Potential of Cyanobacteria Isolated From Different Fresh Water Bodies of Sri Lanka as a Food Supplement

M. S. Malika[2], T. Bowanage[1], A. Sumanasinghe[2], *R. R. Ratnayake[1]
[1] National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Post Graduate Institute of Agriculture, University of Peradeniya, Kandy, Sri Lanka
E-mail:shyamamalika@gmail.com

INTRODUCTION

The projected rise of global population from the current 7.2 billion to over 9.6 billion within the next several decades and food requirement also will be gradually increased with population. This onerous target puts enormous pressure on agriculture sector to achieve the food security(Lum, Kim and Lei, 2013). But such a big gap in food production can be achieved by either bringing more and more land under cultivation or enhancing the production of cultivated lands available (Singh *et al.*, 2016). Today food production practices are strongly depend on intensive tillage, irrigation, application of chemicals (fertilizers and pesticides) which intern create environmental problem such as deforestation, soil acidity, soil erosion, concentration of heavy metals, irrigation problems and climate change. The potential of cyanobacteria photosynthesis for the production of variable compounds or for energetic use is widely recognized due to their more efficient utilization of energy as compared with higher plants (Priyadarshani and Rath, 2012). Cyanobacteria produce a wealth of high-value bio products and have been mass cultivated for centuries as a nutritional supplement (Möllers *et al.*, 2014). The first use of microalgae by human dates back 2000 years to the Chinese, who used *Nostoc* to survive during famine(Priyadarshani*et al*., 2012). Today there are numerous commercial applications of cyanobacteria as they can be used to enhance the nutritional value of food and animal feed owing to their chemical composition. Therefore the overall objective of this study was to investigate the potential use of some selected fresh water cyanobacteria isolated from fresh water bodies of Sri Lanka as a food supplement.

MATERIALS AND METHODS

Cyanobacteria contain water samples were collected representing three climatic zones (wet zone, dry zone and intermediate zone) of Sri Lanka and cultivated them using BG 11 and GO media. Repeated sub culturing in liquid and solid media were used to purifying monocultures. Semi mass culturing of monocultures were carried out by 10L size aspiratory bottles. Cyanobacteria biomass was harvested 40 days after semi mass culturing. Collected algal pellets were transferred into petri plates and placed for oven drying overnight at 50 ^{o}C. The nutritional composition of cyanobacteria including total carbohydrate, total protein, total lipid, individual sugars, and vitamin C and essential macro and micro elements were quantified.

RESULTS AND DISCUSSION

Eleven mono cultures(*Phormidium*sp., *Cephalothrixkomarekian, Chrooccales* sp., *Planktolyngbia* sp., *Cephlothrix* sp., *Microcoleus* sp., *Oscillatoria* sp., *Mycrocystis* sp., *Synechococcus* sp., *Pseudoanabaena* sp., and *Dermocarpa* sp.) were obtained by repeated sub culturing in both, solid and liquid media. The percentage of total carbohydrate in cyanobacteria dry biomass varies between 5.67%-51.94%. *Oscillatoria* sp. and *Pseudoanabaena* sp. had the significantly higher values respectively 51.94% and 51.12%. A study carried out by Rajeshwari and Rajashekar, 2011 reported that carbohydrate content of cyanobacteria sp. S. bohneri and O. *foreaui* ranged between 8.0% and 28.4%. In Nitrogen fixing cyanobacteria 16-38% of carbohydrate content was reported (Vargas *et al.*, 1998). Our study showed a very high amount of carbohydrate compared to the privious reports. Total protein content was ranged between 2.45% to 69.47%. *Microcoleus* sp. show significantly higher value.Total lipid content of eleven strains ranged between 3.85%-34.53%. *Phormidium*sp. had significantly high lipid content. Rajeshwari and Rajashekhar, 2011 Different aquatic habitats of cyanobacteria had the total lipid content range from 10 – 20% (Rajeshwari and Rajashekhar, 2011). Our study showed higher content of lipids than the previous studies. The study showed that cyanobacteria contain individual sugars such as galactose, rhamnose, glucose, arabinose and fructose.Cyanobacterialbiomasses contained a significantly high amount of galactose and glucose. Range of vitamin C was 0.0015 mg/100g – 3.3761 mg/100g in fresh biomass of cyanobacteria. However the content found in oven dried biomass was low. The selected strains were rich in macro and micro element such as Ca, Mg, K, Zn, Mn, Co and Fe.

CONCLUSION

Out of this eleven cyanobacteria strains, *Oscillatoria* sp., *Cynechococcus* sp.and *Pseudoanabaena* sp. were rich in carbohydrates. *Planktolyngbia* sp., *Cephlothrix* sp. and *Microcoleus* sp. were rich in protein. Both *Cynechococcus* sp. and *Pseudoanabaena* sp. were rich as a lipid source. Considering macro elements *Cynechococcus* sp. and *Pseudoanabaena* sp. rich as a Ca source. Microcoleus sp. and Oscillatoria sp. suitable as Mg and K source. Micro elements (Zn, Mn, Co, Cu and Fe) concentrations were high in all eleven cyanobacteria strains.

ACKNOWLEDGEMENT

This research was carried out at the Bioenergy & Soil Ecosystems research laboratory at the National Institute of Fundamental Studies (NIFS), Hantana Road, Kandy, Sri Lanka. I would like to thank the Director and relevant authorities of the NIFS for providing me excellent working facilities to carried out my research project and complete it, successfully.I wish to express my gratitude to Mrs. Kumudini Karunaratne, Ms. S. Jayasekara Mr. M. Kathirgamanathan, Ms. T. Bowanage, Ms. R.P.S.K. Rajapaksha, Y. Buddika and all technical staffs of NIFS, Kandy, who rendered their friendly assistance during the period of my research.

REFERENCES

Lum, K. K., Kim, J. and Lei, X. G. (2013) 'Dual potential of microalgae as a sustainable biofuel feedstock and animal feed', *Journal of Animal Science and Biotechnology*. doi: 10.1186/2049-1891-4-53.

Möllers, K. B. *et al.* (2014) 'Cyanobacterial biomass as carbohydrate and nutrient feedstock for bioethanol production by yeast fermentation', *Biotechnology for Biofuels*, 7(1). doi: 10.1186/1754-6834-7-64.

Priyadarshani, I. and Rath, B. (2012) 'Commercial and industrial applications of micro algae – A review', *Journal of Algal Biomass Utilization*, 3(4), pp. 89–100.

Rajeshwari, K. R. and Rajashekhar, M. (2011) 'Biochemical Composition of Seven Species of

Cyanobacteria Isolated from Different Aquatic Habitats of Western Ghats ', *Brazilian Archives of biology and Technology*, 54(October), pp. 849–857. doi: 10.1590/S1516-89132011000500001.

Singh, J. S. *et al.* (2016) 'Cyanobacteria: A precious bio-resource in agriculture, ecosystem, and environmental sustainability', *Frontiers in Microbiology*. doi: 10.3389/fmicb.2016.00529.

Vargas, M. A. *et al.* (1998) 'Biochemical composition and fatty acid content of filamentous nitrogen-fixing cyanobacteria', *Journal of Phycology*, 34(5), pp. 812–817. doi: 10.1046/j.1529-8817.1998.340812.x.