B-Lemaitre pr. 20/12/00

FB-f 0133282 (hbs)

From [redacted] **Wed Dec 20 07:56:32 2000**
From: [redacted] (Bruno LEMAITRE)
To: Heather Butler <[redacted]>
Subject: Re: Drosophila immunity genes
Date: Wed, 20 Dec 2000 08:58:31 +0100

Dear Heather,
please find attached an excel file containing the immunity genes list. You can used as you wish. Since many paper have been published at the end of this year on immunity. I give you belwo a list of references when you can find more informations on some of these genes.
I aplogize for the delay. if you have some questions donot hesitate to contact me again.
Best regards,
Bruno

List of recent references
on Dm IKKbeta:

- Kim, Y.S. et al. (2000) Lipopolysaccharide-activated kinase, an essential component for the induction of the antimicrobial peptide genes in Drosophila melanogaster cells. J Biol Chem 275 (3), 2071-2079
- Silverman, N. et al. (2000) A Drosophila IkB kinase complex required for Relish cleavage and antibacterial immunity. Genes & Dev. 14, 2461-2471
- Lu, Y. et al. (2000) The antibacterial arm of the Drosophila innate immune resonse requires an IkB kinase. Genes & Dev. in press
On DmKKg

- Silverman, N. et al. (2000) A Drosophila IkB kinase complex required for Relish cleavage and antibacterial immunity. Genes & Dev. 14, 2461-2471
- Rutschmann, S. et al. (2000) Role of Drosophila IKKg in a Toll-independent antibacterial immune response. Nature Immunology 1 (4), 342-347
on Dredd:

- Elrod-Erickson, M. et al. (2000) Interactions between the cellular and humoral immune responses in drosophila. Curr Biol 10 (13), 781-784
- Leulier, F. et al. (2000) The Drosophila caspase Dredd is required to resist Gram-negative bacterial infection. Embo R 1 (4), 353-358
- St ven, S. et al. (2000) Activation of the Drosophila NF-kB factor Relish by rapide endoproteolytic cleavage. Embo R 1 (4), 347-352
on relish:

- St ven, S. et al. (2000) Activation of the Drosophila NF-kB factor Relish by rapide endoproteolytic cleavage. Embo R 1 (4), 347-352

on the peptidoglycan recognition proteins
Werner, T. et al. (2000) A family of peptidoglycan recognition proteins in the fruit fly Drosophila melanogaster. Proc Natl Acad Sci U S A 97 (25), 13772-13777

on Toll like receptors:
Tauszig, S. et al. (2000) Toll-related receptors and the control of antimicrobial peptide expression in Drosophila. Proc Natl Acad Sci U S A 97, 10520-10525
31 Williams, M. et al. (1997) The 18-wheeler mutation reveals complex antibacterial gene regulation in Drosophila host defense. EMBO J. 16, 6120-6130
32
on imd and the local immune response:
Tzou, P. et al. (2000) Tissue-specific indcible expression of antimicrobial peptide genes in Drosophila surface epithelia. Immunity 13, 737-748

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TIG 2000 16(10): 442--
Khush & Lemaitre

<This message contains 2 attachments (not printed)>

Re: Drosophila immunity genes

Drosophila genes potentially involved in responses to microbial infection

name	CG numbe	GADFLY link	Flybase lin	webname	cytology	homology	biology
I. Microbial recognition							
CD36/croquemort (crq) family : 9 members							
croquemort	4280	http://hedgehog.lbl.g	FBgn0015924	http://flybase.t	21C3	crq	Genetic and molecular evidence exists for crq involvement in the phagocytosis of apoptotic cells but not of bacteria.
	5750		FBgn0032662	http://flybase.t	36E3	crq-like	
	12789		FBgn0031915	http://flybase.t	28A1	crq-like	
	7228		FBgn0031969		28D10-11*	crq-like	
	7227		FBgn0031970		28D11*	crq-like	
emp	2727		FBgn0010435		60E7-E8*		epithelial membrane protein is expressed in various embryonic tissues
	3829		FBgn0035091		60E7-E8*	emp-like	
	1887		FBgn0035290		62B9	emp-like	
	related genes						
	7000		FBgn0038867		93C3-C4	more related to sensory neuron membrane protein-1encoding gene	
	2736		FBgn0035090		60E7-E8*	weakly related to emp	
BcDNA	10345		FBgn0027562		89D4-5	weakly related to emp	
Peptidoglycan recognition protein (PGRP) family : 12 members							
	11709		FBgn0030310		10C4	pgrp-like	
	14745		FBgn0033328		44D8*	pgrp-like	
	8577		FBgn0033327		44D8*	pgrp-like	
	14746		FBgn0033325		44D8*	pgrp-like	
	8995		FBgn0030695		13F1	pgrp-like	
	9681		FBgn0036658		73B5*	pgrp-like	
	9697		FBgn0036657		73B5*	pgrp-like	
	14704		FBgn0037906		86E6-7	pgrp-like	
	7496		FBgn0035806		66A8	pgrp-like	
	4432		FBgn0035976		67A8-9*	pgrp-like	
	4384		FBgn0035975		67A8-9*	related to prpg	
	4437		FBgn0035977		67A9*	pgrp-like	
Drosophila scavenger receptor (dScR) family: 3 members							
dScR-I	4099		FBgn0014033		24D4		dScR-I is expressed in embryonic hemocytes and binds to various ligands.
	8856		FBgn0033700		48F[redacted]	[redacted]	
	3212		FBgn0031547		23F5-6	dScR-I-like	
Gram Negative Binding Protein (GNBP) family: 3 members							
GNBP3	5008		FBgn0035939)		66E4-E5		
GNBP2	4144		FBgn0036802		75D2*		
GNBP1	6895		FBgn0036803		75D2*		
Galactines			(Genes encoding 41 other lectins exist in the genome!)				
lectin-galC1	9976		FBgn0016675		37E1*		induced by infection
	9978		FBan0009978		37E1*	lectin-galC1 like protein	

III. Signaling

Genes encoding components of the Toll signaling pathway

These genes encode for components of the Toll pathway and are required for the expression of a subset of the antimicrobial peptide genes (Drs, Cec, Def, AttA). Some of these genes (Toll, pll, tub, cact) are also required during hemo

[redacted]

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printed from: [redacted] D. LEMAITRE [redacted] 12.20

serpin43Ac	1857	FBgn0002930	43A1	belongs to the necrotic cluster and encodes a protease that functions upstream of spatzle
spaetzle	6134	FBgn0003495	97E4	putative ligand of the Toll receptor
Toll	5490	FBgn0003717	97D1	encodes a transmembrane receptor.
tube	10520	FBgn0003882)	82B2	encodes an adaptor protein that functions downstream of Toll
pelle	5974	FBgn0010441	97F4	encodes a kinase that functions downstream of Toll
cactus	5848	FBgn0000250	35F8-F9	encodes an ikB-like protein that functions downstream of Toll
DIF	6794	FBgn0011274	36C2*	DIF (Dorsal-related Immune Factor) encodes an NF-κB-like transcription factor regulated by the Toll pathway.
dorsal	6667	FBgn0000462	36C2*	encodes an NF-κB-like transcription factor regulated by the Toll pathway.

Genes encoding proteins required for the induction of antibacterial peptide genes

These genes encode proteins required for the expression of the antibacterial peptide genes after infection.

relish	11992	FBgn0014018	85C5	encodes a P105-like transcription factor
dredd	7486	FBgn0020381	1B9	encodes an apical capase
Dmikkγ		FBgn0041205	60E	encodes a homolog of mammalian ikkγ, structural component of the IKK complex
Dmikkβ	4201	FBgn0028725	89B6	encodes a homolog of mammalian ikkβ, kinase component of the IKK complex

Genes encoding homologs of mammalian components of the IL1-R/TLR or TNF signalling pathways

Toll-like (Tl) receptors

tehao/Tl-5	7121	FBgn0026760	34B8	Tl-5 expression induces the drosomycin antifungal peptide gene in cell culture.
Tl-8	6890	FBgn0041571	71B5	
Tl-6	7250	FBgn0036494	71C1	
Tl-7	8595	FBgn0034476	56F2	
18 Wheeler	8896	FBgn0004364	56F9	
TL4	18241	FBgn0032095	30A2	required for attacinA and cecropin expression in larvae
Tl-3/mstprox	1149	FBgn0015770	84D2	
Tl-9	5528	FBgn0036978	77B4	

Others

DmMyD88	2078	FBgn0033402	45C4	weak homology to the mammalian MyD88 gene
Dmik2	2615	FBgn0028633	38E1	homolog of the mammalian TANK/IKKε gene
DmTak1	1388	FBgn0031120	19E1	encodes a homolog of the mammalian MAP kinase
pellino	5212	FBgn0025574	95C5-10	encodes a protein that interacts with the pelle kinase in yeast two-hybrid assays
cactin	1676	FBgn0031114	19D2-3	encodes a conserved protein that interacts with cactus and modulates its activity
DmECSIT	10610	FBgn0028436	83C4	homolog of the mammalian ECSIT gene
	10535	FBgn0037926	86E19	homolog of the mammalian IKAP gene
TRAF1	3048	FBgn0026319	24F1	homolog of the mammalian TRAF4 and 2 genes
	4393	FBgn0030748	14C4-5	weak homolog of the mammalian TRAF3 gene
TRAF2	10961	FBgn0026318	7D14	homolog of the mammalian TRAF6 gene
BG5	5576	FBgn0034344	55C9	homolog of the mammalian RIP kinase encoding gene
BG4/dFADD	12297	FBgn0038928	94A1	homolog of mammalian FADD gene

Genes encoding components of the JAK/STAT pathway

Some components of the Drosophila JAK/STAT pathway are involved in hemocyte proliferation and differentiation and in the expression of proteases in the fat body.

STAT92E	4257	FBgn0016917	92E	homolog of the mammalian STAT gene
hopscotch	1594	FBgn0004864	10B8	encodes the Drosophila homolog of mammalian JAK
os/unpaired	5993	FBgn0004956	17A5	os encodes a secreted protein, other related genes exist in the genome.

Genes encoding components of the MAPK pathways

Some components of the MAPK pathways have been implicated in Drosophila antimicrobial resonses.

Mpk2/p38a	5475	FBgn0015765	95E1-2	Overexpression of Mpk2 attenuates the expression of antimicrobial peptide genes.
p38b	7393	FBgn0024846	34D1	
basket	5680	FBgn0000229	31C1-5	basket encodes a MAPK activated by immune challenge in cultured cells.

III. Prophenoloxidase reactions

proPOphenoloxidase family: 3 members

	5779	FBgn0000165	55A1	
	8193	FBgn0033367	45A7	
	2952	FBgn0034815	59C3	

proPAE family: 4 members

	3066	FBgn0037515	84D11	very close homolog of the proPAE gene
easter	4920	FBgn0000533	88E14	encodes a protease closely related to proPAE
	9733	FBgn0039759	99E5	close homolog of the proPAE gene
	1102	FBgn0027930	82A4	close homolog of the proPAE gene

IV. Hematopoesis

lozenge	1689	FBgn0002576	8D8-9	encodes an AML1 like transcription factor required for crystal cell differentiation
serpent	3992	FBgn0003507	89B3-4	GATA factor that regulates embryonic blood cell development and cecropin A expression in the larval fat body
glial cells missing	12245	FBgn0014179	30B12-C1	encodes a DNA binding protein involved in plasmatocyte differentiation

Other genes causing blood cell proliferation are not listed here.

V. Antimicrobial peptides

lysozyme (lys) family: 11 members + 1 gene encoding a protein with 4 lysozyme domains.)

lysX	9120	FBgn0004431	61F3*	expressed in the midgut and may aid digestion.
lysB	1179	FBgn0004425	61F3*	expressed in the midgut and may aid digestion.
lysD	9118	FBgn0004427	61F4*	expressed in the midgut and may aid digestion.
lysS	1165	FBgn0004430	61F4*	expressed in the midgut and may aid digestion.
lysE	1180	FBgn0004428	61F4*	expressed in the midgut and may aid digestion.
lysP	9116	FBgn0004429	61F4*	expressed in the midgut and may aid digestion.
lysC	9111	FBgn0004426	61F3*	expressed in the midgut and may aid digestion.
	7798	FBgn0034092	52F10	
	8492	FBgn0035813	66A10	encodes a large protein with 4 lysozyme domains
	11159	FBgn0034539	57B2*	
	16799	FBgn0034538	57B2*	
	16756	FBgn0029765	4F9	

attacin A (attA) family: 3 members + 1 weakly related gene

att A	10146	FBgn0012042	51C2*	encodes an antibacterial peptide and is induced by infection
	18372	FBgn0033959	51C2*	attA-like
	4740	FBgn0033833	50A8	attA-like
	7629	FBgn0038530	90B6-7	weakly related to attA

diptericin (dpt) family: 2 members

dpt	12763	FBgn0004240	55F5*	encodes an antibacterial peptide and is induced by infection
	10794	FBgn0034407	55F5*	

cecropin (cec) family: 4 members

cecA2	1367	FBgn0000277	99E4*	encodes a peptide with both antibacterial and antifungal peptide and is induced by infection
cecA1	1365	FBgn0000276	99E4*	encodes a peptide with both antibacterial and antifungal peptide and is induced by infection
cecC	1373	FBgn0000279	99E4*	encodes a peptide with both antibacterial and antifungal peptide and is induced by infection
cecB	1878	FBgn0000278	99E4*	encodes a peptide with both antibacterial and antifungal peptide and is induced by infection

drosomycin (drs) family: 7 members

drs	10810	FBgn0010381	63D1*		encodes an antifungal peptide and is induced by infection
	10812	FBgn0035434	63C5*	drs-like	
	11520	FBgn0035441	63C5*	drs-like	
	10813	FBgn0035433	63C5*	drs-like	
	10815	FBgn0035442	63C5*	drs-like	
	2 drs genes not yet annotated				

others

drosocin	10816	FBgn0010388	51C2	encodes an antibacterial peptide and is induced by infection
metchnikowin	8175	FBgn0014865	52A1	encodes a peptide with both antifungal and antibacterial activity and is induced by infection
defensin	1385	FBgn0010385	46D6-7	encodes an antibacterial peptide and is induced by infection
andropin	1361	FBgn0000094	99E4*	encodes an antibacterial peptide in the male genital tract

VI. Miscellaneous

nitric oxide synthase	6713	FBgn0011676	32B1-3	
transferrin	6186	FBgn0022355	17A10-11	induced by infection, encodes a protein that mediates iron transport
Phas1/thor	8846	FBgn0022207	23F3	induced by infection, encodes a homolog of mammalian translation initiation factor 4E
Hml	7002	FBgn0029167	70C3-4	encodes a homolog of silkworm hemocytin and mammalian von Willebrand factor