

## Evaluation on the nutraceutical properties of locally grown microalgae

Hishamuddin Omar and Maznah Ismail

Faculty of Science and Environmental Studies  
Faculty of Medicines and Health Sciences  
Universiti Putra Malaysia  
43400 UPM, Serdang, Selangor  
Malaysia

Telephone Number of Corresponding Author: 03-89466623

E-mail of Corresponding Author: [hishamom@fsas.upm.edu.my](mailto:hishamom@fsas.upm.edu.my)

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### Introduction

Several decades of studies have revealed that algae contain superior nutritional properties compared to other source of food. Japan began to utilize Chlorella as health food supplement in the 70s (Kawaguchi, 1980). At about the same time America and Mexico were mass culturing Spirulina (Cifferi and Tiboni, 1985; Richmond, 1986). In the early 80's till present, the health food industries in America, Japan and Europe has made rapid progress partly due to the awareness of the population on the superior properties of algae as health food. Algae is also known as nutraceutical food: that is the food that can heal. Concerned with the side effect of the pharmaceutical product, many patient turned to nutraceutical food as an alternative. Rapid economic development, improve level of education and high disposable income has enable many Malaysian to consumer health food. According to Ministry of Health, in 1998 Malaysia imported RM 2 billion health food (The Star, June 28, 1998). Economic downturn in 1998 and economic uncertainties in the early 2000 has force Malaysia to review in import of food particularly health food. In order to reduce import of health food, one of the strategy is to produce local health food. Therefore the objective of this study is produce and to evaluate the potential of local microalgae as health food. Two of the most popular microalgae which can be grown in Malaysia are Chlorella and Spirulina.

### Materials and Methods

The study is divided into three section; a.) manipulation and enrichment of growth media in Chlorella and Spirulina, b.) biochemical composition of Chlorella and Spirulina and c.) *in vitro* study of iron bioavailability from Chlorella and Spirulina. Stock culture of Chlorella was obtained from National Prawn Fry Production and Research Center (NAPFRE), Pulau Sayak, Kedah and Spirulina from Institute of Higher Learning, Universiti Malaya. Chlorella was grown in Bold Basal media while Spirulina in Kosaric's media. Various concentration of Fe was added to the growth media in both species. At the end of the culture period, both algae was harvested, freeze dried, digested and Fe content determined using AAS. For biochemical studies freeze dried sample of Chlorella and Spirulina was analysed for total protein (Lowry et al. 1951), lipid (Holland et al. 1971) and carbohydrate (Kochert, 1978). *In vitro* study of iron bioavailability on Chlorella and Spirulina was conducted using Caco-2 cell (Ismail et al. 2001 and Su Peng et al. 2001).

### Results and Discussion

Studies on locally grown microalgae; Chlorella and Spirulina have shown that the iron content or other mineral content and other biochemical composition can be increased by manipulating the growth media and culture conditions. The iron content of locally grown Chlorella and Spirulina were significantly higher than the commercially available (imported) Chlorella and Spirulina. This study have shown that we can produced iron, selenium, chromium or others nutrient enriched in microalgae which is beneficial to health. Fast turnover of microalgae is another advantage to other plant-based product. The protein, lipid and carbohydrate of Chlorella and Spirulina were 45-65%, 4-9% and 26-51% respectively which is superior than most of the conventional and health food source. Beside it also contain chlorophyll<sub>a</sub> and various other pigment which are believed to have nutraceutical properties. The *in vitro* study using Caco-2 cell and *in vivo* study using rats have shown that bioavailability of Fe is superior than Fe from ferrous sulphate. Throughout the study, Fe from Chlorella and Spirulina did not show any adverse effect to the rats. The finding of this study support the claim of other researcher and producer of popular health food (imported) that Chlorella and Spirulina not only contain high nutritional values but the bioavailability of nutrient such as iron is also high.

### Conclusions

1. It is possible to mass produce certain beneficial microalgae under local conditions
2. The biochemical and mineral content of local microalgae can be improved by manipulating the growth media and culture conditions.
3. The biochemical and mineral content of local microalgae is equal or superior than the imported microalgae.
4. Local microalgae (Chlorella and Spirulina) has high Fe bioavailability
5. The finding of this studies indicated that Chlorella and Spirulina is a superior food supplement compared to other mineral supplement because it offer a more complete nutritional package (high bioavailability, slow nutrient release, high protein, balanced carbohydrate and lipid content.

**Benefits from the study**

The knowledge and experience gained from this study can help any interested party to mass produce *Chlorella* and *Spirulina* in Malaysia. Data on mineral and biochemical composition of *Chlorella* and *Spirulina* will help to convince the health food producer and consumer that locally produced microalgae is equally good if not better than imported microalgae. The study also demonstrated that consuming *Chlorella* and *Spirulina* is better than taking mineral salt supplement

**Patent(s), if applicable :**

Nil

**Stage of Commercialization, if applicable :**

Nil

**Project Publications in Refereed Journals:**

Nil

**Project Publications in Conference Proceedings**

1. M. Ismail, L. S. Peng, Y. H. Seng and H. Omar 2001. Bioavailability of iron from *Spirulina platensis*: Evaluation using haemoglobin repletion in anaemic rats. *Poster presented in Bioavailability 2001: Bioavailability of Micronutrients in Relation to Public Health, Interlaken, Switzerland, May 30 – June 1<sup>st</sup>, 2001.*
2. Loh, S. P., Maznah I., Hishamuddin O., Abdul Salam A. and Rehir, D. 2001. The effect of different doses of calcium supplementation on iron availability from *Spirulina platensis* by an *in vitro* digestion/caco-2 cell culture model. *Paper presented in Malaysian Science and Technology Congress 2001, Kota Kinabalu, Sabah, Malaysia, September 24<sup>th</sup>-26<sup>th</sup>, 2001.*
3. S. P. Loh, M. Ismail and H. Omar, 2001. Comparison of the effect of calcium on the bioavailability of iron from *Spirulina platensis* and ferrous sulphate *in vivo*. *Poster presented in the 17<sup>th</sup> International Congress of Nutrition, Vienna, Austria, August 27<sup>th</sup>-31<sup>st</sup>, 2001*
4. Loh, S.P., Maznah I., Rehir D., Abdul Salam A. and Hishamuddin O. 2002. Effect of ascorbic and tannic acid on iron bioavailability from ferrous sulphate and *Spirulina platensis* by an *in vitro* digestion /Caco-2 cell culture model presented in Malaysian Congress and Technology Congress (MSTC 2002) Kuching, Sarawak, 12-14<sup>th</sup> December, 2002
5. Loh, S.P., Maznah I., Hishamuddin O, Rehir D. and Abdul Salam A. 2003. Fe distribution and absorption in iron deficient mice given ferrous sulphate and *Spirulina platensis* as dietary iron sources. Paper presented at 18<sup>th</sup> Nutrition Society of Malaysia Conference, Kuala Lumpur, March 22-23, 2003.
6. Loh, S.P., Maznah I., Hishamuddin O, Rehir D. and Abdul Salam A. 2003. The effect of calcium supplementation on <sup>59</sup>Fe absorption and distribution in iron deficient mice given *Spirulina platensis* or ferrous sulphate as dietary iron. Paper presented at the 5<sup>th</sup> MCBN-UNESCO/ COSTAM/ SFRR (Malaysia/Asean) Workshop "Micronutrients: Molecular Basis of Health and Disease", Kota Kinabalu, Sabah on 16-20 July, 2003.

**Graduate Research**

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Loh Su Peng	<i>In vitro</i> and <i>in vivo</i> studies of Fe availability from <i>Spirulina platensis</i>	Nutrition, biochemistry	Phd (Phd candidate)	In the process of submission

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Kennedy Aguol	Aaron	Mass culture of <i>Arthiospira</i> <i>platensis</i> utilizing aerobically digested palm oil mill effluent.	Aquaculture, plant physiology and biochemistry	Msc.	2003
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