

Title Callus hair growth within the outer cortex of mature apples of 'Fuji' and 'Fuji' sports: its relevance to post-harvest storage and the distribution of phytonutrients and allergens

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Abstract

Mature apples of 'Fuji' and 'Fuji' sports sourced from around the world contain unusual clumps of multicellular branched callus hairs between the parenchyma cells of the outer cortex. The hairs are similar morphologically to the white tufts found in the seed locules of some cultivars and to the aerial cells of apple callus grown on solid culture medium. Callus hairs were found to be particularly well developed in 'Fuji Suprema' from Brazil, and least developed in 'Fuji' from China. Hairs are also found in fruit of close relatives of 'Fuji' and some unrelated cultivars. Callus hairs proliferate in intercellular air spaces and also in larger cavities or lacunae which may have poor connectivity with other air spaces. In these locations they have the potential to restrict or modify the flow of oxygen and carbon dioxide in the outer part of apples, and thus may be one of the factors contributing to internal browning, a post-harvest disorder to which large or late-picked 'Fuji' in modified atmosphere storage are known to be vulnerable. The callus hairs are found within 17 mm of the skin and frequently contain starch even when starch has been metabolised from the surrounding parenchyma during ripening. The vacuoles of callus hairs are rich in autofluorescent compounds and may accumulate red pigment, particularly when growing close to the skin of deep red 'Fuji Suprema'. Initial observations with immunogold labelling have detected low levels of the allergen Mal d 3 associated with the plasmalemma of callus hairs. In corking disorders, callus hairs can invade necrotic cells and proliferate inside them.