



Roadmap of Agricultural Production and Food Safety Science and Technology Development

As Food is related to human survival and health, the country's reputation and image, and the economic benefit and position in the international trade, it has become one of the hottest issues in the world now. As the continuous growth of world population, the constant changes of human life style and the continued deterioration of natural environment, higher requests for food safety are put forward by human society. Therefore, we should not only ensure the safety of quantity, but also to ensure the safety of quality in the food safety field by 2050. New concepts and technological means should be adopted to ensure the constant production and supply of the “green” and safe agricultural production to meet the people's great need for food safety, nutrition and health.

6.1 The Demand and Significance of Development

“The people take food as their prime want”, food is not only the most basic human survival needs, but also the eternal theme for the national stability and social development. The food industry in 21st century is facing tremendous changes, and shows two important trends: The first is to improve the food safety; the second is to enhance the food nutritional value.

6.1.1 Address the Basic Needs of Food Safety

Food safety is the basic needs for the development of human society. Broadly speaking, the food safety includes the quantity safety, quality safety and nutrition safety. With the life sciences and related disciplines on the enormous support of agricultural production, grain output in China has increased exponentially, and the problem about food and clothing has been basically solved. Therefore, from the social development and current situation, food security means more about the food quality safety.

1. Eliminate the hazards that influence the food safety

As we all know, with the continuous improvement of living standards, people's requirement on food has changed from the "quantity" to "quality". However, because of the restriction of the level of productivity, management capability and technology development as well as other factors, there are still many alarming issues in the food safety field. In the past 10 years, the incidence of foodborne diseases worldwide presented an ascending trend^[1-3], with about 4–6 billion cases each year. There are about 180 million people died from such diseases in the developing countries^[4,8]. Even in the developed countries, more than 10% of people were infected with foodborne diseases each year, which not only seriously harms people's health, but also causes enormous economic losses.

(1) Excessive use of pesticides and residues

The world's annual production of chemical pesticides was up to 200 tons, half of which was consumed in China. However, only about 35% of pesticides were absorbed and used; most of residue stay in the fields or flows into surface water and groundwater, causing environmental pollution. With agricultural products such as rice, vegetables, fruits and tea containing excessive levels of pesticide residues through using chemical pesticides, the food security problems are getting more and more serious and have become the focus that national and public pay close attention to these issues.

(2) Hormones and veterinary drug residue and pathogen pollution

With the development of industrial and intensive animal breeding, growth hormone, preservatives, appetite enhancer, clenbuterol, artificial colors and other feed additives and antibiotics, sedatives and other veterinary drugs have been used in animal production. The abuse of additives and drug has led disease resistance of pathogenic microorganisms and drug residues of animal to reach alarming proportions. At the same time, the early warning system for animal disease prevention and control is also facing the grim challenge of the intensive and large-scale farming model. The animal food pathogen contamination^[5-7, 10] (pathogens, viruses and parasites that people and animals suffered from altogether) caused by animal diseases not only threatens human life and health^[11-12] and brings the fatal blow to the livestock breeding, but also will affect social stability, and cause public panic. The outbreaks of bird flu^[9, 14] and *Streptococcus suis*^[15-18] in recent years are the typical instances.

(3) Heavy metal pollution and accumulation

Due to affection of sewage irrigation, industrial activities and organic agricultural fertilizer and other factors, the heavy metal pollution in the environment has imposed tremendous pressure on the safety of agricultural products. The main heavy metal pollution in our country's agricultural products include Hg, As, Pb, Cd, Cr, Cu, Cu, Zn, etc. Long-term consumption of Cd and other heavy metal has caused high incidence of cancer among farmers in Shangba Village, Guangdong Province; there are other cases as to vegetable with high level of Pb and Cd in some areas of south Jiangsu province. In addition, the chemical additives used in the process of livestock and aquaculture also

lead to heavy metals accumulated in animal liver, kidney or other organs. Thus, it is extremely urgent to control the heavy metals pollution in the agricultural production and processing.

(4) The dangers of biological toxins

Biological toxins refer to toxic substances produced by a variety of organisms (animals, plants, microorganisms). Biological toxins come in a wide variety and some of them such as the aflatoxin and *Aspergillus varicolor* toxins in maize and peanut have been proved to be the main inducers for the regional liver, stomach and esophagus; the tetrodotoxin, diarrhetic shellfish poisoning, paralytic shellfish poisoning and neurotoxic shellfish toxins in the aquatic products can have enormous influence on physiological functions of the human body. Mycotoxins are secondary metabolites produced by fungi and more than 200 kinds of them have been known at present. The intake of agricultural and livestock products contaminated by mycotoxin may make human or animals suffer from food poisoning. More seriously, many fungal toxins that have carcinogenic, teratogenic and mutagenic function will cause chronic damage to the human body. The treatment and pollution control of biological toxin poisoning is still a worldwide problem today.

2. Create the standard technology system of safe agriculture products

(1) Build the standard production model of planting

Agricultural standardization refers to the use of the standard principles of “unification, simplification, coordination and preference” depending on the advanced agricultural science and technology achievements and experience to make agricultural produce antenatal, medium and postpartum processed standardly, to ensure the quality and safety of agricultural products. In developed countries, the agricultural products basically have achieved the standardization, and have established a relatively complete support system of agricultural standardization. At present, the green food standardization is the most influential one. For the green food production, firstly, it emphasizes the best ecological environment; secondly, it emphasizes the full-process production management. It proves that the agricultural standardization is playing an increasingly important role in the quality and safety of agricultural production.

(2) Build the standard and safe (green) aquaculture production systems

In the process of animal production, we should create an excellent breeding environment, select and introduce the higher-yield varieties with strong resistance to diseases not carrying pathogens. Also it is necessary to take the precaution of animal disease, improve the prevention and control system, cut off the spread of disease, implement the usage standards of veterinary drugs and feed additives strictly, add the growth, immune modulators with no residual and non-toxic side effects and anti-stress additive to promote and control animal deceases as much as possible. The establishment of animal production of standardized green farming system is an effective way to guarantee the good quality and safety, no harmful residue and no pathogen pollution in animal food.

(3) The forecasting of pest and build of prevention and control system

The excessive use of chemical pesticides has led to increasingly shorter cycle of pests and increases of pest types leading to a vicious cycle of agricultural production. It has proved that using different types of natural enemies and biopesticides to create whole biocontrol system is the fundamental way to ensure the food safety and reduce use of chemical pesticides.

Pathogens resistance to drug and animal products with ultra-high dose of drug residues is another important factor to threaten animal product safety. The purification of pathogenic microorganisms in the environment and animals, improvement of the animal disease early warning and prevention and control system and the research and development of new green veterinary drugs can reduce animal disease and pathogens and drug residues in animal products and establish standard livestock production systems.

(4) The agricultural postpartum storage and processing system

The fruit and vegetable production were 71 million tons and 1.4 million tons, respectively in our country now, and their output will reach 240 million tons and 350 million tons, respectively, by 2050. On one hand, postpartum rot is very serious and have caused the post-harvest losses up to 30 billion yuan each year. On the other hand, because of their special nutrition and flavor, the processed foods with fruits and vegetables as the main raw materials are very popular. Therefore, based on the use of unique plant, fruit and vegetable as raw materials, it is important to develop the innovative processing technology to produce new functional and specialty foods for the future agriculture and industrial development.

(5) Agricultural products safety monitoring and evaluation system

Food safety inspection and testing is one of the most important means to monitor food safety. There is still a wide gap in the development of inspection technology in China compared with international level, so we now could not track and study the hot issues of international food quality and safety. The cases of “Sudan”, “Melamine” and “Clenbuterol” reflected the method and level of our country’s food safety inspection falls behind and the emergency testing capability is so weak that it is difficult to meet the requirements of new situation.

The long-term and short-term risk assessment on hazardous substances of various foods is a good countermeasure for early-warming. Countries in the world have increasingly established the food safety control technology system that is core with risk assessment and integrates assessment, detection, monitoring, early warning and control as a whole, while China has just started in this area. Therefore, it is of great significance to carry out the study of food safety risk assessment and create the technology system of food traceability and early warning.

3. The secure environmental quality is a necessary condition for food safety

At present, due to the effect of the high-intensity use of agricultural resources and the rapid development of industrialization and other factors, the

soil, water and air in China have been badly polluted, and the agro-ecological has been seriously threatened. The degradation of agricultural environment not only enhanced the investment in agriculture and reduce the output, but also increased the polluting extent on agricultural production. Pollutants can affect agricultural products safety, threaten human health and affect international agricultural trade in many ways, such as crop root and leaf absorption, aquatic animal consumption and food chain enlargement. With the further improvement of the agricultural products quality standard of international market, the agricultural products in our country will suffer from more “green barriers” blockade and face more severe challenges.

6.1.2 The Diversity of Needs for Research on Nutrition

As people are concerned more about health and the demand for food diversity and quality, the nutrition research and development has aroused greater attention as people’s living standards improved.

1. Value the nutrition quality is an objective requirement of the food

Nutrients are the material foundation for the survival and development of humanities. Food is the carrier of nutrients and nutritional function is the natural attributes and basic function of food. However, the nutritional quality of food could be reduced by the food processing and result in the loss of food nutrition. Therefore, as an important part of the food industry, there is a natural and necessary link between the agricultural production and processing and the nutritional quality. The nutrition science and philosophy have been generally applied in western developed countries to guide the development of agricultural production and processing industry, to optimize the industry structure, to apply the advanced technology purposefully, and better meet people’s nutritional health needs and market demands.

2. Improvement of living standards demands the improvement of the nutritional quality of food

After 30 years’ rapid economic development, society of China has achieved well-to-do level and the Per capita GDP has reached 1,000 U.S. dollars. International experience tells us that after the GDP per capita national income reached 800 U.S. dollars, the food consumption will enter the rational stage, the diet will change, and people will make better food quality requirements and want to consume foods with more nourishment and the role of disease prevention and health care. The ideas of eating nutritive and healthy food have been accepted by more and more people. It is predicted that the proportion of nutrition and health consumption in the whole food consumption will become heavier.

3. Pay attention to the food nutrition for people nutrition and health

According to the National Nutrition Survey reports published in 2002, the residents of our country was facing the dual challenges of nutritional deficiencies and structural imbalances, especially some micronutrients such

as calcium, iron, iodine and VA are seriously deficient. The calcium intake of the people in our country is less than 50% of the standard recommended amount. There are 5.8 billion people in marginal VA deficiency states; 200 million people suffer from iron deficiency anemia and 1.6 billion people lack of energy and protein intake. At the same time, the nutrition-related diseases caused by imbalance nutrition intake show a high incidence trend. There are 200 million people overweight, more than 6,000 people obese, 40 million people with blood sugar unusual, and the number of people suffer from hypertension or dyslipidemia is 1.6 million. If the sub-health population affected is taken into account, the number will increase by several times. The rate of overweight adults increased by 39% and obesity increased by 97% compared with the National Nutrition Survey data in 1992, which shows that the nutritional status of Chinese residents has not been improved synchronously along with the rapid development of economic, but presents the characteristics of both complex structure and total enlargement.

The severity of the nutritional status of our country is closely related to the unilateral development of the agricultural and food production. Over the years, much more attention has been paid to the quantity increase and technical improvement in the agricultural production and processing, but less emphasis on the nutrition quality of products and production of nutrition foods. So far, we have not integrated the modern nutritional science into the principles to guide the development of production and processing of agricultural products, and have not fully established and popularized the knowledge and philosophy of modern nutritional science.

The western countries had begun to implement the student nourishment and develop the nutrition programs since the 60's of 20th century, which not only significantly improved the nutrition and health of students and residents, but also effectively stimulated the agricultural structural adjustment and promoted the rapid development of the food industry. From the present Chinese agricultural products technical level, there is a high proportion of primary processing of raw materials while the deep processing level of raw materials and the technological content of manufactured goods are low. Therefore, to integrate the philosophy of nutritional science and the production of nutritional foods into the production and processing of agricultural products is not only the common experience of the developed counties of the world, but also the necessary choice to fit in with the people's nutritional health requirements.

6.1.3 The Development of the Individual Needs of Multi-functional Food

The green foods and functional foods will become an important part of modern life. With the social development, the living standards of people continuously improved, but some diet-related diseases, such as the iron deficiency anemia, hypertension, diabetes, high blood cholesterol, reduced immunity, coronary artery and senile dementia, have increased dramatically,

and have become a social problem that seriously influenced the health and well-being of people. According to a survey released by World Health Organization (WHO), the proportion of the sub-health has accounted for the 75% of the population of the world. The public concerned most is weight control; enhance immunity, anti-oxidants and nutritional supplements. In the United States, nearly 60% of people taking the nutritional supplements that contain a variety of vitamins and minerals.

Functional foods, with many characteristics, such as with no dose limit, it is safe to consume under normal conditions, with nutritional and healthy functions and have defined consumptive objects and so on, have been acknowledged as the 21st Century Foods. According to the special physical conditions of the consumer groups, the special functional foods could be developed by scientists. The significance is to emphasize the regulatory function of food on the disease prevention, rehabilitation and health improvement. At present, the foreign countries begin to focus on the research and development of functional foods. Its main functions are: regulation of physiological activity rhythm; regulation and enhancement of body's immune system; regulation of the state of mind, extending aging and maintaining the vitality of the human body, etc.

1. Nutrition balance food for different groups

(1) Target for children, the elderly and women

The irregular daily life and diet lead to a low-aging tendency of chronic diseases, more and more young people and children show high blood fat, overweight, high blood pressure, unbalanced nutrition, fatigue and other symptoms. For example, there are 7.2 million children in the United States, including 270 thousands of children under the age of 19 suffering from high blood fat, 2,000 thousands people under the age of 26 having high blood pressure, 60% of the children feeling tired because of lack of energy and 15% of school children falling asleep. The functional foods which are suitable for children, such as enhanced convenience breakfast foods and dairy products rich in active bacteria are very popular. The vitamin, DHA, EPA and β -carotene are also popular with teenagers and children alike.

As public's expectation for longevity increase, the functional foods have attracted the consumer's attention that can protect brain, help to lose weight, increase appetite, promote digestion, benefit the skin and black the hair, raise eyesight, strengthen immunity, prevent dementia and improve memory.

Women are the target objects of the functional food industries. There are many food items designed specifically for women in the market, even including the nutritional drink and bread containing isoflavones that developed specifically for postmenopausal women. Studies showed that the soy isoflavones could effectively control the menopausal syndrome, osteoporosis, breast cancer, and had the antioxidant and cholesterol lowering physical activity and the role in beauty.

(2) Target for the sub-health adult population

Sub-health and chronic diseases are common in the modern fast-paced life and their harm to human body is undoubtedly enormous. According to statistics, there are 600 million people between 20-45 years old suspected under sub-health condition in the United States. In China, the number of the people under sub-health condition is more than 700 million, accounting for the 60% to 70% of the total population. More and more adults buy nutrient supplements to improve the side effects by the nutritional imbalance and fatigue. In the United States, 29% and 36% of males and females, respectively, concern about mental health, and the brain energy products also appear on the market. Three-quarters of Americans need the food that can enhance the immune system. The products made from lutein, anthocyanins and carotenoids which can improve eyesight have appeared on the European and U. S. markets.

Obesity has become a serious public health problem in the world. There are nearly 105 million adults over 20 years old overweight and 425 million obese in the United States. Therefore, the functional foods including low-calorie diet food is extremely popular in the United States.

2. The personalized foods that target for people with different physiological and health status

(1) Take public health as the goal

With the popularity of the public knowledge of nutrition, “make the functional foods popular, make popular foods functional” will also be the development trend of functional foods. More and more consumers purchase functional foods for health purpose, and for health, the public concerned most including weight control, enhance immunity, anti-oxidation, nutrient balance, etc. Some active ingredient extracted from the natural plants and animals, such as the lycopene, lutein and other antioxidants, has been paid close attention and developed very fast.

(2) Improve body health and mental state as the goal

Among the functional foods that can provide energy, the sports nutritional foods and drinks are the most popular. For example, the functional tea is available anywhere in the market at present. Some functional foods targeted to increase “brain power”, anti-allergic, anti-stress, improve eyesight also appeared on the market. There are still many other functional materials which are very popular among the consumers, such as allicin, peptides, soy isoflavones, chitosan, ω -3-polyunsaturated fatty acids and whey protein and so on.

(3) Reduce the chronic disease risk as the goal

Use functional foods as the auxiliary medical treatment to reduce the symptoms and risk of the disease will become a main channel for the development of functional foods. There are 970 million people worldwide suffering from high blood lipids and 14.3 billion people overweight. About half of Americans believe that the risk of disease could be reduced by using some food instead of drugs. In addition to using the functional food to reduce risk of cardiovascular disease, cancer, obesity and diabetes, consumers also

purchase some functional foods with anti-allergic effect and other healthy food to alleviate osteoporosis, promote gastrointestinal health, prevent dental caries and improve joint pain. For example, the probiotics can improve the function of gastrointestinal tract and reduce the risk of stomach disease.

6.2 Status and Trend of Technology Development

The implementation of sustainable agricultural development strategies and the development of “Green Agriculture” will be the developmental direction of the agricultural economic for every country in the world. Currently, the world economic development and consumer market is undergoing profound changes; the natural and pollution-free products have become a kind of new consumption fashion. The future agricultural production must be in clean soil and produced with clean manner to produce safe food (green food) to meet the global food consumption in the quantity and quality needs. China’s Ministry of Agriculture officially launched the Pollution-free Food Action Plan in 2001. This plan focused on the control of pollution at resource, vigorously promote standardization of agricultural production, and comprehensively improve the quality and safety of agricultural products. The research and demonstration of the green and safety production techniques have been greatly improved. From the controlling technique of the quality of producing area conditions, the green controlling technique of production process, the high efficient utilization technique of recycling resources, quality evaluation technology to the establishment of the standardization of quality control and production techniques of agricultural products have been greatly developed and demonstrated. “The People’s Republic of China Agricultural Product Quality Safety” has been come into force on November 1, 2006, and the safe production of agricultural products will be standardized from the legal point of view.

6.2.1 The Development and Trend of Safe Food

As foodstuff has the function of food and health care, the safety issues are causing more and more attention. As early as 1970’s and 1980’s, developed countries and relevant international organizations have developed the residue standards of food pesticides, heavy metals, nitrates, veterinary drugs and antibiotics. At present, the main trends of the international development of safe food are expressed as the following aspects: attention to the cultivation and development of green food, including organic food, natural food, green agricultural products; focus on the research and develop the alternative chemicals, bio-fertilizer and pesticide; make environment and health as the preferential domain to develop, emphasize to reduce pesticide and fertilizer input, and improve the chemical substances control system to reduce the risk of chemical substances.

1. Plant pests control technology

In recent years, the EPA has withdrawn the registration of 59 chemical pesticides; EU has set the strategic plan to reduce chemical pesticide use; China also has banned 40 kinds of chemical pesticides used in vegetables and listed “green food and bio-pesticides” as one of the priority development projects into “21st century agenda of Chinese”. The research and development of biological control is not only an important part of the modern agriculture, but also the focus of hi-tech competition of international agriculture. Research and development of new pesticides (bio-pesticides or green chemical pesticides) has become the mainstream of the development of modern agriculture. The research of new pesticide is focusing on the synthesis and use of insect pheromones, microbial biological control agents, biological antagonistic bacteria, plant stress inducer, fungicides, insecticides and herbicides, insect virus pesticides, fungi pesticides, and botanical pesticides based on the research of microbial protein.

The main products include microbial pesticides (such as pesticides, insect viruses), anti-inducer (Messenger, abscisic acid, oligosaccharides), biochemical agents (such as the sterilant rodents, insects pheromones, etc.), biological control predators (such as *Trichogramma*), and botanical pesticides (such as matrine, Pyrethrins, etc.). Since 1990s, the global production of biological pesticides is annual increase with the speed of 10-20%. There are about 30 kinds of bio-pesticides in the international market. Including more than 10 biotechnology products, the production value exceeded one billion U.S. dollars.

While China has taken various measures to carry out the prediction, prevention and control of agricultural pests and diseases and study the establishment of GIS-based decision support system for the crop pest management and the prediction model of agricultural pests and diseases based on the artificial neural network, there is still a big gap between China and the advanced countries on the full application of biological control technology to control pests and diseases. We still cannot be like the Nordic and North American to provide the producers with biocontrol technology package, like various natural enemies and more varieties of bio-pesticides, to control pests in some complicated farm land and green house environment.

2. The development of plant resistance inducing factor

The inducible resistance system existing in the plants is similar to that of animals. Many functional materials that can induce plant resistance have been discovered by domestic and foreign scientists and applied to prevent and control plant diseases. During the long-term process of evolution, plants have developed some capabilities and characteristics, including the plants' own immune system and the resistance capabilities that induced by the external factors or elicitors, which can protect themselves from the invasion of pathogens. When stimulated by the inducing factors of external environment, plants can resist to the disease. The factors that can induce or stimulate plant resistance include the virus capsid protein, antagonistic bacteria, germ weak lines, ABA (S-induced

resistance factor), oligosaccharide, and elicitor protein. When these inducing factors or elicitors contact with plants and act on plant tissues, ethylene, salicylic acid, jasmonic acid phytoalexin and pathogenesis-related protein can be produced through the signal transduction. These materials can improve and enhance the ability of plant resistance to pathogen invasion, prevent the occurrence of disease or reduce the disease extent by means of the regulation of plant metabolism and activation of plant immune system and growing system to, so as to reduce the use of pesticides radically, and alleviate the environment and agricultural products pollution caused by pesticides at the source.

3. Animal health breeding

In order to meet the requirements of technical safety, high quality and effective production of animal products, the metabolism and regulation of animal nutrition, animal environmental control and feeding techniques, the research on animal waste harmless and value-added processing, the disease control in the livestock and poultry breeding process and the establishment of standard of health culture has been the core content of the international animal research since the 90' of 20th century. At present, the research on the key technology of health culture and the standard-setting has become the most direct and effective means to implement green technical barriers of animal culture in countries around the world. The over control of “from farm to fork” is the necessary means to protect the safety of animal food, and for this reason the HACCP, GAP and other management systems have been developed. Based on the highly consideration of animal products and feed safety, WTO member states in accordance with the WTO-TBT/SPS (Technical Barriers to Trade / Animal and Plant Quarantine) agreement have developed the laws, regulations and standards for animal products trade. How to maintain the animal product safety, high quality and efficient production and realize the livestock breeding health development has more than their own sustainable development issues, also related to international relations in trade, politics and even national security issues. Under this background, countries around the world competing to carry out the research on animal welfare, animal food safety, high quality and efficient production, to get more favorable position in future international market contests.

4. The safe aquiculture breeding technology

At the beginning of the new century, some aquaculture developed countries have regarded the sustainable development of aquaculture, especially in food security and ecological security as part of national development strategies to re-validation, and worked out the aquaculture development and technology planning. For instance, Japan in March 2002 developed a comprehensive policy plan based on the guiding philosophy of from the “Basic Plan for Fisheries” to “ensure stability of supply of fish” and “the sound development of aquaculture”. National Oceanic and Atmospheric Administration Fisheries Board developed aquaculture technology strategy, the

EU released a new common green paper on aquaculture policy, aims to establish a responsible and sustainable aquaculture.

Aquaculture in our country speedily developed, benefiting from the development of fishery science and technology and the big breakthrough in technology. For example, the artificial reproduction technology of “four everybody fish”, artificial breeding techniques of seaweed, laver, scallop and industrialization of prawn, abalone hybrid technology, the theory and technique system of comprehensive high-yield fish culture in large ponds, large water surface “triple nets” (cage, pen, mesh) for proliferation of fish and integrated support fish culture technology for resources enhancement and fertilizer, prevention and control technology for outbreak of epidemic, modern industrial fishing technology, which provided technical support for the rapid development of aquaculture in China.

5. Pay attention to development of recycling economy

Since the strategies for sustainable development has been put forward in 90's, developed countries have been regarding the development of recycling economy and establishment of recycling society as an important strategy and way to implement the sustainable development strategy. In 1996, a new environmental law-“Circular Economy Law” came into effect in Germany. The core idea of this law is based on reduce, reuse and recycle 3R principle to keep more materials in the production circle. From the viewpoint of domestic or oversea research status, the research on the fluxes process and environmental effects of water, fertilizer and drug in the farmland ecosystem of domestic is still weak, the quantitative research is not enough; the regional spatial nitrate leaching index assessment has not carried out; the development and application in agricultural producing safety warning system also weak. The research on safety production of agricultural products is more from a technical perspective, and is inadequate to carry out system optimization management model from the overall health of the system functionalities. The application of efficient and precise technology in the safe agricultural production is not enough.

6.2.2 The Development and Trend of Nutritional Foods

Nutritional foods were developed under the guidance of nutrition science, which is different from the conventional food and with distinctive nutritional characteristics. Nutritional food includes nutrient-rich food and nutritionally balanced food.

The present research and application on the nutritional foods mainly focus on increasing the content of essential amino acids (lysine, tryptophan), vitamins (A, E), trace elements (iron, calcium, zinc, selenium, etc.), antioxidants (polyphenols, flavonoids, carotenoids, anthocyanidin), unsaturated fatty acids (ω -3) and so on. Foods rich in certain nutrients (such as, fiber, protein and selenium, etc.) were produced by means of agricultural production technology (such as, plants and animals “biological enhancement” breeding, fertilization, irrigation and feeding technology). Among these nutritious foods, some of

them are rich in certain nutrients, such as soy protein, milk calcium and oat dietary fiber, high lysine corn, high VA sweet potato and soybean, and milk rich in selenium and so on. The production of nutritional food can upgrade the agricultural products and meet people's need for nutritional food.

6.2.3 The Development and Trend of Multi-functional Food

As the development of genomics and proteomics, some ingredients with health-care function in plants and some functional peptides in animal and human body have been gradually clarified. For instance, the ferritins distributed in rice and soy which can prevent and treat with iron deficiency anemia; soybean glycinin has lower blood pressure and lipid functions; ω -3 series of α -linolenic acid contained in sesame and perilla have functions to fall blood pressure and blood lipid, improve blood vessel elasticity, and prevent the occurrence of coronary heart disease; the vitamin E contained in sesame and sunflower can prevent coronary heart disease, atherosclerosis, cerebral softening, cancer; resveratrol contained in rape and grape can fall blood lipid and prevent thrombosis. At the same time, some proteins or peptides in animal and human body with promotional health-care function have also been found. For instance, the short peptide found in yolk can low blood pressure, the GLP-1 distributed in human body can stimulate insulin secretion and prevent and treat diabetes.

Although the agricultural products contain health-care functional ingredients, the content of these ingredients is often too low to work effectively. Using modern biotechnology to develop new varieties of plant and animal with nutrition function, and bioreactor technology to produce health functional products have become the inevitable way for the development of multi-functional foods. For example, the "Golden Rice" rich in vitamin AD, maize with high-lysine corn, and rice with high-tryptophan, iron-rich, and pig with high ω -3 polyunsaturated fatty acid content. Meanwhile, rice variety with the function of prevention and treatment of hypertension, diabetes and allergies has also been developed.

Functional foods present a new trend in the development of modern food and it is one of the important areas for the agricultural development in the 21st century. In the next 10 years, the development of functional food industry will by the yearly all exceed 10% rate. At present, the production and consumption of functional food in our country is still relatively low, and the majority of functional foods in the market are developed based on the traditional Chinese tonic, diet, or the experience and formulations of traditional medicine. Most of them are still natural primary products, and the boundaries between some of these products and traditional medicine are not very clear. The majority of health food products on the market now only have a single or mainly in one aspect of health effect, such as regulation of immune system, anti-aging, diet, losing weight and inhibition of tumor and so on. However, the effect of these functional foods is always slowly and not very obvious and the "multi-functional health foods" with two or more health effects are very rare. In

order to make the research and development of our country's functional food serialization, rationalization and stabilization, firstly, we should fully explore the new functional ingredients in plants, and discuss their enrichment theory and regulation mechanisms to develop products with different functions according to the status and characteristics of functional food development in our country; secondly, we should strengthen interdisciplinary research and establish a series of functional evaluation system to evaluate the existing functional food and develop new products and new types of functional foods. We should strengthen the research of new functional food, develop appropriate regulations or management, and establish strict functional evaluation and examination system and approval system based on the international research results.

6.2.4 The Development and Trend of Food Safety Technology System

1. The technology of the quality of agricultural products and the control of safe process

The international experience shows that the realization of the whole process of management “from farm to fork” and the establishment of monitoring system from the source to final consumption are very important for food safety. The application of some advanced food safety control technology in food, such as “good agricultural practice (GAP)”, “Good Manufacturing Practice (GMP)”, “good hygiene practices (GHP)” and “harm analysis critical control point (HACCP)” are very effective to improve the quality of food business and the safety and quality of products. Strengthen the analysis of key factors that affect the agricultural quality during the production process, and enhance the research of pollution ways of toxic and hazardous substances in agricultural products will provide technical support for the base of pollution-free agricultural products, green food product and organic food. For the implementation of source control, some pollution ways and laws data are not sufficient and the basic research is still needed.

2. The key on-site detection technology

The rapid detection and monitoring control techniques for the residues of pesticides, veterinary drugs, food and feed additives and persistent toxic pollutants, environmental hormones and biological toxins can not meet the needs of food safety control, still needed to be improved. At present, we still lack the on-site detection technology which is urgently needed for market oversight and suitable for our production characteristics (sensitivity, fast).

3. Risk assessment technology

Risk assessment is the necessary technical means and important standards, which was emphasized by the WTO and the Codex Alimentarius Commission (CAS) used to establish and evaluate the effectiveness food safety measures. One of the reasons for our country's food safety technical measurements inconsistent

with international standards lies in the wide application of risk assessment techniques, in particularly lack of the exposure assessment and quantitative risk assessment for the chemical and biotic harm. February 28, 2009, the Chapter II of The People's Republic of China food safety law precisely prescribed the content of "food safety risk monitoring and assessment". We must establish a set of new methods to assess and reduce outbreak of foodborne diseases, while strengthening the evaluation of the food-related chemical, microbiological and related risk factors, we need gradually to establish the scientific and predictable safety evaluation system that suitable for our country and continually improve it in practice.

6.2.5 The Development and Trend in Environmental Quality and Safety

United States, Britain and Germany and other developed countries carried out the research earlier on the field of environmental quality and were in the lead of the world in the process of environmental pollution, risk assessment and environmental contamination and remediation. Those countries are strict with the ecological environment quality in agricultural production, and implementing environmental quality standards of production area rigidly. But for China, there are more people and less land; its economy is still growing rapidly and the establishment and implementation of some standards and polices still needed to be further standardized and improved.

Attention on China's ecological environmental problems has been drawn since 1970s. Domestic academia carried out the research on environmental background values and the investigation of environmental capacity, environmental risk assessment of polluted soil and water quality, environmental restoration, water quality and soil environmental quality standards and so on. In terms of soil environmental background and environmental capacity, 42 types of soil and more than 60 parameters of the basic data are included in the analysis of the environmental effects and maximum load capacity of many heavy metals and pesticides for different types of soil, a variety of plant and microorganism; carried out the basic theory and applied research on contaminated soil remediation.

The research on the regional environmental quality of contaminated soil has achieved initial success, especially in some highly polluted areas, such as sewage irrigation and areas around mining and metal company. Based on the soil environmental quality standards and risk assessment, the contaminated soil evaluation method has been set up and the classification of soil pollution has been conducted.

The research on the polluted soil control has been developed for more than 30 years. The method initially used mainly on chemical control, such as using montmorillonite and other natural or synthetic mineral, industrial slag and organic fertilizer, can significantly reduce the pollutants moving from the soil to the aerial parts of crops. However, these methods only can minimize

the bioavailability of pollutants in soil, pollutants still exist in the soil and they can re-release when the environment changes. Therefore, the bioremediation technology has been valued and promoted since the late 90's last century. Many progresses have been made in hyperaccumulator screening, absorption mechanism and crop post-disposal, and the use of plant and microbial remediation technology to treat organic pollutants in contaminated soil also yielded some results.

Air pollution research in our country also has made remarkable progress. The analysis of air pollution sources, the mechanism between pollutants and surface of atmospheric particles, the atmospheric circulation of pollutants and pollution control have been carried out. The study shows that there are many atmospheric pollutants, which have exerted remarkable influence on agricultural production and environmental safety. Although DDT and BHC have been banned in China for more than 20 years, these pollutants still can be found in the atmosphere of Yangtze River Delta region.

Water pollution is seriously harmful to the safe production of agricultural products, it is necessary to control the content of pollutants in water strictly, and establish scientific and reasonable environmental standards for water quality. China has established more than 300 sewage treatment plants, 70% of urban sewage is treated.

6.3 Technology Development Goal

6.3.1 The Overall Goal

Strengthen the researches on agricultural production safety, prevention and control of major pests and diseases; maintain the nutrition of agricultural products, clean control, storage and processing and so on, the key technological breakthroughs and integrated technologies integrative innovation, the establishment of the prevention and control warning system of agricultural pests and diseases, intelligent expert management system, and form the food safety digital tracing system from farm to fork, implementation of accurate monitoring and prevention and control of "active security strategy". On this basis ① to establish a standardized system of safe production of agricultural products and green environment, to ensure the quality and safety of agricultural products in the cultivation, breeding, storage and processing; ② Comprehensive analysis of the theory of agricultural nutrients, using a fast intelligent design platform to achieve precise design and quality regulation of food; ③ create "intelligent personalized nutritional food" to meet the personalized nutritional needs according to the physiological characteristics and health status of different groups, provide the functional foods for the purpose of effectively prevent and reduce the occurrence of disease and enhance the physical quality and fitness of the whole population.

6.3.2 Phase Goals and Priority Areas

1. The development goals and priority areas by 2020

Strengthen the basic research on the related scientific issues according to the key factors that affect the quality and safety of agricultural products; with the application of breakthroughs in key technologies and the integrated application of comprehensive technologies to eliminate the risk factors that affect the agricultural products safety, establish the standardized technical system of agricultural safety, storage and processing, construct the ecological environment of green food production and provide green, safe and high quality food.

(1) The key area of the research and development

Study the mechanism of agricultural diseases and interaction between the pathogenic germ and the host; integrate the comprehensive and efficient disease control technology; study the mechanism of livestock and aquatic diseases and animal's immune defense, integrate the safe and effective disease control technology, warning and monitoring, quarantine and diagnosis and immunization techniques; study the cycling metabolic mechanism of agricultural nutrient postpartum, the mechanisms of disease occurrence and quality control, integrate a series of new storage and refreshing techniques and process and quality control techniques; study the generation and regulation mechanism of pathogenic toxins and antibiotics, form the rapid detection methods and effective control technology; study the circulating transformation mechanism of harmful substances from agricultural production area, develop the biodegradable technology of soil harmful substances, the remediation technology of contaminated soil, and the monitoring and evaluation methods of environmental quality.

(2) The key area of new product development

New environment-friendly bio-pesticides and highly effective biological agents for the control of agricultural diseases; the specific vaccine for the prevention of aquatic and animal diseases; the new green preservatives for fruit and vegetable; the additives of processed food and feed.

(3) The establishment of standard system of key area

The agricultural pest and disease early warning monitoring network and disease prevention and control system; the agricultural technology system of production safety standards; the control technology system of agricultural products storage and procession, create efficient, clean and safe management system, improve the related standards of safe production of agricultural products; the environmental background information system of agricultural, and rational environmental quality standards and risk assessment methods; establish the purification technology system of major disease areas for the main producing areas of animal food, and a platform of separation, screening and research for new green veterinary drugs and feed additives; build the techniques that with fingerprint structure information for the origin and identification

of adulterated agricultural product quality; For the agricultural production process, carry out the systematic study on rapid portable monitoring technology for the risk factors of key step; establish the risk assessment model of risk factors, diet and food safety.

2. The developmental goals and priority areas by 2030

Reveal the regulatory mechanism of factors that affect agricultural products safety, promote the standardization and safe production mode of agricultural products, and realize the precise control of storage, logistics and processing quality of agricultural products; clarify the principles of restoration of contaminated environment, establish the management system of intelligent environmental monitoring and remediation of contaminated soil, create a sustainable ecological environment; study the theory of agricultural nutrients, use the accurate and rapid intelligent design platform to develop processed foods with various nutrition and provide a variety of nutrients that human health needed.

(1) The key area of information technology system

Reveal the metabolism and regulatory mechanism of nutrients of agricultural products, analyze the theoretical basis of the agricultural products, establish the precise and rapid design platform and production technology system; reveal the cycle and transformation mechanism of the environmental harmful substances of producing area, establish the technology system for the continuous, remote monitoring of environmental quality and remediation of contaminated soil, fully implement the comprehensive remediation of contaminated soil and construct the ecological environment for sustainable development; reveal the metabolic mechanism of biological toxins and the antagonistic mechanism between the insect pests and their natural enemies, improve the dynamic model of agricultural pests and diseases of early warning, establish the entire process of digital file management procedures for the agricultural production and agricultural safety, the tracking system can be traced back (TRACEFISH) and risk assessment systems, as well as the digital monitoring and early warning systems of the foods from farm to fork; clarify the antagonistic mechanism and co-evolution law of the pests and their natural enemies, establish the industrialized breeding technology system of the natural enemies; improve the early warning and prevention system of animal disease; improve the standards of application of veterinary medicine, feed and feed additives, and the monitoring system of animal food safety; establish the agricultural products on-line in situ detection technology, improve the monitoring of the key factor of production processes; establish the rapid or non-destructive testing technology of quality of agricultural products and nutrition index, according to agricultural products their own electrical and optical properties and composition changes; establish the expression database of the risk of human health, which is caused by the law of metabolism of agricultural risk factors, with the application of modern molecular biology and information science and technology.

(2) The key research and development area of diversity of nutritional food
Using high-tech bio-technology and new process technology to develop various food nutrition fortifier and multi-functional processed foods, such as rich in amino acids, protein, vitamins, mineral nutrients, trace elements (iron, calcium, zinc, selenium, etc.) and antioxidants (poly)phenols, flavonoids, carotenoids, flower pigments), to improve the diet constitution and meet the requirements of different groups for various health nutrients.

3. The developmental goals and preferential areas by 2050

Clarify the metabolic and synthetic way of various nutritional components, develop a harmonious agricultural environment which can satisfy multi-needs, lay the theoretical foundation of quality regulation of processed foods, set up the design standards of personalized nutritional foods, create “intelligent personalized nutritional food” based on the physiological and health characteristic of different groups, meet the individual nutritional needs, improve the physique and health level of all the people and provide individualized functional foods to effectively prevent and reduce the diseases.

(1) Establishment of key areas of intelligent technology system

Achieve the standardization system of techniques of accurate agricultural products cultivation, and the intelligent management system of matching technology for the treatment of commercialization, establish a complete digital food safety standard, testing and network monitoring system, and comprehensively enhance the quality of agricultural products and the market value of goods; expand the monitoring area and density of agricultural environment, comprehensively restore the contaminated production environment, and restore the quality and function of the contaminated environment; establish the intelligent network control system to monitor and prevent the pests and disease of agricultural products, develop new animal and plant specific resistance inducer, green biological agents and establish the standardized system of industrial production techniques to create accurate and efficient techniques target to the natural enemies and pesticide, and the intelligent system of pest early warning, prevention and control technology; establish the standardized green cultivation technology system of animal production, and the quality control and monitoring system throughout the animal production. Develop the human health monitoring and rapid diagnostic technology, intelligent assessment and design the formula of nutritional requirements; establish the high-throughput, highly sensitive detective technology of functional nutrition according to the properties of agricultural products and conditions of production areas.

(2) Key areas of development of personalized multi-functional food

Use accurate, fast and intelligent design platform, according to the physiological characteristics of different groups (such as the elderly, infants, students, and women), to intelligently design the personalized functional foods, develop “intelligent personality nutritious food”; according to the different human health status (such as hypertension, hyperlipidemia, diabetes, reduced

immunity, atherosclerosis, hyperthyroidism and senile dementia, etc.) to develop “personalized functional food” and the related processing technology, quality intelligent monitoring system and intelligent production management system, meet the individual nutritional needs, provide various and personalized functional foods for the effective prevention and reduction of disease and improvement of the health of all citizens. Establish the functional assessment and safety evaluation system of functional food through the research on its metabolism and mechanism of function and process monitoring.

6.4 Technology Development Roadmap

6.4.1 Science Mission

In view of poignant problems in the food safety of our country, aiming at the research focus and development trend in this field, combined with our country’s science and technology base, the scientific missions of future food safety technology include: the metabolism and regulation mechanism of agricultural nutrient; the interaction mechanism between the defense and pathogens of animal and plant and their host; the metabolism and regulation mechanism of biological toxin; the antagonistic mechanism and co-evolution law of pests and natural enemies; the cycling and metabolic mechanism of agricultural products nutrient; the cycle and transformation mechanism of the harmful substances in the production areas.

At the same time, the development of the following nine core technology and system need to be supported: the technical system of standardized safety production of agricultural products; animal and plant stress resistance inducers, the new vaccine and drug development technology; the scale rearing technology of natural enemies of plant pests; the research and development technology of biological agents and bio-pesticide, the control and risk assessment techniques of contaminated environment; the development technology of multi-nutrient food; the intelligent design technology of personalized functional foods.

6.4.2 The Design Thought of Roadmap

Around the science mission mentioned above, fully absorb and use the computer network technology, 3S technology, computer visualization, geographic information system, high-quality satellite images, BP neural network, intelligent expert systems, high-precision technology management, establish the early warning and monitoring system, and intelligent expert management system of animal pests and diseases, and set up the prevention-based comprehensive prevention and control of food safety technology and management system; establish the food safety digital tracking and warning systems from farm to fork, carry out the “active food security strategy” with accurate monitoring, pre-emptive “disease” and precise prevention and control.

Based on the comprehensive analysis of all elements of animal and plant security products, with the use of the precision and rapid high-throughput based detection and intelligent design platform, develop “intelligent personalized nutritional food”, to satisfy all the people’s permanent need for food security and nutrition.

6.4.3 The Overall Roadmap

The roadmap and sequence graph were drawn (Fig. 6.1, Fig. 6.2) by the integration of various elements, such as needs, tasks, core technologies and platforms, with three development steps:

Before 2020, focus on the clarification of the metabolism and regulation mechanism of agricultural nutrient and bio-toxins; accelerate the establishment of accurate and rapid high-throughput detection platform, develop the pest control technology and security storage and processing technology; establish and optimize the standardized technology system of safe production; eliminate the hazards that affect food safety, form the ecological environment of agricultural products. Set up the tracking system (TRACEFSH) that could be traced back and risk assessment systems, as well as the food safety digital tracing detecting and early warning systems of food safety from farm to fork.

Before 2030, the research of key fields focuses on the diversity demand of nutritious food. The establishment of the early warning dynamics model and monitoring network system of animal and pests diseases, intelligent expert systems and the theoretical system of the animal and plant system acquired immune mechanism, start the 3S-based security monitoring and early warning and intelligence experts and production management platform. Develop the animal and plant stress resistance inducers vaccines; develop the target release technology of chemical pesticide of precise and efficient predators, biological pesticides, and low toxicity through the study of natural enemies breeding technology, high specificity and low toxicity bio-pesticides, bio-antagonist and chemical pesticides with high efficiency and low toxicity. At the same time, develop the multi-functional animal and plant food and nutritious food. Based on the basic research on the immune function in breeding animals, the regulation in the response process, the molecular mechanism of targeted drugs, and the basic research on the engineered vaccine, animal waste heavy metals and the ecological toxicology of pathogenic variability to develop the new technologies and promote the generation of new technology growth.

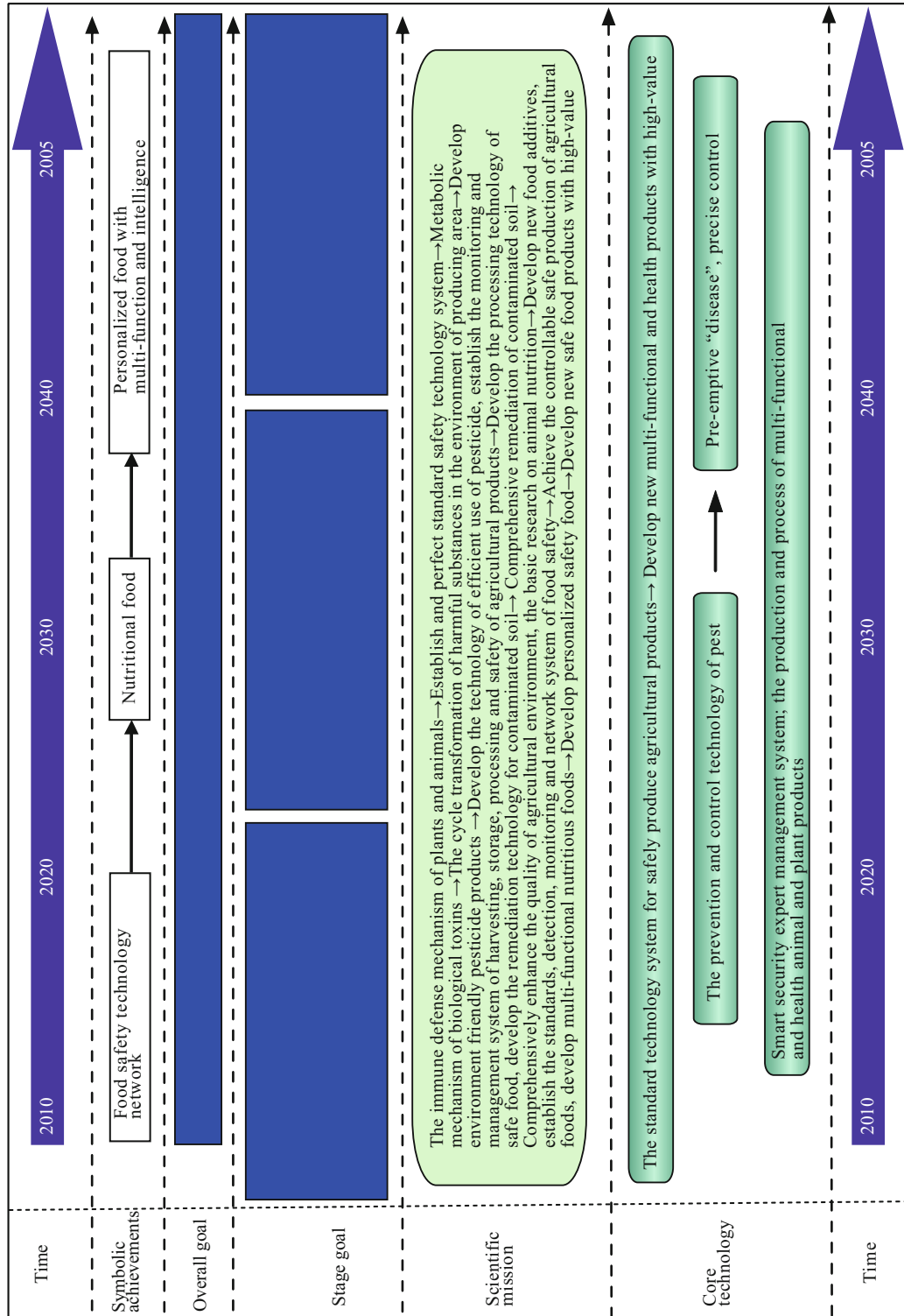


Fig. 6.1 Roadmap of agricultural production and food security

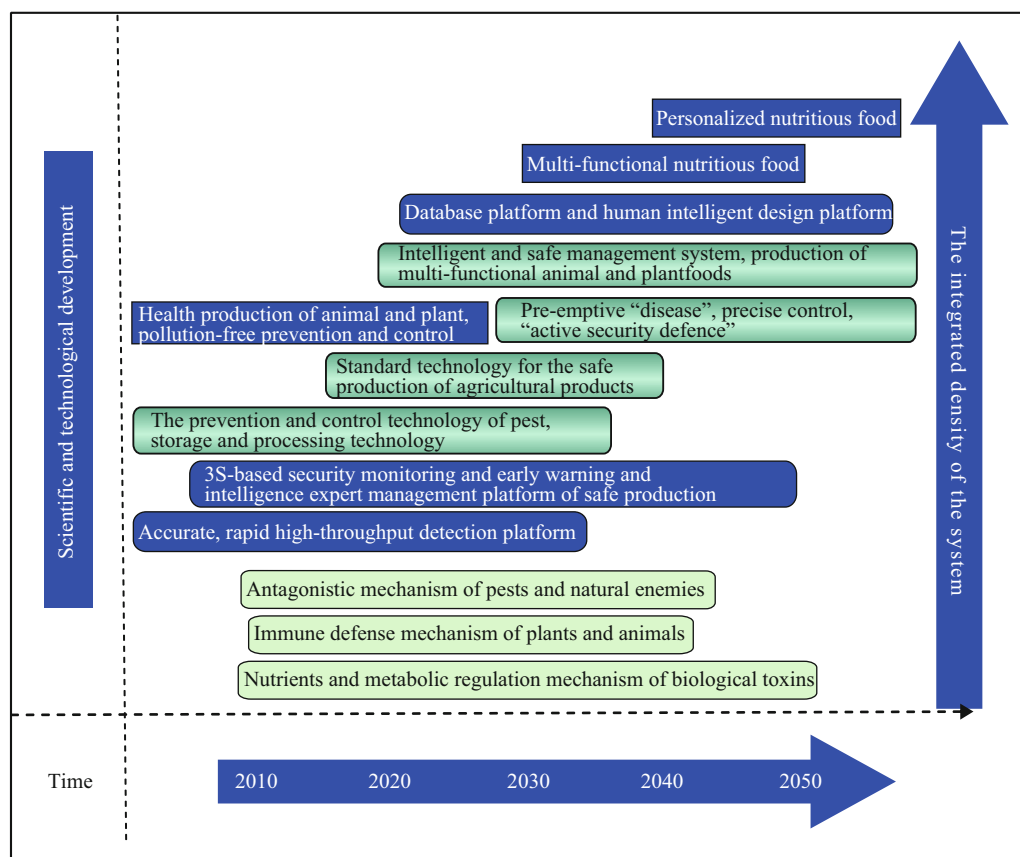


Fig. 6.2 Timing diagram of agricultural production and food security

Before 2050, the key field is to meet the individual needs of multi-functional food. To make major progress in some important scientific issues, such as the interaction mechanism between the animal and plant immune defense, pathogens and the host, the antagonistic mechanism and the co-evolution law of pests and natural enemies. Realize the strategic shift in the field of food safety from the “passive control” to “active safety defense”. Strengthen the dynamic early warning model and the monitoring network systems of animal and plant pests, conduct the monitoring, early warning, diagnosis and prevention and management of the trends and outbreaks of pest and disease. Through the intelligent data platform and human intelligent design to develop the “personality nutritious food”, and establish the “active security defense” system of animal and plant pests and diseases, through the development of natural enemies, resistance, biological control agents and high-precision insect sex pheromone agent to achieve the goals of pre-emptive “disease” and precise control.

6.4.4 The Key Technical Programs to Realize the Roadmap

1. The common technologies of food safety programs

Establish the early warning monitoring and intelligent expert manage-

ment system of pests based on the 3S technology, develop the new technologies of prevention and control of pests, develop the environment-friendly production technologies of biological agents; establish the new technology for the “pre-emptive diseases, precise treatment” of pests, ① adopt the early warning dynamic model and monitoring network system to monitor, early warn, diagnosis and prevent the epidemics and outbreaks of pests and diseases; ② improve their own ability of animal and plant to withstand adversity and immunity, universal application of animal and plant stress resistance inducer and animal and plant vaccines; adopt the integrated pest control techniques, such as the precise release of natural enemies, veterinary drugs, biological pesticides, sex pheromone and low-toxicity chemical pesticides, to achieve comprehensive and lasting security of plant and animal production.

Develop the new storage and preservation technology of animal and plant products, the precise and rapid high-throughput testing technology of quality and safety, the bioremediation technology of environment, the technology with safety and high quality factors optimally allocated, set up the intelligent technology systems of the production of animals and plants products, and the products treatment technology system.

Strengthen the new technologies to design and develop intelligent personalized nutritious food, produce new types of multi-functional and personalized nutritious food, improve the people’s diet structure and health level.

Create the control technology for the major pest and disease and environmental safety, the metabolism regulation of animal and plant nutrition, and the innovative research platform of database and human intelligent design. Upgrade the traditional cultivation and breeding techniques comprehensively, form the innovative research and industry groups with obvious advantages and outstanding features in the field of animal and plant production technology. Lead the transformation and upgrading of technology systems of animal and plant products in our country, provide the proactive technical support for the establishment of efficient, safe and modern system of animal and plant products. Comprehensively enhance the overall quality and developmental capacity of the technology of animal and plant products in our country, make the scientific research and production technology of our country in this filed reach the world advanced level.

2. The safety program of plant production technology

Establish early warning dynamic database of plant pests, develop intelligent expert pest management system. Develop plant stress inducers, plant-based vaccines and other biological control agents. Develop the advanced synthetic technology of high-precision pest sex pheromone; develop the efficient and controllable biological control technology; develop the application technology and its integrated supported system for prevention and control technology with high specificity and low toxicity biological pesticides, chemical pesticides, biological antagonist and accurate target technology. Make sure the residues of toxic substances, drug and heavy metals in the plant products

to be minimized. Develop the safe food additives and preservatives; establish a complete food processing safety standard, testing and monitoring network system.

3. The safety program of livestock production technology

With the application of nutrition, cytology, histology, molecular biology, botany, ecology and even the advanced technology of information science, the advanced technologies of immunology, genomics, genetic engineering, virology, microbiology and bioinformatics will be applied in the technology area of major animal disease prevention and control. The advanced technologies of microbiology, environmental chemistry, ecotoxicology, protein engineering, enzyme engineering, fermentation engineering and systems engineering will be applied in area of environmental safety technology, through the interdisciplinary and technology combination to establish the safety innovation technology platforms (such as the National Key Laboratory) of modern livestock production and animal products, Achieving great discoveries in the basic theory of security studies on the modern livestock production and animal products, has significant breakthroughs in research methods and major innovations in technical aspects of regulation. Adopt the explore means of new genetic resources to develop the core technologies of planting grass and natural pasture, break through the bottleneck that hinder the development of animal husbandry in northern China, rapidly enhance our country's innovative research capability of grass.

4. The safe technology program of aquaculture production

With the use of biotechnology and information technology to conduct long-term, continuous dynamic monitoring, repair and evaluation in the operations of precise fishing, aquaculture resources, ecological systems and environment. Explore and utilize resistance of living aquatic resources to achieve accurate high resistance breeding; develop the processing and feeding technology of pollution-free and efficient feed, research and develop the automatic feed metering technology and technology of feeding on specific time. Establish the technology of rapid detection of pathogens and the diagnosis and early warning and forecast technology of disease of aquaculture. Screening the immune stimulants and new harmless fishery drugs; develop the vaccines for the virus and bacterial disease.

5. The safety technology program of production environment

The ecological environment safety is the foundation and guarantee for the agricultural production safety and food safety, only the safety of environmental quality of agricultural origin can conduct safe agricultural production, avoid producing environmental pollutants from the soil or water to the biology and enlarged in food chain, which can cause the agricultural pollution and damage to human health. Develop the pollution monitoring, control and remediation technology of agricultural ecosystems, combined with information technology

development, put forward our country's agricultural safety policy and management practices, fully establish the safety of agricultural systems.

(1) The quality and safety of soil environment

Carry out the investigation of the soil environmental quality and the study of pollution process of the origin of agricultural products; conduct the assessment of soil environmental quality; raise the standard procedures and methods for the investigation of soil background, establish the informational system of soil background, and discuss the relationship between the quality and safety of agricultural products and soil background environment. Establish the methods of utilization for different soil, the scientific and reasonable soil environmental quality standards and risk assessment methods; develop the agricultural safety planning and zoning; construct the monitoring technology and system of soil environmental quality and its early warning system; the technology based on the fixation and blocking of soil contaminants, and the methods of microbial collaboration and degradation, research the techniques and principles of pollution control and restoration to reduce pollutants transfer from soil to plants. Effectively control the pollution sources, protect the environmental quality of agricultural origin, and restore the contaminated soil in our country gradually, meet the security of crop and animal production.

(2) The water quality and safety

For the key areas or key territorial water, to carry out the investigation of water quality and the research on the pollution process, conduct the assessment of water quality and zoning. Establish the scientific and reasonable standards of water quality and risk assessment methods; set up the planning and zoning of agricultural products production; construct quality monitoring technology and system; strict implementation of the wastewater discharge standards, develop the related technologies of water pollution control, and gradually improve the water quality of rivers and lakes in our country, meet the safe water supply of crop, animal and aquaculture.

(3) The safety of air quality

Carry out the investigation of atmospheric environmental quality and research on the pollution process, to analysis and track the pollution source and evaluate the atmospheric environmental quality. Establish the scientific and reasonable standards of atmospheric environmental quality and risk assessment methods; develop the agricultural safety planning and zoning; Construct the regional air monitoring technology and system networks; control the pollution source strictly, develop the related control equipment and technology to reduce the atmospheric environmental pollution, improve the quality of atmospheric environmental conditions step by step, meet the safety of the crop, animal and aquaculture.

Main References

- [1] National Research Center for Environmental Analysis and Measurements. The memorabilia of dioxin in China. The research on dioxin, [2004-09-30]. <http://www.cneac.com/article/list.asp?id=63>
- [2] Europe's major food safety incidents in recent years, *Journal of Chinese Institute of Food Science and Technology*, 2008, 8 (6): 47
- [3] Wang Y. The overview of infection and pandemicity about *Escherichia coli* O157:H7. *Progress in Microbiology and Immunology*, 2008, 36 (1): 51-58.
- [4] WHO Media centre, Food safety and foodborne illness, Fact sheet, [2007-03]. <http://www.who.int/mediacentre/factsheets/fs237/en/>.
- [5] Daszak P, Cunningham AA, Hyatt AI. Emerging infectious diseases of wildlife threats to biodiversity and human health. *Science*, 2000, 287: 443-449.
- [6] Binder S. Emerging infectious diseases: public health issues for the 21st century. *Science*, 1999, 284: 1311-1313.
- [7] Pearson H. SARS: what have we learned. *Nature*, 2003, 424: 121-126.
- [8] Guan Y. Isolation and characterization of viruses related to the SARS coronavirus from animals in southern China. *Science*, 2003, 302: 276-278.
- [9] Capua H, Alexander DJ. Avian influenza and human health. *Acta Tropica*, 2002, 83: 1-6.
- [10] Nichol ST, Ariwaka J, Kawaoka Y. Emerging viral diseases. *PNAS*, 2000, 97: 12411-12412.
- [11] Ferguson NM, Fraser C, Donnelly CA, et al. Public health risk from the Avian H5N1 influenza epidemic. *Science*, 2004, 304: 968-969.
- [12] Hinshaw VS, Webster RG, Naeve CW, et al. Altered tissue tropism of human-avian reassortant influenza viruses. *Virology*, 1983, 128: 260-263.
- [13] Kilpatrick AM, Chmura AA, Gibbons DW, et al. Predicting the global spread of H5N1 avian influenza. *PNAS*, 2006, 103(51): 19368-19373.
- [14] Li KS, Guan Y, Wang J, et al. Genesis of a highly pathogenic and potentially pandemic H5N1 influenza virus in eastern Asia. *Nature*, 2004, 430: 209-213.
- [15] Wang C, Feng Y, Pan X, et al. Salk/SalR, a two-component signal transduction system, is essential for full virulence of highly invasive *Streptococcus suis* serotype 2. *PLoS ONE*, 2008, 73(5): e2080.
- [16] Feng Y, Zheng F, Pan X, et al. Existence and characterization of allelic variants of Sao, a newly identified surface protein from *Streptococcus suis*. *FEMS Microbiol Lett*, 2007, 275(1):80-88.
- [17] Chen C, Tang J, Dong W, et al. A glimpse of streptococcal toxic shock syndrome from comparative genomics of *S. suis* 2 Chinese isolates. *PLoS ONE*, 2007, 2(3): e315.
- [18] Tang JQ, Wang CJ, Feng YJ, et al. Streptococcal toxic shock syndrome caused by *Streptococcus suis* serotype 2. *PLoS Medicine*, 2006, 3(5):668-676.