

อัลตราสตรักเจอร์และเฟอโรโมนของต่อมแมนติบูลาร์ในกลุ่มผึ้งงานที่หาอาหาร  
ที่พบในประเทศไทย

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ULTRASTRUCTURE AND PHEROMONES OF THE MANDIBULAR GLANDS  
OF HONEYBEE FORAGERS IN THAILAND

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อัลตราสตรักเจอร์ของต่อมแมนดิบูลาร์ในกลุ่มผึ้งงานที่หาอาหารในประเทศไทย ได้วิจัยด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราด (SEM; JSM 5410 LV) พบต่อมแต่ละข้างของผึ้ง *Apis andreniformis* ผึ้ง *A. florea* และ ผึ้ง *A. dorsata* มีจำนวน 2 พู ตั้งอยู่ที่ส่วนฐานของกรามแต่ละข้าง สำหรับผึ้ง *A. cerana* และ ผึ้ง *A. mellifera* มีข้างละ 1 พู พบแขนงท่อลมเล็กๆ แทรกอยู่ที่ผิวของต่อมในผึ้งทุกชนิด พบเนื้อเยื่อเกี่ยวพันคลุมตัวต่อม แต่ไม่พบการเชื่อมโยงของใยประสาท ขนาดของต่อมแตกต่างกัน โดยมีขนาดเส้นผ่านศูนย์กลางด้านกว้าง 182 , 225, 553, 422 ,515 ไมโครเมตรและขนาดเส้นผ่านศูนย์กลางด้านยาว เป็น 217, 341, 644, 512 และ 607 ไมโครเมตร ในผึ้ง *A. andreniformis* ผึ้ง *A. florea* ผึ้ง *A. dorsata* ผึ้ง *A. cerana* และ ผึ้ง *A. mellifera* ตามลำดับ นอกจากนี้ยังได้ศึกษาในรายละเอียดของต่อมแมนดิบูลาร์ในกลุ่มผึ้งงานที่หาอาหารนี้ ด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องผ่าน (TEM; JEOL 200SX) พบว่าโครงสร้างโดยทั่วไปคล้ายกันและจัดเป็นต่อมชนิด tubulo alveolar ประกอบด้วยเซลล์สามชนิดคือ เซลล์ชนิดที่ 1 เป็นเซลล์รูปร่างลูกบาศก์ นิวเคลียสกลม ใหญ่ ตั้งอยู่บริเวณส่วนต้นของต่อม เซลล์ชนิดที่ 2 เป็นเซลล์ที่ย้อมติดสีเข้ม อยู่ติดกับเซลล์ชนิดที่ 3 ซึ่งเซลล์ชนิดที่ 3 เป็นเซลล์ที่ย้อมติดสีจาง ตั้งอยู่ล้อมรอบแอ่งบรรจุของเหลวของต่อม ขนาดของเซลล์แต่ละชนิดแตกต่างกัน โดยขนาดใหญ่สุดพบในผึ้ง *A. dorsata*, *A. mellifera*, *A. cerana*, *A. florea* และ *A. andreniformis* ตามลำดับ พบเม็ดแกรนูลขนาดใหญ่ในผึ้ง *A. mellifera* ชัดเจน ในขณะที่ไม่ปรากฏในผึ้ง *A. dorsata* , *A. cerana*, *A. florea* และ *A. andreniformis*.

จากการวิเคราะห์สาร 2-heptanone ในต่อมแมนดิบูลาร์ในกลุ่มผึ้งงานที่หาอาหาร โดยเครื่องแก๊สโครมาโทกราฟี (GC-Hewlett 5890 series II) และเครื่องแก๊สโครมาโทกราฟี แมสสเปกโทเมทรี (GC-MS Saturn Varian 4D) พบปริมาณ 0.205, 0.425, 1.322 และ 7.076 ไมโครกรัมต่อตัว ในผึ้ง *A. andreniformis* ผึ้ง *A. dorsata* ผึ้ง *A. cerana* และ ผึ้ง *A. mellifera* ตามลำดับ ไม่พบปริมาณ 2-heptanone ในผึ้ง *A. florea* การวิเคราะห์ชนิดของสารที่เป็นองค์ประกอบหลักของเฟอโรโมนของต่อมแมนดิบูลาร์ในกลุ่มผึ้งดังกล่าว พบสารที่เป็นองค์ประกอบหลักคือ 1-eicosanol เป็นสารที่มีคุณสมบัติในการดึงดูดชักนำผึ้งตัวอื่น และพบสาร 70% ของสารที่เป็นองค์ประกอบหลัก 10 ชนิดของผึ้งทั้ง 5 species เป็นสารที่ซ้ำกันอยู่ 7 ชนิด แต่มีสัดส่วนของสารแต่ละชนิดแตกต่างกัน ได้แก่สาร 2-butyl-1-octanol, dibutyl phthalate, eicosane, 1-eicosanol, heneicosanol, 2-hexyl-1-decanol และ nonadecane ส่วนในกลุ่มผึ้งพื้นเมืองทั้ง 4 species พบ 80% ของสารที่เป็นองค์ประกอบหลักเป็นสารที่ซ้ำกันอยู่ 8 ชนิด แต่มีสัดส่วนที่แตกต่างกัน ได้แก่ 1-butanol-3-methyl acetate, 2-butyl-1-octanol, dibutyl phthalate, eicosane, 1-eicosanol, heneicosanol, 2-hexyl-1-decanol และ nonadecan.

ภาควิชา ชีววิทยา  
สาขาวิชา วิทยาศาสตร์ชีวภาพ  
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ลายมือนิสิต.....  
ลายมืออาจารย์ที่ปรึกษา.....  
ลายมืออาจารย์ที่ปรึกษาร่วม.....

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ULTRASTRUCTURE

GUNTIMA SUWANNAPONG: ULTRASTRUCTURE AND PHEROMONES OF  
THE MANDIBULAR GLANDS OF HONEYBEE FORAGERS IN THAILAND.  
THESIS ADVISOR: PROF. SIRIWAT WONGSIRI, Ph.D. THESIS-COADVISOR:  
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The ultrastructure of the mandibular glands of honeybee foragers in Thailand were investigated by using SEM (JSM 5410 LV) showed that they are divided into two groups: two pair of lobed glands which are found in *A. andreniformis*, *A. florea* and *A. dorsata*, and one pair of lobed glands which are found in *A. cerana* and *A. mellifera*. These glands are associated with a dense net of tracheoles and covered by connective tissue; however, no nerve ending can be observed. In addition, average gland sizes are 182, 225, 553, 422 and 515  $\mu\text{m}$  in width, and 217, 341, 644, 512 and 607  $\mu\text{m}$  in length of *A. andreniformis*, *A. florea*, *A. dorsata*, *A. cerana* and *A. mellifera*, respectively. The ultrastructure of these glands using TEM (JEOL-200CX) showed that the secretory glands are tubulo-alveolar glands. Each gland is composed of three cell types. The type I cell is composed of aggregated cuboid cells with lenticular nucleus, locate at the proximal part of glands. The cell type II are electron dense staining cells, which are composed of rich mitochondria, smooth endoplasmic reticulum and various vesicles. These cell types are located beneath the cell type I and adjacent to cell type III or electron light staining cells which contain few mitochondria and enlarged vesicles. These two cell types surround the central reservoir. However, the extra organelles, large dark granules, are found distributed randomly only in cytoplasm of cell type III of *A. mellifera* foragers.

The mandibular gland pheromones of honeybee foragers in Thailand were analyzed by using gas chromatography (GC-Hewlett 5890 series II) and gas chromatography mass spectrometry (GC-MS Saturn Varian 4D). The level of 2-heptanone in *A. andreniformis*, *A. dorsata*, *A. cerana* and *A. mellifera* are 0.205, 0.425, 1.322 and 7.076  $\mu\text{g}/\text{bee}$ , respectively. However, it was undetectable in *A. florea*. The main components of mandibular gland pheromones of *A. andreniformis*, *A. florea*, *A. dorsata*, *A. cerana* and *A. mellifera* are 1-eicosanol which act as attractant pheromones. The ten main components of mandibular gland pheromones are homologous for 70% of the chemicals with different proportions: 2-butyl-1-octanol, dibutyl phthalate, eicosane, 1-eicosanol, heneicosanol, 2-hexyl-1-octanol and nonadecane. Furthermore, 80% homology of ten main components with different proportions are found among native honeybee species: 1-butanol-3-methyl acetate, 2-butyl-1-octanol, dibutyl phthalate, eicosane, 1-eicosanol, heneicosanol, 2-hexyl-1-octanol and nonadecane.

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Guntima Suwannapong

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