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ALTERNATIVES TO ANTICOAGULANTS: CHLORALOSE

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Abstract This paper presents data from the development of a new paste-based formulation containing the acute rodenticide chloralose (RapidPro) in order to assess its suitability as an alternative to anticoagulant rodenticides. Albino mice were single caged and offered a chloralose formulation in a standard 'Choice' test against a non-toxic alternative diet. The 'Paste' based formulation achieved 100% mortality in less than 24 hours with palatability of 23.0%, at ambient temperatures of 19°C - 20°C. By comparison with an earlier developmental 'Block' formulation, which only achieved 30% mortality, it is suggested that apparent poor palatability is actually due to a combination of the rapid action of chloralose and a degree of 'bait shyness' among animals surviving sedation following a sub-lethal dose. Clearly palatability is still important in order to achieve a lethal dose before the effects of chloralose (sedation) start to take effect, and the 'Paste' formulation demonstrated that chloralose can be a very effective and practical alternative to anticoagulants for house mice, with the key advantage of rapid action and faster elimination of an infestation

Key words House mice, *Mus musculus domesticus*, rodenticide, rodent control, palatability, mortality.

INTRODUCTION

Anticoagulants are the toxin of choice for rodent control. However, with the rise of resistance there is an increasing reliance on the most toxic compounds in the class, which pose a significant threat to wildlife. There are also moves to lower the concentrations of active ingredients in order to protect human health (Riby, 2016). This has brought with it a need to impose severe restrictions on use and is a stimulus to search for alternatives.

Chloralose (which is a mixture of the active alpha- isomer and the inactive beta- isomer) has been used for mouse control since the late 1960s (Cornwell, 1969). It is a fast-acting sedative, and rising doses cause unconsciousness and then death through depression of the Central Nervous System and inhibition of the respiratory reflex (McLeod and Saunders, 2013). Traditionally only for use against mice, it has always been considered to be of limited use due to poor palatability and lower efficacy at higher ambient temperatures (Meehan, 1984).

This paper presents data from the development of a new formulation (RapidPro) in order to reassess this accepted wisdom.

MATERIALS AND METHODS

Two treatment groups of 10 albino TO mice (5 females, 5 males) were individually caged and acclimatized for 72 hours with RM1 pelleted diet and water available *ad libitum*. After acclimatisation, the mice were offered the choice of a formulation containing 4% chloralose (nominally 85% of the active isomer alphachloralose and 15% betachloralose) and a non-toxic RM1 powdered diet. One treatment group was offered an earlier developmental 'Block' formulation, the other a new 'Paste' formulation (RapidPro).

Test baits were offered for 4 days and then replaced with the pelleted diet for a further 3 days. Any distress / mortality observed was noted for these 7 days. As chloralose is a sedative, the normal humane endpoints for test animals were not used (severely sedated animals often recover completely) in order to ensure the accuracy of test results. The test room was maintained between 19° C and 20° C throughout the trial.

RESULTS AND DISCUSSION

Table 1 shows the summary data, in terms of palatability (bait consumption) and mortality. The Paste formulation achieved 100% mortality within 24 hours, whereas the Block formulation performed much worse. Palatability is much more difficult to examine, because a lethal dose is between 0.1g and 0.2g of formulated bait and this is difficult to measure accurately. Whilst both treatment groups ate an identical amount of chloralose bait on Day 1, the mice offered the Paste formulation clearly became comatose before they could consume significant amounts of the alternative lab diet – which suggests that they sampled the chloralose bait in greater quantity and did so sooner on Day 1 than the other group. The survivors of the Block formulation thereafter showed a marked preference for the alternative non-toxic diet, although they did not necessarily completely avoid the toxic bait.

Table 1. Test Bait consumption and Mortality resulting from presentation to individually-caged treatment groups of 10 albino TO mice of two different chloralose formulations ('Block' or 'Paste') vs. a non-toxic RM1 powdered diet.

Treatment	Test Bait Consumption (g)					Mortality
	Day 1	Day 2	Day 3	Day 4	Total	
'Block'	2.1	0.4	0.3	1.0	3.8 (2.1%)	3/10
Lab Diet	34.6	40.0	50.6	53.6	178.9 (97.9%)	
'Paste'	2.1	0.0	0.0	0.0	2.1 (23%)	10/10
Lab Diet	7.0	0.0	0.0	0.0	7.0 (77%)	

The degree of 'shyness' towards the Block formulation after Day 1 inevitably results in increased consumption of lab diet, and shows how palatability data can become skewed over a 4 day test. Indeed, it is very difficult to conclude from this data and the author's experience that chloralose baits are unpalatable as the active ingredient is so fast to act after such small amounts of bait take. It is worth noting that attempts to encapsulate chloralose have resulted in greater palatability, but poorer mortality (Meehan, 1984) – the slower release of chloralose from such capsules ensures mice have more time to consume the bait, but unfortunately that slow release also means that a lethal dose is never reached inside the rodent's bloodstream.

Although the mice offered the Block formulation did continue to feed from this bait in small amounts after the first day, it is at lower levels and could still be considered 'bait shyness'. This is perhaps not as well understood in mice as most classic Conditioned Taste Aversion / Bait Shyness studies used rats as their model (e.g. Garcia et al., 1955; Rzoska, 1954) and whereas rats have been shown to display marked bait shyness that can persist for months, Shorten (1954) conducted experiments on acute rodenticides that failed to show significant shyness in mice for more than a few days, although Rao and Prakash (1980) recorded bait shyness of *Mus musculus bactrianus* to Zinc Phosphide that lasted for 30 days. Perhaps the symptoms of chloralose poisoning are not sufficient to cause a complete rejection of the Block formulation, which the mice continue to sample as part of their natural foraging behaviour.

Subsequent field trials have confirmed the efficacy of the new formulation (data unpublished) – a crucial difference in these trials is the shorter treatment times (maximum 14 days) compared to that expected of anticoagulant rodenticides, due to the rapid nature of the active ingredient. In one trial in a heavily infested animal feed merchant 96.3% control was achieved in the main areas of the site. In the Boiler Room, with ambient temperatures between 25° C to 32° C during the trial, a more modest 70.8% control was achieved. Perhaps better control could have been achieved with time, but this shows that alphachloralose can still be very effective at even these higher temperatures.

In summary, this study showed that a rodenticide formulation of chloralose was capable of palatability levels sufficient to deem a rodenticide palatable (ECHA, 2009), and at temperatures which suit its application across all seasons in any temperate environment. This makes it therefore an effective and practical alternative to anticoagulants for house mice, with a key advantage of rapid action and faster elimination of an infestation.

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