Evaluation of Research Projects - 2017

Name of the Project: Natural Products

Name of the Scientist: Prof. U.L.B. Jayasinghe (Project Leader, Senior Research Professor)
Prof. N.S. Kumar (Visiting Research Professor)
Prof. N.K.B. Adikaram (Visiting Research Professor)
Prof. Y. Fujimoto (Visiting Research Professor)
Prof. N. Kuhnert (Visiting Research Professor)

Description of the project: (*maximum one page*):

a. Goals &Objectives of the project:

The overall objective of the Natural Products Project of the NIFS is the identification of bioactive extracts and compounds from natural sources, as potential resources for control of human and plant diseases. Research activities of the project have been focused on the chemistry and bioactivity of secondary metabolites from plants, fungi (including endophytic fungi) and edible fruits of Sri Lanka. Another area of research has been the identification of polyphenols found in tea, medicinal plants, edible fruits and spices using Liquid Chromatography – Mass Spectrometry (LC-MS) and also studies on the cause and control of postharvest fungal diseases and disorders, including one *hitherto* unknown disorder, of edible and export-oriented fruit crops. These research activities are very wide and represent basic research on the field of natural products chemistry, pharmaceutical research and new materials.

b. (i) Activities/ Sub activities listed in the Action Plan 2017 under the Project:

(1)

Activity: Exploitation of extracts from plant sources and common Sri Lankan fungal flora for use in agriculture and human health.

Sub activity- Isolation, identification and separation of pure metabolites from plants and fungi. Characterization and application of these metabolites in agriculture and human health.

(2)

Activity– Plant secondary metabolites and LC-MS profiling of bioactive extracts

Sub activity - Chemistry and LC-MS analysis of bioactive extracts.

(3) Study of some postharvest diseases and disorders adversely affecting the export potential of fruits of mango var. TomEJC, and their management.

c. Significant scientific research findings and inventions during 2016:

(1) Chemistry and bioactivity of fungi associated with medicinal plants, edible fruits: several bioactive plant and fungal extracts were identified. Several secondary metabolites with interesting structural features and some useful bioactivities have been isolated. Structures of some selected compounds are given below. Pseurotin A (**1**), guignasulfide (**2**) {*Aspergillus fumigatus* from *Solanum insanum*}; uridine (**3**), uracil (**4**) {*Phialemonium curvatum* from *Manilkara zapota*}; vermistatin (**5**), chrodrimanin B (**6**) {*Penicillium verruculosum* from *Murraya koengii}*, derivative of yukonin (**7**), 4,7-dihydroxymellein (**8**) *Neofusicoccum parvum* from *Elaeocarpus serratus}*.

(2) Fungi from insects as a source of bioactive Compounds: Insects such as attinine ants, macrotermitine termites, wood wasps and ambrosia beetles have cultivated fungi as a food source for millions of years. Some compounds produced by these fungi affect the growth and development of other fungi thereby protecting the fungal crop of insects. The tea shot hole borer beetle (*Euwallacea fornicates*, TSHB) lives symbiotically with the fungus *Monacrosporium ambrosium* (syn. *Fusarium ambrosium*) in galleries made by TSHB in tea stems. EtOAC extract of liquid cultures of *M. ambrosium* isolated from the TSHB beetles was found by TLC bioautography method to show antifungal activity against a plant pathogen *Cladosporium cladosporioides*. Chromato graphic separation of the extract yielded twelve naphthoquinones, eight of which showed antifungal activity against *C. cladosporioides* at a concentration of 64 µg/spot and all at 128 µg/spot. Bio-inhibitory effect of *M. ambrosium* on the growth of three endophytic fungi isolated from tea stems was studies. *M. ambrosium* was found to show slight inhibitory effects on the growth of these three endophytic fungi by dual culture assay. The antifungal nature of the naphthoquinones produced by *M. ambrosium* suggests its ability to prevent/inhibit the growth of other fungi in TSHB galleries thus protecting the habitat of TSHB beetles.

Caffeine is the major alkaloid found in tea. It is toxic to a variety of insects and fungi, and is known to be pesticidal at the concentrations found in plants. Caffeine shows in vitro inhibitory activity against TSHB beetles. However, TSHB beetles continue to infest tea stems despite the high concentration of caffeine found in tea stems. Study were conducted to investigate whether *M. ambrosium* is able to transform/degrade caffeine in liquid culture media to theophylline and/or theobromine, known to be less fungicidal. Both TLC and HPLC studies showed that caffeine was unchanged, and that caffeine is not converted to theophylline and/or theobromine in culture media.

We also succeeded in the isolation of acetylcholinesterase enzyme inhibitors from the maze – *Myristica fragrance*.

(2) LC-MS is a powerful technique to analyse chemical constituents present in a mixture. Structures of the chemical constituents are generally identified on the basis of their retention times and mass fragmentation pattern by LC-MS studies. We were able to identify new chemical constituents from this study, which are new natural products. Currently we are in the process of profiling polyphenols in popular greens in Sri Lanka.

(3) Study of some postharvest diseases and disorders adversely affecting the export potential of fruits of mango var. TomEJC, and their management.
This project will investigate the cause of some disorders and fungal diseases of fruits of mango var. TomEJC, that adversely affect the fruit exportation, and develop appropriate management practices. National Research Council (NRC) has awarded a Public-Private Partnership (PPP) research grant to investigate in to these diseases and disorders. Two postgraduate research students are currently working on this project.

Section A – Published research output of the project/s

1. SCI/SCI expanded journals

1.aSCI Journals–

Publication in SCI jounals	category 1.a.i or 1.a.ii	Marks
1. Kehelpannala, C.L., **Kumar, N.S., Jayasinghe, L.**, Araya, H., **Fujimoto, Y.** (2018). Naphthoquinone metabolites produced by *Monocrosporium ambrosium*, the ectosymbiotic fungus of tea shot-hole borer, Euwallacea, in stems of tea, *Camellia sinensis*. *Journal of Chemical Ecology*, **44**, 95-101.	1.a	
Total marks		

1.b.SCI/expand –

Publication in SCI expanded journal	category 1.b.i or 1.b..ii	Marks
1. Rathnayake, G.R.N., **Kumar, N.S.., Jayasinghe, L.,** Araya, H., **Fujimoto, Y.** (2017). Chemical investigation of metabolites produced by an endophytic fungus *Phialemonium curvatum* from the leaves of *Passiflora edulis*. *Natural Product Research* (*In Press*). {DOI:10.1080/14786419.2017.1416373}	1.b.i	
2. Padmathilake, K.G.E., Bandara, H.M.S.K.H., Qader, M.M., **Kumar, N.S., Jayasinghe, L., Fujimoto,Y.** (2017). Talarofuranone, a new talaroconvolutin analog from the endophytic fungus *Talaromyces purpurogenus* from *Pouteria campechiana* seeds. *Natural Product Communications*,**12**, 489-490.	1.b.i	
Total marks		

1.c Other recognized peer reviewed journals

Publication in other recognized peer reviewed journals	category 1.c.i or 1.c.ii	Marks
1. Qader, M.M., **Kumar, N.S**., **Jayasinghe**, **L., Fujimoto, Y.** (2018). Shikimic acid production by *Fusarium decemcellulare*, an endophytic fungus isolated from *Flacourtia inermis* fruits *Journal of Biologically Active Products from Nature* (*in press*). {DOI: 10.1080/22311866.2018.1427628} 2. Munasinghe, M.V.K., **Kumar, N.S., Jayasinghe, L., Fujimoto, Y.**(2017). Indole-3-acetic acid production by *Collectrchum siamense*, an endophytic fungus from *Piper nigrum* leaves. *Journal of Biologically Active Products from Nature*, **7**, 475-479.	1.c.i 1.c.i	
Total marks		

2. National and International conference proceedings as peer reviewed full papers

1/ paper

No.	conference proceedings as peer reviewed full papers	Marks
	--N/A	
Total marks		

3. Abstracts in national/international conferences

0.5/ abstract

No.	Abstracts in national/international conferences	Marks
1	Shevchuk, A., Jayasinghe, L., Kuhnert, N. (2017). Differentiation of black teas using LC-MS and bioinformatics tools, Fourth International Conference on *CoCoTea conference*, June 25-28th Italy.	
2	Jayasinghe, L. (2017). Bioprospecting for Drug leads from Sri Lankan Medicinal Plants. Symposium on "*Scientists' role in S & T innovation for national economic development: current status & future trends in the use of Indigenous knowledge and mineral resources*" Sept. 15th, ITI, Colombo.	
3	Rathnayake, G.R.N., Kumar, N.S., Jayasinghe, L., Araya, H., Fujimoto, Y. (2017). Chemical investigation of metabolites from an endophytic fungus *Phialemonium curvatum* from *Passiflora edulis*. PGIS Res Con – 2017, Sept. 8-9th, 98.	
4	Qader, M.M., Illeperuma, V., Bandara, H.M.S.K.H., Ratnatilleke, A., Yakandawala, D., Kumar, N.S., Jayasinghe, L., Araya, H., Fujimoto, Y. (2017). Chemical investigation of the leaves of *Monochoria vaginalis*. PGIS Res Con – 2017, Sept. 8-9th, 121.	

5	Kehelpannala, C., Kumar, N.S., Jayasinghe, L., Punyasiri, P.A.N. (2017). Do liquid cultures of *Monocrosporium ambrosium*, ectosymbiote of *Xyleborus fornicates* (Shot hole borer) of *Camellia sinensis* (Tea), have an effect on caffeine? PGIS Res Con – 2017, Sept. 8-9th, 97.	
6	Munasinghe, M.V.K., Kumar, N.S., Jayasinghe, L., Araya, H., Fujimoto, Y. (2017). Structurally diverse metabolites from an endophytic fungus *Aspergillus fumigatus* isolated from *Solanum insanum*. PGIS Res Con – 2017, Sept. 8-9th, 108.	
7.	Munasinghe, M.V.K., Kumar, N.S., Jayasinghe, L., Araya, H., Fujimoto, Y. (2017). Secondary metabolites produced by an endophytic fungus *Xylaria berteri* from *Piper nigrum* leaves. PGIS Res Con – 2017, Sept. 8-9th, 110.	
8.	Sathya, S., Qader, M.M., Jayasinghe, L., Amarasinghe, N.R. (2017). Search for acetylcholinesterase inhibitors from Sri Lankan spices, PGIS Res Con – 2017, Sept. 8-9th, 104.	
9.	Liyanaarachchi, L.C.P.T., Kanatiwela, D.M., Jayasinghe, L., Gunatilake, M., Bandara, B.M.R. (2017). Anticandidal activity of three plants used for treating diabetes in indigenous medicine, PGIS Res Con – 2017, Sept. 8-9th, 110.	
10.	Liyanaarachchi, L.C.P.T., Jayasinghe, L., Gunatilake, M., Siriwardhana, A., Bandara, B.M.R. (2017). Five phytochemicals from an antidiabetic extract of *Canarium zeylanicum* (Retz.) Blume, PGIS Res Con – 2017, Sept. 8-9th, 132.	
11	Liyanaarachchie L.C.P.T., Gunatilake M., Jayasinghe L., Bandara B.M.R. (2017). Screening of antidiabetic potential of Sri Lankan endemic plant, *Canarium zeylanicum* and its toxic effects using Wistar rat and brine shrimp models, *8th International Conference of Laboratory Animal Scientists' Association (LASA), India on Recent Advances in 3R's and Laboratory Animal Science Organized by Life Sciences, JNU, New Delhi, Institute of Genomics and Integrative Biology (IGIB), New Delhi and Naional Institute of Biologicals, Noida*, 25-26 November 2017, 60 - First Runner UP Cash Prize.	
12	Napagoda M., De Soyza, S., Qader, M., Lorenz, S., Schneider, B, Svatoš, A., Wijayaratne, G., Nagahawatte, A., Jayasinghe, L. (2017) *Plectranthus zeylanicus*: A potent source of antimicrobial phytochemicals from tropical flora. *Proceedings of the International Symposium on Traditional and Complementary Medicine*, Colombo, Sri Lanka. 37.	
13	Napagoda, M.T., Samaranayake, H.K.U.P., Qader, M. M, Jayasinghe, L. (2017). Evaluation of photoprotective potential in Sri Lankan medicinal plants for the development of herbal cosmetics. 14thAcademic Sessions. University of Ruhuna, Sri Lanka. 7.	
14	Kaliyadasa, E., Jayasinghe, L., Peiris, S. (2017). Yield and Phytochemical attributes of Ashwagandha (*Withania somnifera* Dunal) tubers as affected by source of nutrients. Abstract. *8th International Conference on Agriculture and Animal Science (ICAAS 2017). Los Angeles. USA.* pp. 45.	
15	Kaliyadasa, E., Jayasinghe, L., Peiris, S. (2017). Phytochemical evaluation of Ashwagandha (*Withania somnifera* Dunal) tubers as affected by source of nutrients. *Conference Proceeding APMR2017; Second Asia – Pacific Conference on Multidisciplinary Research*, 29-30 July 2017. Colombo, Sri Lanka. P.64	
Total marks		

4. Book chapters

Up to 10/ book chapter

No.	Book chapters	Marks
	- N/A	
Total marks		

5. Books/ Monographs

Up to 10 / each

No.	Books/ Monographs	Marks
	--N/A	
Total marks		

Section B – Other activities of the project/s

1. Research Collaborations (as proved by 2017publications)

*Number of collaborations:**1 per each***

No.	*Number of collaborations*	Marks
1 2 3 4 5 6 7 8.	Tokyo Institute of Technology, Japan. *1.b.2* Meiji University, Japan. *1.a.1, 1.b.1, 1c.1, 1.c.2* Department of Biochemistry, Faculty of Medicine, University of Ruhuna. *(Abs. 12, 13))* Department of Export Agriculture, Uwa-Wellassa University *(Ab. 14)* Department of Chemistry, University of Peradeniya. ***(Abs**: 9)* Department of Botany, University of Peradeniya. ***(Abs**: 4)* Faculty of Allied Health Sciences, University of Peradeniya. ***(Abs**: 8)* *Jacobs University Bremen, Germany.* *(Abs: 1)*	
Total marks		

2. Research supervision:
   a) Ph.D. /M.Phil./M.Sc. Degrees awarded in 2016
   Ph.D. – 10, M.Phil. – 07, M.Sc. –02 (outside – 5, 3, 1)

Degree supervised	Ph.D./M.Phil. / M.Sc.	Internal/outside	Marks
G.R.N. Rathnayake T. Sritharan M.V.K. Munasinghe L.C.P.T. Liyanaarachchie A.M.K.C. Attanayake	M.Phil. M.Phil. M.Phil. Ph.D. M.Sc.	Internal Internal Internal Outside Outside	
Total marks			

   b) undergraduate projects completed
   1/ project

Undergraduate project	University	Marks
Ms. C. Wickramaratne Ms. M. Lankadhikara Ms. M.F.F. Nuzha	University of Peradeniya BMS, Colombo BMS, Colombo	
Total marks		

3. Outside Research Grants received in 2017
   *Local – **05 (for each grant);** International – **10 (for each grant);** Travel Grant – **1 each***

Research grant	Local/ Intl/ Travel	Marks
NRC – 17-054 **Prof. L. Jayasinghe (PI), Prof N.S. Kumar & Prof. N.K.B. Adikaram (CI)** received research grant of Rs. 4,629,302.00 from NRC Sri Lanka (NRC 17-054). **Project Title**: Bioactive metabolites of endophytic fungi from the medicinal plants *Coccinia grandis*, *Costus speciosus* and *Gymnema sylevestre* used in indigenous medicine for treatment of diabetes mellitus and possible commercial applications.	Local	
NSF RG/2017/BS/06 **Prof. L. Jayasinghe (PI), Prof. N.S. Kumar (CI), Prof. N.K.B. Adikaram (Collaborator),** Dr. N.R. Amarasinghe (Collaborator) received research grant of Rs. 2,646,300.00 from NSF Sri Lanka (NSF RG/2017/BS/06) **Project Title**: Chemistry and bioactivity of endophytic fungi from four popular condiment plants *Curcuma longa*, *Myristica fragrans*, *Syzygiuma romaticum* and *Zingiber officinale* used in indigenous system of medicine in Sri Lanka: Possible applications in health and agriculture.	Local	

NRC-PPP 17/01 **Prof. N.K.B. Adikaram (PI), Prof. L. Jayasinghe (CI),** D. Yakandawala (CI) received research grant of **Rs. 3,642,222.00** from NRC Sri Lanka Public Private Partnership programme (NRC-PPP 17/01). **Project Title**: Study of some postharvest diseases and disorders adversely affecting the export potential of mango var. TomEJC and their management.	Local	
NRC 17-17 Prof. J.P. Eeswara (PI), **Prof. L. Jayasinghe (CI),** S. Selvaskanthan (CI) received research grant of Rs. 4,129,916.00 from NRC Sri Lanka (NRC 17-17). **Project Title**: Rapid multiplication and production of Agarwood fragrant constituents by plant cell and tissue culture of *Gyrinopsis walla*	Local	
Total marks		

4. Patents, Awards and Recognitions received in 2017

a) Patent:15/ patent (add 10 for other countries)

Patent	Local/ International	Marks
None	--	--
Total marks		00

b) Awards& Recognitions:

Presidential awards / NRC merit award received in 2016 – **01 points for each;** National competitive awards – **03 (for each award);** International competitive awards – **10 (for each award);** Other recognitions- **(up to 2 per recognition)**

Awards/ recognitions	Presidential awards /National competitive awards/NRC merit awards/ International competitive awards	Marks
C.L. Kehelpannala	*Kandiah Memorial Award for Applied Sciences, Awarded by Institute of Chemistry Ceylon, 2016.*	
M.M. Qader	*Kandiah Memorial Award for Basic Sciences, Awarded by Institute of Chemistry Ceylon, 2016.*	
M.M. Qader	*Research Assistant attached to the Natural Products project was awarded the Competitive Erasmus Mundas - Glink Fellowship to undertake collaborative research at the University of the West of Scotland, UK from European Commission (2017).*	
U.L.B. Jayasinghe	*Presidential Award for Scientific Publications -2015 Awarded in 2017*	
N.S. Kumar	*Presidential Award for Scientific Publications -2015 Awarded in 2017*	
Total marks		

Section C –Dissemination

Actions taken to disseminate the outcomes of the project/s

1. Keynote/plenary/ invited speeches in conferences/ seminars/ workshops etc. in 2016.
   National – ***05 each;*** *International* – ***07 each***

Keynote/plenary/ invited speeches in conferences/ seminars/ workshops etc.	National/ Intl	Marks
Invited Lectures **1. Jayasinghe, L.** (2017). Invited Lecture - Bioprospecting for Drug leads from Sri Lankan Medicinal Plants. Symposium on "*Scientists' role in S & T innovation for national economic development: current status & future trends in the use of Indigenous knowledge andmineral resources*" Sept. 15th, ITI, Colombo.	National	
Total marks		

2. Presentations at conferences/ seminars/ training programs / workshops etc. in 2017.
   (not counted under Section A – 2&A- 3)
   01 each

Presentations not counted under Section A – 2&A-3	Marks
--	--
Total marks	

Section D – Overall assessment on the progress of the project and the targets achieved during 2016: To be filled by the reviewer

Summary of marks obtained:

Section		Marks
Section A –Research output of the project/s		
1.	Publications a. SCI Journals	
	b. SCI/expand	
	c. other recognized peer reviewed journals	
2.	National/ International conference proceedings as peer reviewed full papers	
3.	Abstracts in national/international conferences	
4.	Book chapters	
5.	Books/ Monographs	
Section B – Other activities of the project/s		
1.	Research Collaborations	
2.	Research supervision: a. Ph.D. /M.Phil./M.Sc. Degrees	
	b. undergraduate projects completed	
3.	Outside Research Grants	
4.	Patents, Awards and Recognitions	
	a. Patents	
	b. Awards &Recognitions	
Section C –Dissemination		
1.	Keynote/plenary/ invited speeches	
2.	Presentations not counted under Section A – 2 & A-3	
Total marks		

Overall assessment regarding the progress of the project during 2016:

Please tick only one box.

Excellent	Very good	Good	Fair	Average	Not satisfactory	Poor

Other comments:

Name and the signature of the reviewer: Date: