10 Nov 76

Seminar - Genetics 690 - 4:10 PM - 131 Ross

PHYTAHEMAGGLUTININS AND SPECIES DIFFERENCES: Wilmer J. Miller

Suggested References:

Boyd, W. C. 1962 Introduction to Immunochemical Specificity
Interscience Publishers, John Wiley and Sons NY Chapters 5 and 6.

Gold, E. R. and P. Balding 1975 Receptor-specific proteins:
Plant and Animal Lectins
Excerpta Medica, Amsterdam

Cohen, E. Ed. 1974 Biomedical Perspectives of Agglutinins of Invertebrate and Plant Origins. Ann. NYAS 234: 1-412

A Sample list of plant species and the human cell types they pick out:

A	Lima bean* *Vicia cracca*
A_1	*Coronilla varia* *Dolichos biflorus**
B_1	*Evonymus alatus* " *sacrosancta*
B	*Bandeiraea simplicifolia*
A+B	*Sophora japonica*
B+H	*Magnifera indica*
A+H	*Dictyota bartayresii* (brown algae)
H	*Ulex europaeus** (common gorse) *Laccaria laccata* (fungus) *Dermatocarpon miniatum* (lichen)
I	*Helvella sulcata*
N	*Vicia graminea* *Bauhinia purpurea**
M	*Iberis amara*
A+N!	*Molucella laevis*
Rh+?	*Clerodendron trichotomum*

* = a preferred source

Strongest Phytahemagglutinins: number of quadrupling titers with red cells

Chemical Specificity	β-D-Gal		α-D-man α-D-Glc	β-D-Galp		
	Ricinus communis	Datura meteloides	Canavalia ensiformis	Phaseolus vulgaris	Phaseolus coccineus	Maackia amurensis
Species	castor bean	moonflower	Jackbean	round wax kidney bean	scarlet runner bean	
S. chinensis	6	7	7	7	8	9
F_1 ch/ri	6	6	8	7	8	8
F_1 ch/se	5	6	8	7	8	8
S. senegalensis	5	6	7	6	8	8
S. bitorquata	6	6	7	6	8	7
F_1 bit/ri	6	5	7	6	8	7
F_1 cap/se	7	6	7	7	8	8
F_1 semit/ri	6	6	7	6	8	7
S. humilis	7	6	8	8	8	7
F_1 hu/ri	6	6	7	6	8	6
S. risoria P+	7	6	8	7	10	6
S. risoria P-//+	7	6	8	7	7	5
S. risoria P-//-	6	6	8	6	8	7
F_1 li/ri	6	6	8	8	8	7
C. livia	7	7	8	8	10	7
Z. macroura	5	6	8	8	8	8
F_1 mac/ri	6	7		8	8	5
jungle fowl	5	6	6	5	6	7
chicken	5	7	7	5	6	7
r.n. pheasant						
turkey	6	7	8	6	6	6
guinea fowl	5		6			
mallard	5	6	7	6	5	6
F_1 M/M	6	7	6	7	6	7
muscovy	0,5	7	0,7	7	10	8
human O	5	5	0	5	6	5
human A_3			2			
human A^3	5	5	2	4	7	5
human B	5	6	0,4	5	7	7
human AB						
hog	7	7	3	5	8	6
cow	3	4	0	0	4	4
sheep	3	6	0	7	6	6
w. t. deer	4	7			6	
horse	4	7	8	8	7	8
dog	6	7	8	5	6	8
cat	6	7	8	6	7	9
rabbit	7	8	7	6	7	7
rat	7	5	7	6	8	5
mouse	5	7	7	6	6	6
hamster	7			7	6	
guinea pig	5	4	7	5	8	5
Peromyscus	8	6		7	5	

1	2	3	4	5	6	7	8	9	10
0	4	16	64	256	1024	4096	16384	65536	262144

Titers of phytahemagglutinins with red cells of various species

Chemical Specificity	D-Man	a-D-GalNAc	a-D-GalNAc	D-GalNAc	I a-L-Fuc II D-GlcNAc	D-GlcNAc	β-D-Gal	
	Pisum sativum Alaska Pea	Dolichos biflorus	Phaseolus limensis (lunatus)* Lima bean	Glycine soja Soybean** Hawkeye	Ulex europaeus Gorse	Triticum vulgare aestivum Wheat	Arachis hypogaea Peanut	Chamaecyparis lawsoniana var. pendula Lawson's cypress
S. chinensis	2	0	0	5	0	4	1	2
F_1 ch/ri	2	0	0	5	0	4	2	2
F_1 ch/se	4	0	0	4	0	4	1	2
S. senegalensis	2	0	0	4	0	3	1	2
S. bitorquata		0	0	3	0	4	1	2
F_1 bit./ri		0	0	4	0	4	2	2
F_1 cap/se	4	0	0	6	0	4	1	2
F_1 semit/ri	4	0	0	6	0	4	0	2
S. humilis	0	0	0	5	0	4	1	2
F_1 hu/ri	0	0	0	6	0	4	0,4	2
S. risoria P+	0	0	0	7	0	4	7	2
S. risoria P-//+	0	0	0	7	0	2	0,1,2,3,5	1
S. risoria P-//-	0	0	0	5	0	3	4	2
F_1 li/ri	0	0	0,2,3,4	7	0	4	0	2
C. livia	0	0	0,3,4,5	0,4	0	4	0	2
Z. macroura	5	0	0	0,5	0	4	1	2
F_1 mac/ri	3	0	0	5		2	0	
jungle fowl		0	0	0	0	1	2	0
chicken	0	0	0	0	0	2	0,3	0
r.n. pheasant								
turkey	6	0	0,3	1	0,2		0	0
guinea fowl	0		0		0		6	
mallard	4	0	0,2	0	0	2	0	2
F_1 M/M	0	0	3		0	2	0	0
muscovy	0	0	4	0	0	4	0,3	2
human O	4	0	0	0	3	1	0	0
human A_3					3			
human A	3	4	5	0,2	3	1	0	0
human B	3	0	0,2	0	3	1	0	0
human AB			4				0	
hog	4	1,2,4	0	0,3	0	2	4	1
cow	0	0	0	1	0	0	0	0
sheep	3	0	0	1		1	0	0
horse	5	1	0	0,3	0	4	0,2	0
dog	5	1	0	4	0	1,5	0	0
cat	5	2	0	0,3	0,2	3	4	1
rabbit	5	0	0	7	0	2	0,5	0
rat	7	0		0	0	1	6	0
mouse	5	1	0,1,2,3	1	0	1	0,2	0
hamster	5		4		0	2		
guinea pig	5	0		3		1		0
Peromyscus	7		0	3		1		

* marked strain differences

** prozone

TITER OF SOME ABSORBED LECTINS WITH AVIAN SPECIES AND HYBRIDS

Lectin	Pisum sativum		Phaseolus coccineus			Glycine max		Phaseolus vulgaris		Ricinus communis			Datura meteloide		
	Alaska Pea		Scarlet runner bean			Soybean		Kidney bean		Castor bean			Moonflower		
Chemical Specificity	D-man					D-GalNac				β-D-Gal					
Number of absorbing tubes	-	6	16	13	9	½	3	7 or 9	9	12	19	19	(15)NCA	11	6
Absorbing species	Unab-sorbed	Turkey	Pig 1	Pig 2	Human AB	Turkey	Pig 3	Human or Pig 0	2 Human AB	Human 0	Pig	Turkey	Rabbit	Human 0	She
Test Cells															
Anas platyrhynchos Mallard	4*		3	0	6		0	2	4		2	4	1	2	
F_1 M/M	0		5	0	5		0	4	7		5	3	2	3	
Cairina moschata Muscovy	0	0	6	0	5,6	0	0	6	7		5	0,3	3	3	
Columba livia Pigeon	0	0	5	0	6	0,2	0,2	7	5	0	3,4,5	1,2,3,4	3	2	4
F_1 Pgn/Rn	0	0	0,2,5	0	4	4	4	6	6	0	0,4	2,3	0		4
Streptopelia risoria Ringneck	0	0	0	0	0,2,3	4,5	4,5	0	0,2	3	0	3,4,5	0	0	0
Zenaidura macroura Mourning Dove	5	3	6		4	WO, E3	0	6	6	0	5	0	3	2,3	4
F_1 Md/Rn	3	0			5	3	3	5	6	0		2	3	2	
S. humilis Dwarf turtle dove	0	0	2	0	3	4	0,3,4	1,6	4		0,1	3			0,2
F_1 Dtd/Rn	0	0	0	0	2,3	5	3	0,3	2	3	0				1,3
S. chinensis Pearlneck	2	0	0	0				2	4		0	0			1
F_1PN/Rn	2	0	0	0		3	3	0,2	3		0	0			1
S. bitorquata Phil. turtle dove		0	0		3	3	3	3	3		0				2
F_1 Phil/Rn		0	0		4	3	3	1	3		0				2

*titer in number of quadrupling dilutions

1 September 82
W. J. Miller

Lectin from Wisteria sinensis absorbed by muscovy, turkey, ringneck doves, or pigeons is still reactive with guinea fowl, hog, rabbit erythrocytes, and those of some juvenile ringneck doves, 1/64 titer.

1. Only 2 doves >6 weeks of age possessed W+ reactivity, therefore, we concluded that it is a juvenile character.

2.

Number of Matings	Adult Parents Type	Progeny +	Progeny ±	Progeny -	Total
26*	- x -	46	20	200	266
80	- x -		7	452	459
106					733

*matings that produced one or more W+ progeny at 2-6 weeks of age.

66/266 = .248 ≈ 25% or ¼; a typical frequency for a Mendelian recessive.

If so, an unbiased sampling of 7/97 W+ = q^2; $q = \sqrt{.072} = .27$ W+ gene frequency

3. Also if so, W+ doves as juveniles, mated as adults, should breed true; i. e. all progeny of appropriate age should be W+!

6	+ x +	0	0	41	41

Therefore, assume W+ is a "non-Mendelian character". It still may be gene controlled in production, but some unknown switch mechanism under environmental control is responsible for timing of specific carbohydrate presence on cell surface.

4. W+ reactors exhibit a clustering effect!

A. Seasonal? No. See two columns at right

B. "Near neighbor" analysis in egg clutches? See reverse.

J	5
F	4
M	2
A	2
M	5
J	5
J	3
A	4
S	2
O	5
N	6
D	3

Cluster effect of W+ offspring from W- parents contiguous or "near neighbor" analysis

Mating Number	W+ Individual Squab Letter	Phenotype of Progeny W+	W+	W-	Total	
512	W_3, X_3, Y_3	3	·	20	23	
528	U, V·, X	2	1	14	17	
532	O··, T, U, V·, X	4	1	6	11	
539	G, H	2	·	11	13	
566	L, M	1	1	2	4	
J128	D, E, F, Y	4	·	7	11	
JD37	U,·, W	2	1	16	19	
JD38	W, X	2	·	3	5	
		20	4	79	103	24/103 = .233
527	S, X, Q_2·, S_2	4	3	8	15	
J120	G, U, V	3	·	11	14	
JD36	G_2,J_2,L_2,M_2,N_2,Z_2	5	4	8	17	
		12	7	27	46	19/46 = .41
		43		106	149	43/149 = .288

15 more matings each 1 O, or 1 many