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Meat and Muscle Biology™

Neurophysiologic Changes in Resting State Connectivity Induced by Differing Qualities of Beef Stimuli

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Objectives

Functional magnetic resonance imaging (fMRI) has unveiled how many foods and basic rewards are processed, but imaging has not been widely used to investigate stimulation of solid foods, like steak, due to safety and quality issues that can arise. Resting state fMRI scans allow for administration of a stimulus before scanning, and literature has shown resting state networks reflect functional connectivity between brain regions. Resting state scans show connected regions by evaluating downstream effects of neural connectivity that are correlated to other regions of interest. We believe that hedonic circuits will be activated while eating steak, similar to other rewards. The objective of this experiment was to evaluate functional connectivity after consuming different qualities of steak.

Materials and Methods

Resting state scans of trained participants (n = 8) were taken prior to, directly after, and an extended time (25 to 30 minutes) after receiving high or low quality steak samples. Participants were re-scanned on a separate day, when they were fed the other quality steak. Blood oxygen level dependant imaging displayed hemodynamic fluctuation through the brain during fMRI procedures. Initial images were taken in the scanner before consumption. Participants left the scanning room to eat their sample, and marked a 152.4 mm anchored visual analog scale (VAS) at any point along the line as a subjective evaluation of tenderness, juiciness, flavor, and overall liking. The VAS was anchored as terrible, very poor, poor, fair, good, very good, and excellent at 0, 25.4, 50.8, 76.2, 101.6, 127.0, and 152.4 mm, respectively. After re-entry scans were taken as soon as possible, then participants cleansed their palates in a separate room before a final resting state scan was taken. Analysis of fMRI data was conducted using fMRI Expert Analysis Tool. *A priori* analysis investigated connectivity to the right and left amygdala, as well as the right and left anterior insula. Analysis of VAS data was conducted using SAS (SAS Inst. Inc., Cary, NC).

Results

Imaging data showed that high quality steak resulted in greater functional connectivity between the left and right anterior insula as well as the left and right amygdala to the striatum, medial orbitofrontal cortex, and insular cortex directly after consumption ($P \geq 0.05$). There was also greater functional connectivity between the left and right anterior insula as well as the left and right amygdala to the striatum, orbitofrontal cortex, and hippocampus an extended time after consumption ($P \leq 0.05$). High quality steak was perceived superior for each palatability trait, having mean VAS measurements of 140.46, 134.37, 142.75, and 139.19, for tenderness, juiciness, flavor, and overall liking, respectively. Low quality steak had mean VAS measurements of 49.28, 49.53, 49.02, and 52.58, for tenderness, juiciness, flavor, and overall liking, respectively (P ° 0.01).

Conclusion

These results suggest that resting state fMRI may be useful for evaluating neural processes following sensory experience, paprticularly steak consumption. We observed variation in functional connectivity of steak, due to quality. This novel technique has potential to bring about new methods of sensory evaluation for meat products that incorporate use of neuroimaging. This research adds knowledge and understanding to many areas of study about neural responses to hedonic stimuli.

