Solve Some Practical Problems in Sustainable Agricultural Development by Combining Modern Biotechnology and Chinese Traditional Biotechniques

结合现代生物技术和中国传统生物技术解决农业可持续发展的一些实际问题

Zhu Yang

(TNO Nutrition and Food Research Institute, Department of Bioprocessing, P. O. Box 360, 3700 AJ Zeist. Netherlands, e-mai:Zhu@voeding.tno.nl July 1999)

1 A Dutch view of bottle-neck in Chinese agricultural development

According to the Netherlands Ministry of Agriculture, the Chinese government has put great effort and high priority in the development of the agricultural sector and processing of agro-products. China uses only 7% of the tillable land in the world to feed 22% of the world population. The central government tries to use all stimulating activities to enlarge the agricultural production, to improve the production efficiency and increase the quality. However, there are certain bottle-necks:

Poor structure of agro-business;

Low education lever of the farmer population;

Middle-level function of agricultural research, education and information system;

Lack of high-value agricultural input;

Poorly developed process, storage, transport and distribution system of agricultural products;

Health care of animals.

In a positive way to look at these problems, one can see how successful the Chinese agricultural situation has been to solve the 'eating' problem of 1,2 billion people. In addition, one can also realize the potential of Chinese agricultural development.

There is also an overview of the Dutch Foreign Ministry on the agriculture related problems in China.

Poor infrastructure;

Lack of water resources and degradation of tillable land;

Urbanization and industrialization-effect on tillable land as well;

Poverty population;

Environmental-pesticide and chemical fertilizers.

2 Available knowledge and experience to solve some the problems-innovative and explorative development and application

Based on recent technological development at TNO and considering the situation in China, two technologies can be applied in an innovative and explorative way to solve certain practical problems in sustainable agricultural development. The two technologies are solid-state fermentations (SSF) and food fermentations (FF). Targeted solutions are (bio) pesticide production, nutrition for the population of the poor area, product preservation and wastes utilization (integrated to other applications).

2.1 About SSF

SSF is a fermentation process that is most probably originated from China. The definition of SSF is a microbial process without the presence of free water. Examples are the Koji process of soy sauce production, Chinese vinegar production, among many others.

There are a lot of advntages of SSF including:

Simple medium, normally unrefined agricultural products of by - products , and even agricultural

wastes;

Low water activity favours dominating microorganisms and prevents contamination;

Concentrated nature makes reactor more compact(less space needed);

Less waste water;

easier operation.

Of course there are also disadvantages of SSF including:

Limited species of microorganisms (mostly for filamentous fungi);

Engineering difficulties (heat removal);

Monitoring difficult;

Less scientific studies done yet;

Longer fermentation time.

2.2 About FF

Food fermentation is probably one of the oldest food technologies that originally was used for food preservation. Nowadays, this technique is not only for the preservation purpose, but also for obtaining many other functions in foods and food ingredients, such as flavour, structure, health promoting etc.

2.3 Innovative and explorative applications of the two technologies

2.3.1 Large scale production of safe and effective bio-pesticides by SSF on agricultural wastes It is a world wide trend to use bio-pesticides to replace chemical pesticides in agriculture for the sustainable development. Using chemical pesticides causes serious problems such as environmental pollution, residues in food and resistance to control agents. There is an urgent need for safe and effective control agents for integrated pest management. Biological control agents are promising alternative approaches being developed. Some fungal spores have been found active against certain plant pathogens. However, one of the bottle necks that hampers the wide application of biopesticide in agriculture system is the lack of knowledge and facilities for large scale production of fungal spores.

China has a long history of SSF process and SSF is still widely used in the food industry. Making more efforts in R&D in SSF engineering aspect (or together with foreign partners), such as monitoring and controlling, up-scaling and design, will enable to realize large scale implementation of microbial control system in the Chinese agriculture.

2.3.2 Improvement of nutrition profile of foods by FF (SSF integrated) There are always undesired components in agricultural products, such as anti-nutritional factors or toxins. Through FF process, preferably with an SSF process where water is not added, food grade microorganisms can degrade these undesired components and hence improve the nutritional value of the products. In addition, beneficial components can be produced during the fermentation process, such as vitamins and protein enrichment.

2.3.3 Development of novel protein foods by FF In the west, high consumption of animal protein causes problems in health and environment. Novel protein foods of plant and microbial origin are being developed. In China, people don't need to worry about this yet and the production of animal protein should be stimulated. However, at the stage of protein deficiency, other protein sources can be used for foods. Here again, FF is one of the promising alternatives and China has its long history and experience in using plant proteins.

2.3.4 Innovative food preservation based on FF Food grade microorganisms in traditional FF process can be screened to find natural preservatives to replace chemical or physical preservation methods. A screening procedure is here needed.

2.3.5 Utilization of agricultural wastes by SSF (clean energy production) Agricultural wastes such as straw and bran can be used as substrates to produce clean energy by microbial fermentation. Here again the question is the screening of suitable strains.

2.3.6 Animal health care by natural antibiotics in feed(fermentation) Antibiotics will be forbidden in EC countries. Therefore, if a natural feed fermentation process can produce natural antimicrobial components, antibiotics becomes unnecessary.