

A cytotaxonomic study of *Atractylodes japonica* Koidz. ex Kitam. and *A. macrocephala* Koidz.

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ABSTRACT

The present study was carried out to clarify the chromosome numbers and karyotype of *Atractylodes japonica* Koidz. ex Kitam. and *A. macrocephala* Koidz.. The somatic chromosome numbers of two species were same; basic chromosome number $x=12$, and somatic chromosome numbers $2n=24$. The present result of *A. japonica* Koidz. ex Kitam. was same to previously reports and that of *A. macrocephala* Koidz. was reported first in this study. Size and shape of chromosome were some different from *A. japonica* Koidz. ex Kitam. and *A. macrocephala* Koidz.. The karyotype of *A. japonica* Koidz. ex Kitam. was described as follows; $2n = 24 = 8L + 14M + 2S = 2A^{sm} + 2B^m + 2C^m + 2D^{st} + 2E^m + 2F^m + 2G^m + 2H^{sm} + 2I^m + 2J^m + 2K^m + 2L^m$. And the karyotype of *A. macrocephala* Koidz. was described as follows; $2n = 24 = 10L + 12M + 2S = 2A^m + 2B^{sm} + 2C^{sm} + 2D^{sm} + 2E^{sm} + 2F^{sm} + 2G^{sm} + 2H^m + 2I^m + 2J^m + 2K^m + 2L^m$.

Key Words : somatic chromosome number, karyotype

INTRODUCTION

The genus *Atractylodes* under the subtribe Carlineae of tribe Cynareae in the family Compositae, consists of eight taxa and distributes to East Asia (Willis, 1973; Dittrich, 1977). Among them, *A. japonica* Koidz. ex Kitam. and *A. koreana* Kitam. grow naturally in Korea (Lee, T.B., 1979), and *A. macrocephala* Koidz. distributed only in China is cultivated for medicinal use in Korea.

Cytological study on the genus has been progressed by Arano (1957, 1962), Suzuka (1953), Y.N Lee (1967) using the plants of *A. japonica* Koidz. ex Kitam. in

Japan, Korea and *A. lancea* DC. in China. Their results were limited to the examination of chromosome number and karyotype analysis has been partially studied. Especially the Korean samples of *A. japonica* Koidz. ex Kitam. have never been carried out karyotype analysis and *A. macrocephala* Koidz. have never been cytotaxonomically examined yet.

This study, as a part of the taxonomic studies of genus *Atractylodes* was intended to reveal the chromosome numbers as well as karyotypes of Korean *A. japonica* Koidz. ex Kitam. and cultivated *A. macrocephala* Koidz..

Table 1. Materials and localities

Taxa	Localities
<i>Atractyloles japonica</i> Koidz. ex Kitam.	Mt. Cheongryang(Gyeongbuk), Sokwang-ri(Gyeongbuk), Mt. Munsu(Gyeongbuk) Mt. Yeohang(Gyeongnam) Mt. Dorac(Chungbuk)
<i>A. macrocephala</i> Koidz.	cultivated(Andong, Gyeongbuk)

Table 2. Chromosome numbers of *Atractylodes japonica* and *A. macrocephala*

Taxa	Present result (2n)	Previous reports (2n)	Localities & Habitats
<i>A. japonica</i> Koidz. ex Kitam.	24	24 Arano(1957, 1962) 24 Y.N. Lee(1967)	Japan Korea
<i>A. macrocephala</i> Koidz.	24	-	-

MATERIALS AND METHODS

Plants for this study were collected from April 1999 to August 2000 and transplanted at greenhouse of Andong National University(Table 1). Examined individual plants were prepared into voucher specimens and preserved in the Hebrarium of School of Bioresource Science at Andong National University. Root tips were collected from the 20 potted plants and pretreated in 0.002M 8-Hydroxyquinoline at 12-16°C for 3 hours and then fixed in Aceto-alcohol (1:3) for 10 minutes. The fixed root tips were hydrolyzed in 1N HCL at 60°C for 5 - 10 minutes and stained in 1% Acetic orcein solution for overnight and squashed.

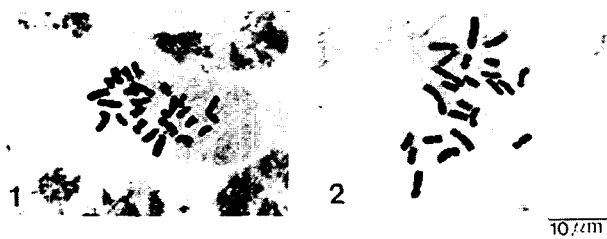


Fig. 1. Microscopic photographs of somatic chromosomes on *Atractylodes japonica* and *A. macrocephala*. 1 : *A. japonica*, 2 : *A. macrocephala*

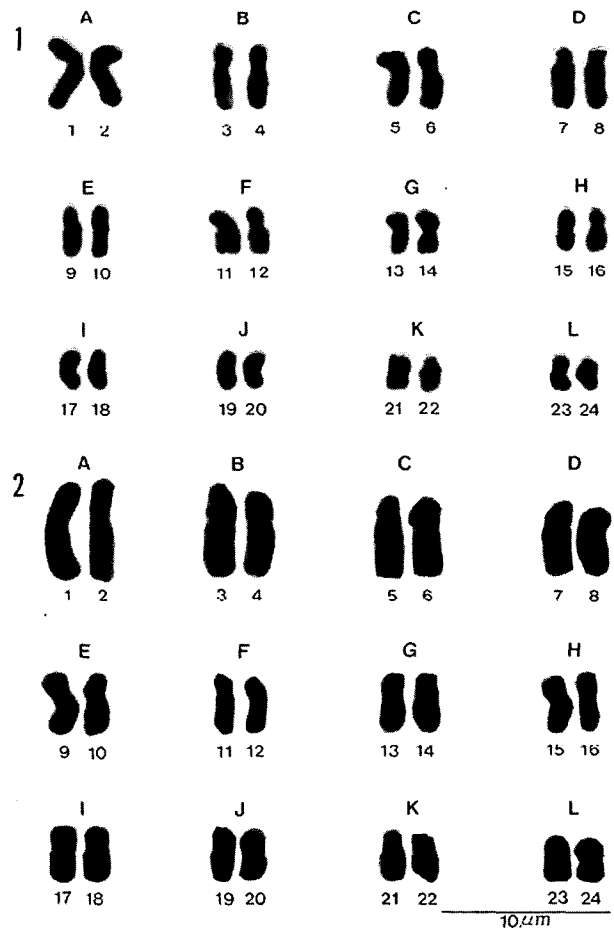


Fig. 2. Karyotypes of somatic chromosomes in *A. japonica* and *A. macrocephala*.

1 : *A. japonica*, 2 : *A. macrocephala*

Table 3. Arm length and ratio of somatic chromosomes in *Atractylodes japonica*

Type	No.	Arm (μm)		Total (μm)	Relative Length	Arm ratio	Centromere	
		Short	Long					
L	A	1	1.95	3.93	5.88	1.62	2.02	sm
		2	2.05	3.66	5.71	1.58	1.79	sm
	B	3	2.32	3.37	5.69	1.57	1.45	m
		4	1.77	2.94	4.71	1.30	1.66	m
	C	5	1.65	2.75	4.40	1.22	1.67	m
		6	1.64	2.66	4.30	1.19	1.62	m
	D	7	0.95	3.34	4.29	1.19	3.52	st
		8	1.02	3.17	4.19	1.16	3.10	st
M	E	9	1.61	1.99	3.60	0.99	1.24	m
		10	1.45	1.99	3.44	0.95	1.37	m
	F	11	1.37	1.94	3.31	0.91	1.42	m
		12	1.34	1.95	3.29	0.90	1.46	m
	G	13	1.41	1.75	3.16	0.87	1.24	m
		14	1.24	1.86	3.10	0.86	1.50	m
	H	15	1.07	1.99	3.06	0.85	1.86	sm
		16	0.97	2.08	3.05	0.84	2.14	sm
	I	17	1.38	1.58	2.96	0.82	1.14	m
		18	1.10	1.81	2.91	0.80	1.65	m
	J	19	1.35	1.49	2.84	0.78	1.10	m
		20	1.25	1.58	2.83	0.78	1.26	m
	K	21	1.20	1.61	2.81	0.78	1.34	m
		22	1.30	1.46	2.76	0.76	1.12	m
S	L	23	1.02	1.61	2.63	0.73	1.58	m
		24	0.93	1.25	2.18	0.60	1.34	m

Chromosomes were observed by using Olympus microscope (AX-70) and well-dispersed chromosome sets of metaphase in mitosis were photographed at $\times 1000$ and their lengths were calculated by Cursor generator(ver. 2.0; Tokyo Electronic Industry Co.). Chromosomes were classified into Long(1.01 and more), Medium(0.75 ~ 1.00), Short(0.75 and less) by method of Chang and Hsu(1974). Arm ratio and centromeric indices as metacentric(m, 1.00 ~ 1.70), submetacentric(sm, 1.71 ~ 3.00) and subtelocentric(st, 3.01 ~ 7.00) were adopted from the method of Leven *et al.*(1964).

RESULTS AND DISCUSSION

1. Chromosome number

The somatic chromosome numbers of *Atractylodes japonica* Koidz. ex Kitam. and *A. macrocephala* Koidz. were $2n=24$, therefore the basic chromosome number was $X=12$ and two species were diploid(Fig. 1). These of two species were constant in the different localities. The present results of *A. japonica* Koidz. ex Kitam. was same to previously reports and the chromosome number of *A. macrocephala* Koidz. was reported first in this study(Table 2).

2. Karyotype analysis

Chromosome size of the examined two species were

classified into Long(L), Medium(M) and short(S) on the basis of Relative length. And Chromosome shape of their were classified into metacentric(m), submetacentric(sm) and subtelocentric(st) on the basis of the Arm ratio.

In *A. japonica* Koidz. ex Kitam., Long type were four pairs, Medium type were seven pairs and Short type was one pair. Among the Long type, Submetacentric(sm) was one pair, Metacentrics were two pairs and Subtelocentric was one pair. Among the seven pairs of Medium type, one pair was Submetacentric and the others were Metacentrics. One pair of Short type was Metacentric(Table 3; Fig. 2). Therefore, karyotype of this species was described as

follows; $2n = 24 = 8L + 14M + 2S = 2A^{sm} + 2B^m + 2C^m + 2D^{st} + 2E^m + 2F^m + 2G^m + 2H^{sm} + 2I^m + 2J^m + 2K^m + 2L^m$.

In *A. macrocephala* Koidz., Long type were five pairs, Medium type were six pairs and Short type was one pair. Among the Long type, Submetacentrics(sm) were four pairs, Metacentric was one pair. Among the six pairs of Medium type, two pairs were Submetacentric and the others were Metacentrics. One pair of Short type was Metacentric(Table 4; Fig. 2). Therefore, karyotype of this species was described as follows; $2n = 24 = 10L + 12M + 2S = 2A^m + 2B^{sm} + 2C^{sm} + 2D^{sm} + 2E^{sm} + 2F^{sm} + 2G^{sm} + 2H^m + 2I^m + 2J^m + 2K^m + 2L^m$.

Compared the karyotypes of two species, *A.*

Table 4. Arm length and ratio of somatic chromosomes in *A. macrocephala*.

Type	No.	Arm (μ m)		Total (μ m)	Relative Length	Arm ratio	Centromere	
		Short	Long					
L	A	1	2.57	4.27	6.84	1.57	1.66	m
		2	2.55	4.26	6.81	1.56	1.67	m
	B	3	2.20	3.87	6.07	1.39	1.76	sm
		4	1.68	3.97	5.65	1.30	2.36	sm
	C	5	1.97	3.38	5.35	1.23	1.72	sm
		6	1.49	3.76	5.25	1.20	2.52	sm
	D	7	1.57	3.42	4.99	1.14	2.18	sm
		8	1.59	3.01	4.60	1.06	1.89	sm
	E	9	1.50	3.09	4.59	1.05	2.06	sm
		10	1.47	3.00	4.47	1.03	2.04	sm
M	F	11	1.05	3.00	4.05	0.93	2.85	sm
		12	1.16	2.81	3.97	0.91	2.42	sm
	G	13	1.20	2.66	3.86	0.89	2.22	sm
		14	1.21	2.61	3.82	0.88	2.16	sm
	H	15	1.52	2.28	3.80	0.87	1.50	m
		16	1.48	2.30	3.78	0.87	1.55	m
	I	17	1.70	2.04	3.74	0.86	1.20	m
		18	1.40	2.16	3.56	0.82	1.54	m
	J	19	1.70	1.77	3.47	0.80	1.04	m
		20	1.40	2.03	3.43	0.79	1.45	m
K	21	1.32	2.06	3.38	0.78	1.56	m	
	22	1.52	1.84	3.36	0.77	1.21	m	
S	L	23	1.41	1.47	2.88	0.66	1.04	m
		24	1.08	1.75	2.83	0.65	1.62	m

macrocephala Koidz. had more one pair of Long type and was consisted of six pairs of the metacentrics and submetacentrics respectively, but *A. japonica* Koidz. ex Kitam. was consisted of nine pairs of metacentrics, two pairs of submetacentrics and one pair of subtelocentric respectively.

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