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An Overvie On food microbiology

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ABSTRACT

Background: Food is imperative for continuation of life. However, it is also an important vehicle of entry of infections. Bacterial, viral and parasitic agents, causing these infections can all spread by foodBacteria can produce many toxins and also be inpassive sometimes, which can lead to diarrhoea and dysentery, respectively. This contamination takes place by risks like cooking food at improper temperature and keeping food open after cooking. These risks lead to various hazards. Also, microbes can help prepare different foods like fermented foods and Kampuchea tea. Modern society relies heavily on processed and ready-to eat foods, both of which can cause foodborne infections. Keeping all these things in mind, the science of food microbiology becomes very important in modern times. Aim: All these aspects of food microbiology and food safety have been discussed in this chapter. Objectives: Many points like food safety, cleanliness and other aspects like chilling of cooked food minimize risks of microbial food contamination and resultant hazards, have been elaborated upon. Methods: Scientific literature search was carried out to study the risk factors and related reports with respect to food microbiology, by food scientists and others. Results: Food contamination can be of microbial origin and a multitude of factors may lead to microbial contamination of food. These factors could be improper cooking, leaving cooked food uncovered, and other things. Conclusion: Food microbiology is a very important aspect of public health and quite neglected too. It should be given its due importance tomitigate microbial contamination of food and consequent foodborne infections.

I. INTRODUCTION

Modern consumers increasingly demand for ready-to-eat or minimally processed foods. This kind of food is microbiologically safe, fresh, and healthyHowever, these food products are susceptible to attack by spoilage and pathogenic microorganisms during processing and distribution.[1]It has been estimated that more than 10% of the population in the USA and the UK suffer from food borne disease each yearMicrobiology is a discipline that has witnessed important advances in consumer's health, biotechnology, and the production of quality foods. It is the study of microorganisms such as algae, bacteria, fungi, viruses, and protozoa. Bacteria are the most abundant organisms. The major focus of food microbiology is food safety. In order to ensure food safety, microbiological testing of food products such as testing for pathogens and spoilage organisms are necessaryAreas of interest which concern food microbiology are food poisoning, food spoilage, food preservation, and food legislation. Microbiological tests can also determine germ content; identify yeasts and moulds and salmonella[2]

CONCEPT OF FOOD MICROBIOLOGY

Microorganisms are present everywhere and they can Survive in wide range of environmental conditions. They are Capable of rapid reproduction under certain conditions. They Are found in food, air; water, soil, humans (nose, gut, skin, Etc.), dust, and surfaces. In foods, microorganisms originate From different sources such as fruits, vegetables, birds, air, Soil, additives, etc. Various factors affect their survival in Foods. They exert both beneficial and harmful effects on food Stuff. Some microorganisms are beneficial in that they cause Desirable changes in the food through the process ofFermentation. Some cause undesirable changes in the foods That lead to spoilage. In case of food safety inventions, the "good" microorganisms are often used to fight the "bad" one. Raw food can Harbor a variety of microorganisms. Dry good Are free from bad microorganisms since they cannot survive Under dry condition. The science of understanding these two Types of microorganisms is called food microbiology [2]. Food microbiology studies the role of microorganisms in Foods as well as the use of microorganisms for production of Ingredients and foods. Its aim is to examine the importance Of microorganism in food, their role in spoilage of foods, and Their application in food production and safety. AnUnderstanding of food microbiology is essential for the food Processor, as it covers the bad microorganisms that Contaminate food and good microorganisms that are needed For producing of foods such as cheese, yoghurt, bread, beer, Wine, and several diary products. Some types of Microorganisms may considerably increase during handling And processing of foods. Foods may be contaminated by each Other and by the equipment with which they come in Contact. Microorganisms that confer health benefits are Known as probiotics. In humans, probiotics can improve Medical conditions such as allergies, cancer, hepatic disease, Etc. The fate of microorganisms in food depends on many factors Such as the intrinsic and extrinsic factors of the food. Intrinsic factors are properties that exist in the food product Itself, while extrinsic factors are the properties that exist in The environment outside the food product. Extrinsic Parameters include temperature, pH, water activity (moisture content), and redox potential. Temperature is Perhaps the most important factor. Storage at low Temperatures slows the metabolic activity in foods

OBJECTIVES OF THE STUDY

To find out the year-wise research output of Food Microbiology.
To identify the source wise distribution in the Food Microbiology research output.
To know the frequency of topmost journals in Food Microbiology research output.
To know the frequency of top most authors in Food Microbiology research in the field.
To identify the frequency of institution in the field of Food Microbiology research.
To identify the frequency of country wise in Food Microbiology research.
To identify the mostly occurrence keyword in the Food Microbiology research area.

METHODOLOGY

Web of Science has citations and indexing services available online, which is maintained by Clarivate Analytics formerly Thomson Reuters. The present study involves three steps for collecting and analyzing the data for the selected study period. Firstly, the data for the selected period (2001 to 2020) was collected from Web of Science (WoS) database utilizing the search query for "Food Microbiology." Secondly, the other queries were excluded from the collected data and restricted to Food Microbiology subject related records that to authors. Finally, the collected data were further analyzed by using histcite software version is 12.03.17.

II. RESULTS AND DISCUSSION

The year-wise research documents and total citation scores at the global level for the Food Microbiology subject are presented in Table 1. For the selected study period, 2571 research documents related to Food Microbiology research were published by authors. The average number of publications per annum for scientists was noted as 128.55. The highest and lowest number of research documents was found as 228 and 202 in 2020 and 2019, respectively. More than 100 records found as a yearly research output in India the other remaining period from 2001 to 2006The fate of microorganisms in foods depends not only on the Physical and nutritional characteristics of the food but also onA set of extrinsic and intrinsic factors of the food and their Interactions. Factors, such as temperature, pH, water activity, And redox potential, can be considered the most important Factors driving microbial fate in foods. Food industry takeAdvantage of the fact that these factors can be conveniently Manipulated to prevent microbial contamination and growth In foods.

Table – 1. Year wise research output of Food Microbiology

Sl. No	Year	Records	Percentage
1	2001	88	3.4
2	2002	71	2.8
3	2003	75	2.9
4	2004	77	3
5	2005	91	3.5
6	2006	88	3.4
7	2007	111	4.3
8	2008	105	4.1
9	2009	118	4.6
10	2010	106	4.1
11	2011	127	4.9
12	2012	126	4.9
13	2013	150	5.8
14	2014	128	5
15	2015	138	5.4
16	2016	180	7
17	2017	178	6.9
18	2018	184	7.2
19	2019	202	7.9
20	2020	228	9.0
	Total	**2571**	100

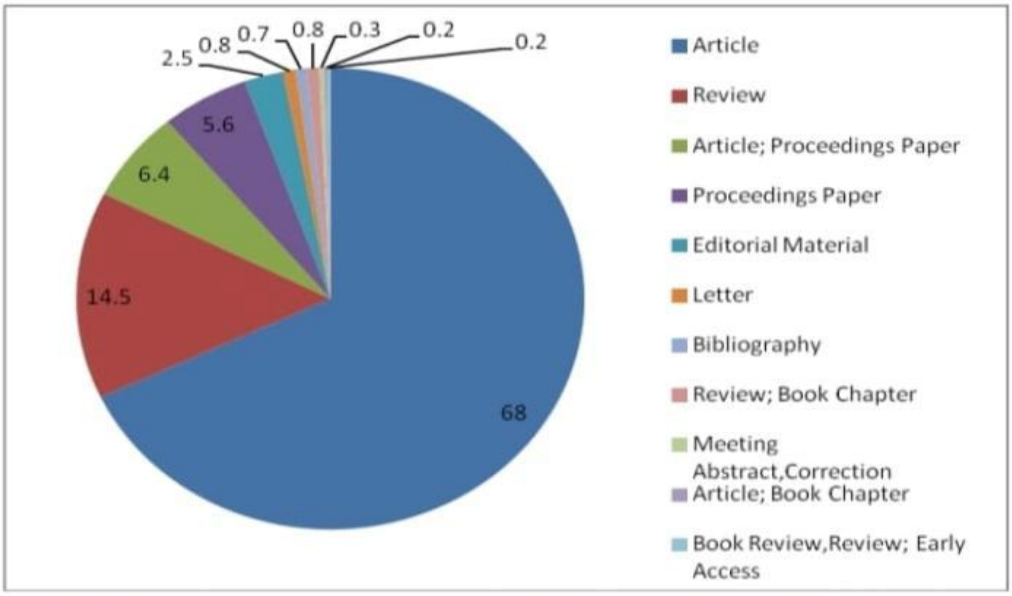

Fig. 1. Research source documents published in Food Microbiology (2001 to 2020).

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➢ **Temperature**

Among factors affecting microbial behaviour in foods, temperature is for sure the most important one. According to Jay), microorganisms can be classified into three groupsAccording to their growth temperature domains: PsychrotrophsGrow well at 7 1C or below and have an optimal growth Temperature range of 20–30 1C; mesophilic grow well between20 and 45 1C and have an optimal growth temperature range Of 30–40 1C; and thermophiles grow well at 45 1C or higher And have an optimal growth temperature range of 55651C.Mostfoodbornepathogensaremesophilicmicroorganisms,With exception of Listeria monocytogenes, Yersinia enterocolitica,And Clostridium botulinum type E, which have markedly Psychrophilic behaviour. Alicyclobacillys, Geobacillus stearothermophilus, and Bacillus sporothermodurans are examples ofThermophilic microorganisms of importance in foods and Beverage industries.Storage at low temperatures is one of the most important Ways of slowing microbial metabolic activity in foods. However, cellular sensitivity to cold stress depends on many factors,Including temperature, cooling/freezing rate, culture medium, strain, and storage time Factors Affecting Microbial Behaviour in Foods The fate of microorganisms in foods depends not only on the physical and nutritional characteristics of the food but also ona set of extrinsic and intrinsic factors of the food and their interactions. Factors, such as temperature, pH, water activity, and redox potential, can be considered the most importantfactors driving microbial fate in foods. Food industry takes advantage of the fact that these factors can be conveniently manipulated to prevent microbial contamination and growth in foods.

➢ **pH**

It is well established that most microorganisms grow better inpH values close to 7.0, although a few can grow in pH values below 4.0. Bacteria tend to be more sensitive to pH than filamentous fungi and yeasts, and pathogenic bacteria are evenmore sensitive. Spoilage microorganisms of the lactic acidbacteria (LAB) group, for example, may grow in pH values aslow as 2.0. Pathogenic microorganisms, such as Cl. Botulinum,will not grow in pH values below 4.6. Because of its pathogenic potential, pH 4.6 is used as a limit for a food to beclassified as of low acidity (44.6) or high acidity (o4.6). ThepH has a marked importance in the definition of intensity ofthermalprocessing, with low and high acid foods being processed above and below 100 1C, respectively.The minimum and maximum pH values tolerated by each microbial species depend also on other factors. For example,The minimum pH required for the growth of certain lactobacilli depends on the type of acid used: Citric, hydrochloric,Phosphoric, and tartaric acids enable growth at lower pHValuesthan acetic and lactic acids . MinimumConcentrations of these acids or preservatives are used for inactivating or inhibiting microorganisms. In principle, growthCould be inhibited by inactivation or disruption of the cell Membrane, cell wall, metabolic enzymes, protein synthesis, orGenetic material .Although the pH 4.6 marks the point below which Pathogenic microorganisms cannot grow, the occurrence ofSeveral outbreaks associated with acidic products, such as fruitsAnd fruit juices, have shown that inability to grow in foodsWith pHo4.6 should not be confounded with ability toSurvive

➢ **Water activity**

Water activity is related to the amount of water available forthe metabolic reactions within the cell. In fresh foods, aw exceeds 0.99. In general, bacteria need higher wateractivity than fungi, and Gram-negative bacteria need higherwater activity than Gram-positive bacteria. Most bacteria associated with food spoilage grow at aw above 0.91, whereasmost filamentous fungi can grow at aw as low as 0.80.Staphylococcus aureus can grow at aw of 0.86, whereas Cl. botulinum needs aw of at least 0.94. Like filamentous fungi, yeastscan withstand lower pH than bacteria, and the same goes forwater activity. The lowest water activity required by a bacterium is 0.75 (halophilic bacteria), whereas xerophilic moulds and osmophilic yeasts can grow at aw of 0.65 and 0.61, respectively. The general effect of reducing wateractivity to a value below the optimum value is to increase thelag phase and reduce growth rate. Lowering the water activitycauses what is known as osmotic stress.Most microorganisms have evolved to function only withincertain water activity ranges. Water activity outside the optimalrange may reduce the essential metabolic functions of the celland inhibit a large part of the physiological processes, such asnutrient absorption and deoxyribonucleicacid replication .[4] In response to osmotic stress,microorganisms produce biocompatible solutes, such as treehouse, glycerol, sucrose, and mannitol. These biocompatiblesolutes help to balance the osmotic pressure of the cell andpreserve protein function .

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- Other factors

individual microorganisms or groups grow in a wide range of storage conditions. In addition to temperature, pH, and water activity, other factors are also important, such as the redox potential (Eh), packaging system, food structure, relative moisture, and atmospheric composition. Some anaerobic bacteria such as those from the genus Clostridium need an environment with reduced Eh to grow (Eh¼ 200 mV), whereas those from the genus Bacillus require positive Eh to grow. The bacteria that grow better in slightly reduced Eh conditions are called microaerophiles, which includes some LAB, [3]such as Lactobacillus (Jay, 2000). Studies have also discussed how the presence and concentration of some gases in the environment prevents or promotes microbial growth. Oxygen prevents the growth of anaerobic microorganisms in modified packaged foods, but high concentrations can increase the speed of oxidation reactions or even allow the faster growth of aerobic microorganisms. Carbon dioxide is the gas used in modified atmosphere packages that possess antimicrobial properties. Nitrogen is not absorbed by foods and is used as filler gas. It is evident that water activity and pH interact with temperature,

- Pathogenic Microorganisms in Foods

Gram-positive foodborne pathogensMost foodborne illnesses are caused by the ingestion of foodor water contaminated with microorganisms or their toxicmetabolic products. Some Gram-positive bacteria, especiallySt. aureus, Cl. botulinum, Clostridium perfringens, Bacillus cereus,and L. monocytogenes, are considered important foodbornepathogens responsible for foodborne illness outbreaks everywhere in the world). Most of these microorganisms,except for L. monocytogenes and Cl. perfringens, can grow onfood and produce toxins that will cause food poisoning wheningested. Clostridium botulinum, Cl. perfringens, and B. cereus arecapable of forming spores, structures that make them resistantto high temperatures and other adverse conditions.Among Gram-positive bacteria, St. aureus stands out because it can grow in foods with high sodium chloride concentrations (10–20%) and low aw (0.83–0.86). Staphylococcusaureus is heat labile and produces heat-resistant enterotoxins. The disease caused by St. aureus isdue to consumption of animal-origin and excessively handledfoods. Staphylococcus aureus have a short incubation period andthe intoxication caused is self-limiting. The clinical symptomsassociated with B. cereus poisoning are very similar to thoseassociated with staphylococcal intoxication. However, B. Cereuscan cause two distinct types of foodborne illnesses, namelyemetic and diarrheal syndromes. Emetic syndrome is causedby the ingestion of a preformed toxin (cereulide) in foods,which stimulates the vague nerve and causes nausea andvomiting . Thediarrheic syndrome is an infection caused by ingesting bacterial cells, which then colonize the small intestine and produce enterotoxins in loco . These two syndromes are also characterized by theirrapid onset and self-limiting nature, not requiring therapeuticinterventions and hospitalization. Despite this, severe andeven fatal cases have been reported.Clostridium botulinum, the causative agent of botulism, is aglobally distributed bacterium. It causes a severe disease withhigh mortality rate due to ingestion of botulinum toxin. Botulinum toxin is preformed in foods and as a neurotoxin, afterabsorption in the intestines, reaches the nervous system and blocks the release of acetylcholine by nerve terminals Despite the severity of the illness, theassociated neurotoxins are heat labile and can easily be destroyed by heating the food to 801 C for 20 min or 851 C for5 min .Clostridium perfringens is another important spore-formingbacterium widely distributed in nature and capable ofproducing more than 15 toxins that cause different diseases inhumans and animals. Food poisoningcaused by this bacterium is among the most common foodborne illnesses in the world. Food poisoning by Cl. Perfringens Is caused by the ingestion of at least 107 cells of the microorganism, which sporulate in the intestines, releasing the Cl.perfringens enterotoxin Differently from the above-mentioned Gram-positive bacteria, L. monocytogenes is characterized by its ability to invade

intestinal cells and diffuse to other organs and tissues . It is a ubiquitous bacterium resistant to desiccation, low water activity, and low pH and may cause anythingfrom a mild gastroenteritis to severe infections of the centralnervous system and abortion, depending on the host's susceptibility . Listeriosis,the disease caused by L. monocytogenes, is a major concern forthose involved in food safety because of its high mortalityrates (approximately 50%). Listeria monocytogenes is a psychrotrophic pathogenic bacterium of very high importance forprocessed foods or minimally processed foods that are storedfor medium to short periods.Gram-negative foodborne pathogensMany Gram-negative pathogenic bacteria can cause foodborneillnesses, including Salmonella spp., Campylobacter spp.,pathogenic Escherichia coli, Shigella spp., Y. enterocolitica, Vibriospp., Aeromonas spp., and Cronobacter sakazakii, among others

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Among these, Campylobacter spp. has been identified asthe main cause of food borne illnesses and outbreaks in theUSA and Europe in the past 5 years. The thermophilic speciesCampylobacter jejuni and Campylobacter coli are the main causesof campylobacteriosis in humans, a usually self-limitinggastrointestinal disease that can, nevertheless, cause severecomplications, such as Guillain–Barré syndrome and reactivearthritis . Salmonella spp.also plays an important role in foodborne illness outbreaksworldwide, being an important public health problem. Most serotypes cause gastroenteritis limited to intestinal infections, but the Typhi andParatyphi serotypes can cause enteric fevers, which are moresevere illnesses and affect other organs and tissues. Although E. coli are considered part of thenormal intestinal microbiota of warm-blooded humans andanimals, some strains can cause foodborne illnesses. Thesepathogenic strains can be grouped into at least six differentgroups: enteropathogenic E. coli (EPEC), enterotoxigenic E. Coli(ETEC), enteroinvasive E. coli (EIEC), enter aggregative E. Coli(EAggEC), diffuse aggregative E. coli (DAEC), enterohemorrhagic E. coli (also known as verocytotoxin-producing E. coli,VTEC, or Shiga toxin-producing E. coli, STEC), and enteroaggregative hemorrhagic E. coli (EAHEC). Foodborne illnessoutbreaks have been particularly associated with VTEC and,toa smaller extent, EPEC, ETEC, and EAggEC. Agreatoutbreakwith EAHEC strain E. coli 0104:H4 occurred in Europe ,with 320 bloody diarrhea cases, 850 cases of hemolytic-uremicsyndrome (HUS), and 82 deathscredited TGCS in the topmost keywords.

Pathogen	*Characteristics*	*Symptoms*	*Incubation*	*Foods*	*References*
Staphylococcus aureus	Ingestion of one or more types of staphylococcal toxins	Intense vomiting, diarrhea, abdominal pain, and nausea	0.5–6 h	Milk and dairy products, meat products, confectionary products, and ready-to-eat foods	Adams and Moss (2008); Argudín *et al.* (2010); Gilmour and Harvey (1990); Kim *et al.* (2011); Schelin *et al.* (2011); Tranter (1990)
Clostridium botulinum	Ingestion of botulinum neurotoxin	Initial gastrointestinal symptoms, double vision, dry mouth, difficulty in swallowing and controlling tongue, and flaccid paralysis	12–36 h	Canned foods (vegetables and meats), honey, milk products, fish, and fermented seafood	Lindstrom *et al.* (2006); Lund and Peck (2000); Peck *et al.* (2011)
Clostridium perfringens	Release of *Clostridium perfringens* enterotoxin after intestinal sporulation	Acute abdominal pain, nausea, and diarrhea	8–12 h	Meat products and meat-based ready-to-eat foods	Lindström *et al.* (2011); Liu (2009); McClane (2001)
Bacillus cereus	Ingestion of cereulide toxin (emetic syndrome)	Nausea and vomiting	0.5–6h	Rice and grain-based foods	Agata *et al.* (2002); Ehling-Schulz *et al.* (2004); Shaheen *et al.* (2006)
	Toxin production in the small intestine (diarrheic syndrome)	Abdominal pain and aqueous diarrhea	8–16 h	Meats, pasta, desserts, cakes, sauces, and milk	Andersson *et al.* (1998); Clavel *et al.* (2004); Granum (1994)
Listeria monocytogenes	Invasion of intestinal epithelial cells and diffusion to other organs and tissues	Fever, headache, abdominal pain, diarrhea, chills, and complications (abortion, meningitis, and septicemia)	2 days to 3 weeks	Vegetables and salads, cheeses, milk, beef, chicken, and fish	Abadias *et al.* (2008); Cabedo (2008); Caramello and Vaudett (1990); Kvenberg (1988)

The advantages of microbes in food

- Fermentation and flavour development:

One of the most Celebrated advantages of microbes is their role in fermentation. Fermentation is a metabolic process in which microbes convert Carbohydrates into alcohol, organic acids, and gases. This processCreates unique flavours and textures in foods and beverages suchAs bread, yogurt, cheese, beer, wine, and fermented vegetablesLike kimchi and sauerkraut. The distinct flavours and complexAromas in these products are often the result of microbialActivity.

- Probiotics and health benefits:

Probiotics are liveMicroorganisms that, when consumed in adequate amounts,Provide health benefits to the host. Foods like yogurt, kefir, andCertain types of cheese contain beneficial bacteria such asLactobacillus and Bifidobacterium. Probiotics are known toSupport gut health, improve digestion, and even boost theImmune system. These beneficial microbes can help maintain aBalanced gut microbiome, which is linked to overall well-being.

- Natural preservation:

Microbes can also act as naturalPreservatives, extending the shelf life of food products. CertainBacteria and moulds produce compounds that inhibit the growthOf harmful microorganisms, reducing the need for syntheticPreservatives. This natural preservation is a key feature inFermented

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foods, where the acidic environment created byMicrobes prevents spoilage and contamination

- Food innovation and alternative proteins:

Microbes are at the Forefront of food innovation. The development of plant-based And cultured meat products relies on microbial processes to Mimic the texture and flavor of traditional meat. Additionally,Microbes are used to produce alternative protein sources, such asMycoprotein, which is derived from fungi. This innovation helpsReduce reliance on conventional meat production and promotesSustainability.

Pathogen	Characteristics	Symptoms	Incubation	Foods	References
Salmonella spp.	Invasion of intestinal cells (gastroenteritis) Typhoid fever (Typhi and Paratyphi serotypes)	Fever, headache, abdominal pain, diarrhea, and chills	12–36 h	Eggs, meats, milk, and dairy products	Crump and Mintz(2010); D'AOUST (2001); Payment and Riley (2002).
Campylobacter spp.	Invasion of intestinal cells	Fever, headache, muscle pain, diarrhea, abdominal pain, and nausea. Complications: Guillain–Barré syndrome and reactive arthritis	2–10 days	Meat and poultry products, raw milk, and contaminated water	Rao *et al.* (2001); Rautelin and Hanninen (2000); Solomon and Hoover (1999); Zilbauer *et al.* (2008)
E. coli (pathogenic) (EPEC, EIEC, EAggEC, ETEC, EHEC, and DAEC)	Adherence to intestinal cells, electrolyte imbalance, toxin production, and rare invasion of intestinal cells	Fever, abdominal pain, chills, diarrhea, and nausea Complications: hemolytic-uremic syndrome (Shiga toxins)	8 h to 4 days	Meats and meat products, milk and milk products, leafy vegetables, and fish	Abadias *et al.* (2008); Atanassova *et al.* (2008); Brandl and Amundson (2008); Eglezos *et al.* (2008)
Shigella spp.	Invasion of intestinal cells and toxin production	Fever, bloody diarrhea, chills, abdominal pain, and vomiting Complications: Hemolytic-uremic syndrome	12–50 h	Shellfish, crustaceans, fruits, vegetables, and salads	Agle *et al.* (2005); Chanachai *et al.* (2008); Kimura *et al.* (2006); Pinu *et al.* (2007); Warren *et al.* (2006)
Yersinia enterocolitica	Invasion of intestinal cells, penetration in mesenteric lymph nodes, and inflammation	Abdominal pain, fever, diarrhea, sore throat, and joint pain	1–3 days	Beef, pork, poultry, oyster, fish, milk, and milk products	Arnold *et al.* (2006); Fredriksson-Ahomaa *et al.* (2007); Yucel and Ulusoy (2006)
Vibrio cholerae	Cholera toxin production in the small intestine	Abdominal pain, aqueous diarrhea, and dehydration	6 h to 5 days	Contaminated water, vegetables, and seafood	Austin (2010)
Vibrio parahaemolyticus	Colonization of the small intestine and production of adhesins and cytotoxins	Abdominal pain, diarrhea, colic, fever, headache, nausea, vomiting, and chills	4 h to 4 days	Shellfish, raw fish, shrimp, and oyster	Chan and Chan (2008); Davis *et al.* (2007); DePaola *et al.* (2003)
Vibrio vulnificus	Colonization of the small intestine and production of adhesins and cytotoxins	Diarrhea, abdominal pain, vomiting, fever, and may cause infections in wounds	7 h to some days	Shrimp, fish, oysters, and mussels	Colakoglu *et al.* (2006); Gopal *et al.* (2005); Jung *et al.* (2007)
Cronobacter sakazakii	Opportunistic infection	Abdominal pain and bloody diarrhea Complications: septicemia, meningitis, and brain abscess		Infant foods and formulas	Strydom *et al.* (2012); Zhou *et al.* (2008)
Aeromonas spp.	Opportunistic infection	Symptoms similar to those of cholera with aqueous diarrhea and mild fever; in some cases, symptoms similar to dysentery with bloody diarrhea, fever, and abdominal pain		Fish, shrimp, milk, and bottled water	Igbinosa *et al.* (2012)

➢ The disadvantages of microbes in food

- Foodborne illness and pathogenic microbes:

Certain bacteriaAnd viruses are responsible for foodborne illnesses, which canCause significant health risks. Pathogens like Salmonella,Escherichia coli (E. Coli), Listeria, and Campylobacter are known toCause severe infections and outbreaks. These harmful microbesCan contaminate food at various stages of production, leading toIllness and, in some cases, death. Controlling these pathogensRequires strict hygiene, proper food handling, and rigorous Testing.

- Food spoilage and waste:

Microbes can also cause food spoilage,Leading to off-flavours, discoloration, and texture changes.Spoilage organisms like moulds and spoilage bacteria thrive inVarious environments, causing food to deteriorate over time.This spoilage contributes to food waste and financial losses inThe food industry. Effective preservation techniques and properStorage are essential to minimize spoilage.

- Allergenic reactions:

Some microbes can trigger allergic Reactions in sensitive individuals. For example, certain moulds inCheese and fermented foods can cause allergies. Sulphites, aBy product of fermentation, are known to cause adverse reactionsIn some people. Understanding these risks is essential for foodSafety and consumer health.

- Regulatory challenges:

Microbial contamination posesRegulatory challenges for food safety agencies. EnsuringCompliance with safety standards requires extensive testing, Monitoring, and enforcement. This process can be costly andTime-consuming, leading to increased costs for food producers

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III. CONCLUSION

The Food Microbiology research output has shown significant publications selected study period, 2571research documents related to Food Microbiology research were published by authors. The average number of publications per annum for scientists was noted as 128.55.. The research articles published in different journals (68%) review articles (14.5 %), Articles; Proceedings paper (6.4%). INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY (253 nos.) the second rank for FOOD MICROBIOLOGY (100 nos.) and third rank for JOURNAL OF AOAC INTERNATIONAL (84 nos). The author ranking most prolific author first place with Van Impe JF (56 articles), second places Geeraerd AH (32 nos) and third places backed by Member JM (20 articles), Agin J , Bird P, Devlieghere F, Goins D (19 articles) and Crowley E (18 articles), Baranyi J, Couvert O, Garcia-Gimeno RM , Peleg M, Perez-Rodriguez F(17 articles) and all other authors contributed 15 and below articles respectively. An Institutional wise result found that first place was the Katholieke Univalve with 80 articles, and TGCS Score was 2858. The INRA has ranking second place with 51 records and TGCS 1656. Among the 107 countries, "USA" 537 documents contributed, "FRANCE " ,UK were 216 documents contributed, "SPAIN" has 185 documents , "BRAZIL" has 164 documents appeared in the data on research output. The highest Global citation score for the keyword search was 5648 keywords found in the results of the Food Microbiology research . Among the keywords, "FOOD" 545 times occurred, "MICROBIOLOGY" has 349 times, "GROWTH" has 285 times, "MICROBIAL" has 238 times and "DETECTION" has 192 times were occurred in the data on research output.

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