

APAARI – JIRCAS

Expert Consultation on Assuring Food Safety in Asia-Pacific

Tsukuba, Japan
4-5, August, 2014

Program and Abstracts

Organized by:

**Asia-Pacific Association of Agricultural Research Institutions
(APAARI)**

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CONCEPT NOTE

The Asia-Pacific region encompasses 41 countries of Southeast Asia, South and Southwest Asia, Central Asia, East Asia and Pacific islands. The region is a very significant producer and consumer of agricultural food products. More than 70% of the world's vegetables are produced here while between 41% and 51% other food commodities like cereals, roots and tubers, pulses, fruits, milk and meat come from this region. On the other hand, China and Japan are among the world's five largest importers of agricultural commodities. Hence, countries of the region have a large role in preventing contamination of food that is consumed by their people as well as ensuring acceptance of their produce in international trade.

Food safety is defined by the FAO/WHO as the assurance that food will not cause harm to the consumers when it is prepared and/or eaten according to its intended use. Reducing the risk of unsafe food involves preventing contamination throughout the food chain from farm to the table. The increasing number of people to feed, especially in the developing countries, means greater stress not only on food production systems but also on post-harvest handling, storage, processing and distribution chains, all of which can become contaminated with food-borne disease organisms. Outbreaks of food-borne diseases are reported frequently from countries of this region. During 2013, outbreaks of cholera, anthrax, salmonella and streptococcus were reported from India, Malaysia, Vietnam, Pakistan and Myanmar. In early 2014, hundreds of children in Japan fell sick due to suspected norovirus food contamination.

Adoption of intensive crop and animal production practices including the use of pesticides, antibiotics and animal growth promoting hormones has increased the potential health risks from food. More challenges are being posed by newer practices like organic agriculture, adoption of genetically modified foods and nanotechnology in agriculture, food additives and even food adulteration. Market globalization leading to larger international trade in raw and processed food items has increased the chances of spread of food-borne diseases and, hence, the challenges to food safety authorities.

Food safety measures are aimed to prevent exposure to unacceptable levels of food-borne hazards along the entire food chain. The Codex Alimentarius Commission, established by the Food and Agricultural Organization of the United Nations (FAO) and the World Health Organization (WHO) coordinates establishment of food standards at the international level. Standards, guidelines and codes of practices developed by Codex are universally accepted for food standardization practices. The World Trade Organization (WTO) agreement relevant to food safety, the Sanitary and Phytosanitary Measures (SPS), require its member countries to harmonize their regulations with the Codex standards. The agreement also requires members to

participate actively in Codex deliberations and adopt uniform safety standards for both the domestic and international trade.

In keeping with their national and international obligations, a number of Asia-Pacific countries have taken legislative and operational food safety measures. However, in several other countries specific food safety policies either do not exist or are inadequate. Lack of resources, infrastructure and technical expertise for effective implementation of food safety guidelines and standard operating procedures have been noted as some of the impediments. The need for regional and subregional cooperation to increase collaboration among national food safety authorities, exchange of food safety information and capacity development has been suggested.

The present Expert Consultation will bring together international experts on research and regulations of food safety, representatives of national food safety authorities of Asia-Pacific countries, and food industry to deliberate on recent developments on science and regulation of food safety, identify country level gaps in effective implementation of food safety measures, and set priorities for regional and subregional cooperation.

Program

4 August 2014

09:00- 09:30 Registration

Opening Session

09:30- 09:40	Welcome Address	Dr. Masa Iwanaga, JIRCAS
09:40-09:50	Welcome Address	Dr. J. L. Karihaloo, APAARI
09:50-10:00	Opening Remarks	Mr. Akira Endo, MAFF
10:00-10:05	Vote of Thanks	Mr. Osamu Koyama, JIRCAS

10:05 – 10:40 **Group Photograph & Tea/Coffee Break**

Session I: Keynote Presentations: Overall Scenario of Food Security and Food Safety

Chair: Dr. Iftikhar Ahmad, PARC

Co-Chair: Dr. J. L. Karihaloo, APAARI

10:40-11:10	Food security and safety in the Asia-Pacific region	Dr. V. Prakash, CSIR JSS-MVP
11:10-11:40	Food safety measures and their related matters	Prof. Kenji Isshiki, JFRL
11:40-12:10	Strengthening food safety-initiatives in the region	Dr. Shashi Sareen, FAO
12:10-12:40	Discussion	

12:40-13:40 Lunch Break

Session II: Country Status Reports

Chair: Mr. W.I.P. Wimal Kumara, SLCARP

Co-Chair: Mr. Osamu Koyama, JIRCAS

13:40-14:00	India	Dr. Meenakshi Singh, FSSAI
14:00-14:20	Japan	Dr. Yasuhiro Inatsu, NARO
14:20-14:40	Malaysia	Dr. Mohamed Shafit Bin Hussain, MARDI
14:40-15:00	Pakistan	Dr. Iftikhar Ahmad, PARC

15:00-15:20 Tea/Coffee Break

15:20-15:40	Philippines	Dr. Edralina P. Serrano, UPLB
15:40-16:00	Sri Lanka	Mr. H.M.S.B. Rathnayake, SLCARP
16:00-16:20	Chinese Taipei	Mr. Chun-Lung Cheng, COA
16:20-16:40	Thailand	Ms. Preeyanooch Tippayawat, DOA
16:40-17:10	Discussion	

18:30 - Dinner hosted by JIRCAS at Restaurant Sansui-tei

5 August 2014

Session III: Issues and scientific advances in specific commodities

Chair: Dr. Mohamed Shafit Bin Hussain, MARDI

Co-Chair: Dr. Masayoshi Saito, JIRCAS

09:00-09:30	Food safety issues and scientific advances related to animal-source foods	Dr. Kohei Makita, ILRI
09:30-10:00	Food safety issues and initiatives of AVRDC-The World Vegetable Center.	Dr. Jun Acedo, AVRDC
10:00-10:30	Breeding for mycotoxin resistance in wheat and maize: CIMMYT's recent work and strategy	Dr. P. K. Singh, CIMMYT
10:30-11:00	Discussion	

11:00-11:20 Tea/Coffee Break

Session IV: International Initiative

Chair: Dr. V. Prakash, CSIR JSS-MVP

Co-Chair: Mr. Chun-Lung Cheng, COA

11:20-11:50	Codex alimentarius and its harmonization	Dr. Meenakshi Singh, FSSAI
11:50-12:20	Translational research on transgenic crops at ICRISAT: towards product development, deployment, food safety and biosafety	Dr. Kiran K. Sharma, ICRISAT

12:20-13:20 Lunch

13:20-13:50	JIRCAS project on advanced application of local food resources in Asia	Dr. Kazuhiko Nakahara, JIRCAS
13:50-14:20	Discussion	

14:20-14:40 Tea/Coffee Break

Session V: Discussion on Key Issues

Chair: Dr. Shashi Sareen, FAO

Facilitator: Dr. J. L. Karihaloo, APAARI

14:40-15:40	Food safety priority issues in the region
15:40-16:30	Challenges and constraints
16:30-17:00	Actions/interventions - National/Regional cooperation

17:00-17:15 Closing ceremony

18:30 - Dinner hosted by APAARI at Okura Frontier Hotel (11F)

S1-1

Assuring Food Security and Safety in the Asia Pacific Region

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Today with the agricultural revolution in many countries and growing more from less, the movement of Food has become so fast and so efficient that what is plucked in one part of the world perhaps can be served as a Salad or as a Meal in the evening in some other part of the world. This is fascinating and amazing ! But along with it comes many problems of Safety and to a large extent the sustainability of the process also in the long run. In order to understand this system with a focus on FOOD SAFETY, globally one has to probably look at several regions of the world such as Latin America, North America, Europe, Africa, Middle East, Asia Pacific region (just to segregate for the purpose of models that are developed) and link it to the backward integration of Agriculture all the way to the consumer. The raw material either from land or from sea or from fresh water undergoes several steps of growing, harvesting, storing, transportation, packaging/processing, wholesale, retail and the marketing which will ultimately reach the consumer or to the community catering. All these processes involves multiple parameters which need to be under control for a safe food ultimately.

In this process unless and until several players gets converged such as Biotechnology, Bioinformatics, Nutritional Sciences, Sustainable Agriculture, Quality water and the handling processes including, transportation, hygienic design of equipments and the high quality hygiene in the kitchen will all ultimately matter to make Food Safe. This demands a global partnership of knowledge with a focus on Food Safety to a large extent and the agenda of Food Security wherein many a times the traditional and ethnic knowledge cannot be set aside and is an important factor to consider “Safe Food for all”. Such a system demands a synergy and networking and interfacing and harmonising many of the regulations in a coordinated fashion that these regulations are Science based but at the same time understand the local processes bringing in a global Food Safety agenda into local harmonisation and global understanding.

In spite of all these problems there are issues from the point of view of unforeseen calamities and one should learn from them and dissipate the information globally so that such things are prevented from happening from time to time elsewhere from a Food Safety angle. The rigours of Food Safety need to be followed and must be in the entire food chain from “*Farm to Fork*” and/or from “*Farm to Folk*” without any exception. In order to bring about a Food

Safety network globally the partnership between several governments and industries as well as academia on the one side with the trade and economy on the other side along with proper infrastructure and the awareness to the consumer must all funnel together into one basket to bring about the needed Food Safety with the context of Food Security for a sustainable and safe food for the population. Science, Technology, networking, media and proactive awareness about Food Safety must be an important agenda in terms of bringing in assurance of the Food Safety agenda in the Asia Pacific region which consists of several countries embedded with tradition, traditional foods and well established social practices which all have to be a part of the entire cascading effect and bring about the Food Safety assurance. This has to be implemented be it be street food, be it be community food, on airline food or restaurant food or even food cooked at home, the population must get that REASSURANCE and ASSURANCE that the food they are consuming is absolutely Safe, Nutritious and Healthy. This is the challenge that the scientists will have to deliver to ensure the confidence that needs to be built up in terms of scientific approach to Food Safety agenda and the expertise that lies in this area for the entire food chain from Farm to the Consumer needs to be tapped.

KEYWORDS :

Food Safety, agriculture, food regulations, traditional foods, consumer

S1-2

Food Safety Measures and their Related Matters

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ABSTRACT

Ensuring food safety is the responsibility taken by the government from the point of view of the public health protection. All stakeholders have the obligations to contribute to food safety and security. To fulfill of the role, everybody from farm to table should learn and implement food safety measures based on science. Food safety information should be shared with stakeholders involved in related issues, including consumers, food business operators, and other stakeholders from various fields.

A series of problems, which were occurred from 1980s such as BSE incidence, have shaken public trust in food safety (Matthews, 2014). This led to the restructuring of framework for food safety regulation in many countries. The new system has been based on an internationally acknowledged principle of risk analysis, which is to scientifically assess the risk and develop necessary measures based on the assessment. The risk analysis consists of three components: 1) risk assessment ; assess risk scientifically, 2) risk management ; implement necessary measures based on risk assessment, and 3) risk communication ; exchange information and opinions among members, such as risk assessors and managers, consumers, and business operators.

Another basic principal is the food chain approach. It means that we always have to check the accomplishment in actual fields from farm to table. It is necessary for us to go together risk analysis and food chain approach to ensure food safety.

Today, we have a complicated problem related to food safety (Motarjemi, 2014). It is the triangle of food safety, food security and food defense. Counter measures to terrorism by the way of food contains the problems of human to human. In Japan, we had incidents caused by intentional addition of pesticides to the frozen foods two times. One causative frozen food was imported, and another was domestic frozen food. They are crimes. It is very difficult for us to protect not only food factory but also our food chain from farm to table.

Basic concept of food safety measures adapted as law in many countries harmonizing with Codex recommendations such as General principle of Food Hygiene. In case of Food Sanitation Act in Japan, the following articles have been describing and protecting

consumers from food safety risks (Japan, 2013).Article 5: food shall be in a clean and sanitary manner

Article 6: unsafe food shall not be sold

Article 7: newly developing food shall not be sold without agree by government

Article 9: unsound livestock shall not apply to the meat

Article 10: food additive shall be specified by government

Article 11: keep criteria for handling methods and standards for food

Severe outbreaks have been reported mainly from developed countries. Notorious causative agents are *Escherichia coli* O157:H7, norovirus and others. In Japan, 8 persons were killed by *E. coli* O157:H7 after eating non-fermented vege-pickles “*asazuke*” in 2012. In recent years in Japan, medical doctors formally reported a lot of people got ill by norovirus. Numbers of the patients were more than 10,000 per year by norovirus came from foods.

The emergence of a new food safety risk may be signaled. The large 2011 *E.coli* O104:H4 outbreak that was centered in Germany resulted in more than 4000 illness, over 850 cases of hemolytic uremic syndrome and 54 deaths (Frank et al., 2011). The outbreak was linked to the consumption of fenugreek sprouts; the epidemiological investigation suggested the seeds were contaminated with the pathogen which grew during sprout production. In 2011, *E. coli* O111:H8 killed 5 people after eating raw-beef dish “*yukke*” in Japan (Watahiki, et.al, 2014). These infectious pathogens can make people sick and dead at very small intake with food. To prevent these food poisonings, everybody should contribute to keep our food chain clean from farm to table. Basic and key countermeasure would be to recognize that there are active pathogens near us and they can enter our food chain. Risk communication is very important as countermeasure to infectious food poisonings.

In this presentation, I would like to report the food safety measures including the following issues;

- Accidental Contaminants
- Intentional Contaminants
- Food Poisonings
- Bovine Spongiform Encephalopathy (BSE)
- Others

KEYWORDS

food safety, risk analysis, food chain approach, measures, from farm to table

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S1-3

Strengthening Food Safety : Initiatives in the Region

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ABSTRACT

In today's era of globalization, with increasing demand by consumers for variety in foods, there is greater transboundary movement and trade of food across countries, both imports and exports, leading to a wide variety of foods available for consumers to choose from. With this continuously increasing global food supply chain and transboundary movement of foods, the potential for spread of contaminants is high which has resulted in food safety acquiring global focus and countries imposing increasingly stringent requirements for protecting the health and safety of their populations both from products produced domestically as well as those imported. In addition to food safety issues, there are also issues relating to quality and acceptability of food by consumers such as aspects of spoilage, poor appearance, size requirements or past best before date amongst others. Another current concern is issues relating to fraud such as the recent cases of contamination of beef with horse meat. In this background food safety standards and their implementation is becoming increasingly important.

The importance of food safety is further exacerbated due to its impact not only on the health and nutritional status of populations but also its effects on food losses and wastes, market access and economic implications. Addressing food safety is a challenging task as a wide variety of factors influence it. Some food safety challenges in the region include the continually changing or emerging newer foodborne hazards and their rapid transmission across borders into the region due to globalization and trade liberalization, finding or maintaining appropriate balance between food safety and food security, linking the final product to the primary food production with greater focus on maintaining traceability, issues of multiagency coordination, need of data for taking risk-based decisions, better measurement with clear indicators for food safety so that an appropriate focus by governments is given to food safety and emphasis on awareness and trainings amongst others.

Achieving food security for all is at the heart of FAO's efforts – to make sure people have regular access to enough high-quality food to lead active, healthy lives. Food safety is an important element of food security. The importance of food safety has been recognized by FAO as a critical area and FAO supports countries by providing technical assistance and guidance through its food safety and quality programme. FAO is currently supporting nearly 20 projects in various countries in Asia and the Pacific region covering capacity strengthening in different aspects of food safety and quality which generally addresses: food

safety policies, legislation, and governance issues; activities relating to standards and Codex; enforcement and surveillance related activities; food safety in various agro food supply chains right from primary production to consumption to address good practices such as GAP, GMP and HACCP; food safety emergency management and recall systems; certifications and accreditation systems; and trainings/ awareness/ education aspects of food safety.

Food safety needs to be addressed in a concerted manner. Future food safety priorities in the region include greater focus on strengthening coordination between Ministries and departments on food safety, an important area due to the multi-sectoral nature of food safety; focusing on risk-basis and the science behind food standards and controls; supporting countries to strengthen food import control systems through a risk-based approach; addressing the issue of voluntary and regulatory standards and how there can play a role to develop synergies and strengthen food controls and thereby safer foods; strengthening good practices across the food chain to include farm level, processing, retail, etc. FAO is working on various initiatives to address these priorities.

In conclusion, it is emphasized that food safety is no longer a simple food safety issue, but impacts trade, economy and our nutrition and food security. It is a multi-dimensional issue – addressed through a range of activities involving multiple stakeholders. The importance of food standards and their implementation by governments and other stakeholders is absolutely essential to ensure availability of safe food.

KEYWORDS

Food safety, risk-based food controls, FAO

S2-1

Country Status Report: Assuring Food Safety in India

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ABSTRACT

India is the second largest producer of food and holds the potential to be the biggest on the global food and agriculture canvas. The food industry in India comprises food production and food-related processing industries. The food processing industry is one of the largest in India – it is ranked fifth in terms of production, consumption, export and expected growth. The Agriculture sector is the basis for most of the food processing industry and this sector has touched a growth rate of 4.4 per cent in 2012-13. The food processing industry is growing at an annual rate of 13% and for the Indian economy the growth of industry is crucial for the overall growth of the nation.

The biggest challenge and national concern is that the food processing sector is dominated by unorganized players who contribute to 80% of the processed food (by volume), unlike other sectors viz. pharma, automobile and IT where over 90% of the sector is under organized industry. There is a trend towards conversion of un-organized food sector to organized sector but we still need to cross quite a distance.

Due to rapid growth including that of food industry, a variety of foods are now available to consumers which have created new challenges to the food safety. Food safety begins with the suppliers of agricultural inputs to farmers and those involved in food production, since materials such as pesticides and veterinary drugs pose diverse risks and therefore require specific attention. Animal feeding material containing pathogens, including bacteria or toxic chemicals, may also pose specific risks. Similarly, irradiations, preservatives and other additives added for improving shelf life, flavor, taste, texture of food products poses new risks. Climate change also has its impact on safety of food.

Rapid changes in diets and lifestyles that have occurred with industrialization, urbanization, economic development and market globalization, has accelerated over the past decade. With this the food processing and availability has also expanded. There have been negative consequences of these lifestyle changes as well. Because of these changes in dietary and lifestyle patterns, chronic non-communicable diseases (NCDs) such as obesity, diabetes mellitus, cardiovascular disease and some other types of cancer are becoming increasingly significant causes of disability and premature death.

In India, The Food Safety and Standards Authority of India (FSSAI), which has been established under the Food Safety Standard Act, 2006, is responsible for food standards, safety and hygiene control. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption. The Act also aims to establish a single reference point for all matters relating to food safety and standards, by moving from multi-level, multi-departmental control to a single line of command.

FSSAI being the regulator has initiated notification of standards under FSS Act 2006. Standard setting is supported by risk assessment conducted by independent scientific panels and considering Codex and other international standards. FSSAI is also coming up with new regulations on import of food products, recall procedures, regulations for nutraceuticals and functional food for benefit of consumers. FSSAI is also engaged in awareness programmes for various stakeholders on good food handling practices, good hygienic practices, good transportation practices, good retail practices, encouraging the implementation of good safety management programme and skill development.

However, food quality and safety cannot be achieved in isolation but requires collaborated and collective efforts. There is need of exchange and dissemination of knowledge across the countries by diverse means like food testing laboratory, capacity building, training, awareness to all stakeholders, recognition of certification bodies, and harmonization of food standards with international standards (Codex), with a prime aim of consumer safety and facilitating trade.

KEYWORDS:

Food safety, food standards, regulation, consumer, hazards, awareness, NCDs

S2-2

Overview of Food Safety Management by Ministry of Agriculture, Fishery and Forestry (MAFF) and the Ongoing National Project Studies to Improve Bacteriological Food Hygiene Condition from Farm to Table

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Food hygiene, defined as “all conditions and measures necessary to ensure the safety and sustainability of food at all stages of the food chain”, is one of the most important and challenging issues all over the world. The increasing cross national grovel transportation of food enhances spreading local novel foodborne pathogen. German outbreak of *Escherichia coli* O104:H4 associated with sprouts (2011) is one of the typical cases. International collaboration to increase food hygiene condition in each country is quite important.

“Food chain approach” and “Risk analysis based food safety policy” is now commonly accepted concept to improve food hygiene condition in the most of countries. It addresses Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs) that will help control microbial, chemical and physical hazards associated with all stages of the production of foods from primary production to packing of the final products. It is quite important to adopt the “process control” strategy instead of “endpoint checking” strategy to ensure the safeness of “all” of the products upper than the expected limit. The HACCP system, one of the typical one based on the process control strategy, must be used with the suitable general hygiene practices (GHP).

To establish fair and equitable trade rules or harmonize safety measure in each country, WTO / SPS agreement article 3 requires members’ countries to set their sanitary measures on international standards, guidelines or recommendations. The FAO / WHO joint Codex Alimentarius Commission (CAC) has published several related documentations such as “Recommended international code of practice general principles of food hygiene” (CAC/RCP 1-1969, Rev.4, 2003), “Code of Hygienic Practice for Fresh Fruits and Vegetables” (CAC/RCP 53 – 2003). The latter code provides a general framework of recommendation applicable to fresh fruits and vegetables grown in the field or in protected facilities (such as hydroponics systems, greenhouses). The “Annex I for Ready –to-eat Fresh Pre-cut Fruits and Vegetables” and “Annex II for Sprout Production” which covers the

hygienic practices for “the processing of ready-to-eat fresh pre-cut fruits and vegetables” and “primary production of seeds for sprouting and the production of sprouts” has also published respectively in 2003. CAC published an additional annex specified for the “leafy vegetable and herbs” in 2010.

Japanese food safety policy is conducted based on the “Food safety basic law” adopted in 2003. The concept of this law is based on the “food chain approach” and “risk-based adaptation of food hygiene measures”, harmonized with international standards based on WTO SPS agreement. The risk assessment body (Food safety commission under cabinet office) is separated functionally from risk management body (MAFF and MHWL). Ministry of agriculture, fishery and forestry (MAFF) is responsible for the food safety risk management from farm to the entrance of food facility or slaughter house in the total food chain. The downstream is covered by the ministry of health, welfare and labor (MHWL). Both of MAFF and MHWL engaged in the enhancement of HACCP adaptation into food facilities however. MAFF and MHWL has set the standard operating procedure (SOP) of food safety risk management according to the “Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius Commission”(adopted by the 26th Session of CAC, 2003; Codex Alimentarius Commission Procedural Manual; 14th edition). Based on the SOP, MAFF established the priority of chemical and biological hazards and the field severance (including the produces) of these hazards has performed since 2006 (chemical) and 2007 (biological), respectively. “Salmonella in Egg” and “Enterohemorrhagic *Escherichia coli* O157 and O26 in cattle (meat)” was targeted in FY 2006. In addition with the cattle, “*Campylobacter* and *Salmonella* in chicken (meat)”, “*Salmonella* and Enterohemorrhagic *Escherichia coli* O157 and O26 in Cucumber and tomato” and “Enterohemorrhagic *Escherichia coli* O157 and O26 in leek” was surveyed in FY 2007. No pathogenic bacteria were detected from surveyed vegetable or their growing field (soil and water) samples.

MAFF promotes the adoption of GAPs to ensure the appropriate management of the entire agricultural production processes in agricultural production sites. The government had set the objective to introduce GAPs in key areas of production (2,000 production sites) for vegetables, fruits, rice, wheat, barley, and so on by FY 2011. MAFF published “A manual for voluntary introduction of GAPs procedure” and “Basic GAPs” series for 9 major produces. These manuals have no legal and political compelling power but only for the reference and suggestion for the private sectors. These manuals are based on the Codex documentations, the collection of practical back data of Japan may be required to convince or catch on the private sectors.

MAFF has conducted a food hygiene related research project (“Research project for ensuring food safety from farm to table”) for 5 year (2008 to 2012 FY) that yielded some scientific evidences of the importance of good hygiene practices (GAP). In the following

year (2013), MAFF kicked off a novel project research program that focused on the injured pathogenic bacteria in food chain (90 million JPY for the first year. 80 million JPY for the second year.). Total 33 researchers in 14 universities or research institutes joined the program to deal with 18 themes. In one of the theme in the novel research project, “Evaluation of the detective methods and characterization of multi-drug resistance foodborne pathogens collaborating with foreign countries”, members of national food research institute, NARO have conducted (or planning to conduct) the study with co-authors in south (-eastern) Asian less / middle developed countries such as Vietnam, Lao PDR, Cambodia, Thailand and Bangladesh based on the MOU with the counterpart in the each of the countries.

S2-3

Assuring Food Safety in Malaysia

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ABSTRACT

One of the National R&D Priority Areas identified is food security. Food safety is crucial and the key to provide good health and nutrition, which is one of the ultimate goals of food security. Therefore, the government is serious in establishing food-based industries that produce high quality and safe food products for consumers both locally and globally. Government regulatory bodies in Malaysia are increasingly concerned about the quality and safety of food for the consumers. Moreover, there are significant changes in the lifestyles of Malaysian consumers. Consumers are going for healthy and nutritious foods.

The Food Safety and Quality Division, Ministry of Health (MOH) is the competent authority for food safety along the food supply chain in Malaysia. Even though the mandate for food safety rests with the Ministry of Health, the food safety framework in Malaysia is an integrated approach involving other ministries, government agencies and departments. The Food Act 1983 and the Food Regulations 1985 are the two laws that are mandatory to food intended for sale in the domestic market. The objective of the Food Act 1983 and the Food Regulations 1985 is to ensure that the public is protected from health hazards and fraud in the preparation, sale and use of foods and for matters connected therewith. The Ministry of Health is responsible in enforcement of the Act and Regulations. The Food Regulations 1985 is continuously revised and updated by the Ministry of Health.

Other legislations that have an impact on food safety are the Pesticide Act 1974, the Fisheries Act 1983, the Veterinary Surgeon Act 1974 and the Animal Ordinance 1953. Others that are related to food include the Food Irradiation Regulations 2011, Food Analysts Act 2011 and Food Analysts Regulations 2013. Codex Alimentarius guidelines and standards are adopted as the benchmark in development of food safety documents.

On 11 July 2007, Parliament passed the *Malaysian Biosafety Act 2007*. The Act came into force on 1 December 2009. The Ministry of Natural Resources and Environment (NRE) is lead and focal agency for all matters relating to biosafety. The Act establishes a National Biosafety Board to regulate the release, importation, exportation and contained use of living modified microorganisms (LMOs), and the release of products of such organisms with the

objective of protecting human, plant and animal health, environment and biological diversity. Items containing LMOs and their product must be labelled.

Ministry of Health manages food import control through the use of a web-based application system called Food Safety Information System of Malaysia (FoSIM) which uses a risk-based approach in determining the food safety hazard of imported food. In this system, all importers need to be registered in the system database, advance notification is given by the importer to the food safety authorities about the food consignment, and food safety analysis results are posted on the system to be readily accessed by the importers. Such a system would also enhance transparency and speed up the process of food importing, thereby reducing the risk of food spoilage.

Availability of scientific R&D data is very important in setting-up of food safety legislation. In Malaysia, scientific data is gathered through collaboration and cooperation among government agencies, research institutes and institutes of higher learning. For example, a taskforce on antimicrobial resistance (AMR) in food was set up because there is a concern where foodborne illnesses cannot be appropriately treated with antibiotics as a result of antibiotic-resistant bacteria (superbugs). Raja Arief Deli and Gulum Rusul (2013) found that *Salmonella* serotypes were 100% resistant to erythromycin. The serotypes were also resistance to tetracycline (86.7%), streptomycin (52.4%), sulphamethox/trimethoprim (43.8%) and chloramphenicol (22.9%). There is an urgent need to monitor the antimicrobial resistance pathogens along the food supply chain. A work force among the Asia-Pacific region could play an important part in minimizing the spread of the superbugs.

When comes to food safety analysis, rapid assay is important in getting quick results, thus able to make a quick decisions. Biosensors together with nanotechnology play an important role in the development of highly specific, selective and rapid, which are adaptable to the food industry. Biosensors and nanosensors are capable of detecting specific chemical compounds in biological samples and are very applicable within the food supply chain such as determining pesticide residues and product quality. The Malaysian government is committed and increased R&D funding for biosensors and nanotechnology R&D.

The Malaysian government also realises the importance of traceability, and setting-up a complete food information and traceability system is crucial. With a good traceability system in-place, Malaysia could be competitive in the global market, especially if it could ensure its food is safe and of high quality. With traceability in place, quality and food safety could be handled more systematically. With traceability system in-place, it would be easier to trace animal and their records from farm to abattoirs such as movement permit, slaughter permit and veterinary health certificate.

Recently, the Food Hygiene Regulations 2009 was implemented to prescribe hygiene requirements for all food premises, including food safety assurance programme and food

traceability system.. In June 2012, the *Makanan Selamat Tanggungjawab Industri* (MeSTI) Scheme was introduced, which is an improvement of *Skim Keselamatan Makanan* (SK1M) to facilitate food enterprises, particularly SMEs, in meeting the requirements under the Food Hygiene Regulations 2009. Under MeSTI, the SMEs are required to develop a planned and documented practical system together with control records such as control of premises, control of operation and traceability. Until December 2012, a total of 283 MeSTI certifications were given to the food industry in Malaysia (MOH, 2012). The Ministry of Health (MOH) in Malaysia realise the importance of food handler's role in the prevention of food poisoning. In 2010, a total of 108,927 food handlers has been trained by the 132 Food Handler Training School (FHTS), which are recognized by the MOH (MOH, 2010). Education increased the hawkers' knowledge, thus improved their attitudes toward food safety and hygiene (Toh and Birchenough, 2000).

The Secretariat to the National Food Safety and Nutrition Council (NFSNC) is the highest national advisory body that provides advice related to food safety and nutrition in Malaysia. The NFSNC establishment was approved by the Cabinet on 21 March 2001. The objective of NFSNC is to ensure the health of the consumers is assured by strengthening food safety at all levels of the food supply chain in the country and to ensure Malaysians achieve optimum nutrition status.

There has been a lot of global concerns regarding the safety of food for human consumption where huge volumes are processed in different regions that are exported and consumed in another region. More than 50% of fruits and vegetables, sugar, non-alcoholic beverages, fish and fishery products are exported from developing countries (Othman, 2007). Therefore, there is a need for food safety research along the value chain from production of raw materials, processing, distribution and preparation of the food products. Collaboration work among the Asia-Pacific members is needed to tackled important agenda in assuring food safety in the region.

KEYWORDS

Malaysia, legislations, food safety, food hygiene and R&D

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S2-4

Food Safety Research and Regulations - Pakistan

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ABSTRACT

The major food safety concerns for Pakistan are of physical, chemical and biological nature, in addition to, organic and genetically modified foods and nutraceuticals. Pakistan is an agro-based, low income, developing economy with major agricultural produce of wheat, rice, cotton, sugarcane, fruits and vegetables etc. The agricultural export earnings are obtained from the rice, fruits, vegetables, textiles, carpets, fish, livestock products, spices etc. The per capita availability of food items lies in acceptable range, viz., energy and protein availability per capita per day are 2,450kcal/d and 72.5g/d, respectively. Pakistan is the house of world-class food commodities like Basmati Rice, Chilies, Chaunsa and Sindhri Mango, Textiles, Fruits, Spices etc. European Union (EU) is the biggest markets for Pakistan's exports. The non-compliance/negligence on international food safety requirements and sensitivity of the EU on food safety issues are the biggest setbacks for the Pakistani exports. The presence of aflatoxin, unauthorized colors, sulphites, pesticide residue, harmful microbes, heavy metals, molds etc. is the serious threats to the Pakistani exports, as a total of 213 consignments have been rejected on these grounds, during last 10 years.

Pakistan does not have an integrated legal framework but has a set of laws, which deals with various aspects of food safety. These laws, although, are old ones but have a capability to ensure a minimum level of food safety. The major food laws which dealt with food safety in Pakistan are The Pure Food Ordinance (1960), The Cantonment Pure Food Act (1966), Pakistan Hotel and Restaurant Act (1976) and The Pakistan Standards and Quality Control Authority Act (1966). The new emerging food safety scenarios are demanding revision in food laws. After the 18th constitutional amendment, being the provincial subject, the provincial administrations are developing their own food safety laws. The Government of Pakistan (GOP) is also working on the development of new guidelines and plans to address the food safety issues. The important decisions that GOP is taking as policy matter includes the updating of existing food safety legislations harmonized with international standards, capacity building programs, strengthening of inspection, testing and certification system and early warning system etc. The GOP is also planning the National Food Safety Program. This program has two-prone approach of developing National Strategy and Food Safety Policy and ensuring Food Quality and Safety to protect consumer's health.

The research and development in Pakistan is now more focused on food safety. The Pakistan Agricultural Research Council (PARC) under the umbrella of Ministry of National Food Security and Research (MNFSR) has diverted attention on the food safety issues, several years back. But the situation requires more comprehensive and coordinated efforts with all stakeholders on board. Pakistan is a developing country and is facing the similar problems as other developing nations. The key problems in food control system are outdated food laws and regulations with poor enforcing capability, absence of national food control strategy, limited infrastructure, equipment, supplies, skilled personnel, inadequate scientific and technical resources for food inspection and compliance etc. The answers to these problems are complex and require harmonized efforts at multiple levels in public as well as private sector. The international cooperation in general and regional cooperation in specific can play a vital role to overcome the deficiencies and bring the developing nations at par with developed nations.

S2-5

Assuring Food Safety in the Philippine Setting

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In recent years, the advent of globalization, trade liberalization, changing lifestyles and consumers' heightened awareness and concerns on health and wellness, have brought into focus the safety and quality aspects in food. Worldwide outbreaks of food-borne illnesses also provided the impetus for consumers to demand for safe and wholesome food. For a food produce or product to be safe for consumption, it must be produced, handled, prepared and packaged in a manner compliant to international standards of safety and quality. Thus, evolved quality assurance programmes that each country must implement, transcending the production- postharvest handling- marketing-consumption continuum.

In the Philippines, a government-initiated food safety assurance programme - the Food Safety Act - has been enacted into a law. The enactment of this Law has been fueled by incidences of food contaminations/poisoning and outbreaks of food-borne diseases and increasing health consciousness. It was made urgent by the emergence of a heightened sensitivity in markets over the assurance of food safety in a globalized trading environment. The Food Safety Act of the Philippines declares "to develop and maintain a food safety regulatory system that will ensure the highest level of protection of human health in the consumption of food, fair practices in the food trade and market access of local foods and food products".

The paper attempts to present the key provisions of the Food Safety Act of the Philippines and the role of government's food control agencies, the academe, the industry and the consumers towards efficient enforcement of the Law to meet its objectives of ensuring consumer protection, enhancing competitiveness and market access of food and food products.

KEYWORDS:

Food Safety, Food Safety Assurance Programs, Food Control System, Risk-based Food Control System

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S2-6

Status of Food Safety in Sri Lanka

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ABSTRACT

The Asia Pacific region is a significant producer and consumer of agricultural food production. Inadequate food production to meet the demand is a global problem with 58% of the global food production consumed by developing countries. Sri Lanka is also a nation struggling to meet the food production targets with a population of 20,263,723 (Census and Statistics, 2012), with 13.8% of the population engaged in agriculture where the contribution to GDP by the agriculture sector is 10.8% (Central Bank, 2012).

Access to food at low prices, year round supplies, and a greater quality of variety of food availability at low prices has been facilitated by increased International trade. The food and beverage industry in Sri Lanka is also a significant contributor from the Asia Pacific region in the supply chain of food and beverages providing fresh produce mainly to the Middle East and processed products mainly to European Countries.

Globalization of food supply chain has also posed new challenges by way of food safety and quality issues, thus food safety/quality and trade –related concerns are becoming more pronounced than before. [2]. As Governments across the Globe seek to regulate food markets in the interest of the Public Health and Safety, the Government of Sri Lanka also plays a vital role in maintain a well established mechanism within the country to ensure that food items available in the market are safe for human consumption.

In Sri Lanka there has been a growing fear/incidence of food safety and quality risks, with the fears raised in year 2008 that melamine contaminated imported baby food, milk and fish feed from China had made its way to the market (Daily News 2008). In the year 2011, E-Coli contaminated food, fears were also raised with regards canned fruits and vegetables imported from Europe and fears were also raised with regards to the importation of Bird Flu infected poultry products, adulterated brown sugar imported from Brazil.

Statistics reveals that Sri Lanka imports 7.6% Food and Beverages, rice 0.1%, Sugar and Sugar confectionaries 1.6%, dairy products, 1.6%, lentils 0.6% and others 3.7 % while 14.8% tea, 2% coconut , 3.4% spices, 0.25% vegetable oil and 1% minor agricultural products are exported (Central Bank 2013).

The more frequent and immediate result of food contamination is diarrhea The Ministry of Health reveals that episodes of diarrhea in 2013 has been 650/100,000 population (Health Bulletin 2013), which is mainly due to food contamination.

The present Food Act No 26 of 1980 issued by the Ministry of Health in consultation with the Food Advisory Committee is the main legislation controlling food safety activities in Sri Lanka. The present Food Act, based on the model food Laws proposed by the FAO and WHO. This Act has been amended by Act 20 of 1991 and Act 29 of 2011. The Food Act controls the Manufacture, Importation, Transport, Sale, Distribution, Advertising, Packaging and Labeling of food and also establishes a food advisory committee to repeal the Food and Drugs Act. The Food Act is primarily divided into four elements as Part i Provision defining prohibition criteria with respect to food. Part ii Provision for establishment of an administration, Part iii Provision defining the nature of offences under Food Act and Part IV. Sixty eight food commodities are covered under the Food Standards as per Regulations of 1991. Product standards are formulated to harmonize with the Codex Alimentarius Commission (CAC) standards which facilitates trade between nations.

Industrialists have started to seek assistance to obtain certification against HACCP, ISO 22000 Good Manufacturing Practices (GMP) due to pressure created by the consumers and the foreign buyers in recent years. Both public and private organizations within the country serve as certification bodies for these schemes. There are about 114 ISO 22000 certified, 74 HACCP certified and 120 GMP Certified food companies/industries in Sri Lanka and about 210 food/beverage commodities with SLS certification from the Sri Lanka Standards Institution.

In Sri Lanka, the task of ensuring food safety is divided among number of organizations. The Food Control Administration Unit (FCAU) of the Ministry of Health is the Central Unit, which maintains an effective food control system. FCAU is responsible for carrying out the decisions of the Food Advisory Committee, (FAC) coordinating activities in this area with all Ministries and Departments, investigating national level complaints, import/export inspection and certification of food and coordinating activities with international organizations. Sri Lanka Standard Institute is the body involved in formulation of standards in agreement with standing setting bodies of the exporting country. The Department of Agriculture, Government Analyst Department, Ceylon Chamber of Commerce, Atomic Energy Authority of Sri Lanka, Sri Lanka Customs and the Consumer Affairs Authority performs vital roles in Food Safety regulations. Research conducted in Sri Lanka has been limited to a few studies mainly on maintaining food safety and quality in managing postharvest losses, conducted by the Food research Unit of the Department of Agriculture, Institute of Postharvest Technology and the Industrial Technology Institute which are the research Institutes mandated to conduct R&D programmes in food.

In conclusion, with the growing incidence of food safety risks in Sri Lanka it is fundamental that a more comprehensive and strict mechanisms be implemented to regulate the flow of imported produce and Sri Lanka has a long way to go in effectively handling this issue.

KEYWORDS

Food Safety in Sri Lanka, Regulations, Risks, Food Act

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S2-7

A Brief Review on Chinese Taipei's Food Safety

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ABSTRACT

Chinese Taipei's food industry is divided into 23 sub-sectors including more than 6000 registered factories with annual revenue at least NT\$ 600 billion. In addition, the value of imported processed foods is more than NT\$ 200 billion per year and the export is about NT\$ 100 billion. The Ministry of Health and Welfare (MOHW) is the competent authority at the central government level on Chinese Taipei's food safety management, and Food and Drug Administration (FDA), MOHW's subordinate agency, was set up in 2010 to coordinate the management of food hygiene and safety of domestic and imported foods. Besides, The Ministry of Economic Affairs (MOEA) and the Council of Agriculture (COA) are involved in food safety management as well. The MOEA is responsible for the registration of factories and the promotion of Good Manufacturing Practice (GMP) system while the COA is in charge of domestic agricultural, livestock and fishery production and the promotion of Certified Agricultural Standards (CAS) system. Every competent authority will carry on its tasks in accordance with the responsible fields and the routine coordination meetings of food safety are also held regularly and the inter-ministerial conference is conducted by the Vice Premier of Executive Yuan to integrate the food safety issues while necessary.

In recent years, several food safety issues took place in Chinese Taipei and drew the highly concerns from the public, such as olive oil adulteration and copper chlorophyll illegally added, unapproved modified starch used in foods, ractopamine residues in imported meat, clouding agents containing plasticizers used as food additives. With all these events, consumers to strongly request the government to strengthen the regulations of food safety management, and furthermore actuated the amendments of Act Governing Food Safety and Sanitation in June 2013 and February 2014. In order to strengthen the food safety management and enhance penalties, 4 new chapters has been promulgated relating to Risk Management for Food Safety, Sanitary Control of Food Businesses, Food Import Control and Food Testing and the articles number of the Act have been increased from origin 40 to 60.

As one of WTO members, Chinese Taipei set standards related to food safety management according to the SPS and TBT agreements, including the maximum residue limits (MRL) of 349 pesticide residues in 4,051 crops, 135 veterinary drug residues in 1,389 food items, and the specifications of 18 categories of 800 food additives, and 40 categories

of food hygiene standards, etc. We will continue to make the revision of related regulations on foods management followed by the international standards and based on relevant scientific researches.

In Chinese Taipei, we take the controlled measures on imported foods at three stages, systematic inspections before the importation, border monitoring inspections, and marketing surveillances. In general, the randomly-selected batch examination is performed based on 2-10% inspection rate, increasing to 20-50% for the unqualified foods, and batch-by-batch examination applied for the foods repeatedly failed to regulations. As to the management of domestic food industry, the general requirements for all shall be in line with GHP, yet some specific industries, such as meat, dairy products and seafood processing industry shall compliance with HACCP. Furthermore, we will gradually make the announcements on the food industry types required for mandatory tracking and tracing. Since risk assessment and preventative measures are the key amendments to Act Governing Food and Safety Sanitation in Chinese Taipei, regulation for all categories of food shall follow the rules. Especially, traceability system for tracing the source and tracking the flow will be launched to reinforce the management on genetic modified food.

Good management on food safety requires industrial self-management following the regulations, governmental effective counseling and supervision, and the establishment of the consumers' correct consumption concept through education. Hopefully the government, industry and consumers from all walks of life can make efforts on food safety to create a win-win situation.

KEYWORDS

Chinese Taipei's Food Safety; Good Manufacturing Practice (GMP); Certified Agricultural Standards (CAS); Good Hygenic Practice (GHP); Hazard Analysis of Critical Control Point (HACCP)

S2-8

Thailand's Food Safety Regulatory Framework

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ABSTRACT

Food safety was officially announced as Thailand's national agenda in 2003 with the effort to mark the year 2004 "food safety year". The first food safety roadmap was drawn up, with multiple agencies involved in operation, covering stages in the supply chain, from import, farms, facilities, and markets. Two key ministries responsible for food safety control are the Ministry of Public Health and the Ministry of Agriculture and Cooperatives. Main objective was to introduce and encourage good practice standards system to farmers and manufacturers, while registration, inspection and certification were used as tools to achieve the food safety control both for domestic and export markets. However, most of standards are voluntary except those specifically designated by the Food Act B.E. 2522 (1979).

Under the National Food Committee Act B.E. 2551 (2008), food safety aspect has been extended as it is considered a building block and inter-related to other major aspects. The strategic framework for food management was developed and later endorsed in 2010. Four strategies are food security, food quality and safety, food education, and food management. The goals are to increase management efficiency and resources sustainability for the sufficiency, quality, and safety, including nutrition, of food for all levels and sectors. Legislation, information management, as well as, education are to be improved and effectively implemented.

Standard plays the key role in the safety strategy covering all stages of the supply chain, similar to the previous roadmap, however it focuses on single safety standard for both domestic and foreign markets. Coupled with the safety assurance system, the food safety strategy is more strengthened. Production at community level is also incorporated into this strategy.

Under the Agricultural Standards Act B.E. 2551 (2008) and amended, standards, both voluntary and mandatory, are to be set in compliance with international standards involved. However, all standards currently established are voluntary. Two hundred twenty standards are subjected for revision. These can be categorized as general standards, product standards, and system standards. Taken into consideration risks involved and current situation, some safety aspects are of more concern. Therefore, ten mandatory standards are to be established. The need for standard implementation/ enforcement is as important as the development. Effectiveness of standard implementation shall be the key element of the country's strategic framework.

Even though the National Food Committee Act B.E. 2551 (2008) has laid down the framework and responsible agencies, integration of work between agencies is still a major concern in order to achieve the objectives as there are gaps and overlap in food safety control scheme at present. Another national concern is the use of pesticides and their residues in produce. Safe and effective use of pesticides, as well as MRLs establishment particularly for minor crops, has been an issue of concern, even with increasing interest when production is inevitably facing the effect of climate change.

Research and development on food safety are scattered among government agencies, academics, and private sectors. Under the food education strategy, promotion of research and development for new knowledge, information/knowledge management, dissemination, and utilization are included. Among various yet scattering development on food safety issue, risk communication tools, namely ASEAN Rapid Alert System for Food and Feed (ARASFF) and Food Alert System of Thailand (FAST) were developed with the support from the European Union in 2007. ARASFF, under the management of the Ministry of Agriculture and Cooperatives, was further developed to Thailand Rapid Alert System for Food and Feed (THRASFF), to serve the demand for national food safety management system. On the other hand, FAST was developed for food safety communication among agencies under the Ministry of Public Health.

KEYWORDS

Thailand, Food safety Roadmap, National Food Committee Act, Strategic framework, Thailand Rapid Alert System for Food and Feed (THRASFF), Food Alert System of Thailand (FAST)

S3-1

Food Safety Issues and Scientific Advances Related to Animal-Source Foods

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ABSTRACT

Every year, 2 billions of diarrhea cases occur for all age groups (WHO, 2010) and currently 700,000 children under five die from this illness (Walker et al., 2013). Animal-source foods provide nutrition but are a major cause of such food-borne diseases (FBDs). FBDs include other, non-diarrheal severe illness such as tuberculosis and brucellosis.

In developing countries, most foods are sold through informal markets, which lack adequate hygiene management. However, these informal markets provide affordable food to the poor, and market opportunities to smallholder farmers and other value chain actors, and thus are economically important.

Since 2008, the Safe food, Fair food project funded by GIZ, and run by International Livestock Research Institute (ILRI) proved that the concept of participatory risk analysis (Grace et al., 2008) is useful in improving food safety in informal markets while ensuring market access for smallholder farmers. In this risk analysis, participatory methods were applied to understanding the level of exposure to pathogens; cultural and traditional risk reduction behavior; communication with stakeholders of food safety; and, education of smallholder farmers and actors along food value chains. The project initially planned five proof-of-concept studies in five sub-Saharan African (SSA) countries, but expanded to 24 studies in eight SSA countries, attracting additional funds. Participatory risk analysis worked very well in quantifying risks and identifying better policy support options using stochastic modeling even in the data-scarce environment (Makita et al., 2012). The second phase in SSA started in 2012 with more emphasis on value-chain based risk analysis including risk management.

The methodology was adopted in Asia- a study started in Vietnam on risk analysis associated with consumption of pork produced by smallholder farmers and vegetable, which is contaminated with pathogens of animal origin. Integration of economic analysis into food

safety risk assessment along pork value chains is being applied in identifying incentive-based hygiene control options in this study. Also in Vietnam, a risk assessment taskforce was established to work jointly with the Ministry of Health and Agriculture on the use of risk assessment for food safety management. Participatory food safety risk analysis may improve hygiene of affordable food and at the same time livelihoods of actors along value chains of animal-source foods in Asia and Africa.

KEYWORDS

Food safety; Participatory risk analysis; Informal market; Value chain; Incentive

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3-2

Food Safety Issues and Initiatives of AVRDC – The World Vegetable Center

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ABSTRACT

Vegetables are pillars of nutritious food systems which are promoted worldwide to achieve food and nutrition security and they can show the dramatic gains in agricultural productivity seen from the Green Revolution experience. Food safety is closely linked to food security; safe foods secure people's health, increase market access, and foster human and economic development. Food safety hazards undermine the food and nutritive value of vegetables; their effects (e.g. acute or chronic health disorders) have very large economic costs, including market losses, lost livelihoods, and human losses. Notable food safety hazards in vegetables include chemical contaminants (pesticide residues and heavy metals), microbial pathogens, biotoxins and antinutritional compounds. Pesticide residues are the most serious and longstanding problem especially in developing countries. Indiscriminate application of chemical pesticides in vegetable production is widespread, harming farm workers and their families, consumers and the environment. In South Asia, 50-70% of vegetables are contaminated with insecticide residues and one-third of the world's pesticide poisoning cases occurs in this region. Pesticides and other chemical treatments are also used soon after harvest to retard produce spoilage. Country regulations for pesticide residues and chemical use usually exist but many developing countries have inadequate enforcement and monitoring systems. Heavy metals, such as cadmium and arsenic, can be present in plants at levels toxic to humans but not to plants. In Vietnam vegetable areas which have mostly acidic soils which are low in organic carbon and clay, soil surveys showed critical levels of cadmium that could render produce unsafe for human consumption. A more widely publicized food safety problem is food poisoning due to consumption of raw or uncooked vegetables contaminated with pathogenic microorganisms (e.g. *Escherichia coli* O157:H7, *Salmonella* spp., *Staphylococcus aureus*, *Bacillus cereus*, *Clostridium* spp., *Shigella* spp., *Vibrio* spp., rotavirus). Some pathogenic infections originate at production and proliferate after harvest due to improper handling, inadequate temperature management, limited access to clean water, and poor hygiene and sanitation. Among biotoxins, aflatoxins produced by *Aspergillus flavus* and *A. parasiticus* are among the most important food safety issues worldwide; aflatoxins are highly toxic and can cause acute and chronic symptoms in humans. Aflatoxin B1 is the most common aflatoxin found in foods and is a very potent carcinogen and mutagen. The aflatoxin-producing fungi can colonize a wide range of crops both in the field as non-

destructive plant pathogens and in storage, and can grow and produce aflatoxins at low moisture levels yet over a broad temperature range (13-37°C). High aflatoxin concentrations have been detected in dried chili products originating in countries of Asia and Africa, resulting in rejection of shipments and product recall in importing countries such as USA and Japan. Aflatoxin contamination in chili is aggravated by genetic, agronomic, marketing and policy shortfalls. Chili pepper is one of AVRDC's principal crops and greater breeding efforts to address the aflatoxin problem are in progress. Finally, several antinutritional factors are present in vegetables; examples are the goitrogens (thiocyanide and thiouracil which cause abnormalities in the thyroid gland leading to goiter) in cabbages and other brassicas. In mungbean, phytic acid reduces nutritional quality by limiting the bioavailability of iron; other antinutritional factors in mungbean include trypsin inhibitor, tannins and saponins. Bruchid beetle infestation in storage increases phytic acid and saponin contents and trypsin inhibitor activity.

AVRDC - The World Vegetable Center, in collaboration with national and international partners, takes on a whole food chain approach to address food safety issues. AVRDC harnesses its wide germplasm collections to develop varieties resistant to pests and diseases thereby reducing the need for chemical pesticides as well as varieties low in antinutritional compounds and dense in nutritional compounds. The Center generally produces open-pollinated varieties which fit well in smallholder production systems and have produced huge impact in many Asia-Pacific countries. These open-pollinated varieties comply with Good Agricultural Practice (GAP) requirements as a food safety assurance system in some countries. These varieties also form part of integrated crop management strategies to control pests and diseases and further reduce farmer reliance on chemical pesticides. Several integrated pest management (IPM) strategies have been developed to control serious pests of eggplant (fruit and shoot borer - *Leucinodes orbonalis*), cabbage and other brassicas (diamond back moth - *Plutella xylostella*, striped flea beetle - *Phyllotreta striolata*), and vegetable legumes (bean pod borer - *Maruca vitrata*). These include the use of bio-pesticides (*e.g.*, *Bacillus thuringiensis*, nucleopolyhedroviruses, entomopathogenic fungi, antagonistic fungi and bacteria), pheromones and biocontrol agents (*e.g.*, parasitoids, green lacewing, predatory mite) in addition to cultural practices such as field sanitation and allowing proliferation of natural enemies by withholding insecticide use; some of these technologies are commercialized in several Asian countries. The IPM strategy to control eggplant fruit and shoot borer could reduce chemical pesticide use by 65-75% in Bangladesh and India, cut production costs by 30%, and increase farmers' incomes by 60%. Other component production methods include the use of starter solution technology as a substitute for up to 50% of conventionally applied fertilizer and simple low-cost drip irrigation that can reduce water and labor use by 20-30% and increase yield by 20-50% while protecting the harvestable part of the crop from contaminated irrigation water. Several protected cultivation systems have also been devised to shield vegetables from unfavorable weather and pests thereby reducing or eliminating chemical pesticide use. Nylon net tunnels, net houses, plastic houses, rain shelters and greenhouses were developed by AVRDC to suit conditions in different countries. Without pesticide sprays, simple net houses can reduce pest damage by 70%. An integrated crop production and protection program for protected cultivation was developed for Central and West Asia using safe procedures and less chemical pesticides. In Vietnam, safe management of heavy metals in soils and agricultural produce is done by

simple and effective farm practices such as selection of crops, liming, adding organic matter and controlling soil applied inputs. Furthermore, small vegetables gardens, such as home gardens, school gardens and community gardens where vegetables can be produced with few or no chemical pesticides, are being intensified and replicated in several Asia-Pacific countries to promote the production and consumption of wholesome and diverse types of vegetables for a nutritious and balanced diet, to improve household food and nutrition security, generate employment and additional income particularly for women and the youth, and to promote gender equity. Breeding is in progress to develop cucurbit varieties suited for garden production. To complete the link between production and consumption at AVRDC, postharvest technologies were developed to reduce losses and enhance the quality and food safety of harvested vegetables. Safe and simple technologies include sanitizing wash in 100-200 ppm sodium hypochlorite solution, dipping for 2 min in 2% bicarbonate solution using food-grade baking soda to reduce tomato rots, applying guava leaf extract (1:1 dilution), lime paste (1:1 lime powder and water mixture) or 15% alum solution at the butt end of cabbage to control bacterial soft rot, modified atmosphere packaging using commercially available plastic bags (low-density or high-density polyethylene or polypropylene bags) to improve shelf life of tomato, chili and leafy vegetables while enclosing them from potential external food safety hazards during handling and marketing, hygienic drying of chili and cabbage using simple solar driers, and hygienic processing of fermented leafy vegetables, chili sauce and tomato paste.

At present, AVRDC has a number of research and development programs with food safety implications; these are mostly collaborative and multidisciplinary and deal with vegetable breeding, crop management, integrated pest management, vegetable garden production, postharvest management in a food chain setting as well as initiatives on vegetable preparation and cooking to ensure the nutritional content remains high and is bioavailable. These continuing initiatives will generate new knowledge, technologies and innovations and will assist the mainstreaming of quality assurance systems in developing countries. These will be promoted to raise the profile of vegetables for improved health and global poverty alleviation.

KEYWORDS

Safe vegetables, Food safety management, Farm-to-table approach, International collaboration

3-3

Breeding for Mycotoxin Resistance in Wheat and Maize: CIMMYT's Recent Work and Strategy

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ABSTRACT

Mycotoxins are secondary metabolites produced by species of fungi that colonize several major food crops, including wheat and maize. It has been proven that mycotoxins are harmful to human beings and animals alike, leading to great public health risk and food safety hazard, besides severe losses to crop and livestock production. In 2006, new EU regulations set the limits of various mycotoxins in food grains, reflecting the concerns for food and feed safety. Similar enforceable regulations are also made in the US, Canada, China, Japan etc., but not in many developing countries, where systematic surveys leading to empirical data on mycotoxins and the numbers of people chronically exposed to mycotoxins is lacking. The International Maize and Wheat Improvement Center (CIMMYT), as a not-for-profit international institution mandated with wheat and maize improvement for the benefit of smallholders, is undertaking intensive work on identifying and developing mycotoxin-resistant germplasm to safeguard global food and feed safety, in partnership with several institutions in the developed and developing countries. Several projects are carried out on breeding for mycotoxin resistance in wheat and maize, besides developing effective mycotoxin screening protocols. In wheat, *Fusarium* head blight (FHB, or scab) is the most important mycotoxin-producing disease globally. Seventeen *Fusarium* species are known to cause FHB with *F. graminearum* being predominant species in many countries, producing mycotoxins represented by deoxynivalenol (DON). CIMMYT has devoted major efforts to breed for DON resistance wheat germplasm since 1980s. The FHB screening field is currently located at CIMMYT, El Batán, Mexico. Selection for DON resistant germplasm is based on multiple-year (usually three consecutive years) data of field FHB index, *Fusarium* damaged kernels, DON concentration, and phenological traits like days to heading and height. Pedigree information was also considered to maintain a good genetic diversity of the nursery. Promising lines with low FHB parameters and good agronomy were compiled regularly as FHB screening nursery (FHBSN) and distributed globally for national wheat breeding programs. Genotypic data of markers linked to major FHB resistance QTLs are available for the nurseries, to elucidate the resistance mechanism at molecular level and to facilitate hybridization schemes. Multi-environmental experiments revealed that many of FHBSN lines exhibited stable and satisfactory FHB resistance. In maize, ear rots caused by *Fusarium* spp. and *Aspergillus* spp. pose great threat to production as well as food and feed quality of maize grains worldwide. Aflatoxin and fumonisins are among the major toxic products threatening the animal and human health. Host resistance is the most practical and economical means to combat the problem, especially for the small-holder farmers and maize

consumers in the developing world. High-throughput screening protocols are developed by CIMMYT and partners for evaluation of maize germplasm for ear rot and mycotoxin resistance, and promising materials are quantitatively evaluated in the laboratory for aflatoxin content, with the economical and reliable ELISA system. Molecular markers and doubled haploid (DH) technology are also being effectively utilized for identifying markers for mycotoxin resistance in maize germplasm, and for accelerating improved germplasm development, respectively. In addition to these direct breeding approaches, breeding for heat and drought tolerance, foliar diseases and insect resistance etc. are also simultaneously being undertaken, since there is adequate evidence that these biotic and abiotic stresses can significantly affect the vulnerability of maize germplasm to ear rots and mycotoxins.

KEY WORDS

Mycotoxins, Deoxynivalenol (DON), Aflatoxin, Fusarium head blight (FHB), Resistance breeding

S4-1

Codex alimentarius and its harmonization

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The Codex Alimentarius is a collection of internationally adopted food standards including related texts aim at protecting consumer's health and ensuring fair practices in the food trade. It includes standards for all the principle foods, whether processed, semi-processed or raw, for distribution to the consumer. The Codex Alimentarius defines provisions in respect of both horizontal as well as vertical standard setting viz; food hygiene, food additives, residues of pesticides and veterinary drugs, contaminants, labelling and presentation, methods of analysis and sampling, and import and export inspection and certification.

Codex standards and related texts are not a substitute for, or alternative to national legislation. Every country's laws and administrative procedures contain provisions with which it is essential to comply. Codex standards and related texts contain requirements for food aimed at ensuring for the consumer a safe, wholesome food product free from adulteration, correctly labelled and presented. A Codex standard for any food or foods should be drawn up in accordance with the format for Codex Commodity Standards and contain, as appropriate, the sections mentioned in the Codex procedural manual. This Manual describes the legal foundations and practical functioning of the Commission and its subsidiary bodies.

Codex has a system for proposals for new work or revision of a standard, prepared by a Codex member countries, and are first considered by the concerned Codex Committee. In short, it should provide details, such as, purpose, scope, relevance, main aspects to be covered and other relevant information. The decision to undertake new work or to revise a standard is taken initially by the concerned Codex Committee followed by the Codex Alimentarius Commission based on the views expressed by the Executive Committee. The Commission decides to elaborate a world-wide or a regional Codex standard and also decides which subsidiary body should undertake the work. Currently, Codex has 10 General Subject Committees (food labelling; food additives; contaminants in food; pesticide residues; residues of veterinary drugs in foods; food hygiene; food import and export inspection and certification systems; nutrition and foods for special dietary uses; and method of analysis & sampling), 6 Commodity Committees; and 6 FAO/WHO Coordinating Committees.

Risk Analysis is fundamental to the scientific basis of Codex Standards. Codex Committees, when developing standards, apply risk analysis and rely on the independent scientific advice provided by expert bodies under FAO/WHO. Risk assessment is carried out by the Joint FAO/WHO Expert Committee on Food Additives (JECFA); the Joint FAO/WHO Meeting on Pesticide Residues (JMPR); and the Joint FAO/WHO Expert Meetings on

Microbiological Risk Assessment (JEMRA); and by other scientific expert consultations arranged by FAO/WHO. In case of nutrition items, this work is carried out by the Joint FAO/WHO Expert Meeting on Nutrition items (JEMNU). The 'recommendations' given by JECFA, JMPR and JEMRA and other Expert Consultation Groups are forwarded to the related General Subject Committees for consideration and decision on adoption of a Codex standard. Since CAC is a final standards-setting body to ensure safety of food and fair practices in the food trade, it is their responsibility to consider any adverse economic impact on the trading partners, in particular, the developing countries. FAO and WHO have set up a Codex Trust Fund which is managed in a transparent manner by WHO.

The FAO and WHO of United Nations regularly encourage countries to harmonise national standards with those adopted by Codex Alimentarius Commission. Harmonisation of national standards with codex standards provides the opportunity to enhance trade, as they are the reference standards within the framework of WTO. In early 2000, harmonization of the food standards was initiated in Asian countries to facilitate the exchange of information and scientific updates among regulators; discuss and share potential mechanisms for improvement of food safety standards; facilitate harmonization efforts towards Codex, where they exists; or towards scientifically- sound regional standards where Codex standards are not in place; and identify gaps for exposure data development and assessment capacity building.

Recently Harmonization of Indian Standards with Codex and other International best practices has been initiated to review of existing Indian standards taking into account the latest development in food science, food consumption pattern, new specifications, presence of new contaminants and toxins as well as use of new food additives and ingredients required by the producers and manufacturers. In this regards, Electronic working groups were formulated for development of vertical standards and horizontal standards. The work of harmonization will be completed within few months and will help in achieving the intended food safety objectives,

KEYWORDS:

Codex, consumer's health, safety, food trade, risk assessment, food standards, harmonisation

S4-2

Translational Research on Transgenic Crops at ICRISAT: Towards Product Development, Deployment, Food Safety and Biosafety

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Transgenic technology has gained significance in the recent years due to increasing demand for efficient agricultural production to provide sufficient food for the growing population, which is estimated to increase by 3 Bn over the next 50 years. While conventional breeding, involving exchange of genes between two plants to produce offspring that have desired traits, is limited to exchanges between the same or very closely related species, whereas transgenic technology enables combining in one plant useful genes from a wide range of living sources and at a relatively shorter time. Agricultural biotechnology has the potential to reduce crop losses from pests and diseases; improve the nutrient efficiency of food and animal feeds; extend the post-harvest life of fruits and vegetables; and to increase the stress tolerance of crop plants allowing them to tolerate various environmental extremes. In developing countries in particular, biotechnology has the potential to revitalize the agricultural sector and increase the profitability of farming. Scientific solutions to improve crop productivity, where biotechnology can play an important role, can empower the rural sector by boosting food production, enhancing income for the small farmer, and improving nutritional security. As with every new emerging technology, GM crop technology needs utmost compliance in terms of biosafety, regulatory, intellectual property, etc. that are extremely important to be considered while developing transgenic crops. With this in view, an entity - Platform for Translational Research on Transgenic Crops (PTTC) - affiliated with ICRISAT and funded by the Department of Biotechnology (GoI), has been established that serves to evaluate potential new genetic engineering options with utmost global compliance. Governed by the CGIAR policies, the transgenic research at ICRISAT adheres to the highest international standards, follows stringent regulations and conducts research in a socially responsible way. PTTC facilitates a collaborative and coordinated approach for the translation of genetic engineering technologies to the development of transgenic crop varieties, which can be efficiently taken through product development to commercialization. The conceptual framework of PTTC and the opportunities for the public and private sector organizations for product development including regulatory compliance will be discussed.

S4-3

Asian Food Resource Network and Safety Evaluation

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ABSTRACT

Thousands of local food resources including indigenous plants, animals, insects and traditional fermented foods has been consumed in Asian people since ancient times. They are not only produced in agricultural fields or farmers houses but also collected from nature. Most area-specific fermented food are not distributed to distant places. To date, scientific information on these local food resources are not fully accumulated. However, some of recent scientific studies have indicated that those regional food resources have a high potential to be a source of health functional components and useful microorganisms. And, it is expected that there will be scientifically uncovered technological keys in the traditional way of food processing. These traditional technologies caouls be applied to develop a new processed food products. At the same time, among the components of regional foods made from indigenous materials, or metabolites of unique microorganisms, there would be a novel effective functional compounds and useful enzymes. Additionally, comprehensive analytical data about chemical composition and microorganism may help to solve food safety issues.

Based on these backgrounds, JIRCAS together with its Asian counterpart organizations agreed to launch the 'Food Research Network of Asia' for the efficient utilization of indigenous food resources under the joint declaration at Bangkok in 2013. Members of the network started to keep close communication and shared their knowledge on major issues concerning food research, particularly food processing technology and physiological functionality of traditional food resources. Through the annual meetings in 2011 - 2013 (at Thailand and China), it was discussed how to extend the activity of the network private sectors of each countries. As an activity of the network, databases on indigenous foods of each region of Asia is now being constructed. The databases will be uploaded on the web.

At the same time, JIRCAS will implement extensive projects (Advanced Application of Local Food Resources in Asia), re-evaluate previous empirical data, bearing in mind that our research outputs will be used in the industries. A group of researchers from JIRCAS, Kasetsart University (Thailand) and Laos University elucidated the regional differences and timedependent transition of bacterial and fungal species (e. g. lactic acid bacteria) living in fermented fi sh produced in Indochina by analyzing DNA via denaturing gradient gel electrophoresis (DGGE) method. On the subject of food processing, researchers from JIRCAS and China Agricultural University developed a new and efficient coagulant agent to produce a Chinese-style tofu. Electron spectroscopic characterization of sticky rice from

Japan and Thailand was carried out to understand the properties of water-soluble polysaccharides, which are expected to be used for various food processing techniques.

KEYWORDS

Regional food resources, local food, traditional food, fermented food

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