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Minireview Article

Parasitic and Chemical Food borne Diseases in Sudan: A review

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Abstract

The interest in parasitic and chemical foodborne diseases has increased due to its increased danger, as chemical poisoning of food often occurs within minutes. This pollution occurs in restaurants or when preparing food and in food industries. In developing countries, intestinal parasites are one of the dangerous problems that affect health and lead to an increase in illness and death because of poor economic, social, and health conditions. Chemical hazards are both natural and unnatural toxins and contaminants in food. Some toxins come from the food source, either naturally or due to mishandling. Safe food provides health to the individual and the community and protects it from the risks of diseases that may cause by consuming these contaminated foods. This review aims to report information and published data of foodborne diseases acquired in Sudan. The review showed that, there are many risks, to varying degrees, in a wide range of food consumed in Sudan, which raises concern about the potential threat to the public health of the people and requires more attention by the responsible authorities in the state such as the Sudanese Standards and Metrology Organization and the judicial authorities to establish laws that regulate and follow up on this.

Keywords: Food borne disease; Parasites; Chemicals; Contamination.

1. Parasitic Foodborne Diseases

The World Health Organization describes food borne disease as an illness that occurs because of taking in contaminated food with infectious or poisonous agents [1]. The diseases that are transmitted through food have been considered the major cause of illness and death, especially in low-wage countries where there are insufficient healthcare capabilities. The most common parasites that are related to polluted food are Giardia lamblia, Trichinella spiralis, Toxoplasma, and Entamoeba histolytica [1]. Chemicals also with its types natural or synthetic considered as a causative reagent in disease that caused by food. In developing countries, intestinal parasites are one of the dangerous problems that affect health and lead to an increase in illness and death because of poor economic, social, and health conditions. In Sudan, due to the reduction of health awareness, bad water drainage, and incorrect disposal of human waste, the spread of parasites poses significant challenges to health agencies that result in pollution of drinking water and food [2].

When people infected with intestinal parasites, they may experience a variety of symptoms. Most of which appear as disturbances in the digestive system and public impairment. The problems of the digestive system such as diarrhoea, dizziness, tension, and abdominal cramps are reflected in general health [3].

Food-borne diseases have occurred due to the ingestion of infected uncooked or not well-cooked food such as meat and milk. The most popular meat that transmits parasites in the Sudan is fish meat, which may be polluted with different parasites such as Diphyllobothrium spp., Spirometra spp., Opisthorchis spp., Clonorchis spp., Gnathostoma spp., and Anisakis
spp. [4]. Mohamed et al. discovered the Toxoplasma-causing agents gondii infection in individuals was handled by handling cats, consumption of uncooked meat, and soil intake [5].

In addition, the infection with Toxoplasma gondii in humans has been transmitted from the mother to her child [6].

In Kheir A. and Abubaker, N study about the intestinal parasites and the risks they cause in the social background of street homeless children, found the most common parasite was Giardia Lamblia, in addition to Entamoeba histolytica and Hymenolepis nana. Furthermore, concluded a strong relationship between sources of drinking water and Entamoeba histolytica [7, 8]. Mohamed, MA et al. and Hassan et al. found that 13% of total fresh vegetables that they gathered from markets in the middle of Khartoum state in Sudan were positive for intestinal parasites, whereas 14% of water specimens that were used for spraying vegetables were positive for Entamoeba histolytica/dispar, Entamoeba coli, Ascaris lumbricoides, Strongyloidesstercoralis, T. trichiur, and hookworms. E. histolytica/dispar was the most common parasite, whereas Strongyloides larvae are most common in water specimens that are used for spraying vegetables [8, 4]. Nesser G et al. [4] reported that the prevalence of toxoplasmosis in pregnant women in Tendelti city, White Nile State, Sudan was 38.5% [9].

Mohamed et al. [5] reported the prevalence of Toxoplasma gondii among Khartoum State people in Sudan was 43.6% by using the Latex Agglutination Test (LAT) [8]. In addition, Abdel Hameed reported that the rate of infection with toxoplasmosis in Gezeira State in Sudan using LAT was 41.17% [10]. In central Sudan found that 90.4% of children host at least one type of intestinal parasite such as A. lumbricoides, H. nana, E. histolytica, and G. lamblia, which are considered the most common parasites, and also found that 18.5% have been infected with over one parasite [10].

In a study on people who handled foods in Khartoum, Sudan, they found 29.4% had intestinal parasites in their stool samples; the most common were Entamoeba coli, Giardia lamblia, and Entamiba histolytica. Intestinal helminths have been found in food-handlers with a percentage of 2.7% [3]. Taha et al. showed there was a high prevalence of toxoplasmosis among aborted ladies in Atbara district, Sudan, and found that the preferred serological test for Toxoplasma gondii is enzyme-linked immuno sorbent assay (ELISA) [3].

1.1 Giardia lamblia

Giardia lamblia causes giardiasis, which is a parasitic disease that affects humans after ingestion of contaminated food. The most common species of Giardia lamblia are G. intestinalis and G. duodenalis [13]. Patients with giardiasis may suffer from abdominal pain and gas, watery diarrhoea, malabsorption, and decreased body weight. An infected person may show no symptoms or may have mild or severe symptoms that are difficult to treat. Infection with giardiasis for a long time is combined with hypersensitivity to food, inflammation in joints, chronic fatigue syndrome, and abnormal growth in children [14]. Mohammed et al. reported that in male children, intestinal parasitic infections are more common, especially at ages between 5 and 10 years old, with a percentage of 85%. This may have been related to poor hygiene at this age, but in older individuals, it is less common. It
was also reported that *Giardia lamblia* and *Hymenolepis nana* are the most common types [15].

### 1.2 Toxoplasma gondii

*Toxoplasma gondii* is an opportunistic parasite that leads to toxoplasmosis, which is a worldwide-distributed disorder, particularly in low and intermediate-earning regions. (Kijlstra and Jongert, 2008). Mustafa, et al. (2019) found that 37% of Sudanese women had direct contact with cats and 66% had extreme eating to undercooked meat, and that neither had a statistically significant association with the showing of reaction by serological method for detection of *T. gondii* [16]

### 1.3 Hymenolepis nana

In Sub-Saharan Africa, *Hymenolepis nana* is the most prevalent intestinal parasitic disease influencing the public’s wellbeing, particularly in deficient-pay nations. In 2013, Hamid et al. found that there was a high prevalence rate of *H. nana* infection among preschool children studying in displacement camps in Khartoum state, where diarrhoea was a major risk factor for *H. nana* disease [17].

### 1.4 Diagnosis of parasitic infection

Intestinal parasitic infection is practically diagnosed by direct wet preparation techniques or concentration techniques. Although the direct wet preparation is less sensitive, it is still applied in some developing countries. The concentration techniques may be applied by using formal ether sedimentation and flotation techniques [18]. Molecular biology assays are used in diagnosis and distinction between normal pathogens and mutants, which are also helpful in determining drug resistance. For example, the application of Polymerase Chain Reaction (PCR)-based kits provided the physician with detection and identification of a high number of parasites at a certain time. However, the serological method may also be applied, but it differs from the molecular and may be unreliable in giving false-negative results [19].

### 2. Chemical Hazard as Foodborne Diseases Cause

Chemical hazards are both natural and unnatural toxins and contaminants in food. Some toxins come from the food source, either naturally or due to mishandling. For instance, some types of seafood produce toxic levels of histamine when they sit out too long or reach an unsafe temperature. Contamination is the other source of chemical hazards and occurs due to the improper application of additives or cleaning solutions. Allergens are another example of a chemical hazard. In these cases, people who are sensitive to certain proteins may experience allergic reactions if their food is contaminated with those proteins [20]. Heavy metals and pesticide residues in food crops are one of the most established natural issues, in consideration that the final products are poisonousness and sickness among people and animals through
consumption of contaminated soils and food crops. Heavy metals constitute a very heterogeneous group of elements that generally differ in their chemical properties and natural capacities. The expression "heavy metals" means "metals having a density greater than 3.5 g/cm³" [21].

2.1 Source of Contamination

Natural or anthropogenic, it can be an exporter of heavy metals. Some anthropogenic activities such as mining, agrochemicals use, and wastewater discharge from industries, households accelerate the reaction of nature, and that increases heavy metal intensity. The contaminants can cross over a long way and be put down on soil or water. Contaminants from air can also contaminate in the same way. Toxic pollutants such as Pb, Cd, and As have been found in high concentrations in drinking water sources all over the world. Residual metal concentrations are also considerably increased in groundwater soil layers in many areas, leading to increased toxicity of water [22,23] an increased amount of lead and barium were found in the rural residents' hair due to water contamination in the Thar Gath oil fields in South Sudan due to toxic industrial waste depositions. From 14 drinking water samples, lead was calculated at more than the limit level of 0.01 mg/L, with a maximum value of 0.59 mg/L. There was 0.37, 2.06, and 2.15 mg/L lead in samples of water that were collected from three abandoned drilling pits. Moreover, the chromium result was (0.01-0.52mg/L), barium was (0.10-0.30mg/L) and strontium was (0.27-8.0mg/L). The barium concentration was 140mg/L in an abandoned drilling pit sample and 0.61-1.2mg/L in oil processing water pond samples [24]. Another study was conducted in the following three regions: Khartoum, Nahr Alnile, and Sinnar). Concentrations in water and fish were measured of Pb, Cd, Hg, As, Zn, and Cu have been measured in water. Findings indicated a high concentration of mercury and lead more than the standard acceptable level and the cadmium level was higher at the Gabal Awalia dam area (Khartoum state). While low levels of zinc, copper, arsenic, and cadmium are less than the acceptable standard (Table1). Water and fish from these areas may pose a health risk to the population [25]. Contamination probably results from the deposition of toxic industrial waste. It could also be concerning the heavy and erratic gold mining activities that lead to pollution of water with critical minerals such as mercury, cadmium, lead, and chromium (Table1). As in the study of Butana drinking water [26]. Natural effectiveness factors, not to be neglected, are also predominant due to the opulence of the regions with different kinds of heavy metals such as gold, iron, cobalt, nickel, zinc, and manganese.
Table 1: The levels of trace elements in water and fish samples

<table>
<thead>
<tr>
<th>Name of material</th>
<th>Concentration in water sample</th>
<th>STD level</th>
<th>Location of study</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead (Pb)</td>
<td>0.3195 ± 0.0128</td>
<td>0.005 [27]</td>
<td>Aluzuzabam</td>
<td>[25]</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0168 ± 2.733</td>
<td>0.005 [27]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>Not measured</td>
<td>5.0 [27]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>Not measured</td>
<td>1 [27]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>0.2030 ± 0.0128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0215 ± 2.733</td>
<td>0.0805 ± 0.0408</td>
<td>Algabaldam</td>
<td>[25]</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.0945 ± 7.72</td>
<td>0.1128 ± 3.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.1745 ± 0.0454</td>
<td>0.1321 ± 3.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>0.2260 ± 0.0128</td>
<td></td>
<td>Sinar dam</td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0155 ± 2.733</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.0161 ± 7.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.1285 ± 0.0454</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>0.1890 ± 0.0128</td>
<td>0.2268 ± 0.0126</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0160 ± 2.733</td>
<td>0.0425 ± 0.0408</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.0950 ± 7.72</td>
<td>0.1180 ± 3.92</td>
<td>Marawy dam</td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.1175 ± 0.0454</td>
<td>0.1403 ± 3.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic (As)</td>
<td>0.0193 ± 1.86</td>
<td>8.50 ± 1.41</td>
<td>[27]</td>
<td></td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>8.50 ± 1.41</td>
<td>0.001 [27]</td>
<td>5.75 ± 1.41</td>
<td>0.5 [27]</td>
</tr>
</tbody>
</table>

In addition to heavy metals, pesticides are the most polluted sources of water in Sudan. The yearly pesticide exhaustion in the Gezira Scheme alone exceeds 2500 tons of active materials. The greater part of the pesticides utilized in Sudan belong to the classes of organophosphorus, organochlorine, pyrethroids, carbamates, and neonicotinoids. Leftovers of pesticides applied in the Gezira and along the White Nile are probably going to find their direction to the principal Nile Stream through different regular cycles of transportation. Fish from both the Gezira and Lake Nubia showed high concentrations of pesticides. Similarly, pesticide residues may have an impact on the final consumers, especially if the fruit is consumed fresh [29]. Random use of pesticides by local farmers is very serious to consumers, resulting from the
fact that a survey of several farmers in the Sudan market found that their products are unconcerned about and insensitive to the waiting required time for the devolution of the utilized pesticides after use. As a result, many pesticides are likely to be transferred to the consumer, causing a variety of health issues. The Gezira Scheme alone, it supersedes 2500 tons of dynamic materials. The greater part of the pesticides utilized in Sudan belong to the classes of organophosphorus, organochlorine, pyrethroids, carbamates, and neonicotinoids. Leftovers of pesticides applied in the Gezira and along the White Nile are probably going to find their direction to the principal, the Nile Stream, through different regular cycles of transportation. Fish from both the Gezira and Lake Nubia showed raised concentrations of pesticides. As a result, pesticide residues may have an impact on the final purchasers, particularly if the organic product is used for the first time [30].

Utilization of pesticides by neighbourhood ranchers is intense to buyers, resulting from the fact that a study of the number of ranchers in the Sudan market found that their items were indifferent to and apathetic to the hanging tight required for the devolution of the used pesticides in the wake of utilizing them. Thusly, a high measure of pesticides stays, probably moved to the purchaser.

3. Conclusion

The current food safety situation in Sudan is an urgent challenge it will continue to have a serious impact if corrective measures are not taken immediately. The increase in foodborne illnesses related to heavy metal poisoning in food is a major problem for developing countries like Sudan. Unscientific waste disposal techniques and careless use of chemical fertilizers or pesticides are one of the major causes of heavy metal contamination in soil and surface water.

Literature shows that most Sudanese food is drastically contaminated with pollutants such as heavy metals and pesticide residues, which poses a dire threat to human health and well-being. Although the socioeconomic impact of foodborne illness is very large, there are few effective measures to reduce it. The reason for this is the lack of a surveillance system in Sudan. It is time for policy makers to respond appropriately to protect people from this food safety threat. Large-scale human studies are needed to find out heavy metal-related diseases.

Food safety should be considered as an integral part of the primary health care system. To this end, health authorities in Sudan should upgrade the current system to an effective foodborne disease surveillance system, develop food safety policies and programs, and collect epidemiological data for risk assessment of foodborne pathogens.

The co-occurrence of toxic mixtures, their interactions and combined toxicity need to be studied. We also suggest that further studies should be conducted on new approaches to phytoremediation and bioremediation of environmental toxins. It is necessary to strengthen the work already done and improve interdisciplinary approaches to understand in good way public health problems, including their economic consequences, which will allow policy makers to develop appropriate prevention strategies to reduce the risk. In addition, all prevention policies must be properly applied to ensure public health.
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