A baited trap system for the early detection of mites in laboratory animal facilities

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INTRODUCTION

Booklice (*Liposcelis spp.*), storage mites (e.g. *Acarus spp*., *Tyrophagus spp*. and Glycyphagid mites) and stored product beetles (e.g. *Tribolium spp*., *Lathridiidae spp*., *Sitophilus spp*. etc) are all common stored-product pests frequently found in laboratory animal facilities. Although they are commonly found they are considered pseudoparasites of laboratory animal facilities. These pests are not generally considered during quarantine of laboratory animals or targeted as part of routine pest control programmes making detection of the early stages of infestation, when numbers are low, extremely difficult. As a result, infestations go unnoticed until numbers have increased dramatically with undesirable consequences (Table 1).

We have developed the first trap specifically designed to attract mites in order to allow an early warning/detection system (Figure 1 & 2).

The trap is composed of a plastic plate with a circular chamber, an inner chamber holds the attractant media. The chamber has a screw top which is partially opened to allow entry of mites through small gaps at the sides of the chamber. The attractant is a non-toxic agar based food lure but also provides the high humidity favoured by mites. Figure 2 show mites feeding on the food lure.

Figure 1. The BT mite trap

The BT trap has been successfully used in the food and manufacturing industries. Table 2 lists the mites and insects commonly encountered in a BT trap. We propose that this system could be of benefit in animal facilities as it could be used to pinpoint sources of mite/insect infestation.

Table 1. Consquences of storage mite infestation in laboratory animal facilities

Acariasis	Some laboratory animals may be susceptible to acariasis, a syndrome described in humans that is caused by mite invasion of various tissues (Cui, 2014; Warner& Bohane, 2014).
Ectoparasite misidentification	Storage mites, particularly grain mites, can be confused with *Myobia*, *Myocoptes* and *Radfordia* species leading to additional testing or unnecessary treatment and ultimately unnecessary culling of rodent colonies.
Transmission of pathogens	Mites may also act as vectors or fomites for the transmission of adventitious agents in laboratory animal facilities (Turner, 1997).
Financial losses	The damage caused by mite infestation can lead to direct financial losses due to the deterioration of food stores and/or to the unnecessary culling of rodent colonies.
Occupational health risk	Growing evidence links mites and their by-products to an increase in human allergy and has been demonstrated as a risk associated with laboratory animal facilities (Ruoppi et al., 2014). *Acarus siro* is one of several mites that have been identified as a cause of intestinal, pulmonary, and urinary acariasis in humans (CUI, 2014).

Figure 2. Mites feeding on the food lure

Table 2. Common species detected by the BT trap

Insect species	*Gnatocerus, Triboliom, Ryzopertha, Lathriidae, Dermestid beetles and larvae, Ahasverus, Anthrenus, Typhaea, Sitophlius, psocids, Ptinus, spiders, earwigs, springtails, flies, Stegobium, Lasioderma, Cryptolestes, Oryzaephilus, moths e.g Ephestia.*
Mite species	*Acarus sp., Glycyphagid sp.; Caloglyphus sp., Sancassania, Tarsonemids, Oribatid/soil mites e.g Rhizoglyphus sp., Cheyletus and other predatory mites (e.g. Blattisocius, Hypoaspis) , Aleuroglyphus, Thyreophagus, Carpoglyphus , Goheira, Bryobia, Lardoglyphus.*

Validation of the BT trap for use in laboratory animal facilities

Historically the trap has been used and validated as a non-sterile trap. However, to meet the high levels of biosecurity required in laboratory animal facilities we produced a sterile trap with sterile bait. In order to determine if there was any negative impact regarding attraction of mites to the bate traps we performed a short investigation comparing sterile vs non-sterile bate traps in the laboratory. To confirm our findings we also tested the traps in an animal facility.

Laboratory Sterile vs Non-sterile trap lure trial

To provide an enclosed environment, the BT traps were placed in to containers. A total of 15 containers were used. Five containing a sterile and non-sterile trap, five containing a sterile trap only and five containing a non-sterile strap only. Approximately 100 mixed life stages of *Tyrophagus putrescentiae* (a cosmopolitan storage mite) were added to each container at a point furthest away from the traps. The containers were then sealed and left at 20°C 80% RH for four days. After four days the traps and containers were then examined. The number of mites in the traps and in the containers was recorded.

Figure 3 and Table 3 shows the percent of mites detected in the sterile, non-sterile traps and containers.

- Only small numbers of mites were found outside the traps in the container. In all cases the mites found in the container were dead and therefore all mobile mites had entered the traps
- When the two types of trap were placed together in a container in a choice test situation, the non-sterilised trap attracted slightly more mites than the sterilised trap (table 3)
- When used on their own, both types of trap attracted all mobile mites equally well

Animal facility test

The sterile and non-sterile traps were tested in a laboratory animal facility which holds multiple animal species. The traps were placed in three separate feed storage area's. The results of the trial can be seen in Table 4.

The results of both investigations demonstrated that sterilising the traps and bait had no adverse effect on the ability of the baited traps to attract mites.

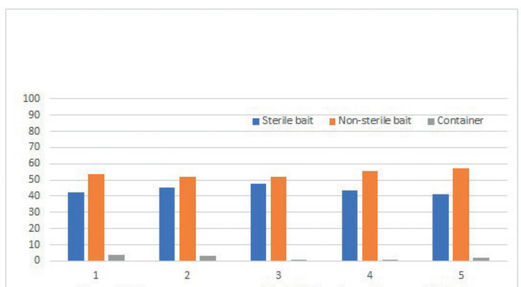

Figure 3. Percentage trap catch with Sterile vs Non-sterile bait

Figure 3. Percentage trap catch with sterile vs non-sterile bait

Table 3. Percentage number of mites found in the sterile trap, non-sterile trap or container

Container number	Sterile trap	Non-sterile trap	Container
1	42.54	53.73	3.73
2	45	52	3
3	47.88	51.52	0.61
4	43.52	55.55	0.92
5	41.18	57.14	1.68
6	-	96.95	3.06
7	-	98.83	1.17
8	-	99.39	0.61
9	-	98.31	1.69
10	-	98.79	1.2
11	97.74	-	2.26
12	97.86	-	2.14
13	97.53	-	2.47
14	97.93	-	2.03
15	98.17	-	1.83

Table 4. Animal Facility Sterile vs non-sterile attraction test results

Trap Number	Number of Mites	Mite Identification
1 Area 1 (Non-sterile Trap)	175	168 *Acarus species*, 5 *Tyrophagus species*, 2 *Glycyphagid* mites
2 Area 1 (Sterile Trap)	500+	500+ *Acarus species*, 68 *Tyrophagus species*, 12 *Glycyphagid* mites
3 Area 2 (Non-sterile Trap)	0	
4 Area 2 (Sterile Trap)	1	1 *Tyrophagus species*
5 Area 3 (Non-sterile Trap)	4	2 *Tyrophagus species*, 1 *Acarus species*, 1 Predatory mite
6 Area 3 (Sterile trap)	0	

Summary

We have demonstrated that the attractant properties of the bait was not affected by the sterilisation process. The BT trap could be a useful addition in developing an holistic monitoring and control strategy that effectively targets all pests that may inadvertently enter an animal facility. The use of the BT trap would facilitate the detection of mites at a critically early stage allowing appropriate control measure to be put in place limiting the population growth of mites and the potentially adverse effects on research facilities. Future investigations to determine if the BT could be used to trap *Radfordia species*, *Myobia species* and *Myocoptes* species directly from rats and mice by placing the traps in change stations and dirty bedding will be undertaken. We propose that the BT mite trap should be used to enhance animal facility biosecurity, closing a gap that currently exists in animal facility biosecurity control.

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