

Chemoreception in *Antheraea assama-Exorista sorbillans* complex : Role of host plant chemicals



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Introduction : Host plant specificity and host selection in phytophagous insects are governed largely by responses to chemicals that are characteristic of certain plant taxa. Insects perceive olfactory information by activation of olfactory receptors located in sensilla on the antennae while sapid stimuli are ‘tasted’ through various sensilla located on the mouthparts, antennae and/or legs which contribute to initiating and eventually maintaining feeding and/or oviposition. We examined chemoreception in the Muga silkworm, *Antheraea assama* – a polyphagous species with a restricted host range feeding primarily on *Litsea polyantha* and *Persea bombycina* – host plants that are endemic to Assam. In our attempts to physiologically characterize the gustatory sensilla, we examined their sensitivity to a variety of chemicals grouped as stimulants and deterrents by recording their electrical impulses. In addition, electroantennogram responses (EAG) of the Uzi fly, *Exorista sorbillans*, a notorious parasite of *A.assama*, to host plant and host related chemicals were also evaluated in our efforts to identify compounds that could be used as a trap/bait to lure the parasite.

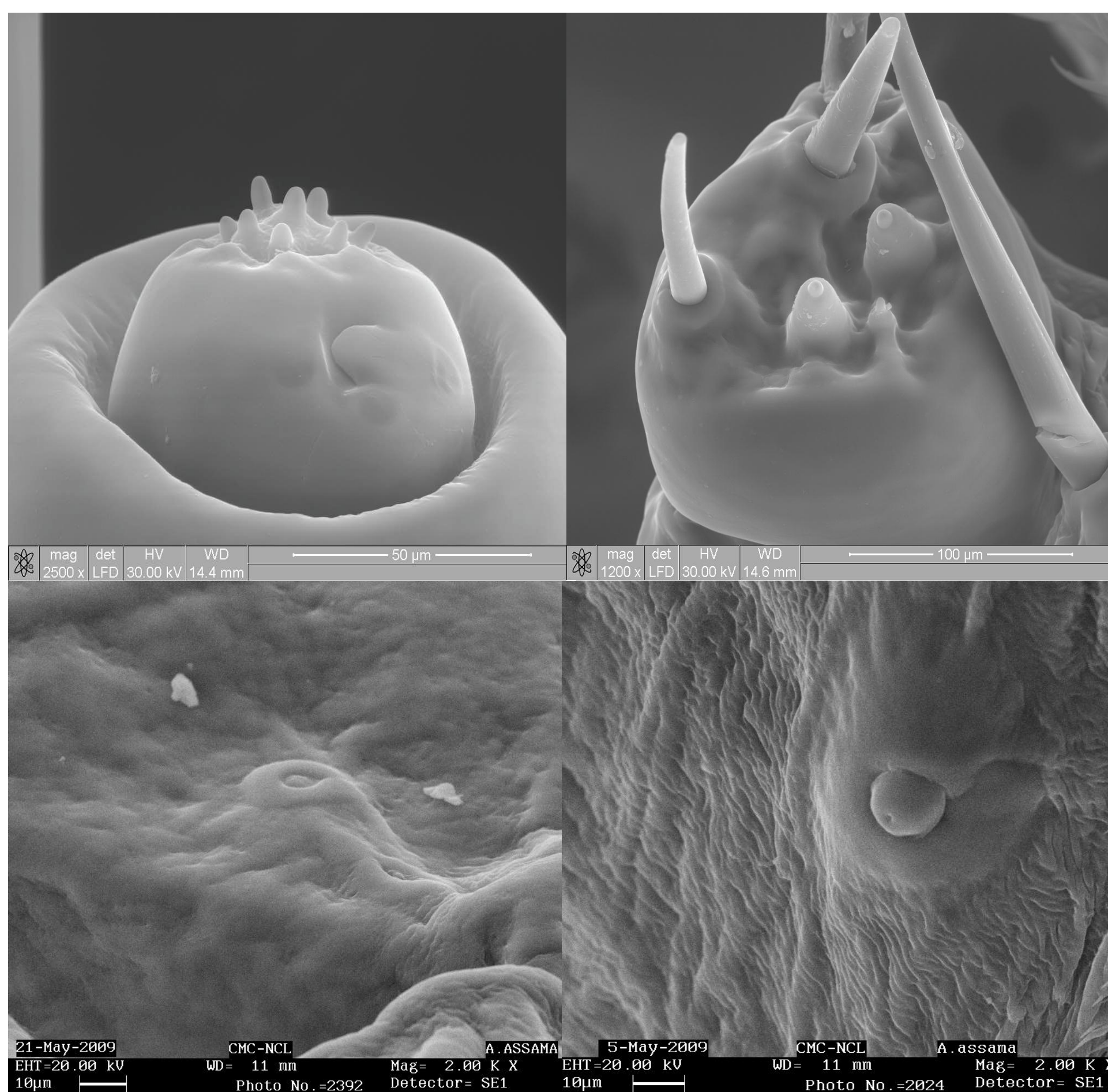
Materials and Methods:

Neural Recordings : We recorded sensory responses from gustatory sensilla of *Antheraea assama* using a non-invasive extracellular tip-recording technique (Gothilf and Hanson, 1994). The recording procedure involved placing a stimulating/recording electrode over the tip of the sensillum and recording the ensuing action potentials from a live and intact preparation. Signals were analyzed offline with the Autospike software.

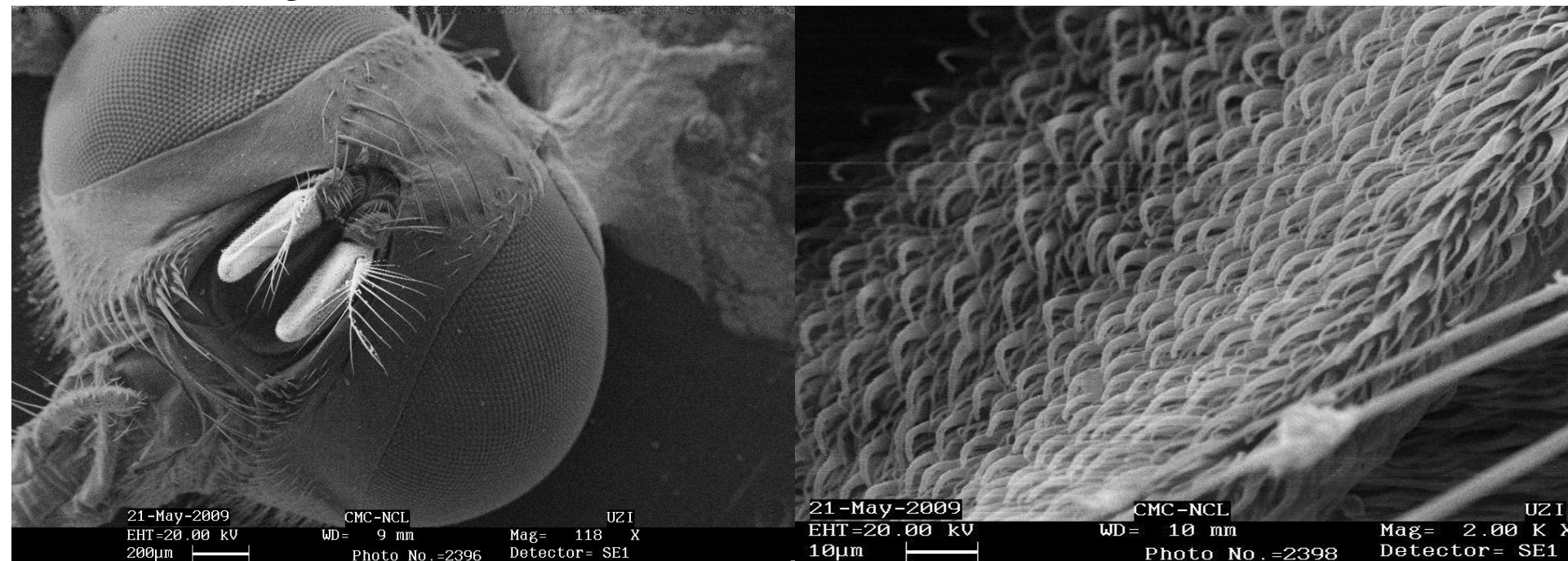
Electroantennograms (EAG): EAG's are the summated slow receptor potentials generated across various sensilla on the antennae. EAG were recorded from 5-6 days old females of *Exorista sorbillans*. The indifferent electrode was placed in the head while the recording electrode was placed over the apical tip of the antennae. An air stimulus controller (Syntech, CS-05) was used for air and odor delivery. With the customized EAG program (Syntech, version 2.6c, 1998), the resulting EAG amplitude was computed as the difference between the baseline level and the maximum reached during stimulation.

Volatile Collections : Plants with or without *A.assama* larvae were placed in a glass bell jar through which charcoal filtered air was passed @ 1L min⁻¹. During collection, air was pulled through traps containing 50mg of Porapak . Volatile compounds were eluted from traps with 150ul of CH₂Cl₂.

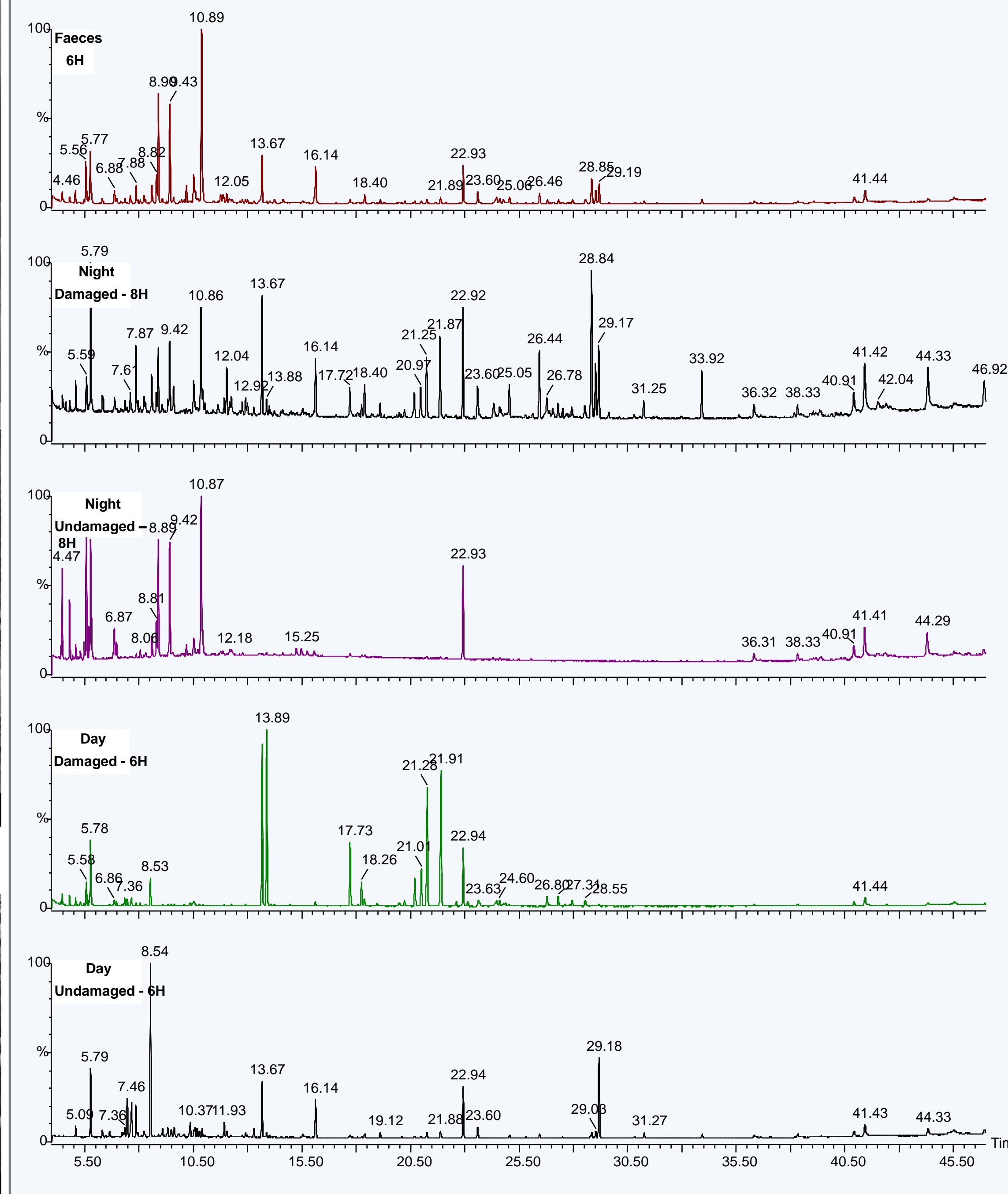
SEM of mouthpart sensilla of *A.assama*



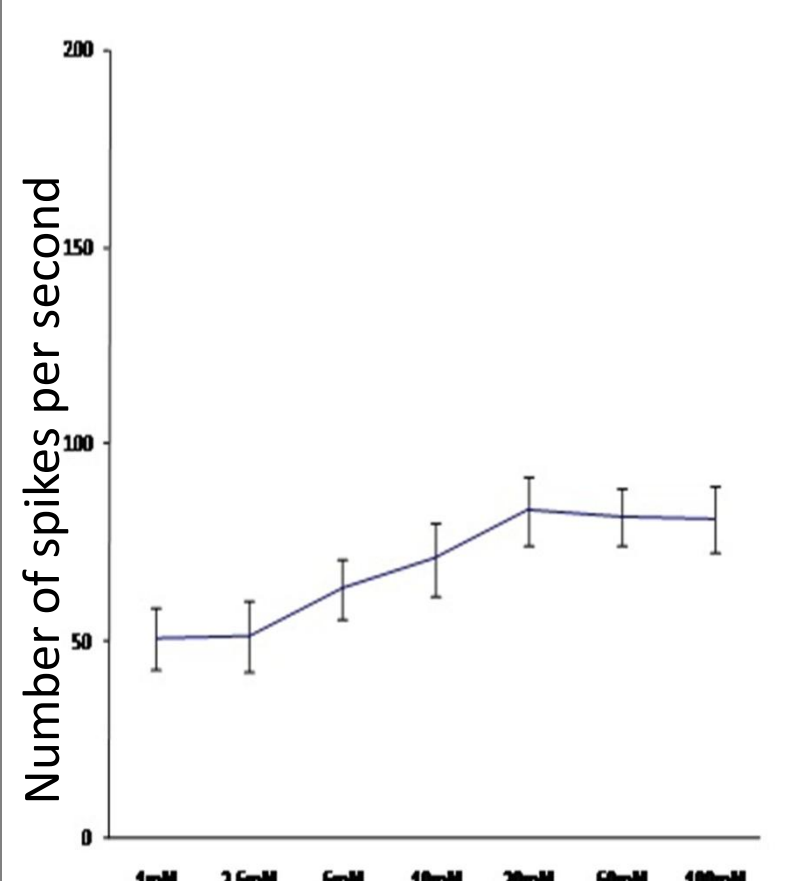
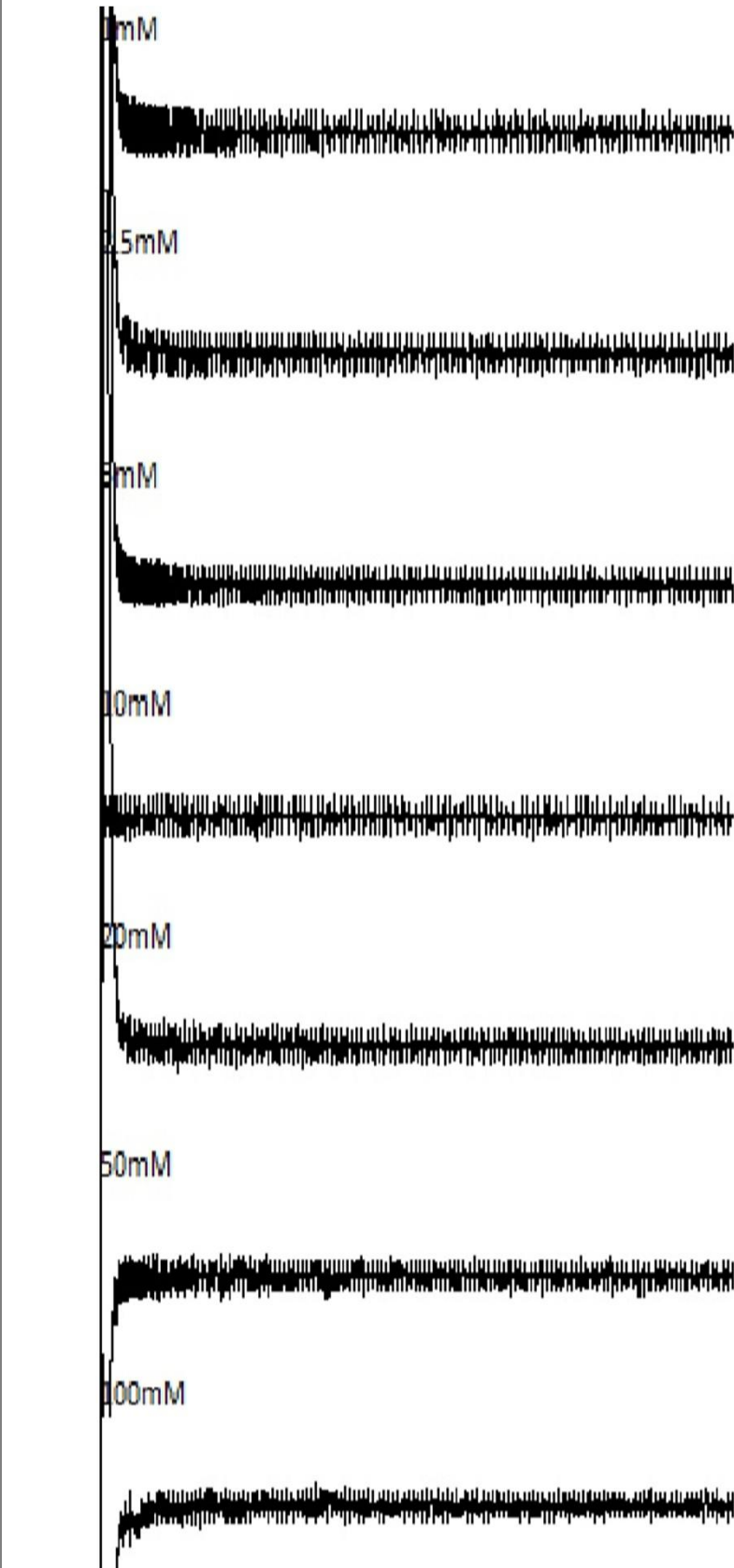
Olfactory sensilla on antennae of *E.sorbillans*



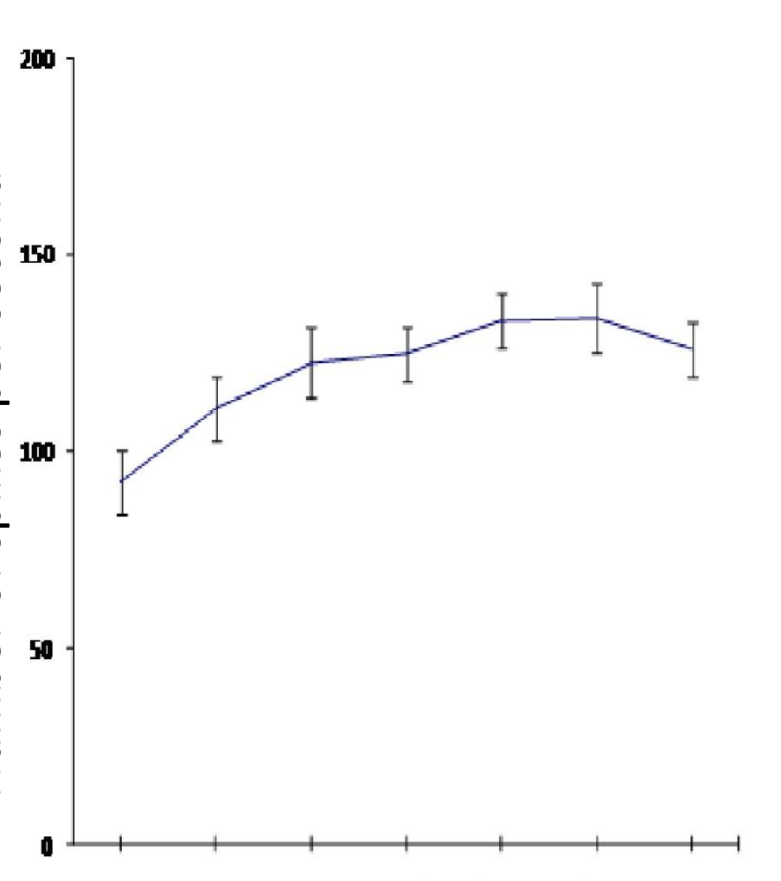
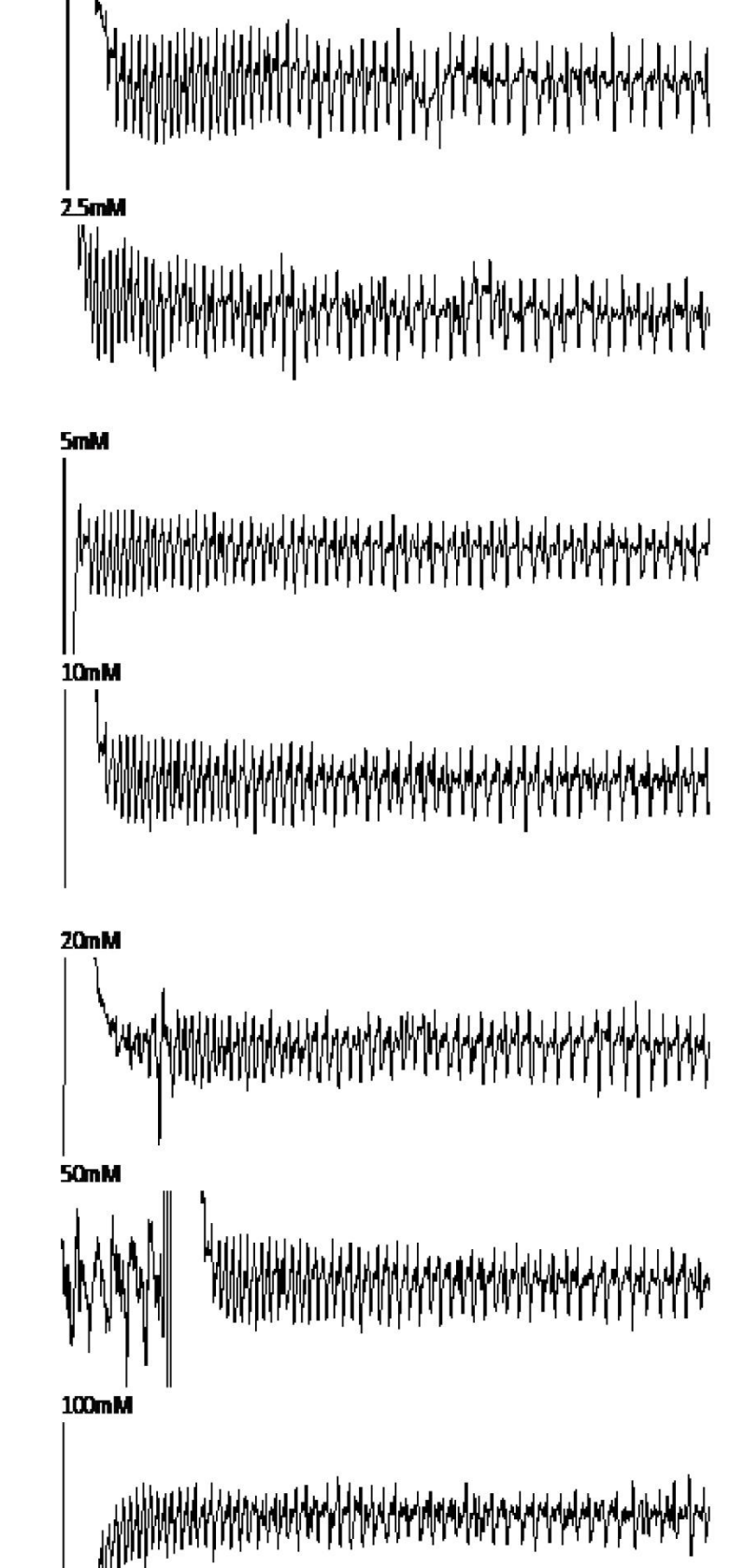
GC Profiles of *A. assama-P. bombycina* complex



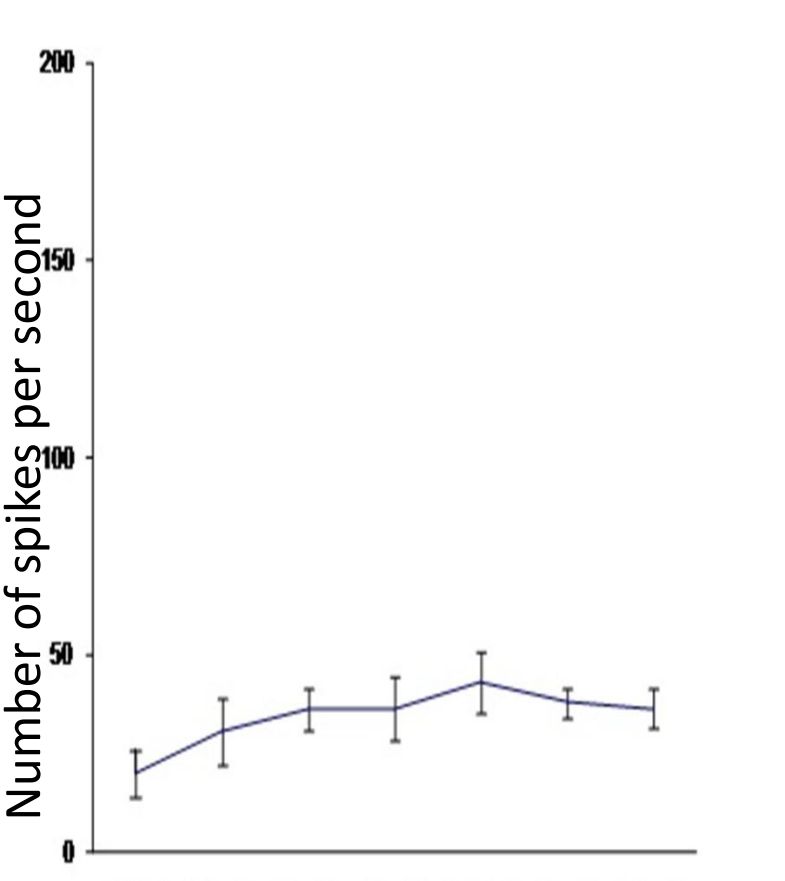
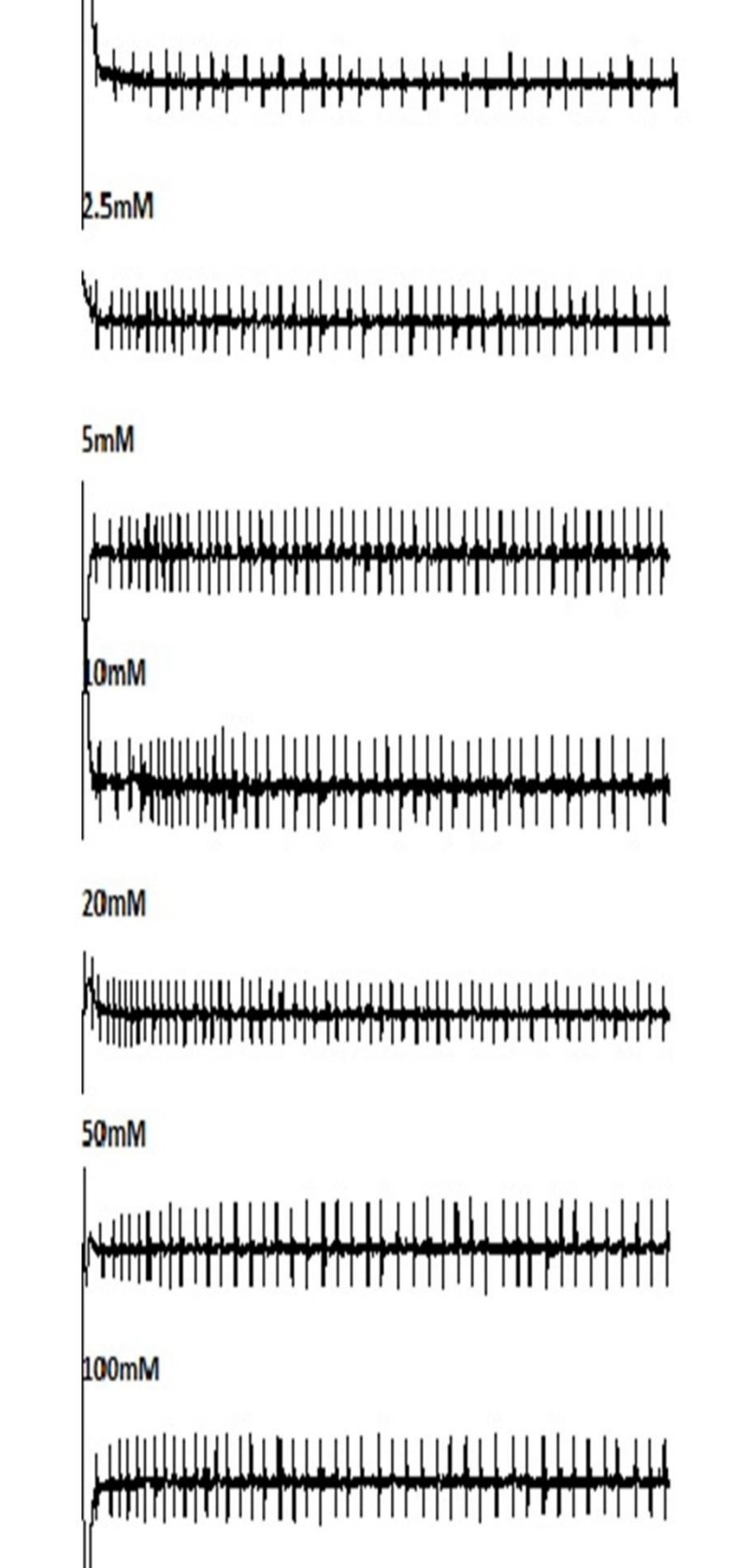
Response of medial sensillum of *Antheraea assama* to increasing concentrations of Inositol



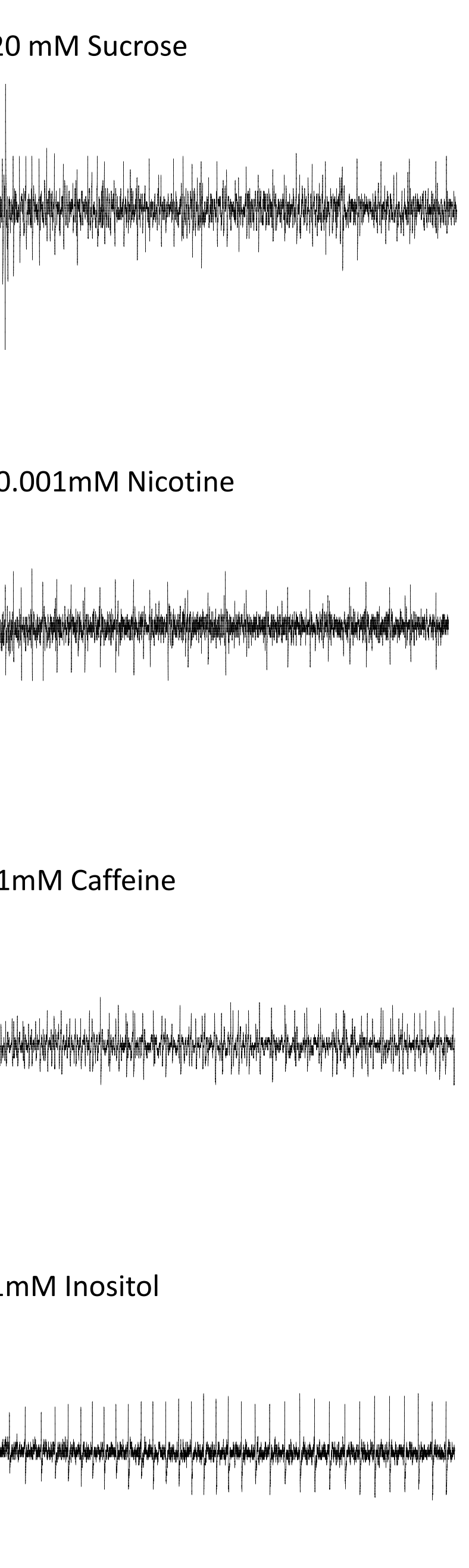
Response of medial sensillum of *Antheraea assama* to increasing concentrations of Sucrose



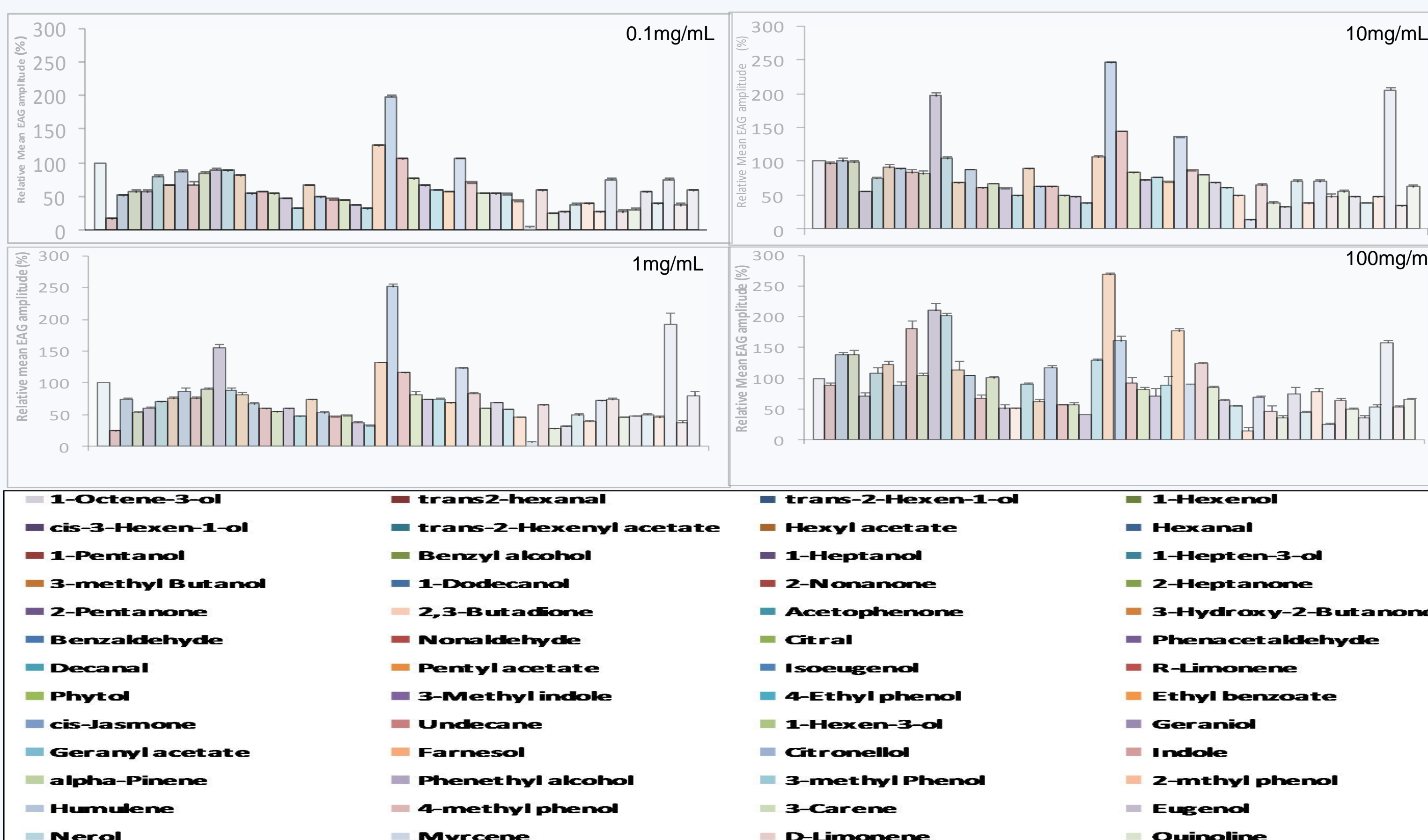
Response of medial sensillum of *Antheraea assama* to increasing concentrations of Nicotine



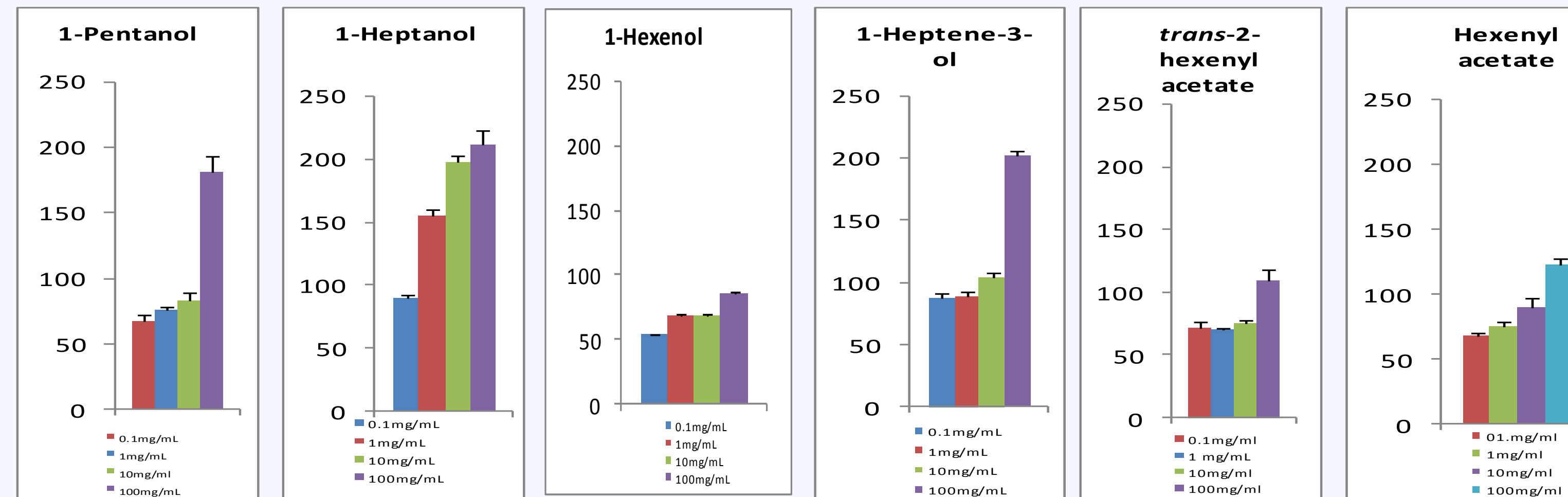
Response of epipharyngeal sensilla to concentration of Sucrose, Nicotine, Caffeine and Inositol



Relative mean EAG amplitudes of *Exorista sorbillans* to phytochemicals



EAG responses to individual chemicals varying in their carbon chain length



Results:

SEM studies : Larvae of *Antheraea assama* possess a pair of uniporous sensilla – lateral and medial sensilla on the maxillary galea. On the tip of the maxillary palpi, there are eight sensilla, five of which are uniporous and three are olfactory. A digitiform sensilla is observed on the distal segment of the maxillary palpus. At the base of the bilobed epipharynx, two sensilla are observed – a campaniform and a coeloconic sensilla, the latter being gustatory.

Gustation in *A.assama* larvae: Electrophysiological characterization of the medial and lateral sensilla styloconica reveal that they are sensitive to a wide group of chemical compounds including sugars and sugar alcohols, salts, deterrents and plant saps. The strongest response was obtained with inositol in the medial sensillum while the lateral sensillum responded strongly to sucrose. In addition, a cell in the medial sensillum responds to deterrents such as caffeine, salicin and nicotine. The epipharyngeal sensillum responds to inositol, sucrose and deterrents such as nicotine, salicin and caffeine.

Electroantennogram studies : In order to identify compounds that are primarily important in the olfactory orientation of the uzi fly, *Exorista sorbillans*, electroantennogram studies were conducted to evaluate volatile chemicals belonging to different chemical classes. Each of the 52 chemicals exhibit concentration dependent responses and among the fatty acid derivatives, the alcohols elicited higher responses than the aldehydes. The response of acetates was similar to that of alcohols. Compounds with odd number of carbon atoms elicited higher responses. Other than myrcene, all other hydrocarbon monoterpenes elicit low responses as also the oxygenated monoterpenes such as citronellol, farnesol, phytol etc.

GC-MS analysis : Qualitative and quantitative differences are observed in the volatile profiles of *Persea bombycina* day and night time collections as well as between damaged and undamaged plants both during day and night. Night damaged plants released high amounts of α -pinene, α -phellandrene, D-limonene, farnesol, caryophyllene and germacrene-D while α -pinene, (E)-3-carene-3-ol, ethyl benzaldehyde and azulene were released in plants damaged during the day. Presence of large amounts of acids, viz., 9-octadecanoic acid, tridecanoic acid and (E)-9-octadecanoic acid were observed in undamaged plants. Interestingly, several of these compounds were identified in the faeces.

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