

II Review of Literature

Review of literature of the present study entitled **“Effect of Food Safety Intervention on Safe Handling Practices among Food Handlers and Microbial Assays of Processed Food Products of Fruits and Vegetables Industries”** is discussed under following headings:

- A. Food Safety and Safe Handling Practices –An overview**
- B. Food Laws and Standards - The need of the hour**
- C. Hazards , microbial assays and quality assurance of processed fruits and vegetables products and**
- D. Importance of food safety intervention and education on food safety and safe handling practices**

A. Food Safety and Safe Handling Practices –An Overview

Food safety refers to the proper handling, cooking, and preservation of food to protect from foodborne illnesses caused by microbes such as viruses, bacteria, parasites, and fungi (WHO, 2015).

Every food Establishment uses, processes, and sells food in several ways. However, the overall issues and key principles of food safety remain an equivalent, regardless of the sort of the operation. All food safety training programs should contain the “big three” factors that would cause food to become unsafe. Food must be kept out of harm’s way from human errors, but if we do not train food workers what they are, they won’t know why these factors are so important to the operation. The basics can make us or break us in one or even two food handling mistakes. Those basic three principles that we must train all managers and food workers about are personal hygiene for food professionals, time and temperature and control cross contamination prevention (Motarjemi and Lelieveld, 2013).

Food workers must observe the very best possible standards of private hygiene to form certain that food doesn’t become contaminated by pathogenic microorganisms, physical or chemical hazards. High standards of private hygiene also play a crucial part in creating an honest public image, also as protecting food. Hand washing, fingernails, food worker illness policy (including exclusion of ill workers, cuts, burns,

bandages, etc.), hair, uniforms, glove use, jewellery, personal cleanliness, or unsanitary habits such as eating, drinking, smoking, or spitting are all parts of defining personal hygiene standards. Poor hand washing is one among the leading causes of foodborne illness. “Active Hand Hygiene” may be a concept that basically helps in preventing food borne illness (Edress, 2018).

A food handler also must remember of unconscious body habits and must avoid actions like scratching or rubbing the head, nose or other body parts, stroking hair/beards, picking pimples, licking fingers when tasting food and therefore the like. Ordinarily, these unconscious body habits don't create problems, but when handling foods for the general public, it's not only unprofessional behaviour but is potentially dangerous (Kubde.et.al 2016).

Allam et.al (2016) revealed that food poisoning bacteria may be spread to food by a food handler coughing or sneezing over food tasting food using fingers or working with an infected cut Salmonella and eubacteria are often present within intestine of seemingly healthy people. Inadequate washing of hands after going to the toilet may result in faecal material being transferred to the food. If healthy people are carrying bacteria, then people suffering from nose throat or chest infections intestinal upset or skin infections will be shedding bacteria at an even greater rate. If you are sick you should not handle food. Report any abnormal health conditions. Keep cuts or burns covered with a clean waterproof dressing.

According to Kozak et.al (2014) bacterial growth in potentially hazardous foods by can be reduced by limiting the time food is within the zone (140° F to 41° F) during any steps of the food flow from receiving through service. Everyone who works with food is liable for ensuring that buyers are shielded from contaminated food and therefore the risk of gastrointestinal disorder, which causes extreme discomfort, absence from work or school and, in some cases, death. People get sick from food poisoning because the food they've eaten has contained bacteria, viruses or chemicals. It can take from an hour to a couple of days to develop gastrointestinal disorder, counting on the cause, and therefore the best way of preventing food gastrointestinal disorder is to use safe food handling practices .Bacteria are the most important problem, because they're so common, and are found in soil, on animals, people and even clothes. In the kitchen, bacteria often come from vegetables and

meat. Sometimes these bacteria can move from raw ingredients to cooked food, in during a process called cross contamination.

Cross contamination is the transfer of harmful microorganisms or substances to food and covers a mess of potential food handling errors altogether stages of food flow. Cross contamination can occur at any time through three routes, food to food, hands to food and equipment to food. Ready-to-eat foods must receive the foremost care to stop contamination (Gombas.et.al 2017).

Okpala and Korzeniowska (2021) noted that workers handling food products throughout transport and storage play a critical role in food quality and safety. For this reason, training of personnel at each step within the process is vital. They are liable for ensuring products and packaging are neither physically bruised and broken nor bent. Products must be kept free of dust, moisture, unsuitable temperatures, odours and various rodents and insect pests, all of which are capable of damaging the quality of the product (Shankar and Abrol, 2012).

Food hygiene involves preventing the spread of infection by people that handle food and ensures that food preparation areas, equipment and surfaces are clean. When storing food, the aim is to guard food from contamination and to minimise microbial growth. Appropriate storage conditions help to maximise quality and minimise wastage due to deterioration and spoilage. There are certain conditions common to dry stores, cool-rooms and freezers critical to the minimisation of food spoilage and the prevention of food poisoning (Todd.et.al 2010).

Oliveira et.al (2014) observed that the risk of contamination is particularly high whenever food is being prepared for cooking or processed in some other way in readiness for consumption. It is important for the food handler to be aware of the critical points when microbial growth is favoured. Appropriate preventative measures can then be followed to create awareness related to food safety and safe handling practices.

Pest is an undesirable organism at a given place and time. Pests could also be plant or animal. In a commercial kitchen the pests of most concern are flies, cockroaches, stored product pests, rats and mice. They have the potential to spread disease causing considerable spoilage of foodstuffs. Pest control, prevention is best than cure. Make the environment uninviting to pests, keep premises well maintained and

during a state of excellent repair. Don't allow rubbish, used cartons or boxes to accumulate. Deny shelter during which pests can live and breed. Store foods in containers with tight fitting lids. Rotate stock. Perform regular and thorough cleaning of all areas where food is received, stored and ready to be consumed (Biehler,2013).

Food safety is the best ensured by the shared responsibility of everybody involved with food from the professional to the consumer. All along the food chain, various procedures and good practices are implemented to ensure that the food which reaches the consumer's table is fit for consumption, that the risks of contamination are minimised so that the population as a whole is healthier from the benefits of safe quality food. But responsibility for food safety should not only be the priority of professionals in the food industry. There are rules and procedures to guide the professionals, but the consumer is equally responsible in order to ensure the safety of food in the home. Safe food is one of the most important human rights and in developed society's protection from diseases and improvement of human health is of primary importance, and is important for both governments and industries but also for consumers themselves (Zeeshan, 2017).

Akabanda et.al (2017) showed that the food poisoning occurs as a result of consuming food contaminated with microorganisms or their toxins, the contamination arising from inadequate preservation methods, unhygienic handling practices, cross-contamination from food contact surfaces, or from persons harbouring the microorganisms in their nares and on the skin. Unhygienic practices during food preparation, handling and storage creates the conditions that allows the proliferation and transmission of disease causing organisms such as bacteria, viruses and other food-borne pathogens. Additionally, many reported cases of food-borne viral diseases have been attributed to infected food-handlers involved in catering services.

(Good Manufacturing Practices (GMPs), adequate knowledge on food safety, good hygiene practices, and contamination free the processing environment are essential aspects for food safety and sanitation. The roles played by food handlers along the food chain are critical in food safety and quality assurance. Food handlers are known to be carriers of foodborne pathogens hence potential sources of food contamination (Soares et al. 2012).

Poor personal hygiene and inappropriate food handling practices have been reported as major causes of food contamination by food handler (Baluka et al. 2015).

B. Food Laws and Standards - The need of the hour

Pardeshi (2019) stated that the Food Safety and Standards Authority of India (FSSAI) is an autonomous body established under the Ministry of Health and Family Welfare, Government of India. The FSSAI has been established under the Food Safety and Standards Act, 2006 which is a consolidating statute related to food safety and regulation in India. FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safety.

The FSSAI functions under the administrative control of the Ministry of Health and Family Welfare. The main aim of FSSAI is to lay down science-based standards for articles of food, regulate manufacture, storage, distribution, sale and import of food. The development of standards is a dynamic process based on the latest developments in food science, food consumption pattern, new food products and additives, changes in the processing technology leading to changed specifications, advancements in food analytical methods, and identification of new risks or other regulatory options (Chaudhary, 2019).

Food is one of the basic necessities for sustenance of life. Pure, fresh and healthy diet is most essential for the health of the people. It is no wonder to say that community health is national wealth (Suba and Thirumani Devi, 2021).

Jeeva (2019) points out that adulteration of food-stuffs was so rampant, widespread and persistent that nothing short of a somewhat drastic remedy in the form of a comprehensive legislation became the need of the hour. To check this kind of anti-social evil a concerted and determined onslaught was launched by the Government by introduction of the Prevention of Food Adulteration Bill in the Parliament to herald an era of much needed hope and relief for the consumers at large.

Regulatory agencies is to ensure the wholesomeness of food and maintenance of sanitary conditions during its preparation, service, transportation or storage. They work in the interest of the public and prevent the spread of food-borne illness. Food standards have been formulated in the interest of the public, to protect them from consuming improperly handled food and thereby prevent food –borne illness from

spreading. There are several acts and regulations that are in force. In any given area, the local health authority ensures that these acts are followed (Troller, 2012).

Violation of these acts is against the law and any person who fails to comply with these codes may have to pay a heavy fine or undergo prosecution. The food operator has a lot to gain by cooperating with the regulatory agencies and conforming to the rules laid down by them (Rouviere and Royer,2017).

Gahukar (2014) emphasised that food standards protect people from health hazards because of adulteration, it is necessary to impose control and check over the quality of food available to consumers. Standards are yardsticks established by an authority for measuring quantity, weight or quality. This system ensures that each food stuff is what it purports to be or what its label claims it to be and assures uniformity. National official standards are set to safeguard the consumer's health and ensure fair food trade practices.

Marone (2016) has indicated that standards and guidelines in relation to articles of food meant for human consumption, procedure for making or amending regulations in view of urgency concerning food safety or public health assist in notifying the regulations pertaining to limits of additives, contaminants, toxicants , heavy metals and tolerance limits of pesticides assist in finalizing the procedures for manner of marking and labelling of foods ,assisting in notifying the conditions and guidelines relating to food recall procedures.

All food processing units are aware that quality of their products and services is vital if they have to survive in the competitive market. Initially the term quality was used for the product and this was evaluated by quality control inspectors. The meaning of quality has broadened to include much more than ensuring the quality of the finished product. Today the term "quality" includes every aspect of production and service right from the source of procurement of the raw material up to customer satisfaction. The customer today wants to be assured that the product he or she is purchasing is safe and has been processed and handled safely and will not be detrimental to health. (Upadhye.et. al 2010).

Quality is not just the responsibility of a single individual in the processing unit. Everyone involved directly or indirectly in the production process is responsible for the quality of the product. If quality has to be achieved, it is necessary to have a

system that ensures that all procedures that have been designed and planned are being followed (Mitra ,2016).

Roday (2011) stated that the standards are essential in most aspects of our life. They ensure that products and services have desirable characteristics such as quality, safety, reliability, efficiency, eco- friendly and are available at an economical cost. We often take these desirable characteristics for granted, but when standards are absent and products are of inferior quality, are unsafe, unreliable or incompatible with the equipment we already have, we are concerned. When products, systems, machinery and equipment work efficiently and safely, it is often because they meet standards.

Routine inspections of food service facilities long have been employed as regulatory tools to enforce sanitary codes and reduce the risk of food borne out-breaks. Failure to meet regulatory standards are assumed to increase the risk of food borne disease. Certainly it is not uncommon to find food borne outbreaks associated with facilities with a history of regulatory failure. (Kassa, 2010).

It has been well established that failure to comply with food safety regulations in food processing environments often leads to microbial contamination that results in incidences of foodborne diseases and food spoilage (Mahmoud and Sivakumar, 2014).

C. Hazards, microbial assays and quality assurance of processed fruits and vegetables products

The Food Processing Industry sector in India is one of the largest in terms of production, consumption, export and growth prospects. Important sub sectors in food processing industries are Fruit and Vegetable Processing, Fish-processing, Milk Processing, Meat and Poultry Processing, Packaged/Convenience Foods, Alcoholic beverages and Soft drinks and Grain Processing etc. India is the world's second largest producer of fruits and vegetables, but hardly 2% of the produce is processed and still lesser amount is exported. One major reason behind little export of processed products is poor quality and inability to meet international standards. Food safety and testing microbiological analysis has become an essential part of recommended international food production and distribution system. The food-borne pathogens related deaths especially those caused by common pathogens such as

Clostridium, Salmonella, Listeria, etc., have made microbiological analysis of food products a top quality control concern (Singh.et.al 2012).

Fruits and vegetables can become contaminated whilst growing in fields, or during harvest, handling, processing, distribution and use. These normally carry a non-pathogenic epiphytic micro flora. However, pathogenic bacteria can be present in low numbers as a result of the uptake of water through certain irrigation or washing procedures. If these waters are contaminated with human pathogens these may also be introduced. The survival or growth of contaminating microorganisms is affected by intrinsic, extrinsic and processing factors. Mechanical shredding, cutting and slicing of the produce open the plant surfaces to microbial attack. About two thirds of the spoilage of fruits and vegetables is caused by molds (Garg,2019).

Alegbeleye (2018) quoted that the foodborne illness resulting from the consumption of contaminated fresh produce is a common phenomenon and has severe effects on human health together with severe economic and social impacts. The implications of foodborne diseases associated with fresh produce have urged research into the numerous ways and mechanisms through which pathogens may gain access to produce, thereby compromising microbiological safety. This review provides a background on the various sources and pathways through which pathogenic bacteria contaminate fresh produce; the survival and proliferation of pathogens on fresh produce while growing and potential methods to reduce microbial contamination before harvest. Some of the established bacterial contamination sources include contaminated manure, irrigation water, soil, livestock/ wildlife, and numerous factors influence the incidence, fate, transport, survival and proliferation of pathogens in the wide variety of sources where they are found. Once pathogenic bacteria have been introduced into the growing environment, they can colonize and persist on fresh produce using a variety of mechanisms. Overall, microbiological hazards are significant; therefore, ways to reduce sources of contamination and a deeper understanding of pathogen survival and growth on fresh produce in the field are required to reduce risk to human health and the associated economic consequences.

Fruits, vegetables and herbs are agricultural products that could be contaminated with biological, chemical or physical hazards. Contamination could occur in the growing environment, after harvest, during preparation for storage and processing, in

shipping to the market, in food service establishments, and/or in the home (Gil.et.al 2015).

Weldezgina and Muleta (2016) observed that the raw salad vegetables (RSV) are an essential ingredient of a healthy diet, and the demand for salad vegetables has increased in recent years. Nutritionists emphasize the importance of raw vegetables in healthy diets, and researchers and governmental publicity campaigns around the world tend to recommend consumption of at least five servings of fruits and vegetables per day. In contrast to their health benefits, the consumption of fresh vegetables has also been associated with risk for consumers. Vegetables are rich in carbohydrates, anti-oxidants, minerals, vitamins and fibres (Said 2012) and often consumed uncooked. The phytonutrients can act as effective media for the transmission of pathogens (Abougrain et al. 2010).

Maffei et al. (2016) confirmed that the raw Salad Vegetables can become contaminated with pathogenic micro-organisms whilst growing in fields, or during harvesting, postharvest handling, processing and distribution. Different agronomic practices can contaminate vegetables in various stages. Contamination occurs mostly before harvesting, either by contaminated manure, sewage, irrigation water, and wastewater from livestock operations or directly from wild and domestic animals or during harvesting, transport, processing, distribution, and marketing or even at home.

The use of wastewater for irrigation affects the quality of Raw Salad Vegetables and human health. It could be the possible source of pathogenic microorganisms on vegetables. Pathogens like Salmonella sp., Shigella sp., Campylobacter sp., L. monocytogenes and E. coli O157:H7 can contaminate Raw Salad Vegetables through contact with sewage and manure. Contaminations may also occur after harvest through dirty wash water, by cross-contamination from an infected food-handler and their consumption either raw or uncooked can be the important risk factor for the transmission of pathogens (Said, 2012).

Seo et. al. (2010) pointed out that the microorganisms adhere the surface of the vegetables and are mainly Gram-negative saprophytes that may survive even after washing and sanitizing steps due to the formation of biofilms on the surface of the vegetable or from protection by the cuticle of the vegetable.

The human infections associated with consumption of raw fruits and vegetables have increased during the past decade (Eraky et al. 2014) and have been recognized as a means of transmission of foodborne pathogens (Pagadala et al. 2015). The factors contributing to this increase may include changes in agronomic practices and an increase in the number of immune-compromised consumers (Eraky et al. 2014).

Oliveira et al. (2011) reviewed that the specified pathogenic bacteria may adhere to the surface of raw vegetables and cause foodborne outbreaks or chronic infections. Foodborne illnesses caused by *E. coli* are one of the most important gastrointestinal diseases and represent a public health risk. Its presence on the surface of Raw Salad Vegetables indicates the contamination of faecal origin. Therefore, the presence of *E. coli* can be used to evaluate the microbiological quality of raw vegetables. A number of national microbiological guidelines have been published in many countries such as the UK, France, Japan, Korea and Singapore (Seo et al. 2010).

Galli et al. (2016) stated that the foodborne diseases, as a result of the consumption of food contaminated by diarrheagenic *E. coli* (DEC), have been recognized as one of the most prevalent health issues worldwide. Certain path groups are typically transmitted by contaminated food and water; however, their prevalence in food is restricted to outbreaks and research studies in certain regions. These bacteria are affected by a multiplicity of limiting factors present in food, e.g., temperature, pH, water activity, food processing, and intrinsic microorganism factors such as injury and inoculum. Emerging intervention processing techniques are receiving good attention because of their potential for food quality and safety improvement. During the last decade, some of these technologies—high-pressure processing, high-pressure homogenization, pulsed electric field, ultraviolet light, intense light pulses, ultrasound, radiation, ozone and organic acids, among others—have been tested to control diarrheagenic *E. coli* DEC in food.

Food safety must be principally ensured by a more preventative approach, such as product and process design and the application of the Good Hygiene and Manufacturing Practices and the Hazard Analysis Critical Control Point principles. Epidemiological studies provide invaluable information to define more effective management strategies. In this context, risk analysis tools have proven effectiveness

to reduce foodborne diseases through the design, development, implementation, evaluation, and communication of control measures to protect the public health. To achieve a strategic control of *E. coli* infections, a multidisciplinary approach through stages of the agro-food chain is required to generate evidence-based risk management measures. Only in this way will it be possible to protect the health of consumers (Fortin et.al. 2021).

In India, Food Safety and Standards Authority of India (FSSAI 2006) have published a regulation which covers food safety in the country. There has been an increasing number of fresh produce associated foodborne illnesses identified internationally and efforts are being made to resolve these food safety problems. However, information on the microbiological quality of Raw Salad Vegetables, especially with respect to incidence of bacterial pathogens, are not well documented in the city of Dhanbad, India. This study aimed to evaluate the microbial contamination on the surface of unwashed Raw Salad Vegetables consumed in Dhanbad city of India (Denis et al. 2016).

Minimally processed, ready-to-eat (RTE) vegetables, are consumed raw so have to comply with microbiological requirements to ensure safety and avoid possible foodborne illnesses. The objective of this study was to evaluate the microbiological quality of RTE vegetables: lettuce, spinach, carrot, cabbage with carrot, parsley, parsley curd and coriander that are sold in supermarkets in the city of Loja, Ecuador. A total of 128 samples from 3 production batch were analysed for total aerobic count, total coliform and *E. coli*. The aerobic count obtained averaged 6,6 log₁₀ CFU/g and ranged from 4,57 to 7,82 log₁₀ CFU/g. The coliform counts a ranged from 0,48 to > 5,04 log₁₀ MPN/g and in 11 samples >5,04 log₁₀ MPN/g was observed. Generic *E. coli* was detected in 32 samples at levels less than 6,2 MPN/g. In our study, 50% and 98% of the samples exceeded the reference limits for aerobic and coliform counts, respectively. The results of this study indicate that RTE vegetables have, in some cases, the same microbial load as packaged vegetables that are produced without a disinfection process, and maybe potential vehicles for pathogen transmissions, which means the necessity of regulate the quality assurance of RTE vegetables (Hualpa et.al 2018).

Piližota, (2014) confirmed that the increasing number of produce-related outbreaks in industrialized countries has raised awareness to interventions that remove human pathogens from fresh produce. However, contamination of produce has always been a concern in the developing regions of the world which lack basic sanitary conditions. Chlorinated water has been widely used to sanitize fresh produce, but not enough to ensure the microbial safety of produce. The efficacy of several other chemical agents has been evaluated as potential alternatives to chlorine. Also, alternatives or modified methods have been also proposed such as MAP, irradiation, pulsed energy processing, etc.; however, none have yet gained widespread acceptance by the industry. To date the most important measures to ensure safety of fruits and vegetables remains prevention of contamination through the application of systems such as GAP.

Hualpa et.al (2018) declared that the consumption of vegetable products has dramatically increased in India during the past few decades. It is also estimated that about 20% vegetables produced is lost each year due to spoilage. This review paper will address the characteristics of spoilage microorganisms associated with vegetable categories including spoilage mechanisms, spoilage defects, prevention and control of spoilage, and methods for detecting spoilage microorganisms. Spoilage microorganisms can be introduced in the crop on the seed itself, during crop growth in the field, during harvesting and postharvest handling, or during storage and distribution. Many thermal and non-thermal technologies have been developed to control microorganisms on fresh cut produce. Chemical technologies can be divided into gas-phase sanitation and liquid-phase sanitation based on the physical state of the chemical used. The most widely used chemical treatment in the fresh-cut produce industry is chlorinated water. In addition to these active control measures, other factors important in the prevention of microbial spoilage include raw material quality, processing technologies, good manufacturing practices (GMP), packaging, and temperature management. Processing techniques, including peeling, cutting, washing, and dewatering, also influence the vulnerability of fresh-cut fruits and vegetables to microbiological spoilage. This review addresses microbial spoilage of vegetables, impact of microbial spoilage in vegetables, sources of microbial contamination in vegetables, characteristics of vegetable spoilage microorganisms,

methods for detection and isolation of spoilage microorganisms and prevention of microbial spoilage (Saranraj 2012).

Alexandre et al. (2012) emphasized that the consumers' demand for increased quality standards has spurred the search for new and less aggressive processing technologies, which permit greater retention of natural taste. As a consequence, minimal processing techniques emerged with the objective of replacing traditional preservation methods with the intention of extending shelf-life, without the detrimental effects caused by severe heating. Non-thermal methods have emerged as attractive alternatives to conventional thermal processing methods. They constitute challenging processes aiming at reducing pernicious effects of thermal methods, by preserving quality and nutritional attributes of fruits and vegetables, and yielding safe and less-perishable products. Ozone, UV-C irradiation and ultrasounds treatments are promising techniques for the fruits and vegetable industry. The application of such technologies may yield products with limited losses of colour, flavour, texture and nutrients, while retaining the desired shelf-life and safety. However, the efficiency related to each safety or quality indicator depends on the product/indicator under consideration.

Vegetable-borne disease outbreak that occurred in Japan during the year 1996 is the biggest ever reported disaster in the history of food-borne illness. *Salmonella* spp., are gram negative, rod-shaped and non-spore-forming bacteria, most commonly found pathogens in the fresh produce. Several vegetables such as lettuce, melons, tomatoes, cauliflower, sprouts and spinach are prone to its contamination. *Escherichia coli* are gram negative, rod-shaped and facultative anaerobic bacteria. Majority of *E. coli* strains are non-pathogenic and are normally found in the intestines of all animals, including humans. *Listeria* spp. are psychrotolerant that is they grow at refrigeration temperatures are ubiquitous organisms and are found in the faeces of livestock, soil, water and vegetation. Cyclospore is a protozoan pathogen transmitted by faeces-contaminated fresh produce and water. Nor virus contaminate water and salads. These viruses cause gastroenteritis in humans. Enzyme-Linked Immunosorbent Assay (ELISA) is widely used method for the detection of food-borne pathogens. (Manjunath, 2018).

Pierangeli. et.al (2014) emphasized that the food-borne pathogens take a serious toll on public health. It is estimated in the United States alone that approximately 14 million incidents of food related illness occur. A recognized source for food-borne pathogens is faecal contamination of water used for irrigation, or for processing, of fresh produce. While many agricultural products are cooked prior to eating, many Southeast Asian cultures also consume uncooked produce either directly or as fresh condiments to other dishes, such as soups.

The changing food safety standards, stricter sanitary and phyto-sanitary requirements and improved global product norms trigger the necessity to improve legislative network of a country based on codex Hazard Analysis Critical Control Point (HACCP). Due to multiplicity of laws in a majority of developing nations processed food industry is facing a major threat for survival and growth. In India nine different ministries were involved in controlling this area. Food Safety and Standards Act was established to integrate the food safety laws in India, in-order-to systematically and scientifically re-orient food processing and manufacturing industry from regulation to self-compliance. In this study, authors' focuses on issues related to the food legislation enforced time to time based on international scenario and trade. This study brings out the fact that more holistic approach is seen in new scientific standard development and covers a wider variety of products including functional food, novel food and beverages. The basic requirements of food hygiene and Good Manufacturing Practice (GMP) practices as described by codex are important for any national food safety control. However, the study concludes that there exists a gap in infrastructure and risk-based approach in the both implementation and enforcement. The study also provides the SWOT analysis of Indian legislative model and recommendation for improvement (Shukla ,2014).

Garg (2019) noted that any process-associated food preservation deteriorates overall quality of food materials to some extent. Many a time, improper preservation practices result in harmful effects on foods. Contamination can be accessed through different pathways including biological, chemical, as well as physical ones. Improper process conditions, processing environment, wrong ingredient, and improper balance of processing components may cause mild to severe contamination in food materials over the time of preservation process. Out of the contaminations, excess chemical

preservation and proliferation of microorganisms lead to severe negative health consequence. Proper hygiene practices, leaving harmful preservatives, and maintaining required preservation conditions would ensure the safe quality of preserved foods (Joardder et.al 2019).

D. Importance of food safety intervention and education on food safety and safe handling practices

Cleaning and sanitising form the basis for the hygienic condition. Cleaning is the removal of matter from a surface on which it is unwanted. Sanitising is carried out after the cleaning operation and results in a reduction in the number of harmful bacteria to safe levels. The management processing unit has an important role to play in maintaining high standards of sanitation and a safe work environment. They should be convinced of the importance of food sanitation and should be interested in ensuring that all employees practice safe food handling (Zeeshan et.al.2017).

The processing unit should be safe to work. A safe and clean establishment increases productivity and profits. Not only should consumers be protected from food –borne illness, but in the interest of both customer and employees, premises should be safe and it is the foremost duty of the management to ensure safety at the work place. Prevention of accidents and sanitation are closely related in the sense that accidents may result in food contamination. The processing units should realise that accidents do not just happen, they are caused. They can very often be prevented from happening by practicing proper work habits (Panghal.et.al 2018).

In the industry today, special attention needs to be focussed on training all employees directly or indirectly concerned with food, in safe food practices. In most instances, it has been observed that the managers are busy with other matters like running the processing unit and proprietors may not be inclined to spend time and money on training employees. This training is however necessary because the incidence of food borne illness is on the rise. It is the legal responsibility of the processing unit to produce clean and wholesome food. Most of the employees have no formal training either before or at the time of recruitment and have picked up the job from an experienced food handler to whom they been assigned. In food industry labour turnover rate as well as job change rate is very high. Very few processing units

have an inbuilt, well -structured sanitation programme. Professionally trained food handlers are not available or do not have the time (Early, 2012).

Zanin (2017) pointed out that training food handlers in safe food practices will cost the management both time and money as the food handlers and trainers will stay away from work for some time. Learning resources like films, slides, posters and hand outs have to be procured and a professional trainer may also be needed. However in the long run this training is beneficial as it helps cut down on losses incurred due to visibly spoiled food. Loss of reputation on account of outbreak of food borne illness, presence of hair, insect droppings or body parts or any filth in food products prepared. Unhygienic processing, dirty toilets and financial loss if licence is suspended.

Most food handlers belong to the lower socio economic group and have studied till primary school only. They may have language problems and difficulties in reading and writing. They usually have no formal training and for them chances of promotion are bleak. Because of this background, they do not understand the importance of sanitation. Because of low chances of promotion, low pay scales, inconvenient long work hours, working break shift or on holidays and the temporary nature of some jobs, the employee turnover is high. There is a frequent need to train new employees about their job. Training in sanitation should thus go side by side and should begin as soon as an employee join duty (Akabanda, 2017).

Seaman, (2010) emphasized that the ideal situation would be one where it is mandatory for every food handler to complete a course in sanitary food handling. This programme should be continuous one. But this may not always be feasible as some proprietors may object because of high training expenses as well as high employee turnover. In such cases, to begin with all managers should be trained and they in turn would train food handlers. This would cut down on training expenses but would put pressure on the already over- burdened managers.

Jaworski et.al (2018) stated that the advantages of the training programme for the employer are labour turnover will be reduced, employees will need lesser supervision, increased food production, need for skilled employees will be partly fulfilled, working conditions will improve and there will be a reduction in cases of food borne illness. On the other hand advantages of the training programme for the

employee are chances of advancement in position, greater sense of security and job satisfaction.

The training programme should include personal, food and environmental hygiene. Instructions and training material should be specifically related to food industry. To make it interesting posters on hygiene should be displayed in prominent places and principles of sanitation should be distributed free of cost to all food handlers. For a training programme to be really effective, it must be carefully planned, well executed, continually monitored and evaluated (Seaman, 2010).

Food safety can, however, be enhanced by creating awareness through training and implementation of stringent hygiene measures along the value chain (production, processing, storage, distribution, and consumption) (Korada et al., 2018).

Several studies carried out by Husain et.al.(2016) revealed that the identified food safety training as can effective tool for improving food handlers' knowledge and practices.

A study by Webb and Morancie (2015), recommended the detailed attention on planning, implementation, monitoring, and evaluation of food safety training to improve food safety knowledge among food handlers. Adesokan et al. (2015), also proposed food safety training as an approach for improving food handling practices.

An education effect could affect the improvement of hygiene knowledge, but the food safety practice and hygiene management performances were not improved. However, considering the fact that there were some significant increases in knowledge, it is concluded that practicing continual and repetitive hygiene education could be effective even in improving the sanitation management level as well as the hygiene knowledge and sanitation practices. To do this, the frequency of food safety training reinforced through specific goal setting, and more concrete training programs suitable for the employees' educational background should be designed. In addition, designing the program to motivate employees to maintain and self-regulate proper practices should be required (Park et.al 2017).

Kassa.et.al.(2010) evaluated the effectiveness of the food manager training and certification program to increase compliance with sanitary codes in Boston. Their study clearly showed a significant improvement in mean inspection scores in

restaurants after training managers compared to restaurants not receiving this training. They also found a significant decrease in critical violations in restaurants with trained managers compared to restaurants without trained managers one year after training, but after two years there were deficiencies in some critical food safety elements in both types of restaurants. Training had limited long-term impact in some important critical food safety elements.

Azanaw et.al. (2019) revealed, that there was poor food handling practice among food handlers. Marital status, food safety training, supervision by health professionals, routine medical check -up, and level of knowledge of food handlers were significantly associated with good food handling practice. Owners, managers and local health professionals should enhance the level of knowledge of food handlers, provide food hygiene, safety training, undertake periodic supervision, and routine medical check-up.

Research carried out by Soon et.al (2012) has shown that traditional food safety training programs and strategies to promote hand hygiene increases knowledge of the subject. However, very few studies have been conducted to evaluate the impact of food safety training on food handlers' attitudes about good hand hygiene practices. Food safety training increased knowledge and improved attitudes about hand hygiene practices. Refresher training and long-term reinforcement of good food handling behaviour's may also be beneficial for sustaining good hand washing practices.

For many years social cognition models and workplace health education theories have been used to map out the variables and identify determinants of various health-related behaviours, including hand hygiene practice, food handling and the use of food thermometers. Whilst many models and theoretical frameworks identify specific determinants or variables of behaviour and organisational interactions this paper takes a holistic approach to food hygiene training and proposes a new theoretical framework. This framework (The Food Hygiene Training Model) encompasses and utilises various theoretical models and educational theories to recognise the various influences on the training, beliefs, motivations, and conditions required for food handlers to perform safe food handling practices in the workplace (Seaman 2010).

Effective food hygiene training and the enactment of safe food handling practices learnt during training are critical elements in the control of food-borne illnesses throughout the world. Therefore, future food hygiene training strategies, if they are to be effective, should consider the adoption of the Food Hygiene Training Model, to aide overall improvements in food businesses, and thus, an overall reduction of food-borne illnesses (Medeiros et.al 2011).

Tomohide,(2010) quoted that an important element in the effectiveness of food hygiene training is the support given by managers, both pre and post training, to motivate food handlers to enact the safe food handling practices learnt during training. This study explores the personal views of food handlers, their managers, and accredited training providers towards the provision and evaluation of food hygiene training in the South-West London region, exploring the pre and post training support given to food handlers, and its effects on the attitude and behaviour of food handlers to enact safe food handling practices in the workplace. In total seventy telephone interviews were conducted. Findings demonstrate that most food industry managers are aware of their responsibilities to train food handlers, but often do not provide adequate support to promote the enactment of safe food handling practices, or evaluate its effectiveness. Thus, any positive effects gained from food hygiene training programmes, are ephemeral. (Seaman 2010). Personal hygiene and environmental sanitation are key factors in the transmission of food-borne diseases. Investigations of outbreaks of foodborne disease throughout the world show that in nearly all instances, they are caused by failure to observe satisfactory standards in the preparation, processing, cooking, storing or retailing of food.

Cunha et.al (2014) suggested that refresher and short duration training of two weeks at a stretch are key features of an effective training programme for improved food safety practices. It was, however, observed that the area of training appeared not to have any significant impacts on the food safety knowledge and behaviour of the food handlers.

Akabanda et.al (2017) showed that food-handlers might not necessarily be practicing strict food safety procedures during food handling, even when they provide answers to show that they are knowledgeable in a survey. Therefore, other factors such as employee motivation and continuous education and training on the job should be

provided to inspire food-handlers, which will affect attitudes and subsequently food-safety practices.

Wallace.et.al (2018) proclaimed that the food safety is best ensured by the shared responsibility of everybody involved with food from the professional to the consumer. All along the food chain, various procedures and good practices are implemented to ensure that the food which reaches the consumer's table is fit for consumption, that the risks of contamination are minimised so that the population as a whole is healthier from the benefits of safe quality food. But responsibility for food safety should not only be the priority of professionals in the food industry. There are rules and procedures to guide the professionals, but the consumer is equally responsible in order to ensure the safety of food in the home.

Shaw, (2018) confirmed that the best way to practice food safety is to be well-informed about the basics of food: natural processes and, especially, the hazards to food from chemicals - both those naturally occurring and those coming from the environment. Ultimately, everyone benefits from being better informed about food safety. Food safety is of necessity a shared responsibility for every individual especially in food industries.