Chapter

Food Safety Endangers the Potential *Escherichia coli* Contamination on Currencies

Dewi Susanna, Tris Eryando, Budi Hartono and Lassie Fitria

Abstract

Hands have a role in the transmission of pathogen of microbes such as virus, fungi, and bacteria. The transmission is often through the contact between hands and mouth. When money touches with sundries, there is a possibility of transfer of microorganisms from hands to money and vice versa, then the dirty money will be held by someone else. Contamination of money is vital for public health problems because it can be a source of easy transmission of pathogens between handlers. Literacy related to how important is the *Escherichia coli* transmission through currencies is needed and also the way to measure its contamination. This paper describes the possibilities the existence of *E. coli* found on the surface of two types of currencies for instance papers and coins, and the steps to measure the contamination are also given in the Methods section.

Keywords: *Escherichia coli*, coin, currency, food safety, paper, transmission

1. Introduction

Escherichia coli (*E. coli*) is commonly found in the intestines of humans and warm-blooded animals, and most of the strains of *E. coli* are harmless. Shiga toxin-producing *E. coli* (STEC) can cause severe foodborne illness. It is transmitted to humans primarily through consuming contaminated food, such as raw or undercooked ground meaty products, raw milk, and contaminated raw vegetables and sprouts [1]. Person-to-person transmission has been partially identified as a source of the pathogen. Hands have a role in the transmission of bacteria. People often touch objects already held by others and often put their hands to their mouths [2]. Besides that, *E. coli* can be moved from one object to the other with the help of human hands. One of the objects most often contaminated with *E. coli* is money. Money is a means of economic transactions that quickly move from one person to another. When money touches with sundries, there is a possibility of transfer of microorganisms from around to money. Then the dirty money will be held by someone else and so on. Contamination of money is vital for public health because it can be a means of easy transmission of pathogens between handlers.

Both coins and banknotes are frequently identified as materials for various microorganisms [3]. Fomites are inanimate objects capable of absorbing, storing, and transmitting infectious microorganisms [4]. Whether in the form of coins or banknotes, money is probably the item most people handle daily worldwide. It may become contaminated with microorganisms from the respiratory and gastrointestinal tracts during counting using saliva, coughing and sneezing on hands followed by currency exchange, placement or storage on dirty surfaces, poor handwashing after toilet. The banknote then acts as a bacterial vehicle to the following user [5, 6]. Most pathogens such as *Escherichia coli* can survive on surfaces, and this surface can act as a source of pathogen transmission if no disinfection is carried out. In addition, the level of general hygiene of a community or society can contribute to the number of microbes found on coins and banknotes, and thus the possibility of transmission during the handling of money.

Currency notes could potentially function as a fomite in transmitting microorganisms such as *E. coli* O157:H7 that cause enteric disease in humans. *Escherichia coli* is one of the microorganisms often found on the surface of an object, including the surface of the money. The research done in one of the meat markets in Nigeria showed that of the 189 samples, 12 (19.7%) were contaminated with *E. coli*, where (41.7%) are confirmed *E. coli* O157:H7 [7].

Another study showed that banknotes assessed through microbiological culture, microscopic visualization, and biochemical techniques identified *E. coli* contamination of about 4.75% [8]. While the currency used by the public (banks, hospitals, municipal corporation) in India was found to be highly contaminated with various pathogenic bacteria [9]. In Bangladesh, among banknotes, it was contaminated with three different bacterial isolates, including *E. coli* (87.5%). They were resistant to amoxicillin, ampicillin, and ciprofloxacin, susceptible to azithromycin and norfloxacin [10].

In Indonesia, it is quite difficult to find literacy that identifies *E. coli* on the surface of money. A study conducted in 2007 showed that there was *E. coli* on the surface of a 1000-rupiah bill in a community trader at Pasar Kleco, Surakarta [11].

2. The existence of *Escherichia coli* on currencies

2.1 Papers

The presence of bacteria on banknotes is strongly influenced by the material made of banknotes [3]. Banknotes are made from fibers that are coarse and provide an environment that is comfortable for the bacteria to survive. In addition, bacteria will have more surviving life in money paper that made fibers naturally dissolve in the mixed material plastic. Money paper does not give effect toxic on bacteria.

Research on Iranian currency also shows that *Escherichia coli* is the microorganism with the highest percentage in each type of currency [12]. This study also proves that the physical condition of money also affects the number of microorganisms on its surface. The more soiled the condition, the greater the number of microorganisms on its surface.

Research conducted by Gedik in 2013 concluded that the material that forms and composes money significantly affects the presence of microorganisms on the surface of money [13]. Banknote paper is manufactured from cotton fiber, which gives the paper its strength, durability, and distinctive feel. The cotton is sometimes mixed with linen, abaca, or other textile fibers. Banknote paper is infused with polyvinyl alcohol or gelatin to give it extra strength. This study also proves that Romanian banknotes are

currencies whose ingredients can support the survival of microorganisms. In the same study, a microorganism transfer test was carried out on three respondents; the results showed that three respondents holding Romanian money were contaminated by the same microorganism [13]. The results of this study can be considered for countries that use money with the same materials and ingredients, especially for countries whose currencies are used globally, such as the US dollar and the euro.

Susanna, in 2019, researched banknotes and coins circulating at one of the universities in Depok, Indonesia. The communities taken are students and traders in the canteen. The sample money is money with large values such as 50,000 rupiahs to low-value banknotes, namely 1000 rupiahs. Based on the laboratory analysis results, there were no *E. coli* on the surface of the money, but there was still money contaminated with coliform [14]. This condition may occur because most money circulating is in good condition. The money holders have good knowledge regarding cleanliness because they are in an educational environment, so that the habit of washing hands can become one of the habits often done. The University of Indonesia already has a healthy canteen program under university management, which has provided education regarding personal hygiene to traders in the canteen.

2.2 Coins

Escherichia coli can survive on some metal surfaces, and *E. coli* O157 can survive for over 28 days at refrigeration and room temperatures on stainless steel [15]. Studies of *E. coli* on coins are not as much as studies on banknotes; this may be because the number of banknotes in circulation is far more than coins. Money and meager value denomination coins change hands frequently in poorer societies, unlike the people using plastic money. Generally, knowledge regarding personal hygiene in poorer societies is minimal, so this is an excellent factor contributing to the presence of microorganisms on coins. A study conducted by Curia in 2009 took samples of coins from contractor workers, food traders, and meat traders. The results showed that there were bacteria such as *E. coli* and fungi on the surface of the coins [4].

The presence of bacteria on coins does not last as long as on banknotes due to the direct toxic effect of coins on bacteria [3]. However, bacteria can adapt to the presence of coinage in their environment and increase their life span by the time they have adapted to the presence of coinage.

Like paper money, Susanna in 2019 also researched coins circulating at one of the universities in Depok, Indonesia. The sample money is money worth 1000 Indonesia Rupiah (IDR) to 100 IDR. Based on the laboratory analysis results, there were no *E. coli* on the surface of the money, but there was still money contaminated with coliform [14].

3. *Escherichia coli* detection on currencies

3.1 Materials and methods

The method used is total plate count (TPC) [7]. The working principle of TPC analysis is the calculation of the number of bacterial colonies present in the sample by dilution as needed and carried out in duplicate. All work is carried out aseptically to prevent unwanted contamination, and multiple observations can improve accuracy. The number of bacterial colonies that can be counted is a petri dish that has bacterial colonies between 30 and 300 colonies [16].

3.2 Isolation and identification of *E. coli*

There are several media used to isolate microorganisms in agar, including potato dextrose agar (PDA) [17], mannitol salt agar (MSA), xylose lysine deoxycholate (XLD) agar, MacConkey agar (MAC), eosin methylene blue (EMB) agar, bile salts citrate thiosulfate (TCBS) agar, *Bacillus cereus* (BCAM) agar base media [7]. Holt-Harris and Teague developed EMB agar (eosin methylene blue agar) media in 1916. EMB agar medium is selective for growing Gram-negative bacteria. They are generally used to separate and distinguish non-fecal coliform and fecal coliform bacteria. EMB can distinguish between bacterial colonies that can ferment lactose and those that cannot ferment the lactose [18, 19]. EMB agar consists of peptic digest of animal tissue 10,000 (GMS/L), dipotassium phosphate 2000 (GMS/L), lactose 5000 (GMS/L), sucrose 5000 (GMS/L), eosin-Y 0.400 (GMS/L), methylene blue 0.065 agar 13.500 (GMS/L), final pH (at 25°C) 7.2 ± 0.2 [18].

3.3 Total eligible count

The total viable count (TVC) is a simple way to dissect the microbial community's composition. It is used to indicate the different types and numbers of bacteria in a given sample. It is possible to isolate various bacteria from a single environmental sample, whether a soil sample or a wound swab [20].

Total feasible amount serial dilutions were made from 1 mL sample and 9 mL standard saline solution, two drops surface plated on plate count agar (PCA) for TVC. Plates were incubated at 37°C for 24 h. The number of different colonies on each plate was calculated using a colony counter, colony-forming units (CFU) per mL or cm^2 of the sample were calculated using the respective dilution factors and converted to log10, CFU/cm, or mL values.

4. Conclusion

Whether in the form of paper or coins, money is one of the media that can be a source of *E. coli* contamination. *Escherichia coli* has a reasonably long life on the surface of money, especially on coins that provide comfortable conditions for *E. coli* to survive, such as rough surfaces, natural fiber materials, and room temperature.

The existence of *E. coli* in money is very dependent on the cleanliness of the person holding the money (handler) when a money holder who has activities at risk of being contaminated with *E. coli*, such as food vendors and butchers, does not have the habit of washing hands, *E. coli* will quickly pass from hand to hand into someone else's hands.

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Conflict of interest

The authors declare no conflict of interest.

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