

Genetic markers in the Aboriginal populations of Argentina

Francisco R. Carnese

ABSTRACT

The present paper analyzes intertribal variability and estimates the genetic distances between several Indian populations of the Chaco and Patagonia regions of Argentina, belonging to diverse linguistic families. Nine genetic loci were employed in the study: ABO, Rh, MNSs, P, Duffy, Diego, hemoglobins, haptoglobins and transferrins. The degree of ethnic admixture of the different groups studied was measured using the ADMIX program. Genetic distances were calculated using the BYOSIS computer program.

The results suggest that the Chorotí and Matacos, who share the same habitat and belong to the same linguistic family, show a strong genetic association. The Chiriguano-Chané and the Toba-Chulupí are also closely bonded couples; in both of these cases, the two ethnic groups involved belong to different linguistic families, yet the genetic similitudes are coherent with what we know about the historical background.

The tribes of the Chaco region as a whole are genetically distinct from the Mapuche of Patagonia. The level of dissimilarity is consistent with the geographical distance and the difference in linguistic roots between the respective populations.

INTRODUCTION

Genetics research was first undertaken in Argentina by Mazza and Franke (1927), who studied an Indian population of the North. From that time to the mid-1980s, work in this area was limited almost entirely to typing and analysis of blood groups markers. Few studies included other genetic polymorphisms (Carnese *et al.*, 1991-1992). The first estimation of genetic distances was done by Palatnik (1987), using five blood-group loci. He studied various Indian populations of diverse linguistic origin in the Argentinean Chaco region, including a Calchaquí group from Tartagal (Province of Salta, Argentina) and also Toba and Chulupí located in neighboring Paraguay. Our own research group recently did a study (Carnese *et al.*, in press) similar to that of Palatnik, but adding to the previously existing samples some new information on Mapuche villages in the Patagonian region of southern Argentina. Recent research has aimed at analyzing the inter- and intratribal variability of the Indians of Argentina. A significant number of erythrocyte genetic markers, erythrocyte enzymes, serum proteins, HLA system alleles and mitochondrial and nuclear DNA have been

determined in this research (Haas *et al.*, 1985; Theiler *et al.*, 1991; Cerna *et al.*, 1992; Ginther *et al.*, 1993; Bailliet *et al.*, 1994; Carnese *et al.*, in press).

With the available biological information in view, our aim in the present paper is to analyze intertribal variability and to estimate and comment on the genetic distances between the different Indian populations of the Argentinean Chaco and Patagonia.

SUBJECTS AND METHODS

Table I details the indigenous populations included in this study; their geographical distribution is presented in Figure 1. The groups selected represent the different linguistic families of the Argentinean Chaco and Patagonia.

The Toba speak one of the Guaycurú family of languages, which belong to the Paleoamerican linguistic category. In Argentina they are now settled in parts of the provinces of Chaco, Formosa, and Salta, although some groups have migrated to the outskirts of the cities of Resistencia, Rosario and Buenos Aires. Traditional subsistence activities are hunting, gathering and fishing. In the rural areas they practice subsistence agriculture (maize,

Table I - Genetic studies of the Indian populations of Argentina.

Populations	Localities	References
Toba	Carmelo y Puntana (Salta)	Matson <i>et al.</i> (1969)
Toba	Fortín Lavalle (Chaco)	Cabutti and Palatnik (1975)
Toba	Several villages in Chaco and Formosa	Pagés Larraya <i>et al.</i> (1978)
Chulupí	Tabacal (Salta)	Matson <i>et al.</i> (1969)
Chorotí	La Merced y Tabacal (Salta)	Matson <i>et al.</i> (1969)
Chorotí	Several villages in Salta	Pagés Larraya <i>et al.</i> (1978)
Mataco	San Luis, Santa María y Puntana (Salta)	Matson <i>et al.</i> (1969)
Mataco	Several villages in Formosa	Pagés Larraya <i>et al.</i> (1978)
Chanés	Tartagal, Tijuutí y Yacuy (Salta)	Matson <i>et al.</i> (1969)
Chiriguano	Caraparí, Tatima y Yacuy (Salta)	Matson <i>et al.</i> (1969)
Calchaquí	Finca Santa Rosa, near Tartagal (Salta)	Matson <i>et al.</i> (1969)
Mapuche	Rucachoroy (Neuquén)	Haas <i>et al.</i> (1985)
Mapuche	Blancura Centro (Río Negro)	Carnese <i>et al.</i> (1993)
Mapuche	Blancura Centro (Río Negro)	Carnese <i>et al.</i> (in press)

squash, sweet manioc) and they are familiar with cotton culture. The total number of individuals belonging to this ethnic group, including those who migrated to urban areas, is estimated at between 35,000 and 50,000 (Cloux, 1989; Martínez Sarasola, 1992).

The Matacos are settled in the northwest corner of the provinces of Chaco and Formosa and in the northeast of the province of Salta. There are some 125 groups in Argentina with a total of 25,000 individuals (Cloux, 1989; Martínez Sarasola, 1992). Hunting, gathering and fishing are their main subsistence activities. In forested areas they work as lumberjacks and often migrate to the sugar mills during the harvest season.

The Chorotí and Chulupí are less numerous. They are estimated at 1,000 individuals in all and are distributed among seven sites which they share with the Matacos. They are located mostly in the province of Salta, in the Rivadavia Banda Norte Department, near Santa Victoria. These three ethnic groups belong to the Mataco-Mataguayo language family of the Paleoamerican linguistic category.

The Chiriguano and Chané, on the other hand, belong, respectively, to the Tupi-Guaraní and Arawak linguistic families. The first expanded widely in prehispanic times. From their centers of dispersion located on the Lower Amazon, they reached as far as the Argentinean Chaco, approximately in the Sixteenth Century. The Chané, on the other hand, are thought to have dispersed from the Guayana region, across South America and North through the Antilles; in the South they reached the mid-west of what is now the Argentinean Chaco. They were sedentary farmers,

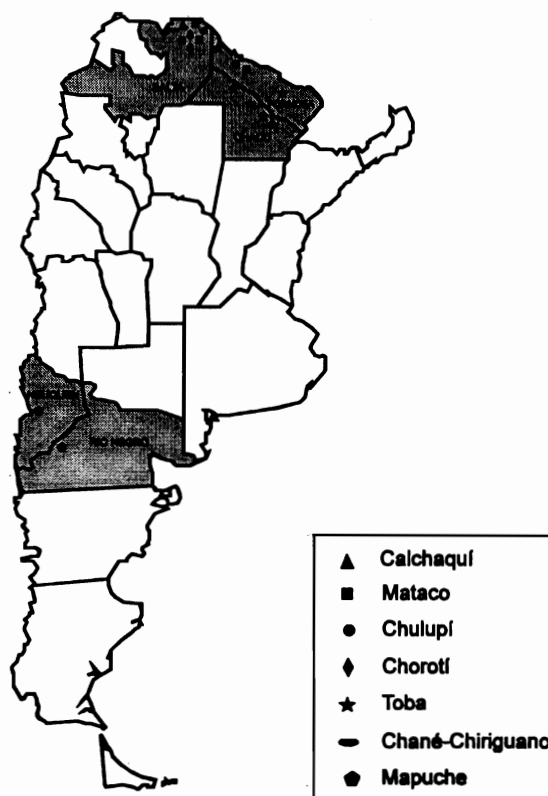


Figure 1 - Map of Argentina. Geographic distribution of Argentinean Indians. The provinces of Chaco, Formosa and Salta belong to the Chaco region. The provinces of Neuquén and Río Negro belong to the Patagonian region.

cultivating manioc, squash, sweet potato and maize. Hunting and fishing were secondary subsistence activities. At the present time, peanuts, beans, soybeans and garden vegetables have also been introduced (Martínez Sarasola, 1992). The number of Chiriguano is estimated at 21100 and that of the Chané at 1400. They are now located in the area along route 34 in the provinces of Jujuy and Salta.

The Calchaquí settled the valleys and ravines of the Argentinean Northwest. They were a subgroup of the Diaguita and their language, Cacá or Cacán, was shared by all of the Diaguita people. In prehispanic times they had sedentary agriculture, possessed artificial ditch irrigation and terraced cultivation: their main products were maize, squash and beans. They are now centered in the northwestern parts of the provinces of Catamarca and Tucumán, some distance to the West of the Chaco region (the Calchaquí village sampled in Tartagal is thus atypical in its geographical location); they raise goats, grow garden vegetables, produce folk handicraft and sweets (Martínez Sarasola, 1992). There is no good estimate of the number of individuals in the various Calchaquí groups.

The Mapuche, along with the Huilliche and Picunche, are of Araucanian origin. Their language is Mapudugun. The Mapuche crossed the Andes from what is now Chile starting in the Seventeenth Century. They were formerly agricultural but in Argentina they have specialized in extensive goat- and sheep-raising. In some areas they practice subsistence horticulture. They inhabit rural and urban areas of the provinces of Río Negro, Neuquén, Chubut, Santa Cruz, La Pampa and Buenos Aires. There are various estimates of the number of individuals in this indigenous group. According to Nardi (1981-82), the sum total of rural and urban populations amounts to approximately 50,000 people.

The samples for the above-mentioned populations were analyzed for nine genetic loci: ABO, Rh, MNSs, P, Duffy, Diego, hemoglobins, haptoglobins and transferrins. When an ethnic group was represented by more than one population, weighted averages were calculated for the gene frequencies.

In estimating the degree of ethnic admixture with non-aboriginal populations, we considered only the Spanish contribution to the respective Indian gene pools. The estimate was made using the method established by Chakraborty (1975) (ADMIX program). The genetic distances were calculated following Cavalli-Sforza and Edwards (1967), using the BYOSIS computer program. For the cluster analysis we employed an unweighted pair-group method using arithmetic average (UPGMA).

RESULTS

We found the highest figure for ethnic admixture in the Calchaquí sample (13%). In the other six tribes sampled in the Chaco region these values varied from 2% to 6%. The lowest figure for admixture was found among the Toba of

Fortín Lavalle (2%). Among the Mapuche, they varied from 7% to 9%. With the exception of the Calchaquí, these values are not very high and we believe they make it possible to establish adequate comparisons between the different populations studied.

Table II presents the gene frequencies of the markers that were analyzed. Almost all the groups appear to have high levels of IO, RhR1, RhR2, Fya, TFC alleles and are monomorphic for HB*A locus. On the other hand, IB and rhr(Rh-) are low or absent. Attention is drawn to the high frequency of RhRZ among the Toba and the low prevalence or outright absence of LMS among the Mapuche.

As was expected, the MNSs system seems to be highly variable, although in most of the populations the L^{MS} chromosome is more frequent, except among the Chorotí and Calchaquí where L^{MS} and L^{NS} , respectively, are highly prevalent. The P system also shows broad variation among the different groups with values of P^1 as low as 0.268 for the Mapuche and as high as 1.000 for the Calchaquí. The lowest frequency of the Di^a allele was observed among the Mapuche (0.035) and the highest in the Chulupí sample (0.192). The Mapuche and the Calchaquí both differ from the other six Chaco groups in their high rates for HP^1 allele (0.782 and 0.800, respectively).

Figure 2 two shows the dendrogram of genetic distances. The value of the cophenetic correlation coefficient (0.943) indicates that the dendrogram is representative of the values of the matrix of genetic distances. The most closely associated populations appear to be the Chorotí-Matacos who constitute a bind; a similar close association can be observed in Chané-Chiriguano and in Chulupí-Toba. A level of dissimilarity of 0.27 separates the Calchaquí from the rest of the tribes being studied. The six Chaco tribes of Chulupí, Toba, Chorotí, Matacos, Chané and Chiriguano are strongly joined. The Mapuche are distant from the cluster formed by these six groups, with a level of dissimilarity of 0.16.

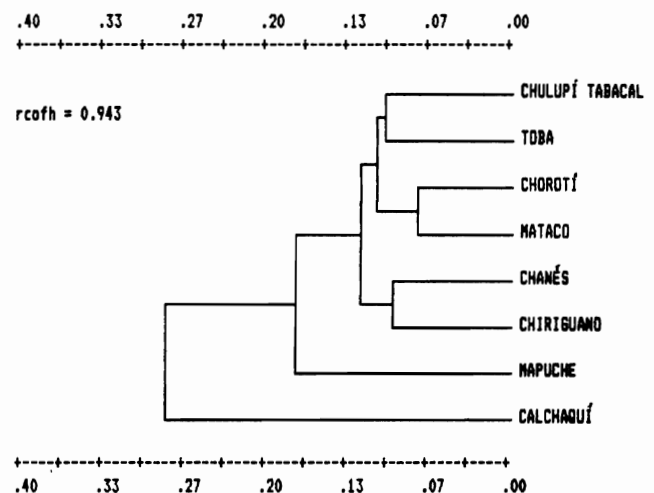


Figure 2 - Dendrogram of eight Argentinean Indian groups.

Table II - Allele frequencies for nine genetic systems studied in Argentinean Indians.

Alleles	1	2	3	4	5	6	7	8
ABO								
(N)	353	96	204	120	90	38	376	397
I ⁰	.987	.995	1.000	.992	.948	.858	.907	.996
I ^A	.011	.000	.000	.004	.051	.142	.072	.005
I ^B	.002	.005	.000	.004	.000	.000	.021	.000
Rh								
(N)	353	96	204	120	90	38	376	397
R ¹	.419	.452	.436	.464	.470	.387	.487	.369
R ⁰	.441	.452	.537	.426	.431	.413	.314	.612
R ²	.009	.017	.009	.033	.030	.139	.028	.010
R ^Z	.117	.079	.018	.032	.069	.060	.052	.010
r	.014	.000	.001	.045	.000	.001	.092	.000
r ^{''}	.000	.000	.000	.000	.000	.000	.029	.000
MNSs								
(N)	353	96	204	120	90	38	376	397
MS	.196	.302	.425	.278	.279	.121	.082	.252
Ms	.435	.464	.296	.470	.427	.379	.501	.432
NS	.117	.057	.033	.068	.121	.090	.070	.033
Ns	.252	.177	.245	.194	.173	.410	.348	.283
P								
(N)	353	96	204	120	90	38	376	397
P ¹	.377	.544	.325	.658	.667	1.000	.268	.412
P ²	.623	.456	.675	.342	.333	.000	.732	.588
Diego								
(N)	353	96	204	120	90	38	376	397
Di ^a	.114	.192	.117	.084	.045	.074	.035	.169
Di ^b	.886	.808	.884	.916	.955	.926	.875	.831
Duffy								
(N)	353	96	204	120	90	38	376	397
Fy ^a	.774	.827	1.000	.796	.702	.771	.647	.838
Fy ^b	.227	.177	.000	.204	.298	.229	.353	.162
Hemoglobin								
(N)	24	37	92	54	55	26	201	26
Hb*A	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Haptoglobin								
(N)	188	100	142	120	109	38	370	47
HP*1	.465	.440	.430	.530	.520	.800	.782	.480
Transferrin								
(N)	50	100	142	120	109	38	370	47
TF*C	1.000	1.000	1.000	1.000	1.000	1.000	.913	.930

1 - Toba; 2 - Chulupí; 3 - Choroti; 4 - Chané; 5 - Chiriguano; 6 - Calchaquí; 7 - Mapuche. 8. Mataco.

DISCUSSION

The results obtained reflect a high level of genetic similarity between the Chiriguano and the Chané, despite the fact that their linguistic (and thence geographical) origins are quite different (Tupi-Guaraní and Arawak, respectively). Palatnik (1987) has pointed to the need for a historical explanation of this biological similarity. We know that the Chiriguano came from what are now Brazil and Paraguay, crossed the Chaco and enslaved the Chané, who probably had originated in the Guianas. Contact between them seems to have begun in the Fifteenth Century and has continued to the present, creating a common gene pool.

On the other hand the Calchaquí show a marked dissimilarity from all the other Indian groups. According to Palatnik (1987), this may be due to a high degree of isolation attributable to the environment, the action of hostile tribes or other, unknown, factors.

However, we should not ignore the influence of other factors that might help explain such a high figure for dissimilarity. One of these could be related to non-biological variables such as the small size of the Calchaquí sample (38 individuals). On the other hand, there is the relatively high biological admixture (13%). Further research will be necessary, particularly on populations with less contact with non-aborigines, in order to get a clearer idea of the genetic characteristics of this ethnic group.

The Choroti-Matacos are genetically bound, belong to the same language family (Mataco-Mataguayo) and share the same habitat, which explains the genetic similarity found between them. The case of the genetic bond between the Toba and the Chulupí is different, because they come from different language families (Guaycurú and Mataco-Mataguayo, respectively). Besides, the Chulupí are located in the western Chaco and the Toba are to the east. The two groups preserve part of their cultural heritage and have strong feelings of identity, which makes it difficult to understand this level of association. However, according to Palatnik (1987), when the Toba adopted horse culture in the Eighteenth Century they expanded through various regions of the present-day territories of Argentina, Paraguay and Brazil, developing, especially through warfare, an extended network of relations, particularly with the Mataco-Mataguayo. In that context, the exchange of genes between the Toba and their subject peoples would not be improbable. The present study makes it clear that the Chiriguano, Chané, Toba, Matacos, Chorotí and Chulupí constitute a closely associated cluster.

The present research uses nine genetic systems. A previous investigation (Carnese *et al.*, in press), which applied the same methodology but used only five loci, showed the Chorotí to be separated from the Chaco population as a whole by a dissimilarity level of 0.16. If discrepancies of this kind are attributable to the number of genetic variables included in the analysis, it is possible that, as the number of markers is increased in the research, at least among these Chaco tribes, a greater correspondence may

emerge between genetic similitude, geographical proximity and linguistic affinity.

The most striking differences between the Mapuche and the Indians of the Chaco are expressed, especially, in the varying frequencies of the L^{MS}, Di^a, P¹ and HP¹ alleles. The dendrogram shows a difference between the Mapuche and the cluster of six Chaco tribes, at a dissimilarity level of 0.16. This may be explained by the Mapuche belonging to a different language family and being located in a distant geographical area. Among the populations studied, the closest sites are Rucachoroy (Province of Neuquén) and Fortín Lavalle (Province of El Chaco), which are 2430 kilometers apart.

There were similarities but also differences in relation to other genetic markers. For example, the Mapuche population of Blancura Centro and Anecón Grande in the Province of Río Negro show high rates of DRB1 1602 and 1402 of the HLA system (Theiler *et al.*, 1991; Ginther *et al.*, 1993). Among the Toba, Pilagá and Matacos, too, there are high frequencies of DRB1 1402, yet there is a notable absence of DRB1 1602 in all the Chaco populations (Cerna *et al.*, 1992). As regards the polymorphisms of mitochondrial DNA, the Mapuche share with the Matacos, although in differing frequencies, certain types of nucleotide sequences found in other Amerindian populations. However, the C haplotype (loss of an *HincII* site at bp 13259), which among the Mapuche has a frequency of 20%, is absent in the Matacos of the Argentinean Chaco (Bailliet *et al.*, 1994).

Unfortunately, despite the recent contributions, we still lack an updated picture of the biology of our country's different indigenous populations. Besides, most of the attempts to calculate the relationship of each of them with other Amerindian groups is based on merely typological criteria. Therefore, we believe caution to be necessary in formulating hypotheses about the probable affinities and biological relations between the communities involved in this study. Despite these limitations, the present research does yield interesting findings:

(1) The Chaco tribes as a whole do show differences with respect to the Mapuche of Patagonia; these dissimilarities are in accord with the geographical distance and the difference in linguistic origin between the two.

(2) In the relations between some of the groups found in the Chaco there is a correspondence between genetic similitude and shared linguistic roots (Mataco-Chorotí), while in others there is a strong genetic association, despite different territorial and/or linguistic origins (Chiriguano-Chané, Toba-Chulupí); nevertheless, these findings are coherent with the historical background of these populations and are useful for understanding the need to articulate biological and socio-cultural information in studies like the present one.

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the Department of Science and Technology of the University of Buenos Aires (UBACYT).

RESUMO

O presente artigo analisa a variabilidade intertribal e estima a distância genética entre diversas populações indígenas das regiões de Chaco e Patagônia na Argentina, pertencentes a diversas famílias lingüísticas. Foram usados nove locus genéticos no estudo: ABO, Rh, MNSs, P, Duffy, Diego, hemoglobinas, haptoglobinas e transferrinas. O grau de mistura étnica dos diferentes grupos estudados foi medido usando-se o programa ADMIX. Distâncias genéticas foram calculadas usando-se o programa para computador BYOSIS.

Os resultados sugerem que Chorotí e Matacos, que vivem em um mesmo habitat e pertencem à mesma família lingüística, mostram uma forte associação genética. Os Chiriguano-Chané e os Toba-Chulupí são também parecidos; em ambos os casos, os dois grupos étnicos envolvidos pertencem a diferentes famílias lingüísticas; não obstante, as semelhanças são coerentes com o que conhecemos sobre a história passada.

As tribos da região de Chaco, em geral, são geneticamente distintas da Mapuche de Patagônia. O nível de dissimilaridade é consistente com a distância geográfica e as raízes da lingüística entre as respectivas populações.

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