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### SHORT COMMUNICATION

# Monomorphic and polymorphic enzyme genetic markers of the Waiãpi Indians of Amapá and of inhabitants of Manaus, Amazonas\*

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## ABSTRACT

One hundred nineteen Waiãpi Indians and 348 inhabitants of Manaus, Amazonas, were tested using nine enzyme genetic systems in the first population and two in the second. The Waiãpi showed some marked differences compared to South American Indian averages in **ACP\*A** (1% vs.  $14 \pm 9\%$ ), **GLO1\*1** (9% vs.  $30 \pm 14\%$ ) and **ESD\*1** (99.6% vs.  $70 \pm 17\%$ ), while **ESD\*1** and **CA2\*1** prevalences in the Manaus population were within the range previously found in the northern region of Brazil (**ESD\*1**: 85% vs. 80-94%; **CA2\*1**: 98% vs. 89-99.8%). The almost identical frequencies obtained for these two markers in this population, when the sample was subdivided according to skin color, suggest that such morphological classifications have little value in this region. Genetic distances between the Waiãpi and other tribes, obtained using these and other genetic markers, showed good parallelism with the geographical distances which separate these Indians from the other groups considered.

## INTRODUCTION

Development of meaningful evolutionary histories for mankind depends on the painstaking accumulation of genetic data. We have previously studied the Waiãpi Indians of Amapá for 20 blood groups, enzymatic and non-enzymatic blood proteins, as well as HLA (Black *et al.*, 1983), and the population of Manaus (tested for seven such systems; Santos *et al.*, 1983). However, information related to nine genetic systems among the Waiãpi and two for the population of Manaus remained unpublished. This is unfortunate, since for population comparisons the reliability of the inferred relationships generally depends on the number of markers considered. In addition, some markers such as the carbonic anhydrase 2 alleles can provide useful evidence about interethnic admixture, a process that undoubtedly influenced the gene pools of Brazilian groups. This note, therefore, puts on record the indicated data.

## SUBJECTS AND METHODS

The Waiãpi (Oyampi, Wayampi, Wayãpy) Indians inhabit an area that was specifically delimited for them, around

geographical coordinates 1°N, 53°W. Their present population is estimated as approximately 500 individuals, with an equivalent number of members of this tribe living in French Guiana (Ricardo, 1996). They speak a Tupi language, and contacts of a more permanent nature with non-Indians started in 1973. Their land, however, is practically intact and free of intruders. In the 580 thousand hectares of tropical forest they have at their disposal, they hunt and gather, practice rudimentary agriculture, and recently have engaged in small-scale gold extraction. This latter activity is subject to much controversy (Gallois, 1996, 1997). Aspects of the Waiãpi schooling process, especially the integration of the Indians' objectives with a need to adapt to the surrounding non-Indian society, have been dealt with by Kahn (1996). Genetic studies of the French Guiana population were performed by Tchen *et al.* (1978a,b,c, 1981), while Black *et al.* (1983) studied the Brazilian groups.

Manaus (geographical coordinates: 3°8'S; 60°2'W) is the capital of the Brazilian State of Amazonas. Founded in 1669, its demographic evolution involved the contribution of Indians, Europeans (mainly Portuguese), and African-derived individuals. Present population is around one million persons. The sample reported here is composed of control subjects who were studied for a comparison with malaria patients (Santos *et al.*, 1983).

Bloods were collected in 1978-1980 (Manaus) and 1980-1981 (Waiãpi) with anti-coagulant, refrigerated shortly afterwards, and transported in this condition to Porto Alegre (in the case of the Indian samples via Belém) and then to Ribeirão Preto. The typing procedures are given in Harris and Hopkinson (1976), and were performed in 1984.

## RESULTS AND DISCUSSION

The Waiãpi, similar to most other South American Indians (Salzano and Callegari-Jacques, 1988) were found to be monomorphic for esterase A, carbonic anhydrase 2, and peptidases A, B, and C ([Table 1](#)). The frequency of **GPT\*1** (40%) was similar to the average obtained for Amazonian Indians in general (18 groups,  $50 \pm 14\%$ ; Callegari-Jacques *et al.*, 1994). Three other markers, however, showed quite different frequencies (**ACP\*A**: 1% vs.  $14 \pm 9\%$ , 69 groups; **GLO1\*1**: 9% vs.  $30 \pm 14\%$ , 39 groups; **ESD\*1**: 99.6% vs.  $70 \pm 17\%$ , 61 groups). All averages refer to South American Indians in general, as reported in Santos *et al.* (in press). Tchen *et al.* (1978b) examined five of the systems studied here in the Waiãpi of French Guiana. As in the present study, no variation was found for peptidases A and B. However, for three of the markers, they found values which were more similar to the general averages (46% for **GPT\*1**, 14% for **ACP\*A** and 88% for **ESD\*1**).

<b>Table I - Phenotype and allele frequencies obtained in the populations of Waiãpi Indians of Amapá and of Manaus, Amazonas.</b>				
Population and system	Phenotype	No. of individuals	Allele	Frequency
<b>Waiãpi Indians</b>				
Acid phosphatase	AB	1	ACP*A	0.006
	B	86		
Glutamate	1-1	13		
pyruvate transaminase	2-1	41	GPT*1	0.399
	2-2	30		
Esterase A	1-1	87	ESA*1	1.000
Esterase D	1-1	118	ESD*1	0.996
	2-1	1		
Glyoxalase 1	1-1	1	GLO1*1	0.091
	2-1	19		
	2-2	96		
Carbonic anhydrase 2	1-1	87	CA2*1	1.000
Peptidase A	1-1	70	PEPA*1	1.000
Peptidase B	1-1	87	PEPB*1	1.000
Peptidase C	1-1	87	PEPC*1	1.000
<b>Manaus</b>				
Esterase D				
Whites	1-1	52	ESD*1	0.836
	2-1	18		
	2-2	3		
Light brown	1-1	126	ESD*1	0.848
	2-1	50		
	2-2	2		
Dark brown	1-1	22	ESD*1	0.855
	2-1	9		
Unclassified	1-1	3		
Total	1-1	203	ESD*1	0.847
	2-1	77		
	2-2	5		
<b>Carbonic anhydrase 2</b>				
Whites	1-1	71	CA2*1	0.993
	2-1	1		
Light brown	1-1	218	CA2*1	0.980
	2-1	9		
Dark brown	1-1	44	CA2*1	0.978
	2-1	2		
Unclassified	1-1	3		
Total	1-1	336	CA2*1	0.983
	2-1	12		

Santos *et al.* (in press) compared the Waiãpi with 15 other Tupi-speaking populations, using 21 genetic systems (ABO, ACP, AK, ALB, CA2, CHE1, CP, ESD, Duffy, G6PD, GLO, HBA, HBA2, HP, P, PGD, PGM1, PGM2, PEPA, PEPB, TF). They showed a closest relationship with the Araweté, followed by the Urubu-Kaapor, and more distantly the Gavião. The two first links make sense, since the three populations do not live very far away from each other, but the Gavião are more distant, being located in the southeastern portion of the Amazon Region. This distance is greater than those which separate the Waiãpi from other Tupi tribes considered in the comparison. Callegari-Jacques and Salzano (1989) performed another, more restricted, within-Tupi comparison (eight populations, 12 systems), and in this case the Waiãpi clustered with their neighbors, the Emerillon (not included in the 1998 study). In another analysis involving 27 Amazonian Indian tribes (Salzano *et al.*, 1991), the Waiãpi clustered with the Wayana, Apalai and Tiryó (all Carib tribes living in their vicinity), but also with the Pano, who live far away.

The values obtained in the total Manaus sample (85% for **ESD\*1**; 98% for **CA2\*1**; [Table I](#)) are within the range obtained in northern Brazil (**ESD\*1**: 80-94, eight populations; **CA2\*1**: 89-99.8%, six populations; Schüler *et al.*, 1982; Schneider *et al.*, 1987; Santos *et al.*, 1987; Bortolini *et al.*, 1992; Guerreiro *et al.*, 1993; Ribeiro-dos-Santos *et al.*, 1995; Santos *et al.*, 1996; Bortolini *et al.*, in press). The CA2\*1 results do not strictly correlate with the amount of African admixture estimated for these communities (see Santos and Guerreiro, 1995; Bortolini *et al.*, 1995; Bortolini *et al.*, in press), although, as expected, high **CA2\*1** frequencies are generally associated with low African admixture (Óbidos: 10% and **CA2\*1**: 99%; Manaus: 12% and 98%; Parintins: 13% and 99.8%), the opposite also being true (Trombetas: 56% and 89%). The almost identical frequencies observed for **ESD\*1** and **CA2\*1** in the three subgroups classified according to color in Manaus in our study ([Table I](#)) indicate that such groupings are meaningless in this population.

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## RESUMO

Um total de 119 índios Waiãpi e 348 habitantes de Manaus, Amazonas, foram testados usando nove sistemas genéticos enzimáticos na primeira população e dois na segunda. Os Waiãpi mostraram algumas diferenças marcantes quanto às médias dos indígenas sul-americanos em **ACP\*A** (1% vs.  $14 \pm 9\%$ ), **GLO1\*1** (9% vs.  $30 \pm 14\%$ ) e **ESD\*1** (99,6% vs.  $70 \pm 17\%$ ), enquanto as prevalências de **ESD\*1** e **CA2\*1** na população de Manaus mostraram-se dentro do intervalo encontrado previamente na região norte do Brasil (**ESD\*1**: 85% vs. 80-94%; **CA2\*1**: 98% vs. 89-99.8%). As frequências quase idênticas obtidas para esses dois marcadores nesta população, quando a amostra foi subdividida de acordo com a cor da pele, sugerem que tais classificações morfológicas têm pouco valor nesta região. Distâncias genéticas entre os Waiãpi e outras tribos, obtidas usando esses e outros marcadores genéticos, mostraram bom paralelismo com as distâncias geográficas que separam esses índios dos outros grupos considerados.

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