JOURNAL OF PURE AND APPLIED MICROBIOLOGY, June 2012. Vol. **6**(2), p. 543-549

Search for Coagulase-Positive *Staphylococcus*, *Salmonella* spp. and *Listeria monocytogenes* from Cockroaches in Residential Kitchens

Margarida Flores Roza-Gomes[1]*, Eliandra Mirlei Rossi[2], Marciele Bogo[3], Michelly Suzanne Zanella[4] and Diane Scapin[5]

[1]Department of Biological Sciences and Health – University of West of Santa Catarina – Rua Oiapoc, 211, São Miguel do Oeste – SC – Brazil - 89900-000.
[2]Department of Biological Sciences and Health – University of West of Santa Catarina – 89900-000 – São Miguel do Oeste – SC – Brazil.
[3,4]Department of Biological Sciences and Health – University of West of Santa Catarina – Graduate Course in Biology – 89900-000 – São Miguel do Oeste – SC – Brazil.
[5]Department of Biological Sciences and Health – University of West of Santa Catarina – 89900-000 – São Miguel do Oeste – SC – Brazil.

(Received: 08 January 2012; accepted: 27 February 2012)

Cockroaches can carry and disseminate microorganisms. The objective of this study was to investigate the presence of coagulase-positive *Staphylococcus*, *Salmonella* spp. and *Listeria monocytogenes* from cockroaches in residential kitchens. The study was conducted from March to December 2010 and involved 120 inspections. In each kitchen, three traps were placed and left for 24 hours. The samples were subjected to microbiological analysis for *Salmonella* sp., *L. monocytogenes* and coagulase-positive *Staphylococcus*. The insects were also quantified, sexed and classified. Twenty-nine cockroaches were collected, none of which was contaminated with *Salmonella* sp., coagulase-positive *Staphylococcus* or *L. monocytogenes*. However, microorganisms of the genus *Citrobacter* sp. (23.52%), *Enterobacter* sp. (23.52%), *Proteus* sp. (23.52%), *Serratia* sp. (5.88%), *Flavimonas* sp. (2.94%), *Morganella* sp. (2.94%), *Providencia* sp. (2.94%), *Alcaligenes* sp. (2.94%), *Staphylococcus* sp. (8.82%) and *Acinetobacter* (2.94%) were found. Thus, we observed that cockroaches can carry microorganisms which reinforces the importance of the control of these insects.

Key Words: Microorganism, Bugs, Health public, Food-borne disease, Food safety.

Cockroaches (Blattodea: Blattidae) are adaptable because of their nutritional requirements, reproductive potential and ability to hide, which protects them from detection and predators[1]. These bugs have been around for 400 million years, and during this period, they have undergone little change in appearance. They can be feed on almost anything that has some nutritional value[2].

* To whom all correspondence should be addressed.
Tel.: 04936311000 or 04936228393;
E-mail: margarida.gomes@unoesc.edu.br

In urban areas, cockroaches take advantage of favourable conditions: they are omnivores and exhibit necrophagy, coprophagy and high reproductive potential. They also have the ability to adapt to different environments easily hide in small gaps[3].

Approximately 4000 species of cockroaches exist, of which 1200 live in the neotropical region, representing 460 genera (in the neotropical region). They have spread across all zoogeographical regions. Some species have adapted to urban conditions and have spread throughout the world; these species include *Blatta*

orientalis, *Blatella germanica*, *Periplaneta americana, Periplaneta australiase* and *Supella longipalpa* [4].

The cockroaches are vectors for many microorganisms and distribute them on surfaces, utensils and food. Several bacteria can cause FBD, including *Staphylococcus aureus*, *Salmonella* sp. and *Listeria monocytogenes* [5].

S. aureus (a species of coagulase-positive *Staphylococcus*) is one of the most common pathogens responsible for bouts of food-borne intoxication. Food poisoning provoked by this microorganism is due to ingestion of an enterotoxin produced and released by bacteria during their growth in food, which represents a public health risk [6].

Another organism that gets attention is *Salmonella* sp., which diffuses widely in nature and may be present in soil, air, water, waste water, animals, humans, food and faeces[7, 8]. However, the natural habitat of *Salmonella* sp. is the intestinal tract of animals such as cattle, pigs and poultry [9]. Moreover, it is important to emphasise that *Salmonella* spp. is considered the leading cause of food-borne disease the State of Rio Grande do Sul, southern Brazil [10].

In recent years, *L. monocytogenes* has acquired extreme importance both in industrial environments and in residential kitchens; it is a bacterium that adapts to different environmental conditions and grows rapidly over wide ranges of temperature and pH [11]. *L. monocytogenes* is unquestionably pathogenic to humans, and unlike other food-borne pathogens that cause gastrointestinal symptoms, the main clinical symptoms are initially similar to a cold with fever and malaise. However, *L. monocytogenes* infection may progress to meningitis, meningoencephalitis, septicaemia, abortion or premature birth [12].

According to the Secretariat of Health Surveillance[5], residences are places where the greatest proportion of outbreaks of food-borne disease have been reported (45.3%), followed by food services in restaurants (19.6%) and schools (10.1%). Therefore, it is important to verify whether cockroaches present in residential kitchens carry microorganisms that cause food-borne disease, as they are frequently encountered in these locations. Thus, this study aimed to search for the presence of coagulase-positive *Staphylococcus*, *Salmonella* sp. and *L. monocytogenes* carried by cockroaches in residential kitchens. In addition, we completed a quantitative survey of residential kitchens and took samples of cockroaches present in those locations, as well as made sure that they can carry microorganisms that cause food-borne disease.

MATERIALS AND METHODS

The study was conducted from May to December 2010 in 120 kitchens in a randomly selected residential city in the far-west region of Santa Catarina, Brazil. Three traps were placed (disinfected with 70% alcohol) in each residence. The traps were baited with attractive food (sugar, powdered chocolate and onion), installed during the day, and left in place for 24 h. The traps were identified in accordance with the collection point number. The cockroaches were living and healthy because they had just been used for microbiological study. When captured, they were transferred to the microbiology laboratory at the University of West of Santa Catarina (UNOESC), Brazil.

In the microbiology laboratory, the insects were subjected to a temperature of less than -10°C for a period of 10–15 min. to the immobilization of these. After, the cockroaches were immersed in tubes containing peptonated saline 0.1% and then agitated manually for 10 seconds.

Subsequently, this mixture was microbiologically analysed for *Salmonella* sp., *Listeria monocytogenes* and coagulase-positive *Staphylococcus*.

All the microbiological tests were conducted according to regulations No. 62 of 2003, the Ministry of Agriculture, Livestock and Supply (MAPA)[13], which formalises the official analytical methods for microbiological analysis for the control animal products and water [13].

Coagulase-positive *Staphylococcus* was plated in 100µl dilutions of concentrations of 0.1, 0.01 and 0.001mL on plates containing Baird-Parker agar (DIFCO, France). These plates were incubated at 37°C for 48 h. Characteristic colonies (black with halos) were subjected to gram staining and biochemical tests to confirm the presence of catalase and coagulase. The results were expressed in CFU/cockroach.

In the survey of *Salmonella* sp., 0.01 ml was used for the initial sample added to 0.09 ml of 1% buffered peptone water (DIFCO, France) and incubated for 16–20 h at 36±1°C. Subsequently, 1 mL was inoculated simultaneously in this sample test tube containing tetrathionate broth (MERCK, Germany). These were incubated at 41±0.5°C for 24 h. Then, these samples were separately streaked onto brilliant green phenol red lactose sucrose agar (OXOID, England) and xylose lysine deoxycholate (MERCK, Germany) and incubated at 36±1ºC for 18–24 h.

Characteristic colonies were confirmed by biochemical and serological tests, including citrate utilization, urea hydrolysis, nitrate reduction, lysine de-carboxylation, oxidase production, methyl red, Voges-Proskauer, triple-sugar iron, motility, indole production, H_2S production and decarboxylation of ornithine tests [14].

The results were choice in the presence or absence of *Salmonella* sp. For *L. monocytogenes*, we used 0.1 ml of pre-diluted sample and pre-enriched Listeria enrichment broth (broth LEB- DIFCO, France) and inoculated tubes containing 10 ml of Fraser broth (AES, Bruz Sedex). We then incubated the tubes at 30±1°C for 24-48 h.

After this period, these samples were streaked on Oxford agar (AES, Bruz Sedex) and incubated at 30±1°C for 24–48 h. Characteristic colonies (black colonies surrounded by a dark halo) underwent gram staining and biochemical tests (methyl red, Voges-Proskauer, nitrate reduction, motility, indole production, H_2S production and hemolysis on blood agar 5%).

After microbiological testing, the cockroaches were transferred to flasks containing 70% alcohol and transported to the laboratory of zoology and botany at the UNOESC, where quantification, sex determination and classification at the species level were conducted with the help of a stereoscopic microscope and a dichotomous key of Buzzi[4].

RESULTS AND DISCUSSION

Of the 120 residential kitchens evaluated in fifteen (12.5% of houses) cockroaches were captured. Among the 15 residences where insects were found, 60% were constructed of wood, 20% masonry and 20% mixed wood-masonry.

Table 1. Cockroaches number collected in residential kitchens, 2010.

Species	Number of individuals	Dimorphism	
		Male	Female
Blatella germanica	6	2	5
Periplaneta americana	7	4	2
Periplaneta australasiae	7	3	4
*Supella longipalpa**	9	8	0
Total	29	17	11

*One individual of this species was of unidentified sex.

We found 29 specimens of the cockroaches; 17 were males, 11 were females and one was unidentified. Of the cockroaches encountered, 6 individuals (20.68%) were *P. americana*, 7 individuals (24.13%) were *P. australasiae*, 7 were individuals (24.13%) *B. germanica*, and 9 individuals were (31.03%) *S. longipalpa* (Table 1). All of these species are synanthropic and common in Brazil and other tropical countries[15].

None of the 29 cockroaches analysed were contaminated with *Salmonella* sp., coagulase-positive *Staphylococcus* or *L. monocytogenes*, the microorganisms of interest in this study.

However, 80% of the other microorganisms that were found were from the family Enterobacteriaceae (Table 2), with the highest number of occurrences from the genera *Citrobacter* spp. (23.52%), *Enterobacter* spp. (23.52%), *Proteus* spp. (23.52%), *Serratia* spp. (5.88%), *Morganella* sp. (2.94%) and *Providencia* sp. (2.94%).

Table 2. Genus and species of microorganisms isolated from the cockroaches, 2010.

Genus	Species	Occurrence	Frequency (%)
Alcaligenes sp.	*Alcaligenes faecalis*	01	2.94
Acinetobacter sp.		01	2.94
Citrobacter spp.	*Citrobacter amalonaticus*	03	8.82
	Citrobacter freundii	04	11.76
	Citrobacter kosen	01	2.94
Enterobacter spp.	*Enterobacter aerogenes*	04	11.76
Enterobacter gergoviae		01	2.94
Enterobacter sp		03	8.82
Flavimonas sp.		01	2.94
Morganella sp.	*Morganella morganii*	01	2.94
Proteus spp.	*Proteus freundii*	01	2.94
	Proteus mirabilis	02	5.88
	Proteus myxofaciens	01	2.94
	Proteus vulgaris	04	11.76
Providencia sp.	*Providencia rustigianii*	01	2.94
Serratia spp.	*Serratia fonticola*	01	2.94
	Serratia marcescens	01	2.94
Staphylococcus sp.		03	8.82
Total		34	100.00

Although we did not encountered coagulase-positive *Staphylococcus*, the genus *Staphylococcus* sp. was present, making up 8.82% of the total.

The number of cockroaches found in this study may have been influenced by many different factors because, according to Soares[1] the adaptation of many species of cockroaches to homes may be due to domestic heating (in temperate countries), the lack of natural enemies in buildings and the wide availability of small shelters such as cracks and crevices in the walls of houses, especially wooden homes.

In this study, 15 insects in 120 inspections were found. The climatic variation can be explained by climatic variation during the period of collection. According to meteorological data provided by Epagri/Ciram[16], the mean temperature registered in the months from June to December 2010 (the period when the study was conducted) was 17.8°C. Of the 29 cockroaches collected, 12 were collected in December, which had the highest average temperature (21.15°C) during the collection period, corroborating the conclusions made by Soares[1].

According to Lopes[15], low temperatures and the lack of food are crucial in stimulating the search for new areas of colonization for the species *B. germanica*. In addition, Oliveira[2] found that this insect prefers humidity and heat. Buzzi[4] found that the optimum temperature for development and proliferation of *P. americana* is 29°C. Dutra *et al*.[17] found that cockroaches prefer places with high temperatures of between 30 and 33°C.

Of the total number of cockroaches analysed in this study, none were contaminated with *Salmonella* sp., coagulase-positive *Staphylococcus* or *L. monocytogenes*. Cloarec *et al*.[18] corroborated these results by analysing low-income housing and found cockroaches in 52 different homes; however, none of the samples were contaminated by coagulase-positive *Staphylococcus*.

Many of the microorganisms found in this study are deteriorating, capable of breaking down food, but some can be pathogenic to humans, or indicate the presence of pathogens, as in the case of microorganisms of the Enterobacteriaceae family. Cockroaches are no longer just a socio-economic problem; they are becoming a greater risk for public health. Some genera that are considered non-pathogenic may eventually act as opportunistic pathogens, e.g. *Citrobacter* spp., *Enterobacter*

spp., *Proteus* spp., and *Serratia* spp., among others. Many of these microorganisms, pathogenic or not, cause food spoilage[19].

The genus *Citrobacter* spp. was present in 23.52% of the samples in this study; according to Felipe[19], these microorganisms are frequently isolated from clinical specimens and are opportunistic pathogens that are also found in soil, water, sewage and foods.

Chaichanawongsaroj[20] found that in public catering establishments and residences, the species *Citrobacter* spp. were isolated from cockroaches, in addition to other genera, such as *Serratia* spp., *Enterobacter* spp., *Proteus* spp. and *Morganella* spp. The results of this study are similar to the findings of Prado[21] who conducted a study in Ribeirão Preto/SP in which the microorganisms of the genera *Enterobacter* (55%), *Serratia* (26%), *Citrobacter* (14.5%) and *Providencia* were isolated from the cockroach species *P. americana* .

In this study, we found many species of the genus *Enterobacter*, which represented 23.52% of the samples. These naturally occurring microorganisms are found in sweet water, soil, sewage, plants, vegetables and the faeces of humans and animals[22]. Many species, most notably *E. cloacae*, *E. sakazakii*, *E. aerogenes*, *E. agglomerans* and *E. gergoviae*, are opportunistic pathogens at the sites of burns and wounds; they also cause urinary tract infections and occasionally septicaemia and meningitis[19].

Another genus of the family Enterobacteriaceae, which represented 23.52% of the samples, was *Proteus*, which can be found in the intestines of humans and many animals, soil and polluted water[23]. *Proteus* is considered a human pathogen that causes urinary tract infections[24] and invades secondary septicaemic lesions frequently found in burns patients[19].

The presence of the genus *Staphylococcus* sp. (coagulase-negative), found in our study (8.82% of the samples), is of concern based on the results obtained in several studies[25, 26, 27], which demonstrated that coagulase-negative *Staphylococcus* may have genes responsible for production of toxins involved in food poisoning outbreaks.

In relation to gender, *Serratia* spp. (5.88% of isolates) does not present the risk for transmission of food-borne disease, but it has clinical importance, since in the hospital it is an opportunistic pathogen, causing septicaemia and urinary tract diseases[19]. This genus occurs in water, soil, plants, insects and animals[28].

The genus *Flavimonas* was also isolated from the analysed samples from these cockroaches (2.94%). These microorganisms are pathogens that can infect immuno-depressed patients, especially those who undergo surgery or have indwelling venous catheters.

Other clinically important microorganisms found were bacteria from the genus *Providencia* (2.94%), which can be isolated from diarrhoea in humans, as well as from wounds, burns and bacteraemia[19]. *Providencia* frequently cause urinary tract infections and contribute to stone formation in the kidney; they are also related to skin lesions and diarrhoea in children[29].

Alcaligenes spp., which occurred in 2.94% of the samples, can be culled from the cockroaches, as well as from contact with contaminated soil and water, since these microorganisms are normally found in these environments. *Alcaligenes* is associated with both local and systemic infections, such as meningitis, pneumonia, urinary tract infections and osteomyelitis[29].

Acinetobacter spp., which occurred in 2.94% of the analysis performed, persist in hospital environments for long periods due the expression of virulence factors. *Acinetobacter* spp. are important causative agents of infections in ICU patients and are usually associated with lower respiratory tract infections[30].

The presence of other bacteria from the family Enterobacteriaceae (*Morganella* spp. and *Providencia* spp., which made up 2.94% of samples) also presents risks to public health, since these are important human pathogens that cause a variety of diseases including nosocomial infections, urinary tract infections, septicaemia and wound infections[31].

According to Rafael[32] problems with synanthropic animals can be combated by cleaning the insides and outsides of homes or businesses disposing of scraps of food and rubbish, And avoiding moist, dark, unventilated environments with many cracks where cockroaches can hide. Thus, cockroaches can have the ability to transmit diseases to humans and food spoilage-causing bacteria to food; they carry various microorganisms

of concern to the medical and food industries.

Microorganisms that belong to the family Enterobacteriaceae have been isolated from cockroaches can cause various infections. Although we did not find our microorganisms of interest in this study, it appears that these insects can be vectors of opportunistic bacteria and potential pathogens.

In this sense, the need to educate the general public about the control of these insects in residences, as well as in other places such as hospitals, schools and food services, becomes apparent.

ACKNOWLEDGMENTS

The authors thank the people who collaborated in this research by allowing the traps to be installed in their homes. We also thank the University of West of Santa Catarina (UNOESC) for providing scientific initiation scholarships to the 3rd and 4th authors via Article 170 (PIBIC/ UNOESC).

REFERENCES

1. Soares. C.C.A.E. *Biologia de Supella longipalpa (Fabricius,* (1978) *(Dictyoptera: Blatellidae) e Potencial de Contaminação por fungos e bactérias em três Bairros da na Cidade de Manaus* – AM. Brasil. p. 58, 2005.
2. Oliveira C. J. *Entomologia Forense. Quando os insetos São Vestígios*. Editora Millenium. 2 edição. Campinas-SP. p. 420, 2007.
3. Parreira, R. S.; Ferreira, M. da C.; Martinelli, N. M.; Silva, I. C. da; Fernandes, A. P.; Romani, G. da N. Mortalidade de *Blattella germanica* (L., 1767) (Blattodea: Blattellidae) sob diferentes áreas e períodos de exposição a diferentes inseticidas. *Biosci. J.*, Uberlândia, 2010; **26**(1): 40–51.
4. Buzzi, J. Z. *Entomologia Didática*. Editora UFPR. 4°edição. Curitiba. p. 343, 2008.
5. SVS- Secretaria de Vigilancia Sanitaria. Doenças transmitidas por alimentos. (2009) Disponivel em: http://portal.saude.gov.br/portal/saude/profissional/visualizar_texto.cfm?idtxt=31756 Acesso em 12 de Jan. 2011.
6. Albuquerque, W. F.; Macrae, A.; Sousa, O. V.; Vieira, G.H.F.; Vieira, R.H.S.F. Multiple drug resistant *Staphylococcus aureus* strains isolated from a fish market and from fish handlers. *Brazilian Journal of Microbiology*. Rio de Janeiro, 2007; **38:** 131–34.
7. Siqueira, A. A., Cardoso, W. M., Silva, E. E., Romão, J. M., Nogueira, G. C., Andrade, J. D. M., Castro, S. B., Teixeira, R. S. C. *Identificação de enterobactérias em ovos de codornizes japonesas (Coturnix japonica) na Região Metropolitana de Fortaleza – Ce, Brasil*. Faculdade de Veterinária da Universidade Estadual do Ceará – FAVET/UECE, 2008.
8. Baú, D., Siqueira, M. R., Mooz, E. D. *Salmonella – agente epidemiológico causador de infecções alimentares: uma revisão*. Tecnologia de Alimentos para Agroindústrias, UNIOESTE/ Francisco Beltrão, 2009.
9. Germano, P. M. L., Germano, M. I. S. *Higiene e vigilância sanitária de alimentos: qualidade das matérias-primas, doenças transmitidas por alimentos,treinamento de recursos humanos.* Barueri, SP: Manole, 2008; pp. 229–230.
10. Brasil – Departamento de Vigilância Sanitaria do Rio Grande do Sul, 2005.
11. Guerra, M.M., Bernardo, F. A. Multiplicação e sobrevivência de *Listeria monocytogenes* sob condições ecológicas desfavoráveis: Parte I: Temperatura, acidez e AW. *Revista Higiene Alimentar*. São Paulo, 2006; **20**(139): 65–73.
12. Santos, L. A. G. ; Pinto, P. S. A. ; Bevilacqua, P. D. ; Monteiro, L. L.; Teodoro, V. A. M. ; Guimaraes, K. R. Listeriose transmissível por produtos de origem animal. *Revista Higiene Alimentar.* São Paulo, 2004; **18**(124): 35-42.
13. Brasil, Instrução Normativa n°. 62 de 26/08/ 2003. Oficializa os métodos analíticos oficiais para análises microbiológicas para controle de produtos de origem animal e água. Brasília, DF. Diário Oficial da União, 2003.
14. Macfaddin, Jean F. *Biochemical tests for identification of medical bacteria*. 3rd ed. 2000.
15. Lopes, M.I.L., Miranda, P.J., Sarinho, E. Diagnóstico de alergia a baratas no ambiente clínico: estudo comparativo entre o teste cutâneo e IgE específica. *Jornal de Pediatria*. v.82, 2006.
16. Epagri. Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina. 2010.
17. Dutra, C. C., Rieder, A., Galbiati, C., Santos, M. F. Baratas (Insecta: Blattodea) domésticas em Cáceres, Mato Grosso (Mt), Brasil. *Revista de Ciências Agro-Ambientais.* Alta Floresta, 2007; **5**(1) : 17–25.
18. Cloarec, A., Rivault, C., Fontaine, F., Le Guyader, A. *Cockroaches as carriers of bacteria in multi-family dwellings*. Laboratoire d' Entelogie, URA CNRS 375, Université de Rennes I, Campus de Beaulieu, França, 1992.
19. Felipe, L. M. Associação de bactérias da família *Enterobacteriaceae* e *Clostridium estertheticum*

com a deterioração “blown pack” em cortes cárneos embalados a vácuo. Faculdade de Ciências Agrárias e Veterinária. Jaboticabal, 2008.

20. Chaichanawongsaroj, N., Vanichayatanarak, K., Pipatkullachat, T., Polrojpanya, M., Somkiatcharoen, S. Isolation of gram-negative bacteria from Cockroaches trapped from urban environment. *J Trop Med Public Health*, 2004; **35**(3).
21. Prado, A. M. Enterobactérias isolada de baratas (Peripalneta americana) capturadas em um hospital brasileiro. *Rev. Panam Salud Publica*. 2002; **11**(2).
22. Gurtler, J. B., Kornacki, J. L., Beuchat, L. R. Review *Enterobacter sakazakii*: A coliform of increased concern to infant health. *International Journal of Food Microbiology*, 2005; 104:1–34.
23. Cantón, R., Sánchez-Moreno, M. P., Reilly, M. I. M. *Proteus penneri*. Enfermedades Infecciosas y Microbiología Clínica, 24, Supplement 1, p. 8–13, 2006.
24. Madigan, M. T., Martinko, J. M., Parker, J. *Microbiologia de Brock*. Editora. Prentice hall. 10º ed. São Paulo, 2004.
25. Zell, C., Resch, M., Rosenstein, R., Albrecht, T., Hertel, C., Götz, F. Characterization of toxin production of coagulase-negative staphylococci isolated from food and starter cultures. *International Journal of Food Microbiology*, 2008; **127**: 246 - 51.
26. Irlinger, F. Safety assessment of dairy microorganisms: Coagulase-negative *Staphylococci. International Journal of Food Microbiology*, 2008; **126**: 302–10.
27. Rosec J.P., Guiraud, J.P., Dalet, C., Richard, N. Enterotoxin production by staphylococci isolated from foods in France. *International Journal of Food Microbiology*, 1997; **35**: 213-21.
28. Khanafari, A., Assadi M. M., Fakhr, F. A. Review of Prodigiosin, Pigmentation in *Serratia marcescens*. British Columbia Canada. *Online Journal of Biological Sciences*, 2006; **6**(1): 1-13.
29. Munslinger, I. Pesquisa de Agentes Ambientais no Córrego Brasília. Faculdade Dinâmica de Cataratas – UDC, Foz do Iguaçu – PR, 2009.
30. Carneiro, M., Saridakis, H. O. Pneumonia associada à ventilação mecânica por *Acinetobacter baumannii* resistente a carbapenem. Universidade de Santa Cruz do Sul Curso de Medicina, Hospital Santa Cruz – Santa Cruz do Sul/RS. *Rev Panam Infectol*, 2008; **10**(2):28–33.
31. Janda, J. M.; Abbott, S. L.; Khashe, S.; Robin, T. Biochemical Investigations of Biogroups and Subspecies of *Morganella morgani.* Microbial Diseases Laboratory, Division of Communicable Disease Control, California Department of Health Services, Berkeley, California. *Journal of Clinical Microbiology*., 1996; **34**(1): 108 -13.
32. Rafael; J. A.; Silva, N. M. da; Dias, R. M. N. S. Baratas (Insecta, Blattaria) sinantrópicas na cidade de Manaus. Amazonas, Brasil. *Acta Amaz.*, 2008; **38**(1):173- 8.