

ABSTRACT

Cacao (*Theobroma cacao* L.) is subject to severe attack by a range of herbivores wherever it is grown. Birds and mammals including rodents are among the most severe predators. A series of experiments were conducted with the following objectives: (1) confirm that squirrels/rats are serious pests of cacao in Trinidad, (2) identify whether squirrels/rats preference for ripe or unripe cacao pods, (3) determine cacao accessions in the International Cacao Genebank, Trinidad (ICG, T) that may be resistant to squirrel/rat attack, (4) identify physical or chemical nature of source of deterrence, (5) determine whether the cacao leaves deter squirrels/rats as well, (6) observe the reaction of squirrels and rats to the deterrent factors under controlled surroundings, and (7) conduct chemical analyses to isolate the source of detergency.

The results of the experiments confirmed that rodents, in particular, the neotropical red squirrel (*Sciurus granatensis* Humboldt), were serious pests of cacao and that varietal resistance to squirrel attack existed among the accessions in the ICG, T. The study identified a very highly susceptible accession, SCA6, and a highly resistant accession, IMC6. The study showed that squirrels preferred ripe pods to unripe pods ($P < 0.01$), but once they began to consume a pod, it was eaten irrespective of ripeness, indicating that squirrels' preference for ripe pods was related to colour and scent, rather than taste.

Based on the results of a human taste experiment to determine the apparent factors that influence squirrels' taste preferences, the results demonstrated that squirrels preferred

hard husks, with low mucilage content, and no unpleasant taste. The non-preferred accession IMC6 had hard husks, low mucilage content, and no unpleasant taste. But since the squirrels never touched this accession in its unripe state, they were not discriminating against it based on physical criteria. Therefore, the nature of the deterrence was hypothesized to be a chemical nature.

In an effort to determine whether the leaves of the most preferred accession, SCA6, and least preferred, IMC6, contained the deterrent compound(s), they were tested against caged squirrels. The squirrels detected clonal variation between the two accessions. In separate trials using rats, these also detected the repellency compounds in IMC6, but they showed distinct contact irritation from the deterrent compounds.

Attempts to isolate the deterrent compound(s) using chemical extracts proved to be inconclusive and basic chromatographic procedures using thin layer and paper chromatography were also unsuccessful. Ethanol extracts were prepared from the IMC6 and SCA6, and subjected to gas chromatography–mass spectrometry. This was also unsuccessful in isolating the deterrent compound(s) but a completely unexpected compound was isolated from the cacao accession SCA6. This compound was identified as N-butylbenzanesulphonamide, an antibiotic. Repeat runs confirmed its presence in SCA6 with trace quantities found in IMC6. This finding may have positive implications in controlling cacao diseases and further experiments are necessary to test the effectiveness of N-butylbenzane-sulphonamide against cacao pathogens. Further trials

would also have to be conducted in efforts to isolate and identify the repellent compound(s) in the cacao accession IMC6.

Based on the overall results, it was concluded that this study showed that one cacao accession IMC6 appeared to possess deterrent properties against both squirrels and rats. Therefore, further trials can be conducted using rats. Squirrels are not readily available and this could facilitate screening trials. In addition, as shown, the leaves also contain the deterrent. In this regard, since cacao pods are not readily available throughout the year, year-round trials could be conducted using leaves and obtaining the same results.

Keywords: Cacao; *Theobroma cacao* L.; mammals; rodents; squirrels; deterrent; varietal resistance; susceptibility