
Role of food safety and quality in Indian food supply chain

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Abstract: Food security and preserving food quality has become preemptive when food trade and transport are addressed. High level of quality standards are followed for food being sold in the market and ensure that it is safe for consumption and free from infections. Due to increasing customer demand and food trade, safety, quality and standards are becoming a matter of utmost importance for producers, sellers, distributors and government. From the production to the consumer, it moves through various stages of supply chain, which arises the need of regular monitoring and maintaining food quality standards in the entire supply chain. The purpose of this study is to review the food supply chain with major focus on food safety and regulatory framework, which could be useful for industry, academicians, researcher, and policymakers. This study also highlighted the criticality of safety and quality in the food supply chain, especially from logistics and distribution perspective.

Keywords: food safety; food quality; food supply chain; distribution; transportation.

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1 Introduction

Sustaining food safety and security has become absolute when it comes to food trade and customer demand. The food placed on the market has to be of good quality and harmless for consumption, as well as not be a source of infection and disease. For this reason, safeguarding food safety and quality is a matter of international importance and responsibility of food producers and governments. The food contamination cases arising in the last few years have called the attention of scholars and practitioners across the globe to better food safety practices. In 2008 and 2009, the USA and Canada found evidence that peanut butter paste was contaminated with salmonella, causing nine deaths and affected another 637 people (Layton and Miroff, 2009). In 2008, pork goods produced in Ireland were contaminated by dioxin and affected global suppliers in several countries (EFSA, 2008). In China, milk powder was adulterated with melamine which results in six deaths and 294,000 contaminated people (Spencer, 2009). In 2011, bean sprouts produced in Germany were contaminated by *E. coli*, resulting in 37 deaths and another 3,000 people contaminated (Marucheck et al., 2011). These episodes and their consequences claim urgent and rigorous treatment, as they cause severe problems for

general public health and firms' value and profits (Resende-Filho and Hurley, 2012; Roth et al., 2008).

Despite that, there were several incidents of unstable/adulterated food distribution as well as food scarcity in the last few months challenging the food security and food safety systems of the country. It is hardly possible to ensure food safety and food security in the absence of efficient delivery and control and tracking mechanisms across supply chains. "In India, food security and food safety become major issues which are grabbing the attention of Regulators, Industry, and consumers. The need of the moment is to enhance food safety as well as food security by maintaining a food supply chain which can ensure availability of healthy choices for all budgets and provision of information for consumers to make informed choices", said Mr. Ravi Mathur, CEO, GS1 India (India Infoline News Service, 2018).

According to Roth et al. (2008), these contamination cases are partially related to changes in modern supply chains, such as the globalisation of food produce, amalgamation or associations of large companies, and commoditisation of food products. These alterations put stress on producers to cut cost (Tang and Babich, 2014), which, in turn, respond by reducing the investment in safety actions. Also, in global supply chains, the distribution centres play another important role in helping the prevention of safety hazards, because they collect food products and can detect food contamination before such food reaches the end consumers (Chebolu-Subramanian and Gaukler, 2015; Lao et al., 2012). The increasing number of tiers in the supply chain, for example, also affects the risk of food contamination, because the presence of many interacting elements increases the likelihood of chemical and physical contamination (Reiner and Trcka, 2004; Sloane and O'Reilly, 2013; Van der Gaag et al., 2004). During the process of distributing food products go through all stages of a supply chain, i. e. all processes which describe how food travels from a farm to the consumer's tables. The aim of this strategy, called 'from the farm to the table', is to achieve full command of food safety in the modern world, because the journey leading from food production to the consumer is time and space consuming. Along with this journey, there are many hazards of food contamination, be it in the very production, during the transport, food storage, or food preparation. To enable food quality and sanitary safety of food products, companies have to accurately follow legislation, standards, and norms at every stage of the supply chain.

This paper describes the supply chain process flow considering food safety and security. Food products are not only delicate, but they are perishable and hence require more consideration while storage and distribution and proper measures are taken to maintain temperature, humidity, etc. Food safety and quality are legally regulated while storage and distribution in the supply chain, companies ensure a high level of hygiene and temperature levels that different kinds of food products require. Regulatory bodies and the government is working on food safety improvement and standardisation. Historically, food safety in India has been regulated by a wide variety of legislative orders and acts, but this ad hoc approach is becoming more streamlined and effective. However, logistical challenges remain the same.

After the introduction and literature review section, this study discussed the types and importance of supply chain in the food industry. It also discussed the present vital standards and norms for safety and preservation of food quality. As the policy of food safety in last decades become highly relevant, this study also highlighted the importance of food policy and discussed in detail the food quality monitoring systems and food safety control systems in the food industry.

2 Literature review on food safety and control

Authors have collected literature, including research papers from peer-reviewed journals. Papers were collected applying a structured search, using phrases such as ‘food quality’, ‘food safety’. Various research databases such as Emerald, Science Direct, Inderscience were searched for related papers. The authors have referred various international journals. Some of them are *International Journal of Production Economics*, *International Journal of Logistics Economics and Globalization*, *International Journal of Operations and Production Management*, *The International Journal of Logistics Management*, *International Journal of Food Safety, Nutrition and Public Health*, *Supply Chain Management: An International Journal*, *Journal of Agribusiness in Developing and Emerging Economies*, and *International Food and Agribusiness Management Review*.

It is evident from the literature that several studies have been conducted on food supply chain focusing on the importance of food quality, food safety, food traceability, standards and regulation to improve the performance of the supply chain, also to improve the health of the consumers in today’s changing demand and consciousness towards food products. Studies have been conducted in different nations like India, US, UK, UAE, Kuwait, Europe, etc. Some of the studies and their focus are discussed in a chronological manner in this section.

Zhong et al. (2017) reviewed the food supply chain management (FSCM) in detail, so the research could be used for academic and industrial practitioners in the future. Authors reviewed total 192 articles related to the data-driven systems for FSCM. Mahalik and Kim (2016) identified the role of IT developments in the food supply chain integration and monitoring. Al-Mazeedi et al. (2015) studied the food safety issues to increase consistency among local health departments and their interpretations in food service rules in Kuwait. Vukasovic (2015) identified the relationship between food quality and food safety based on consumer’s perception with specific reference to Slovenia. Smigic et al. (2015) analysed the current situation of multidimensional food safety assurance in Serbia region and highlighted the need of improved effectiveness and efficiency of food safety control system.

Baines (2014) evaluated the delivery mechanism of the most important global food safety standards. The standards compared in the study included pre-farm gate standards (SQF1000, Global GAP and ISO22000) and food industry standards (SQF2000, BRC Global, IFS and ISO22000). Mahajan et al. (2014) evaluated the process of implementation of HACCP, food safety controls in India, and highlighted its current status in India. Rajneesh et al. (2014) explained how global food safety can be created through stringent implementation of Codex and World Trade Organization (WTO) sanitary and phytosanitary food safety regulations in India. Behzadi et al. (2013) developed an optimisation model to maximise the food safety and controlling the logistics cost. Al Halaseh and Sundarakani (2012) investigated the halal food supply chain (HFSC) requirements by the Islam religion, and the effect of these requirements on the quality attributes of the meat through the supply chain and their alignment with non-halal meat quality attributes. Authors conducted a SWOT analysis to assess the UAE-HFSCs competitive strategy.

Table 1 Past studies on food safety and quality

<i>Author</i>	<i>Inference</i>
Zhong et al. (2017)	Research in the area of supply chain management pertaining to food can be expected to increase in the coming future.
Mahalik and Kim (2016)	For successful IT deployment for food safety and quality, traceability, food processing and packaging, and the application of nanotechnology in food processing and packaging are the important component.
Al-Mazeedi et al. (2015)	The study will act as a pathway for developing a detailed action plan for strengthening Kuwait food safety system.
Vukasovic (2015)	Quality and safety perception is linked to food choice and consumer demand, addressing questions of price perception and the validity of willingness-to-pay measurements. Food quality and safety are central issues in today's food economics.
Smigic et al. (2015)	The food safety system in Serbia needs improvements in the area of effectiveness and efficiency of food safety control and inspection services, knowledge and expertise of state inspectors, governmental officials, food safety consultants, and auditors.
Baines (2014)	Delivery mechanism of each standard discussed in the paper and summarised in two decision trees, one for food safety and quality and the other for the environment, worker care, and food defence.
Mahajan et al. (2014)	Illustrates the implementation using a case study of Deli Processed Food Products Ltd. (deals in milk processing and milk products produced in India).
Rajneesh et al. (2014)	Global food safety norms laid down by WTO such as goods manufacturing practices, good hygienic practice, hazard analysis critical control point, has been developed to embody principles of safe food processing sector globally. India has also developed their food safety norms as per laid down principles by WTO.
Behzadi et al. (2013)	A robust optimisation model has been developed aiming to maximise the food safety aspects and thus to minimise the logistics cost of the cold chain system.
Al Halasch and Sundarakani (2012)	An in-depth industry review and SWOT analysis have been conducted to assess the UAE-HFSCs competitive strategy.
James and James (2010)	The specific stages of the cold chain for maintaining food quality are chilling, freezing storage transport and retail display.
Wilson et al. (2008)	People from the rural region had a higher preference for eating raw cookie dough, compared to people from southern and northern regions, respectively.
Griffith (2006)	Food handler behaviour and its links with food safety organisational culture, and food safety management systems needs to be included to reduce the incidence of foodborne disease.
Ritson (1998)	There are few ways in which a market economy can 'fail' in providing the optimum-asymmetry in the knowledge of risks; aspects of food safety which are public goods; social costs of food safety and the divergence between objective scientific evidence and consumer perception.
Wilson and Clarke (1998)	Proposed system that makes use of the IT for food supply chain to improve the performance and increase the food quality.
Leat et al. (1998)	Outlines the European system of third-party certification for quality assurance schemes.
Pugh (1990)	Evaluates how the industry has responded to customers' needs, with specific reference to Tesco.

James and James (2010) discussed the food quality management by focusing on controlling the temperature. Authors highlighted the importance of maintaining cold chain for the microbiological safety and quality of foods. Wilson et al. (2008) assessed the food safety practices of supervisors in Nevada childcare facilities and found that people from the rural region had a higher preference for eating raw cookie dough. Griffith (2006) reviewed the history of food safety and present a model for studying food safety. Author highlighted the need of food safety management systems to reduce the incidence of foodborne disease.

Ritson in 1998 discussed the financial implications of maintaining acceptable levels of food safety, where the author discussed the social costs of food safety. Wilson and Clarke (1998) developed the mechanism for the design and development of a software system that can monitor, track and trace the food quality. Leat et al. (1998) summarises how the Scottish agri-food industry has been developing farm and quality assurance activities since the early 1990s to strengthen its competitive position in the world market. Authors sketches the European system of third-party certification for quality assurance schemes. Pugh (1990) discussed the importance of food safety in the eyes of customers. Author explained food safety within the overall context of customers' shopping choices and evaluated how the industry has responded to customers' needs and requirements.

The summary of the literature regarding food supply chain which highlights the significance of food safety and quality across the globe has been presented in Table 1.

3 Supply chain and its role in food industry

3.1 Supply chain and its importance

Supply chain cannot be defined explicitly. Various experts have defined it with different approaches, so they have to be critically assessed. Supply chain is term is often connected with the term logistics, where logistics is narrower in scope than supply chain and vice versa, or the terms are seen as interchangeable. Supply chain management is a broader concept than logistics, which is defined as a process of strategic management of supply, movement and storage of materials, partially or completely finished goods and information, through the organisation and its marketing channels (Christopher, 2011), while Ferišak (2006) defines supply chain as an organisational and informational integration of individual processes of supply of business functions in a company, which makes the internal part of supply chain, and their connection to the processes from outside directly involved in creating value, which makes the external part of supply chain, and all this with the aim to optimise the whole process of the flow of goods (materials, intermediate and finished products) and to increase possibilities of creating value. The system for supply chain management comprises a broader specter of activities in relation to those comprised by logistics, for it includes time periods for resource allotment and various other activities dealing with the establishment of long-term relations with suppliers and customers. According to Cooper (1997), logistics deals with the flows of materials, supplies and information inside the supply chain, while supply chain management integrates all business processes between all companies involved. Despite different definitions of the supply chain, it is clear that the purpose of managing the supply chain as an integration function is to develop a competitive business model through connecting key business functions and processes inside and among economic

subjects. Therefore, five elements crucial for achieving the supply chain results can be determined: production, supplies, location, transport and information. The coordination of these elements is needed in order to achieve the best combination of efficiency and profitability for the targeted market (Hugos, 2003). The coordination of the flow of goods, information and finance between the involved companies along the journey from the raw material to the final consumer is, in fact, managing the supply chain. The term of supply chain relates to monitoring the process of supply from all the participants in the distribution channel, with the aim of assessing how consumers' demand influences the movement of product supply through a number of mediators. The members of the supply chain are producers, manufacturers, distributors, wholesalers, dealers who cooperate in the process of supply, delivery, production and sales, all with the aim to meet the demand. When assessing the efficiency of the supply chain, special attention needs to be given to the research of business relations between participants, because it defines the supply chain performance. A successful supply chain gives a competitive advantage to all its members.

A supply chain can be defined as a network or a group of firms interconnected by multiple buyer-supplier relationships in which products and related information flow to help the process of developing, producing, and delivering goods and services to consumers. For instance, a firm could be the supplier or customer of other similar firms, selling or buying inputs for production activities. Because of these connections, the supply chain management has emerged as one of the most important concepts to help organisations improve their performance through the use of better supply chain practices (Burgess et al., 2006).

3.2 Food supply chain

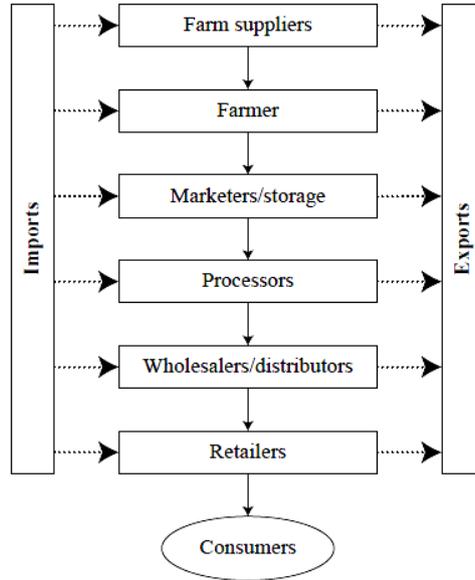
Food supply chains are the lifeline for the human being on the earth. Whether these chains are domestic or global, the availability of food at the right time, right quality, and right quantity are paramount.

The chain of processes, operations, and entities that support to take the food from its raw state to the consumer's plates is known as the food supply chain. It is not a particular chain of individual entities, but a complex web of interconnected entities occupied to make food available. The food supply chain starts with the grower/producer (an agriculture-focused organisation/farmer) and the food sourced at this stage moves through various methods of processing. The movement is facilitated by a host of logistics and transportation service providers. These providers or companies make sure that the food reaches to the consumers on time and at the right quality. The actors involved in a generic food supply chain are food producers (farmers), traders or commission agents, food processors (food processing units), caterers (food service providers), distributors, wholesalers, retailers, etc. According to Beske et al. (2014), food supply chain can be defined as a set of interdependent companies that manage the flow of goods, services, and related information along the value-added chain of agricultural and food products seeking to achieve superior customer value at the lowest possible cost. A typical food supply chain is illustrated in Figure 1. It is important to note that importers and exporters are linked to all the phases of supply chain system, showing that any tier of the chain can be connected to the global supply chain.

The differences of FSCM from other supply chains such as furniture logistics and supply chain management are the importance reflected by factors like food quality,

safety, and freshness within a limited time, which make the underlying supply chain more complicated and challenging to manage (La Scalia et al., 2016).

Figure 1 Model of food supply chain



Source: Roth et al. (2008)

Supply chain management of food is complicated as compared to the supply chains of other manufacturing items due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for food safety and quality (Vorst and Beulens, 2002). One of the significant factors which make the difference is its dependency on production on climate conditions (Salin, 1998).

Globalisation of the food supply chain gives rise to several challenges to management because this type of chain has become increasingly dynamic and industrialised (Roth et al., 2008). Some of these challenges are food traceability and tracking (Alfaro and Rábade, 2009; Epelbaum and Martinez, 2014; Fritz and Schiefer, 2009), supply chain dispersion and food distribution (Rong and Grunow, 2010; Akkerman et al., 2010), quality assurance (Ting et al., 2014), risk assessment (Dani and Deep, 2010; Wang et al., 2012), and related trust and commitment among firms (Ding et al., 2014).

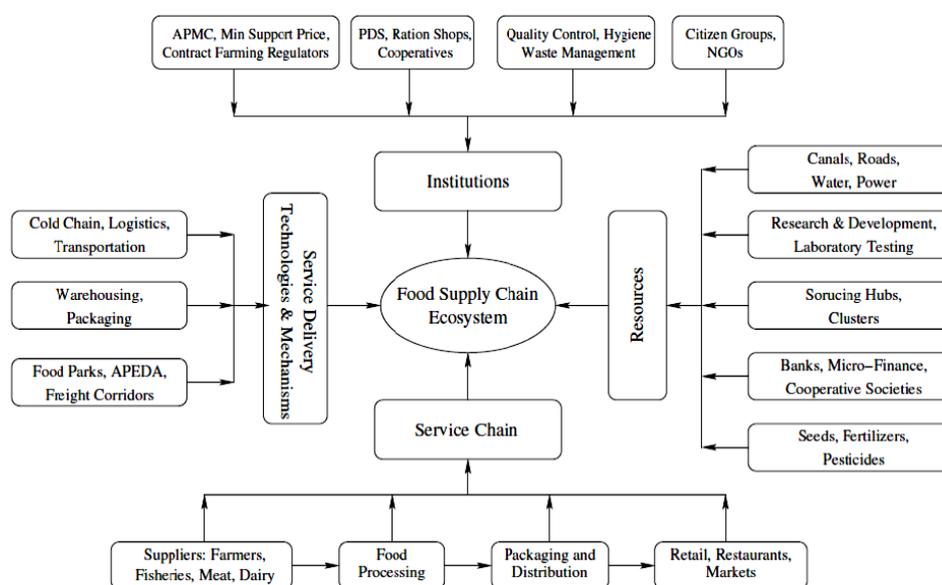
The Food Safety failures have led to the development of standards like hazard analysis and critical control point (HACCP), good agricultural practice (GAP), good manufacturing practice (GMP) and various protocols have been introduced by ISO.

3.3 Food supply chain ecosystem

The foodchain ecosystem is formed through the participation of all stakeholders, including, seed growers, farmers, merchants, transporters, wholesalers, retailers, financial institutions and insurance companies. In this entire chain, the most important aspect is proper communication between all the parties who are involved directly or indirectly in

fulfilling the requirements of customers. Information sharing is essential for generating efficiencies (Viswanadham, 2008).

Figure 2 Food supply chain ecosystem



Source: Viswanadham (2008)

In food supply chain various components play significant roles such as regulatory bodies, the resources, logistics service providers. The food supply chain ecosystem consists of institutions like Agricultural Produce Market Committee (APMC), and Public Distribution System (PDS); resources like water, power supply, banks, seeds, fertilisers, etc.; service chain which helps to move the produce from the farms to the consumers plate and finally the service delivery mechanisms like, logistics of food, cold chain facilities, warehousing services, packaging, etc. (Viswanadham, 2008). The specific components in food supply chain ecosystem are shown in Figure 2.

3.4 Types of food supply chain

The food supply chain can be viewed from two perspectives: food security and food safety. According to Maruchek et al. (2011), food security refers to the delivery of food ‘that is uncompromised by intentional contamination, damage, or diversion within the supply chain.’ Security problems can arise from other people or organisations that intentionally perform actions to alter the food characteristics or disrupt the supply chain to prevent its functionality.

Food safety refers to the development of actions to reduce the likelihood of food contamination and prevent the resulting harmful consequences of unsafe food, such as illness and death (Akkerman et al., 2010; Maruchek et al., 2011). A supply chain perspective can highlight the safety problems that arise while transferring the products

along the chain, such as improper and inefficient storage, handling and distribution of the food (Maruchek et al., 2011). Because the authors are interested in understanding the food contamination in supply chain management, the present study is focused on food safety.

The food supply chain differs from product to product like for fresh fruits and vegetables, food grains, dairy, meat products, etc. However, in general, it can be classified as the following:

- 1 serving markets (as industrial products) – majorly focused towards commodity
- 2 serving final consumer – majorly focused towards value to the customers.

The first type of supply chain works through the trading of agriculture produce in bulk or as a commodity and the second type works towards the fulfilment of the consumers' needs. These supply chains are discussed below in detail.

3.4.1 Commodity- and producer-focused chains

In this kind of supply chain, the agro produce from farms moves towards outbound in two formats, either directly as fresh produce to the consumer (fresh fruit and vegetables, milk, grain and so on) or in bulk as a raw material within food processing industry. The procurement for bulk items can be done through strategic planning and partnerships with the producers or traders or can be done through the practices like contract farming. Partnerships in supply chain management are two types: vertical integration and horizontal integration (alliances). Vertical integration is the term used to describe the successive stages in a supply chain when they come under sole ownership whereas partnerships in the food industry are between successive links in the food chain (e.g., retailer with processor and processor with farmer), alliances are, generally, between firms at the same level (e.g., processor with processor), hence, termed as horizontal partnerships (Hughes, 1994).

3.4.2 Consumer-driven value chains

The consumer-driven supply chain focuses on delivering value to the customer from the point of origin to the point of consumption. Food traceability and identity are very crucial aspects in this chain as customers are nowadays more focused towards the quality and safety of food and it has a direct impact on the health and well-being of the consumer. Retailer plays a very vital role in this supply chain. Retailers provide well processed and branded products to the customer keeping in mind the quality of the products as per the changing demand and requirements of the customers. Unlike the commodity-focused chain, the consumer-driven chain is more regulated, sometimes vertically integrated with farmers, and works more on the belief of cooperation and collaboration. The consumer-driven chain has barriers to entry, such as 'voluntary' standards, codes and international benchmarks, international regulations and phytosanitary certification, which can affect the entry to markets. Tracking and tracing are essential, and technology intervention is required to make the supply chain effective and efficient.

4 Factors influencing food supply chains

Multifarious atmosphere influenced by geographical, industrial, technological, economic, social, political and legal factors form the accessibility of food, the nature of the food product and the delivery of the food from plow to our plates. Stakeholders within the food supply chain aim to improve the functioning of the chain, from the view of quantity, quality, efficiency and pricing along with the requirements for absolute food safety and security.

These complexities in the food supply chain are derived from within many areas:

- 1 agriculture production
- 2 involvement of various governmental/non-governmental bodies
- 3 processing and maintaining quality
- 4 consumer and market choices
- 5 local authorities
- 6 logistics companies
- 7 a host of other small companies actively involved in this food supply chain and providing secondary value or value addition.

The world around us is continually changing. Technological innovations, new business models, globalisation and the movement of people have made food supply chains rethink fulfilment and effectiveness parameters. Innovations in processing, storage, transport, and packaging have made products more suitable for global distribution, and innovations in management and information and communication technologies (ICT) have allowed supply chains to become more responsive to the increasingly sophisticated food demands of consumers.

5 Food safety and food quality standards

5.1 Key standards and norms for food safety and food quality

5.1.1 GAP and GHP

GAPs covers on-farm production and harvesting practices while good handling practices (GHP) covers packing, storage, and the distribution of crops. The responsibility for product safety and the continued observance of best practices rests with the operation producing and handling the fresh product. GAP and GHP audits verify adherence to the recommendations made in the US Food and Drug Administration's *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* and industry recognised food safety practices. In 2015, The USDA Audit Program performed audits in 50 states, Puerto Rico, and Canada, covering over 90 commodities (United State Department of Agriculture, 2015).

5.1.2 HACCP

Hazard analysis and critical control point (HACCP) is an internationally recognised system for reducing the risk of safety hazards in food. A HACCP System requires that potential hazards be identified and controlled at specific points in the process. These hazards include biological, chemical or physical hazards. Any company involved in the manufacturing, processing or handling of food products can use HACCP to minimise or eliminate food safety hazards in their product. HACCP Plans are prepared for each process or product and identify possible hazards and controls in place to make sure the hazards are eliminated or controlled to ensure acceptable levels in the food product. Awareness of foodborne illness is increasing, and concern throughout the industry is driving the use of HACCP and HACCP-based certification programs (22000 tools, 2016).

5.2 *The food safety and standards act*

The Food Safety and Standards Act, 2006 is the primary law for the regulation of food products and formulation and enforcement of food safety standards in the country. The act is intended as an ‘umbrella law’ for food safety by consolidating older laws, rules, and regulations like Prevention of Food Adulteration Act, 1954 Fruit Products Order, 1955, Meat Food Products Order, 1973, Vegetable Oil Products (Control) Order, 1947, Edible Oils Packaging (Regulation) Order 1988, Solvent Extracted Oil, De-Oiled Meal and Edible Flour (Control) Order, 1967, Milk and Milk Products Order, 1992.

The foreword to the act states that it strives for “consolidation of the laws relating to food and to establish the Food Safety and Standards Authority of India to lay 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 gives statutory powers to the Food Safety and Standards Authority of India (FSSAI). Some of the critical functions of the FSSAI include:

- 1 the framing of regulations to lay down food safety standards
- 2 laying down guidelines for accreditation of laboratories for food testing
- 3 providing scientific advice and technical support to the central government
- 4 contributing to the development of international technical standards in food
- 5 collecting and collating data regarding food consumption, contamination, emerging risks, etc.
- 6 disseminating information and promoting awareness about food safety in India.

The FSSAI functions under the administrative control of the Ministry of Health and Family Welfare.

5.2.1 *Role of FSSAI in food safety and security supply chain*

FSSAI, established under the Food Safety and Standards Act, 2006. It is the regulating body related to food safety and laying down of standards of food in India. FSSAI started numerous initiatives and efforts to educate, interpret and implement the new rules and regulations. Considerable efforts in the area of consumer awareness, product approval, labelling and nutritional claim, import regulation, and other pertinent matters were put in

for effective implementation. Authorities can only conceptualise and enact laws and, at best, inspect and penalise for non-compliance. However, the responsibility of implementation and practice is in the hands of stakeholders whose action or inaction impacts the very purpose of the act.

5.2.2 Role of Agricultural and Processed Food Products Export Development Authority

The Agricultural and Processed Food Products Export Development Authority (APEDA) carries out the following extension and advisory activities in the area of food safety:

- 1 fixing of standards and specifications for the scheduled products for exports
- 2 provides financial assistance for measures taken to improve product safety and quality, such as an implementation of HACCP system
- 3 assessment and recognition of laboratories based on the availability of requisite instrumentation and the criteria laid down by APEDA.
- 4 the registered exporters of food products can utilise the services of these recognised laboratories for sampling, testing, residue monitoring, etc. and obtain test certificates for exports of specified products
- 5 recognition of HACCP implementation and certification agencies for active service to the APEDA registered exporters.

6 The relevance of supply chain service provider in food quality and safety

The food supply chain service provider (SCSP) plays a significant role in moving and handling products from source to consumption points and during this journey performs various acts like transportation, storage, packaging, handling, sorting, and value addition. In the role of the 'food business operator' (FBO), the SCSP are designated by Food Safety Standard Act, is accountable for confirming that those requirements under the act and the rules and regulations are being fully complied with, for the business under his control.

The following are the areas of activities where controls need to be established and complied with by a socially responsible SCSP. A detailed checklist of control points under each of the following activities needs to be drawn and practiced.

- licensing under FSSAI
- sourcing of product and acceptance
- primary transportation
- receiving at storage
- documentation, system update, and storage
- secondary transportation and last mile distribution
- other critical capabilities like product traceability, product recall, etc.

An FSSAI compliant SCSP is one who has put in place processes and controls in business and practices the same to ensure that products passing through the system are safe for human consumption.

The European Union has defined food safety as a situation with the total absence of hazards and one of the key priorities. According to the Food and Agricultural Organization of the UN and World Health Organizations, food safety refers to all those hazards, whether chronic or acute, that may make food injurious to the health of the consumer (WHO, 2003). The issue related to food safety can be classified into two aspects. The first safety is the security of food source (food security), important in developing economies like India, and second safety aspect sanitary measures (food safety). Food safety aims at protecting the health and interests of the consumers and securing the free flow of foods on the market (Ronald et al., 2005). The strategy 'from the farm to fork' (from the field to the table) that encompasses entire supply chain of food safety to be achieved, the food supply chain journey starts from the very production, harvest, then during transportation and warehousing and food preparation. Hence, supply chain visibility through communication and information sharing is crucial among all the stakeholders involved through food production processing storage and distribution, legislation and regulatory framework plays a crucial role in monitoring and maintaining in the quality and safety of food along its supply chain. Four main elements of the food safety strategy in the European Union are as follows: food safety for humans and animals regulations, independent and public health judgement, concrete actions in the regulation enforcement and process control, knowing the consumers' rights to choice based on complete information on where the food comes from and its content (European Commission, 2004). One of the elements of the food safety relates to the legislation enforcement and food control and is performed by the system of rapid information on food for humans and animals rapid alert system for food and feed (RASFF) which enables a rapid flow of information about new risks.

7 Food safety standard enforcement in India

The retail supply chain and its food processors are governed and regulated by FSSAI. It was introduced to replace a fragmented structure that was dependent upon multi-level, multi-departmental control, and now sends a single line of command, as well as a more visible and recognisable organisation. Figures 3 and 4 shows the food regulatory system in India and how it integrates? The FSSAI has been generated to lay down science-based standards for articles of food and to regulate their manufacturing, storage, distribution, sale, and import to ensure availability of safe and wholesome food for human consumption.

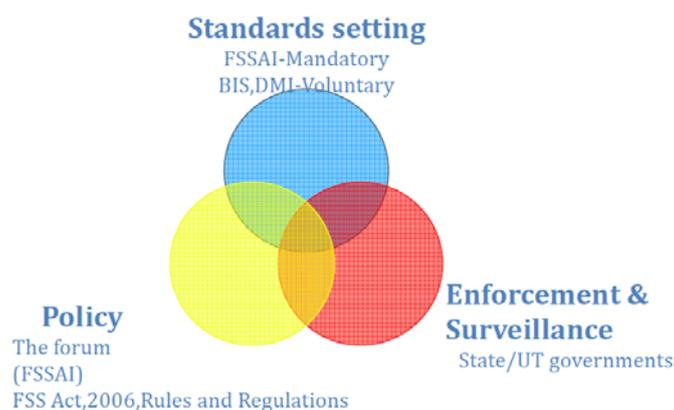
To improve food safety standards and open the country for international business India's Food Safety and Standards Act 2006 (FSSA) consolidates the country's existing laws into one cohesive act and is the building block upon which the FSSAI is based.

To ensure the availability of safe, wholesome food for human consumption, the FSSA sets down scientific standards for food articles, to regulate their manufacture, storage, distribution, sale, and import. Quality standards for most food categories in India are set in particular legislation, to inform, aware and protect consumers.

The legislation encompasses:

- 1 authorised technological methods applied in the food production and processing, defined chemical, physical, physical-chemical and sensory properties, food content (types and quantity of ingredients)
- 2 classification, categorisation, and name of the food, additional requirements for food labelling
- 3 methods set by the FSSAI for the control of prescribed standards of food quality.

Figure 3 India's food regulatory system (see online version for colours)



Source: Kotwal (2014)

Companies dealing with food have two parallel systems for food quality preservation and safety. The system enabled by the state is based on legislation which define ways of ensuring quality and set mandatory and voluntary standards, and which are controlled by state inspections.

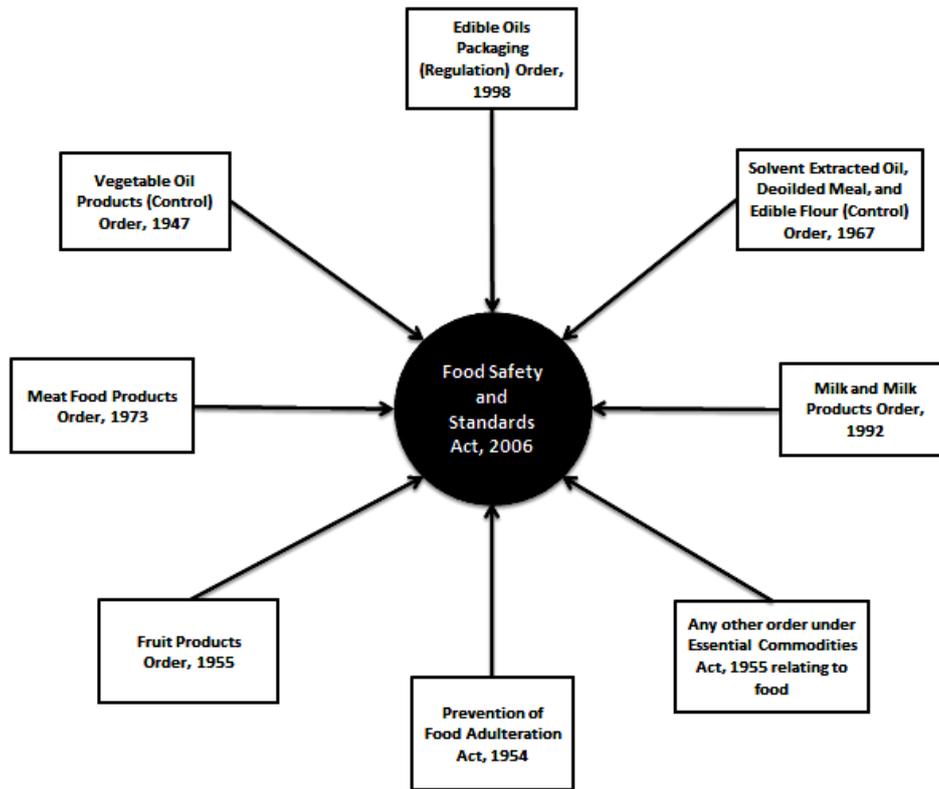
The other system for food preservation is based on standards which are voluntary and led by market laws, which are defined and set by, for example, international associations (Knežević et al., 2013).

Introducing standards leads to the improvement of company performance. Food companies achieve competitive marketing advantage, as well as increase market share by applying recognised standards. They also achieve multiple advantages like easier accomplishing the goals and quality policies related to food safety set by the administration, alignment with international standards and global market requirements, which, in the end, can influence the increase in productivity.

On the global market, there is a growing issue of food safety, so the participants in the food production chain need to internationally align the norms which would enable a complete system for food safety management and produce and market placement of entirely safe and quality food. A consensus establishes the norms, and they set different requirements for safety, quality, traceability of product, as well as protection of safety and health of people, environmental protection, etc. Certain norms have to be administered by Indian producers and distributors. However, which voluntary norm and when a food company will apply it, depends on the decisions of top-level management. Concerning the ever-growing global market with changeable market laws, the food companies are forced to adapt to these changes continually, and one way is to accept and implement internationally recognised standards. In India FASSI ACT 2006 was

established with the aim of increasing the level of product safety, environment protection, preservation of health, improvement of production efficiency, promoting product and service quality and eliminating technical barriers in the international trade. The food safety and standards act can be depicted in Figure 4.

Figure 4 Food safety and standards act



Source: Kotwal (2014)

8 Role of ISO in food safety

With an estimated increase of 105 million hungry people in 2009, there are now 1.02 billion malnourished people in the world, meaning that almost one-sixth of all humanity is suffering from hunger. ISO standards support the FAO by helping to promote the transfer of technologies to the developing world, encouraging economic and technical cooperation among developed and developing countries contributing to sufficient, safe and nutritious food.

Of the hundreds of ISO food-related standards, the ISO 22000 series deals directly with food safety:

- 1 ISO 22000:2005 gives the requirements for food safety management systems. At the end of 2007, it was implemented by over 4 000 organisations in 93 countries.

- 2 ISO/TS 22003:2007 defines the rules applicable for the audit and certification of a food safety management system and provides the necessary information and confidence to customers about the way certification of their suppliers has been granted
- 3 ISO 22005:2007 establishes the principles and requirements for the design and implementation of a feed and food traceability system, ensuring the security of food products for consumers.

Also relevant to this year's World Food Day is the ISO 28000 series which specifies the requirements for a security management system to ensure safety in the supply chain. These standards can be applied by organisations of all sizes involved in manufacturing, service, storage or transportation by air, rail, road and sea at any stage of the production or supply process.

ISO 22000 is a Food Safety Management System that can be applied to any organisation in the food chain, farm to fork. Becoming certified to ISO 22000 allows a company to show their customers that they have a food safety management system in place. Normative documents of 22000 are international norms which enable safe food in the supply chain (MINPO 2013).

9 Impact of national food security act, 2013 on international trade

After the introduction of Food Security Act, the annual price of consumption of food was shallow as compared to the earlier years which itself reflects the success of National Food Security Act. Global food price indicators do not consistently reflect country-level realities. India where a huge share of the world's deprived and malnourished people live, food prices rose considerably in 2013, mainly for high-nutrient foods such as vegetables. The government wants to plan an 'income policy' approach rather than 'price policy' approach which signifies equality among the people.

Even though India is among the top five wheat producing countries still India does not have a dominant presence in the international trade market. There is a substantial financial burden on India as it has to supply food grains to almost 1.2 billion people and most of the food grain is due to inadequate storage and warehousing. For the enhancement of production, maintaining market infrastructure, observation of additional movement expenditure is needed to support the welfare schemes.

10 Conclusions

The prime objective of any food and beverage manufacturing firm incorporates newer ways of conducting business to deliver food products as quickly as possible, along with ensuring specific safety and quality level standards, to satisfy the growing consumer base and consumer demands. FASSI is encouraging HACCP implementation in the processed food sector in India. FASSI since its inception continued to be responsible for developing the regulations, standards, policies, and procedures. These regulations, standards, policies, and procedures serve as guidelines for Indian food producers, processors, marketers, distributors, retailers, foodservice operators and related logistics organisations. There has been an increase in knowledge and understanding of GMP, ISO, GHP and

HACCP by the Indian processed food sector. Food products go through every stage of the supply chain (procurement production, transportation, storage and sale and distribution) and cause behind this is, to maintain safety and quality of products from plow to plate. It is therefore relevant to accentuate the importance of every link in the supply chain because if one link of the supply chain is endangered or missing, it affects the entire chain. The participants in every phase of the chain are obliged to ensure the quality, sanitary safety and traceability of food in line with all legislation, standards, and norms, like, for example, Food Safety and Standards Act Law, HACCP and ISO 22000.

Bearing in mind that during the transportation, food contamination can happen due to the harmful effect of chemical, physical and biological factors, it is essential to respect general conditions of the HACCP Guide for Good Sanitary Practices for transportation of goods.

This paper has extensively discussed the significant role of food safety in the increasing and changing need of customers towards safe food. Authors extensively discussed past studies conducted on food supply chain concerning food quality and food safety and also discussed in detail that how food safety has increased as a major concern for every nation specifically in India. This paper also discussed different regulatory bodies working in India for ensuring food quality and safety throughout the supply chain.

This paper can be a framework for future studies on food supply chain where the major concern will be on safety and quality.

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