Storage time and temperature affects volatile organic compound profile, alliinase activity and postharvest quality of garlic

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Postharvest Biology and Technology, Volume 177, July 2021, 111533

Abstract

Garlic (*Allium sativum* L.) has a long history of use as a culinary seasoning and source of health-promoting compounds. In particular organosulphur compounds derived from the action of alliinase on alliin are of interest for their antimicrobial action. Due to the seasonal nature of the garlic harvest, long-term storage is required to ensure year-round supply of high-quality bulbs. However, quality is known to deteriorate throughout storage, and storage regimes are aimed at maintaining culinary, not biochemical quality, posing challenges for biotech firms extracting high value products, such as alliinase, from garlic. Storage typically involves extended periods of up to 9 months at -1.5 °C. Here, quality parameters (disease incidence and moisture content) as well as biotechnological quality parameters (alliinase yield and activity) were measured, and correlated with gene expression and volatile organic compound (VOC) profiles comparing storage at -1.5 °C and 22 °C. The aim is to develop potential molecular markers for garlic quality assessment. Alliinase activity fell in the first 6 months of storage, with garlic stored at -1.5 °C losing more activity, however 22 °C stored garlic suffered higher spoilage after 12 months storage. Alliinase activity loss was not proportional to gene transcript levels, suggesting post-translational control. A total of 150 VOCs were detected across all samples using thermal desorption gas chromatography, time of flight mass spectrometry of intact garlic bulbs, the most abundant of which were organosulphur compounds. Storage temperature significantly affected the whole VOC profile and discrete profiles were detected from garlic cold-stored for different time periods. Using weighted correlation network analysis 17 VOCs were identified that correlated with storage time, six VOCs that were indicative for storage temperature and four VOCs (azulene, octanal, o-Xylene and 4-methylhexadecane) were significantly associated with alliinase activity.