Comparative Review on the Incidence Causes of Foodborne Diseases and Strategies for Control in the United Kingdom and China

Luka Y.B*, Tabita S.G, Abubabakar A.A, Jibrin M.M, Lawan Z.B & Emmanuel B

Umar Suleiman College of Education Gashua, Yobe State, Nigeria
*Corresponding Author**

Abstract: **The study reviews the incidence causes of foodborne diseases and strategies for control in the united kingdom and china base on the result it is clear that the food safety problem in China is practically bigger than it is in UK, China despite the numerous strategies to contained the situation. As it was reported to the Chinese government between 1994-2005, 12,687 foodborne diseases incidents where 289,380 individuals were affected leading to the death of 2,297 individuals, *Salmonella* and *Vibrio parahaemolyticus* are responsible for 22.16% and 18.73% respectively.The increase in foodborne deseases outbreaks in China can be linked to the changes in the type of feeding habits, at a point many people change from eating well cooked food to eating raw or partially cooked foods where parthogenic microarganisms are still active and regenarate. Foodsafety is one of the leading challeges in China due to limited investment in surveillance, inter-agency coordination, outbreak investigation and synthesis of data. Lack of functional national laboratory based surveillance system makes it difficult or practically imposible for them to detect widespread foodborne outbreaks or to identify new infections. Comparing this to the UK, things tend to be different in the records of the foodborne outbreak the United kingdom hardly encounter cases of *Vibrio parahaemolyticus* as the major cause foodborne diseases. In the UK majority of the foodborne diseases is caused by *Salmonella, Campylobacter* and *Listeria* monocytogenes. The differences between the situation in the UK and China is assume to be due to feeding habits and other variation in the cultural behaviour of the two countries eating raw food or partially cooked food and improper hygiene is responsible for the higher record in China. Other factors includes overpopulation and inadequate food safety strategies and policy implementation between the two countries**

Keywords: **Foodborne, Diseases, Causes, Compare, Strategies, Control, China and United Kingdom**

I. INTRODUCTION

Foodborne diseases refer to any infection contacted through consumption of food or beverages that subsequently result in distress and could be life threatening sometimes (WHO, 2008). Eating contaminated food result in a wide range of illnesses mainly due to the presence of food pathogens, chemicals and parasites that had effected on the foods at different stages in food production, processing and storage (Tauxe *et al.* 2010). Intoxications and infections caused by pathogens including bacteria, viruses, protozoans, parasites, toxins, natural and manufactured chemicals, metals and prions are the main sources of food borne diseases. Presently there is over 250 foodborne diseases in the but the most familiar ones include the following: *botulism*; brucellosis; *campylobacteriosis*; *Escherichia coli*; *hepatitis* A; *listeriosis*; *salmonellosis*; *shigellosis*; *toxoplasmosis; viral gastroenteritis*; *taeniasis*; *trichinosis* etc (WHO, 2008). The annual expenditure on foodborne diseases is estimated at $2,034 billion leading to loss of productivity due to lack of man power in industries and organisations (WHO, 2011). In developing countries there is constant cases of infant diarrhoea and even adult in some instances leading to a significant of infant mortality (Kafarstein *et al*., 1997), it is estimated that 1.8 million childhood mortality occur and this often in developing countries (Tauxe *et al.* 2010). According to Chan and Chan (2011) the incidence of foodborne illness is on the increase. Similarly Scot (2003) asserted approximately one third of the industrialised countries experience the challenges of foodborne illness annually. Food Standard Agency (2011) also reported that, food and water borne illnesses is responsible for the death of 2.2 million people on annual bases.

According to Shao et al. (2011) foodborne zoonosis in China is mainly caused by microorganism ranging from bacteria, fungi, viruses and parasites. The implications of foodborne disease in China enormous and alarming as it results in substantial death of individuals, health systems, food industries and subsequently a significant loss on the economy of the country (Egen et al. 2007 in Lu *et al*. 2012). Aside the immediate effects of foodborne diseases on health, many are at risk of developing different illinesses such as haemolytic ureamic syndrome in *E.coli* infection, or reactive arthritis after Salmonellosis, Campylobacteriosis or Yersiniosis (Wang *et al*. 2007).

This article looks into the incidence of bacterial foodborne pathogens in China discussing the outbreaks by emphasizing the bacterial pathogens that are more common in causing food safety problems in the country. The various regulatory control strategies implemented in the country to reduce or prevent the incidence will be highlited and compared to the situation in The United kingdom.

II. INCIDENCE OF FOODBORNE PATHOGENS IN CHINA

The rapid economic, industrial and socio-economic changes, increased food production, supplies and consumption in China have led to increase in number of outbreaks of foodborne diseases in the country resulting to a negative effect on public health (Shao *et al*. 2011). From the year 1994-2005, about 12,987 cases of foodborne diseases' outbreaks was recorded , 289,380 affected by different illness and among this figure 2297 deaths were recorded respectively. Microbial pathogens are responsible for 4515 events with 146,852 people becoming ill and 349 deaths. Bacteria are responsible for more than 28.25% of all the cases of foodborne diseases and over 42.75% of cases yearly (Chinese annual edition committee, 1995-2005 in Wang *et al.* 2007).

70-80% cases of all the bacterial foodborne diseases were caused by *Salmonella amounting* to about 90%. Livestock products such as meat, eggs and milk are found to be contaminated by the bacteria (Shi *et al*. 2012).

A general publication review was conducted were the result of 2447 papers published in China was analysed, it reported 1082 cases of bacterial foodborne disease from 1994-2005 among of which *Vibrio parahaemolyticus* caused the most outbreak (Wang *et al.* 2007), followed by Salmonella, meanwhile *Clostridium botilinum* is responsible for most of the deaths. There was also variation in the the nature of the distribution of the pathogens between inland and littoral (coastal) provinces, *Vibrio parahaemolyticus* outweighing the percentage in the littoral provinces responsible for 23.04% of events reported then *Salmonella* with (14.36%), a mixture of different agents (10.35%) followed by *Bacillus cereus* (10.02%) compared to the incidence in inland provinces where *Salmonella* now predominates the percentage with (20.09%), then *B.cereus* with (18.32%), *Vibrio parahaemolyticus* with (14.32%), *Proteus* with (10.6%) and *Staph. aureus* (8.39%). This table below clearly outlines the report

Table 7. Regional distribution of 1082 bacterial foodborne disease events

	Littoral province				Inland province				Unknown			
	Events		Cases		Events		Cases		Events		Cases	
Etiologic agent	*n*	%	No.	%	*n*	%	*n*	%	*n*	%	*n*	%
Vibrio parahaemolyticus	138	23.04	6001	20.82	64	14.13	3784	14.02	9	30	1005	56.08
Salmonella	86	14.36	4862	16.87	91	20.09	7635	28.28	4	13.33	272	15.18
Proteus	74	12.35	3475	12.06	48	10.6	3086	11.43	2	6.67	98	5.47
Mixture bacteria	62	10.35	4368	15.15	25	5.52	1932	7.16	2	6.67	154	8.59
Bacillus cereus	60	10.02	2163	7.50	83	18.32	3498	12.96	2	6.67	83	4.63
Staphylococcus aureus	44	7.35	1619	5.62	38	8.39	1367	5.06	2	6.67	69	3.85
Escherichia coli	34	5.68	1185	4.11	36	7.95	2535	9.39	2	6.67	20	1.12
Other *Vibrio*	27	4.51	1002	3.48	6	1.32	266	0.99	2	6.67	14	0.78
Aeromonas	14	2.34	918	3.18	3	0.66	164	0.61	0	0	0	0
Shigella	14	2.34	614	2.13	9	1.99	868	3.22	1	3.33	35	1.95
Clostridium botulinum	5	0.83	27	0.09	23	5.08	209	0.77	2	6.67	18	1
Other bacteria	41	6.84	2590	8.99	27	5.96	1652	6.12	2	6.67	24	1.34
Total	599	100	28 824	100	453	100	26 996	100	30	100	1792	100

Adopted from Wang *et al.* 2007

Foodborne diseases causing organism in China

Out of 2387 incidents of severe foodborne illnesses in China reported in published journal papers, bacteria is responsible for majority of the cases and the following organinsims are noted to be the front runners; *Vibrio parahaemolyticus*, *Salmonella, Proteus bacillus vulgaris*, *Bacillus cereus, Staphlococcus, Escherichia coli, Shigella, Clostridium botilinum, Vibrio alginolyticus* and *Aeromonas*. These bacteria are reported to be responsible for 53.3% of the incidents, subsequently 64.6% of the reported illnesses and 16% mortality and *C.botilinum* is noted to be the deadliest responsible for 11.6% of the deaths, 1.3% of the incidents and 0.3% of the illnesses (Xue and Zhang, 2013).

III. CHINA'S FOOD SAFETY REGULATORY BODIES AND FOOD SAFETY CONTROL STRATEGIES.

There is Chinese Centre for Disease Control (CCDC) they are responsible for surveillance and control of different diseases including foodborne related diseases. There is also the State Food and Drug Administration agency (SFDA) which is responsible for regulating restaurants and catering services; the State Agency for Inspection and Quarantine (SAIQ) also regulates commercial products for imports and exports followed by the Ministry of Agriculture (MOA) which is

responsible regulating edible agricultural products in connection with other agencies that deal with regulations of livestock and licensing of food production facilities (Varma *et al.* 2012).

Moreover, the government of China also introduce the food safety law (FSL) in 2009 this became the major food safety protection law in the country they oversees all the coordination of responsibilities and management of food safety issues by the Ministry of Health (MOH). They work on food safety risk assessment, formulation of food safety standards, information dissemination, setting of codes of practice and conduct for food safety organisations as well as the investigation of major food safety incidents in China (Chung and Wong, 2012). Other related governmental organisation includes ministries like the Ministry of commerce (MOC) and the Ministry of Environmental Protection (Ni and Zeng, 2009).

Incidence of foodborne pathogens in United Kingdom

A study on foodborne outbreaks in the UK spanning 1992-2008 shows a decline of foodborne outbreaks. In 10966 outbreaks reported by the Health Protection Agency (HPA), 2429 (22.2%) of all the cases was foodborne related cases. Around this time foodborne outbreaks decreases significantly from 238 in 1992 to 40 in 2008 excluding 1995 and 2005. 58,424 people were affected, 2141 were hospitalized and subsequently 127 deaths were recorded. *Salmonella* species is responsible for the highest number of people affected (27339) with 1500 hospitalized and 97 deaths reported. The highest number of outbreaks was caused by *Crystosporium. Listeria monocytogenes* was responsible for the highest mortality rates (2/33, 6.1%) and *Escherichia coli* 0157 causes of most hospitalized patients (286/1165, 24.5%), (Gormley *et al.* 2011). The figure below illustrate the information

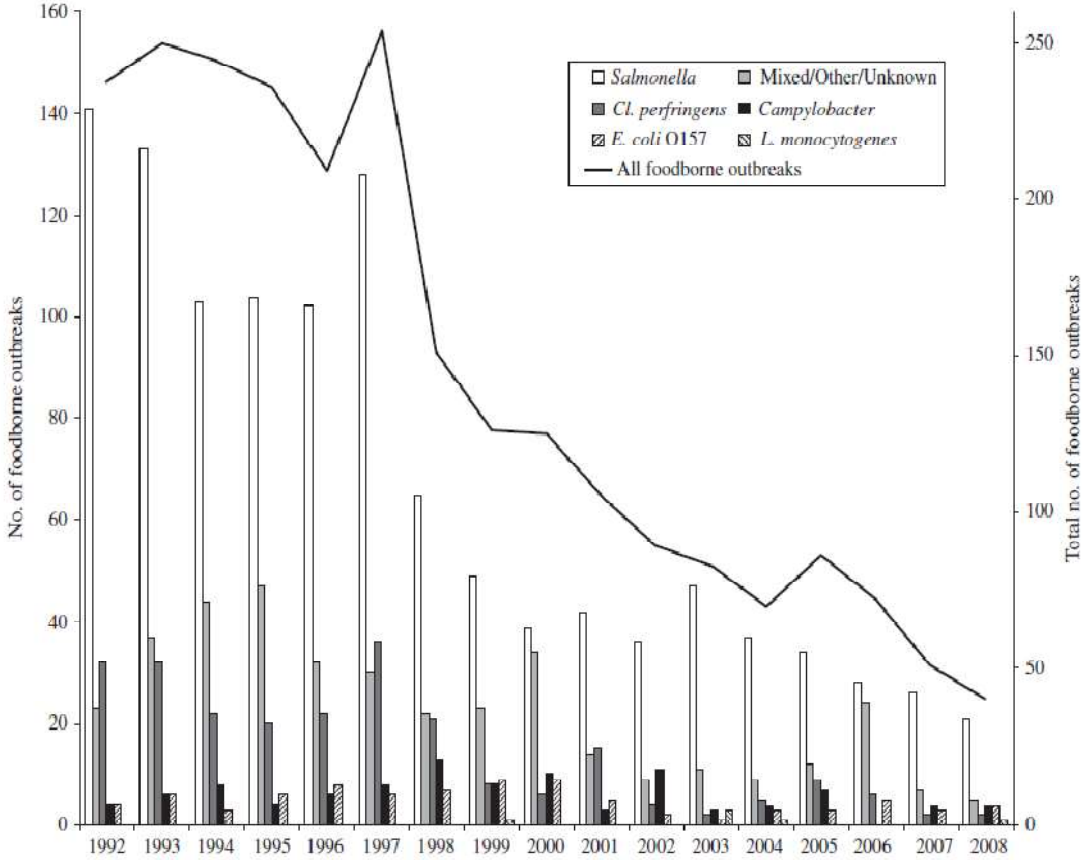


Fig. 1. Number of foodborne outbreaks in England & Wales (1992–2008) stratified by causative pathogen. Overall annual numbers of foodborne outbreaks are also shown.

Source: Adopted from Gormley *et al.* 201

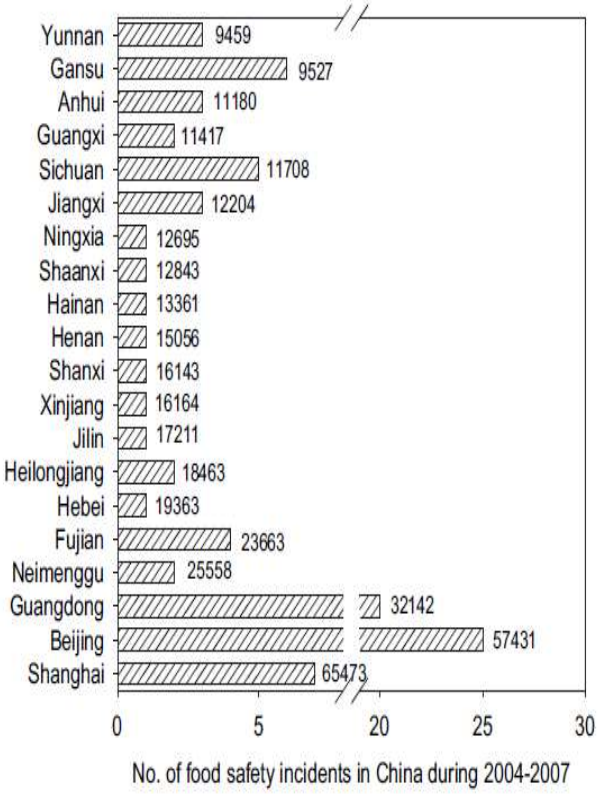
IV. COMPARATIVE STUDY OF FOODBORNE INCIDENT IN CHINA AND UNITED KINGDOM

The food safety problem in China is practically bigger than it is in UK and in most western Europe. There are evidence of breakdowns in the system everywhere within the country ranging from food production to where it's served, foodborne disease outbreak is higher in China than in United kingdom and the unfortunate thing to say is that the incident is still on the increase in bb, *Campylobacter* is also evident but contributed a negligeable infact (Shao *et al.* 2011). However,

in the United kingdom, there was increased in the cases of *Campylobacter* during the surveillance period and this is due to high poultry meat consumption. *Lysteria monocytogenes* accounted for frequent deaths with substantial morbidity rate in spite of causing small number of outbreaks (Gormley *et al.* 2011).

The increase in foodborne deseases outbreaks in China can be linked to the changes in the type of feeding habits, at a point many people change from eating well cooked food to eating raw or partially cooked foods where parthogenic microarganisms are still active and regenarate inside the body, the increase in food supplies, production and consumption in China has improved the economy causing different types of socio-economic changes (Shao *et al.* 2011). Ranging from 2004-2007; the number of foodsafety incidents in some developed regions tend to be higher than it is in the undeveloped regions of China this is due to the intensified supervision observable in developed cities such as Beijing, Shanghai and Guangdong provinces, there was adequate monitoring, reporting, and supervision of foodsafety incidents in the developed areas contrary to what is observable in undeveloped areas where monitoring, reporting supervision is inadequate. This demonstrate a significant correlation between economic status and foodsafety (Lin *et. al.* 2010).the graph below shows a distribution of foodsafety incidence in China during 2004-2007;

Adopted from Lin et al. 2010



Foodsafety is one of the leading challeges in China due to limited investment in surveillance, inter-agency coordination, outbreak investigation and synthesis of data. Lack of functional national laboratory based surveillance system makes it difficult or practically imposible for them to detect widespread foodborne outbreaks or to identify new infections (Varma *et al.* 2011).

Numerous laws and regulations governing foodsafety standards in China came into play, but the implementation of these laws focusses strictly on government supervision and administrative punishments instead of looking at civil liability issues of food and associated products manufacturers. Moreover, there is also the problem of blind-spots created during foodsafety supervision emanating from ambiguity of responsibilities of the several government departments responsible who are responsible for food safety supervision making it difficult or impossible in some instances for partnership between different departments to trace the source of food contamination on time (Ni and Zeng, 2009).

United kingdom in 200 set up an organisation called the Food standards agency (FSA) this agency is set to protect public health and consumer interest in respect to food in conjunction with other related governmental agencies such as the Department of Environmental, Food and Rural affairs (DEFRA), the Department of Trade and Industry (DTI) also contribute to food policy (Sue, 2002). The Health protection Agency (HPA) has also retained cooperative surveillance on foodborne outbreaks in England and Wales since 1992 (Shao *et al.* 2011). Aside, policy and implementation of food safety laws and standards, there was consumer foodsafety education and guidance is also provided in the UK from various organisations such as the food standard agency (FSA) and the Food and Drink Federation (FDF). Farm to fork strategy for food hygiene campaign for caterers and consumers was also implemented with a nation wide campaign to regulate cross-contamination. In july 2001, a food hygeine initiative meant to reduce foodborne disease by 20% by april 2006 with standard and efficient monitoring of laboratory in the UK was also introduced (FSA 2001 in Redmond and Griffith, 2006). And recently, things are in place to develop strategies in an attempt to reduce the presence of *Campylobacter* and *Salmonella* in raw poultry meats including farm practices etc to reduce the carriage of the pathogen, and also increase the level of hygiene in slaughter houses and meat processing unit across the UK also implementation of hazards analysis and critical control points (HAACP) principles. The FSA also have sets up a target to achieve a 50% reduction in the *Campylobacter* incidence in the UK caused by Poultry by 2010 (Little *et al.* 2008).

Vibrio parahaemolyticus

V. parahaemolyticus is a gram negative facultative anaerobic rod shaped bacteria mostly found in many raw seafoods including crustaceans, molluscan shellfish and fishes inclusive. they are found occuring naturally in marine

enviroment and are responsible for some of the serious diseases in fish, shelfish and shrimps, it is also a serious human pathogen which is contacted through consumption of contaminated seafoods. The emergence of serotype O_3:K_6 that carries the *tdh* gene is responsible for most of the outbreaks worldwide (Nelapati *et al.* 2012). Consumption of raw or undercooked sea food as well as contaminated cooked foods are the major routes for contacting the disease (Yam et al., 1999). It is a mesophillic organism but is capable of growing at the temperature ranging from of 5 oC to 43 oC. When food is heated to temperature up to 65 oC the organism can simply die, it has ptimum pH range from 7.8 – 8.6, but can grow from 4 – 11. It can grows at the salinity level of 0.5% to 19%. its generation time is between 9 – 10 minutes and can easily multiply to produce the infective dosage (105 and 107 viable cells) within a short period of time.

There diiferent antigenic type of the organism which can be distinguished as lipopolysaccharide 'O' group and capsular 'K' group by serotyping. Over 75 different combinations of these antigenic types of Vibrio parahaemolyticus exist but not all the strains are pathogenic in nature the pathogenic strains are capable of producing a thermo stable factor called thermo stable direct haemolysin (TDH) and TDH-related haemolysin (TRH)(CHP, 2010). The toxigenic strains exists in both fresh and iced or frozen seafoods (Yang *et al.* 2008).

Gram negative rod-shaped vibri parahaemolyticus

Diseases Caused by Vibrio Parahaemolyticus

It is responsible for cases of severe gastroenteritis resulting in diarrhea, vomitting and abdominal cramps via consumption of contaminated seafoods (Shao *et al.* 2011). It is responsible for other complications such as travellers diarrhea, wound infection, ear infection and scepticaemia (Nelapati *et al.* 2012).

V. PREVENTION AND CONTROL MEASURES

Temperature controlled harvest is a strategy used in controlling *V.parahaemolyticus* it requires limiting the time of food exposure to higher temperatures and by cooling harvested seafoods to 10^{o}C which prevent proliferation of the pathogen (Su and Liu, 2007).

Thermal processing techniques such as cold storage, freezing as well as low temperature pasteurization also proven to be effective in reducing the number of Vibrio species in oysters. Non-thermal food processing techniques such as high pressure processing and irradiation also proven to be effective in killing the pathogen. Other control measures such as ; proper heating during cooking and handling of foods prior to consumption, adequate proper hygeine of products to regulating cross-contamination and good environmental hygiene strategies can handled the pathogen to avoid infection (Nelapati *et al.* 2012).

Comparing the cases of V. parahaemolyticus in China and United Kingdom.

Vibrio parahaemolyticus is responsible for significant number of outbreaks in China (19.5%) with 18.73% cases of foodborne illnesses recorded between the range of 1994-2005, which makes it the second cause of foodborne illness in the country between 1994-2005. In Jiangsu province, there was prevalence of 47.2% in acquatic products, with tdh^+ and trh^+ strains causing 8.5% and 1.5% prevalence figures respectively (Chao *et al.* 2009). Between 1992-2001 *Vibrio parahaemolyticus* cause 31% of the 5770 foodborne in China (Liu *et al.* 2004 in Kim *et al.* 2012). The cases of *V. parahaemolyticus* foodborne disease in most of the Asian countries are similar considering what is happening in Japan and Taiwan where this organism emerged the higest in the list of the etiologic agents (Chan and Chan, 2008). Comparing this to the UK, things tend to be different in the records of the foodborne outbreak the United kingdom hardly encounter cases of *Vibrio parahaemolyticus* as the major cause foodborne diseases. In the UK majority of the foodborne diseases is caused by *Salmonella, Campylobacter* and *Listeria* monocytogenes. The differences between the situation in the UK and China is assume to be due to feeding habits and other variation in the cultural behaviour of the two countries eating raw food or partially cooked food and improper hygiene is responsible for the higher record in China. Other factors includes overpopulation and inadequate food safety strategies and policy implementation between the two countries. According to Alcorn, T. and Ouyang, Y. (2012) the best explanations regarding the prevalence of foodborne illness in China, is due to the rapid growth of the country's economic development over the past 30 years and the transition in which the country finds itself with poverty and cosmopolitan opulence.

VI. CONCLUSIONS

From this study, it can be concluded that , foodborne outbreaks is increasing in China as compared to the UK despites It's rapid economic growth. This is due to the fact that despite the numerous laws and foodsafety regulatory bodies set up by the Chinese government fail to curtail the problem there seems to be inadequate surveillance , improper

inter-agency coordination and outbreak investigation as well as limited priority in consumer education and hygiene initiatives at critical points in the food distribution pathway from farm to fork as opposed to the situation in the UK.

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