An Assessment of House Flies and Food Poisoning: A Critical Analysis of Effective Prevention and Control

EKANEM, Moses Columba
Department of Food Technology,
Akwa Ibom State Polytechnic, Ikot Osurua,
Ikot Ekpene L. G. Area, Akwa Ibom State

AND

WILSON, I. U.
Department of Biology Sciences,
School of Applied Science,
Akwa Ibom State Polytechnic, Ikot Osurua

ABSTRACT

This study was to assess the house files and food poisoning: a critical analysis of effective prevention and control. The study adopted a descriptive survey design. The study was undertaken in Akwa Ibom State. The population of the study consisted of food technologies and biological scientists in Akwa Ibom State. Stratified sampling technique was used in selecting 150 respondents made up of food technologists and biological scientists in Akwa Ibom State. The instrument, titled "House Files and Food Poisoning Prevention and Control Questionnaire (HFFPPCQ)", was used for data collection. Face and content validation of the instrument was carried out to ensure that the instrument was recorded with accuracy, while the Cronbach Alpha technique was used to determine the level of reliability of the instrument. Interestingly, the reliability coefficient obtained was 0.86, which was high enough to justify the use of the instrument. The researchers subjected the data generated for the study to appropriate statistical techniques such as descriptive analysis and simple regression. The test for significance was done at a 0.05 alpha level. The study concluded that house flies have a major impact on food poisoning and human health, with food poisoning typically occurring after consuming contaminated food. Food poisoning can sometimes be caused by allergens. It is largely treatable if proper care is taken and therapy is given in a timely manner. However, when it is severe and lasts for an extended period of time, it can be life threatening. Despite taking precautions, practically everyone in the world gets food poisoning at least once in their live time. Food poisoning happens in both affluent and developing countries. Therefore, there may be a greater focus on food quality and safety globally. One of the recommendations made was that the government should increase public knowledge about the harmful effects of house flies and food poisoning on human health through health programs or seminars.

KEYWORDS: House Files, Food Poisoning, Prevention and Control

Introduction

The housefly (Musca domestica) is a synanthropic insect which has always been able to colonise the organic substrata that man has placed at its disposal. The environment in which the fly lives makes it a carrier of a number of pathogenic organisms. It is a carrier of over 100 different pathogenic organisms, including organisms for diseases like typhoid, cholera, bacillary dysentery, tuberculosis, anthrax, ophthalmia neonatorum, and infantile diarrhoea, as well as parasitic worms (Sasaki et al., 2000). The fly is considered a successful insect due to its ability to multiply rapidly and its fecundity. Even if the presence of very high fly populations is constant in rural environments, especially in livestock farms, it is possible to find large populations in food industries. These occur when organic matter is heaped up without due precautions and fermentation starts. It is also possible to observe their presence in towns, where organic waste is gathered irregularly and incompletely. Sacca (1984) refers to having found fly larvae nesting at 20cm deep inside soil impregnated with liquid manure in a Middle East shanty town. The housefly (Musca domestica) has worldwide distribution and is found throughout the country in close association with human activities.

In addition to being a nuisance pest, it is a vector for many pathogens. Pathogenic organisms are picked up by the flies from garbage, sewage, and other sources of filth and transferred to human food either mechanically from contaminated external body parts or after consumption by houseflies through vomiting and defecation while feeding on food (Sasaki et al., 2000). The control of M. domestica is thus vital to human health and comfort. Common control measures are sanitation, use of traps and insecticides. However, in some instances, integrated fly control has been implemented and found to be successful. The development of resistance in houseflies to insecticides and their associated toxicity has necessitated the evaluation of safer alternatives for housefly control. The use of safer alternatives like biological control or insect growth regulators (IGR) is thus gaining attention as an important intervention in housefly management programmes (Tunaz and Uygun, 2004). From this perspective, the present review aims to bring into focus various fly control strategies for the sustainable control of fly populations.

Objective of the Study

The main purpose of this study was to assess the house files and food poisoning: a critical analysis of effective prevention and control. Specifically, the following objectives were drawn:

1. To examine the effect of house flies on food poisoning.
2. To find out the influence of house flies on human health.
3. To find out various ways of controlling house flies from food poisoning.

Research Questions

1. What are the effects of house flies on food poisoning?
2. What is the influence of house flies on human health?
3. What are the various ways of controlling house flies from food poisoning?

Research Hypotheses

1. There is no significant influence of house flies on food poisoning
2. There is no significant influence of house flies on human health

Conceptual Review

Concept of House Flies

The housefly is believed to have evolved in the Cenozoic Era, possibly in the Middle East, and has spread all over the world as a commensal of humans. It is the most common fly species found in houses. Adults are gray to black, with four dark, longitudinal lines on the thorax, slightly hairy bodies, and a single pair of membranous wings. They have red eyes, set farther apart in the slightly larger female. The female housefly usually mates only once and stores the sperm for later use. She lays batches of about 100 eggs on decaying organic matter such as food waste, carrion, or feces. These soon hatch into legless white larvae known as maggots. After two to five days of development, these metamorphose into reddish-brown pupae, about 8 millimeters (3/8 inch) long. Adult flies normally live for two to four weeks, but can hibernate during the winter. The adults feed on a variety of liquid or semi-liquid substances, as well as solid materials that have been softened by their saliva. They can carry pathogens on their bodies and in their feces, contaminate food, and contribute to the transfer of food-borne illnesses, while, in numbers, they can be physically annoying. For these reasons, they are considered pests. Houseflies have been used in the laboratory in research into ageing and sex determination. Houseflies appear in literature from Ancient Greek myth and Aesop's The Impertinent Insect onwards. Authors sometimes choose the housefly to speak of the brevity of life, as in William Blake's 1794 poem "The Fly," which deals with mortality subject to uncontrollable circumstances (Government of India, 2005).

Adult houseflies are usually 6 to 7 mm (1/4 to 9/32 in) long, with a wingspan of 13 to 15 mm (1/2 to 19/32 in). Based on Bryant (1977), females tend to be larger-winged than males, while males have relatively longer legs. Females tend to vary more in size, and there is geographic variation with larger individuals in higher latitudes. According to Alves & Bélo (2002), the head is strongly convex in front and flat and slightly conical in back. The pairs of large compound eyes almost touch in the male, but are more widely separated in the female. They have three simple eyes (ocelli) and a pair of short antennae. Houseflies process visual information around seven times more quickly than humans, enabling them to identify and avoid attempts to catch or swat them since they effectively see the human's movements in slow motion with their higher flicker fusion rate. The mouthparts are specially adapted for a liquid diet; the mandibles and maxillae are reduced and not functional, and the other mouthparts form a retractable, flexible proboscis with an enlarged, fleshy tip, the labellum. This is a sponge-like structure that is characterized by many grooves called pseudotracheae, which suck up fluids by capillary action (Gullan & Cranston, 2010). It is also used to distribute saliva to soften solid foods or collect loose particles. Houseflies have chemoreceptors, organs of taste, on the tarsi of their legs, so they can identify foods such as sugar by walking over them. Houseflies are often seen cleaning their legs by rubbing them together, enabling the chemoreceptors to taste afresh whatever they walk on next. Due to research conducted by Ray (2002), he stated that at the end of each leg is a pair of claws, and below them are two adhesive pads, pulvilli, enabling the housefly to walk up smooth walls and ceilings using Van der Waals forces. The claws help the housefly unstick the foot for the next step. Houseflies walk with a common gait on horizontal and vertical surfaces, with three legs in contact with the surface and three in movement. On inverted surfaces, they alter their gait to keep four feet stuck to the surface. Houseflies land on a ceiling by flying straight towards it; just before landing, they make a half roll and point all six legs at the surface, absorbing the shock with the front legs and sticking a moment later with the other four (Dahlem, 2009).

The thorax is a shade of gray, sometimes even black, with four dark, longitudinal bands of even width on the dorsal surface. The whole body is covered with short hair. Like other Diptera, houseflies have only one pair of wings; what would be the hind pair is reduced to small halteres that aid in flight stability. The wings are translucent with a yellowish tinge at their base. Characteristically, the medial vein (M1+2 or fourth long vein) shows a sharp upward bend. Each wing has a lobe at the back, the calypter, covering the haltered. The abdomen is gray or yellowish with a dark stripe and irregular dark markings at the side. It has 10 segments, which bear spiracles for respiration. In males, the ninth segment bears a pair of claspers for copulation, and the 10th bears anal cerci in both sexes. A micrograph of the tarsus of the leg showing claws and bristles, including the central one between the two pulvilli known as the empodium (Sanchez-Arroyo & Capinera, 2017). According to Paterson (2009), a variety of species around the world appear similar to the housefly, such as the lesser house fly, Fanniacanicularis; the stable fly, Stomoxyscalcitrans; and other members of the genus Musca, such as M. vetustissima, the Australian bush fly, and several closely related taxa that include M. primitiva, M. shanghaiensis, M. violacea, and M. varensis. The systematic identification of species may require the use of region-specific taxonomic keys and can require dissections of the male reproductive parts for confirmation.

According to Hewitt (2011), the housefly is probably the insect with the widest distribution in the world; it is largely associated with humans and has accompanied them around the globe. It is present in the Arctic as well as in the tropics, where it is abundant. It is present in all populated parts of Europe, Asia, Africa, Australasia, and the Americas. The order of flies (Diptera) is much older. True houseflies are believed to have evolved at the beginning of the Cenozoic Era. The housefly's superfamily, Muscoidea, is most closely related to the Oestroidea (blow flies, flesh flies, and allies), and more distantly to the Hippoboscoidea (louse flies, bat flies, and allies). They are thought to have originated in the southern Palearctic region, particularly the Middle East. Because of their close, commensal relationship with humans, they probably owe their worldwide dispersal to co-migration with humans. The housefly was first described as Musca domestica in 1758 based on the common European specimens by the Swedish botanist and zoologist Carl Linnaeus in his System anaturae and continues to be classified under that name. A more detailed description was given in 1776 by the Danish entomologist Johan Christian Fabricius in his Genera Insectorum (Pont, 1981).

Concept of Food Poisoning

When a person gets sick after consuming a food item, it is normally called "food poisoning." The most basic symptoms of food poisoning are vomiting, pain in the stomach, diarrhea, etc. Food poisoning is considered to be a result of consuming toxic or contaminated food. As per available information, cases of food poisoning are more common in poor and developing countries. However, people from developed countries also suffer from food poisoning. Still, food poisoning means illness resulting from ingestion of food with microbial or non-microbial contamination. According to Rajesh (2017), the condition is characterized by a history of ingestion of a common food, attacks of many people at the same time, and similarity of signs and symptoms in the majority of cases. The World Health Organization estimates that there are more than 1 billion cases of acute diarrhea annually in developing countries, with 3–4 million deaths. According to the Food Standards Agency (FSA), there are nearly 900,000 cases of food poisoning each year. Our lifestyles have changed over the last few years, which include an increasing reliance on ready-prepared meals, eating out rather than cooking, and taking more holidays abroad. We all lead busy lives and, as a result, tend to spend less time preparing and cooking food. People often cook several meals in advance and freeze them for a long period of time, or buy convenience foods that only have to be put in a microwave oven.

This is the reason for the increasing food poisoning cases in the present scenario. Knowing where your food is sourced from and the standards of care and safety that have been applied may help to reduce the incidence of food poisoning. There is no definite time limit when symptoms of food poisoning are felt by the patient after consuming toxic or contaminated food. It depends on the type of toxic or contaminated material present in the food and its quantity. It also depends on the body defense mechanism of the person. Symptoms may be visible within an hour of consuming contaminated food or sometimes even after many days or weeks. Common symptoms of food poisoning are abdominal pain (cramps), nausea, vomiting, diarrhea, fever, headaches, etc. The symptoms must not be ignored if they persist for a long time. It has been reported that sometimes food poisoning may be life threatening. In fact, many deaths occur annually due to food poisoning. As per recent data released by the World Health Organization (WHO), on an average, one in ten people falls sick due to food poisoning every year, and there are nearly 420,000 deaths due to food poisoning every year. Out of these, more than 50% of deaths are due to diarrhea. If any person suffers from any of the following symptoms, it is recommended that the person consult the doctor as soon as possible: Dehydration in the body can be indicated by dry mouth, difficulty drinking liquids, and no or little excretion of urine. Having problem in speaking or eye sight.

Prevention and Control of House Flies

Three types of control methods are used to suppress houseflies: cultural, biological and chemical. It is best to use all three methods:

Cultural control: Cultural control means changing the environment to prevent houseflies from developing. The best cultural method is to properly dispose of any organic matter, such as vegetables or other food by-products, where houseflies might lay eggs. Place these materials in garbage bags and tie the bags securely. Remove all food residues and clean your garbage cans weekly. Another cultural method is to keep houseflies out of homes and businesses by:

- keeping windows screened and doors closed,
- placing exhaust (blower) systems above doors, and
- installing doors that open and close mechanically.

Sticky traps and ultraviolet light traps placed around a home or business can also reduce housefly populations. Hang resin strips (flypaper) in infested areas where there is little or no air movement. A rule of thumb is to place one 10-inch strip per 1,000 cubic feet of space. Install the fly strips within 6 feet of the floor because most fly activity is near the ground. The strips are effective for up to about 3 months, or until completely covered. Install light traps where they cannot be seen by flies outdoors to avoid attracting more insects to the building. To make the traps more noticeable to the flies in a room, place them at least 15 feet away from doors and other entryways and in darker areas away from bright lights and sunlight. Place the traps at least 5 feet away from food preparation areas to minimize the risk of food contamination. It is important to maintain the traps. Replace the bulbs each spring just before the peak season of fly activity because older bulbs lose their attractiveness to insects. Also, clean them out regularly because dead flies serve as food for other insects.

Biological control: Parasitic wasps and fire ants suppress housefly populations naturally. If you want to use this form of natural pest control, you can order fly pupae from insectaries in Texas or across the United States. The pupae, which are already infected with the parasites, can be spread around homes or near where houseflies are developing. Place the pupae in areas out of direct sunlight where they will not be stepped on. Parasitic wasps do not harm people or animals. They seek out and kill immature houseflies. However, parasitic wasps take time to work, and they alone will not eliminate a housefly population. Use this method in combination with other methods.

Chemical control: When necessary, insecticides can help suppress housefly populations. Fly baits, such as Quick Bayt and Golden Malrin, are usually sugar-based and contain a compound that attracts adult flies. Flies that feed on these baits are killed by the insecticide they digest. Many sprays of pyrethroid-based insecticides can suppress houseflies in and around homes. These products can be purchased at grocery and hardware stores. Be sure to read and follow the instructions on all insecticide labels.

Effect of House Flies on Food Poisoning

According to Nichols (2005), flies can spread diseases because they feed freely on human food and filthy matter alike. The fly picks up disease-causing organisms while crawling and feeding. Those that stick to the outside surfaces of the fly may survive for only a few hours, but those that are ingested with the food may survive in the fly's crop or gut for several days. Transmission takes place when the fly makes contact with people or their food. Most of the diseases can also be contracted more directly through contaminated food, water, air, hands and person-to-person contact. This reduces the relative importance of flies as carriers of disease. The diseases that flies can transmit include enteric infections (such as dysentery, diarrhoea, typhoid, cholera and certain helminth infections), eye infections (such as trachoma and epidemic conjunctivitis), poliomyelitis and certain skin infections (such as yaws, cutaneous diphtheria, some mycoses and leprosy). Due to their indiscriminate movements, ability to fly long distances, and attraction to both decaying organic materials and places where food is prepared and stored, houseflies greatly amplify the risk of human exposure to food borne pathogens.

Houseflies can transport microbial pathogens from reservoirs (animal manure) where they present a minimal hazard to people to places where they pose a great risk (food). Due to their indiscriminate movements, ability to fly long distances, and attraction to both decaying organic materials and places where food is prepared and stored, houseflies greatly amplify the risk of human exposure to food-borne pathogens.

Houseflies can transport microbial pathogens from reservoirs (animal manure) where they present a minimal hazard to people to places where they pose a great risk (food) (Olsen, 1998). Stable flies are bloodsucking insects and important pests of domestic animals and people. They can cause great economic losses in the animal industry (Jones, Patel & Levy, 2008), and they can also play a role in the ecology of various bacteria originating from animal manure and other larval developmental habitats (Rochon, Lysyk & Selinger, 2005).

Effects of Houseflies on Human Health

Houseflies exist as major pests of humans, poultry, and livestock surroundings and facilities where they transmit vector-borne infections globally (Akter, Sabuj, Haque, Rahman, Kafi, & Saha, 2020). They are known for carrying pathogens that can cause serious and life-threatening diseases in humans. Over 100 pathogens, including bacteria, viruses, fungi, and parasites (protozoans and metazoans) have been associated with houseflies (Tsagaan, Kanuka & Okado, 2015). Based on World Health Organization (WHO) records, major vector-borne infections account for almost 17% of communicable diseases that occur per annum worldwide, with a high incidence in tropical and subtropical regions (WHO, 2017). In accordance with Bahrndorff, de Jonge, Skovgrd, and Nielsen (2017), molecular analysis noted that houseflies carry very diverse groups of microorganisms. Evidence supporting the role of the housefly in the transmission of diseases is mostly circumstantial, with the strongest evidence pointing to the correlation between the rise in incidence of diarrhoea and an increase in the fly population (AHA & Akram, 2014). The characteristics of the pathogens carried by houseflies depend on the area where the insect is collected; houseflies captured from the hospital environment or animal farms (where there is extensive use of antibiotics as growth promoters) commonly carry antimicrobial-resistant bacteria and fungi that are threatening to human health (Nazari, Mehrabi, Mostafa, & Alikhani, 2017). Furthermore, houseflies presenting in the hospital environment may also be associated with the transmission of nosocomial infections (Doud & Zurek, 2012). Accordingly, Oyeyemi, Agbaje, and Okelue (2016) stress that houseflies pose a significant human health threat in that they may contribute to the spread of food-borne parasitic diseases.

Method

The study adopted a descriptive survey design. The study was undertaken in Akwa Ibom State. The population of the study consisted of food technologists and biological scientists in Akwa Ibom State. stratified sampling technique was used in selecting 150 respondents made up of food technologists and biological scientists in Akwa Ibom State. The instrument, titled "House Files and Food Poisoning Prevention and Control Questionnaire (HFFPPCQ)", was used for data collection. Face and content validation of the instrument was carried out to ensure that the instrument was recorded with accuracy while the Cronbach Alpha technique was used to determine the level of reliability of the instrument. Interestingly, the reliability coefficient obtained was 0.86, which was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical techniques such as descriptive analysis and simple regression. The test for significance was done at a 0.05 alpha level.

Result and Discussion

Research Question

The research question sought to find out the various ways of controlling house flies from food poisoning. To answer the research percentage analysis was performed on the data, (see table 1).

Table 1: Percentage analysis of the various ways of controlling house flies from food poisoning

CONTROL	FREQUENCY	PERCENTAGE
Cultural	16	10.67
Biological	5	3.33*
Chemical	129	86**
TOTAL	**150**	**100%**

** The highest percentage frequency
* The least percentage frequency

SOURCE: Field survey

The above table 1 presents the percentage analysis of the various ways of controlling house flies from food poisoning. From the result of the data analysis, it was observed that "Chemical" 129(86%) was rated the post popular ways of controlling house flies from food poisoning, while "Biological" 5(3.33%) was rated the least popular way of controlling house flies from food poisoning.

Hypothesis Testing

Hypothesis One: The null hypothesis states that there is no significant influence of house flies on food poisoning. In order to answer the hypothesis, simple regression analysis was performed on the data (see table 2)

TABLE 2: Simple Regression Analysis of the Influence of House Flies on Food Poisoning

Model	R	R-Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	0.95a	0.90	0.90	0.75	0.90

***Significant at 0.05 level; df= 148; N= 150; critical R-value = 0.197**

The above table 2 shows that the calculated R-value (0.95) is greater than the critical R-value of 0.197 at 0.05 alpha levels with 148 degrees of freedom. The R-Square value of 0.90 predicts 90% of the influence of house flies on food poisoning. This rate of percentage is highly positive and therefore means that there is significant influence of house flies on food poisoning. It was also deemed necessary to find out the influence of the variance of each class of independent variable as responded by each respondent (see table 3).

TABLE 3: Analysis of Variance of the Influence of House Flies on Food Poisoning

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	756.05	1	756.05	1332.85	.000b
Residual	83.95	148	0.57		
Total	840.00	149			

a. Dependent Variable: Food Poisoning
b. Predictors: (Constant), House Flies

The calculated F-value (1332.85) and the P-value as (.000b). Being that the P-value (.000b) is below the probability level of 0.05, the result means that there is significant influences exerted by the independent variables i.e. House Flies on the dependent variable which is food poisoning. The result therefore means that there is significant Influence of House Flies on Food Poisoning. The result therefore is in agreement with the research findings of Nichols (2005) who asserted that house flies can spread diseases because they feed freely on human food and filthy matter alike. The fly picks up disease-causing organisms while crawling and feeding. The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

Hypothesis Two: The null hypothesis states that there is no significant influence of house flies on food poisoning. In order to answer the hypothesis, simple regression analysis was performed on the data (see table 4)

TABLE 4: Simple Regression Analysis of the Influence of House Flies on human health

Model	R	R-Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	0.70a	0.48	0.48	1.34	0.48

***Significant at 0.05 level; df= 148; N= 150; critical R-value = 0.197**

The above table 4 shows that the calculated R-value (0.70) is greater than the critical R-value of 0.197 at 0.05 alpha levels with 148 degrees of freedom. The R-Square value of 0.48 predicts 48% of the influence of house flies on human health. This rate of percentage is highly positive and therefore means that there is significant influence of house flies on human health. It was also deemed necessary to find out the influence of the variance of each class of independent variable as responded by each respondent (see table 5).

TABLE 5: Analysis of Variance of the Influence of House Flies on Human Health

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	246.22	1	246.22	138.49	.000b
Residual	263.12	148	1.78		
Total	509.33	149			

a. Dependent Variable: Human Health
b. Predictors: (Constant), House Flies

The calculated F-value (138.49) and the P-value as (.000b). Being that the P-value (.000b) is below the probability level of 0.05, the result means that there is significant influences exerted by the independent variables i.e. House Flies on the dependent variable which is human health. The result therefore means that there is significant Influence of House Flies on human health. The result therefore is in agreement with the research findings of Akter, et al (2020) who asserted that houseflies exist as major pests of humans, poultry, and livestock surroundings and facilities where they transmit vector-borne infections globally. Houseflies pose a significant human health threat in that they may contribute to the spread of food-borne parasitic diseases (Oyeyemi, et al., 2016). The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

Conclusion

The study concluded that house flies have a major impact on food poisoning and human health, with food poisoning typically occurring after consuming contaminated food. Food poisoning can sometimes be caused by allergens. It is largely treatable if proper care is taken and therapy is given in a timely manner. However, when it is severe and lasts for an extended period of time, it can be life threatening. Despite taking precautions, practically everyone in the world gets food poisoning at least once in their lives. Food poisoning happens in both affluent and developing countries. Therefore, there may be a greater focus on food quality and safety globally.

Recommendations

1. The government should raise public awareness about the harmful effects of house flies and food poisoning on human health through health programs or seminars.
2. The government should help in creating awareness of how house flies can be prevented and controlled.

REFERENCES

AHA, K. and Akram, W. (2014). The effect of temperature on the toxicity of insecticides against Musca domestica L.: Implications for the effective management of diarrhea. *PLos One*, 9(4): e95636.

Akter, S., Sabuj, A. A. M., Haque, Z. F., Rahman, M. T., Kafi, M. A. and Saha, S. (2020). Detection of antibiotic-resistant bacteria and their resistance genes from houseflies. *Veterinary World*, 13(2), 266–274.

Alum, E. A., S. Urom and C. M. A. Ben, 2016. Microbiological contamination of food: The mechanisms, impacts and prevention. *International Journal of science and technological research*, 5(3): 65-78.

Government of India (2012). Appendix C: The State Emblem of India (Prohibition of Improper Use) Act, 2005. In Righteous Republic: *The Political Foundations of Modern India*. Cambridge, MA and London, England: Harvard University Press, p. 257.

Bahrndorff, S., de Jonge, N., Skovgård, H. and Nielsen, J. L. (2017). Bacterial Communities Associated with Houseflies (Musca domestica L.) Sampled within and between Farms. *PLoS ONE*, 12(1): e0169753

Bintsis, T. (2018). Microbial pollution and food safety. *Microbiology*, 4(3): 377.

Chang, T., B.-K. Jung, S. Hong, H. Shin, J. Lee, L. Patarwut and J.-Y. Chai, (2019). Anisakid larvae from anchovies in the South Coast of Korea. *The Korean journal of parasitology*, 57(6): 699-704.

Dahlem GA (2009). *House Fly (Musca domestica)*. In Resh VH, Carde RT (eds.). Encyclopedia of Insects (2nd ed.). Elsevier. pp. 469–470.

Doud, C.W. and Zurek, L. (2012). Enterococcus faecalis OG1RF:pMV158 Survives and Proliferates in the House Fly Digestive Tract. *J Med Entomol*., 49(1):150–5.

Gullan PJ, Cranston PS (2010). *The Insects*: An Outline of Entomology (4th ed.). Wiley. pp. 41, 519.

Hewitt CG (2011). *The House-Fly*: Musca Domestica Linn: Its Structure, Habits, Development, Relation to Disease and Control. Cambridge University Press. pp. 5–6.

Jones, K. E., Patel, N. G. Levy, M. A. (2008). Global trends in emerging infectious diseases. *Nature*, 451(7181), pp. 990–993.

Kassahun, M. and S. J. B. Wongiel, (2019). Food poisoning outbreak investigation in Dewachefa Woreda, Oromia Zone, Amhara Region, Ethiopia. *BMC Research Notes*, 12(1): 377.

Kumar, A. (2019). Food quality: Hygiene, contaminations and quality testing. *Journal of nutrition & food sciences*, 2(1): 100008.

Lynch, M. F., R. V. Tauxeand C. W. Hedberg, (2009). The growing burden of foodborne outbreaks due to contaminated fresh produce: Risks and opportunities. *Epidemiology injection*, 137(3): 307-315.

Mayounga, A. T. (2018). Antecedents of recalls prevention: Analysis and synthesis of research on product recalls. In: Supply Chain Forum: *An international journal Taylor & Francis*, pp: 164-177.

Miller, J. M. and Griffin, P. M. (2012). One health through eyes of clinical and public health microbiology. *Microbe*, 7(1): 23-27.

Nazari, M., Mehrabi, T., Mostafa, S. H. and Alikhani, M. Y. (2017). Bacterial Contamination of Adult House Flies (Musca domestica) and Sensitivity of these Bacteria to Various Antibiotics, Captured from Hamadan City, Iran. *J. Clin. Diagn. Res*., 11(4): DC04–7.

Nichols, G. L. (2005). Fly transmission of Campylobacter. *Emerging Infectious Diseases*, 11(3), pp. 361–364.

Okafo, C. N., Umoh, V. J. and Galadima, M. (2003). Occurrence of pathogens on vegetables harvested from soils irrigated with contaminated streams. Science of the total environment, 311(1-3): 49-56.

Olsen, A. R. (1998). Regulatory action criteria for filth and other extraneous materials. III. Review of flies and foodborne enteric disease. *Regulatory Toxicology and Pharmacology*, 28(3), pp. 199–211.

Oyeyemi, O. T., Agbaje, M. O. and Okelue, U. B. (2016). Food-borne human parasitic pathogens associated with household cockroaches and houseflies in Nigeria. *Parasite Epidemiology and Control*, 1(1), 10-13.

Paterson HE (2009). The Musca domestica complex in Sri Lanka. *Journal of Entomology Series B, Taxonomy*, 43 (2): 247–259.

Pont AC (1981). The Linnaean species of the families Fanniidae, Anthomyiidae and Muscidae (Insecta: Diptera). *Biological Journal of the Linnean Society*, 15(2): 165–175.

Ray, C. C. (2002). *Gleeful Flies*? The New York Times.

Rochon, K., Lysyk, T. J. and Selinger, L. B. (2005). Retention of Escherichia coli by house fly and stable fly (Diptera: Muscidae) during pupal metamorphosis and eclosion. *Journal of Medical Entomology*, 42(3), pp. 397–403.

Sanchez-Arroyo H, Capinera JL (20 April 2017). *House fly*: Musca domestica. Featured Creatures.

Tsagaan, A., Kanuka, I. and Okado, K. (2015). Study of pathogenic bacteria detected in fly samples using universal primer-multiplex PCR. *Mongolian Journal of Agricultural Science*, 15(2), 27–32.

Tumrasvin W, Shinonaga S (1977). Report of Species Belonging to the Genus Musca Linné, Including the Taxonomic Key (Diptera: Muscidae). *Bull. Tokyo Med. Dent. Univ.*, 24: 209–218.

World Health Organization (2017). *Media Centre*. News Release. WHO publishes list of bacteria for which new antibiotics are urgently needed.

Zeighami, H., Nejad-dost, G. Parsadanians, A., Daneshamouzand, S. and Haghi, F. (2020). Frequency of hemolysin BL and non-hemolytic enterotoxin complex genes of bacillus cereus in raw and cooked meat samples in Zanjan, Iran. *Toxicology reports*, 7: 89-92.