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CHEMICAL COMMUNICATION IN TAPHOZOUS MELANOPOGON (BLACK BEARDED TOMB BAT)

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Abstract

Chemical communication through scent glands is universal. Taphozous melanopogon possess specific modified skin glands at distinct regions to secrete odoriferous compounds. Social lifestyle studies during the breeding season of these bats reveal the besides acoustic signals, chemical signals are also involved in communication. The secretions of the scent glands of Taphozous melanopogon were identified on the basis of mass spectra obtain by GC-MS. The results confirmed that the secretions differ in chemical composition with respect to sex and the locations of the scent glands.

Keywords: Communication, odoriferous compounds, chemical signals, scent gland.

Introduction

Chemical cues are likely to be an important mode of gathering information, advertisement of social and reproductive status, territory marking and kin recognition (Brooke and Decker, 1996). Chemical signals from integumentary glands aid mate recognition in big brown bat, Eptesicus fuscus (Blosset al., 2002), mate choice in sac winged bat, Saccopteryx bilineata (Voigt and Helversen, 1999) and colony recognition in fishing bat, Noctilio leporinus (Brooke and Decker, 1996). These signals honestly inform females even about the genetic compatibility of potential males (Rich and Hurst, 1998).

Bats have a wide variety of odour producing organs which include specialized integumentary glands. These glands produce chemical substances in the form of a liquid or sebum (oily secretion) which serves as an important odour source. Bat's scent glands are generally located on regions like frontal in Hipposideros gigas, Hipposideros commersoni and throat in Croseonycteris thonglongyai (Hill, 1974); shoulder as in the case of Pteropus giganteus (Neiweller, 1969) and the surrounds of the anal opening in Taphozous melanopogon and Hipposideros speoris (Lily, 2005). The glands are of two types namely apocrine sudoriferous and holocrine sebaceous. The differences in gland type and their secretions and between the species of bat strongly suggest that the olfactory cues are highly variable among bat species (Schmidt, 1985).

Materials and Methods

The bats were caught by the mist nets from the specific roost. The mature adult males and females were selected and different integumentary tissues from various parts, frontal region, surrounding the eye, lip region, neck and surrounding the anal regions were removed both during breeding and nonbreeding seasons. The tissues were fixed in Bouin's fluid and stored in 70% ethyl alcohol for histological study. The glandular extracts were analysed under GC-MS. Video recording was made to study the behavior during breeding and non-breeding seasons.

Results

The histological study reveals that the frontal glandular secretions were observed in between the eyes. It is more prominent in males during mating season. The sebaceous glandular layer produces new cells continuously. The thick secretory product is called 'sebum'. The smell of this product is similar to rotten degraded fruit odour in their roosting site.

The glandular secretions collected in Taphozous melanopogon during breeding and non-breeding season were subjected in GC-MS analysis. The GC-MS chromatogram results exhibit the chemical compounds of the secretions. These chemical compounds differ even within the sex and also in individuals from region to region depending upon the glandular secretions. The odour producing components of the glandular secretions are given in Table 1, 2 and 3.

Discussion

Generally, in mammals' glandular secretions contribute much for the individual odour and also to its habitat, where the animal lives. The integumentary glands empty their products outside the animal's body to expel the odour. Such type of glands is prominent more in the head (Kunz, 1990) and the surroundings of the anal opening (Kannan, 1998).

The frontal gland secretions of black tailed deer, Odocoileushemionus, Odocoileus virginionus and ferret, Mustelo furo (Clapperton, 1989) were used by these mammals to mark their territories and select their mates. Similarly, the male frontal glandular secretions rubbed over the selected female indicate that they are the chemical substance used to attract and mark the females. The anal secretion mixed along with the urine disperses the scent in their roosting sites. The fishing bat, Noctilioleporinus produces a musky sweet odour from sub-axial glands and also a bitter scent from the inguinal pockets found on either side of the testes (Gudger, 1945). Such specific pungent smell was observed in the roost of Rousettus lechenaulti (Lily, 2005).

GC-MS profile of glandular secretions of bat species confirm that they have specific fatty acid composition like octadecanoic acid, hexadecanoic acid, steroid derivatives, aromatic and heterocyclic compounds. These major constituents bring species – specific odour to the bats and their roosting site.

In Taphozous melanopogon, the males possess fatty acids with higher number of carbon atoms in the frontal glandular secretions C_{16}-C_{17}hexadecanoic acid and C_{14}decanoic acid. These fatty acid secretions were not noticed in both sexes during non-breeding season. Similar possession of fatty acid compounds were reported in other animals, C_{15}-C_{25} fatty acids from the occipital secretions of camel (Ayorindeet al., 1982); C_{15}-C_{18} fatty acid secretions from preorbital secretions of Ourebiaorebi (Mo et al., 1995) and C_{10} – C_{25} fatty acids from precloacal secretions of Liolaemus lizard (Carlos et al., 2001) are used as sex attractants to select their mate.

During breeding season, the frontal glandular secretions wet the hair of the face and the bats show peculiar rubbing and sniffing behavior with the selected mates. Clapperton (1989) reported that the male ferret sniffs the anal region of the female to identify the resident females. Schaller (1967) observed the tiger sniffs the genital region of females to identify the partner. Similar reports have been identified in Kangaroo. In the present study, the presence of ester compounds in Taphozousmelanopogon used for peculiar rubbing and sniffing

behavior by the males with the selected females were observed in this species. Anal secretions of females convey the oestrous status to the males (Hurst, 1990).

Chemical odorants show a great deal of variation in the composition by the possession of various functional groups. Such groups with oxygen atoms play a vital role in the production of strong odour for a prolonged time. In bat species these chemical compounds are helpful to mark the territory. (elapperton, 1989)

The chemical compounds like alkanes, steroid, heterocyclic compounds and specific compounds with sulphur and nitrogen composition proved to be odour producing substances. These compounds specially help individual and group recognition in a colony and also aids in sex determination in a social system.

The same biochemical composition is present in Taphozous melanopogon. Reports about similar biochemical compounds playing the vital role in individual recognition are known from the preorbital secretion of musk Ox, Ovibos moschatus (Flood et al., 1989) and blesbok, Damaliscus dorcus phillipsi (Burger et al., 1999).

In addition, bats use a special way of dispersing body fragrance by way of wing flapping and fanning behavior. Males fan the odour by fluttering fast to disperse the scent. Most of the time one wing is folded and the other wing is fluttered over the responding female. Dispersal of odour by self-anointment has been noticed in several mammals, black taileddeer, Odocoileus hemionus, Genetta tigrina, ground squirrel Spermophilus columbianus and fallow deer, Doma doma (Chapman and Chapman, 1975).

Chemical cues during breeding season in bat species play an important role in mate choice, individual identity and also to propagate the reproductive status to colony mates. The chemical signals during non-breeding season mainly help the colony to maintain the social status and roost fidelity.

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Table 1. GC-MS analysis of facial gland of Taphozousmelanopogon (*indicates the Odoriferous compounds)

Types of gland	Male				Female			
	Breeding	**Nature**	**Non-Breeding**	**Nature**	**Breeding**	**Nature**	**Non-Breeding**	**Nature**
Facial gland	Decanoic acid	Acid	Cholesta-7,9(11)-dien-3-ol*	Steroid	Octadecyl ester of Octadecanoic acid*	Ester containing acid	No compounds	
	3-I(1-Oxohexadecyl) oxy] propyl ester of octadecanoic acid	Ester containing acid	-		Decyl ester of Acetic Acid*	Ester containing acid		
	Bis (2-ethyl hexyl ester of 1, 2 Benzene dicarboxylic acid	Ester containing acid			1,1-Di(2-Methoxy phenyl azo Benzene*)	Aromatic		
	2-Bromo-cyclic 1, 2-ethane diyl Cholestan-3-one	Steroid			-	-		

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Table 2. GC-MS analysis of male neck gland of Taphozousmelanopogon(* indicates the odoriferous compound)

Type of gland	Male				Female			
	Breeding	**Nature**	**Non-Breeding**	**Nature**	**Breeding**	**Nature**	**Non-Breeding**	**Nature**
Neck gland	2-[(Oxo dodecyl)oxy]-1,3-propanediyl ester of Octadecanoic acid	Acid with ester	2, Butyl, 1-Octanol	Aliphatic	No specialized glands in the neck region of female			
	2-(1-Methyl ethylidene)-cyclic 1, 2-ethanediyl acetal) Cholestan-3-one	Steroid	3-Phenyl-methyl ester of 4-Isothiazole carboxylic acid	Acid with ester				
	3-(1-Oxohexa decyl) oxy-2-(1-oxotetradecyl) oxy propyl ester of Octadecanoic acid	Acid with ester	-	-				
	(Bromomethyl) methyl bis (hydroxyl imino) heptyl ester of Propanedioic acid*	Acid with ester	-	-				

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Table 3. GC-MS analysis of male and femaleanal gland of Taphozousmelanopogon (* indicates the odoriferous compound)

Type of gland	Male				Female			
	Breeding	**Nature**	**Non-Breeding**	**Nature**	**Breeding**	**Nature**	**Non-Breeding**	**Nature**
Anal gland	-1-Hexadecyl ester of acetate*	Aliphatic ester	No compounds		1, 3, 5, 2, 4, 6-Triazatri phosphor-rine	Phosphorus compound	No compounds	
	Decyl ester of Acetic acid	Aliphatic ester			Estra-1, 3, 5 (10)-trien-17-one*	Steroid		
	1-(3-(Octadecyloxy) propoxyl]-9 Octadecane*	Aliphatic			Prostaglandin*	Steroid		
	Cholestan-3-One*	Steroid			25 Ethyl-24-hydroxy-3- beta-methoxy-4, 4, 14, alpha-trimethyl* cholest-9(11)-ene	Steroid		