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COCKROACHES AND FOOD-BORNE PATHOGENSES

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Abstract
Cockroaches were caught through sweeping combined with trapping from different locations indoor including toilette's, kitchens, dormers, and classrooms in the study area. Food-borne disease is a widespread and escalating public health problem globally. About a quarter of the microorganisms isolated from cockroaches are food-borne pathogens including Escherichia coli, Staphylococcus aurous, Bacillus cereus Shigella dysenteries,
Salmonella enterica subso, enterica serovar Typhi, Rotavirus, Aspergillus fumigatus, and Cryptosporidium parvumThus, cockroaches could be an important reservoir and mechanical vector of food-borne pathogens Generally, the role of cockroaches in human infections is poorly understood and has been an issue of debate for several years. This article aims to elucidate the possible role of cockroaches in food-borne infections by reviewing the relevant research publications.

KEYWORDS:
1.Escherichia coli
2.food-borne pathogens
3.antibiotic resistance
4.cockroach

STUDY AREA AND DATA COLLECTION:

A total of 10 cockroaches were collected from January to May 2014 in Gondar town. Thirty of them were obtained from various types of wards in University of Gondar college environment. The remaining 30s were trapped from college surrounding environments including different parts of the college (kitchens, bathrooms, and toilets). Cockroaches were collected using sterile test tubes and transported to the microbiology laboratory for bacteriological analysis within two hours of collection. Species identification was done in accordance with a standard taxonomic key.

INTRODUCTION:

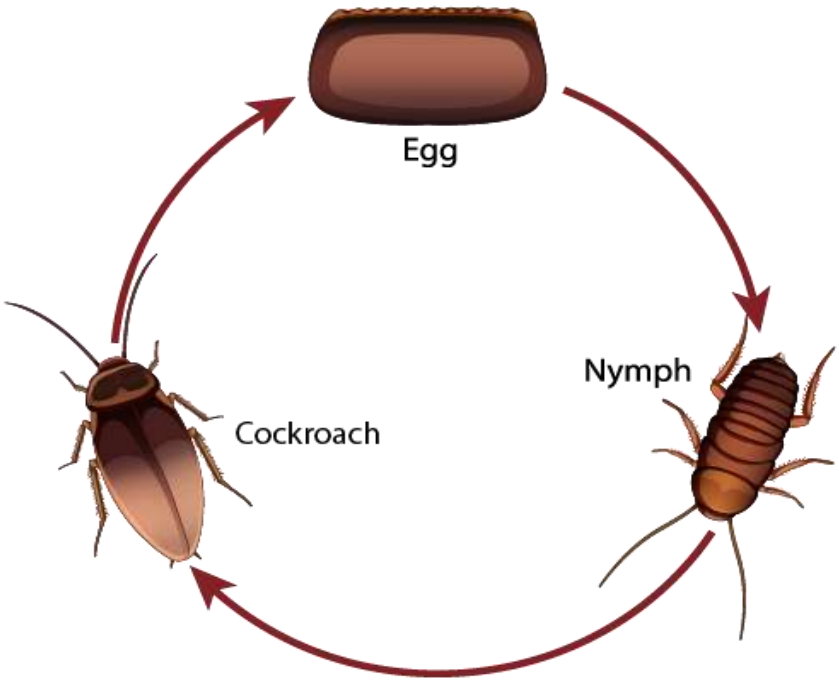
Cockroaches are common in many of human habitations, particularly in place where food is stored, processed, prepared, or served. Apart from that, they are also frequently detected in college environments, such as dorms, class rooms, area of toilets, and laboratory room's Food is an important vehicle for the transmission of infectious pathogens to humans. The high incidence of food-borne diseases coupled with the emergence and re-emergence of food-borne pathogens, have placed food safety high on the agenda of public health issues Cockroaches appear to be suitable mechanical transmitters for a wide range of food-borne

pathogenic microorganisms due to their filthy behavior and occurrence in places where food is stored or handled. Microorganisms may be carried externally on the cuticle of cockroaches or may be ingested and then later excreted or regurgitated. In this way, cockroaches can easily contaminate food when they come into contact with it. Although there exist about 4000 species of cockroaches, only 30 are associated with human habitations. The most common cockroach species found in human habitations or environments are Periplaneta Americana, Battelle germanica, Blatta orientalis, Periplaneta australasiae, and Supella longipalpa. Generally, the role of cockroaches in human infections is poorly understood and has been an issue of debate for several years In the last 2 decades, there has been an accumulation of adequate research data that contributes significantly to our understanding of this subject In this regard, the scientific community could benefit from a review of available research data that can provide a global understanding of the role of cockroaches in transmission of human infections.

Therefore, in this review article, the author aims to elucidate the possible role of the transmission of food-borne pathogens by reviewing the relevant research publications

LIFE CYCLE OF COCKROACH:

A female cockroach lays between 10 and 40 eggs at a time. On average, the female can lay around 30 batches of eggs in her lifetime. The hatched young look the same as adult cockroaches, but smaller and without wings. Depending on the conditions and type, a cockroach can live for up to 12 months. These insects are cold-blooded and thrive in warm, humid conditions. This is why buildings in the northern parts of Australia are particularly prone to infestations.



BRIEF OVERVIEW OF FOOD-BORNE INFECTIONS:

The World Health Organization estimates that food-borne diseases cause about 600 million illness episodes, 420 000 deaths and 33 million healthy life years lost (disability-adjusted life years, DALYS) annually. Food-borne disease is most prevalent in Africa and South-East Asia, where more than a third of all food-borne illness occurs. Food-borne pathogens account for the vast majority of food-borne diseases, and diarrheal agents are responsible for more than half of the global burden of food-borne infections. Although all human beings are at risk, the impact of food-borne infections is most severe in very young and elderly people, as well as immune-compromised individuals. Food-borne illness is associated with huge economic costs.

Generally, data on the financial costs of food-borne illness in the developing world are lacking, though the majority of food-borne cases occur in these countries. The pathogens implicated in food-borne infections cover a wide spectrum of microbes including bacteria, parasites, viruses, and fungi. Some of the common food-borne pathogens and types of food they affect are shown in. The incidence/prevalence of food-borne diseases caused by different pathogens has changed in the last few decades. For example, in the united kingdom, in 2010, campylobacter displaced/prevalence of food-borne diseases caused by different pathogens has changed in the last few decades. Viruses are implicated in an Increasing number of food-borne cases in the United Kingdom currently, while toxin breducing Acchia coli such as E coli remain less common, but serious pathagen due to their clinical impact. In the next decades of years, new food borne patnegens are likely to emerge globally driven by factors such as microbial evolution and changes in food production processes. In addition, food-borne infections due to existing pathogens can be expected to increase, especially in developing countries, partly because of environmental and demographic changes, as well as massive consumption of risky foods

COCKROACHES AND FOOD-BORNE PATHOGENS:

In the 1950s, Tarshis provided a compelling evidence incriminating cockroach as possible vectors of human infections, through a study that reported a correlation between the incidence of hepatitis A and the lack of cockroach control. From 1956 to 1959, the Carmelitos Housing Project had 20% to 39% of the hepatitis A cases in Los Angeles. However, through a concentrated pest control programme, there was a sharp decline in the incidence of endemic infectious hepatitis: in 1960, the hepatitis A incidence at the housing project reduced to 6.6%, then further to 3.6% in 1961, and to 0.0% in 1962. Meanwhile, around the same period, every other place in Los Angeles County that was not receiving the pest control service experienced increasing incidence of the infection. It was observed that the decline in hepatitis A incidence occurred simultaneously with a significant reduction (about 70%) in cockroach infestation due to the pest control programme. The hepatitis A virus occurs in the faeces of infected persons and is usually transmitted through consumption of contaminated water or food. The Association of cockroaches with faeces and food makes their transmission of Nelanto A crul highly plausible Although the study of Tarshis was not supported with

experimental data, it provides evidence supporting the theory that cockroaches plav a role in the transmission of foodborne pathogens. Experimental evidence supporting the possible role of the cockroach. Cockroaches in the transmission of food-borne pathogens have been provided by several investigators. A study done by Ash and Greenberg in 1980 reported that exposure of cockroaches to Salmonella enterica subsp.

The association of cockroaches with S. Typhi should be viewed with seriousness in developing countries where typhoid fever is most prevalent and lack of food hygiene is also of serious concern. S. Typhimurium causes a mild gastroenteritis and is often transmitted from animals through consumption of raw or under copied animal source food such as meat. Compared with Shigella,

Salmonella los relatively high infective dose of 10 to 10 cells. The isolation of E. coli from cockroaches is interesting, as this organism emerged as a food-borne pathogen anly in the 1990s. The organism resides in the intestinal tract of live animals and is shed in their faeces, which may contaminate food, water, and the environment. It has unusual persistence features in the environment and survives at low temperatures and under acidic conditions. The infective dose of E. coli is very small (10-100 cells) and is implicated in severe clinical conditions including, haemorrhagic colitis leading to bloody diarrhoea, haemolytic uremic syndrome and kidney damage. S. aureus and B. cereus, also isolated from cockroaches, are among the predominant food-borne pathogens globally. Both pathogens have an infective dose of 10 to 10^{o} cells and produce toxins, which mediate the food-borne disease; S. aureus produces enteroxins, which cause diarrhoea, while B. cereus produces an emetic and enterotoxin responsible for vomiting and diarrhea, respectively. B. cereus is a sporeforming bacteria and can therefore survive for a very long period in the environment, which enhances its chances of contaminating cockroaches. Compared with bacteria, the other types of food-borne microbes tend to be carried by cockroaches to a lesser extent.

Four main food-borne parasites are reported to be carried by cockroaches:

Cryptosporidium parvum, Cyclospora cayetanensis, Entamoeba histolytica, and Giardia duodenalis. These pathogens are transmitted faecal-orally from ingestion of their oocyst/cysts, which can persist and survive for long periods in the environment, water, and on foods. Animals are known to be a reservoir of human infection for C. parvum and G. duodenalis, but not C. Cayetanensis and E. histolytica. Among food-borne viruses, rotavirus and hepatitis

A virus have reported to be associated with cockroaches. Rotavirus is the of severe diarrhoea in young children globally, and is responsible for about 50% of paediatric diarrheal disease hospitalizations in developing countries, in this regard, the presence of cockroaches in homes could have serious implications for paediatric health. Hepatitis A is the most common form of acute viral hepatitis worldwide and therefore its association with cockroaches is a cause for concern, especially in the developing world where the infection is mostly prevalent. Several fungi implicated in food-borne infections have been isolated from cockroaches and include Aspergillus spp., Candida spp., Mucor spp., and Alternaria spp. Among these fungal pathogens, Aspergillus spp. poses the biggest threat to humans through the production of aflatoxins, which are extremely potent liver carcinogens. The most pathogenic species of Aspergillus is A. fumigatus, followed by A. flavus, both of which have been isolated from cockroaches.

COCKROCH DISEASES:

Only a small number of the thousands of identified species play a significant role in transmission of disease to humans. These species are. These species are well adapted to life inside building The most important ones are the American Cockroach (Periplaneta Americana), the German cockroach (Blatella germanica), the Oriental cockroach (Blatta orientalis) and the Smokybrown Cockroach (P. fulginosa). Our native New Zealand bush cockroaches Celatoblatta (about 16 species) normally live outdoors and are of no public health concern. Although cockroaches are not usually associated with widespread disease outbreaks, their presence is a sign of poor sanitation procedures and they are known to carry a Number of bactries, which could give rise to serious illness in humans. They may also induce allergies and asthma symptoms in susceptible people.

Cockroaches are a serious sanitary concern for humans but may also play a role in transmission of some worms and diseases to other animals when they are ingested. Although cockroaches can bite, diseases are almost exclusively passed on through mechanical transmission whereby their bodies are contaminated with bacteria which is then transferred to other surfaces they encounter as they move about. This may lead to wound infections, food poisoning and gastric upset. Amongst the organisms known to be carried by cockroaches are; Salmonella spp. including Salmonella typhi causing typhoid, Entamoeba histolytica causing amoebiasis, Shigella dysenteriae causing dysentery, and potentially also the poliomyelitis virusesponsible for polio. Other species known to be carried are Proteus spp., Staphylococcus aureus, Staphylococcus epidermis, and streptococcus. Their habits and body structure enable them to potentially transmit pathogens.

Cockroaches are omnivorous and will readily eat and move between food sources such as faecal matter and fresh food intended for immediate human consumption. In doing humans can become exposed to potentially dangerous pathogens through contaminated surfaces and food products. They also do not feed exclusively on one food source but will scavenge for a variety of foods.

TYPHOID

Typhoid fever is a life-threatening illness caused by the bacterium Salmonella typhi. It is still common in the developing world, where it affects about 21.5 million persons each year. Most cases in developed countries can be attributed to infections picked up overseas. The easiest ways to avoid typhoid are by being vaccinated and by avoiding risk food and drinks. Persons with typhoid fever usually have a sustained fever as high 39° to 40° C. They may also feel weak, or have stomach pains, headache, or loss of appetite. In some cases, patients have a rash of flat, rose-colored spots. The only way to know for sure if an illness is typhoid fever is to have samples of stool or blood tested for the presence of Salmonella Typhi. Even if your symptoms seem to be gone, you may still be carrying Salmonella Typhi. If so, the illness could return, or you could pass the disease to other people. In fact, if you work at a job where you handle food or care for small children, you may be barred legally from going back to work until a doctor has determined that you no longer carry any typhoid bacteria.

AMOEBIASIS:

Amoebiasis is a disease caused by the parasite Entamoeba histolytica. It can affect anyone, although it is more common in people who live in tropical areas with poor sanitary conditions. E. histolytica infection can occur when a person ingests or puts anything into their mouth which has touched faeces or been otherwise contaminated with E. histolytica, or swallows cysts of F. histolytica picked up from contaminated surfaces or fingers. Only about 10% to 20% of people who are infected with E. histolytica become sick from the infection. Symptoms usually develop within 2 to 4 weeks. The symptoms are often quite mild and can include loose faeces, stomac., pain, and stun ach cramping. Arnoebic dysentery is a severe form of amoebiasis associated with stomach pain, bloody stools, and fever. Rarely, E. histolytica invades the liver and forms an abscess. In a small number of instances, it has been shown to spread to other parts of the body, such as the lungs or brain, but this is very uncommon.

Diagnosis of amoebiasis can be very difficult. A blood test is available but is only recommended when your health care provider thinks that your infection may have spread beyond the intestine (gut) to some other organ of your body, such as the liver. However, this blood test may not be helpful in diagnosing your current illness because the test can be positive if you have had amoebiasis in the past, even if you are no longer infected now. Several antibiotics are available to treat amoebiasis. Treatment must be prescribed by a physician. You will be treated with only one antibiotic if your E. histolytica infection has not made you sick. You probably will be treated with two antibiotics

POLIO:

Polio is an infectious disease caused by a virus that lives in the throat and intestinal tract. It is most often spread through contact with the stool of an infected person and may also be spread through oral/nasal secretions Approximately 95% of persons infected with polio will have no symptoms. About 4-8% of infected persons have minor symptoms, such as fever, fatigue, nausea, headache, flu-like symptoms, stiffness in the neck and back, and pain in the limbs, which often resolve completely. Fewer than 1% of polio cases result in permanent paralysis of the limbs (usually the legs). Of those paralyzed, 5-10% die when the paralysis strikes the respiratory muscles.

The virus invades local lymphoid tissue, enters the bloodstream, and then may infect cells of the central nervous system. Replication of poliovirus in motor neurons of the anterior horn and brain stem results in cell destruction and causes the typical manifestations of poliomyelitis. The death rate increases with increasing age. Fever than 1% of all polio infections result in flaccid paralysis. Paralytic symptoms generally begin 1 to 10 days after prodromal symptoms and progress for 2 to 3 days. Generally, no further paralysis occurs after the temperature returns to normal. Additional symptoms can include a loss of superficial reflexes, initially increased deep tendon reflexes and severe muscle aches and spasms in the limbs or back. The illness progresses to flaccid paralysis with diminished deep tendon reflexes, reaches a plateau without change for days to weele, and is usually asymmetrical. Strength then begins to return. Patients do not experience sensory losses or changes in cognition. Many persons with paralytic poliomyelitis recover completely and, in most,

muscle function returns to some degree, Weakness or paralysis still present 12 months after onset is usuallpermenent.

SALMONELLOSIS:

There are so many reasons to hate cockroaches, Perhaps the most reviled creatures among all of God's creations, cockroaches- at least those that live in or around our homes - have the aesthetic features of tiny monsters crawling around us. They even have this nasty habit of crawling on you or flying over you, making it seem like they are really out to get each and every human being. And when you slap them silly and think they are dead, well surprise! A few minutes later they would be right back on track as if trying to kill them only made them stronger. They do not care about being clean. In fact, they thrive in filth, They eat anything, from rotten food, decaying meat, dead animals, human and anirnal excrement, and anything that is in your garbage. Due to this nasty habit of theirs, cockroaches naturally would carry with them all the dirt, plus bacteria and viruses in and on their bodies. This also means they get to accumulate plenty of pathogenic organisms which they transmit to food and other surfaces that touch food each time they crawl and eat.

Cockroaches are therefore transmitter of diseases. Cockroaches are known to transmit diseases like Campylobacteriosis, E. Coli infections, cholera, dysentery, Typhoid fever, leprosy, asthma, and salmonellosis. What is even more frustrating about it is that it is so difficult to get rid of the roaches, they do not die easily, Cortspaches are hardy insects. They can live without food for a month and without water for a week. It can even live for up to a week with its head cut off. They have been around for 300 million years, and will probably be around for 300 million years more.

Route Of Cockroaches Spread Diseases:

Cockroaches spread diseases in many ways: through their urine, droppings, vomit, and transfer through their feet and other body parts. When a cockroach eats something unsanitary, like feces or rotten meat, pathogenic organisms will enter their bodies and may stay inside their digestive system. It may even become dormant there. When the cockroach defecates, their droppings can contaminate food or surfaces that are in contact with food. Urine, vomit, and saliva work similarly. Food can get contaminated when it gets in contact with the pathogens from these.

The cockroaches' legs can easily pick up bacteria and viruses. Cockroaches love to live in sewers, drains, cesspits, and garbage bins. That is why anything that the cockroaches crawl on becomes contaminated. Humans usually get diseases by eating and drinking food and drinks that are contaminated by cockroaches. Another way is by eating and drinking food using kitchen utensils that are contaminated by cockroaches. One of the diseases we can get from cockroaches is called salmonellosis, a very common intestinal infection in the United States.

Salmonellosis:

Solmonello causes salmonellosis. No, it is not seafood, which is what I thought it was when I first heard about it. Salmonella is a bacteria that are dangerous because it causes food poisoning. When cockroaches crawi in dirty places, they accumulate Salmonella, which would remain in their digestive system for about a month. This would then be transferred then expelled through their droppings and yomit. Salmonellosis is one of the most common gastrointestinal infections in the United States. This disease is more common in summer than in winter. Young children are more highly to get this illness than adults. It is estimated that Salmonella causes about 1.2 million illnesses, and of this number, there are 450 deaths annually in the United States. Food is the number 1 source. If you are thinking that its name was derived from that freshwater fish that is full of Omega-3 fatty acids, then you missed the mark. The bacteria was actually named after Daniel Elmer Salmon, a U.S. veterinarian. It has been known to cause illnesses for 125 years now.

Signs And Symptoms:

People who are infected with Salmonellosis develop diarrhea, fever, and abdominal cramps. This develops after 12 to 72 hours after infection. Salmonellosis usually resolves by itself; most patients recover after 4 to 7 days even without treatment. For elder patients, infants, and those with compromised immune systems may develop complications and might need further health care.

Some people may have the infection spread beyond the intestines to the bloodstream and other parts of the body. This is when Salmonella becomes fatal if not given the proper treatment. Salmonella may cause lasting symptoms as well, like pain in urination, joint pain, and eye irritation. If you have these symptoms, seek medical care when your fever is higher than 100 degrees. F, diarrhea that lasts for 3 days and has not seen any improvements, stools, and an extended period of vomiting that causes you to dehydrate.

Diagnosis And Treatment:

Salmonellosis diagnosed when laboratory tests detect the bacteria Salmonello in a person's stool sample, body tissue, urine, or blood. Once Salmonella is found in the sample, further testing may be done to further identify the Sa'monella. Laboratory scientists co this by propagating microorganisms in the patient's sample. If the Salmonella bacteria grow, then that confirms the diagnosis. After that, the test results will then be forwarded to the treating clinician and submit the Salmonella isolates to the state public health laboratories for stereotyping and DNA fingerprinting. Stereotyping, by the way, is grouping within a single species of microorganisms that share distinctive structures. They will then submit the results to the Center for Disease Control's Enteric Disease Surveillance. Additional confirmation will be done by the National Salmonella Reference Laboratory. Salmonellosis usually resolves on its own, so patients do not need further treatment. For patients with severe illness, antibiotics are given Because diarrhea is present, patients should drink lots of fluids to prevent dehydration. If the diarrhea is so severe, it may be required of the patient to seek medical care. If the Salmonella infection spread to the bloodstream, antibiotics should be given, otherwise, death may occur.

Cockroach Control:

To protect humans from diseases associated with cockroaches, all areas likely to attract or harbor the inserts should have some form of cockroach control applied This could mean filling cracks in external walls and foundations, fixing or replacing leaking plumbing, keeping areas dry and clean, removing wastes in an efficient manner, ensuring food and human waste is not accessible by insects, setting baited traps or boards to trap or kill any cockroaches that may be present or applying an insecticide. An effective cockroach control program is essential to prevent infestations.

Cockroaches may be detected by physically searching resting sites. Looking for signs of cockroach faeces is also a good way to spot past or present cockroach activity. Cockroaches will oftentimes be disturbed by the light and run away, making them even easier to spot.

The presence of several stages of nymph, eggs and adults in an area suggest the population has become well established. Smaller infestations can be treated with the use of traps and bait stations. They are a good option where aerosols and sprays are unable to be used such as around electrical equipment. Trapping can determine resting areas and infestation severity, monitor effectiveness of chemical controls, and detect population increases, which may then require insecticide treatment.

Several types of traps can be purchased. Most are about the size of a large matchbox, have openings at both ends, and have the inside surface covered with a very sticky adhesive and slow-release food attractant. Cockroaches detect the food odour, enter the trap, and become immobilized by the adhesive. Traps can also be made from deep glass jars with a layer of petroleum jellv on the inside to prevent escape, and either commercially available bait or a piece of fruit as an attractant. Traps should be positioned with (both) ends open and accessible to intercept cockroaches as they travel to and from harborage and feeding areas. For maximum efficiency they should be placed in dark areas such as along bulkheads and in tight spaces. Traps should be left out for a minimum of 24 hours including an overnight period. A suitably placed trap can catch numerous cockroach adults and/or nymphs daily. Traps are relatively inexpensive, convenient to use, disposable, and do not need to contain toxic chemicals. If two or more cockroaches are caught within a 24hour period this may signal that a pesticide control operation is required.

The German cockroach in particular has developed resistance to a range of organophosphates, organochlorides and pyrethroids. Chemical control should always be followed up with environmental management to provide a well-rounded, control program against cockroaches. Insecticidal dusts can also be useful as they can be placed deeper into crevices and voids, and are also safe around electrical outlets where liquid sprays would not be safe to use. Dusts usually provide longer lasting residual control that sprays but are not effective in wet or damp locations. Dusts can be applied in squeeze bottles or in bulb or bellow type dusters. Where a liquid spray is to be used, it should be taken into consideration whether or not to use oil versus water based spray. Oil based sprays adhere better to smooth surfaces such glass and metal, but may damage painted surfaces, plaster or lino. Where cockroach eradication of a site is not possible and diseases such as typhoid and polio are endemic individuals should seek immunization against these. In areas or situations where dysentery and other gastric diseases are present, good personal hygiene can help mitigate

risks of further spread to the individual. Drinking bottled or thoroughly boiled water, washing all raw fruits and vegetables, and thorough cooking will also help to prevent ingestion of food contaminated with faeces or bacteria.

DISCUSSION

Cockroaches are common in many of human habitations, particularly in place where food is stored, processed, prepared, or served. Apart from that, they are also frequently detected in college environments, such as kitchen, class rooms, and laboratory rooms Indeed, cockroaches are found everywhere and possess nocturnal and omnivorous features; these characteristics make them the ideal carriers of pathogenic microorganisms including bacteria, protozoa, helminthes, fungus, and virus. It is well indicated that cockroaches are known to harbor pathogens, which can cause potentially devastating diseases, such as gastroenteritis, typhoid, and diarrheal syndromes According to findings, cockroaches are the main source of bacterial pathogens and they are also associated with multiple drug resistant strains. Therefore they have a great Impact on the spread of diseases and dispersal of MDR bacterial strains.
The present study demonstrated that cockroaches are the potential source of pathogenic bacteria. Hence, 181 bacterial species from 12 different genera were identified; predominantly the isolates were Enterobacteriaceae, 160/181 (88.4%), and the rest were Gram positive bacteria (S. aureus and CNS), 21/181 (11.6%). Of the isolates, K. pneumonice was the leading isolate from external and internal surfaces of cockroaches followed by E. coli and Citrobacter spp. It is known that isolates are the main causes of diverse types of nosocomial and community acquired infections, notably pneumonia, urinary tract infection, respiratory tract infection, skin infections, septicemia, and gastroenteritis Likewise previous reports have also indicated that the above-mentioned bacteria pathogens were the common isolates from cockroaches..

This study has also explored antibiotic resistance patterns of isolates and it was surprising that high resistance rates were observed against some of the antibiotics. Among antibiotics tested for all isolates, more than half of isolates were found to be resistant to cotrimoxazole, and especially Gram positive bacterial isolates have showed complete resistance to penicillin. However, ciprofloxacin was relatively the most powerful antibiotic against the isolates. Even though, antibiotics are not normally applied on cockroaches, but it is known that high resistance rates were reported among pathogens associated foods. In fact, a great association between cockroaches and foods could be the probable reason for isolation of resistant strains from cockroaches.

CONCLUSION

A large number of bacterial species were recovered from cockroaches. Enterobacteria were the principal isolates. Relatively, high resistance rates were noted in cotrimoxazole, but ciprofloxacin was the most effective antibiotic against isolates. Gram positive bacteria especially (S. aureus and CNS) have showed extreme resistance to penicillin Moreover, Salmonella, Shigella, and Enterobacter spp. were found to be predominant MDR isolates. Since cockroaches are the potential source of bacterial pathogen and MDR stains and, therefore, appropriate preventive, and control measures are suggested to reduce cockroach associated infections. Cockroaches could harbour and disseminate many food-borne microbial pathogens including bacteria, fungi, viruses, and parasites. These food-born pathogens vary widely in their biological characteristics, host associations, virulence determinants, and transmissions. This implies that cockroaches could play a very broad role in food-borne infections. Given the association between cockroaches and food-borne pathogens, it is important to consider them in food-borne outbreak investigations, which has not been the case hitherto. Further studies are needed to describe cockroach carriage of the several other food-borne pathogens that have not been reported previously. These include important food-borne pathogens such as C. perfringens. C. botulinum, Campylobacter spp., norovirus, and hepatitis A. In addition, there is the need for a better understanding regarding host-microbe relationships that occur between cockroaches and food-borne microbial pathogens.
Microbiome studies could provide invaluable insights in this regard. Considering the foodborne risks associated with cockroaches, their presence should not be tolerated in the food industry. Similarly, cockroaches should not be tolerated in the hospital setting as they might spread nosocomial pathogens such as S. aureus and E. coli. Efforts to control cockroaches should involve good hygiene and sanitation of facilities and also the application of proper insecticides to cockroach hiding spots. It is also important to remove hiding places of cockroaches such as cardboard, as this will prevent future infestations.

RESULTS

A total of five cockroaches were trapped from in our collage and surrounding areas environment. One hundred eighty-one bacterial species were isolated from 100% examined cockroaches. Klebsiella pneumoniae (17.7%) was the leading Bolate from external and internal surfaces of cockroaches followed by E. coli (16%) and Citrobacter species (15%). Besides, K.pneumoniae was also the commonest isolate from cockroaches in collage environment, whereas E. coli and Citrobacter species were predominantly isolated from environment cockroaches.

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