**Walaa Mousa, PhD**

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**Work experience**

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| Feb 2017-till present | Lecturer, Department of Pharmacognosy, Faculty of Pharmacy, Mansoura, Egypt  |
| April 2016- March 2017 | Postdoctoral fellow, Department of Biochemistry and Biomedical Sciences, McMaster University ON, Canada. |
| 2012- Feb 2016 | Graduate researcher, University of Guelph ON, Canada. |
| 2006-2010 | Graduate researcher School of Pharmacy, Mansoura University, Egypt. |
| 2006-2011 | Teaching assistant (30 h per week)School of Pharmacy, Mansoura University, Egypt. |
| 2005-2006 | Hospital pharmacist (30 h per week)Urology and Nephrology Center, Egypt. |
| 2003- 2005 | Part time pharmacist (10 h per week)Al-Tarshopy Pharmacies, Mansoura, Egypt |

**Education**

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| 2012-2016 | University of Guelph ON, Canada.Doctor of Philosophy, Microbial Biochemistry and Molecular Genetics |
| 2006-2010 | School of Pharmacy, Mansoura University, Egypt.Master of Sciences, Natural Products Chemistry |
| 2000-2005 | School of Pharmacy, Mansoura University, Egypt.Bachelor of Pharmaceutical Sciences, ranked seventh out of 1200 students. |

**Teaching and Mentoring**

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| 2009-2011 | **Plant Science**, graduate courseSchool of Pharmacy, Mansoura University, Egypt. |
| 2009-2011 | **Microbiology and Biotechnology III**, graduate coursesSchool of Pharmacy, Mansoura University, Egypt. |
| 2008-2009 | **Biochemistry I and II**, undergraduate courses School of Pharmacy, Mansoura University, Egypt. |
| 2006-2008 | **Phytochemistry I and II**, undegraduate coursesSchool of Pharmacy, Mansoura University, Egypt. |
| 2006-2007 | **Advanced Microbiology**, undergraduate courseSchool of Pharmacy, Mansoura University, Egypt. |

**Research Interests**

* Plant and human microbiome
* Host-pathogen interactions
* Microbiota signals in health and disease
* Natural product chemistry
* Molecular biology and genetics of bacteria

**Postdoctoral Research outline**

My current postdoctoral research involves studying microbial natural products, in particular **Ri**bosomally synthesized **p**ost-translationally modified **p**eptides “RiPPs” produced by human microbiota. RiPPs are thoughts to act as signals to mediate microbe-host and microbe-microbe interactions. To date, only few dozen RiPPs have been isolated from human microbiota. However, genome sequencing data has revealed thousands of RiPP clusters within our microbial partners. I am working, in collaboration with computer programmers, to develop bioinformatic tools to predict novel RiPP structures and possible activity directly from the genome and automatically de-replicate known compounds. I am also working on downstream applications to purify target RiPPs and study their role in signaling networks within the human body in response to invading pathogens.

**PhD Thesis outline**

My PhD research concerned biochemical, molecular, cellular and ecological studies of host-microbe-pathogen interactions. My research involved: (1) isolation and taxonomic classification of bacterial and fungal endophytes, defined as microbes that live inside plant tissues without causing disease; (2) characterization of their anti-fungal activities *in vitro* and *in planta*; (3) discovery of the genes that encode the anti-fungal activity using transposon mutagenesis, whole genome sequencing and other molecular techniques; (4) purification of the antifungal compounds following bio-guided assay fractionation; (5) structural elucidation of the antifungal compounds using NMR techniques and mass spectroscopy; (6) studies concerning the anti-fungal mode of action using vitality staining/ light microscopy; (7) ecological *in planta* colonization studies using GFP-tagging, florescence staining and confocal laser microscopy. During the course of my PhD, I screened 250 microbes, resulting in the discovery of 11 microbes that combat host-specific pathogens and identification of 13 antifungal compounds. From the most promising microbe, I characterized 13 genes that encode the antifungal activity and showed that these genes are inducible by the host pathogen. The most exciting discovery of my research is that an endophytic bacterium (strain M6, Enterobacter sp.), isolated from the roots of finger millet, builds a remarkable physical barrier consisting of bacterial micro-colonies that protect the host against pathogen invasion. M6 creates an unusual root hair-endophyte stacking (RHESt) formation that prevents entry and/or traps the pathogen which is then killed. Tn5 mutant analysis demonstrated that the endophyte kills the fungal pathogen by using a c-di-GMP-dependent signaling network and diverse fungicides including phenazine. The endophyte has evolved an epistatic regulatory interaction to suppress an antibiotic released by *Fusarium* which would otherwise inhibit phenazine release into the RHESt. The end-result of this remarkable physico-chemical barrier is a reduction in levels of the mycotoxin DON, thus potentially protecting millions of subsistence farmers and their livestock. To the best of my knowledge, RHESt represents a novel plant defence mechanism and suggests the value of exploring the microbiomes of the world's ancient, orphan crops as source of endophytes with antimicrobial activity.

**MSc Research**

My Masters research concerned the purification and structural elucidation of valuable pharmaceuticals from agro-industrial wastes. My research involved: (1) clinical evaluation of the characterized pharmaceuticals as protective agents against gastritis, hyperlipidemia, hypercholestremia and hepatic steatosis using several biological assays in experimental rats; (2) pharmaceutical evaluation of some carbohydrate derived compounds as formulating agents in tablet industry; and (3) microbial biotransformation of agro-industrial wastes and/or purified compounds into value-added compounds.

**Technical Research Skills**

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| **Field** | **Techniques** |
| **Biochemistry**  | * Chromatographic methods (analytical and preparative HPLC,
* Flash C., ion size exclusion C., affinity C., etc)
* Spectroscopic structural elucidation methods (NMR, LC-MS, IR, UV, etc)
* A wide range of additional techniques in biochemistry
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| **Molecular biology and genetics** | * Recombinant DNA techniques (DNA cloning)
* Competent cell preparation and bacterial transformation Sequencing and sequence analysis
* Various PCR techniques including quantitative real time PCR and gene expression analysis
* High throughput bacterial mutagenesis, transposon/plasmid rescue
* Community microbial profiling (tRFLP)
* Total DNA extraction from bacteria, fungi and plants
* RNA and plasmid purification from bacteria
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| **Biological assays** | * Antibiotic susceptibility testingHuman pathogen susceptibility testing
* 96-well plate assays (spectroscopy, luminescence, etc)
* Enzyme purification and bioassays
* Hypolipidemic, hypocholestremic and peptic ulcer protection assays using experimental animals
* DPPH antioxidant assay
* Anticancer assay using brine shrimp lethality test
* Bacterial motility assays
* Bacterial biofilm/adhesion assays
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| **Biotechnology** | Biotransformation reactionsAerobic and anaerobic microbial fermentation |
| **Microscopy** | Confocal microscopy and GFP trackingViability and cell death stainingSEM and STM |
| **Software** | Genome mining and cluster analysisNatural products de-replication Phylogenetic analysis **(**MetaCyc, KEGG, Phlogenyt, PhytaT).Statistical analysis (Prism, InStat, Excel) Biological analysis (Assess) |

**Patent applications**

Novel bacterial endophyte with antifungal activity Inventors: Manish N Raizada, **Walaa K Mousa** and Charles Shearer (# 36580-P47034US00).

**Peer-Reviewed Publications**

1. **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2016). Root-hair endophyte stacking in finger millet creates a physicochemical barrier to trap the fungal pathogen *Fusarium graminearum*. ***Nature Microbiology***, available online September 26, 2016doi.10.1038/nmicrobiol.2016.167. (Full Article).
2. **Mousa, W.K.,** Schwan, A., and Raizada, M.N. (2016). Characterization of antifungal natural products isolated from endophytic fungi of finger millet (*Eleusine coracana).* ***Molecules*** 3, 21(9). doi: 10.3390/molecules21091171.
3. **Mousa, W.K.,** Schwan, A., Davidson, J, Strange, P., Liu, H., Zhou, T., Auzanneau, F-I., and Raizada, M.N. (2015). An endophytic fungus isolated from finger millet (*Eleusine coracana*) produces anti-fungal natural products. ***Frontiers in Microbiology*** 6, 1157.
4. **Mousa, W.K.** and Raizada, M.N. (2016) Natural Disease Control in Cereal Grains. **In Encyclopedia of Food Grains. 2nd Edition**. pp. 257-263. (Eds: C. Wrigley, H. Corke, K. Seetharam, J. Faubion). Oxford:Academic Press.
5. **Mousa, W.K.** and Raizada, M.N. (2015). Biodiversity of genes encoding anti-microbial traits within plant associated microbes. ***Frontiers in Plant Science*** 6, 231.
6. **Mousa, W.K.,** Shearer, C Limay-Rios V., Zhou, T., and Raizada, M.N. (2015). Bacterial endophytes from wild maize suppress *Fusarium graminearum* in modern maize and inhibit mycotoxin accumulation. ***Frontiers in Plant Science*** 6, 805.
7. Ettinger, C.L., **Mousa, W.K.**, Raizada, M.N., Eisen, J.A. (2015). Draft Genome Sequence of *Enterobacter* sp. Strain UCD-UG\_FMILLET (Phylum Proteobacteria). ***Genome Announcements*** 3:e01461-14.

### Johnston-Monje, D., Mousa, W.K.,  [Lazarovits](http://scholar.google.ca/citations?user=AoP1zgYAAAAJ&hl=en&oi=sra) G., Raizada, M. N. (2014). [Impact of swapping soils on the endophytic bacterial communities of pre-domesticated, ancient and modern maize](http://www.biomedcentral.com/1471-2229/14/233). *BMC Plant Biology* 14, 233.

### Mousa, W.K., Raizada, M. N. (2013). The diversity of anti-microbial secondary metabolites produced by fungal endophytes: An interdisciplinary perspective. *Frontiers in Microbiology* 4, 65.

1. **Mousa, W.K.,** Afifi, M. S., Zaghloul, M. G., El-Sharkawy S. H. (2012). Apple Pomace; A source of pharmaceuticals. ***Journal of American Science*** 8, 1114-1119. (ISSN: 1545-1003)
2. El-Sharkawy S. H., Afifi, M. S., Zaghloul, M. G., **Mousa, W.K**., (2011). Isolation and Charaterization of Pectin from Some Agro-industrial Wastes. ***Journal of Environmental Science***42, 50-58.

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**Conference presentations**

**12.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2016). Unusual natural products mediated root hairs-endophyte stacking (RHESt) that traps and kills pathogens. Oral presentation, international level: 9th joint Natural Products Conference, July 24th, Copenhagen, Denmark.

**11.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2015). A story of ancient co-evolution between an ancient host, a beneficial microbe and a pathogenic fungus. Oral presentation, international level: Crop Science Society of America, November 14th, Minneapolis MN, USA **Awarded best oral presentation prize.**

**10.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2015). Role of beneficial host associated endophytes in defense mechanisms. Oral presentation, international level: University of Nanjing, October 27th, Nanjing, China. **Awarded best oral presentation prize.**

**9.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2015). Beneficial microbes combat serious fungal pathogens. Oral presentation, institutional level: Departmental retreat, April 12th, Ridgetown, Canada. **Awarded best oral presentation prize.**

**8.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2014). An ancient African crop hosts a novel bacterial endophyte that suppresses modern crop diseases. Oral presentation, international level: American Society of Microbiology 5th Conference on Beneficial Microbes, September 27th, Washington DC, USA.

**7.** Raizada, M.N., Johnston-Monje, D., Soliman, S.M., **Mousa, W.K.,** and Shehata, H.R., (2013). Contributions of microbes to eukaryotic fitness. Oral presentation, University of Minnesota, MPGI Fall Symposium (The Hidden Side of Everything), August 29th, Minnesota, USA.

**6.Mousa, W.K.,** Shearer, C Limay-Rios V., and Raizada, M.N. (2014). Plant associated microbes as promising source of biological control agents. Oral presentation, provincial level: Grain Farmers of Ontario Funding Report, July 22nd, University of Guelph, Guelph, ON Canada.

**5. Mousa, W.K.,** Shearer, and Raizada, M.N. (2013). Microbial endophytes that suppress the fungal pathogen *Fusarium graminearum.* Oral presentation, regional level: Genomics for Agricultural Sustainability: Third Annual Research Meeting, University of Guelph, June 10th, Guelph, ON Canada.

**4.** **Mousa, W.K.,** Shearer, and Raizada, M.N. (2015). Genome inspired discovery of an ancient co-evolution between an African host crop, a beneficial bacterial endophyte and a pathogenic fungus Poster presentation, international level: World Applied Microbiology Congress, August 18th, Frankfurt, Germany.

**3.** **Mousa, W.K.,** Shearer, C Limay-Rios V., Ettinger, C.L., Eisen, J.A. , and Raizada, M.N. (2015). Merging genome mining with ancient three-way species co-evolution may open a novel gate for informative natural products discovery. Poster presentation, international level: American Society of Pharmacognosy, July 25-29th, Colorado, USA. *Planta Medica*, 81, 906 (Abstract).

**2.** **Mousa, W.K.,** and Raizada, M.N. Poster presentation, provincial level (2015). Microbe helps Ontarians crops fight serious fungal disease. OMAFRA Plant Production Systems Research Symposium, March 18th, Guelph, ON. Canada.

**1.** **Mousa, W.K.,** and Raizada, M.N. (2014). An ancient African crop hosts a novel bacterial endophyte that suppresses modern crop diseases. Poster presentation, national level: Canadian Society of Plant Biologists, Eastern Regional Meeting, Nov. 28-29, 2014, Guelph, ON Canada.

**Awards and Honors**

1. Full Scholarship from the Egyptian Government for PhD studies in Canada, 2012-2015
2. Outstanding Student Oral Presentation Award of American Society of Crop Science, USA (2015).
3. Outstanding Student Oral Presentation Award of Nanjing University, China (2015).
4. Graduate Student Authorship Prize (2015).
5. Outstanding Student Oral Presentation Award of Plant Agriculture, Canada (2015).
6. Nanjing University international travel award (2015).
7. Robb Travel Grant (2014).
8. American Society of Microbiology Travel award (2014).
9. Graduate Student Authorship Prize (2014).
10. International student University scholarship (2013).
11. Ontario Agriculture College volunteer award (2013).
12. Kenneth and Murray scholarship (2013).
13. Graduate Student Authorship Prize (2013).
14. University of Guelph Entrance scholarship (2012).

**Scientific Societies Memberships**

* American Society of Pharmacognosy
* American Society of Microbiology
* Canadian Society of Biochemistry, Molecular and Cellular Biology
* Canadian Society of Plant Biologists