Physiology Final Lab Report

Change in Heart Rate and Body Temperature Varies With the Consumption of Different Types of Peppers

Monday Computer # 2

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Hypothesis

Heart rate and core body temperature will increase when the subject eats a pepper. In looking at the effect of the hotness of the pepper, heart rate and core body temperature will increase more when the subject consumes a pepper with a higher Scoville score.

Specific aims

We will record the ECG and core body temperature of our subjects before they eat the peppers after they eat the jalapeno pepper, and after they eat the ghost pepper. We will analyze the ECG traces and the changes in the core body temperature of the subjects to gain an understanding of how pepper consumption affects the electrical and mechanical events of the cardiac cycle as well as the body's ability to make and get rid of heat.

Background

Some individuals enjoy spicy foods while others can't tolerate spices. The motivation behind this study is to see how the body interprets a spicy stimulus. When spicy food is consumed, individuals describe the sensation as hot. Hot is a word that is often used to showcase a rise in temperature. So, does this mean the internal temperature rises when one consumes chili? In this lab, we will monitor the change in core body temperature and heart rate after consuming chilies.

Capsaicin is a component that is found in chili peppers. Capsaicin is produced in the plant genus *Capsicum* and gives chilies its pungent odor and spicy effect. According to Christina Wu Nasrawi and Rose Marie Pangborn, the burning sensation in the mouth caused by capsaicin consumption is due to the presence of 3-methoxy-4-hydroxy-benzyl residue [2]. In this experiment, we have used two types of chilies: Ghost pepper (800,000 – 1,001,300 SHU) and Jalapeno (2,500 - 8,000 SHU). The notation SUH is an abbreviation for Scoville Heat Units.

SHU is computed by extracting the capsaicin, then diluting it with sugar solution until the irritant cannot be tasted. The scientific name of ghost peppers is *Capsicum chinense*; Whereas, the scientific name for Jalapeno is *Capsicum annuum*. The amount of capsaicin determines the intensity of the effect the molecule has.

According to the study *Detection and modulation of capsaicin perception in the human oral cavity*, capsaicin is an irritant that affects the oral cavity in a thermal and nociceptive manner [1]. This shows that capsaicin triggers the pain receptors as well as the temperature receptor, hence inducing a sensation described as hot. The body detects capsaicin as an irritant when it induces pain and temperature. In response to the stimulus, the body activates physiological systems to reduce the temperature increase and pain by removing the irritant.

Materials

- BIOPAC Electrode Lead Set (SS2L)
- BIOPAC Disposable Electrodes (EL503) 3 electrodes per subject
- Biopac Student Lab System: BSL 4 software, MP36 or MP35 hardware
- Computer System
- Thermometers
- Thermometer probe covers
- Jalapeño
- Ghost pepper

Methods

In order to complete this experiment, two different peppers were used based on their Scoville scores. The two types of peppers that were used included jalapeño and ghost pepper. We

attached three electrodes and clip leads in the Lead II setup. We placed the white lead (-) on the right forearm, the black lead (ground lead) on the right leg, and the red lead (+) on the left leg. As we began calibrating, each subject was seated, relaxed, and facing away from the monitor. First, we recorded the subject's body temperature and heart rate before and after eating the jalapeño. Then, we recorded the subject's body temperature and heart rate after eating the ghost pepper. This process was repeated by six different subjects.

Results

Table 1: Comparison of heart rate when consuming different peppers

Subject	At rest	Jalapeno	Ghost Pepper	ΔHR (Jalapeno)	ΔHR (Ghost Pepper)
AJ	74.2 bpm	102.38 bpm	112.94 bpm	28.18 bpm	38.74 bpm
Romessa	67.2 bpm	98.4 bpm	128.2 bpm	31.2 bpm	61.0 bpm
Ahmad	63.5 bpm	97.56 bpm	114.1 bpm	34.06 bpm	50.6 bpm
Mary	77.7 bpm	96.2 bpm	112.2 bpm	18.5 bpm	34.5 bpm
Pablo	69.5 bpm	122.4 bpm	144.88 bpm	52.9 bpm	75.38 bpm
John	66.5 bpm	93.75 bpm	120.48 bpm	27.25 bpm	53.98 bpm
Mean	69.77 bpm	101.78 bpm	122.13 bpm	32.015 bpm	52.37 bpm

Where BPM= beats per minute, HR= heart rate

Table 2: Comparison of Core Body Temperature (CBT) when consuming different peppers

Subject	At rest	Jalapeno	Ghost Pepper	Heart rate (Jalapeno)	ΔCBT (Ghost Pepper)
AJ	35.8°C	36.6°C	38.1°C	.8 °C	2.3°C
Romessa	36.1°C	36.6°C	37.9°C	.5°C	1.8°C
Ahmad	36.0°C	36.9°C	38.1°C	.9°C	2.1°C
Mary	35.7°C	36.8°C	38.1°C	1.1°C	2.4°C
Pablo	35.9°C	36.9°C	38.5°C	1.0°C	2.6°C
John	35.6°C	36.2°C	37.4°C	.6°C	1.8°C
Mean	35.85°C	36.67°C	38.02°C	.817°C	2.17°C

Discussion

In the lab, we measured how the intensity of pepper causes changes in heart rate and oral temperature. When we analyze the data in table 1, we can see that the heart rate for AJ (male), at rest, was 74.2 bpm. Once the jalapeno pepper was consumed, the heart rate increased by 28.18 bpm. Within a fraction of 6-7 minutes, we also observed a slight increase in the oral temperature. ΔCBT had increased by .8 °C. Once the data was collected for the jalapeno pepper, the subject consumed the ghost pepper. The heart rate elevated from 102.38 bmp to 112.94 bmp and the core body temperature elevated from 36.6 °C to 38.1 °C. This data shows that the increase in the concentration of capsaicin leads to heart rate and core body temperature elevation. For the female subject, Mary, after consuming jalapeno pepper the heart rate elevated from rest to 96.2 bpm and the core body temperature elevated to 36.8 °C. Compared to AJ, Mary only ate half the pepper. Compared to AJ, Mary only ate half the pepper. This shows that the concentration of capsaicin determines the intensity of the response. After the readings were collected, Mary consumed a part of the ghost pepper. This led to an elevation in the heart rate from 92.6 bpm to 112.2 bpm and the core body temperature rose to 38.1°C. A similar trend can be seen in all other subjects. When hot peppers are consumed by an individual, the capsaicin molecules coat the tongue, binding to the TRPV1 receptors and triggering a stimulus. The TRPV1 receptors aid in nociception and thermoception. Nociception and thermoception are the body's perception of painful or intense temperature stimulus respectively. Given that the TRPV1 receptors perceive pain and temperature, the brain gets the signal that the oral cavity is on fire due to the pain and temperature change caused by capsaicin binding. Once the capsaicin binds to the TRPV1 receptor, it triggers the physiological response like that of the change in temperature. When the human body detects an increase in environmental temperature, the body tries to maintain an

internal temperature of 98.5 °F. To undertake the task of maintaining homeostasis, the body increases heart rate and induces sweating. The cooling effect couldn't be recorded as the temperature mentioned in this lab was taken by placing a thermometer in the mouth.

The normal range for heart rate for an adult at rest is 60-100 bpm. The mean heart rate measured in our data is 69.77 bmp which lies within the normal range. The elevation of heart rate is due to the body's effort to cool itself down. Capsaicin tricks the body into believing that there is an increase in external temperature. In response, the body pumps blood towards the skin and causes vasodilation of the arterioles near the skin. The blood carries heat away from the core causing a slight drop in the internal temperature. This causes the body to shiver in response to the increase in core temperature. Another response to the assumed increase in temperature, the body starts sweating. During exercise, the body tries to maintain homeostasis by sweating. When we sweat as the body releases heat by evaporative cooling. This cools the body down till it reaches the set point.

The limitations of the experiment are in the data. We had few subjects, hence the averages generated are not precise. Given the time constraint for the experiment, we couldn't test if the subjects were accustomed to a diet with high capsaicin. This could create a change in the data as people who eat more capsaicin tend to build a tolerance to it and hence their body reacts to it differently. Other parameters like height, body weight, etc. were not monitored as these could affect heart rate too.

The data collected for the ghost pepper is faulty as the amount of capsaicin in the subject's system is a combination of both ghost pepper and jalapeno. As mentioned before, the intensity of the pepper is directly related to the concentration of capsaicin. TRPV1 receptors are

not only found in the mouth but also in other parts of the body. This was made evident when Ahmad subconsciously touched his eye and complained about a burning sensation. It can be speculated that TRPV1 receptors are also present in the stomach as 4 out of 6 subjects reported abdominal pain.

Conclusion

At the beginning of this lab, we hypothesized that the heart rate and core body temperature will increase when the subject eats a pepper. The analytical data and observations made in this lab proves this hypothesis. Heart rate and core body temperature does rise when the subject consumes pepper. Moreover, higher the SHU of the pepper the higher the elevation in heart rate and temperature. The hypothesis is proved to be true as the experimental data in the tables 1 and 2 numerically show the changes that were measured during experimentation.

Reference

1. Smutzer, Gregory, et al. “Detection and Modulation of Capsaicin Perception in the Human Oral Cavity.” *Physiology & Behavior*, vol. 194, 2018, pp. 120–131.
2. Nasrawi, Christina Wu, and Rose Marie Pangborn. “Temporal Effectiveness of Mouth-Rinsing on Capsaicin Mouth-Burn.” *Physiology & Behavior*, vol. 47, no. 4, 1990, pp. 617–623.
3. Widmaier, Eric P, Hershel Raff, Kevin T. Strang, and Arthur J. Vander. *Vander's Human Physiology: The Mechanisms of Body Function*. Boston: McGraw-Hill Higher Education, 2008. Print.