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The Variation of 15 Autosomal Microsatellite DNA Loci in Five Indigenous Populations of South Siberia

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Abstract—The allele frequencies of 15 autosomal STR loci (D3S1358, *vWA*, *FGA*, *TH01*, *TPOX*, *CSF1PO*, D5S818, D13S317, D7S820, D16S539, D2S1338, D8S1179, D21S11, D18S51, and D19S433) included into the AmpFlSTR SGM Plus and AmpFlSTR Profiler Plus kits (Applied Biosystems, United States) were determined for five indigenous populations of South Siberia: Buryats, Altaians, Tofalars, Sojots, and Khakassians ($N = 261$). No significant differences in allele frequencies were found between the populations. The combined power of discrimination of the STR loci was determined for every population.

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Key words: STR locus, autosomal microsatellite loci, human population genetics, genetic diversity

INTRODUCTION

The variation of short tandem repeats (STRs), or microsatellites, dispersed throughout the human genome, is actively investigated in connection with the problems of personal DNA identification and determination of genetic relationships between individuals [1, 2]. Advancement in studying the variation of autosomal microsatellite loci has become possible owing to highly efficient multilocus DNA amplification systems, such as AmpFlSTR SGM Plus, AmpFlSTR Profiler Plus, PowerPlex® 16, and PowerPlex® ES. Thus, multilocus detection of autosomal microsatellites is now one of the most powerful tools in studies of genetic variation.

In spite of the progress in creating databases of the allele and genotype frequency distributions of STR loci in various groups of the global population and individual ethnic groups, information about polymorphic autosomal microsatellite loci in the ethnically differentiated population of the Russian Federation is still insufficient. Data on the allele frequency distribution of loci used in forensic studies are available only for ethnically Russian populations from various regions of Russia [3–7]. As for Siberian indigenous populations, only northern Altaians, Tuvinians, Buryats, and Evenks have been studied using a set of nine dinucleotide microsatellite loci included into a panel for genetic linkage analysis [8]. In this work, we obtained the first data on the variation of 15 microsatellite loci in the Altaian ($N = 68$), Buryat ($N = 78$), Sojot ($N = 29$), Tofalar ($N = 35$), and Khakassian ($N = 51$) populations from South Siberia, using AmpFlSTR SGM Plus and AmpFlSTR Profiler Plus multiplex PCR amplification systems.

EXPERIMENTAL

Sample. Genomic DNA was isolated from venous blood by a standard technique, which included treatment with a detergent (1% SDS) and proteinase K (Sigma) and chloroform–phenol extraction [9]. The sample included 261 unrelated individuals from five ethnic groups of South Siberia: Buryats ($N = 78$; Kizhinginskii, Khorinskii, Zakamenskii, Eravninskii, Selenginskii, Barguzinskii, and Kabanskii districts of the Republic of Buryatia), Altaians ($N = 68$; Kosh-Agachskii, Ulaganskii, Ongudaiskii, Ust'-Kanskii, Shebalinskii, and Turochakskii districts of the Republic of Altai), Tofalars ($N = 35$; Alygdjer village of the Irkutsk region), Sojots ($N = 29$; Okinskii and Tunkinskii districts of the Republic of Buryatia), and Kha-

Table 1. Allele frequencies and other statistical parameters of 15 STR loci in Buryats (N = 156 chromosomes)

Allele	D3S1358	*vWA*	*FGA*	*TH01*	*TPOX*	*CSF1PO*	D5S818	D13S317	D7S820	D16S539	D2S1338	D8S1179	D21S11	D18S51	D19S433
6	–	–	–	0.096	–	–	–	–	–	–	–	–	–	–	–
7	–	–	–	0.353	0.000	–	0.051	–	0.006	–	–	–	–	–	–
8	–	–	–	0.160	0.500	–	–	0.160	0.269	0.026	–	–	–	–	–
9	–	–	–	0.269	0.141	0.051	0.013	0.179	0.109	0.378	–	–	–	–	–
9.3	–	–	–	0.122	–	–	–	–	–	–	–	–	–	–	–
10	–	–	–	–	0.026	0.321	0.103	0.179	0.179	0.103	–	0.103	–	–	–
11	–	–	–	–	0.308	0.301	0.397	0.231	0.231	0.141	–	0.064	–	–	0.006
12	–	–	–	–	0.026	0.244	0.282	0.147	0.167	0.231	–	0.115	–	0.006	0.064
13	–	–	–	–	0.000	0.045	0.147	0.071	0.032	0.083	–	0.244	–	0.192	0.314
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.064
14	0.026	0.090	–	–	–	0.038	0.006	0.013	0.006	0.032	–	0.205	–	0.321	0.167
14.2	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–	0.083
15	0.442	0.026	–	–	–	–	–	0.019	–	0.006	–	0.218	–	0.135	0.077
15.2	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–	0.141
16	0.340	0.237	–	–	–	–	–	–	–	–	0.013	0.045	–	0.115	0.026
16.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.058
17	0.122	0.276	–	–	–	–	–	–	–	–	0.090	0.006	–	0.026	–
18	0.071	0.244	–	–	–	–	–	–	–	–	0.115	–	–	0.045	–
19	–	0.083	0.032	–	–	–	–	–	–	–	0.179	–	–	0.038	–
20	–	0.045	0.013	–	–	–	–	–	–	–	0.115	–	–	0.038	–
21	–	–	0.071	–	–	–	–	–	–	–	0.006	–	–	0.032	–
22	–	–	0.109	–	–	–	–	–	–	–	0.045	–	–	0.045	–
23	–	–	0.212	–	–	–	–	–	–	–	0.205	–	–	–	–
23.2	–	–	0.006	–	–	–	–	–	–	–	–	–	–	–	–
24	–	–	0.333	–	–	–	–	–	–	–	0.147	–	–	–	–
24.2	–	–	0.006	–	–	–	–	–	–	–	–	–	–	–	–
25	–	–	0.122	–	–	–	–	–	–	–	0.058	–	–	0.006	–
25.2	–	–	0.019	–	–	–	–	–	–	–	–	–	–	–	–
26	–	–	0.045	–	–	–	–	–	–	–	0.019	–	–	–	–
26.2	–	–	0.006	–	–	–	–	–	–	–	–	–	–	–	–
27	–	–	0.013	–	–	–	–	–	–	–	–	–	–	–	–
28	–	–	0.013	–	–	–	–	–	–	–	0.006	–	0.026	–	–
28.2	–	–	–	–	–	–	–	–	–	–	–	–	0.006	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	0.205	–	–
30	–	–	–	–	–	–	–	–	–	–	–	–	0.449	–	–
30.2	–	–	–	–	–	–	–	–	–	–	–	–	0.026	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	0.096	–	–
31.2	–	–	–	–	–	–	–	–	–	–	–	–	0.006	–	–
32	–	–	–	–	–	–	–	–	–	–	–	–	0.006	–	–
32.2	–	–	–	–	–	–	–	–	–	–	–	–	0.115	–	–
33.2	–	–	–	–	–	–	–	–	–	–	–	–	0.038	–	–
34.2	–	–	–	–	–	–	–	–	–	–	–	–	0.026	–	–
MP	0.176	0.082	0.065	0.110	0.198	0.111	0.130	0.070	0.070	0.093	0.046	0.066	0.110	0.071	0.053
PD	0.824	0.918	0.935	0.890	0.802	0.889	0.870	0.930	0.930	0.907	0.954	0.934	0.890	0.929	0.947
PIC	0.610	0.760	0.786	0.714	0.572	0.696	0.685	0.806	0.772	0.733	0.848	0.797	0.700	0.800	0.810
PE	0.416	0.416	0.638	0.662	0.343	0.477	0.521	0.738	0.457	0.543	0.613	0.662	0.310	0.816	0.638
PI	1.625	1.625	2.786	3.000	1.393	1.860	2.053	3.900	1.773	2.167	2.600	3.000	1.300	5.571	2.786
H(ob)	0.692	0.692	0.795	0.744	0.641	0.731	0.756	0.872	0.718	0.769	0.808	0.833	0.590	0.910	0.744
H(ex)	0.673	0.796	0.803	0.702	0.638	0.750	0.739	0.839	0.810	0.771	0.869	0.829	0.716	0.825	0.743
P	0.715	0.020	0.408	0.762	0.452	0.819	0.485	0.061	0.374	0.285	0.020	0.559	0.180	0.277	0.817

Note: Here and in Tables 2–5, MP, genotype matching probability; PD, power of discrimination; PIC, polymorphism information content; PE, power of exclusion; PI, paternity index; H(ob), observed heterozygosity; H(ex), expected heterozygosity; P, probability of deviation from the Hardy–Weinberg equilibrium.

Table 2. Allele frequencies and other statistical parameters of 15 STR loci in Altaians (N = 136 chromosomes)

Allele	D3S1358	*vWA*	*FGA*	*TH01*	*TPOX*	*CSF1PO*	D5S818	D13S317	D7S820	D16S539	D2S1338	D8S1179	D21S11	D18S51	D19S433
6	–	–	–	0.147	–	–	–	–	–	–	–	–	–	–	–
7	–	–	–	0.243	–	–	0.022	–	–	–	–	–	–	–	–
8	–	–	–	0.088	0.522	0.007	–	0.250	0.272	0.015	–	–	–	–	–
9	–	–	–	0.346	0.044	0.015	0.044	0.125	0.081	0.213	–	0.007	–	–	–
9.3	–	–	–	0.162	–	–	–	–	–	–	–	–	–	–	–
10	–	–	–	0.015	0.007	0.199	0.051	0.103	0.265	0.132	–	0.103	–	–	–
11	–	–	–	–	0.397	0.353	0.574	0.272	0.176	0.228	–	0.044	–	–	0.007
12	–	–	–	–	0.022	0.309	0.221	0.213	0.191	0.235	–	0.059	–	0.044	0.044
13	–	–	–	–	0.007	0.081	0.081	0.029	0.007	0.147	–	0.463	–	0.118	0.346
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.051
14	0.022	0.103	–	–	–	0.037	0.007	0.007	0.007	0.029	–	0.228	–	0.287	0.184
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.074
15	0.449	0.044	–	–	–	–	–	–	–	–	–	0.059	–	0.110	0.081
15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.096
16	0.221	0.287	–	–	–	–	–	–	–	–	–	0.015	–	0.088	0.074
16.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.037
17	0.257	0.287	–	–	–	–	–	–	–	–	0.096	0.015	–	0.147	–
18	0.051	0.184	0.015	–	–	–	–	–	–	–	0.059	0.007	–	0.051	–
19	–	0.081	0.015	–	–	–	–	–	–	–	0.154	–	–	0.022	–
19.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.007
20	–	0.015	0.051	–	–	–	–	–	–	–	0.147	–	–	0.051	–
20.2	–	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–
21	–	–	0.081	–	–	–	–	–	–	–	0.022	–	–	0.015	–
22	–	–	0.206	–	–	–	–	–	–	–	0.059	–	–	0.037	–
23	–	–	0.176	–	–	–	–	–	–	–	0.221	–	–	0.022	–
23.2	–	–	0.015	–	–	–	–	–	–	–	–	–	–	–	–
24	–	–	0.257	–	–	–	–	–	–	–	0.132	–	–	–	–
24.2	–	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–
25	–	–	0.110	–	–	–	–	–	–	–	0.081	–	–	0.007	–
25.2	–	–	0.000	–	–	–	–	–	–	–	–	–	–	–	–
26	–	–	0.074	–	–	–	–	–	–	–	0.015	–	0.007	–	–
27	–	–	–	–	–	–	–	–	–	–	0.007	–	–	–	–
28	–	–	–	–	–	–	–	–	–	–	0.007	–	0.066	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	0.191	–	–
30	–	–	–	–	–	–	–	–	–	–	–	–	0.301	–	–
30.2	–	–	–	–	–	–	–	–	–	–	–	–	0.007	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	0.096	–	–
31.2	–	–	–	–	–	–	–	–	–	–	–	–	0.110	–	–
32	–	–	–	–	–	–	–	–	–	–	–	–	0.007	–	–
32.2	–	–	–	–	–	–	–	–	–	–	–	–	0.154	–	–
33.2	–	–	–	–	–	–	–	–	–	–	–	–	0.044	–	–
34.2	–	–	–	–	–	–	–	–	–	–	–	–	0.015	–	–
MP	0.156	0.076	0.061	0.109	0.275	0.112	0.193	0.080	0.094	0.074	0.045	0.121	0.074	0.042	0.076
PD	0.844	0.924	0.939	0.891	0.725	0.888	0.807	0.920	0.906	0.926	0.955	0.879	0.926	0.958	0.924
PIC	0.626	0.750	0.812	0.730	0.479	0.687	0.570	0.759	0.747	0.778	0.851	0.680	0.799	0.838	0.795
PE	0.372	0.461	0.672	0.616	0.260	0.351	0.294	0.616	0.643	0.701	0.760	0.437	0.588	0.561	0.535
PI	1.478	1.789	3.091	2.615	1.172	1.417	1.259	2.615	2.833	3.400	4.250	1.700	2.429	2.267	2.125
H(ob)	0.662	0.721	0.824	0.603	0.574	0.647	0.603	0.809	0.824	0.853	0.882	0.706	0.779	0.779	0.662
H(ex)	0.686	0.792	0.834	0.666	0.579	0.741	0.615	0.797	0.787	0.813	0.871	0.720	0.799	0.860	0.737
P	0.715	0.894	0.104	0.614	0.891	0.553	0.638	0.995	0.699	0.884	0.268	0.506	0.043	0.398	0.039

Table 3. Allele frequencies and other statistical parameters of 15 STR loci in Tofalars (N = 70 chromosomes)

Allele	D3S1358	*vWA*	*FGA*	*TH01*	*TPOX*	*CSF1PO*	D5S818	D13S317	D7S820	D16S539	D2S1338	D8S1179	D21S11	D18S51	D19S433
6	–	–	–	0.186	–	–	–	–	–	–	–	–	–	–	–
7	–	–	–	0.243	–	–	–	–	–	–	–	–	–	–	–
8	–	–	–	0.043	0.743	–	–	0.300	0.343	0.014	–	–	–	–	–
9	–	–	–	0.186	0.057	0.043	0.014	0.200	–	0.043	–	–	–	–	–
9.3	–	–	–	0.343	–	–	–	–	–	–	–	–	–	–	–
10	–	–	–	–	0.029	0.157	0.029	0.143	0.371	0.100	–	0.043	–	–	–
11	–	–	–	–	0.143	0.257	0.643	0.129	0.171	0.186	–	–	–	–	0.014
12	–	–	–	–	0.029	0.443	0.214	0.071	0.071	0.371	–	0.043	–	0.029	0.014
13	–	–	–	–	–	0.100	0.100	0.129	0.043	0.171	–	0.429	–	0.057	0.257
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.043
14	0.071	0.071	–	–	–	–	–	0.029	–	0.114	–	0.314	–	0.329	0.357
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.114
15	0.343	0.057	–	–	–	–	–	–	–	–	–	0.143	–	0.071	0.114
15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.057
16	0.157	0.143	–	–	–	–	–	–	–	–	0.014	–	–	0.129	0.029
17	0.400	0.443	–	–	–	–	–	–	–	–	0.043	0.029	–	0.114	–
18	0.029	0.214	–	–	–	–	–	–	–	–	0.029	–	–	0.014	–
19	–	0.057	0.029	–	–	–	–	–	–	–	0.357	–	–	0.029	–
20	–	0.014	0.086	–	–	–	–	–	–	–	0.229	–	–	0.129	–
20.2	–	–	0.014	–	–	–	–	–	–	–	–	–	–	–	–
21	–	–	0.100	–	–	–	–	–	–	–	0.029	–	–	0.029	–
22	–	–	0.086	–	–	–	–	–	–	–	0.029	–	–	0.029	–
23	–	–	0.086	–	–	–	–	–	–	–	0.057	–	–	0.043	–
24	–	–	0.386	–	–	–	–	–	–	–	0.086	–	–	–	–
25	–	–	0.200	–	–	–	–	–	–	–	0.129	–	–	–	–
26	–	–	0.014	–	–	–	–	–	–	–	–	–	–	–	–
27	–	–	–	–	–	–	–	–	–	–	–	–	0.014	–	–
28	–	–	–	–	–	–	–	–	–	–	–	–	0.043	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	0.114	–	–
30	–	–	–	–	–	–	–	–	–	–	–	–	0.414	–	–
30.2	–	–	–	–	–	–	–	–	–	–	–	–	0.014	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	0.129	–	–
31.2	–	–	–	–	–	–	–	–	–	–	–	–	0.071	–	–
32	–	–	–	–	–	–	–	–	–	–	–	–	0.057	–	–
32.2	–	–	–	–	–	–	–	–	–	–	–	–	0.129	–	–
33.2	–	–	–	–	–	–	–	–	–	–	–	–	0.014	–	–
MP	0.180	0.113	0.096	0.107	0.370	0.162	0.282	0.079	0.164	0.112	0.082	0.197	0.099	0.086	0.110
PD	0.820	0.887	0.904	0.893	0.630	0.838	0.718	0.921	0.836	0.888	0.918	0.803	0.901	0.914	0.890
PIC	0.637	0.692	0.753	0.711	0.395	0.656	0.482	0.785	0.657	0.743	0.763	0.642	0.749	0.817	0.744
PE	0.365	0.547	0.547	0.451	0.153	0.451	0.175	0.498	0.599	0.653	0.599	0.653	0.547	0.547	0.825
PI	1.458	2.188	2.188	1.750	0.921	1.750	0.972	1.944	2.500	2.917	2.500	2.917	2.188	2.188	5.833
H(ob)	0.657	0.771	0.771	0.571	0.457	0.714	0.486	0.743	0.800	0.829	0.800	0.829	0.657	0.771	0.800
H(ex)	0.702	0.736	0.798	0.649	0.450	0.726	0.561	0.822	0.729	0.784	0.800	0.703	0.737	0.844	0.667
P	0.193	0.700	0.411	0.721	0.432	0.402	0.398	0.232	0.331	0.119	0.634	0.447	0.040	0.000	0.329

Table 4. Allele frequencies and other statistical parameters of 15 STR loci in Sojots ($N = 58$ chromosomes)

Allele	D3S1358	*vWA*	*FGA*	*TH01*	*TPOX*	*CSF1PO*	D5S818	D13S317	D7S820	D16S539	D2S1338	D8S1179	D21S11	D18S51	D19S433
6	–	–	–	0.121	–	–	–	–	–	–	–	–	–	–	–
7	–	–	–	0.397	–	–	0.017	–	–	–	–	–	–	–	–
8	–	–	–	0.034	0.569	–	–	0.241	0.190	–	–	–	–	–	–
9	–	–	–	0.241	0.121	0.052	0.034	0.034	0.155	0.172	–	–	–	–	–
9.3	–	–	–	0.172	–	–	–	–	–	–	–	–	–	–	–
10	–	–	–	0.034	0.017	0.379	0.052	0.190	0.190	0.155	–	0.086	–	–	–
11	–	–	–	–	0.259	0.293	0.517	0.276	0.379	0.345	–	0.086	–	–	0.017
12	–	–	–	–	0.034	0.259	0.172	0.086	0.052	0.259	–	0.138	–	0.052	0.052
13	–	–	–	–	–	0.017	0.207	0.121	0.034	0.069	–	0.224	–	0.224	0.345
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.017
14	0.017	0.069	–	–	–	–	–	0.052	–	–	–	0.190	–	0.241	0.259
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.069
15	0.517	0.017	–	–	–	–	–	–	–	–	–	0.224	–	0.069	0.017
15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.172
16	0.328	0.345	–	–	–	–	–	–	–	–	–	0.052	–	0.086	0.034
16.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.017
17	0.069	0.207	–	–	–	–	–	–	–	–	0.103	–	–	0.069	–
18	0.069	0.293	–	–	–	–	–	–	–	–	0.172	–	–	0.086	–
19	–	0.052	0.052	–	–	–	–	–	–	–	0.155	–	–	–	–
20	–	0.017	0.155	–	–	–	–	–	–	–	0.034	–	–	0.069	–
21	–	–	0.086	–	–	–	–	–	–	–	0.017	–	–	0.017	–
22	–	–	0.190	–	–	–	–	–	–	–	0.052	–	–	0.034	–
23	–	–	0.103	–	–	–	–	–	–	–	0.172	–	–	0.017	–
24	–	–	0.155	–	–	–	–	–	–	–	0.155	–	–	0.017	–
25	–	–	0.172	–	–	–	–	–	–	–	0.052	–	–	0.017	–
26	–	–	0.086	–	–	–	–	–	–	–	0.086	–	–	–	–
28	–	–	–	–	–	–	–	–	–	–	–	–	0.017	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	0.207	–	–
30	–	–	–	–	–	–	–	–	–	–	–	–	0.483	–	–
30.2	–	–	–	–	–	–	–	–	–	–	–	–	0.017	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	0.086	–	–
31.2	–	–	–	–	–	–	–	–	–	–	–	–	0.121	–	–
32.2	–	–	–	–	–	–	–	–	–	–	–	–	0.017	–	–
33.2	–	–	–	–	–	–	–	–	–	–	–	–	0.052	–	–
MP	0.208	0.113	0.056	0.151	0.313	0.168	0.213	0.084	0.103	0.118	0.058	0.073	0.132	0.054	0.096
PD	0.792	0.887	0.944	0.849	0.687	0.832	0.787	0.916	0.897	0.882	0.942	0.927	0.868	0.946	0.904
PIC	0.551	0.702	0.841	0.698	0.537	0.643	0.612	0.776	0.721	0.716	0.853	0.804	0.664	0.843	0.743
PE	0.316	0.412	0.719	0.467	0.586	0.586	0.467	0.525	0.525	0.525	0.859	0.586	0.237	0.788	0.525
PI	1.318	1.611	3.625	1.813	2.417	2.417	1.813	2.071	2.071	2.071	7.250	2.417	1.115	4.833	2.071
H(ob)	0.621	0.690	0.862	0.621	0.793	0.793	0.724	0.759	0.759	0.759	0.931	0.793	0.517	0.897	0.690
H(ex)	0.655	0.767	0.873	0.679	0.604	0.713	0.673	0.824	0.770	0.769	0.887	0.842	0.673	0.872	0.733
P	0.807	0.454	0.854	0.291	0.061	0.891	0.121	0.528	0.871	0.560	0.753	0.386	0.170	0.890	0.726

Table 5. Allele frequencies and other statistical parameters of 15 STR loci in Khakassians ($N = 102$ chromosomes)

Allele	D3S1358	*vWA*	*FGA*	*TH01*	*TPOX*	*CSF1PO*	D5S818	D13S317	D7S820	D16S539	D2S1338	D8S1179	D21S11	D18S51	D19S433
6	–	–	–	0.118	–	–	–	–	–	–	–	–	–	–	–
7	–	–	–	0.441	0.010	–	0.020	–	–	–	–	–	–	–	–
8	–	–	–	0.088	0.529	–	–	0.167	0.235	0.020	–	–	–	–	–
9	–	–	–	0.206	0.069	0.020	0.049	0.137	0.098	0.216	–	–	–	–	–
9.3	–	–	–	0.137	–	–	–	–	–	–	–	–	–	–	–
10	–	–	–	0.010	0.049	0.196	0.078	0.118	0.176	0.196	–	0.078	–	0.010	–
11	–	–	–	–	0.235	0.235	0.353	0.206	0.225	0.304	–	0.069	–	–	–
12	–	–	–	–	0.098	0.441	0.363	0.245	0.225	0.098	–	0.069	–	0.010	0.049
13	–	–	–	–	0.010	0.098	0.137	0.108	0.029	0.108	–	0.451	–	0.140	0.333
13.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.029
14	0.039	0.069	–	–	–	0.010	–	0.020	0.010	0.059	–	0.167	–	0.260	0.265
14.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.059
15	0.382	0.059	–	–	–	–	–	–	–	–	–	0.069	–	0.230	0.137
15.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.039
16	0.422	0.294	–	–	–	–	–	–	–	–	–	0.078	–	0.090	0.078
17	0.157	0.275	–	–	–	–	–	–	–	–	0.078	0.010	–	0.060	0.010
18	–	0.225	–	–	–	–	–	–	–	–	0.098	0.010	–	0.060	–
19	–	0.069	0.010	–	–	–	–	–	–	–	0.157	–	–	0.060	–
20	–	0.010	0.088	–	–	–	–	–	–	–	0.118	–	–	0.040	–
21	–	–	0.108	–	–	–	–	–	–	–	0.039	–	–	–	–
22	–	–	0.147	–	–	–	–	–	–	–	0.049	–	–	0.040	–
23	–	–	0.284	–	–	–	–	–	–	–	0.186	–	–	–	–
24	–	–	0.186	–	–	–	–	–	–	–	0.147	–	–	–	–
25	–	–	0.127	–	–	–	–	–	–	–	0.108	–	–	–	–
26	–	–	0.029	–	–	–	–	–	–	–	0.020	–	–	–	–
27	–	–	0.020	–	–	–	–	–	–	–	–	–	–	–	–
28	–	–	–	–	–	–	–	–	–	–	–	–	0.029	–	–
28.2	–	–	–	–	–	–	–	–	–	–	–	–	0.029	–	–
29	–	–	–	–	–	–	–	–	–	–	–	–	0.225	–	–
30	–	–	–	–	–	–	–	–	–	–	–	–	0.382	–	–
30.2	–	–	–	–	–	–	–	–	–	–	–	–	0.020	–	–
31	–	–	–	–	–	–	–	–	–	–	–	–	0.059	–	–
31.2	–	–	–	–	–	–	–	–	–	–	–	–	0.206	–	–
32	–	–	–	–	–	–	–	–	–	–	–	–	0.010	–	–
32.2	–	–	–	–	–	–	–	–	–	–	–	–	0.039	–	–
MP	0.210	0.136	0.060	0.134	0.177	0.137	0.126	0.066	0.080	0.093	0.044	0.106	0.112	0.059	0.072
PD	0.790	0.864	0.940	0.866	0.823	0.863	0.874	0.934	0.920	0.907	0.956	0.894	0.888	0.941	0.928
PIC	0.581	0.739	0.804	0.686	0.605	0.655	0.669	0.801	0.771	0.769	0.860	0.718	0.718	0.819	0.757
PE	0.325	0.880	0.570	0.535	0.277	0.351	0.351	0.643	0.535	0.501	0.840	0.379	0.570	0.715	0.501
PI	1.342	8.500	2.318	2.125	1.214	1.417	1.417	2.833	2.125	1.962	6.375	1.500	2.318	3.571	1.962
H(ob)	0.627	0.941	0.784	0.745	0.588	0.647	0.647	0.824	0.765	0.745	0.922	0.667	0.745	0.860	0.667
H(ex)	0.656	0.782	0.834	0.672	0.654	0.708	0.730	0.833	0.809	0.813	0.884	0.752	0.726	0.849	0.731
P	0.158	0.207	0.500	0.374	0.170	0.435	0.130	0.467	0.311	0.052	0.913	0.248	0.266	0.583	0.784

kassians (N = 51; Askizskii, Shirinskii, Beiskii, and Ordzhonikidzevskii districts of the Republic of Khakassia).

Genotyping. STR loci were amplified using AmpFlSTR SGM Plus and AmpFlSTR Profiler Plus multiplex systems as recommended by Applied Biosystems. The amplification products were electrophoretically separated using an ABI Prism 377 DNA sequencer (Applied Biosystems). Control DNA samples and allele standards were used for quality control. The size of the PCR products was determined using GeneScan (v. 3.1) and Genotyper (v. 2.0) software (Applied Biosystems). Alleles are designated as recommended by the DNA Commission of the International Society for Forensic Hemogenetics [10].

Statistical analysis of the data was carried out using the Arlequin software package (v. 2.000) [11] and the PowerTyper Excel spreadsheet program (Promega) [12].

RESULTS AND DISCUSSION

The allele frequencies of 15 STR loci (D3S1358, *vWA*, *FGA*, *TH01*, *TPOX*, *CSF1PO*, D5S818, D13S317, D7S820, D16S539, D2S1338, D8S1179, D21S11, D18S51, and D19S433) assayed in the five ethnic groups from South Siberia are shown in the tables.

In total, 129 alleles were revealed. The number of alleles in populations varied from 99 (Tofalars) to 113 (Buryats). The population average heterozygosity was 0.750, and the expected heterozygosity of the total sample was 0.761. There was no statistical discrepancy in heterozygosity between individual populations: heterozygosity varied from 0.708 (Tofalars) to 0.764 (Buryats). The loci did not reliably differ in heterozygosity in individual populations (0.585–0.862) and the total sample (0.603–0.871).

Comparison of the allele frequency distribution of the STR loci in different populations revealed no reliable distinction in F_{ST}. Similar results were obtained using the exact test for interpopulation differentiation [11]. Six loci (*FGA*, D2S1338, D8S1179, D21S11, D18S51, and D19S433) were most variable by the molecular diversity test (the number of observed alleles >10 and the polymorphism information content (PIC) >0.8, Tables 1–5).

A high intrapopulation genetic diversity of the microsatellite loci was reflected in a significant power of discrimination (PD). High PD values varying from 0.920 to 0.959 were determined for 8 out of 15 loci (*vWA*, *FGA*, D13S317, D16S539, D2S1338, D21S11, D18S51, and D19S433). The combined PDs of the total locus panel were 0.999 999 999 999 999 830 (Buryats), 0.999 999 999 999 999 671 (Altaians), 0.999 999 999 999 922 209 (Tofalars), 0.999 999 999 999 993 458 (Sojots), and 0.999 999 999 999 999 226 (Khakassians). The observed genotype frequencies did not correspond to the Hardy–Weinberg equilibrium in three of the five populations: Buryats (loci *vWa* and D21S11), Altaians (D21S11 and D19S433), and Tofalars (D21S11 and D18S51). Possible reasons for such a deviation are related to the population dynamics factors and the small sample sizes.

The data obtained in our work make an important contribution to the creation of a reference molecular database, required for further improvement of the statistical basis of forensic studies in the Russian Federation. Further studies of the variation of this microsatellite panel are promising for detecting genetic differences between related populations and estimating the genetic subdivision of the North Eurasian population.

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