

## FOOD WASTE, MICROBIAL WASTE, AND ITS DISORGANIZED MANAGEMENT ~ A REVIEW

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### ABSTRACT

*Food safety is nothing but utilizing various resources in order to ensure that all types of foods are properly started, prepared and preserved. Hence, they are safe for consumption. Internal auditing should be conducted on a repeated to make external auditing a smooth-running process. The priority should lie in maximizing food sales, and giving away or selling foods past their prime involved risks that may undermine sales. Times have moved on towards reaching perfection with technology being updated almost every passing hour in the twenty-four. Food wastage, in more than a certain method is gripping problem in the rising scientific scenario. In fact, the Food and Agriculture Organization (FAO) admits, wastage of food has become a perilous question and an issue in our society affecting both poor and rich nations. Food wasting also means wasting “the time and energy” of producing and procuring food, our natural resources and the available land for agriculture. It has a very big and deep and everlasting impact on the economics of a nation affecting the overall greenhouse gas emission. Our focus in this review paper is to create social awareness by reducing food wastage and recycling wasted food through embedded systems.*

**KEYWORDS:** *Food Waste, Biodegradable Waste; Food Loss; Food Waste Management; Waste Management.*

### INTRODUCTION

Food, shelter and clothing are the basic needs of human beings to lead dignified human life. Indeed, it is enthusiastic researching on food waste management and a self- assessment questionnaire in controlling food waste management. The questions what, why, where, when and how are vital in acquiring knowledge about anything. Food safety and equal wisdom of food waste is no exception. Food safety can be probed with these questions. Interestingly, we can think about what type of food is ‘prepared’, where, why, when and how it is ‘prepared’. Researchers in general do not think this line of probing is either of low standard or insignificant. In the past, if one can see, there has been many an attempt to quantify global food waste and many an assessment on various food supply chains and envisioned to a much bigger picture. It has been even said that, more than 60% of the actual cultivated food is gone waste before it can reach the waiting hands of the consumer.

### DEFINITIONS

Waste, we know is a pejorative term for unwanted materials. Food waste occurs at many a level in the Food supply chain or simply FSC, evidently defined at the retail and the consumer stages. Yet, we understand food is a biological product and

is like any, subject to degradation and deterioration. Below are two definitions with respect to waste and one with regard to the waste management.

Wholesome edible material intended for human consumption, arising at any point in the food supply chain that is instead discarded, lost, degraded or consumed by pests. (FAO 1981).

As the above, but including edible material that is intentionally fed to animals or is by-product of food processing diverted away from the human food. (Stuart 2009).

The collection, transportation and disposal of garbage, sewage and other waste products.

The first one is considered to be the most relevant one and the second one, equally relevant provided ample data. The third one is that of the waste management. It encompasses management of all processes and resources for proper handling of waste materials, from maintenance of waste transport trucks and dumping facilities to compliance with health codes and environmental regulations. As the food industries and food organizations (domestic and international) pave the way to immeasurable amounts of pollution, refuse it is becoming tedious to safeguard it. Technology has advanced, often exceeding the boundaries of usage and so are the demands of ethics and safety of the environment. As a result of this, our trustworthy guardian at the top, "Ozone layer" is getting damaged and leading to destruction. Another vital issue on the land, opposite to those in the skies is the amount of food wasted despite high inflation. Ironically, more than 60% of the thrown food is an absolute waste and of no use. It is therefore the need of the hour to minimize the waste and recycle the non-edible part to good. Henceforth, it is in our very hands to design and develop an effective food waste treatment.

## THE RESEARCH QUESTION

Proper lack of knowledge in the holder, improper waste characterization, and ever-growing rise in waste at both the national and international levels has been a growing concern of safety. This includes from field to fork and has led to the ambiguity and disaggregation of the resources. The actual data on the waste disposal and waste generation is rare, unfound and there is a dearth of good literature. This is due to,

- Lack of segregation and measurements of food waste,
- Making a mess of food waste and organic waste by treating them on par and leading to an utter chaos in the calculation of the actual food wasted,
- Physical quantifying of waste, leading to pragmatic, health and safety hazards and Mandatory waste is highly limited to mixed solid waste streams at the points of disposal.

## COMPONENTS OF WASTE

A look into the chemistry of refuse/waste, components like Poly Vinyl Compounds (PVC), Corrugated boxes, Meat scraps, Fried fats, polystyrene, Plastic coated paper, Waxed milk cartoons, to name a few constitute to the major slop.

### Types of Waste in Food Service Sectors

- Lean path, an automated food waste prevention tracking systems based in US classifies food waste as follows.
- Food waste: This, they can be mainly categorized as pre-consumer food waste and post-consumer food waste.

- Packaging waste: This includes inbound supply chain waste and packaging waste.
- Operating supplies: These are the physical terms required for running a manufacturing function. These are positioned in the front of the house and at the back of the house.

## FOOD WASTE MANAGEMENT AND MICROBIOLOGY

Spoilage can be characterized as food product changes that render it unacceptable to the consumer from a sensory point of view. Because microorganisms are usually the most important cause of spoilage, obtaining more information on microorganisms present throughout this process will help improve methods for treating and utilizing food waste<sup>1</sup>. During the spoilage of food, lactic acid bacteria (LAB), including *Pseudomonas* and *Enterobacteria*, are the dominant species<sup>2,3</sup>. LAB are clade of gram-positive, low GC- content (G and C DNA bases), acid-tolerant, generally non-respiring, either rod- or cocci- shaped bacteria that share common metabolic and physiological characteristics. LAB are known to play an important role in food preservation and fermentation processes by lowering the pH and producing bacteriocins, which prevent the growth of pathogenic and spoilage microorganisms<sup>4</sup>. *Lactobacillus* are also considered “friendly” bacteria that commonly live in the digestive, urinary, and genital systems of humans and animals without causing disease. The growth of *Enterobacteriaceae* during spoilage is of great concern because of their harmful effects on human beings and consequent economic losses<sup>1</sup>. The family *Enterobacteriaceae* comprises a large group of gram-negative, non- spore-forming, facultatively anaerobic bacteria, which includes several important human pathogens such as *Salmonella enterica* serovar Typhi, *Shigella dysenteriae*, *Yersinia pestis*, and a range of pathogenic *Escherichia coli*. In addition to their clinical importance, some members of this family are important food spoilage organisms and are responsible for substantial economic losses. On the basis of these concerns, understanding changes in LAB and *Enterobacteriaceae* populations during spoilage is important for the treatment of food waste; nevertheless, few studies have focused on this.

In recent years, the rapid development of molecular biotechnological methods has made it possible to learn more about the spoilage of food waste<sup>1</sup>. Recently, bacterial identification based on modern molecular methods, especially those that incorporation sequencing of genes coding for 16S rRNA, have become a significant tool for detailed study of bacterial communities in samples of food and drink.

Many relative tests have been carried out to check the spoilage of food like, Changes in pH during storage of food, characterization of food waste sample, Changes in bacterial diversity based on T-RFLP., Changes in bacterial diversity based on Illumina MiSeq sequencing, Quantification of *Lactobacilli* and *Enterobacteria*.

## SOURCES OF PATHOGENS IN FOOD

Sources of pathogen contamination of fresh produce at the farm level include livestock and human movement, land-application of raw manure, contaminated irrigation water, immature compost application, contaminated soil, and runoff from compost and manure stockpiles on the farm. Produce leaves that touch the ground are more prone to pathogenic contamination than plants whose leaves have not<sup>5</sup>. Water distribution systems such as surface furrow and drip irrigation system pose less risk than sprinkler systems because the latter irrigation water comes in contact with the edible portion of the plants. Fecal contamination was identified as the primary source of milk contamination at farms. Processing steps are often found to be more susceptible to pathogen contamination than production steps.

Environmental samples (soil, feces, water), poorly sanitized food contact surfaces (conveyor belt, knives, slices etc.) and poorly sanitized non-food contact surfaces (walls, drains, floors etc.), unhygienic design of plants, unregulated traffic patterns, non-sanitized worker's hands, transport trailers and crates are some of the sources of contamination. High contamination in meat processing plants and cutting and packaging rooms may be due to unhygienic design of bleeding, plucking and evisceration equipment. Cross contamination with foodborne pathogens can occur during transportation or while animals are waiting in lairage before slaughter. Biofilms (thin slime layers of bacteria) are the major vehicle for microbial food contamination<sup>5</sup>.

At the retail stage, observed food contamination may originate at the retail site or from previous stages in the food supply. Shelf life, packaging materials and style, rodents and refrigeration systems are some of the factors which need to be taken into consideration for prevention of further contamination. Various field management techniques, poor regulatory guidance, emphasis on minimal application of antibiotics and interest in organic processes could be some of the reasons for the high prevalence of pathogens in produce collected from a farmer's market. When food with foodborne pathogens is prepared for consumption, kitchen surfaces and implements can transfer pathogens from one food to another, causing cross contamination. This can be attributed to stringent regulation and enforcement of food and produce safety protocols.

Poorly sanitized food contact and non-food contact surfaces, unhygienic processing plants and cross contamination were the reasons proposed for the high prevalence of *L. monocytogenes*. Lack of use of antimicrobials in the post-harvest control process in organic fresh produce was suspected to contribute to the higher prevalence of *Salmonella* at farmers' markets than in conventional supermarket samples.

Contamination at the brooder house or in the post-slaughter stages was suspected to be the possible reasons for the high prevalence of *Campylobacter* in chicken. The possibility of pathogen contamination of food, and subsequently in food waste, could raise the incidence of pathogens in the final product after food waste treatment. Some of the food borne pathogens like *Bacillus*, *Campylobacter*, *Clostridium*, *E. coli*, *Listeria*, *Norovirus*, *Salmonella*, *Shigella*, *Staphylococcus*, *Streptococcus*, *Vibrio*.

## SCOPE OF RESEARCH

When the FAO, Food and Agricultural Organization of the United Nations were established in 1945, it had a deduction of food losses within its gazette. However, despite many an effort there lacked a systematic technical focus and falling short of solving the problems. It was Grolleaud, in the year 2002 who led to the development of a holistic approach. Ideal research on food waste management can be effectively carried out in the following steps.

- To conduct a face-to-face door to door survey, carrying out interviews of the targeted households. This would help the local bureaucrats in providing information and a tool ensure to better hygiene and safety of the people concerned.
- To generate organic waste, to analyze the current methods for disposing and re-using these materials and to support the residents in providing a centralized organic waste collection program.
- To understand the food supply chain, global trends that influence supply chain, estimating the losses of FSC (Food supply chain) and those losses confined to the food processing units.

## REVIEW OF RELATED LITERATURE

A lot has been written about and analyzed on food waste at domestic and international levels and in the present-day global food supply chains. A few even went ahead in penning down some definitions on waste and waste management. Yet we throw away our food into the garbage bins outside our homes and make things filthy. Nearly 60% of the food is gone waste. This brings us to the need of examining the feasibility, costs, benefits of promoting source separation of organic wastes, and to develop potential strategies of managing these separated organic wastes for implementing for the better growth of the society. A few surveys and collections from data reported, people are highly concerned with the inflation and the importance of curtailing the waste and recycling the non-edible parts. However, there lies a real dearth of literature and reviews on food waste, waste management, estimates varied widely and post-harvest losses of grain from field to fork. Hence, the Review of Literature is categorized into three (3) sections for the sake of convenience. They are,

Survey to investigate attitudes and reported behavior related to food waste and food waste collections. Organic waste generation and methods deployed for disposing and re- using the materials. Food waste within food supply chains, quantification and potential opportunities for development.

- Food production, Distribution and Marketing,
- Global Food Safety Programme,
- Food Safety Laws and Standards and
- British Retail Consortium.

## QUESTIONNAIRE FOR THE FOOD WASTE SURVEY

A general questionnaire towards understanding food waste and microbial management as listed below is expected to provide data in rural households.

- In general, how much are you concerned about the safety of food
- Do you cook, prepare or shop for food for your house?
- Thinking about various types of food waste, how much uneaten food, overall, would you say you generally end up throwing away?
- Compared with two years ago, would you say that the amount of food that you buy but does not get eaten has increased, decreased or stayed the same? Do you?
- Why have you reduced the amount of food you throw away?
- How much general garbage and the miscellany of unwanted materials do you think your household throws away?
- How much uneaten food do you think, is thrown away by your household?
- In the foods that were thrown into the garbage bin at home, which foods are the ones you think could be saved from wasting out?

- How much are you aware regarding the food labels?
- What best does it describe to you with respect to the “use by date” and “best before” date on the food labels?

## CONCLUSIONS

The purpose of this study is to emphasize the relevance of food safety standards and various waste management strategies in reducing food waste. The problem must be handled by strong collaboration and integration of multiple trans-disciplinary approaches, as multifaceted sociodemographic factors are partly to blame. By raising public awareness of the social and environmental effects of food waste and emerging technologies for controlling food waste disposal, individuals will be able to handle food in a more sustainable and appreciative manner. This paper also addresses the self- introspective questions that must be addressed in order to avoid

Food waste. Furthermore, to address global food waste control and disposal practices, different ways to analyze the effectiveness and impact of various policy measures and other interventions on food safety, as well as initiatives to tackle food waste in a systematic manner, should be monitored.

## Author Contributions

1) Conceived and designed the analysis; Collected the data; wrote, reviewed, and edited the paper. 2) Collected data, wrote methodology and discussion. 3) Wrote food waste management and microbiology and lack of pathogens in food sections.

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## Conflicts of Interest

The authors declare no conflict of interest.

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