

Biochemical characterization of α -amylases from differently feeding pests: sap-sucking *Aphis craccivora* and tissue chewing *Pectinophora gossypiella*

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Abstract

Aphis craccivora (Hemiptera) is a major sucking pest of cowpea. *Aphis craccivora* is also known as the cowpea aphid. *Pectinophora gossypiella* (Lepidoptera) is an oligophagous chewing pest of cotton, commonly known as the pink bollworm. These insects cause severe losses in the production of cowpeas and cotton, respectively. The α -amylases of these insects were characterized to shed light on the complement of amylases of these two insects from different orders. The α -amylases of *A. craccivora* and *P. gossypiella* were found highly active at pH 8 and 9 respectively. At 37 °C, the activities of α -amylase in *P. gossypiella* and *A. craccivora* were 1.720.078 mg/min/ml and 0.36430.007 mg/min/ml, respectively. As calculated by Lineweaver–Burk plots, the Km values of *A. craccivora* and *P. gossypiella* were $10.5 \pm 1.5 \mu\text{M}$ and $27.7 \pm 6.5 \mu\text{M}$ respectively. The Vmax value of *A. craccivora* amylase was $5 \pm 0 \text{ mM/min}/\mu\text{g}$ and $21.8 \pm 4 \mu\text{M/min}/\mu\text{g}$ for *P. gossypiella*. Electrophoretic visualization indicated 6 isoforms of α -amylase in both the 3rd and 4th instar larvae of *P. gossypiella*. In *A. craccivora*, 3 isoforms were observed. The molecular weight of *P. gossypiella* amylases was around 30 to 294 kDa and *A. craccivora* amylases were around 77 to 160 kDa. Fe and Mn activated amylase activity in *P. gossypiella*, while Co and Zn were inhibitory in *A. craccivora*. Mn activated the amylase activity. The biochemical and electrophoretic characterizations of the amylases of these insects may significantly contribute to the understanding of the physiology of these chewing and sucking pests. The insights may be exploited for amylase inhibitor-based pest control strategies against this differently-feeding insect.

Keywords α -Amylase · *Aphis craccivora* · *Pectinophora gossypiella* · Amylase isoforms · Starch zymography · Biochemical characterization

Introduction

Aphis craccivora (Hemiptera) is the most damaging sucking pest of cowpea, infesting all developmental stages of the crop. This aphid is a major concern for cowpea production (Omoigui et al. 2017). On the other hand, *Pectinophora gossypiella* (Lepidoptera) is a devastating pest of cotton, limiting cotton productivity (Naik et al. 2018). Cotton and cowpea are significant crops cultivated around the globe. These crops contribute to India's agricultural gross domestic production (Chakravathy et al. 2014; FAO (Food and

Agricultural Organization of the United Nations) 2014; Vonzun et al. 2019; Naik et al. 2020). Insect pest attack is one of the major aspects that affect the total production of these crops both qualitatively and quantitatively (Omoigui et al. 2017; Naik et al. 2020).

The plant pests belonging to the family Aphididae are the plant sap feeders (Omoigui et al. 2017). The mouthparts of these sucking pests have evolved for the ease of sucking the phloem sap (Ravan et al. 2009). The stylet is the specialized mouthpart used by aphids for piercing the plant tissue, and it is injected into the phloem to extract the plant sap (Darvishzadeh et al. 2014). Aphid feeding removes a large quantity of sap, resulting in nutrient and water depletion in plants. It causes stunting of leaves, eventually affecting the growth and survival of the plants (Mweke et al. 2020). Additionally, honeydew deposition stimulates fungal growth on plants, reducing their photosynthetic rate. The transmission

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