insects

MDPI

*Article*

# Assessing the Pathogenicity of Two Bacteria Isolated from the Entomopathogenic Nematode *Heterorhabditis indica* against *Galleria mellonella* and Some Pest Insects

**Rosalba Salgado-Morales [1,2], Fernando Martínez-Ocampo [2], Verónica Obregón-Barboza [2], Kathia Vilchis-Martínez [3], Alfredo Jiménez-Pérez [3] and Edgar Dantán-González [2,*]**

[1] Doctorado en Ciencias, Instituto de Investigación en Ciencias Básicas y Aplicadas, Universidad Autónoma del Estado de Morelos, Av. Universidad 1001, Chamilpa, 62209 Cuernavaca, Morelos, México; salgadomoralesr@hotmail.com

[2] Laboratorio de Estudios Ecogenómicos, Centro de Investigación en Biotecnología, Universidad Autónoma del Estado de Morelos, Av. Universidad 1001, Chamilpa, 62209 Cuernavaca, Morelos, México; fernando.martinezo@uaem.mx (F.M.-O.); veronica.obregon@uaem.mx (V.O.-B.)

[3] Centro de Desarrollo de Productos Bióticos, Instituto Politécnico Nacional, Calle Ceprobi No. 8, San Isidro, Yautepec, 62739 Morelos, México; vilchisk78@gmail.com (K.V.-M.); aljimenez@ipn.mx (A.J.-P.)

* Correspondence: edantan@uaem.mx; Tel.: +52-777-329-7000

Received: 20 December 2018; Accepted: 15 March 2019; Published: date

insects

# Supplementary Materials

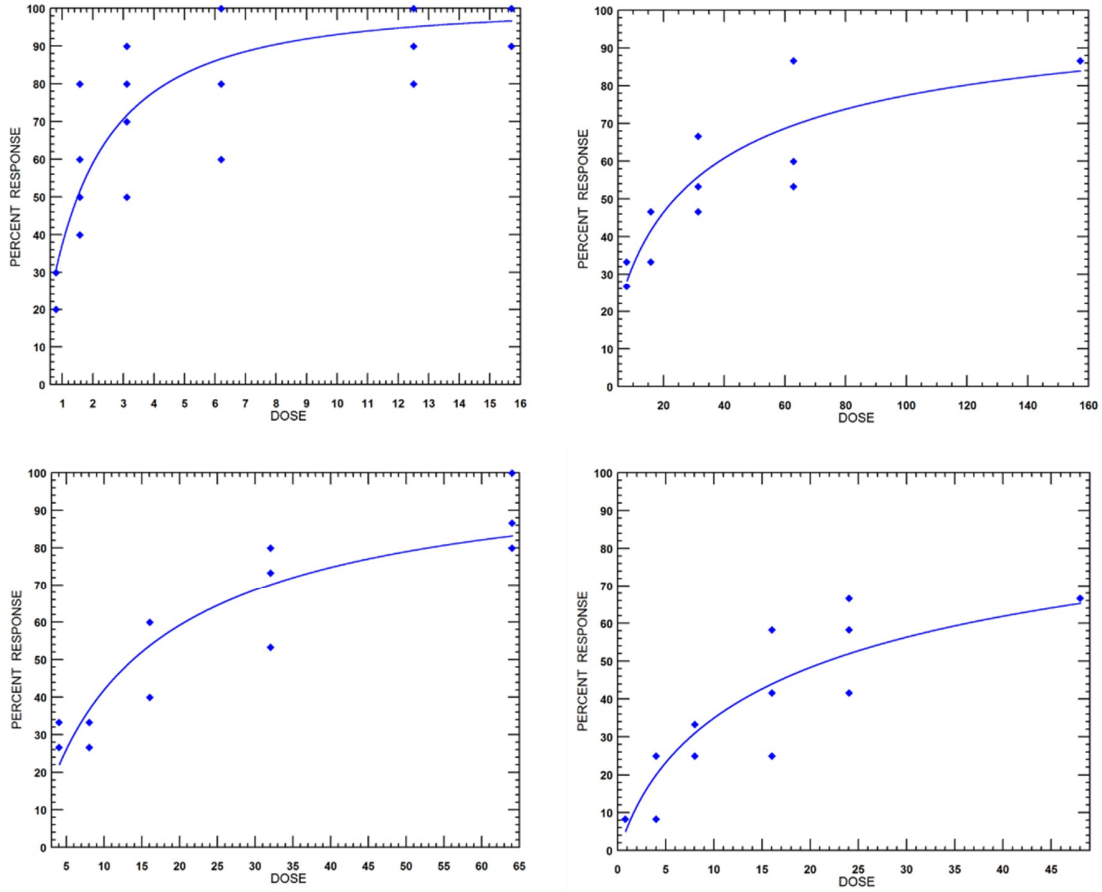


**Figure 1.** Dose–response curves and LC50 of *H. indica* MOR03 against insects. (**a**) *G. mellonella* LC50 = 1.4 (1.0–1.9) 95% CI) **IJs/cm²**; (**b**) *T. molitor* LC50 = 23.5 (15.8–33.3) 95% CI) **IJs/cm²**; (**c**) *H. subflexa* LC50 =13.7 (10.1–18.3) 95% CI) **IJs/cm²**; and (**d**) *D. magnifactella* LC50 = 21.7 (14.4–43.8) 95% CI) **IJs/cm²**.

**Table S1.** Proteins involved in the pathogenesis *Photorhabdus luminescens* HIM3.

| Start | Stop | Strand | Funtion |
|---|---|---|---|
| 403112 | 403930 | + | Type III secretion thermoregulatory protein |
| 412474 | 413406 | + | Type III secretion injected virulence protein |
| 88772 | 92383 | + | Virulence sensor protein bvgS precursor |
| 74364 | 75290 | + | Virulence factor VirK |
| 128132 | 127134 | - | Type III secretion injected virulence protein YopT |
| 2380 | 2592 | + | Unknown, probable insecticidal toxin |
| 2940 | 2686 | - | YoeB toxin protein |
| 3194 | 2940 | - | YefM protein (antitoxin to YoeB) |
| 4449 | 14645 | + | RTX toxins determinant A and related Ca2+-binding proteins |
| 16367 | 16603 | + | CcdA protein (antitoxin to CcdB) |
| 16606 | 16920 | + | CcdB toxin protein |
| 105357 | 101491 | - | Unknown, probable toxin |
| 54874 | 54656 | - | CcdA protein (antitoxin to CcdB) |
| 34760 | 35014 | + | RelB/StbD replicon stabilization protein (antitoxin to RelE/StbE) |

| | | | |
|---|---|---|---|
| 35004 | 35294 | + | RelE/StbE replicon stabilization toxin |
| 36628 | 36449 | - | ParE toxin protein |
| 37017 | 36748 | - | RelB/StbD replicon stabilization protein (antitoxin to RelE/StbE) |
| 47217 | 47498 | + | HigB toxin protein |
| 47509 | 47787 | + | HigA protein (antitoxin to HigB) |
| 54294 | 54704 | + | Antitoxin 1 |
| 82143 | 77728 | - | Unknown, probable insecticidal toxin |
| 85080 | 82192 | - | Unknown, probable insecticidal toxin |
| 11597 | 11295 | - | FIG045511: hypothetical antitoxin (to FIG022160: hypothetical toxin) |
| 11893 | 11594 | - | FIG022160: hypothetical toxin |
| 70910 | 68766 | - | RTX toxin transporter, ATP-binding protein |
| 72268 | 70913 | - | RTX toxin transporter, determinant D |
| 74366 | 72261 | - | RTX toxin transporter, ATP-binding protein |
| 75171 | 75524 | + | RTX toxin activating lysine-acyltransferase (EC 2.3.1.-) |
| 75552 | 87755 | + | RTX toxins determinant A and related Ca2+-binding proteins |
| 88400 | 100636 | + | RTX toxins determinant A and related Ca2+-binding proteins |
| 59707 | 61428 | + | toxin protein |
| 99997 | 100206 | + | Prevent host death protein, Phd antitoxin |
| 121847 | 126595 | + | Putative toxin subunit |
| 128840 | 132292 | + | Unknown, probable insecticidal toxin |
| 132314 | 136450 | + | Unknown, probable insecticidal toxin |
| 219949 | 219623 | - | HigA protein (antitoxin to HigB) |
| 327897 | 327748 | - | ParE toxin protein |
| 403153 | 402863 | - | YefM protein (antitoxin to YoeB) |
| 539091 | 539501 | + | Unknown, hypothetical toxin |
| 543217 | 543396 | + | FIG022160: hypothetical toxin |
| 543369 | 543731 | + | FIG045511: hypothetical antitoxin (to FIG022160: hypothetical toxin) |
| 38357 | 41632 | + | Putative toxin subunit |
| 41654 | 45229 | + | Putative toxin subunit |
| 45292 | 49749 | + | Unknown, probable insecticidal toxin |
| 51423 | 49831 | - | Unknown, probable insecticidal toxin |
| 50632 | 50345 | - | HigA protein (antitoxin to HigB) |
| 50910 | 50632 | - | HigB toxin protein |
| 8724 | 2047 | - | Unknown, probable insecticidal toxin |
| 9089 | 11836 | + | Putative insecticidal toxin complex |
| 65585 | 65800 | + | Antitoxin YgiT |
| 425121 | 424705 | - | Antitoxin 1 |
| 1599 | 1841 | + | VapB protein (antitoxin to VapC) |
| 1834 | 2238 | + | VapC toxin protein |
| 13294 | 2657 | - | RTX toxins determinant A and related Ca2+-binding proteins |
| 24483 | 13918 | - | RTX toxins determinant A and related Ca2+-binding proteins |
| 17069 | 14913 | - | Putative toxin transport protein |
| 20571 | 18457 | - | RTX toxin transporter |
| 65989 | 65717 | - | Prevent host death protein, Phd antitoxin |
| 212084 | 207210 | - | Unknown, probable toxin |
| 158066 | 156807 | - | Unknown, hypothetical insectidal toxins. |
| 307869 | 304738 | - | Putative insecticidal toxin complex |
| 312698 | 308004 | - | Unknown, probable insecticidal toxin |
| 315699 | 312799 | - | Unknown, probable insecticidal toxin |
| 331160 | 334069 | + | Putative insecticidal toxin complex |
| 1923 | 1564 | - | Programmed cell death toxin MazF |
| 2171 | 1923 | - | Programmed cell death antitoxin MazE |
| 23829 | 24095 | + | Prevent host death protein, Phd antitoxin |

| | | | |
|---|---|---|---|
| 239286 | 239753 | + | Prevent host death protein, Phd antitoxin |
| 239750 | 240040 | + | Death on curing protein, Doc toxin |
| 70558 | 70307 | - | VapB protein (antitoxin to VapC) |
| 112945 | 112619 | - | Death on curing protein, Doc toxin |
| 113220 | 112945 | - | Prevent host death protein, Phd antitoxin |
| 188284 | 187910 | - | Programmed cell death toxin PemK |
| 221072 | 218265 | - | Putative insecticidal toxin complex |
| 28788 | 21271 | - | Unknown, probable insecticidal toxin |
| 56195 | 56380 | + | ParD protein (antitoxin to ParE) |
| 56373 | 56657 | + | ParE toxin protein |
| 25086 | 25982 | + | dermonecrotic toxin |
| 26203 | 27135 | + | Putative insecticidal toxin complex |
| 78538 | 82074 | + | Unknown, probable insecticidal toxin |
| 82067 | 86161 | + | Unknown, probable insecticidal toxin |
| 122306 | 117405 | - | Dermonecrotic toxin |
| 127038 | 124243 | - | Putative insecticidal toxin complex |
| 150818 | 151063 | + | Programmed cell death antitoxin MazE |
| 151063 | 151395 | + | Programmed cell death toxin MazF |
| 199320 | 192100 | - | Unknown, probable insecticidal toxin |
| 120978 | 123824 | + | Putative insecticidal toxin complex |
| 130138 | 136761 | + | Unknown, probable insecticidal toxin |
| 137080 | 145002 | + | Unknown, probable insecticidal toxin |
| 145059 | 149492 | + | Unknown, probable insecticidal toxin |
| 150029 | 152911 | + | Putative insecticidal toxin complex |
| 154542 | 162116 | + | Unknown, probable insecticidal toxin |
| 162269 | 165061 | + | Putative insecticidal toxin complex |
| 166838 | 174412 | + | Unknown, probable insecticidal toxin |
| 174469 | 178914 | + | Unknown, probable insecticidal toxin |
| 53727 | 52549 | - | IncI1 plasmid conjugative transfer pilus-tip adhesin protein PilV |
| 89270 | 91750 | + | Unknown, probable export and assembly of fimbrial adhesin |
| 93007 | 94017 | + | Fimbrial adhesin precursor |
| 44 | 859 | + | Putative large exoprotein involved in heme utilization or adhesion of ShlA/HecA/FhaA family |
| 97046 | 97711 | + | Lipoprotein NlpE involeved in surface adhesion |
| 325511 | 328882 | + | Galactophilic lectin PA-I |
| 139940 | 140110 | + | Fimbrial operon regulator |
| 93007 | 94017 | + | Fimbrial adhesion precursor |
| 949909 | 95484 | + | 21 kDa hemolysin precursor |
| 226726 | 226267 | - | Hemolysin |
| 5492 | 6847 | + | Siderophore biosynthesis non-ribosomal peptide synthetase modules |
| 30584 | 31564 | + | Iron siderophore receptor protein |

**Table S2.** Proteins involved in the pathogenesis *Pseudomonas aeruginosa* NA04.

| Start | Stop | Strand | Function |
|---|---|---|---|
| 80281 | 82347 | + | Pathogenesis related protein |
| 573998 | 574381 | + | PE-PGRS virulence associated protein |
| 675441 | 676106 | + | Virulence factor mviM |
| 44725 | 44444 | - | ParE toxin protein |
| 44949 | 44722 | - | Prevent host death protein, Phd antitoxin |

| | | | |
|---|---|---|---|
| 8852 | 9898 | + | RTX toxins and related Ca2+-binding proteins |
| 28549 | 28899 | + | Accessory cholera enterotoxin |
| 28901 | 30163 | + | Zona occludens toxin |
| 5934 | 7367 | + | Multidrug and toxin extrusion (MATE) family efflux pump YdhE/NorM |
| 511530 | 509614 | - | exotoxin A precursor |
| 202704 | 202297 | - | ParE toxin protein |
| 9900 | 10919 | + | Large exoproteins involved in heme utilization or adhesion |
| 55407 | 54460 | + | Sigma-fimbriae tip adhesin |
| 104465 | 104947 | + | Fimbrial protein precursor |
| 105119 | 105781 | + | Putative fimbrial chaperone |
| 57776 | 55404 | - | Sigma-fimbriae usher protein |
| 58581 | 57793 | - | Sigma-fimbriae chaperone protein |
| 235021 | 236721 | + | Type IV fimbrial assembly, ATPase PilB |
| 236725 | 237942 | + | Type IV fimbrial assembly protein PilC |
| 6874 | 687116 | - | Type III effector HopPmaJ |
| 209217 | 208786 | - | Type III secretion effector protein YopR |
| 331105 | 332601 | - | Vibriolysin, extracellular zinc protease |
| 487642 | 485711 | - | Phospholipase/lecithinase/hemolysin |
| 42578 | 43333 | + | Putative hemolysin |
| 124307 | 124885 | + | 21 kDa hemolysin precursor |
| 59860 | 61938 | + | Non-hemolytic phospholipase C precursor |
| 219737 | 218715 | - | Iron siderophore sensor protein |
| 12 | 305 | + | Non-ribosomal peptide synthetase modules, pyoverdine @ Siderophore biosynthesis |