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Fumigation of Apples and Sunflower Seeds with Phosphine – Desorption Behavior and Aroma Profiles

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Since many decades, fumigations of stored products are an accepted and worldwide used method to control pest organisms. Infested stored goods can be treated with anoxia and chemical fumigants to eradicate pests very effectively and without any movement of the products. Stored-product insects present a serious problem causing economic loss and contamination of food destined for animal or human consumption as well as a direct physical damage of materials and objects.

Therefore, fumigations are an effective option in manufacturing, storage and shipment. Since the International Standard for Phytosanitary Measures No. 15 (ISPM 15) is approved, container fumigations against quarantine pest have become important and customary in international trade.

We investigated several subjects related to fumigation such as occupational safety, modification of flavor profiles in fumigated crops and the development of resistance against fumigants.

Fumigation of goods for protection against pests is common practice in the context of global trading. One of the most commonly used fumigants for this purpose is phosphine (PH3). Apples are fumigated prior to export to control eggs of pest insects like the codling moth (*Cydia pomonella*). In this study we addressed the question whether phosphine fumigation affects the aroma profile of apples (*Malus domestica* 'Royal Gala'). For this purpose, a headspace solid-phase micro-extraction (HS-SPME) technique was developed and coupled to subsequent gas chromatography-mass spectrometry (GC-MS).

Previously we looked into the desorption behavior of phosphine after the fumigation of apples and sunflower seeds. Furthermore, the effects of fumigation on the overall volatile profiles were studied. Alterations of the volatile profiles were observed for apples and sunflower seeds.

A second question addressed concerns the adsorption and desorption behavior of phosphine from apples and sunflower seeds under different conditions as well as the chemical residues. The impact of the initial fumigation concentration and of the storage temperature was analyzed. The phosphine concentration was thereby monitored using GC-MS instrumentation.

Dates fumigation with phosphine

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Abstract

Stored dates are usually infested by sap beetles and moths. For years, the common practice for dates disinfestation was fumigation with methyl bromide (MB). After MB phase-out, heat treatment and modified atmosphere are used. However, there are several limitations of these methods. In search for alternatives for dates disinfestation, fumigation by phosphine was evaluated.

Commercial fumigations of Medjool dates variety using phosphine were conducted in a standard 20 ft. shipping container. Two formulations of phosphine were used: Magtoxin® Plates 56% (Detia Freyberg GmbH, Germany), and Phostoxin® Tablets 56% (Detia Freyberg GmbH, Germany). The phosphine dosage range was 1-4 g/m^3. The exposure time range was 24-72 hrs. Several fumigations were carried out by an innovative phosphine generator model OMT 501 developed by Universal Probes. Most fumigations carried out demonstrated total dates disinfestation. The application of Magtoxin plates, especially using the OMT 501 demonstrates significant advantages versus Phostoxin tablets; the advantages were in quicker gas development, and achieving much higher maximum and pre-ventilation phosphine concentration levels. Upon fumigation using the OMT 501, plates are easily collected and disposed, no residual dust left on the dates, which avoided their contamination. No phosphine residues were found in the fumigated dates, neither changes in organoleptic properties were noted. Phosphine fumigation using the phosphine generator model OMT 501 provides safer, quicker, more efficient dates disinfestation.

Keywords: fumigation, phosphine, dates

Introduction

Stored dates are usually infested by sap beetles and moths. For years, the common practice for dates disinfestation was fumigation with methyl bromide (MB). After MB phase-out, heat treatment and modified atmosphere are in use (Navarro, 2006; Navarro and Navarro, 2015; Rafaeli et al., 2006). However, there are several limitations of these methods. Today, phosphine is the main fumigant for postharvest treatment in stored products, such as grain and dry food. To improve the phosphine