Commercial Production of Spirulina
A New Industry in China

Spirulina (spiro algae), a blue-green algae, is an ancient marine organism that has existed for the past 3.5 billion years. Spirulina has been labeled as 'the ideal foodstuff for the future' and recommended as a highly nutritious food by the United Nations Food and Agriculture Organization. The nutritive value of the algae is extremely high: one gram of spirulina contains an equivalent amount of nutrients to one kilogram of mixed vegetables. With a protein content as high as 70%, its per unit protein content being five times higher than an egg, it is regarded as one of the richest sources of proteins in the world. In addition, spirulina is also rich in amino acids, vitamins, active substances found in living organisms, non-saturated fatty acids, and essential minerals (see table).

Contents of Spirulina

1. Protein
   - amino acids
2. Vitamins
   - B_{12}
3. Active substances
   - β corotene
   - γ linolenic acid
4. Minerals
   - zinc
   - iron
   - copper
   - calcium
   - trace elements
5. Others
   - chlorophyll
   - xanthophyll
   - phycocyanin
6. Non-saturated fatty acids

Due to its well-balanced and highly nutritious content, spirulina is much sought after for its beneficial effects on human health and well-being. Not only is it easily digestible, but it is believed that regular consumption of the algae can assist in regulating the physiological mechanisms of the body, increasing metabolic rate, enhancing immunity to diseases, increasing tissue resistance to damage by radiation, lowering the cholesterol level, preventing metal poisoning, and providing supplementary therapeutic aid against cancer, anemia and cardiovascular diseases. Apparently, it can also help in the slimming process — one feature that will ensure its rise in popularity as a modern health food. In Germany, spirulina has already been marketed as a health food for weight loss, while in France and Japan it is used in cosmetic products.

Following the trend started by these countries, China has also developed more than 20 varieties of spirulina products to cater to the modern lifestyle and taste of its population. In 1986, researchers from the Wuhan Institute of Botany, Academia Sinica, were assigned to handle the 'Algae Proteins Research and Development' Project under the National seventh Five-Year Plan. The group, headed by Professor Hu Hongjun (胡鴻鈞), conducted systematic tests at Chenghai Lake in Yunnan Province (雲南省程海湖畔), selecting ten new species of spirulina of high productivity and good quality for investigation. They also developed a new technique to dehydrate algae.

Recently, large-scale spirulina cultivation and manufacturing bases were set up at Kunming (昆明) and by Chenghai Lake, Yongsheng County (雲南永勝縣程海湖畔), where dried algae powder was manufactured into drugs, health food and cosmetics. These three products have since found their way into the domestic and foreign markets, and have helped to form a new enterprise in the Yunnan Province called 'The 18 Bio-Project', from which the provincial government hopes to collect a sales revenue of 10 billion yuan (US$1.2 billion) for each project within the next five years. Four spirulina factories have been set up by Chenghai Lake. As a whole, their annual production amounts to 800 – 1000 tonnes, which works out to an annual production volume of 120 – 150 million yuan (US$14.5 – 18.1 million). By far, the largest spirulina cultivation farm in China is Hainan Simai Enterprising Ltd (海南思邁實業有限公司). It has been identified as a key industrial pillar of Hainan Province (海南省). It occupies 60 000 square feet and is located in Chengmai (澄邁). The company has an annual production of 200 tonnes of algae powder, which accounts for 25% of the total national output of spirulina, and 10% of the world output. The company plans to manufacture algae pills, capsules and other pharmaceutical products under the brand name 'Simai'.

Other companies are also seizing the opportunity to establish a niche in this new industry. ShiPuRui Co. Ltd. (施普瑞有限公司) from Yunnan has signed long-term R&D corporation agreements with the Wuhan Institute of Botany for the duration of the ninth Five-Year Plan. The Hainan Huiguang Industry Co. Ltd (海南惠光實業有限公司). has marketed the 'Tian Lü' Brand spirulina powder, and is actively developing new products like spirulina in the liquid form, spirulina drinks, and 'Jiang Zhi Ling' (降脂靈) — a drug which decreases the lipid level in the blood.

Chinese Company Succeeds in Producing Recombinant Human Granulopoietic Stimulating Factor

The National Drug Administration, China, has recently approved an injectable preparation of a recombinant human granulopoeisis stimulating factor developed by Jiu Yuan Genetic Engineering Corporation in Hiangzhou, Zhejiang Province (浙江省杭州九源基因工程有限公司). Called 'Gilifen' (吉粒芬), this is one of the key projects under China's National '863' Plan and its production will be carried out under the ninth Five-Year plan. The drug can effectively raise the white blood cell count and correct leukopenia caused by bone marrow transplantation or chemotherapy of carcinoma. When produced, Gilifan will replace those being imported from the US and Japan to meet the needs of the whole country.

Microspore Culture Technique for Breeding Vegetables

Professor Li Genyi (栗根義) from the Institute of Horticulture, Henan Academy of Agricultural Sciences, has successfully bred the Chinese cabbage using the microspore culture technique. In 1996, his project was awarded a top prize by the provincial government in recognition of his group's effort to promote advanced technology. Professor Li has been studying this technique since 1989. His research group developed eight hybrids of Chinese cabbage which can be cultivated in different seasons throughout the year — Yucun 1 (March and April), Yuyuan 50 (May and June), Yuzao 1 (July), Yuzao 2 (August) and Yuyuan 1, 2, 3 and 4 (to be stored as winter supply). In recent years seed production by the hybrid plants has reached 1.12 kg/hectare (compared to only 0.37 kg/hectare earlier). Professor Li has also managed to shorten the breeding cycle from 10 to 5 months. His finding has helped to overcome the Chinese cabbage shortage due to seasonal changes. So far this technique has also been applied in breeding broccoli, cauliflower, lettuce and pakchoi.

China Breeds Transgenic Pigs

As part of the State '863' Hi-Tech Program, the Institute of Livestock in the Hubei Academy of Sciences has undertaken a project to breed transgenic pigs. The project was a success — it resulted in the breeding of pigs with high-quality meat, low feed consumption, and high resistance to diseases. The project was evaluated by experts recently.

Four types of genes were injected into a total of 2592 fertilized eggs, out of which 56 transgenic pigs were obtained. The transgenic efficiency of 2.1% — twice as high as figures reported from abroad — was attributed to the use of auto-implantation of embryos and gene microinjection techniques, which also helped to simplify the manipulation.

Mice with HBV Genome Used as Models for Studying HBV Diseases in Humans

The hepatitis B virus infects humans and higher primates exclusively. For years, research on the treatment and prevention of HBV has been severely hampered by the lack of suitable experimental animal models. Now, after five years of intensive research, a group of scientists from the Second Medical University of the People's Liberation Army, headed by Dr. Hu Yi-Ping (胡以平), has successfully bred a new stock of mice, using microinjection to incorporate whole genomic DNA derived from two different HBV into the genome of the mice.

Tests indicate that since this stock of mice responded in the same way as human subjects infected with the virus, they can be suitable animal models in the study of HBV-related diseases in humans. This may serve to increase the understanding of the pathological process of hepatitis and hepatoma, and to find an effective therapy for HBV diseases.

HMI BALESTIER HOSPITAL

INPATIENT SERVICES
- Single, 2, 3 and 4 bedded Rooms
- Operating Theatres
- Intensive Care Unit (ICU)

OUTPATIENT SERVICES
- 24hr General Practice(GP) Clinic
- Specialist Clinics
- Diabetes Centre
- Day Surgery Centre
- Health Screening Centre
- Excimer Laser Centre

SUPPORT SERVICES
- Pharmacy
- Laboratory
- Diagnostic Radiology
- Physiotherapy
- Public Health Education Programme

HMI Balestier Hospital is a 62-bed private hospital with a full range of outpatient, inpatient and specialised services and facilities.

Corporate Client Services
- Managed Care Programme under IHP HealthPlus
- Health Education / Promotion
- Tailored Health Screening Programme

HMI BALESTIER HOSPITAL PTE LTD
363 Balestier Road, Singapore 329784
Tel : 253 3818 Fax : 251 0530

Japan Develops New Material for Use as Artificial Bone

Two scientists from Japan Kyoto University have successfully developed a new material for use as artificial bone. This new material will be used in surgeries involving replacement of thigh junctures, the jaw and other human bone structures. The raw materials used for the artificial bone are pure titanium, an alloy of titanium, aluminum, vanadium, niobium and tantalum. They are soaked in sodium hydroxide for 24 hours and then heated at 600° C for an hour.

Experiments to test the effectiveness of the new materials were conducted on rabbits. It was found that, when implanted into the thighs of rabbits, the new material was able to interact with the bone tissues; it gradually produced apatite with a similar structure to that of bones. Ultimately, it was able to bond with the bones. After four months of post-surgical observation, the peel strength was noted to have increased to 6 kg from an initial reading of 3 kg taken during the second month.

New Method to Produce Triazo Nucleoside

Triazo nucleoside is an antiviral medicine used in the treatment of influenza, hepatitis, and oral herpes. It is also used in the treatment of AIDS in the UK, Switzerland, Italy and other countries.

In China, the medicine was formerly produced using chemical synthesis. Recently, production using the enzymatic method has been gaining popularity. The advantages of this method compared to chemical synthesis are a higher production rate and lower costs. As a key task of the '95 Plan', this method was tested in small scale production and was shown to match that of international standards. The Shanghai Pacific Corporation for Advanced Biological Science and Technology is testing out the method for medium scale production, and is expecting to achieve desirable results by the end of the year.

Vaccine for Hepatitis C Produced by Silkworms

The Institute of Biochemistry of Zhejiang Agricultural University, in collaboration with the Shanghai Institute of Biochemistry (Chinese Academy of Sciences) and Haining Silk Corporation (海寧絲綢集團公司) have succeeded in producing Hepatitis C vaccine in silkworms and in their cocoons. Approximately 0.5 – 0.6 mg of the antigen can be extracted from each silkworm or cocoon. The antigen can be administered orally as a liquid, or in the form of a capsule.