

## ARTIGOS

### A KEY FOR IDENTIFYING FAECAL SMEARS TO DETECT DOMESTIC INFESTATIONS OF TRIATOMINE BUGS

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*Early detection of residual populations of domestic triatomine bugs that survive insecticide treatment is a key component of successful evaluation and vigilance for Chagas disease control. We have recently demonstrated that sheets of paper, tacked on to the walls of infested houses, can become streaked with the faeces of triatomine bugs and thus reveal the presence of an infestation. In this paper, we present a simple key to differentiate the faecal streaks of triatomine bugs from those of other domestic arthropods such as cockroaches, ticks and cimicid bedbugs.*

Key words: Chagas' disease. Vector control. Triatominae.

Detection of low-density infestations of triatomine bugs in houses is important for the evaluation of insecticidal control attempts. After insecticide application, any remaining bug population will probably be too small to be detected by timed manual sampling. But the small residual population could still represent a risk for Chagas disease transmission and, if left untreated, could reproduce and return to its original numbers<sup>9 10</sup>. Early detection of residual bug populations that survive insecticide treatment is therefore a key component of successful evaluation and vigilance for Chagas disease vector control.

One approach used to detect low-density populations of domestic triatomine bugs uses the Gómez-Núñez box, which acts as an artificial refuge for the bugs<sup>4 6 8</sup>. On examination, the box may be found to contain live bugs, exuviae, eggs or eggshells, but the most frequent evidence of an existing infestation is to encounter streaks of bug faeces on the papers inside the box. Gómez-Núñez boxes have proved to be a sensitive research tool, but they are too expensive and time-consuming for wide use in large-scale control campaigns.

A simpler and cheaper method is to tack sheets of paper on the walls of houses and subsequently examine the paper for streaks of bug faeces. This method has recently been tested in Brazilian houses

and appears to be almost as sensitive as the Gómez-Núñez boxes in detecting low-density bug populations<sup>3</sup>. Faecal streaks from triatomine bugs may also be found on the walls and other artifacts within a house, and can provide evidence that the house has been infested at some time. However, it is important that such faecal streaks be correctly identified<sup>7</sup> and, unless the streaks are found on a recent artifact, such as a calendar or specially placed and dated paper, they do not necessarily indicate that the house is still infested<sup>3</sup>.

In most cases, the dejecta left by triatomine bugs on non-absorbant paper have a very distinctive appearance. Bug faeces are very moist when first eliminated and are streaked on the paper to give a "dripping candle-wax" effect. Like most blood-sucking insects, the faeces of triatomine bugs are dark brown or black due to undigested haem from the previous blood-meal, and some of the faecal streaks are creamy white due to suspended spheres of uric acid which is the bug's nitrogenous waste product. Other domestic arthropods, especially cimicid bedbugs and cockroaches, may also deposit their faeces on the test papers, while flies such as *Musca domestica* also deposit droplets of regurgitated material wherever they have rested and sampled the substrate with their labellae. To distinguish between these traces, we have developed a simple key to differentiate between the dejecta of domestic arthropod species that may be present in Latin American houses.

#### MATERIALS and METHODS

All arthropods used in preparing faecal smears on the test papers were from stock colonies maintained

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routinely at the London School of Hygiene and Tropical Medicine, in London. The following species were used:

**Triatominae:**

*Triatoma infestans* (adults, first and fifth instar nymphs)

*Rhodnius prolixus* (adults, first and fifth instar nymphs)

**Cimicidae:**

*Cimex lectularius* (mixed adults and nymphs)

**Cockroaches:**

*Blatella germanica* (mixed adults and nymphs)

*Periplaneta americana* (mixed adults and nymphs)

**Ticks:**

*Argas persicus* (adults only)

**Flies:**

*Musca domestica* (adults)

The arthropods were confined in vertical glass tubes measuring 200 x 35 mm, lined with white non-absorbant typing paper. All species were fed to repletion and then left in the tubes for three weeks, or until all had died. The triatomine bugs, bedbugs and ticks were fed on the ears of rabbits; flies and cockroaches were fed on milk, agar and rat-food pellets.

**RESULTS**

Examples of the appearance of the dejecta are shown to scale in Figure 1. Dejecta on all our test papers were compared to produce the following dichotomous key. The key uses characters of the shape, distribution and colour to distinguish dejecta from different arthropods. To help in distinguishing the colours of faecal streaks, we recommend that our experimental procedure be followed to produce authentic reference samples of dejecta to assist in the use of the key.

**Key to the appearance of traces of domestic arthropods on vertically-placed non-absorbant paper.**

1. Traces mainly of vertical streaks, more than 2mm long ..... 2

Traces predominantly as discrete spots or blotches, up to 7mm diameter. Streaks, if present, are mostly less than 2mm long ..... 3

2. Streaks narrow (less than 3mm wide) or broad (4-7mm wide); some streaks black or very dark brown, others cream or white **TRIATOMINAE**

Streaks narrow (less than 3mm wide) and varying shades of brown, never black, cream or white.

**COCKROACH**

3. Black spots present ..... 4

Black spots absent ..... 5

4. Spots black or very dark brown. White or cream spots absent. Spots often in the form of dotted or dashed lines, not necessarily vertical, where the arthropod has walked along while defaecating. Vertical streaks absent. **Argas**

Spots black or very dark brown. White or cream spots may be present. Spots do not form dotted or dashed lines. Streaks, if present, are all vertical or close to vertical ..... 6

5. Spots mostly pale brown, yellowish or pale green when fresh; no black or very dark brown spots. Short streaks, if present, are in random directions, not all vertical. **Musca**

Spots of varying shades of brown, but not black. Streaks, if present, are more or less vertical and less than 3mm wide. Spots may be smudged to appear as single dashes rather than dots. **COCKROACH**

6. Most spots black or very dark brown, circular, rarely more than 1mm in diameter, often clustered in groups of black dots with some cream or white spots. Streaks, if present, are vertical or close to vertical, never longer than the width of the spot. **Cimex**

Most spots black or very dark brown, otherwise cream or white. Often streaked, rarely punctate. Spots range from 1-7mm diameter; streaks normally longer than the width of the spot. **TRIATOMINAE**

**DISCUSSION**

The fluidity and volume of faecal discharge from triatomine bugs appears to be reliable for distinguishing their traces from other types of blood-sucking arthropods. Faeces from small, first or second stage nymphs of Triatominae may superficially resemble those of cimicid bedbugs, both in colour and size, but whereas the faeces of bugs are almost invariably streaked to some extent, this is very rare for the faeces of cimicids. In both Triatominae and Cimicidae, the faeces are very dark brown to black, due to haem from the previous blood meal, but discrete traces of creamy-white uric acid are also present. This characteristic readily distinguishes both types of bug faeces from those of domestic cockroach species. The faeces of cockroaches are generally brown in colour, rather than black, although the actual shade of brown coloration would depend to a large extent on the previous diet of these scavenging insects. Also, most species of cockroach void very little uric acid in their excreta, and that small quantity which is excreted is mixed with other faecal material rather than voided discretely<sup>1</sup>; instead, cockroaches appear to store most of their urates in the fat body to form a mobile reserve of nitrogen<sup>2</sup>.

Generally, the faeces and vomitus of muscid flies form inconspicuous traces. In our studies, large

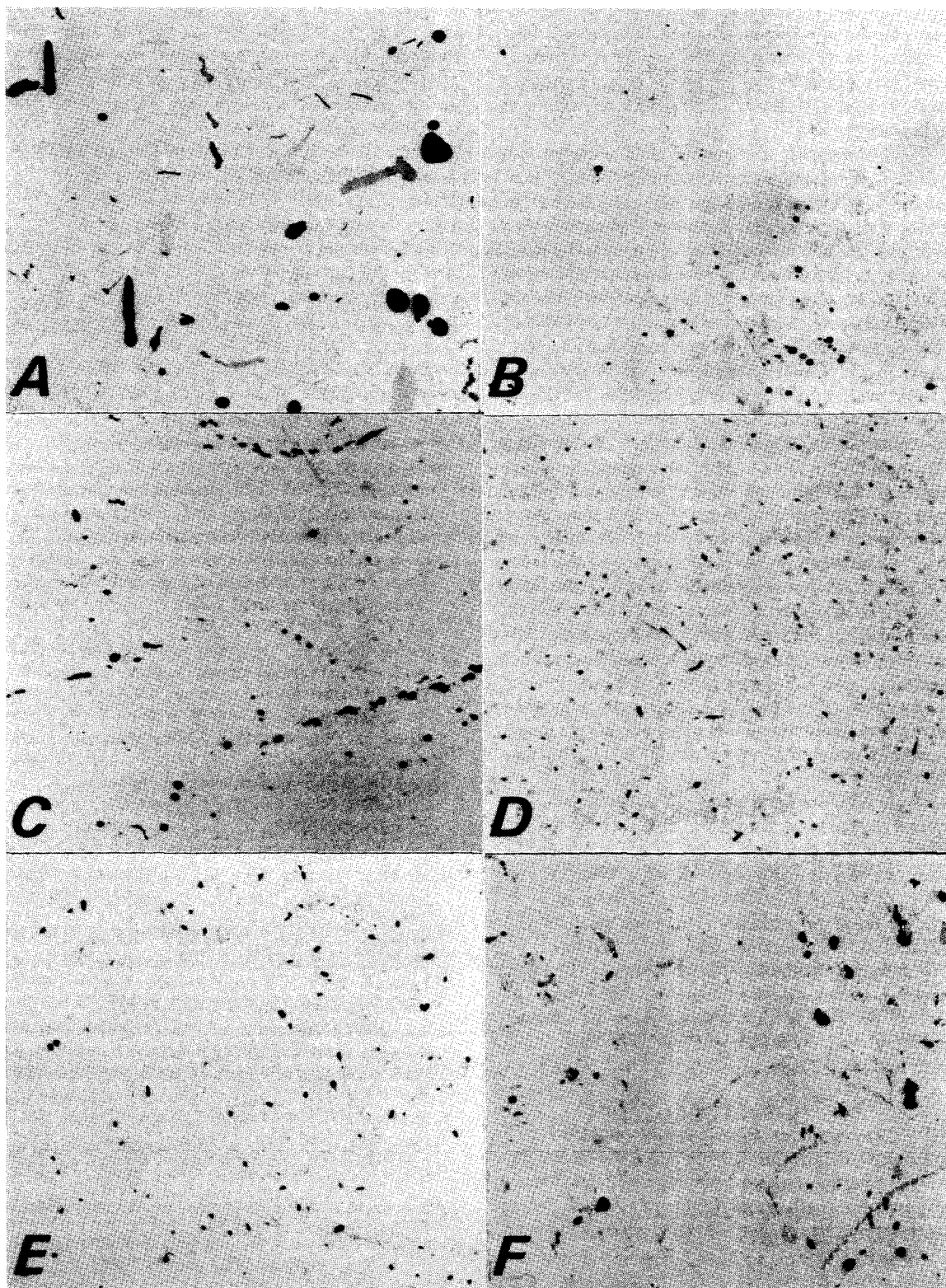


Figure 1—Life size photographs of faecal smears and dejecta. A, *Triatoma infestans*; B, *Cimex leuctularius*; C, *Argas persicus*; D, *Musca domestica*; E, *Blattella germanica*; F, *Periplaneta americana*.

concentrations of these traces were elicited by confining the flies in a very small space. In any event, their traces are easily distinguishable from those of haematophagous insects by their uniformly pale colouration, lack of obvious streaking, and the randomly smudged appearance.

Cockroaches, flies and cimicid bedbugs, are frequently encountered in houses infested with triatomine bugs. Argasid ticks are less commonly associated with Triatominae, except in dry areas where chickens and ducks are maintained as domestic animals, as for example in houses in the arid north of Chile<sup>5</sup>. Like cockroaches, ticks void few urates in their excreta, which tend to appear uniformly black or very dark brown due to haemic residues from their blood meals. Small quantities of tick faeces may appear similar to those of Triatominae, but larger quantities can be readily distinguished by the absence of creamy-white dejecta, and the characteristic "dotted lines" of faeces (rather than vertical streaks) caused by faecal contamination of the legs and ventral part of the tick which smudges the faeces along the paper as the tick walks about.

Other creatures which could deposit their faeces on papers in houses include lizards (especially geckos), bats, and birds. These should all be clearly distinguishable from the dejecta of arthropods by their relatively large size, and by the white streaks of uric acid mixed within the faecal mass. In our experiments, the faecal streaks of adult and fifth instar Triatominae were never greater than 7mm wide, whereas the faecal streaks of vertebrates would usually be much wider than this.

The faeces of predatory arthropods, such as spiders and predatory reduviidae, have not been studied. We expect that their faeces could be similar to those of haematophagous arthropods, specially following predation on insects of this type. However, it seems likely that the faeces of predatory arthropods would not be streaked to the same extent as those of triatomine bugs. The fluidity of triatomine faeces results from rapid removal of surplus water from the bug's blood-meal, so that if the bug is then preyed upon by another arthropod, much of the surplus fluid will already have been lost.

## RESUMO

*Determinar as populações de barbeiros residuais nas casas depois de borrifação com inseticidas é um componente importante na vigilância e evolução do controle dos vetores da doença de Chagas. Recentemente, mostramos que folhas de papel, afixadas na*

*parede das casas infestadas, podem ser manchadas com fezes dos triatomíneos, assim revelando a infestação. Neste trabalho, apresentamos uma chave simples para diferenciar as fezes dos triatomíneos de outros artrópodos, como baratas, carrapatos e perceijos de cama.*

*Palavras chaves: Doença de Chagas. Controle de vetores. Triatomíneos.*

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