Investigating nectar- and blood-feeding behaviour of sand flies to optimise Attractive Targeted Sugar Baits.

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Abstract

Many insect vectors of disease use sugars, such as nectar, as fuel to enable them to obtain blood, that in turn sustains parasite transmission. In most blood feeding Diptera sugars are diverted to the crop where it is stored and released into the midgut for energy whereas blood is taken directly to the midgut where it is digested to provide nutrients for egg development. For sand flies the cues required to switch between sugar and blood feeding programmes are unknown but if they were they could be exploited to improve Attractive Targeted Sugar Baits (ATSB) as a means of poisoning sand flies when they sugar feed. In this study we find that the neotropical sand fly, *Lutzomyia longipalpis*, uses a combination of physical cues (biting/piercing vs sucking) and meal composition to allow them to efficiently feed on nectar and blood. We show that they sense protein and adenosine triphosphate (ATP) to direct blood to the midgut and we demonstrate that this can be turned to our advantage to improve the lethality of ATSB. We show that inclusion of bovine serum albumin as a source of protein and the phagostimulant ATP can trick sand flies to blood feed on sugar and direct the insecticide fipronil to the midgut where it was 355-fold more potent than in sugar alone. These results show the potential of phagostimulants to improve the efficacy and selectivity of ATSB towards blood feeding arthropods, including sand flies, and highlights the value of understanding the feeding programmes of disease vectors in general.

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