



Medical Entomology Lecture 3
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College of Education
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the orders with medical importance

TABLE I

**Principle Orders of Insects and Arachnids of
Medical-Veterinary Interest**

| Order | Common names |
|------------------------|---|
| Class Insecta | |
| Order Blattaria | Cockroaches |
| Order Phthiraptera | Lice |
| Order Hemiptera | True bugs: bedbugs, kissing bugs, assassin bugs |
| Order Coleoptera | Beetles |
| Order Siphonaptera | Fleas |
| Order Diptera | Flies: mosquitoes, black flies, no-see-ums, horse flies, deer flies, sand flies, tsetse flies, house flies, stable flies, horn flies, bot flies, blow flies, flesh flies, louse flies, keds, etc. |
| Order Lepidoptera | Moths and butterflies |
| Order Hymenoptera | Wasps, hornets, velvet ants, ants, bees |
| Class Arachnida | |
| Order Scorpionida | Scorpions |
| Order Solpugida | Solpugids, sun spiders, camel spiders, barrel spiders |
| Order Acari | Mites, ticks |
| Order Araneae | Spiders |



Order Blattodea_(new name)

- Order :Blattaria_(old name)

- **Cockroaches** among the oldest and most primitive insects. They evolved about 350 million years ago during the Silurian Period,
- Cockroaches are recognized as the order Blattaria(Blattodea). Although the majority of species are feral and not directly associated with people, a few species have evolved in proximity to human habitations, where they have adapted to indoor environments.
- Their **omnivorous feeding** behaviour, facilitated by their unspecialized chewing mouthparts, has contributed to a close physical relationship between cockroach populations and humans, with resultant **كناج** chronic exposure of humans to these pests.
- The presence of some species in the home (e.g., German , american and brown banded cockroaches) often is an indicator of poor sanitation or substandard housekeeping

Taxonomy

- There are about 4000 species of cockroaches worldwide within five cockroach families, three of which include most of the pest species: families **Blattidae**, **Blattellidae**, and **Blaberidae**.
- Species in the family **Cryptocercidae** are unusual in that they have gut symbionts similar to those found in termites, and they live in groups in decaying logs.
- Members of the family **Polyphagidae** include those dwelling in arid regions, where they are capable of moving rapidly through sand. Species in these two families are rarely pests.

- Cockroaches have retained their basic ancestral form. The Blattaria are distinguished from other insect orders by morphological characters associated with **wing size** and **venation, biting/chewing mouthparts,** and **prominent cerci.** They differ from other Orthopteroid insects by having **hind femora which are not enlarged,** cerci typically with eight or more segments, a body that is dorsoventrally flattened and generally ovoid, and a **head that is largely concealed from above** by a relatively large pronotum.

A common indicator of cockroach infestations is their egg cases, or *oothecae* (singular ootheca), purse-shaped capsules يشبه كيس دراهم that typically contain 5-40 embryos (Fig. 1).

- Coloration ranges from light brown to chestnut brown, depending on the degree of sclerotization. A keel that runs the anterior length of the ootheca permits transport of water and air to the developing embryos. Each embryo is contained in a separate compartment that may or may not be obvious externally. In some species (e.g., German and brown banded cockroaches) lateral, anterior-to posterior indentations denote the individual developing embryos. تشير المسافات المتسنة إلى الأجنة النامية. Others have only weak lateral indentations (e.g., brown and smoky brown cockroaches), and still others have no lateral indentations but differ in their symmetry (e.g., Oriental, American, and Australian cockroaches).

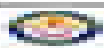


indentations

Fig 1. cockroach ootheca

Cockroaches Life cycle





Life Cycle of a Cockroach

The life cycle of cockroach begins with the egg. After mating, cockroach female produces resilient egg cases known as oothecae.

Under favourable conditions, immature cockroaches known as nymphs will emerge.

1. Ootheca Containing Eggs

2. Hatching

3. Nymph

4. Nymph

5. Nymph

6. Nymph

Adult cockroaches have an average lifespan of around a year but it depends on species.

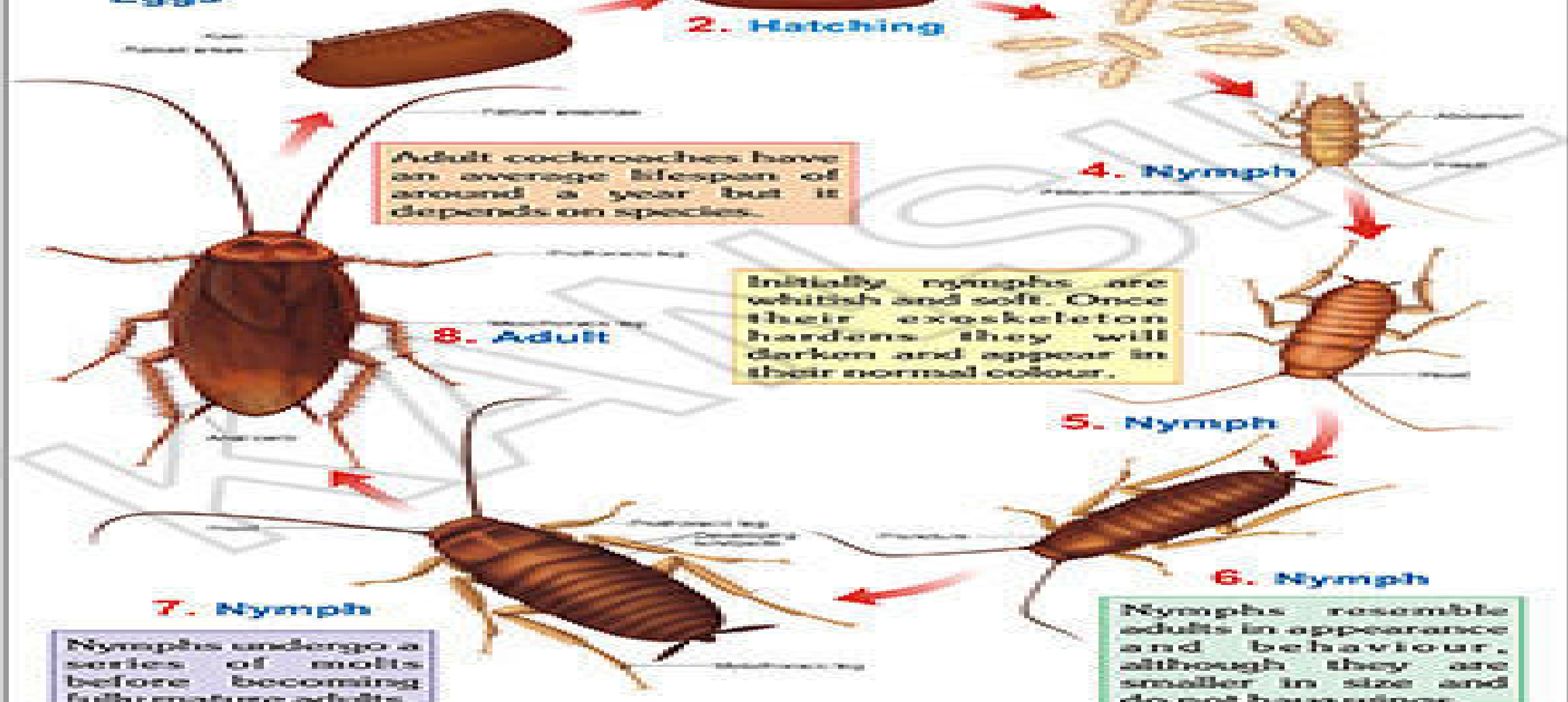
Initially nymphs are whitish and soft. Once their exoskeleton hardens they will darken and appear in their normal colour.

Nymphs resemble adults in appearance and behaviour, although they are smaller in size and do not have wings.

Nymphs undergo a series of molts before becoming fully mature adults.

8. Adult

7. Nymph



AMERICAN

ORIENTAL

SMOKEY BROWN

GERMAN

BROWN BANDED

1.5 INCHES



- **American cockroach (*Periplaneta americana*)**
- The American cockroach is a large species with adults 34-53 mm in length. It is reddish brown, with substantial variation **كبير** in light and dark patterns on the pronotum. Adults are winged and capable of flight.
- Nymphs typically complete development in **13-14 months** while undergoing **13 molts**.
- Adults live an average of **15 months**, but longevity may exceed 2 years. Females drop or glue their oothecae (8 mm long) to substrates within a few hours or days of formation. Each ootheca has 12-16 embryos.
- A female generally produces 6-14 egg cases during her life (mean of 9). The American cockroach is perhaps the most cosmopolitan peridomestic pest species. Together with other closely related *Periplaneta* species, *P. americana* is believed to have spread from tropical Africa to North America and the Caribbean on ships engaged in slave trading. 1620

- The males are longer than the females because their wings extend 4 to 8 mm beyond the tip of the abdomen. Males and females have a pair of slender, jointed **cerci** at the tip of the abdomen. The male cockroaches have cerci with 18 to 19 segments while the females' cerci have 13 to 14 segments. The **male** American cockroaches have a pair of **styli** between the cerci while the females do not.

- The habitats of this species are quite variable. American cockroaches infest landfillsمدافن النفايات, municipal sewage systemsانظمة الصرف الصحي المحلي, storm drainage systemsأنظمة تصريف العواصف, septic tanksخزانات الصرف الصحي, crawl spaces beneath buildingsمساحة أو غرفة داخل سطح المبنى, atticsمساكنات الزحف أسفل المباني, tree holes, voids in wallsالفراغات في الجدران, ships, electronic equipment, caves, and minesمناجم.
- Studies indicated movement by a number of individuals several hundred meters through sewer systems and into neighboring homes.
- This species often can be seen at night on roofs and in air stacks or vents of sewage systems, through which they enter homes and commercial buildings. Entrance also is gained to homes through laundry vent pipesأنابيب تنفيس الغسيل and unscreened or unfiltered attic ventilation systems. This cockroach is known to move from crawl spaces of hospitals via pipe chases into operating theaters, patients' rooms, storage facilities, and food preparation areas. Consequently, the potential of this cockroach for disseminating pathogenic microorganisms نشر الكائنات الحية الدقيقة المسببة للأمراض can be a significant concern for health care personnel.

Medical importance of Cockroaches

- **pathogenic agents**
- Cockroaches are the potential source of bacteria pathogens with multidrug resistant strains and hence effective preventive and control measures are required to minimize cockroach related infections. They are capable of transmitting microorganisms (table II) and other disease agents indirectly by contaminating foods or food preparation surfaces.

| Isolated Bacteria from Cockroaches | Alimentary Tract No. (%) | External Surface No. (%) | Total No. (%) |
|---|---------------------------------|---------------------------------|----------------------|
| <i>Enterobacter aerogenes</i> | 3(3.26) | 2(2.30) | 5(2.79) |
| <i>Enterobacter cloacae</i> | 3(3.26) | 3(3.45) | 6(3.35) |
| <i>Enterobacter agglomerans</i> | 9(9.78) | 9(10.35) | 18(10.10) |
| total | 15(16.30) | 14(16.10) | 29(16.20) |
| <i>Klebsiella pneumonia</i> | 12(13.04) | 13(14.94) | 25(14.00) |
| <i>Klebsiella oxytoca</i> | 2 (2.17) | 1(1.15) | 3(1.70) |
| total | 14(16.30) | 14(16.10) | 28(15.64) |
| <i>Citrobacter freund</i> | 9(9.78) | 7(8.05) | 16(8.94) |
| <i>Escherichia coli</i> | 13(14.13) | 11(12.64) | 24(13.41) |
| <i>Salmonella para A</i> | 3(3.26) | 2(2.30) | 5(2.79) |
| <i>Serratia marcescens</i> | 4(4.35) | 4(4.60) | 8(4.50) |
| <i>Proteus mirabilis</i> | 5(5.43) | 6(7.00) | 11(6.2) |
| <i>Proteus vulgaris</i> | 2(2.17) | 1(1.15) | 3(1.70) |
| total | 7(7.61) | 7(8.10) | 14(7.82) |
| coagulase Negative Staphylococci | 11 (11.96) | 9(10.35) | 20(11.17) |
| <i>Staphylococcus aureus</i> | 3 (3.26) | 4(4.60) | 7(3.91) |
| <i>Bacillus cereus</i> | 9(9.78) | 10(11.50) | 19(10.61) |
| <i>Bacillus subtilis</i> | 3(3.26) | 4(4.60) | 7(3.91) |
| total | 12(13.04) | 14(16.10) | 26(14.53) |
| Total | 92(52.57) | 87(47.43) | 179(100) |

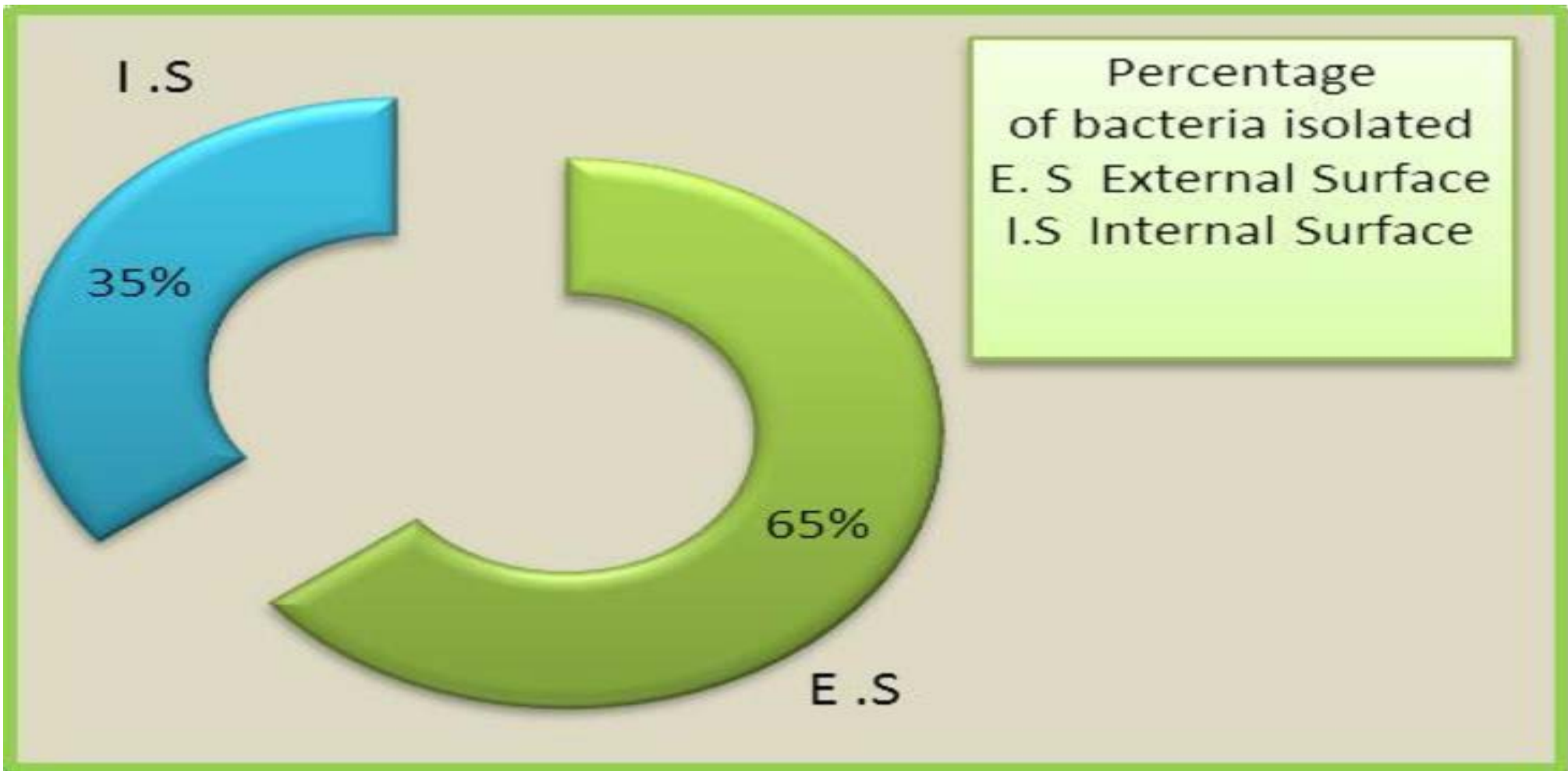


TABLE II

Bacteria Pathogenic to Humans That Have Been Isolated from Field-Collected Cockroaches

| Pathogen | Associated disease | Cockroach species |
|--------------------------------|---|--|
| <i>Alcaligenes faecalis</i> | Gastroenteritis, secondary infections, urinary tract infections | <i>Blatta orientalis</i> <i>Periplaneta americana</i> |
| <i>Bacillus subtilis</i> | Conjunctivitis, food poisoning | <i>Blaberus craniifer</i> , <i>Blatta orientalis</i> , <i>P. americana</i> |
| <i>B. cereus</i> | Food poisoning | <i>Blaberus craniifer</i> |
| <i>Campylobacter jejuni</i> | Enteritis | <i>Blatta orientalis</i> , <i>P. americana</i> |
| <i>Clostridium perfringens</i> | Gas gangrene, food poisoning | Cockroaches |
| <i>C. novii</i> | Gas gangrene | <i>B. orientalis</i> |
| <i>C. perfringens</i> | Food poisoning gas gangrene | <i>B. orientalis</i> |
| <i>Enterobacter aerogenes</i> | Bacteremia | <i>Blattella germanica</i> , |

| | | |
|-------------------------------|--|---|
| <i>Escherichia coli</i> | Diarrhea, wound infection | <i>Blatta orientalis</i> , <i>Blattella germanica</i> , <i>P. americana</i> |
| <i>Klebsiella pneumoniae</i> | Pneumonia, urinary tract infections | Cockroaches |
| <i>Mycobacterium leprae</i> | Leprosy | <i>B. germanica</i> , <i>P. americana</i> , <i>P. australasiae</i> |
| <i>Nocardia spp.</i> | Actinomycetoma | <i>P. americana</i> |
| <i>Proteus morgani</i> | Wound infection | <i>P. americana</i> |
| <i>P. rettgeri</i> | Wound infection | <i>P. americana</i> |
| <i>P. vulgaris</i> | Wound infection | <i>Blaberus craniifer</i> , <i>Blatta orientalis</i> , <i>P. americana</i> |
| <i>P. mirabilis</i> | gastroenteritis, wound infection | <i>P. americana</i> |
| <i>Pseudomonas aeruginosa</i> | Respiratory infections, gastroenteritis | <i>Blaberus craniifer</i> , <i>Blatta orientalis</i> , <i>Blattella germanica</i> , |

| | | |
|-------------------------------|--|---|
| <i>Salmonella bredeny</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. newport</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. oranienburg</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. panama</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. paratyphi-B</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. pyogenes</i> | Pneumonia | <i>Blatta orientalis</i> |
| <i>S. typhi</i> | Typhoid | <i>B. orientalis</i> |
| <i>S. typhimurium</i> | Food poisoning, gastroenteritis | <i>Blattella germanica,</i> <i>Nauphoeta cinerea</i> |
| <i>S. bovis-morbificans</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>S. bareilly</i> | Food poisoning, gastroenteritis | <i>P. americana</i> |
| <i>Serratia marcescens</i> | Food poisoning | <i>Blatta orientalis,</i> <i>Blattella germanica,</i> <i>P. americana</i> |
| <i>Shigella dysenteriae</i> | Dysentery | <i>B. germanica</i> |
| <i>Staphylococcus aureus</i> | Wound infection, skin infection, infection of internal organs | <i>Blaberus craniifer,</i> <i>Blatta orientalis,</i> <i>Blattella germanica</i> |
| <i>Streptococcus faecalis</i> | Pneumonia | <i>Blatta orientalis,</i> <i>Blattella germanica,</i> <i>P. americana</i> |
| <i>Vibrio spp.</i> | Not applicable | <i>Blatta orientalis</i> |
| <i>Yersinia pestis</i> | Plague | <i>B. orientalis</i> |



- **Intermediate hosts**

- Cockroaches can serve as intermediate hosts for animal parasites (Table III).
- The eggs of seven species of *helminths* have been found naturally associated with cockroaches.
- These include hookworms (*Ancylostoma duodenale* and *Necator americanus*), giant human roundworm (*Ascaris lumbricoides*), other *Ascaris* species, pinworm (*Enterobius vermicularis*), tapeworms (*Hymenolepis* species), and the whipworm *Trichuris trichuria*.
- *Development of these* helminths in cockroaches has not been observed. These relationships probably represent incidental associations with the omnivorous feeding behavior of cockroaches.

TABLE III

Cockroaches as Intermediate Hosts of Parasites of Veterinary Importance

| Phylum and parasite | Scientific name | Definitive host | Cockroach intermediate host |
|---|----------------------------------|-----------------------------------|---------------------------------|
| Acanthocephala (thorny-headed worms) | <i>Moniliformis moniliformis</i> | Rat, mice, dog, cat (primates) | Oriental, German |
| | <i>M. dubius</i> | Rat | American, Smokybrown, German |
| | <i>Prosthenorchis elegans</i> | Captive primates | German, Madiera, others |
| | <i>P. spirula</i> | | |
| Pentastomida (tongue worms) | <i>Railiictiella hemidactyli</i> | Reptiles | American |

| | | | |
|---|---------------------------------|---|---------------------------------|
| Nematoda (round worms) | | | |
| Esophageal and gastrointestinal worm | <i>Abbreviata caucasica</i> | Primates (humans) | German |
| Stomach worm | <i>Cyrnea colini</i> | Prairie chicken, turkey, bobwhite, quail | German, American |
| Esophagus worm | <i>Gongylonema neoplasticum</i> | Rodents, rabbit | Oriental, American |
| Gullet worm | <i>G. pulchrum</i> | Cattle (humans) | German |
| Stomach worm | <i>Mastophorus muris</i> | Rodents, cat | American, Madiera |
| Eye worm | <i>Oxyspirura mansoni</i> | Chicken, turkey | Surinam |
| Eye worm | <i>O. parvorum</i> | Chicken, turkey | Surinam |
| Esophageal worm | <i>Physaloptera rara</i> | Dog, cat, raccoon, coyote, wolf, fox | German |
| Esophageal worm | <i>P. praeputialis</i> | Dog, cat, coyote, fox | German |
| Roundworms | <i>Protospirura bonnei</i> | Monkeys | German, brownbanded |
| | <i>P. muricola</i> | | |
| Stomach worm | <i>Spirura rytipleurites</i> | Cat, rat | Oriental |
| Stomach worm | <i>Tetrameres americana</i> | Chicken, bobwhite, ruffed grouse | German |
| Stomach worm | <i>T. fissipina</i> | Ducks, geese waterfowl (also chicken, turkey, pigeon, quail) | Unspecified multiple species |



- **Cockroach allergies**

- Allergic reactions result after initial sensitization to antigens following inhalation, ingestion, dermal abrasion, or injection. Allergens produced by cockroaches are rapidly being recognized as one of the more significant indoor allergens of modernized societies.



- Several proteins that can cause human allergies have been identified in the German cockroach. Different exposure histories are likely to result in allergies to different proteins. Cast skins, excrement, and partially consumed food of cockroaches, in addition to living cockroaches, all produce allergenic proteins. Some are extremely persistent and can survive boiling water, ultraviolet light, and harsh pH changes, remaining allergenically potent for decades. Traditionally, whole-body extracts have been used to screen for allergens in skin tests and in bronchial challenges for diagnosing cockroach allergies

- **Veterinary importance**

- Cockroaches serve as intermediate hosts for a number of parasitic worms of animals (Table III). Most of these relationships are of no economic importance. The majority of the parasites are *nematodes in the order Spirurida*, all members of which use arthropods as intermediate hosts. Species infesting dogs and cats, among other hosts, attach to the mucosa of the gastrointestinal tract, where erosion of tissue may occur at the points of attachment.

you should not forget cockroaches benefits to environments and humans

- Cockroaches are **professional recyclers, chowing down just about anything, including dead plants and animals, and animal waste.**

- **Cockroaches Are Decomposers**

- **Cockroaches Help Make Soil Fertile**

- **Cockroaches Are Food For Other Animals**



7 benefits of cockroaches to humans:

1. Recycling Nature
2. Food Source to Predators
3. Natural Germ Killers
4. Robotic Functions
5. Cure for Health Problems
6. Source of Food for Humans
7. Source of Income

- **Natural Germ Killers**

- A typical cockroach breeds and survives in an unkempt and filthy environment. However, there is hardly a chance that it gets sick. But can a cockroach get sick from the condition of its nasty habitat?
- Not much researches have been conducted, but a few claims have it that a cockroach can get sick, probably when there is an overload in its bacterial content.
- Scientists discovered cockroaches to possess a unique source of antibiotics. There are researches underway to uncover the possible applications of cockroach antibiotics to humans.
- A cockroach, regardless of its pathogenic nature, is believed to be capable of fighting staph infections, including Methicillin-Resistant Staphylococcus Aureus (MRSA) that resists conventional antibiotics.



Cure for Health Problems

- The nonloving cockroaches you find in your home aimlessly serve as a cure to burns. BBC reports that hospitals in China, for instance, use creams from powdered cockroaches to treat burns. Sometimes, roach syrup is administered to patients to relieve the symptoms of gastroenteritis.
- Admittedly **باعتراف الجميع**, dried cockroaches are a commodity **سلعته** in China already. As a result, entrepreneurs **ارواد الاعمال** such as Wang Fuming own cockroach farms in underground bunkers for providing dried cockroaches strictly.

Source of Food for Humans



وجبات الصراصير الشهية





Who's Hungry For Some Cockroach Cake?



What is cockroach milk?

Cockroach milk is a protein rich, crystallized substance produced by a specific type of cockroach called *Diploptera punctata* (1).

This species is unique because it gives birth to live offspring. Members make “milk” in the form of protein crystals to serve as food for their developing young (1).

In recent years, scientists have discovered that this milk-like crystalline substance is nutritious and considered a complete food, as it’s a good source of protein, carbs, and fats.

Additionally, cockroach milk is considered a complete protein source, as it provides all nine essential amino acids — the building blocks of protein that can only be attained through your diet (2).

This fact is important because most non-meat foods lack one or more of the nine essential amino acids, which is why cockroach milk has gained buzz as a nondairy milk alternative (2).

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• **Prevention and Control**

- Traditionally, cockroaches have been controlled using a variety of toxic chemicals applied as residual pesticides to harbourage sites or areas frequented by foraging individuals. *Most* materials are neurotoxins that disrupt the nervous system, causing locomotory and respiratory failure. These include organophosphates, carbamates, botanicals such as pyrethrins, and pyrethroids.
- Several other materials with different modes of action also are currently in use. When ingested, boric acid (delivered as a fine powder or a dilute solution) damages the gut epithelium of cockroaches and kills them by interfering with nutrient absorption. Inorganic silica dust is absorptive, reducing cuticular lipids and causing desiccation. Active ingredients with other modes of action, such as hydramethylnon and sulfluramid, are metabolic inhibitors which disrupt the conversion of food to energy.

- **Insect growth regulators** (IGRs) can be used to prevent cockroaches from reaching maturity. Two commonly used IGRs are juvenile hormone analogs and chitin synthesis inhibitors. Juvenile hormone analogs regulate morphological maturation and reproductive processes.
- **Integrated pest management**, which incorporates various control techniques, has contributed significantly to successful control of cockroaches. This approach uses nontoxic agents, such as sticky traps, vacuum devices, diatomaceous earth, or silica-gel repellents and desiccants, and manipulation of harbourage sites to reduce or prevent infestations.

• Principles of Effective Cockroach Control

- The key to effectively eliminating cockroaches is to follow an Integrated Pest Management (IPM) approach. It includes the following steps:
- An inspection to find where and how serious the infestation is;
- Identification of contributing factors (such as sanitation problems), and taking corrective measures;
- Use of various tools to kill cockroaches and continued monitoring and treatment as needed.
- All of these procedures are essential to maintain a cockroach-free living environment.



- **Biological control** of cockroaches has drawn increased attention in recent years. Among the natural agents that have been investigated are parasitic wasps, nematodes, and sporulating fungi.
- Females of the eulophid wasp *Aprostocetus hagenowii* and the evaniid wasp *Comperia merceti* deposit their eggs in the oothecae of certain peridomestic cockroaches. Major shortcomings in utilizing these wasps are difficulties involved in their mass production and the fact that they do not completely eliminate cockroach infestations.
- The use of parasitic nematodes (e.g., *Steinernema carpocapsae*) and several fungal pathogens that have been isolated from cockroaches has not yet proved to be effective as a practical management tool. Another drawback to their use is the allergenic nature of several components of nematodes and many sporulating fungi that can become airborne and, upon inhalation, cause asthmatic responses in humans.