Prevalence of some enteric parasites in rats at Taif governorate with special reference to associated pathogenic bacteria

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Accepted 13 February, 2012

Forty nine rats (28 Rattus rattus and 21 Rattus norvegicus) were trapped from various locations at Taif governorate, and examined parasitologically for defining of enteric parasites and associated pathogenic bacteria. The recovered enteric parasites were Hymenolepis nana, Hymenolepis dimunata, Giardia Lamblia cyst, Entamoeba histolytica and Cryptosporidium. The incidence rate recorded for the above mentioned parasites were 20.4, 18.3, 14.2, 10.2 and 6.1%, respectively. A total of 6 potentially pathogenic bacteria were recovered from the trapped rats. These include Salmonella typhimurium, Providencia rettgeri, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa and Streptococcus faecalis.

This present study indicated that the type of enteric parasites and associated pathogenic bacteria in rats varied according to the localities, and furthermore highlighted role of rats as a biological reservoir of enteric parasites and pathogenic bacteria. The study has also provided evidence of efficiency and importance in regard for preventive control procedures which have a good effect upon prevalence of parasitological and bacterial, and furthermore highlighted the infections of human and animals. It was worthy to mention that the parasitic helminthes identified and bacterial strains isolated and accompanied together are recorded for the first time from Taif Governorate rats in KSA as a new host and locality records. The public health significance of each isolated parasite and bacterial species for man and animal as well as the symptoms and pathology of the diseases they cause, will be discussed in details in this paper.

Key words: Prevalence, enteric parasites, pathogenic bacteria, rats (Rattus rattus, Rattus norvegicus).

INTRODUCTION

Rodents are widely distributed throughout the world, and they account for about 40% of mammals living at present time (WHO, 1972). In the last years, rodents’ population has markedly increased in number in Egypt (Morsy et al., 1980) and Saudi Arabia (Albogami, 2010). The best-known rat species are Black Rat (Rattus rattus) and Brown Rat (Rattus norvegicus). The group is generally known as the Old World rats or true rats, and originated from Asia. Rats are bigger than most Old World mice, which are their relatives, but seldom weigh over 500 grams (1 lb) in weight (Cornish, 1908; Hungerford, 1975; Fragaszy and Perry, 2003).

Apart from economic lost that rodents produce, they are responsible for transmitting bacterial, viral, rickettsial and parasitic diseases. The worldwide distribution and public health importance of parasitic diseases infecting rodents have attracted the attention of several investigators (Chandler and Read, 1961; Lee and Lee,

1966; Arafa, 1968; Schafica et al., 1981; Tosson et al., 1981; El-Masry et al., 1985; El-Sokkary and Heikhel, 1986; Salyers and Whitt, 2001; Tortora et al., 2001; Forbes et al., 2002).

On the other hand, several authors have been studying the microbiology of animals and humans in relation to pathogenic and nonpathogenic bacteria. In respect of *Salmonella* Spp., it has been demonstrated that *Salmonella* Spp., is a genus of gram-negative, facultative anaerobic bacteria of the Enterobacteriaceae family, made up of non-spore-forming rods, usually motile with peritrichous flagella. They use citrate as a sole carbon source and generally ferment glucose but not sucrose or lactose. The genus contains pathogenic species causing enteric fevers (typhoid and paratyphoid), septicemias, and gastroenteritis. The most frequent clinical manifestation is food poisoning. *Salmonella* Spp. are widely distributed in lower animals, frequently producing disease (Salyers and Whitt, 2001; Forbes et al., 2002).

*Pseudomonas* Spp., is a genus gram-negative bacteria of the family *Pseudomonadaceae*, consisting of straight or curved rods that are motile by polar flagella. The genus comprises of several hundred species, including many uncertain status. Most species are strict aerobes and some produce pigments. The organisms are usually saprophytic, being found in soil, water, and decomposing matter; some are pathogenic for plants and animals (Forbes et al., 2002).

*Escherichia* Spp. is a genus of gram-negative, facultative anaerobic, rod-shaped bacteria of the tribe *Escherichieae*, in Enterobacteriaceae family, found in the large intestine of warm-blooded animals. The organisms are nonpathogenic or opportunistic pathogens. They are members of the “coliform” group of bacteria, their presence in water supplies being used as an indicator of fecal contamination. *Escherichia coli* are the principal species of the genus of *Escherichia* and the predominant facultative organism of the intestine of humans and other animals (Blood et al., 1983; Salyers and Whitt, 2001).

Concerning *klebsiella* Spp. infections, quite a few of studies have stated that this organism is a genus of bacteria, of the Enterobacteriaceae family, made up of small, gram-negative, facultative anaerobic, no motile rods, usually occurring singly; they are widely distributed in nature and are commonly found in the human intestinal tract. They are a frequent cause of nosocomial urinary and pulmonary infections and of wound infections (Tortora et al., 2001).

On the other hand, outbreaks of *Providencia* Spp. infections have been reported to be associated with urinary tract and secondary tissue infections. In recent years, the increase in these infections caused by the mentioned bacteria has grown into an ever bigger challenge for human society. *Providencia* Spp. is a genus of gram-negative, facultative anaerobic, motile, rod-shaped bacteria of the family of Enterobacteriaceae, occurring in normal urine and feces. The organisms are potential pathogens detected in urinary tract and secondary tissue infections. It was formerly classified as a species of the genus *Proteus* Spp. (*Proteus inconstans*) (Forbes et al., 2002).

*Streptococcus* Spp. gram-positive, facultative anaerobic coccic bacteria which occurs in pairs or chains, assigned to the family of Streptococcaceae. The genus consists of four groups: the pyogenic group, the *viridans* group, the *enterococcus* group, and the *lactic* group. The first group includes the β-hemolytic human and animal pathogens, the second includes α-hemolytic, potentially pathogenic organisms occurring as normal flora in the human upper respiratory tract, the third group includes organisms with variable hemolysis that are normal flora of the intestinal tract, and fourth group includes saprophytic forms associated with the souring of milk. *Streptococci* Spp. are classified according to patterns of hemolysis on blood agar, antigenic composition, and physiologic and biochemical characteristics (Finegold and Baron, 1986).

The purpose of the present work is to illustrate the role of rodents as a biological reservoir of some enteric parasites and bacteria.

MATERIALS AND METHODS

In summertime forty nine rats (females and males) were trapped alive from different localities of Taif governate. The captured rats were identified according to Kamel (1958) and anaesthetized by chloroform vapour.

Parasitological examinations

Methods applied for Parasitological examination, were recommended by Bauer (1982), Finegold and Baron (1986), the Merck Veterinary Manual (1991), and Forbes et al. (2002). Each rat of the forty nine rats were subjected to parasitologic investigation, it was dissected and its intestine extracted and split opened in a wide Petri-dish full of saline. The contents were thoroughly examined for adult *Hymenolepis* Spp. Smears from different parts of the intestine were taken, some of them were mixed with saline and iodine solution for direct microscopically examinations while others were dried in air and fixed with methanol, then stained by modified Ziehl-Neelsen technique (Henriksen and Pohlenz, 1981) for *Cryptosporidium* oocysts. Other smears were stained with Heidenhim’s iron haematoxylin for *Entamoeba* Spp. and *Giardia* Spp. stages.

Bacteriological examination

Bacteriological procedures, tests and observations were done on the intestinal fecal samples and isolated colonies according to techniques advised by Bauer (1982), Finegold and Baron (1986), and Forbes et al. (2002) with some modifications. All feces samples...
of each intestine were cultured on the following primary and differential-media which involving Mueller Hinton Agar (HiMedia Laboratories Limited, India), Mannitol Salt Agar (HiMedia Lab. India), blood Agar Base No. 2 (Oxoid Ltd. England), MacConkey Agar (HiMedia Lab. India), Nutrient Agar (Oxoid Ltd. England), Xylose-Lysine-Deoxychocolate (XLD) Agar (Scharlau Chemie S. A. Barcelona, Spain, European Union) and Potato Dextrose Agar (Oxoid Ltd. England). Incubation of plates was at 37°C and bacterial growth was evaluated after 24 and 48 h.

RESULTS

Results are presented in Tables (1 and 2) and Figures (1 to 3), a total of 34 parasitic helminthes and 235 bacterial isolates were recovered from examined intestinal samples of the rats subjected to parasitological and bacteriological procedures and examinations. From the finding recorded in Table (1) and Figures (1 and 2), it is clearly evident that the total incidences rates of H. nana, H. diminuta, G. lambia, E. histolytica, and Cryptosporidium Spp. were 20.4, 18.3, 14.2, 10.2 and 6.1%, consecutively. From Table (2) and Figure (3), it is clearly demonstrated that from 235 different bacterial isolates were identified. E. coli and S. faecalis were the most prevalent bacteria isolated (66 and 50 strains, respectively). While from 235 bacterial strains isolated, 37 S. typhimurium, 26 P. aeruginosa, 23 K. pneumoniae and 33 P. rettgeri bacterial isolates were identified.

DISCUSSION

H. nana and diminuta are the most common cestodes in humans, mice, domestic and wild rats (Macko and Hanzelova, 2008; Mahmoud et al., 2011). The results recorded and presented in Table (1) and Figures (1 and 2) revealed that, the total incidence of H. diminuta eggs in the examined rats were 18.3%. These results are higher than those obtained by Schafica et al. (1981) and El-Masry et al. (1985). But, are lower than those established by Abu’Shady et al. (1983), El-Sokkary and Heikel (1986), and nearly similar to the results obtained by Kaoud et al. (1983) and Samaha and Otify (1991).

These variations in the mentioned total occurrence rate of H. diminuta eggs may be attributed to the climatic conditions which including temperature and relative humidity prevailing in such areas. H. nana is the common tapeworm of humans throughout the world (Mohammadzadeh et al., 2007). It is more common in warm climates (Beaver et al., 1984). This tapeworm is found in the small intestine of rats, mice and humans (Marquart et al., 2000). The prevalence of H. nana is variable in the world.

Moreover, H. nana eggs were detected at a rate of 20.4% in the examined rats (Table 1) which is nearly similar to the results reported by Arafa (1968), Kaoud et al. (1983), El-sokkary and Heikel (1986) and higher than the results papered by Samaha and Otify (1991). However, Monib (1980) detected H. nana in the examined rodents without mentioning their incidence percentage. H. nana is a common parasite of rodents as well as human intestine. This parasite has been reported from all over the world including Iran. The infection rate has been recorded up to 40% in some areas of Iran (Mohammadzadeh et al., 2007). In Iran, the most prevalent area of human hymenolepiasis is Khouzestan with up to 31.8% infection rate (Farahnak, 2001). The infection rate of H. nana in rodents of Khouzestan has been reported 31.3% (Sadjadi and Massoud, 1999).

Regarding the public health importance of both H. diminuta and nana, Riely (1920) and El-Masry (1985) detected both types in children and considered, rodents faces as a main source of human infestation. As well as, Albogami (2010) at Saudi Arabia could detected two parasitic helminthes belong to phylum Platyhelminthes (Cestoda), namely, H. diminuta and Rodentolepis nana, where the two previous mentioned helminthes were demonstrated and detected in several localities in Taif Governorate.

Hymenolepiasis is an infection with Hymenolepis Spp. Hymenolepidae are a family of small to medium-sized tapeworms of the order Cyclophyllidea, subclass Cestoda, which parasitizes birds and mammals, including humans. Hymenolepis is of medical importance genus of tapeworms, family Hymenolepidae. H. diminuta is a tapeworm of rats and mice, occasionally found in man. H. nana is the dwarf tapeworm, a species about 7 to 80 mm long that is parasitic in rats, mice and humans, especially children. Infected persons are usually asymptomatic, but in massive infection symptoms may include dizziness, abdominal pain, diarrhea, insomnia and convulsions etc (Forbes et al., 2002).

Entamoeba histolytica cysts were detected at an incidence rate 10.2% (Table 1) and Figures (1 and 2) in the examined samples of rats, which is higher than those recorded by El-Masry et al. (1985) and Samaha and Otify (1991). The obtained data coincided with those previously recorded by Tosson et al. (1981). This attributed to the large populations of rats at Taif governorate, decline of healthy preventive procedures and control. The infestations with E. histolytica cysts mostly associated with pathogenic bacteria due to shortening of the life of cysts, increased excretion of a large numbers of these cysts in the environmental habitats of rats and available foods infected with these parasites for rats continuously. However, Omar (1976) could not detected E. histolytica in the intestine of the
Table 1. Showing the number and types of rats as well as the type of enteric parasites in the examined rats.

<table>
<thead>
<tr>
<th>Type of rodents</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rattus rattus</em></td>
<td>28</td>
</tr>
<tr>
<td><em>Rattus norvegicus</em></td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of parasites</th>
<th><em>Hymenolepis nana</em></th>
<th><em>Hymenolepis dimenuta</em></th>
<th><em>Giardia lamblia</em></th>
<th><em>Entamoeba histolytica</em></th>
<th><em>Cryptosporidium Spp.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>8</td>
<td>28.6</td>
<td>21.4</td>
<td>6</td>
<td>10.7</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>3</td>
<td>14.2</td>
<td>4</td>
<td>19.0</td>
</tr>
<tr>
<td>10</td>
<td>20.4</td>
<td>9</td>
<td>18.3</td>
<td>7</td>
<td>14.2</td>
</tr>
<tr>
<td>10</td>
<td>20.4</td>
<td>9</td>
<td>18.3</td>
<td>7</td>
<td>14.2</td>
</tr>
</tbody>
</table>

Table 2. Showing Enterobacteriaceae organisms detected in examined rats samples.

<table>
<thead>
<tr>
<th>No. of examined samples</th>
<th>Positive samples</th>
<th>No. of strains isolated</th>
<th>Types of <em>Enterobacteriaceae</em> organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td><em>Salmonella typhimurium</em></td>
</tr>
<tr>
<td>49</td>
<td>49</td>
<td>100</td>
<td>235</td>
</tr>
</tbody>
</table>

examined rats. Concerning the public health importance, Neal (1950) stated that rodents play a prominent role in the transmission of amoebic dysentery to man. On the other hand, WHO (1979) reported that the infestation with *E. histolytica* may be harmful for persons dealing with animals and rodents. However, *E. histolytica* cysts were detected in the *Rattus rattus* and *Rattus norvegicus* rodents subjected to examinations at an incidence of 10.7% and 9.5%, respectively. However, these findings obtained are not compatible and higher than those recorded by Samaha and Otify (1991) who mentioned that the incidence of *E. histolytica* cysts was established in the examined *R. rattus* and *R. norvegicus* at percentages of 4.3% and 2.8% successively.

Entamebiasis is an infection with *Entamoeba* Spp. *Entamoeba* is a genus of naked ameboid protozoa (suborder Tubulina, order Amoebida) parasitic in invertebrates and vertebrates, including humans, and characterized by the presence of a vesicular nucleus with a comparatively small central karyosome with a number of peripheral chromatin granules attached to the nuclear membrane. *E. histolytica* is the only species of *Entamoeba* with the potential for producing human amebiasis; it is transmitted through ingestion of cysts in contaminated food and water. Trophozoites may invade the tissue of the large intestine and may be spread to extra-intestinal sites such as the liver, spleen, brain, lungs and pericardium (Finegold and Baron, 1986).

*G. lamblia* cysts were recovered from the intestine of the examined *R. rattus* and *R. norvegicus* at an incidence rate of 10.7% and 19.0% consecutively-respectively, which are variable as recorded by El-Masry et al. (1985), and Samaha and Otify (1991) in the examined *R. rattus* and *norvegicus* only in which the incidence of this parasite in the late study was 5.6%.

Giardiasis is a common infection of the human small intestine with the protozoan *G. lamblia*, spread via contaminated food or water or by direct
Figure 1. Showing the percentage of isolated parasites from rodents.

Figure 2. Showing the total percentage of isolated parasites from rodents.
Figure 3. Showing the percentage of Enterobacteriaceae organisms detected in examined rats samples

person-to-person contact. Most of those infections are asymptomatic, but a small percentage presented with symptoms ranging from nonspecific gastrointestinal discomfort to mild to profuse diarrhea, nausea, lassitude, anorexia and weight loss. *Giardia* is a genus of flagellate intestinal protozoa (suborder Diplomonadina, order Diplomonadida) parasitic in various vertebrates, including humans, characterized by the presence of a large sucking disk on the ventral body surface, by means of which the organism adheres to the microvilli of the host's intestinal epithelium; two anterior nuclei; and eight flagella in four pairs. *G. lamblia* is a species that is the usual cause of giardiasis in humans; it may also infect domestic animals. Called also *Giardia intestinalis* or *Giardia duodenalis* (Garcia and Shimizu, 2000; Gardner and Hill, 2001).

*Cryptosporidium* oocysts were observed in the stained faecal smears of both *R. rattus* and *norvegicus* at a rate of 3.6% and 9.5%, respectively (Table 1). The specificity of the mammalian species of *cryptosporidium* Spp. is not known (Grant et al., 1980). The possibility of cross infestation between rodents and man with *cryptosporidium* Spp. need further investigations.

The 2 main species of *Cryptosporidium* that infect humans are *Cryptosporidium hominis* and *C. Parvum* (Hunter et al., 2007). The common species and sub-genotypes causing cryptosporidiosis were studied in 394 children and 627 animals with diarrhea in Vellore in southern India. Although no zoonotic strains were identified in 13 infected children, 1 of 12 infected animals had *C. hominis*, indicating the potential for cross-species transmission. The investigators of this study also have been demonstrated *C. xiao* for the first time in India (Rajendran et al., 2011).

Cryptosporidiosis is an infection of young farm animals (calves, lambs, foals, or piglets) with protozoa of the genus *Cryptosporidium*, which may be associated with or contribute to enteric disease. Human infection with *Cryptosporidium*, usually seen as a self-limited diarrhea in those who work with cattle; in immune-compromised patients it is much more serious, manifested as prolonged debilitating diarrhea, weight loss, fever, and abdominal pain, with occasional spread to the trachea and bronchial tree. *Cryptosporidium* is a genus of minute homoxenous coccidian protozoa (suborder Eimeriina, order Eucoccidiida), characterized by the presence of oocysts with four sporozoites; they are parasitic in the intestinal tracts of many different vertebrates, including humans, causing cryptosporidiosis (Hungerford, 1975; Bauer, 1982; Finegold and Baron, 1986). Unlike immune-competent adults, in whom cryptosporidiosis is usually self-limited, people with AIDS are susceptible to a
devastating form of cryptosporidiosis manifested by chronic, voluminous diarrhea. The factors which predispose these people to chronic cryptosporidiosis rather than self-limited illness appear to be immunologic (Ramratnam and Flanagan, 1997; Clark, 1999). On the other hand, the Enterobacteriaceae which could be isolated from the examined fecal samples were: S. typhimurium (15.8%), P. aeruginosa (11.0%), E. coli (28.0%), K. pneumonia (9.8%), P. rettgeri (14.0%), and S. faecalis (21.2%) (Table 2).

As regard to bacterial diseases potentially transmissible to man by rats, much more investigators have been recorded that Salmonellosis is any disease caused by infection with Salmonella Spp.; in humans it is most often manifested as food poisoning with acute gastroenteritis, vomiting, diarrhea and rarely septicemia, or as typhoid or paratyphoid fever. Recurrent fevers and diarrhea with more serious gastrointestinal symptoms are seen in immuno-compromised patients. Salmonella Spp. infections also cause abortions in horses, sheep and diarrhea and fowl typhus in chickens (Hungerford, 1975; Blood et al., 1983; Forbes et al., 2002). P. aeruginosa, is a type of genus species of Pseudomonas; it produces pyocyanin and flourescein, which give the color to the "blue pus" observed in certain infections, and it produces a variety of toxins and enzymes. It is a major cause of nosocomial infection, such as pneumonia, especially in young, debilitated, or immunocompromised patients, or severe, even fatal infections of the urinary tract, wounds, abscesses, or the blood stream. It may also cause eye infections in those who use contact lenses (Finegold and Baron, 1986; Forbes et al., 2002; Memon and Mirbahar, 2007).

E. coli is the principal bacterial species of the genus Escherichia. This organism is the predominant facultative organism of the intestine of humans and animals. Serotypes of this organism are based on the distribution of heat-stable OAg, ViAg of varying heat stability and HAg that are heat labile. They are usually nonpathogenic, but pathogenic strains producing pyogenic infections and diarrhea are common. The pyogenic strains are found in infections in the urinary tract, abscesses, conjunctivitis and occasionally septicemia, such as the hemorrhagic septicemia in newborn infants known as Winckel's disease. The enteropathogenic E. coli (EPEC) produce intestinal disease and diarrhea, especially in hospitalized infants and other baby animals. The enterotoxigenic E. coli (ETEC) cause diarrhea in piglets, and calves and, a cholera-like disease in human infants and adults. Enteroinvasive E. coli (EIEC) invade the epithelial cells of the human colon, causing dysentery, sometimes associated with food poisoning. They often become predominant bacteria in the flora of the mouth and throat during antibiotic therapy. Enterohemorrhagic E. coli (EHEC) cause acute bloody diarrhea. Enteroadherent E. coli (EAEC) are subdivided into enteroaggregative groups (EAg-gEC), which adhere to the enteric mucosa to form colonies and typically cause chronic watery diarrhea in children in developing countries, and diffusely adherent (DAEC) groups (Tortora et al., 2001; Forbes et al., 2002; Mokady et al., 2005).

Klebsiella Spp. is a genus of bacteria of the family Enterobacteriaceae, made up of small, gram-negative, facultative anaerobic, no motile rods, usually occurring singly; they are widely distributed in nature and are commonly found in the human intestinal tract. They are a frequent cause of nosocomial urinary and pulmonary infections and of wound infections. The most important organism of the previous genus mentioned above is K. pneumonia. It is the etiologic agent of an acute bacterial pneumonia for humans and animals (Hungerford, 1975; Tortora et al., 2001; Giakkoupi et al., 2005).

In relation to k. pneumoniae, Tortora et al. (2001) and Forbes et al. (2002), pointed out that this organism is an encapsulated species found in soil, water, and grain, in the intestinal tract of humans and animals, and in association with infections of the urinary and respiratory tracts. It is the etiologic agent of an acute bacterial pneumonia.

Regarding the infections caused by P. rettgeri, it has been declared that the species mentioned above is a species isolated from human clinical specimens and from chicken feces, a possible cause of nosocomial infections (Finegold and Baron, 1986; Salyers and Whitt, 2001).

Forbes et al. (2002) stated that S. faecalis in humans will cause several infections for intestinal and respiratory tracts, and influence the digestion which is directly reflected on the healthy state of the body.

With relation to bacterial disease of rats, numerous investigations have shown that these animals may be a main reservoir for different pathogenic and potentially nonpathogenic bacteria infected humans. The most important diseases infected rats are Pseudomonas Spp. infection and Salmonella Spp. (Paratyphoid), and K. pneumoniae disease. Regarding Pseudomonas infection, it is evident that Pseudomonas are part of the normal intestinal flora but may cause early deaths in stressed, irradiated, or otherwise immune-suppressed mice and may also cause otitis media and interna in nonirradiated mice.

Prevention and control are best accomplished by acidification (pH 2.5) or chlorination (10-12 ppm) of the drinking water. Salmonella Spp., usually S. typhimurium or enteritidis, may cause enteritis and septicemia with focal necrosis of the liver or spleen in rats and mice. Although rarely a problem in commercially bred rodents, Salmonellosis can be introduced into a colony by feral or wild rodents, or contaminated feed or bedding products.
Clinical signs include anorexia, rough coat, weight loss, conjunctivitis, and sporadic deaths. Subclinical carries make elimination of the infection difficult. Because of the public health hazard, infected rodents should be eliminated. Miscellaneous bacterial infections of rats include, *S. aureus*, this bacteria cause skin and facial abscesses in nude athymic mice. *K. pneumoniae* may rarely cause bronchopneumonia, pleuritis and abscesses in various organs of mice. *S. pneumoniae* is a cause of acute bronchopneumonia, pleuritis, pericarditis, meningitis and splenic infarcts in rats. Together with other than mentioned bacteria such as *S. moniliformis*, *B. bronchiseptica* and *P. multocida* may also occasionally cause several dangerous diseases for rats and transmissible to man (Hungerford, 1975; Blood et al., 1983; The Merck Veterinary Manual, 1991).

Generally, the presence of rodents constitutes a complex economic and public health problems. So, ratproofing measures in human being and animal buildings and the maintenance of sanitary measure and control and preventive procedures together with the mechanical, chemical and biological destruction of rodents are essential.

**ACKNOWLEDGEMENTS**

We really appreciate and thanks to Prof. Dr. Moatz Abd El-Fattah (Al-Hada Military hospital, Taif, KSA) for his aid in this study.

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