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Strategies for food safety: A contemporary approach

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Abstract
Access to adequate and safe diet is the elementary human necessity and essential to have a hunger-free world. Unsafe productivity leads to unsafe food, foodborne illness and death. Foodborne illnesses impose a substantial burden on the livelihood, healthcare systems, economy of human and trade and tourism in a broad way. Yet, the full spectrum of such burden has never been quantified on a global basis since foodborne disorders remain unnoticed specially in developing nations like India where improper knowledge, average education, poor hygienic measures catalyse the reaction. Therefore, it is imperative to integrate food safety into government policies and provide necessary interventions to improve nutrition and food security for the common people. Thus a multipronged and multidisciplinary approach involving consumers, public health analysts, industry and policy makers at various levels is needed to ensure food safety at all levels.

Keywords: Food safety, food trade, food safety strategy

Introduction

Rapid globalization of food production and trade has increased the propensity of incidents involving spoilt food affecting people across the globe. Serious outbreaks of foodborne diseases have been documented every now and then, illustrating the public health and social significance of these diseases [1]. Poor nutrition and foodborne diseases form a vicious cycle of worsening health in which poor are the most exposed and the worst sufferers. Globally, at least 2.2 million people are killed annually with foodborne and waterborne diarrhoeal diseases, with 23,000 people dying in the United States alone [2]. Food safety is the assurance that food will not cause harm to the consumer upon use. It is slowly becoming a major criterion for sustainable development, being directly associated with better productivity and livelihood.

Food safety broadly encompasses following four areas:

1. The microbial safety of food which includes inhibiting the occurrence of major foodborne pathogens like Salmonella, *E. coli*, Listeria etc
2. The chemical safety of food (freedom from antibiotic and pesticide residues and heavy metal contamination)
3. GMOs and other novel foods like organic foods and pre-packaged or frozen Ready –to-eat meals (development of policies regarding safe use of these in foods)
4. General quality of diet

With increasing awareness in both consumers and industries regarding the importance of food safety, the stakes have become higher in the field. Its importance to human nutrition and food security can no longer be ignored or taken for granted and any aberration in the flow-chain of safe food might have devastating outcomes. Henceforth food safety involves voluntary access of development, implementation and maintenance of hazard analysis based curriculums to launch external supervising and verification schedules [3]. Food safety standards can be demarcated as the requirements and practices essential for the purpose of ensuring food safety in terms of hygiene and health [4]. Food safety starts right from handling and preparation to storage assuring that food will be harmless to consumers [5].The regulations have become very important today because they highlight and emphasise boldly on mitigating the alterations in food production, supply and food contamination including factors due to environmental changes. Moreover, new and emerging bacteria, viruses and parasites, toxins and antibiotic resistance in foodborne germs are further exacerbating the problem.

So there lies a need of multiprong approach among the consumers, governments, industry for better detection of multistate outbreaks scientifically. Besides, new techniques for quick detection and rapid analysis of foodborne infection like the culture-independent diagnostic tests, penside and platform tests allowing rapid determination of the cause of an illness hold great potential [6]. However, most of these tests require centralised laboratories, highly skilled technical staff and a lot of funding which is not always available. Availability of fast, simple, reliable, sensitive and portable methods are required to tackle food safety issues. Biosensors provide a viable and effective alternative for monitoring of foodborne diseases and other food related issues. They can be easily incorporated into equipments, packaging systems and food manufacturing monitoring systems like HACCP.

Need for Food safety: SWOT Analysis

A safe supply of food of good quality is necessary for sustaining humanity and quality of human life and creating a world without hunger and reduction of poverty. Occurrence of foodborne diseases affect not only people's health and well being, but is also a major impediment on socioeconomic health of societies, individuals, families, businesses as well as countries. Whenever a food borne disease outbreak occurs, there is a threat to trade and tourism, putting substantial burden on health care systems, increased DALYS, threaten the livelihood, reducing the economic productivity thereby creating a vicious circle of poverty getting out of which is nearly impossible. Globally, nearly 600 million cases of foodborne diseases and 420000 deaths are reported every year of which 30% deaths are of children less than 5 years of age. This amounts to a loss of nearly 33 million years of productive and healthy lives due to eating unsafe food all over the world, every year and so many cases are not even reported. Infact we can say that 1 in every 10 persons falls ill after getting exposed to contaminated food and water [7]. The major culprits responsible for nearly 18 million DALYS worldwide were non typhoidal Salmonella and enteropathogenic Escherichia coli (EPEC) along with *Salmonella typhi* and *Taenia solium* [8]. Despite the ubiquitous nature of the threat posed by foodborne pathogens and the burden of illness caused by them spread evenly throughout the world, there is gross underreporting of these incidents, ranging from 10% to as low as 1% [9]. The full scale of the burden of foodborne diseases has never been determined on a global basis. All the above mentioned statistics are just regionally acquired and sporadic occurrences.

CDC identifies five major risk factors including food from unsafe source, inadequate cooking, improper holding temperature, contaminated utensils/equipments and poor personal hygiene to be responsible for majority of foodborne outbreaks [10]. With more and more people trying out wider, newer and high priced varieties of foods than in the past and non seasonal foods available all through the year, there are always some rapidly emerging risks which need to be dealt with [11]. Burgeoning population, urbanisation, expanding trade and change in technology have further catapulted the need of food safety norm at the fore front of every policy maker in the world. [12] Genetically Modified Organisms (GMOs), Bovine Spongiform Encephalopathy etc are some of the other issues emerging to exacerbate the situation. Thus, there should be clear policies and procedures to manage such crisis judiciously. On one hand, the integration and consolidation of agricultural and food industries, new dietary habits, globalization of food trade is beneficial to consumers as well as to the countries involved in food trade to earn foreign exchange. On the other hand, it also provides opportunities for diseases to travel faster, easily catapulting them into global crisis in no time.

The Changing Approach for food safety at Different levels

Over the past decade and so, important breakthroughs have been made in the field of food safety and control, including the development of food standards at both national and international level. Adoption of different sets of food safety standards by individual nations is a major hindrance to international trade for both exporting and importing countries. Thus to ensure optimum global coordination and facilitation of trade, international food standards have been developed by a multitude of international agencies, viz., the Food and Agriculture Organization (FAO), the World Health Organization (WHO), the World Trade Organization (WTO), the Codex Alimentarius Commission (CAC). These agencies work at national, regional and international platform to provide coherent policy advice, stimulate intercountry collaboration mechanisms, mobilize resources and provide necessary technical advice, training and assistance needed to tackle food safety issues. The involvement of these agencies also propagates and boosts the technical capacities of the national food safety programmes and generates awareness among the general population [13].

In the year 2000, food safety was given the status of a public health priority by the WHO. [14, 15] WHO is an international organization of the United Nation established on 7th April 1948 in Geneva with its main emphasis being international public health and food safety. In 1963, WHO and FAO jointly established the Codex Alimentarius Commission (CAC) as a guideline to international food safety. The CAC is now recognized worldwide by the WTO as an international reference point for the resolution of disputes concerning food safety and consumer protection. [16]

In 2007, WHO established 'a Foodborne Disease Burden Epidemiological reference Group (FERG)' to estimate the global burden of foodborne diseases, under the leadership of WHO's Department of Food Safety and Zoonoses (FOS). [17, 18]

"Food Safety-from Farm to plate, make food safe "was adopted as theme for the World Health Day 2015 [8] to create awareness among general public on the importance of food safety in day today life.

The WTO was established in 1995 as a replacement of the General Agreement on Tariffs and Trade (GATT) and is now the largest international economic organization in the world regulating international trade in food products [19].

Incidence of foodborne outbreaks affect the food exports and imports. So effective global food safety management systems are very essential for the protection of consumers meanwhile avoiding any unnecessary trade restrictions or embargos. Internationa Food Ssafety Authority Network (IFSAN) was established with a motto to provide timely information during food safety emergencies so that involved parties can take precautions in advance [15, 20]. A Global Foodborne Infections Network has also been developed by the WHO to encourage surveillance and monitoring of incidences related to breach of food safety and to encourage multisectoral collaboration. [15]

To reduce the incidence of microbiological foodborne illness and food spoilage worldwide and to facilitate global trade, the International Commission on Microbiological Specifications

for Foods (ICMSF) was formed in 1962 through the action of International Committee on Food Microbiology and Hygiene, a committee of the International Union of Microbiological Societies (IUMS). FAOLEX is one of the world's largest repository of national laws and regulations on food, agriculture and renewable natural resources. [21]

'Foodborne Zoonoses 2013-2022' is a collaborative plan for food safety devised by WHO that calls for encompassing collaborations between public health, agriculture and animal health sectors. The widespread adoption and preference to Hazard Analysis & Critical Control Points (HACCP) systems by food industry throughout the world is a clear indication that consumers are now enlightened towards this aspect and are aware of their right to demand food which is safer and sumptuous at the same time.

Food-borne hazards can occur at any point of consumption and at any stage in the food chain. Thus, the consequences of unsafe food can be serious. International Organization for Standardization (ISO), an independent, non-governmental international organization comprising of 168 standards organizations of member countries was established in 1947 to develop world standards to create safe, reliable and good quality products and services. These standards are required to increase productivity while minimizing errors and waste. As products from different markets could be directly compared, new avenues and opportunities become available to the companies for trade and assist in the development of global trade on a fair basis. These minimum international standards ensure that the common consumer who is the end-users of products and services gets the certified products only thereby ensuring his safety and health. The ISO 22000 group of International Standards specially reports food safety management [22]. These standards help organizations to identify and control food safety hazards.

Likewise, different countries have also created their jurisdictions through various regulatory bodies independently, few are listed below.

Table 1: Major Food Regulatory Agencies around the Globe.

Agency	Country	Formed
Food and Drug Administration	USA	1906
Canadian Food Inspection Agency (CFIA)	Canada	1997
National Agency for Food and Drug Administration and Control (NAFDAC)	Nigeria	1993
Department of Food and Drug Administration	Myanmar	1995
China Food and Drug Administration (CFDA)	China	1950 [2013 reorganised]
Centre for Food Safety (CFS)	Hong Kong	2006
Food Safety and Standards Authority of India (FSSAI)	India	2011
Food and Drug Administration	Philippines	1963
Ministry of Food and Drug Safety (MFDS) [Korea Food & Drug Administration (KFDA)]	South Korea	2013 [1996]
European Food Safety Authority (EFSA)	European Union	2002
Federal Institute for Risk Assessment (BfR)	Germany	2002
Norwegian Food Safety Authority	Norway	2003
Economic and Food Safety Authority (ASAE)	Portugal	2005
Catalan Food Safety Agency (ACSA)	Catalonia	2002
Food Standards Agency	UK	2000
Food Standards Australia New Zealand (FSANZ) [Australia New Zealand Food Authority (ANZFA)]	Australia & New Zealand	1991
New South Wales Food Authority	Australia	2004

Food Safety Implementation Constraints

Keeping with the pace of globalization, WHO has recommended five keys for safer food which are used to spread the food hygiene message among the food manufacturers and consumers throughout the world. This campaign promotes personal hygiene, adequate cooking, avoiding cross-contamination, keeping food at safe temperatures and avoiding food from unsafe sources [23]. India is struggling with age old problem of poor environmental sanitation, less safe water availability and poor disease surveillance. As a result, these 'five-finger rules' are just rules unless they are implemented at household levels.

Cross-contamination, as in the 'poor-kitchen' conditions where indigenous ways of storing food are still practiced, also poses a major challenge [24, 25] Improper cooking of food like simple warming rather than thorough cooking threatens the security of food, ultimately human sickness [24].

Adulteration is another important concern in this regard signifying a higher possibility of imposing serious risk to health as the food is made sub-standard by employing external unnecessary materials which can be dangerous to health of the consumers. It can be intentional (sand) and/or incidental (pesticide residue) [26]. Moreover, personal hygiene still remains an active barrier till date, especially in case of handling food [27]. Besides there are a vast range of more prominent attributes that influence the food assurance priorities in a way or other. The following figure highlights such arenas.

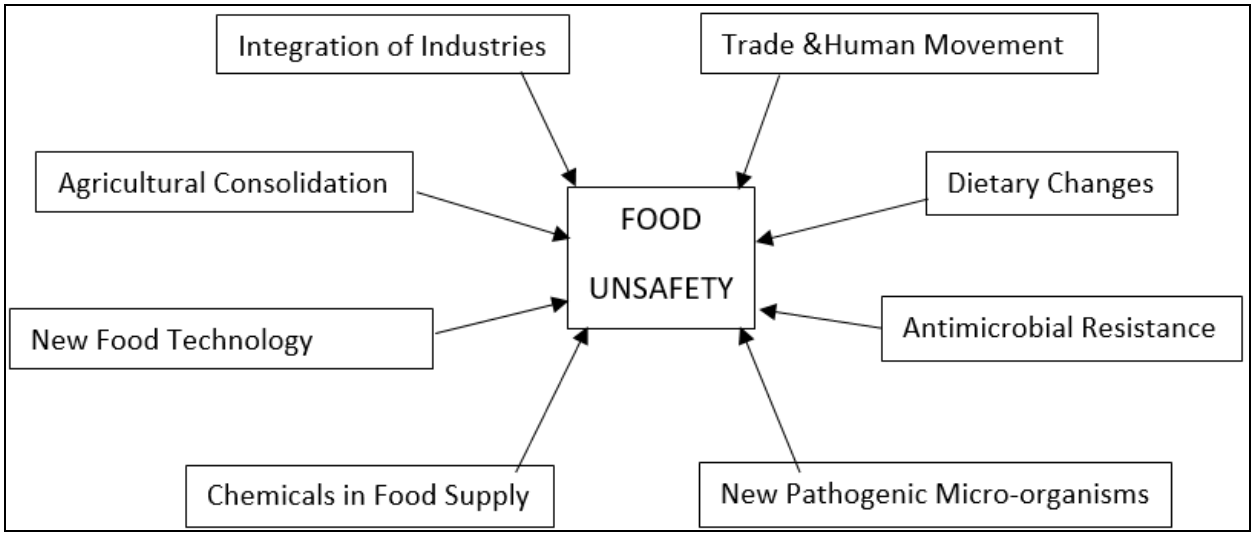

Fig 1: Factors influencing food vulnerability

Food Safety Strategies

Food safety cannot be acquired only with stricter regulation, global manufacturing standards, distribution and competitiveness. Also, there lies a necessity to reflect behavioural, structural and cultural issues along the continuum of food from farm to table [28]. Good food habits and manufacturing practices have to be inculcated right from the manufacturers to the consumers. For this, effective cross-sectoral collaboration and strong functional links have to be developed between different sectors particularly related to food and human health creating a strong partnership among these. The following diagram depicts the interrelationship of the associated features for having public health safety.

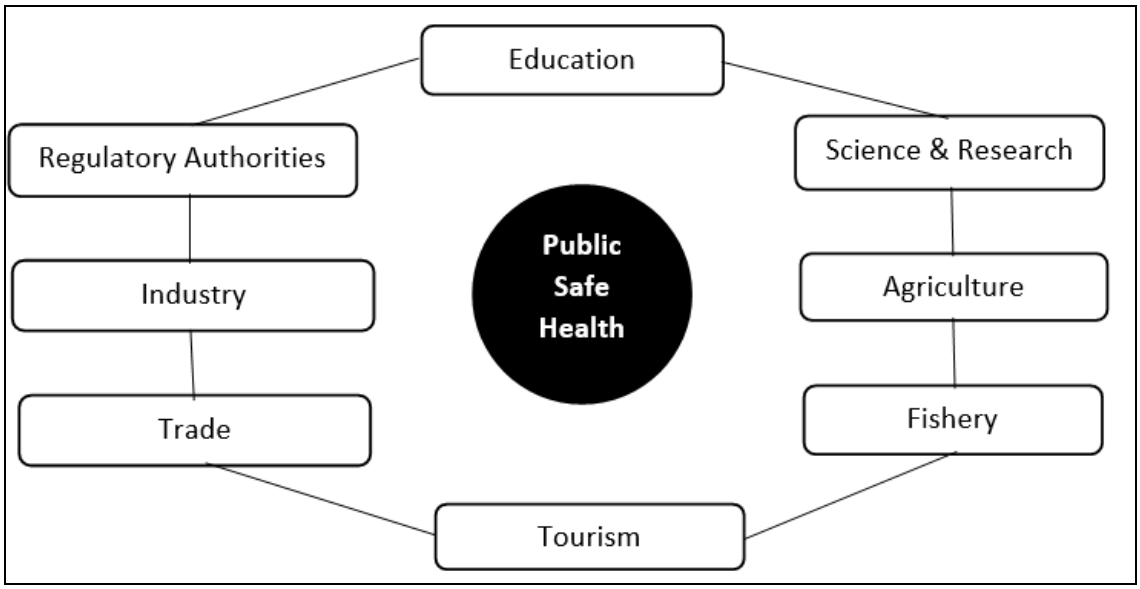

Fig 2: Partnerships and Correlation among Aspects enhancing Public Health.

Formulation of global food safety strategy, rapid globalization changes, climatic impact on food production, distribution and consumption, emerging biological and environmental contamination of food chain and new food technological effects are emerging challenges to the global food safety. To tackle these, improvement in food control systems, prevention of foodborne illnesses with effective surveillance systems, new food laws, acts and standards, appropriate action plans, alignment with international standards and alert systems must be given priority.

Food legislations should be adopted and updated to modernize and harmonize national legislation with the Codex guidelines. As a result of consumer awareness, enactment of the Food Safety and Standards (FSS) Act is accomplished, realizing the safety importance. Hereafter, the national food laws ought to possess objective of provision of high level food protection and assurance of only safe food to consumers.

Risk analysis is necessary to manufacture high quality goods, to comply with international and national market standards and to reduce food borne illnesses. Risk assessment, risk management and risk communication are the main parts of Risk analysis. Standardization of food sampling and analysis methods, food contaminants monitoring and quality assurance system development are required to meet the international standards [22].

In October 2004, WHO inaugurated the International Food Safety Authorities Network (INFOSAN) for preventing international spread of contaminated food and foodborne disease and strengthening safety norms globally. In view of the increased food trade, Indian government has made export certification mandatory in the form of Export (Quality Control and Inspection) Act 1963. The official certification body for

exports, Export Inspection Council of India, develops standards based on Codex. The main export inspection and certification system followed in Indian food sector is the Food Safety Management Systems-based Certification (FSMSC) founded on Hazard Analysis and Critical Control Point (HACCP). Also, Good Management Practices (GMP), Good Hygiene Practices (GHP) and Sanitary and Phytosanitary Measures (SPS) are followed.

HACCP is a systematic preventive approach of food safety from all aspects, viz., biological, chemical and physical hazards. The primary measure is to reduce such risks to a safe level. HACCP attempts to avoid hazards rather than inspecting only finished products for the effects of those hazards. This system can be effectively used at all stages of a food chain, from food production to distribution.

Food safety In India

Economic growth, rising incomes and urbanization have influenced Indians' eating habits to a much greater extent. This has lead to increased demand for greater variety in food choices, increased use of canned and pre-prepared food items and different cuisines. Increasing educational standards, general awareness and access to all sorts of information through net has made Indians more concerned about food quality and safety. The 2015 withdrawal of Maggi noodles and ruckus about unsolicited presence of pesticide residues in cold drinks in 2004-05 is a glaring example about the level of awareness about Indian consumers regarding the food safety situation. Monitoring by government agencies and NGOs has also raised awareness and emphasised on the importance of safe food [29].

In India, reporting of food-borne diseases is by and large erratic and most of the cases often go unreported. A nationwide study in 2006 projected the extent of food-borne illness to be affecting 13.2% of households. [30]

The Food Safety and Standards Act (FSSA) of 2006 was promulgated to improve the overall food safety of the population and to oversee the national and international food trade. It led to the establishment of Food Safety and Standards Authority of India (FSSAI) in 2008 which is an autonomous body promoting public health through regulation and supervision of food safety [31].

While the awareness for food safety among Indian consumers has increased especially among urban consumers, rural consumers remain susceptible to unsafe food. They need to be educated through mass-media campaigns and other methods which expose them to the concept of food safety. FSSAI should reach out to them, working in consortium with other ministries to raise awareness about workplace, farm, and household hygiene as well as safe use of pesticides. Innovative governmental policies like 'Swachh Bharat Mission' and 'Make in India' campaigns have linkages with food safety. The former promotes cleanliness and hygiene and the later helps in export of safe high value produces. Side-by-side advertisement could support awareness raising campaigns about safety, security, nutrition and consumers' rights.

Conclusion

Food safety is a broad term combining various job descriptions like handling, preparation and storage of food. The food safety challenges need multi pronged approach and collaboration of all the parties involved at all levels. There is requirement of scientific rationale, means and resources to practice the globally approved food safety standards. Such programmes may aim to address the entire farm-to-fork-to-consumption with cultural sensitive adaptive tactics. Strategies necessary for building an effective network and partnership among all relevant sectors for developing a national food safety policy and plan of action are needed. A high-level national structure or body to endorse the procedures and to monitor implementation and progress should be constituted. The tools and techniques adopted for monitoring and evaluation preferably be simple, sustainable and possibly be aligned with internationally accepted protocols, analytical tools and databases. Quantitative microbial risk assessments to identify critical points within the food continuum at which effective interventions can be made, have the greatest impact on decreasing food hazards. Innovative interventions are needed to control pathogens in animal production at entry level itself. Thus, the incorporation of evaluation mechanisms in the food safety programme extends to the establishment of evidence based public health practices. Today Consumer is God. When he demands safe foods, all the concerned parties viz., industry, producers, and food handlers have to accept the challenge, get in sync and comply.

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