A SAMPLING OF GAUR BLOOD TYPES

by
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Gaur, Bos gaurus or Bibos gaurus are closely related to cattle, Bos taurus (cf. Walker, l964). They are generally native to India, Burma and Indonesia. Their red cell surface antigens should be similar to those of cattle. Their erythrocytes should react with blood typing reagents of cattle approximately as well as such reagents do with the red cells of bison, American buffalo ('Stormont, Miller and Susuzki, 1961).

Ten gaur, 8 males and 2 females belonging to the Henry Doorly zoo, Omaha, Nebraska, were sampled for such tests. Their cells reacted very well in at least 7 genetic blood typing systems of cattle. Some comparison tests with bison and wisent, European bison, courtesy of Stormont Laboratories, Ind., Woodland, California, with goat, sheep, and white tailed deer (courtesy of Dr. Ed Powell, ISU) erythrocytes were possible also.

Materials and Methods

Blood samples were collected from gaur immobilized for semen collection via electroejaculation, and from animals immobilized for health maintenance procedures such as hoof trims.

Gaur were immobilized with a combination of xylazine (0.1-0.2 mg/Kg) and carfentanil (0.01-0.03 mg/Kg) administered intramuscularly via dart or pole syringe. Blood was collected from the jugular vein by venipuncture in 60 ml syringes using an 18 gauge inch and a half needle. The sample was then transferred directly to tubes containing heparin anticoagulant. The sample size was 100ml. Reversal of anesthesia was accomplished with naltrexone (1.0-4.5 mg/Kg) given 1/4 intravenously and 3/4 subcutaneously or with naloxone (1.0-3.0 mg/Kg) given 1/4 intravenously and 3/4 subcutaneously.

Forty five different blood typing reagents for cattle plus many replicates and some putative new factor reagents were used to test the gaur samples in 10 blood group systems as noted in table l. This test is hemolytic instead of agglutinative, requiring selected or absorbed rabbit complement that lacks normal antibodies for the species cells undergoing test. Two drops of prepared antibody reagents were put into small test tubes, then one drop of washed 3% red cells followed by one drop of complement were added. The test is conducted over a 5-6 hour period with three readings of the degree of lysis at 30 minutes, 2 hours and 4-6 hours. 1 Dept. of Zoology/Genetics, ISU, Ames, Iowa 2 With the cooperation of Douglas Armstrong Henry Doorly Zoo; Omaha, Nebraska 3 Recommended by Kevin Stalder.

The reactive cells were classified for their antigenic factors and assigned to their genetic systems of cattle. Phenogroups of the B system were evident (Stormont, et. al. l951), although without family data they remain tentative.

Antisera to one gaur, 4471 was produced in unrelated rabbits by multiple, every other day (12), injections of 1 ml of washed red cells at approximately 20% suspension. About 50 ml of blood from each rabbit was collected, allowed to clot, and the expressed antisera centrifuged clear, labeled and stored frozen for later use. This antisera was tested in titer tests of quadrupling dilutions, and absorptions made with goat, sheep and cattle red cells.

The blood types of the 10 gaur tested with cattle reagents are listed in Table 1. No reactions were detected in the L and M systems. The A system showed factor A present twice, 4478 possessed also D and H factors. Four others had H alone and 4 no detected factor. The D antigen present in all cattle lacking A1 (as well as some with A1) was not surely present in these 4. The B system (Stormont, 1951), always of major interest had several cattle factors phenogrouped into 7 probable B groups, 3 being present more than once.

BY1A'Y'34	4X
BY1A'Y'	
BTA'Y'	
I1P	4X
I1KPQD'	5X
I1KPD'	
Y1A'Y'34	

Table 1. Blood groups in 10 gaur.

Systems	A	B	C	FV	J	L	M	S	Z	R'S'	
m 4927	H	BY1A'Y'34/ I1 P	C1 R2	V	-/-	-/-	-/-	U H'	Z	S'	B'
m 4478	A1DH	BY1A'Y'344/ I1 P	C1 R2	FV	J +-	-/-	-/-	U'H'	Z	.	B'
m 4908	.	BY1A'Y' ./ I1K2PQD'	C1 R2	FV	J	-/-	-/-	H'	Z	.	B'
m 5677	H	BY1A'Y' ./ I1K2PQD'	C1 R2	V	-/-	-/-	-/-	-/-	Z	.	B'
m 4934	H	BY1A'Y'34 / BY1A'Y'34	C1 R2	.	-/-	-/-	-/-	-/-	Z	.	B'
f 3925	.	I1K2PD' / .Y1A'Y'34	C1 R2	V	-/-	-/-	-/-	U'	Z	.	B'
m 4741	H	I1K2PQD' / BTA'Y'	R2	V	J	-/-	-/-	H'	Z	.	A'B'
m 4434	.	BY1A'Y'34 / I1 P	C1R2 X2	FV	-/-	-/-	-/-	H'	Z	.	nt
f 4050	.	BY1A'Y'34 / I1 P	C1R2 X2	FV	-/-	-/-	-/-	H'	Z	.	B'
m 4965	A1	BY1A'Y' 34 / I1K2PQD'	C1R(1)	FV	-/-	-/-	-/-	-/-	Z	S'	nt

The C system of gaurs frequently has C1 and R2 factors. X2 was present twice and R1 once. The F system evidently was lacking in one gaur, V alone present in 4 and FV in five gaur. J factor was found in 2 and possibly a weak J in another. But none of the J negative gaur possessed anti-J as do some J negative cattle. Further inhibition tests of the plasma of 4478 and 4908 failed to demonstrate J substance in the plasma as J cattle have (Stormont 1949).

The S system exhibited 3 U' factors and 6 H', while 3 gaur were non-reactive in this system. Z was present in all 10 gaur. S' was present at least twice. But the reaction was so weak that further tests are necessary for the lack of S' in these animals. A bison-specific reagent non-reactive with cattle did react with all 10 gaur. Four weak new factor reagents reacted with one or more gaur.

Absorptions of some cattle reagents with gaur cells was made to test possibly "identical" antigens versus cross reactivity. The majority of gaur antigenic reactions with cattle reagents removed all reactivity from cattle cells in absorptions (12) implying possible "identity" or at least fully cross-reactive antigens. One of these in the B system, D', appeared to be "identical" for D' of Y1D'I' and B2GD' phenogroups of cattle, but not for BO1Y2 D' nor D'E'3F'G'O' groups.

C2 , J and V reagent absorptions weakened the cattle homologous reaction considerably, but did leave in reaction implying that the gaur factor was related but not identical to the J of cattle. G, F, and V absorptions removed for gaur cells but did not affect the strength of reaction for cattle cells, implying considerable antigenic divergence for those factors.

Z was present in all 10 gaur. If such lack of polymorphism is extended to other gaur, it could be called species- specific. This would parallel the L of bison which is essentially species-specific in bison, but polymorphic in cattle.

Table 2. Titer Results of Rabbit anti-Gaur 4478.

Red Cells from	Rabbit		
	N.Z. White	Minilop	Harlequin
Antisera unabsorbed			
Gaur 4478	7	7	6
F1 G/HF	5	5	5
3 cattle	5	5	4
wisent & 2 bison	4,5	5	5
2 goats	5	6	5
2 sheep	5	6	5
2 white tailed deer			
Absorbed by goat			
Gaur 4478	6	5	5
F1 G/.HF	4	4	3
3 cattle	4	4	3
wisent & 2 bison	3	2~,3	3
2 goats*	o	o	o
2 sheep	(4)	(3)	(2)
2 white tailed deer	o	o	o

Table 2 continued

Red Cells from	Rabbit		
	N.Z. White	Minilop	Harlequin
Absorbed by sheep			
Gaur 4478	6	5	5
F1 G/HF	5	3	4
3 cattle	5	4	4
wisent & 2 bison		3 (the 3 sources pooled)	
2 goats	4	3	3
2 sheep**	o	o	o
2 white tailed deer	o		
Absorbed by cow #3			
Gaur 4478	5	5	5
F1 G/HF	2	3	2
3 cattle	o	o	o
2 goats	o	o	o
2 sheep	o	o	o
2 white tailed deer	o		
Absorbed by goat +sheep			
Gaur 4478	6	5	6
F1 G/HF	5	4	5
3 cattle	5	4	5
wisent & 2 bison	3	2	3
2 goats	o	o	o
2 sheep	o	o	o

( ) = late reading only
* Absorbing cell type Nubian ; other test cell Alpine
**Jacob sheep M&F
~ one bison weaker=2

1Titer expressed as number of quadrupling dilutions: 1= undiluted
2=1/4 5=1/256
3=l/16 6=1/1024
4=1/64 7=1/4096

Two anti-elk absorbed by cattle were both zero with bison and wisent, gaur, and 2 white tailed deer.

Table 3. Tests of crossreactions of gaur erythrocytes with cattle blood typing reagents by absorptions.

1.5:1 ratio in 2 tubes	All reactivity removed from cattle reagent	weakened = some removed	removed only for self
	A --C86	C2 --C45	V --R10
	Y2 --C25	J -- 308 NS	G --C14
Gaur 4478	R2 --C76	V --C11	F --C12
	D --R11		
	B --C2		
	P --C45B		
	H' --C45		
	Z --C54		
Gaur 4965	R --C77		
	A' --C111		
	D' --C93	for Y1D'I' and ~B2GD'; but not for BO1Y2D' nor D'E'3F'G'O'	
	Q --C82	for I1Q of Salers cattle	

Table 4. Tests of gaur normal plasma for J substance and antibodies for cattle cells.

No anti- J in		No inhibition of J* by		Suspect anti-U' in**	
Gaur Male	4434	Gaur Male	4478	Gaur Male	4934
"	4927	"	4908	" Female	3925
"	4934				
"	4965				
"	5677				
Female	4050	Weak inhibition of J by		Suspect anti-U-like in**	
"	3925				
		Gaur male 4741		Gaur Male	4927
				"	5677
				Female	4050

*308NS
**undiluted only

Discussion

The gaur are as cattle-like as bison, especially in the B system. Different reagents do give different results sometimes. This is not surprising in species comparisons. For example, ISU replicate reagents A, D',V, S, and Z reagents exhibited differential cross-reaction with the gaur cells. Stormont laboratories Inc. also had similar differences with the Q, E'3 and O' reactions. Unknown "extra reaction" specificities of another system in some reagents are possible, but not necessary as an explanation, since Irwin's principle of classical Immunogenetic species-cross reactions, and Landsteiners dictum of different specificities elicited against the same antigen are sufficient to explain the results.

Crossreacting antigens of 2 or more species have relationships that can be classified as "identical", or similar (crossreactive) but not identical. Absorptions are the classical method of distinguishing such relationships. If an absorption removed all specificity then the absorbing antigen could be (but need not be) identical. Different reagents against the same antigen may give identical versus related results ....Antigens unique to one or the other species also occur and may be polymorphic or species specific (all individuals possessing the antigen) as with type L in bison versus polymorphic in cattle.

The postulated B phenogroups for gaurs mostly are not known among the nearly 700-1000 known in cattle. Y1A'Y' in gaur is found in Holstein-Friesian (.006 gene frequency, Immgen.). That phenogroup could be PY1A'Y', since the P is "covered" by the P in the alternative phenogroup. In this case it would be as found in several Zebu types and hybrids including Santa Gertrudis.

The lack of F or V in gaur 4934 could be a subtype of F or V not detected by the present reagents. This explanation is preferred to its complete absence, since F and V are, like M and N in humans, a closed system.

Table 2 includes the rabbit anti-gaur cross-reaction with a hybrid gaur (courtesy of Dr. S. M. Hopkins, ISU, cattle, wisent, and 2 bison (courtesy of Stormont Laboratories, Woodland, CA).

The 3 antisera are so similar that they are pooled in this discussion. The unabsorbed titer reaches 1/4096 for the homologous gaur cells, 1/256 for the F G/HF hybrid and cattle cells, bison, goats and sheep. Absorption by the more closely related cattle cells reduced the titer by 1 to 2 quadrupling dilutions and removed reaction for both goats and sheep. But pooled goat and sheep cells did not remove for cattle cells.

In Table 4 tests for presence of anti-J antibodies in 7 gaur lacking J substance failed to demonstrate such antibodies whereas in cattle a few would be likely to show some anti-J. Serum from weakly active J gaur, 4478, and a stronger one, 4908, failed to inhibit J in inhibit tests. Gaur 4741, also J positive, did inhibit J at least weakly. Normal anti U antibodies were indicated in 5 gaur.

The recent interest in gaur speciation arose from Zoo mating animals turning up with reduced fertility. Chromosome counts may show different numbers so that the Indian and Burmese types might well be different species. Blood typing with M. R. Irwin's principles in mind would be the first line of evidence after the chromosome count for different species. More gaurs of known geographical lineage and further blood typing studies should make possible species differences evident.

Molecular studies could confirm or deny the more classical results.

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