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Effect of modified atmosphere on larval and pupal stages of *Rhyzopertha dominica* in stored chickpeas

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Abstract

The lesser grain borer, *Rhyzopertha dominica* (Fabricius), is a pest of stored chickpeas in Mexico. The control of this pest is based largely on the application of pesticides, but this strategy has important limitations: there are few active compounds available, there is a high risk of development of resistance to them and the residues left in the chickpeas have harmful effects on consumer health and on the environment. For this reason, an alternative strategy to pesticides for the conservation of stored chickpea was evaluated with the use of modified atmospheres (MA). The effect of three different MAs (50%, 70% and 90% CO_2, in air) on the larval and pupal stages of *R. dominica* were evaluated. To obtain larvae and pupae of *R. dominica*, eggs were incubated for a variable period of time until reaching the desired stage: 9-15 days for 1st and 2nd larval instar and 35-39 days for pupae. Tests were carried out by placing chickpeas containing a total of 15 larvae or pupae plus 50 g of healthy chickpea in small ventilated boxes. These ventilated boxes were individually placed inside of plastic bags (30 x 21 cm, Cryovac BB4L µm). Bags were filled with desired MA before sealing, which were previously prepared in a gas mixer (Witt Km 100-3M/MEM). A control treatment without MA was also included. To verify the CO_2 and O_2 content inside the plastic bags a gas analyzer (OXYBABY®) was used and the gas levels were determined at the beginning and at the end of the treatment. Plastic bags were opened at different periods of exposure (larvae up to 5 days; pupae up to 10 days) and ventilated boxes were kept until adult emergence to assess mortality. Results show that increasing the concentration and exposure time of CO_2 increases the mortality rate of larvae and pupae of *R. dominica* (Fig. 1). The most resistant developmental stage was the pupae, with an LD_{90} of 241 h (50% CO_2) compared to the larval stage with an LD_{90} of 22 h (90% CO_2). The tolerance of the MA is greater in the pupal stage due to the reduction of respiration in this stage.

Keywords: *R. dominica*, pest, chickpea, alternative strategy, modified atmosphere.

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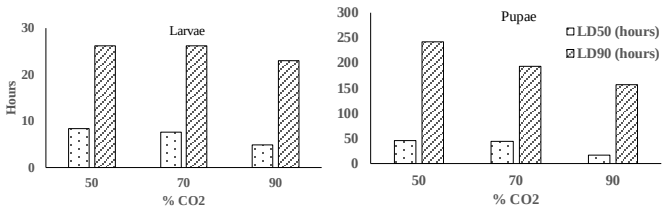

Fig 1. LD_{50} and LD_{90} of larval (left) and pupal (right) stage of *R. dominica* exposure at MA with 50, 70 and 90% of CO_2 on air.