Distribution Of Allelic Frequencies Of 15 Microsatellite Markers (Strs) In Tangier Population

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Abstract: STRs or Short Tandem Repeats allows tracing the demographic history of populations, and the interactions between different population groups. The introduction of these markers in the study of populations explains their strong informative capacities and their high degrees of polymorphism. In this study, 15 STRs markers (D8S1179, D21S11, D7S820, CSF1PO, D3S1358, TH01, D13S317, D16S539, D2S1338, D19S433, vWA1, TPOX, D18S51, D5S818, and FGA) are used to study genetic diversity of the Moroccan population of Tangier. The study involved a sample of 300 individuals with informed consent. The results show that the population is in Hardy-Weinberg equilibrium for all markers, except for 3 markers except 3 markers which show a significant deviation D21S11, D18S51 and D19S433 (p = 0.0000).

Index Terms: Tangier, microsatellites, Hardy-Weinberg equilibrium, allelic frequencies

1 INTRODUCTION

Historical and geographical are major factors that make each population genetically special and different [1], having its own way of life. To highlight these differences, various bio-anthropological studies associated with new genetic methods were used to study the north Moroccan Tangier population. This city is considered as crossroad of civilizations, and the geographical link between Europe and Africa. Nowadays, new techniques appear in molecular biology and bioinformatics, this development helps to produce a lot of research works in genetic anthropology [2]. Single parent markers such as Y chromosome and mitochondrial DNA represent only one non-recombinant marker and their informative capacity may be affected by several disturbing factors [3], that is the reason why it is recommended to use autosomal markers (SNPs and STRs). In this study, 15 STRs (Short Tandem Repeats) were chosen; these markers are non-coding and highly polymorphic. These microsatellites will be used to study genetic diversity by analyzing the distribution of allelic frequencies, genetic distances in the population and compare these measures with worldwide populations.

2 MATERIALS AND METHODS

The study was conducted on a sample of 300 individuals with informed consent. These individuals are from the city of Tangier from the north of Morocco. These volunteers speak Jebli (one of the two dialects of the region), their parents and grandparents are originally from the same region.

The extraction of DNA was performed on salivary samples, we used two techniques: extraction by Maxwell 16 extractor using the Kit DNA IQ ™ Reference Sample Kit for Maxwell® 16 and organic extraction with phenol-chloroform alcohol Isoamelic, for high efficiency. The AmpFlSTRIdentifiler ® kit was used to amplify 15 STR markers (D8S1179, D21S11, D7S820, CSF1PO, D3S1358, TH01, D13S317, D16S539, D2S1338, D19S433, vWA1, TPOX, D18S51, D5S818, FGA). It allows the co-amplification of five multiplex systems labeled by different fluorochromes absorbing at different wavelengths including: 6-FAM (blue), VIC (green), NED (yellow), TAZ (red) and SID (purple). The sixth dye, LIZ (orange), is used to label GeneScan ™ 600 LIZ. The system used for fragment analysis is the ABI® PrismGenetic Analyzer 3130XL (16 capillaries). It allows detecting and separating the PCR products according to their size and their fluorescence. DNA data is collected by the Data Collection v2.0 software [4], and it is analyzed by GeneMapper ID v3.2. [4]. Genotyping is performed on 96-well plates.

3 RESULTS

The following table (Table 1) shows the allelic frequencies, observed heterozygosity (Ho) and expected heterozygosity (He) of the Tangier population, and forensic parameters (PD, PE, PIC, and MP) generated by Arlequin ver. 3.1 software [5]. The average heterozygosity is 0.76620, with a maximum value observed at the marker D8S1179 and D2S1338 (0.89583), and a minimum value observed at the level of the marker CSF1PO (0.63889).

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Table 1. *Distribution of allelic frequencies of 15 STRs markers in the population of Tangier using AmpFlSTRIdentifiler ® (n=300). (Ho: observed heterozygosity; He: expected heterozygosity, H0 : Observed heterozyosity ; He : Expected heterozygosity ; P : Exact test of Hardy-Weinberg equilibrium; PD : Power of discrimination ; PE : Power of exclusion ; PIC : Polymorphic information content ; MP : Cumulative distribution of coincident*

	D5S818	FGA	D8S1179	D21S11	D7S820	CSF1PO	D3S1358	TH01	D13S317	D16S539	D2S1338	D19S433	vWA	TPOX	D18S51
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	0.211806	-	-	-	-	-	0.003472	-
6,3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	0.006944	0.006944	-	0.197917	0.003472	-	-	-	-	0.006944	-
7,3	-	-	-	-	-	-	-	0.003472	-	-	-	-	-	-	-
8	0.041667	-	0.010417	-	0.104167	0.013889	-	0.177083	0.083333	0.038194	-	-	-	0.395833	0.006944
8,2	-	-	-	-	0.006944	-	-	-	-	-	-	-	-	-	-
8,3	-	-	-	-	-	-	-	0.006944	-	-	-	-	-	-	-
9	0.062500	-	0.017361	-	0.100694	0.017361	-	0.284722	0.031250	0.149306	-	-	-	0.170139	-
9,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9,3	-	-	-	-	-	-	-	0.093750	-	-	-	-	-	-	-
10	0.048611	-	0.052083	-	0.319444	0.284722	-	0.024306	0.038194	0.100694	-	0.020833	-	0.090278	0.006944
10,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	0.263889	-	0.125000	-	0.277778	0.329861	0.006944	-	0.357639	0.312500	-	0.013889	-	0.302083	0.027778
11,2	-	-	-	-	-	-	-	-	-	-	-	0.006944	-	-	-
12	0.329861	-	0.118056	-	0.152778	0.309028	-	-	0.274306	0.180556	-	0.107639	-	0.027778	0.170139
12,2	-	-	-	-	-	-	-	-	-	-	-	0.006944	-	-	0.003472
13	0.218750	-	0.211806	-	0.024306	0.031250	-	-	0.121528	0.180556	-	0.260417	0.010417	-	0.125000
13,2	-	-	-	-	-	-	-	-	-	-	-	0.020833	-	-	-
14	0.027778	-	0.218750	-	0.003472	0.003472	0.055556	-	0.083333	0.031250	-	0.260417	0.125000	-	0.163194
14,2	-	-	-	-	-	-	-	-	-	-	-	0.024306	-	-	-
15	0.003472	-	0.194444	-	-	-	0.302083	-	0.006944	0.003472	0.003472	0.159722	0.211806	-	0.083333
15,2	-	-	-	-	-	-	0.003472	-	-	-	-	0.048611	-	-	-
16	-	0.003472	0.045139	-	-	-	0.298611	-	-	-	0.059028	0.024306	0.225694	-	0.156250
16,2	-	-	-	-	-	-	-	-	-	-	-	0.013889	-	-	0.027778
17	0.003472	0.003472	0.006944	0.003472	-	0.003472	0.187500	-	-	-	0.267361	0.017361	0.239583	0.003472	0.097222
17,2	-	-	-	-	-	-	-	-	-	-	-	0.003472	-	-	-
18	-	0.003472	-	-	-	-	0.121528	-	-	0.003472	0.121528	0.003472	0.118056	-	0.059028
18,2	-	-	-	-	-	-	-	-	-	-	-	-	0.003472	-	-
19	-	0.031250	-	-	-	-	0.020833	-	-	-	0.107639	0.003472	0.048611	-	0.010417
20	-	0.104167	-	-	-	-	0.003472	-	-	-	0.100694	-	0.017361	-	0.024306
20,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	-	0.260417	-	0.003472	-	-	-	-	-	-	0.059028	-	-	-	0.003472
21,2	-	-	-	0.00694	-	-	-	-	-	-	-	-	-	-	-

				4											
22	-	0.215278	-	-	0.003472	-	-	-	-	-	0.041667	-	-	-	0.003472
22,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	-	0.166667	-	-	-	-	-	-	-	-	0.065972	-	-	-	-
24	-	0.149306	-	-	-	-	-	-	-	-	0.100694	-	-	-	0.003472
25	-	0.041667	-	0.003472	-	-	-	-	-	-	0.052083	0.003472	-	-	-
25,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	0.020833	-	-	-	-	-	-	-	-	0.020833	-	-	-	0.027778
27	-	-	-	0.020833	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	0.100694	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	0.225694	-	-	-	-	-	-	-	-	-	-	-
29,2	-	-	-	0.003472	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	0.256944	-	-	-	-	-	-	-	-	-	-	-
30,2	-	-	-	0.006944	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	0.055556	-	-	-	-	-	-	-	-	-	-	-
31,2	-	-	-	0.104167	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	0.006944	-	-	-	-	-	-	-	-	-	-	-
32,2	-	-	-	0.142361	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	0.003472	-	-	-	-	-	-	-	-	-	-	-
33,2	-	-	-	0.034722	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	0.003472	-	-	-	-	-	-	-	-	-	-	-
34,2	-	-	-	0.003472	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	0.010417	-	-	-	-	-	-	-	-	-	-	-
35,2	-	-	-	0.003472	-	-	-	-	-	-	-	-	-	-	-
Ho	0.74306	0.87500	0.89583	0.85417	0.70139	0.63889	0.74306	0.71528	0.79167	0.77778	0.89583	0.64583	0.72222	0.68750	0.80556
He	0.76757	0.82460	0.83762	0.83962	0.77846	0.71557	0.76873	0.79687	0.76837	0.80505	0.86868	0.82489	0.81729	0.71661	0.88441
P	0.06169	0.33559	0.76187	0.00000	0.02999	0.19791	0.80798	0.05811	0.21791	0.12994	0.70876	0.00000	0.00573	0.56668	0.00000
PIC	0,809	0,816	0,743	0,697	0,723	0,777	0,686	0,778	0,819	0,768	0,801	0,67	0,866	0,674	0,838
MP	0,051	0,046	0,083	0,111	0,096	0,066	0,116	0,065	0,043	0,068	0,054	0,125	0,027	0,123	0,038
PD	0,949	0 ,954	0,917	0,889	0,904	0,934	0,884	0,935	0,957	0,932	0,946	0,875	0,973	0,877	0,962
PE	0.662	0.68	0.570	0.507	0.537	0.622	0.501	0.620	0.687	0.612	0.650	0.483	0.755	0.486	0.708

4 DISCUSSION

The exact values of Guo and Thomson have showed that the population is in Hardy-Weinberg equilibrium for all the markers included in AmpFlSTRIdentifiler ®. Applying the Bonferroni correction all p-values <0.003 were considered statistically significant (0.05 / 15 = 0.003) (Weir, 1996), except 3 markers which show a significant deviation D21S11, D18S51 and D19S433 (p = 0.0000). The MPC for the 15 STRs studied is 2.61.10-18 (1 / 2.61.10-17), the PEC is 0.99999966 and the PDC is 0.99999937. The average value of the PIC is of the order of 0.7645 with a maximum value at the vWA locus and the minimum value at the D19S433 locus. The probability of coincidence varies between (0.125) at the D19S433 locus and (0.038) at the D18S51 locus. The probability of exclusion varies between 0.483 (D19S433) and 0.755 (vWA). The large difference between expected and observed frequencies leads us to think about an evolutionary force wich it prevents random unions within this population. These deviations could be explained by an excess of homozygotes due to population substructuring [6].

The genetic structure of the population of Tangier is influenced by various factors that can lead to the modification of its genetic structure. However, Tangier is the city that represents northern Morocco economically and geographically. This region is recently studied, the results underlined a high endogamy rate (86%). and a high percentage of consanguinity (24, 37%) in the population [7, 8]. This marital behavior can explain the disequilibrium of these three STRs markers: D21S11, D18S51 and D19S433.

5 CONCLUSION

The geographical position and the new economic situation of Tangier made of this city an industrial capital. These conditions create dynamism of gene flow within and between populations or subpopulations, and affect marital selection and choice, as well as the genetic structure of this population.

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