2023-2024 School of Exercise and Nutritional Sciences Student Research Grant Report

Authors: Selene Alvarado Martinez, Changqi Liu

Title: Exploring Flavors of Edible Ants: A Path to Sustainable Gastronomy and Consumer Acceptance

Purpose: Our study was aimed at understanding the flavor profiles of different ant species which are essential for creating appealing insect-based products that can overcome disgust-based aversions associated with insect consumption.

Methods: To explore the flavor profiles of these edible ants, the volatiles of leaf cutting ants (*Atta mexicana*), common black ants (*Lasius niger*), spiny ant pupae and adults (*Polyrhachis* sp.), and weaver ant workers and queens (*Oecophylla smaragdina*) were analyzed using headspace solid-phase microextraction (SPME) and gas chromatography-olfactometry-mass spectrometry. Approximately 2 g of insect powders was added to a headspace vial. The vial was hermetically sealed and incubated at 70 °C for 10 min to release the volatile compounds. SPME fiber was used to extract the volatile compounds for 20 min at 70°C. After the extraction, the fiber was transferred into the injector (250 °C) of the GC system using helium as a carrier gas with a flow rate of 1 mL/min. Volatile compounds were separated on an apolar capillary column. The GC oven temperature was first set at 35 °C, held for 5 min, and increased at 5 °C/min up to 200 °C, and then from 200 to 245 °C at 15 °C/min. The temperature of transfer line was maintained at 250 °C. Volatile compounds were identified by comparing the mass spectrum of each peak to that from the NIST library. A sensory panel evaluated the aroma profiles and intensities of the edible ant samples in duplicate. The panel defined the flavor profile for each sample by recording the descriptors that they sensed. The intensity of the odor descriptors was evaluated using a 4-point-scale recording meter device used in conjunction with the olfactometer.

Results: Our study revealed distinctive odor profiles for different ant species. The common black ants were characterized by a pungent, acidic, and vinegary smell primarily due to their high formic acid content, a secretion from their venom glands. Additionally, numerous Dufour gland alkanes such as tridecane, undecane, and pentadecane, known to act as alarm pheromones, were detected in this species. Like common black ants, the adult spiny ants contained formic acid. In contrast, the pupa did not contain formic acid, because venom glands grow as they mature. Weaver ants were characterized as having a nutty, sweet, and caramel-like aroma due to the presence of various pyrazines and pyrroles. However, they also possess hay and urine-like off-flavors likely due to compounds such as isobutyraldehyde, ammonium acetate, and amines. Leaf-cutting ants exhibited nutty, roasty, woody, and fatty notes. Unlike Formicinae ants, leaf-cutting ants did not contain formic acid. Instead, they had alarm pheromone 4-methyl-3-heptanone and trail pheromone 2,5-dimethylpyrazine. The fatty aroma of leaf-cutting ants was probably attributed to their abundant presence of aldehydes such as hexanal, octanal, and nonanal.

Conclusion: In addition to being a sustainable protein source, edible insects can also lend unique flavors to food. Flavor profiles of edible insects vary considerably between different species, metamorphosis stages, and processing conditions. More research is needed to evaluate the flavor profiles of edible insects based on feed as well.