Development of a feeding device to reduce reliance on field trials to test novel poultry red mite controls

Francesca Nunn[1], Kathryn Bartley & Alasdair Nisbet

[1] Moredun Research Institute, Edinburgh EH26 0PZ

Moredun Research Institute, Pentlands Science Park, Bush Loan, Penicuik EH26 0PZ, Scotland. E-mail @mri.sari.ac.uk

www.moredun.org.uk

Poultry red mites (PRM) are small, mobile ectoparasites that feed on the blood of hens. They are considered to be the most important ectoparasites in laying hens and are found in all housing systems worldwide. Infestation can cause an increase in mortality and stress behaviours[1] and a decrease in egg production[2].

Testing of novel control methods uses mites in laboratory-based tests followed by field trials. Field trials use large numbers of hens (~400) per experimental group, which are then exposed to high numbers of mites for extended periods of time[3].

This strategy has 2 major drawbacks:

1) The data from the in vitro feeding devices (Fig. 1) are highly variable leading to misleading results

2) Requires invasive sampling of hens

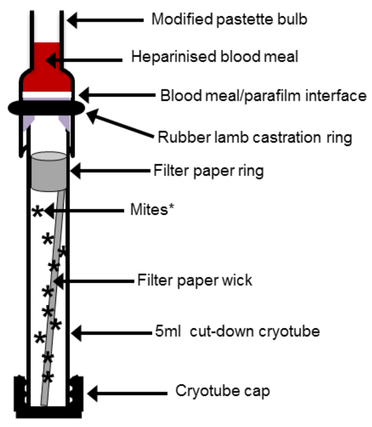


Fig. 1. *In vitro* feeding device[4]

Prototype *in vivo* feeding device

To replace the *in vitro* feeding device we developed a prototype *in vivo* feeding device for adult mites that can be attached to the hens' thighs for short periods. Consistent feeding rates of 50% and a low background mite mortality were demonstrated.

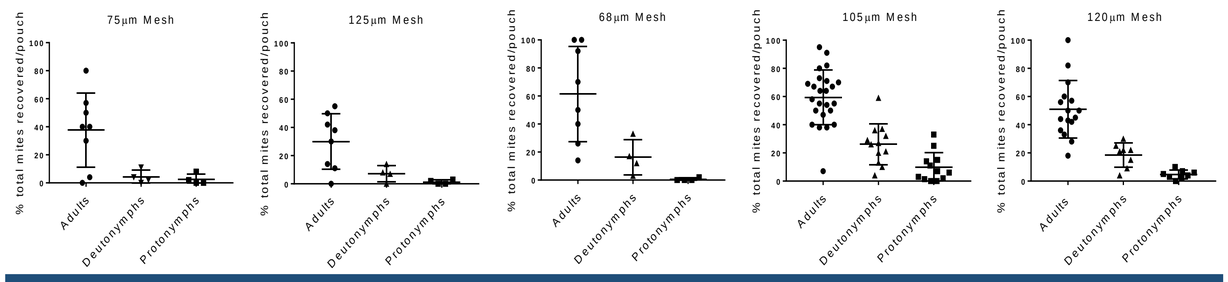
An important innovation in Reduction and Refinement

- **Reduction**: Use of the in vivo feeding device to pre-screen vaccines leads to a decreased number of hens per study (384 'v' 4 per group) and less testing of suboptimal products in large field trials
- **Refinement** (improved welfare): reduces the frequency and duration of exposure to mites in field trials (50-100 mites for 3 hours/time point 'v' tens of thousands mites for several weeks) and less invasive blood sampling of hens.
- For optimal use, the device needed further development for use against all blood feeding PRM life stages

Device optimisation

Meshes of different aperture size, thickness and materials were tested to optimise use for all haematophagous PRM life stages. Figure 2 shows the results of meshes with differing aperture sizes and thickness. Feeding rates were significantly higher for protonymphs using the 105µm aperture and this was chosen to then study conditioning of the mites prior to feeding[4].

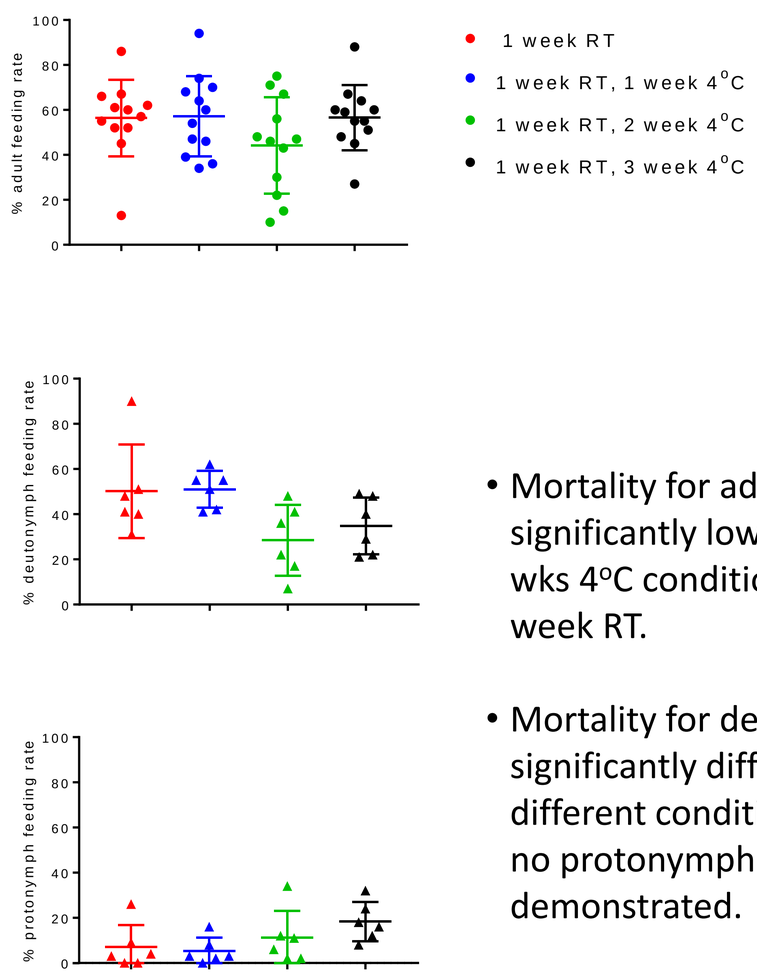
Fig. 2. Graphs showing mite feeding rates associated with different mesh aperture sizes and thicknesses[5].



Mite conditioning

To determine the best treatment of mites prior to feeding assays, four protocols were tested: Each mite preparation was stored at room temperature (RT) for 1 week and thereafter at 4°C for up to 3 weeks prior to feeding on hens.

Fig. 3. Percentages of mites fed following different conditioning periods: adult (a) deutonymph (b) protonymph feeding rates (c)[5]



- Mortality for adult mites was significantly lower after 1wk RT 3 wks 4°C conditioning than at one week RT.
- Mortality for deutonymphs was not significantly different across the different conditioning points and no protonymph mortality was demonstrated.

Summary

- Device optimised to allow all hematophagous PRM life stages to feed *in vivo*
- Compared to the *in vitro* device and initial *in vivo* prototype:
  - Improved mite feeding rates
  - Reduced background mortality
  - High welfare for the hens
  - Easily used by trained individuals

References:
1. Chauve, C. Vet. Para. 79 (1998) 239-245
2. Flochlay, S., Thomas, E. Sparagano, O. Parasites and Vectors (2017) 10:357
3. Bartley *et al.*. Vet Para. 244 (2017) 25-35
4. Bartley *et al,*. Int J Parasitol. 45 (2015) :819-830
5. Nunn *et al,*. Vet. Para. 267 (2019) 42-46.

Moredun Centenary