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TASTE PREFERENCES OF THE COMMON VAMPIRE BAT (*Desmodus rotundus*)[1]

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Abstract—Taste preference tests, with simultaneous presentation of treated and untreated food, were administered to 24 common vampire bats (*Desmodus rotundus*). The bats received brief exposures to four different stimuli representing sweet, salty, sour, and bitter tastes, each at four different concentrations. Despite a strong location bias, the bats significantly ($P < 0.01$) avoided the highest concentrations of the salty, sour, and bitter tastes. Consumption of the sweet stimulus at all concentrations was similar to that of the untreated standard. Vampires evidently can discriminate based on taste, although their ability is apparently poorly developed when compared with some euryphagous species such as the rat. Hence, taste is probably not a factor in host selection by the vampire.

Key Words—Taste, taste preference, *Desmodus rotundus*, citric acid, sucrose, sodium chloride, quinine, vampire bat.

INTRODUCTION

The common vampire bat (*Desmodus rotundus*) depends solely on blood from living hosts for sustenance. Yet within the confines of their extreme stenophagia, vampires do prefer certain types of hosts (Goodwin and Greenhall, 1961; Turner, 1975). Factors influencing these preferences are unknown and may range from simply the availability or abundance of hosts to their accessibility, vulnerability, degree of domestication, or to some unique

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aspect of their detectability such as size, odor, or color. Although little is known about the sensory basis of food selection by noninsectivorous bats (Suthers, 1970), it seems likely that vampires utilize various sensory systems for locating and selecting hosts.

Several investigators have studied aspects of the olfactory, visual, and auditory senses of vampires (Mann, 1960; Schmidt and Greenhall, 1971; Pru and Briceno, 1972; Suthers, 1966; Shumake et al., 1977), but few have studied the vampire's sense of taste. Park and Hall (1951) described the gross anatomy of the vampire tongue, showing that taste buds are present. Suthers (1970) summarized the results of investigations by Fishman and others, in which electrophysiological responses to gustatory stimuli were compared in several species, including the vampire. They applied test solutions to fungiform papillae on the tip of the tongue of test animals and recorded the steady-state height of the integrated action potentials of the chorda tympani nerve. These studies demonstrated that vampires have highly functional taste receptors.

The study reported here was designed to further evaluate the sense of taste by examining the vampire's preference for sweet, salty, sour, and bitter.

METHODS AND MATERIALS

We used 24 adult vampire bats. They were captured in Mexico, shipped to our laboratory in Denver, individually housed in wire cages (34 × 17.5 × 17.5 cm), and adapted to feeding on fresh defibrinated cattle blood from glass feeding tubes.

We measured the preferences of each animal using an automated electronic testing apparatus which has been previously described in detail by Thompson and Grant (1971). The device (Figure 1) is based on the principle of the brief-exposure, foods-together technique described by Young and Kappauf (1962). By this technique, the test animal is given a traditional two-choice situation; however, the apparatus is programed such that the animal briefly samples each food alone before the two foods are presented together for choice behavior. Temporal and spatial positional habits are minimized by alternating the sequence and positions in which the choices are presented. According to Young (1967), the technique yields a cross-section of relative levels of acceptability before postingestional factors influence results. The foods-together technique was used by Young (1945, 1966, 1967), Young and Madsen (1963), Young and Greene (1953), and Christensen (1962) to rate the palatability of liquid foods and thus appeared particularly applicable to this study.

Fresh defibrinated whole bovine blood was treated with sucrose, citric acid, sodium chloride, or quinine hydrochloride to represent the basic taste categories of sweet, sour, salty, and bitter, respectively. Molar concentrations

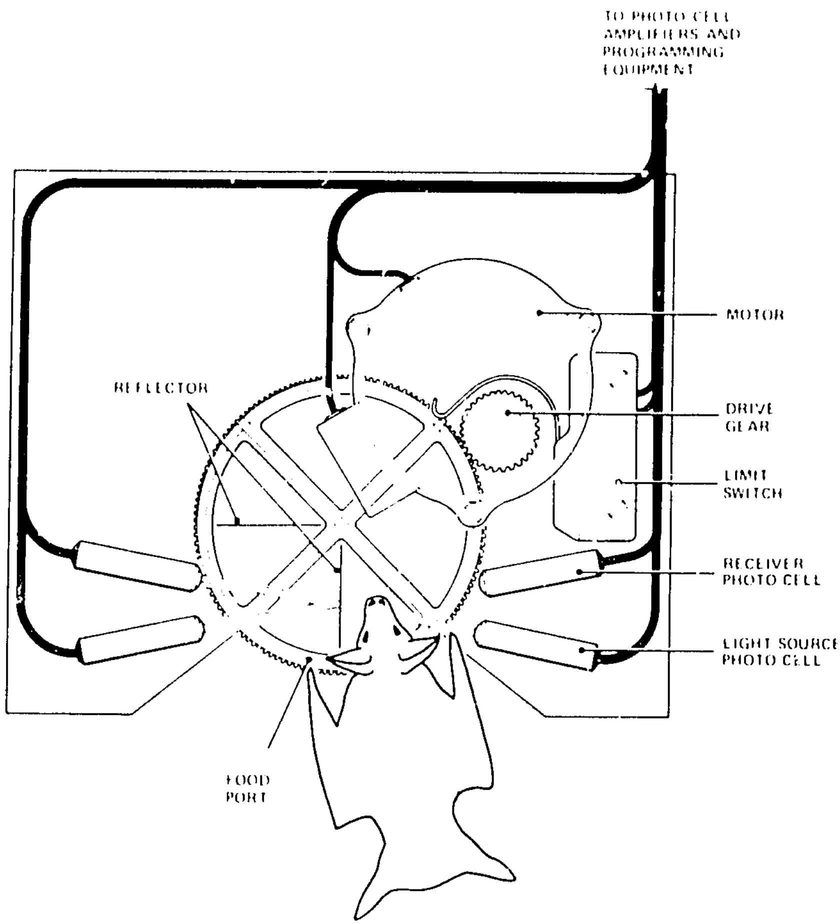

FIG. 1. Automated electronic testing apparatus for measuring taste preference behavior (modified from Thompson and Grant, 1971).

from 1×10^{-4} to 1×10^{-1} were used for citric acid and quinine, and molar concentrations from 6.6×10^{-4} to 3.3×10^{-1} were used for sucrose and sodium chloride. Four concentrations of each taste (Table 1) were used for the preference evaluations. Fresh untreated defibrinated blood was used as the alternate choice. The preference test was replicated (treated vs. untreated positions reversed) and mean preference values were calculated for each bat. Tests were conducted betwen 0800 and 1100 each day before the bats received their regular daily blood ration. Fresh test samples (both treated and untreated) were prepared before each test and were at room temperature (about 21°C) before measurements were made.

Equal amounts (4.0 cc) of treated or untreated blood were weighed and

TABLE 1. TASTE STIMULUS TEST CONCENTRATIONS

Stimulus	Concentration (g/100 ml of blood)			
	C^1	C^2	C^3	C^4
Sucrose	0.034	5.682	11.364	17.114
Sodium chloride	0.006	0.971	1.942	2.925
Citric acid	0.002	0.021	0.210	1.150
Quinine hydrochloride	0.004	0.040	0.400	2.188

pipetted into each of the small compartments and 8.0 cc were placed in the large compartments (see Figure 1). The two large quadrants are used for the nonchoice food-sampling positions and the remaining two quadrants are bisected for the choice positions. Placement of treated or untreated blood was reversed for alternate bats. As the bats fed from the preference testers, the compartmentalized food trays rotated in sequence to various positions. In a typical test cycle, the bat samples the untreated food, samples the treated food, chooses between the two presented simultaneously, samples the treated food, samples the untreated food, and again chooses between the two together but with positions reversed from the first exposure. The time each animal spent feeding at each compartment was automatically recorded on digital counters. Immediately after each bat had made sixteen 6-sec choices, the test apparatus was removed from the cage and the blood remaining in each compartment was weighed. Preference was calculated according to the following formula.

$$\text{Consumption preference } (\%) = \frac{\text{amount treated blood consumed}}{\text{total blood consumed}} \times 100$$

Preferences were analyzed by two-way analysis of variance.

RESULTS AND DISCUSSION

The vampires exhibited a stereotyped behavior when confronted with the two-choice situation in the study. That is, some bats consistently drank from the left (or right) side of the preference tester whereas others drank from the first compartment that rotated toward them, regardless of treatment. There were no significant differences ($P > 0.05$) in preference for untreated blood versus blood treated with sucrose. However, bats avoided the salty, sour, and bitter tastes. Preferences at the highest concentrations (C_4) of these tastants were significantly lower ($P < 0.01$) than for untreated blood. A graphic comparison of the mean preference responses to each taste stimulus is given in Figure 2.

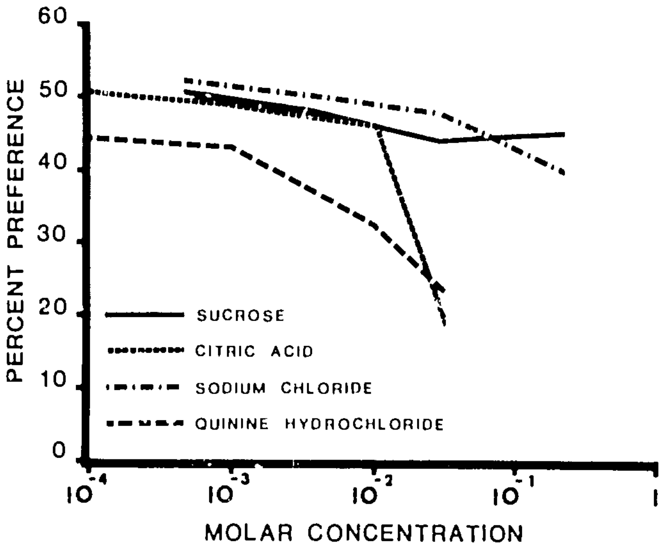

FIG. 2. Mean consumption preference responses of vampire bats to basic taste stimuli of sweet, sour, salty, and bitter.

Our results generally agree with those summarized by Suthers (1970) in that vampires responded to the sweet and salty tastes less than to the bitter and sour ones. The strong avoidance of citric acid at the highest concentration level is also in agreement with Suthers' (1970) report that the response of *Desmodus* to a sour stimulus exceeded that of all other species tested.

Our results do not correspond to the findings of Fishman, who reported (personal communication) no difficulty in recording integrated nerve responses to these stimuli in the same range of concentration. Perhaps the bats detected the sweet or salty tastes but were indifferent to them. Alternately, receptor responses may not have been processed or integrated to the extent necessary to produce a change in preference response. Of course it is frequently difficult to infer or predict behavioral responses from electrophysiological data. For example, the rat shows a relatively low chorda tympani nerve response to quinine or sucrose but both produce very pronounced hedonic preference changes (Fishman, 1971; Shumake et al., 1971).

Our study, and those summarized by Suthers, indicate that vampires can discriminate tastes. The other chemical sense, olfaction, generally serves a variety of functions (e.g., mate selection, avoidance of enemies, guidance), but the function of taste is limited to regulation of ingestion of nutrients and possibly the avoidance of toxic substances (Kare and Ficken, 1963). Because of the extremely specialized diet of the vampire, it is reasonable to assume that the sense of taste in vampires, although present, is not very functional. The results of our study would tend to support such a hypothesis. If this is true, it is probably a contributive factor to the high efficacy of the systemic method of vampire control described by Thompson et al. (1972) and Bullard and Thompson (1977). The toxicant present in the bovine bloodstream apparently elicits no aversive response from the vampires which would result in cessation of feeding. Efficacy of control with this technique is generally 95% or greater. And, if this hypothesis regarding the vampires' sense of taste is valid, then it follows that prey selection is due to other factors such as those discussed at the beginning of this report.

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