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Meat and Muscle Biology™

The Effect of Grain and Grass Fed Beef and Chicken Breast Consumption on the Functional Connectivity in the Brain Using Resting State Functional Magnetic Resonance Imaging

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Objectives

Understanding functional connectivity after consuming meat can be essential to fully understanding consumer's preferences and the connection to certain flavor compounds. The objective of this study was to determine differences in the functional brain connectivity of consumers after consuming grass-fed beef, grain-fed beef and chicken while determining the different chemical and volatile components that differentiate the treatments.

Materials and Methods

Grass-fed strip steaks, Grain-fed strip steaks and chicken breasts were collected, aged 21 d and cut into 1×1-inch consumer steaks. Each steak was vacuum sealed with a random identification number and frozen at –20°C. 23 volunteered consumers evaluated each treatment randomly followed by a Blood Oxygen Level-Dependent (BOLD) fMRI scan. Each consumer received a resting state scan and three scans following each sample. The beef was cooked to a medium degree of doneness (71°C) and the chicken was cooked to a well-done degree of doneness (75°C), followed by a 1-min resting period. The consumers were asked to complete a sensory ballot for each sample to quantify tenderness, juiciness, flavor, overall liking and quality. Each attribute was evaluated on a 100mm line scale. The sensory ballot, volatile and fatty acid data were analyzed by ANOVA and multiple means comparison using SAS while the fMRI data were analyzed using FSL's FEAT software.

Results

The results indicated all treatments were equal for tenderness and flavor, but the chicken was the least juicy ($P < 0.05$) and the grain-fed steak was ranked higher for overall liking ($P < 0.05$) in comparison to chicken. Furthermore, based on an independent component analysis, there was a significant difference in the functional connectivity ($P < 0.05$) from the resting state scan to all three treatments within the insular, medial prefrontal cortex, and amygdala regions. Additionally, there were significant differences in connectivity ($P < 0.05$) between the insula and orbitofrontal cortex in grass-fed compared to grain-fed beef. These areas are involved in processing sensory characteristics related to smell and taste and tend to track differences in preferences and stimulus value. Also, the samples were evaluated for volatile compounds with GC–MS and fatty acids using the FAMES method. Chicken and grass-fed beef was found to have a higher concentration ($P < 0.05$) of dimethyl sulfone in comparison to grain-fed beef, while the grass-fed steaks possessed a higher concentration ($P < 0.05$) of toluene in comparison to grain-fed steaks, but not differing from chicken. Dimethyl sulfone and toluene have been tied to grass-fed beef and chicken flavor profiles (Tansawat et al., 2013).

Conclusion

The results from the functional brain connectivity in the reward pathways and the chemical components of the different treatments indicated a trend for grain-fed beef to be the most different from grass-fed beef and chicken. Moreover, tying brain activity to the flavor and chemical components in meat can be vital in understanding consumer's preferences not observed in behavior alone. Therefore, these results can provide a basis to determine the ability to track reactions within the functional connectivity in the brain and the chemical aspects of different steaks to determine and understand consumer's preferences and the true value of beef and chicken.