

ABO BLOOD GROUPS IN NATURAL POPULATIONS OF CALLITRICHIDAE (PLATYRRHINI, PRIMATES)

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ABSTRACT

Blood and saliva samples were collected from 88 *Saguinus fuscicollis weddelli* and 47 *Callithrix emiliae* specimens captured along the banks of the Jamari river in Rondônia and from 35 *Callithrix jacchus jacchus* specimens captured in the State of Rio Grande do Norte. Their saliva was tested for the presence of ABH substances by the standard hemagglutination inhibition method. The three species were found to be monomorphic for the ABO system, all belonging to the A blood group. These results are similar to those obtained in most previous studies conducted on the family Callitrichidae.

When plasma samples were tested for the presence of natural ABO system agglutinins discrepancies between the saliva and serum phenotypes were observed in the three species.

INTRODUCTION

The blood groups of non-human primates have been extensively investigated, with important information having been obtained for the understanding of the origin and evolution of these systems. In addition, the study of the genetic characteristics of populations permits inferences about the migratory movements that occurred in the past and about the interrelationships of these populations, through the detection of intra- and interspecific differences.

Even though New World monkeys are widely used in medical-biological investigations, few species have been studied in terms of genetic traits. Furthermore, many of the studies of this type have been carried out on captive animals that were

not representative of natural populations. In the present paper we report on the distribution of ABO blood groups in natural populations of three Callitrichidae species, two of which, *Callithrix emiliae* and *Callithrix jacchus jacchus*, are described for the first time.

MATERIAL AND METHODS

Blood and saliva samples were collected from 47 *C. emiliae* and 88 *Saguinus fuscicollis weddelli* specimens when the reservoir of the Samuel hydroelectric plant was formed on the Jamari river, a tributary of the right bank of the Madeira river (Rondônia). Thirty-five *C. jacchus jacchus* specimens were captured along the edge of Extremós lake near Natal, in the State of Rio Grande do Norte. These animals are currently being held captive at the National Primate Center (CENP-FSESP, State of Pará), where the blood and saliva samples were collected.

ABH substances were detected in saliva by the hemagglutination inhibition method, using commercially available anti-A and anti-B reagents (Ortho Diagnostic) and anti-H lectin (*Ulex europeus*) prepared in our laboratory. The substances were quantified by the standard method and the titers were converted to base 2 logarithms for statistical analysis, as recommended by Dunsford and Bowley, 1967). Natural agglutinins were investigated in 50 plasma samples from *S. f. weddelli*, 40 from *C. emiliae*, and in all plasma samples from *C. j. jacchus*. The sample collection procedure and the techniques employed have been described in previous papers by Schneider *et al.* (1987) and Harada-Hamel *et al.* (1988).

Means and standard deviations and differences between means (t-test) for ABH titers were estimated using the Statistical Package for Social Sciences (SPSS) for PC microcomputers. The program was also used to compare mean ABH titers among species.

RESULTS AND DISCUSSION

The results obtained in the present study are listed in Table I together with those previously published for the family Callitrichidae. It can be seen that all individuals of the three species investigated in the present study had the A phenotype, suggesting that these populations are monomorphic for the ABO system.

The results reported for *C. emiliae* and *C. jacchus jacchus* are the first for this genus. However, five different species of the genus *Saguinus* have been studied previously. Wiener *et al.* (1967) studied a sample of 18 *S. fuscicollis* monkeys and classified them all as group A. These authors also investigated four *S. oedipus*, three *S. mystax* and six *S. nigricollis* specimens, in which they only detected group A. The same result was obtained by Gengozian (1964) in a study of eight *S. nigricollis* animals. The only species that presented polymorphism for the ABO system was *S. midas niger* in

which Schneider *et al.* (1987) detected the occurrence of groups A, B and AB. The gene frequency estimated by these investigators showed that the I^B allele is the most frequent in this population, suggesting that the genetic composition of this species differs considerably from the remaining ones in this genus.

Table I - ABO blood groups in the family Callitrichidae.

Species	Blood groups				N	References
	O	A	B	AB		
Genus <i>Callithrix</i>						
<i>C. emiliae</i>	0	47	0	0	47	Present study
<i>C. jacchus jacchus</i>	0	35	0	0	35	Present study
Genus <i>Saguinus</i>						
<i>S. nigricollis</i>	0	8	0	0	8	Gengozian, 1964
<i>S. fuscicollis</i>	0	18	0	0	18	Wiener <i>et al.</i> , 1967
<i>S. mystax</i>	0	3	0	0	3	Wiener <i>et al.</i> , 1967
<i>S. nigricollis</i>	0	6	0	0	6	Wiener <i>et al.</i> , 1967
<i>S. oedipus</i>	0	4	0	0	4	Wiener <i>et al.</i> , 1967
<i>S. midas niger</i>	0	11	45	25	81	Schneider <i>et al.</i> , 1987
<i>S. f. weddelli</i>	0	88	0	0	88	Present study

Table II shows the gene frequencies estimated for New World monkeys in the present and in previous studied. Five genera of the family Cebidae (*Alouatta*, *Aotus*, *Cebus*, *Chiropotes* and *Saimiri*) and two of the family Callitrichidae (*Callithrix* and *Saguinus*) have been investigated thus far. It can be seen that the genus *Saimiri* seems to be the most polymorphic one, followed by *Cebus* and *Aotus*, whereas *Alouatta* and *Chiropotes* are monomorphic. Interestingly, the I^A allele was detected in all genera except *Alouatta* and *Aotus*. These data suggest that, in general, Cebidae monkeys are more polymorphic than Callitrichidae.

Mean substance A titer (Table III) was significantly higher than H titer in the three species (*C. emiliae*: t-test = 17.14, df = 46, $P < 0.001$; *C. j. jacchus*: t-test = 45.52, df = 34, $P < 0.001$; *S. f. weddelli*: t-test = 35.04, df = 87, $P < 0.001$). Similar results were obtained for *Ateles* and *Saguinus* by Wiener *et al.* (1964, 1966, 1967) and for *Cebus* by Schneider *et al.* (1985) and Harada-Hamel *et al.* (1988). In contrast, Wiener *et al.* (1964) detected an inverse relationship between these substances in *Saimiri*.

Table II - ABO genes frequencies in New World monkeys.*

Species	N	Gene frequencies			Reference
		I^A	I^B	I^O	
Genus <i>Alouatta</i>					
<i>A. palliata</i>	52		1.00		1
<i>A. belzebul</i>	50		1.00		2
Genus <i>Aotus</i>					
<i>A. nancymai</i>	93		0.12	0.88	3
<i>A. vociferans</i>	20		0.29	0.71	3
Genus <i>Callithrix</i>					
<i>C. emiliae</i>	47	1.00			**
<i>C. jacchus jacchus</i>	35	1.00			**
Genus <i>Cebus</i>					
<i>C. apella apella</i>	19	0.36	0.21	0.43	4
<i>C. a. apella</i>	95	0.50	0.22	0.28	5
<i>C. a. paraguayanus</i>	55	1.00			6
Genus <i>Chiropotes</i>					
<i>C. satanas</i>	72	1.00			7
Genus <i>Saimiri</i>					
<i>Saimiri</i> sp.	11	0.53	0.14	0.33	8
<i>S. s. macrodon</i>	8	0.62	0.38		****
<i>S. boliviensis peruviensis</i>	44	0.85	0.15		****
<i>S. boliviensis</i> 1980***	17	0.46	0.28	0.26	9
1981***	18	0.52	0.28	0.20	9
1982***	22	0.86	0.14		9
Genus <i>Saguinus</i>					
<i>S. nigricollis</i>	8	1.00			10
<i>S. fuscicollis</i>	18	1.00			11
<i>S. midas niger</i>	81	0.26	0.66	0.08	12
<i>S. f. weddelli</i>	88	1.00			**

*Only those primate samples consisting of at least eight individuals are included in this table; **Present paper; ***First called *Saimiri sciureus* by Terao et al. (1988), the species was renamed by the authors as *S. boliviensis* based on Hershkovitz (1984); ****Unpublished material.

(1) Froehlich et al., 1977; (2) Corvelo et al., 1985; (3) Harada-Hamel et al., 1990a; (4) Schneider et al., 1985; (5) Corvelo et al., 1987; (6) Harada-Hamel et al., 1988; (7) Harada-Hamel et al., 1990b; (8) Socha e Ruffié, 1983; (9) Terao et al., 1988; (10) Gengozian, 1964; (11) Wiener et al., 1967; (12) Schneider et al., 1987.

Table III - Comparison of ABH antigen titers in the family Callitrichidae.

Blood Groups	N	Antigens	Titer*			
			Mean	SD	Minimum	Maximum
<i>Callithrix emiliae</i>						
A	47	A	7.8	1.9	3.0	11.0
		H	3.8	1.3	1.0	7.0
<i>Callithrix jacchus jacchus</i>						
A	35	A	12.4	1.0	10.0	15.0
		H	1.0	1.2	0.0	4.0
<i>Saguinus fuscicollis</i>						
A	88	A	10.4	1.3	7.0	13.0
		H	4.3	1.4	1.0	8.0

* The antigen inhibition titers were recorded according to the logarithmic method referenced in Dunsford and Bowley (1967).

SD = Standard deviation.

Comparison of substance A and H titers revealed statistically significant differences among the three populations in all comparative analyses. The highest A antigen titers were detected in *C. j. jacchus* and the lowest in *C. emiliae*, and the highest H titers were observed in *S. f. weddelli* and the lowest in *C. j. jacchus*. It is interesting to note that only the species *C. j. jacchus* presented H-deficient individuals (46%), demonstrating the small amounts of H antigen present in these animals. H-deficient animals are not rare among New World monkeys, having been detected in *Ateles* (Wiener *et al.*, 1966), *Saguinus* (Gengozian, 1964; Wiener *et al.*, 1964, 1967), *Aotus* (Harada-Hamel *et al.*, 1990a) and *Chiropotes* (Harada-Hamel *et al.*, 1990b). In most of the studies cited above, the anti-H reagent used by the authors was more diluted (1 to 2 agglutinating units) and most individuals were found to have extremely low levels of antigen H.

Serum agglutinin measurement revealed the presence of anomalous antibodies (presence of anti-A antibodies and/or absence of anti-B antibodies) in all three species. Anti-A agglutinins were detected in 11% of the *C. j. jacchus* specimens studied, in 19% of *C. emiliae* and in 2% of *S. f. weddelli*. In addition, the absence of anti-B antibodies was notable in the two *Callithrix* species (63% in *C. j. jacchus* and 28% in *C. emiliae*) and relatively low in *S. f. weddelli* (6%).

Discrepancies between saliva and serum phenotypes have been reported for other groups of non-human primates as well as for man. Since serum samples are submitted to exhaustive absorption before the tests for agglutinin identification, low antibody titers may not be detected, thus explaining the absence of agglutinins expected to be present on the basis of saliva results. However, the fact that an individual presents an antibody complementary to its saliva antigen remains unexplained. Several hypotheses have been raised to explain these results, such as the influence of environmental or genetic factors on the production of ABH substances, individual differences between red blood cell and secretion antigens, differences between humans and monkeys, or different genes controlling the production of anti-A and anti-B antibodies. None of these hypotheses, however, has been confirmed thus far. On this basis, the occurrence of anomalous antibodies continues to be an open question awaiting clarification.

ACKNOWLEDGMENTS

The authors thank Anna Christina Tojal for technical assistance in testing the saliva samples.

This work was supported by the following institutions: UFPA (Universidade Federal do Pará), FINEP (Financiadora de Estudos e Projetos), CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), FAPESP (Fundação de Amparo e Desenvolvimento da Pesquisa) and ELETRONORTE (Environmental Division).

RESUMO

Foram coletadas amostras de sangue e saliva de 88 *Saguinus fuscicollis weddelli* e 47 *Callithrix emiliae*, capturados às margens do rio Jamari (Rondônia), e 35 *Callithrix jacchus jacchus*, capturados no estado do Rio Grande do Norte. A existência de substâncias ABH foi investigada em amostras de saliva, através do método convencional de inibição da hemaglutinação. As três espécies apresentaram-se monomórficas para o sistema ABO, sendo os indivíduos classificados como pertencentes ao grupo sanguíneo A. Esses resultados são semelhantes a maioria dos estudos realizados anteriormente na família Callitrichidae.

As amostras de plasma foram utilizadas na detecção de aglutininas naturais do sistema ABO, tendo-se observado discrepâncias entre os fenótipos salivar e sérico nas três espécies.

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(Received December 15, 1989)