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METABOLISM AND TRANSLOCATION OF LINAMARIN IN CASSAVA (*MANIHOT ESCULENTA* CRANTZ)

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Fulfilment of the Requirements
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ABSTRACT

The metabolism of linamarin in cassava (Manihot esculenta Crantz) has been investigated. Information on the biosynthetic pathway, synthetic sites, translocation and turnover of the cyanoglucoside has been obtained by precursor administrations to various parts of cassava plants grown under partially controlled conditions in the glasshouse.

Three volatile ^{14}C-labelled precursors of linamarin isobutyronitrile, isobutyraldoxime and 2-hydroxyisobutyronitrile were prepared, purified and administered to cassava leaves by a new technique in which the leaves were allowed to take up precursor vapour in an enclosed glass chamber. The incorporation of these precursors, and of L-valine administered by solution uptake, was consistent with a pattern of linamarin biosynthesis in cassava involving the reaction sequence through valine, isobutyraldoxime, isobutyronitrile and 2-hydroxyisobutyronitrile established for other plants.

The solution administration of L-[U-^{14}C] valine to various organs of the plant indicated that the leaves and the shoot apex synthesised linamarin more efficiently than the woody stem and the roots and tubers. More detailed investigations of leaf biosynthesis showed much higher incorporation of ^{14}C-valine into linamarin by the petioles and midribs (45-62% ^{14}C incorporation by petioles and 20% by midribs) than the leaf blades (2%). There was no direct relationship between endogenous linamarin content (which was higher in the blades than the petioles) and the apparent ability to synthesise

linamarin from exogenous valine. However, the low ability of the blade tissue to incorporate valine into linamarin could be due to more active competing pathways removing the exogenously administered valine. In further investigations with tuber peels and the edible cores, similar competing pathways have been implicated for an apparently low biosynthetic efficiency of linamarin.

The translocation of linamarin was demonstrated by specifically labelling ^{14}C-linamarin in attached leaves with 2-hydroxy[1-^{14}C] isobutyronitrile vapour and following the change in labelled linamarin content in the leaf and the distribution of linamarin to other parts of the plant. In both non-tuberous and tuberous plants there was a rapid loss of ^{14}C-linamarin due to translocation from the fully expanded leaves up to 69 hours after synthesis. However a residual component of the ^{14}C-linamarin (25-37% of that initially synthesised) remained in the leaves. A compartmentation of synthesised linamarin in cassava leaf tissues into a readily mobile and partially immobile fraction would account for these observations. In senescing leaves a continuous loss of both ^{14}C-labelled and endogenous linamarin occurred leaving almost no residual component although this was attributed to both translocation and turnover.

Translocated linamarin was distributed to all parts of the plant but the general pattern of translocate flow differed between non-tuberous and tuberous plants. An apical direction of linamarin distribution existed in

the non-tuberous plants while tuber-directed linamarin translocation prevailed in the tuberous plants. Leaf senescence apparently enhances linamarin translocation to the tubers.

There was little turnover of freshly synthesised ^{14}C-linamarin in detached leaves and tuber tissues over a period of 1 to 3 days. However the low recoveries of ^{14}C-linamarin in the whole plant translocation experiments suggest that active turnover may be occurring during translocation or in certain sink tissues.

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