

Effects of Giant Water Bugs Scent on the Autonomic Nervous System

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Abstract

Giant water bugs (*Lethocerus indicus* Lep. and Serv.) or “Maengdana” (แมงดานา) is one of famous edible insects in Thailand. Although their aromatic essence is chiefly used as savory additive in Thai chili sauce or *nam-prik*, the effect of autonomic nervous system in response to giant water bug scent has not yet been studied. The purpose of this study was to investigate the effect of giant water bugs scent on autonomic nervous system, including blood pressure, heart rate, respiratory rate and skin temperature. The 30 healthy people aged 20-40 years were selected by purposive sampling method. Before the experiments, general health data were collected from each subject by employing questionnaire. During inhalation, their vital signs were monitored using vital sign recorders. All data were analysed using frequency, percentage, average and standard deviation (SD). Paired t-test was applied to compare the results after inhaling almond oil and giant water bug odours. Results from these studies indicate that giant water bugs scent affects autonomic nervous system resulting in significant changes of heart rates, respiratory rate and skin temperature.

Keywords : Giant water bugs, autonomic nervous system, essential oil

บทคัดย่อ

ปัจจุบันการใช้กลิ่นแมงดานามีอย่างแพร่หลายในการปรุงแต่งอาหาร แต่ยังไม่พบการวิจัยด้านผลกระทบต่อระบบประสาทอัตโนมัติ วัตถุประสงค์ของการวิจัยนี้เพื่อศึกษาผลของการดมกลิ่นแมงดานาต่อระบบประสาทอัตโนมัติ ได้แก่ ความดันโลหิต อัตราการเต้นของหัวใจ อัตราการหายใจ และอุณหภูมิผิวหนัง กลุ่มตัวอย่างที่ใช้ในการศึกษาผ่านการคัดกรองจากกลุ่มสุขภาพดีจำนวน 30 คน โดยเลือกแบบเจาะจง เครื่องมือที่ใช้ในการวิจัยได้แก่ เครื่องวัดสัญญาณชีพ แบบสอบถามข้อมูลสุขภาพ แบบบันทึกสัญญาณชีพ ผู้วิจัยเก็บรวบรวมข้อมูลด้วยตนเองและได้ดำเนินการเมษายน 2557 ถึงเดือนกรกฎาคม พ.ศ. 2558 ทำการวิเคราะห์ข้อมูลพื้นฐานของกลุ่มตัวอย่าง และข้อมูลที่ได้ โดยใช้สถิติการแจกแจงความถี่ โดยใช้ค่าสถิติแจกแจงความถี่ ร้อยละ ค่าเฉลี่ยเลขคณิต และส่วนเบี่ยงเบนมาตรฐาน เปรียบเทียบผลการเปลี่ยนแปลง ระบบประสาทอัตโนมัติ ขณะได้รับกลิ่นน้ำมันอัลมอนด์ และกลิ่นแมงดานาโดยใช้สถิติ Paired t-test ผลการวิจัยพบว่ากลิ่นของน้ำมันสกัดจากแมงดานามีผลต่อระบบประสาทอัตโนมัติ ทำให้ อัตราการเต้นของหัวใจ อัตราการหายใจเพิ่มขึ้น และอุณหภูมิของผิวหนังลดลง อย่างมีนัยสำคัญทางสถิติ

คำสำคัญ : แมงดานา ระบบประสาทอัตโนมัติ น้ำมันหอมระเหย

1. Introduction

Giant water bug (*Lethocerus indicus* Lep. and Serv.) or “Maengdana” in Thai are large aquatic insect (3–5 cm in length) which are abundant in the northern and north-eastern parts of Thailand and in other parts of Southeast Asia, such as Laos, Vietnam and Cambodia. Only the male giant water bug has scent glands which contain sex pheromones responsible for the strong and desirable odour. Its has been used as an essential ‘flavour’ component of Thai chili paste, or *nam prik*, and as an ingredient in some types of fish sauce or other food dishes in Thailand and in some other south-east Asian countries (Patthamawadi, 2015). Hence, the added odour or scent of male bugs is important for consumer acceptance in those food products. Devakul and Maarse (1964) studied the gland liquid of the abdominal reservoir of giant water bug and reported that the major volatile constituent was (*E*)-2-hexenyl acetate, with (*E*)-2-hexenyl butanoate which are an important character-impact odorant in male giant water bug aroma. It is generally known that inhalation of aromas caused psychological changes in humans via the sense of smell or olfactory system which in turn cause a physiological effect (Tapanee, 2004). Despite that knowledge, the effect of giant

water bug scent on autonomic nervous responses has not yet been addressed. In this study, the effects of giant water bug scent on blood pressure, respiratory and heart rates were then evaluated.

2. Objective

To study the change in functioning of the autonomic nervous system, including blood pressure, heart rate, respiratory rate and skin temperature upon inhalation of giant water bug scent.

3. Materials and methods

The oil was analyzed by a gas chromatography/mass spectrometry (GC/MS) equipped with a Finnegan DSQ MS detector, (Model Trace GC Ultra, Thermo Finnegan). The oil's constituents were matched by their mass spectra and retention times as indicated in the NIST05 MS library (Hübschmann, 2009). The giant water bug oil used in this study was obtained by steam distillation. Its chemical composition was analyzed by gas chromatography/mass spectrometry (GC/MS) and the main components were identified to be (*E*)-2-hexenyl acetate (85.79%) and (*E*)-2-hexenyl butanoate (13.28%).

The healthy subjects (15 males and 15 females) aged 20-40 years with normal body mass index (mean 20.79 ± 1.69) were selected by a purposive sampling specific selection method. Handedness was also tested using Edinburgh Handedness Inventory scale, as a number of studies showed differences in activity between the left-handed and right-handed subjects during olfactory tasks, and only right-hander was used. They were screened for a normal sense of smell by the n-butyl alcohol method test (mean score 9.75 ± 0.76). All subjects freely agreed to volunteer in this study. Each of them read and signed consent form before participating in the experiments. The protocol of this study was approved by the Human Research Ethics Committee of Rangsit University No. RSEC 08/2555. Giant water bugs oil obtained by steam distillation) and base oil (sweet almond oil was purchased from Honghuat Co.,Ltd.) at 10%v/v concentration was delivered from oxygen pump system through a plastic tube via a face mask that permitted selective routine air flow (2L/min). Before the experiment, all the participants were not allowed to use hair spray, antiperspirants or perfume. In addition, alcohol, cigarettes and caffeinated products were also avoided. None of them felt fatigued or drowsy during the experiment date.

All the experiments were performed in a quiet air-conditioned room ($24 \pm 1^{\circ}\text{C}$) with 40-60% humidity. Each subject was seated comfortably in an armed-chair and was acclimated for 10 min during which pulse rate, respiration rate, and blood pressure were monitored using vital signs monitor (Model M 7000, Guangdong Biolight Meditech Co., Ltd). In the first experiment, sweet almond oil was applied through 2 liter/min-pressure oxygen tank for 10 min, and blood pressure, heart rate respiratory rate and skin temperature were recorded for every 5 min, 1 min, and 1 min, respectively. In the second experiment, mixture of giant water bug oil and sweet almond oil was used in replacement and the vital signs were monitored as before.

The frequency distribution, percentage, average and standard deviation (SD) of the data were analyzed and the paired t-test was applied to compare the difference between values obtained before and after smelling each sample.

4. Results

The effects of giant water bug scent on autonomic nervous system including blood pressure, heart rate, respiratory rate and skin temperature are shown in Table 1 and Table 2.

Table 1 Mean and SD values of systolic and diastolic blood pressure changes under resting, sweet almond oil and giant water bug oil inhalations.

State	Systolic Blood Pressure (mmHg)		p-value	Diastolic Blood Pressure (mmHg)		p-value
	Mean	SD		Mean	SD	
Resting	109.41	8.95		64.14	6.20	
Sweet almond oil	110.81	10.57	0.329 ^A	65.36	6.74	0.252 ^A
Sweet almond oil + Giant water bug oil	112.25	9.38	0.261 ^B	66.46	7.01	0.100 ^B

* at 95 % confidence level, A = compared resting with sweet almond oil after scent inhalations, B = compared sweet almond oil with giant water bugs after scent inhalations.

The mean and standard deviation (SD) values of systolic and diastolic blood pressures measured during resting, sweet almond oil and giant water bug oil inhalations are presented in Table 1. In comparison to resting stage, sweet almond oil inhalation caused no change in systolic and diastolic blood pressures (p value > 0.05). When the subjects inhaled sweet almond oil containing giant water bug oil, the results were not significantly different from those of sweet almond oil alone (p value > 0.05).

Table 2 Mean and SD values of heart rate, respiratory rate and skin temperature changes under resting, sweet almond oil and giant water bug oil inhalations.

State	Heart rate (beat/min)		p -value	Respiratory rate (bpm)		p -value	Skin temperature ($^{\circ}$ C)		
	Mean	SD		Mean	SD		Mean	SD	
Resting	68.23	8.48		15.97	6.20		31.24	2.33	
Sweet almond oil	67.67	10.28	0.607 ^A	16.72	6.74	0.172 ^A	31.25	1.16	0.996 ^A
Sweet almond oil + Giant water bug oil	69.54	8.72	0.027 ^{B*}	17.75	7.01	0.038 ^{B*}	30.45	2.48	0.041 ^{B*}

* at 95 % confidence level, A = compared resting with sweet almond oil after scent inhalations, B = compared sweet almond oil with giant water bugs after scent inhalations

The mean and standard deviation (SD) values of heart rate, respiratory rate and skin temperature changes under resting, sweet almond oil and giant water bug oil inhalations are presented in Table 2. The results showed that inhalation of sweet almond oil only did not affect heart rate, respiratory rate and skin temperature as compared to resting stage. Giant water bug scent, however, increased not only heart rate but respiratory rate (p value < 0.05). On the other hand, the skin temperature became decreased upon its inhalation (p value < 0.05).

5. Discussion

From the experimental results, it is apparent that giant water bug scent causes some effects on autonomic nervous system by increasing heart rate and respiration rate but lowering body temperature. In comparison to inhaling sweet almond oil. It is likely that the compound responsible for the activity of giant water bug odor is hexen-1-yl acetate comprising of 85% from the structure of a substance aliphatic acids and esters. These compounds vary in smells according to the number of carbon atoms. This is the first report of this compound in giant water bug oil and its physiological effects. Previously, most reports of this group of compounds were from mint plants, for example trans-2-hexenyl acetate in the oil of peppermint oil, cis-3-hexenyl isobutyrate in spearmint oil and benzyl acetate in jasmine oil. In the previous study topical application of jasmine oil was found to increase blood pressure, the rate of breathing and also emotional arousal (Tapanee, 2010). Consistent with another finding (Winai, 2011) that when volunteers smell jasmine oil, their blood pressure, heart rate and breathing rate became increased. In terms of emotion, it also made them feel good, fresh and also relaxed. The study of inhalation of peppermint oil by healthy volunteers during sleeping was found to increase heart rate and keep them more alert (Kikuchi et al., 1992).

6. Conclusion

Results from this study indicate that giant water bug scent affects autonomic nervous system by increasing heart rate and respiratory rate, decreasing skin temperature but has no effect on both systolic and diastolic blood pressures.

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