-GUU, trnL-UAG,</i>
	光系统 I 亚基 Subunits of photosystem I	<i>psaJ, psaI, psaB, psaA, psaC,</i>
	光系统 II 亚基 Subunits of photosystem II	<i>psbH, psbT, psbB, psbJ, psbL, psbF, psbE, psbK, psbI, psbM, psbD, psbC, psbZ, psbA,</i>
	NADH 脱氢酶亚基 Subunits of NADH-dehydrogenase	<i>ndhB, ndhC, ndhK, ndhJ, ndhF, ndhD, ndhE, ndhG, ndhI, ndhA, ndhH</i>
	细胞色素 b/f 复合体亚基 Subunits of cytochrome b/f complex	<i>petD, petB, petL, petG, petA,</i>
	光合作用基因 Gene for photosynthesis	

	ATP 合酶亚基 Subunit for ATP synthase	<i>atpA, atpF, atpH, atpI, atpE, atpB,</i>
	Rubisco 大亚基 Large subunit of rubisco	<i>rbcl,</i>
	成熟酶 Maturase 包膜膜蛋白 Envelope membrane protein	<i>matK cemA,</i>
其他基因 Other genes	乙酰辅酶 A 羧化酶亚基 Subunit of Acetyl- carboxylase	<i>accD,</i>
	C 型细胞色素合成基因 C-type cytochrome synthesis gene	<i>ccsA,</i>
	保守开放阅读框 Conserved open reading frames	<i>ycf3, ycf4,</i>

附表 3 9 种叶绿体基因组中 SSR 的类型与数量

Supplementary table 3 Types and amounts of SSRs in the nine chloroplast genomes

SSR type	Repe at unit	Number								
		<i>H.</i> <i>ac</i>	<i>H.</i> <i>mo</i>	<i>H.</i> <i>se</i>	<i>H.</i> <i>palu</i>	<i>H.</i> <i>add</i>	<i>H.</i> <i>ing</i>	<i>H.</i> <i>ton</i>	<i>H.</i> <i>ascy</i>	<i>H.</i> <i>ro</i>
		<i>m</i>	<i>ii</i>	<i>n</i>	<i>ii</i>	<i>ii</i>	<i>m</i>	<i>m</i>	<i>m</i>	<i>ii</i>
Mono	A	41	38	36	28	25	31	28	45	38
	C	0	2	1	0	1	0	0	0	2
	G	2	1	2	1	1	0	1	0	2
	T	39	42	32	31	30	28	32	48	40
Di	AG	0	0	0	1	0	0	0	0	0
	AT	2	4	1	5	0	2	3	3	2
	CT	0	0	0	1	0	0	0	1	0
	TA	1	2	1	5	1	1	0	2	1
Tri	AGA	0	0	0	0	0	0	1	0	1
	AAG	0	0	0	0	0	0	0	0	1
	TAA	1	1	1	0	0	1	0	0	0
	TAT	0	0	0	1	2	0	0	0	0
	TTA	0	0	0	1	0	0	0	0	1
	TCT	0	0	0	0	1	1	0	0	0
Tetra	ACT	0	0	0	1	0	0	0	0	0
	A	0	0	0	1	0	0	0	0	0
	ATT	0	0	0	0	1	0	0	0	0
	T	0	0	0	0	1	0	0	0	0

附表 4 九种金丝桃属植物 SSR 的长度分布

Supplementary table 4 Length Distribution of SSRs in Nine *Hypericum* Species

SSR length	<i>H.bea</i> <i>nii</i>	<i>H.asc</i> <i>yron</i>	<i>H.forre</i> <i>stii</i>	<i>H.acmos</i> <i>epalum</i>	<i>H.perfo</i> <i>ratum</i>	<i>H.mono</i> <i>gynum</i>	<i>H.petiol</i> <i>ulatum</i>	<i>H.samp</i> <i>sonii</i>	<i>H.addi</i> <i>ngtonii</i>	Total
4	1	0	1	0	0	0	0	0	0	2
5	1	0	0	1	0	1	0	3	1	7
6	2	4	1	3	2	2	3	2	2	21
7	0	0	1	0	2	2	2	1	2	10
8	0	2	0	0	0	0	0	0	0	2
10	36	33	28	44	25	33	48	27	24	298
11	20	20	13	22	9	10	17	22	14	147
12	5	11	10	5	10	6	9	12	8	76
13	5	6	2	6	4	5	5	9	3	45
14	2	3	1	3	5	0	6	3	2	25
15	3	6	2	1	4	4	7	5	3	35
16	0	3	1	0	1	0	1	2	0	8
17	0	1	0	1	1	0	0	0	1	4
18	0	0	0	0	1	0	1	0	0	2
19	0	0	0	0	0	1	0	2	0	3
21	0	0	0	0	1	0	0	0	0	1
Total	75	89	60	86	65	64	99	88	60	686

附表 5 9 种叶绿体基因组中重复序列的长度分布

Supplementary table 5 The length distribution of repeat sequence in nine chloroplast genomes

Species	Directions	30-39	40-49	> 49
<i>H. acmosepalum</i>	Forward	126	49	94
	Palindromic	30	8	22
	Reverse	2	0	0
	Complement	0	0	0
<i>H. addingtonii</i>	Forward	29	12	21
	Palindromic	11	4	14
	Reverse	1	0	0
	Complement	0	0	0
<i>H. ascyron</i>	Forward	126	49	94
	Palindromic	29	8	22
	Reverse	2	0	0
	Complement	0	0	0
<i>H. beanii</i>	Forward	123	42	63
	Palindromic	34	10	21
	Reverse	2	0	0
	Complement	0	0	0
<i>H. forrestii</i>	Forward	81	34	30
	Palindromic	28	20	9
	Reverse	0	0	0
	Complement	0	0	0
<i>H. monogynum</i>	Forward	60	58	62
	Palindromic	24	11	13
	Reverse	3	0	0
	Complement	4	0	0
<i>H. perforatum</i>	Forward	108	31	42
	Palindromic	39	3	17
	Reverse	1	0	0
	Complement	2	0	0
<i>H. petiolulatum</i>	Forward	85	34	47
	Palindromic	26	11	19
	Reverse	3	0	0
	Complement	0	0	0
<i>H. sampsonii</i>	Forward	12	106	163
	Palindromic	6	11	52
	Reverse	0	0	0
	Complement	0	0	0