

The Protease Activity in the Digestion Tract of *Schistocerca americana* (Drury) (Orthoptera: Acrididae)

Daniel Ramirez

Editor: Steven Thweatt

Abstract: The insect digestive tract has been identified to contain three major part identified as foregut, midgut and hindgut. These three region partake in the digestion of food but not at equal levels. A grasshopper identified as *Schistocerca americana* was used to determine the highest levels of digestion via protease activity in the alimentary tract. The grasshopper was given wheat and left to digest it. Afterwards the digestive tract was removed and then divided by each distinct section and placed in a spectrophotometer. Protease activity showed higher abundance in the foregut than mid or hindgut concluding to higher enzyme levels in the foregut.

Keywords: Grasshopper, Digestion, Protease Activity

Methods

Insects are known to contain three major part in their alimentary canal. These sections fall under as the foregut, midgut, and hindgut and are lined with epithelial cells (Klowden 2013). Each segment performs a different task that aids in the digestion and absorption of nutrients taken in the organism. The foregut contains the crop which functions as a storage chamber while also initiating partial digestion. The midgut processes the main digestion and nutrition absorption and the hindgut absorbs any nutrients left in the waste and excretes the waste (Gillott and Cedric 2005). After knowing the specific function of all three regions of the alimentary canal of the grasshopper an experiment was initiated. Since the foregut is predominately used as a storage chamber for food, the midgut will be hypothesized of consisting as the main region for digestion of food in the alimentary canal through the observation of protease activity while also seeing if boiling part of each alimentary canal will increase or decrease protease activity.

The experiment was conducted at the Heep building at Texas A&M University in College Station, TX. The specimens consisted of a grasshopper *Schistocerca americana* caught in the wild, which had been deprived of food for six hours. The grasshopper was placed in a clear plastic container and given fresh cut wheat to feed on for fifteen minutes. Afterwards the alimentary canal was pulled out of the exoskeleton by cutting off the last two segments of the abdomen and pulling of the head. Saline solution was used to help identify the three regions of the alimentary canal. Each section was divided and placed in separate test tube containing 5 ml of 0.5% NaCl where they were grinded down to fine pieces. The solution was mixed with a vortex test tube mixer and strain into a new tube using glass wool. From the new test tubes, 2 ml were then extracted into three new tubes in which were then boiled for ten minutes. Afterwards there were three tubes that were boiled and three that were not. From the six tubes 1 ml were extracted into six new tubes,

which contain 10 mg Azure powder and 5 ml of distilled water. The tubes were then placed in a water bath of 35°C for twenty minutes then put into an ice bath. Lastly, a Spectrophotometer, which was set at 650 nm wavelength, was used to measure the intensity of each solution and then rank from lightest to darkest.

Results

The foregut demonstrated absorbance values at 0.046 and 0.210 for boiled and nonboiled respectively. The hindgut values at boiled were 0.017 and 0.057 at nonboiled. The final values were 0.072 for boiled and 0.196 nonboiled when measuring for the mid gut (Table 1).

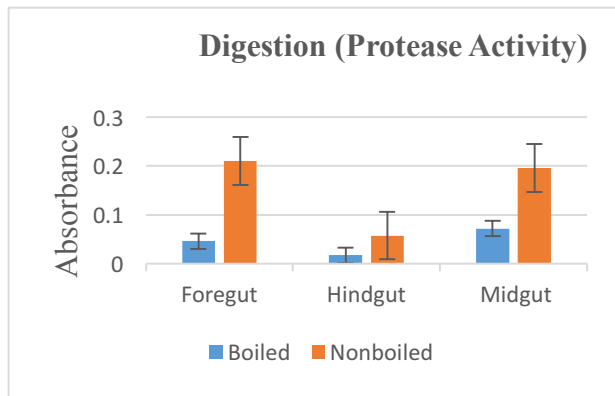


Table 1: Demonstrating protease activity through absorbance values for each section in the digestive tract.

Discussion

The end results did not support the main hypothesis of the midgut being the primary source of digestion. From the non-boiled foregut and midgut the result showed a higher digestion in the foregut than the midgut by demonstrating a higher absorbance value of 0.210 to the midguts value of 0.196. A possibility for the occurrence could be that 15

minutes is not adequate time for the grasshopper to fully digest the wheat. In which a further study can be conducted to determine the allotted time need for full digestion by a grasshopper. Now in the boil solutions each section only showed a fraction of protease activity when compared to their respected nonboiled values. This demonstrated that boiling reduces the amount of protease activity. In the end, the hypothesis of the midgut having a greater digestion rate than the foregut was not confirmed. A following experiment could be initiated, this time with an increased amount of time for the grasshopper to fully digest the wheat after feeding.

References

Gillott, Cedric. 2015. Entomology. Springer Netherlands, [eTextbook]. [Cited 2015 Oct13]; 2005:

Klowden, Marc J. 2013. Physiological Systems in Insects (3rd Edition). Academic Press [eTextbook]. [Cited 2015 Oct13]; 2013:92101-4495.