SKF7997-treated samples contained no kaurenal, but in the SKF7997-treated one the presumed diol accumulated. This compound and the components of the sterol fraction are under investigation.

Fraction (B) contained small amounts of kaurene, epimanol oxide, kaurenol, fujenal and 7-hydroxy-kaurenolide, but the major component was 7,18-dihydroxykaurenolide.

Fraction (A) was a mixture of gibberellins in which gibberellic acid predominated. The results with SKF525 showed that this compound inhibited the conversion of kaurenal into kaurenoic acid, with the accumulation of kaurene, kaurenol and kaurenal in the mycelium; Dennis & West (1967) showed that SKF525 inhibited the conversion of kaurenol into kaurenoic acid in *Echinocystis macrocarpa* Greene. The present studies indicate the importance of examining the total metabolites of *G. fujikori*, not only those in the culture fluid but also those in the mycelium.

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Monoterpene β -D-Glucosides in Roses: Isolation and Formation from DL-[2- 14 C]Mevalonate

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It has been reported (Staikov & Zolotovitch, 1960) that petals of *Rosa damascena* var. Mill contain monoterpenes in non-steam-distillable forms ('bound monoterpenes'). We have shown that the petals of *Rosa damascena* var. Versicolora and of *Rosa dilecta* cultivar Lady Seton also contain 'bound monoterpenes'.

The non-volatile monoterpene derivatives have been isolated from petals of the *Rosa dilecta* cultivar Lady Seton and purified by silica gel chromatography and preparative thin-layer electrophoresis. On hydrolysis either with sulphuric acid or with β -glucosidase, monoterpene alcohols and a monosaccharide were released in equimolar proportions. The monoterpene alcohols have been shown to comprise 80–85% of geraniol, with traces of nerol and citronellol, and the monosaccharide moiety to be D-(+)-glucose. The purified glucosides had identical chromatographic and electrophoretic properties with both enzymically and chemically synthesized geraniol β -D-glucoside. We conclude that the petals of *Rosa dilecta* cultivar Lady Seton contain geraniol β -D-glucoside together with smaller amounts of nerol and citronellol β -D-glucosides.

The formation of free monoterpenes and monoterpene β -D-glucosides has been investigated as a function of flower maturation in the *Rosa dilecta* cultivar. Both free monoterpene and monoterpene β -D-glucoside concentrations increased rapidly when the flowers were opening. The maximum concentration of monoterpene β -D-glucoside occurred approx. 2 days before that of the free monoterpenes, the latter occurring when the flowers were fully open.

Studies on the biosynthesis of free monoterpenes and of monoterpene β -D-glucosides have been carried out on isolated flowers near the stage when they contained maximum concentrations of monoterpene β -D-glucosides. Radioactivity, applied to the peduncles of harvested flowers as dibenzyl-ethylenediamine DL-[2- 14 C]mevalonate, appeared in both free monoterpenes and monoterpene β -D-glucosides within 15 min. About 0.8% of the radioactivity was incorporated into free monoterpenes and 10–11% into monoterpene β -D-glucosides. The flux of carbon atoms derived from mevalonic acid through the monoterpene β -D-glucosides was rapid, reaching a maximum 1 hr. after addition of label and returning to a minimum after 3 hr.

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Isolation of Ubiquinone-11 and Ubiquinone-12 from Green Peppers

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It is well established that ubiquinones-1 to -10 occur in biological materials (Crane, 1965; Daves, Muraca, Whittick, Friis & Folkers, 1967). In the course of investigating the ubiquinone complements of higher-plant tissues, we have isolated ubiquinones-11 and -12 from green peppers.

Green peppers (2 kg.) were deseeded and the lipid was extracted by a routine procedure (Whistance, Threlfall & Goodwin, 1967). The lipid was then fractionated by chromatography on a column of Brockmann grade III acid-washed alumina (Woelm) developed by stepwise elution with light petroleum (b.p. 40–60°) containing increasing amounts of diethyl ether (Whistance *et al.* 1967). The ubiquinone-containing fractions (eluted from the column by 3% and 5% diethyl ether in light petroleum) were examined by our routine thin-layer chromatographic procedures (Whistance *et al.* 1967; Whistance, Dillon & Threlfall, 1969), when it was found that, in addition to ubiquinones-8 (6 μ g.), -9 (94 μ g.) and -10 (1012 μ g.), compounds with the

properties expected of ubiquinones-11 (274 $\mu\text{g.}$) and -12 (16 $\mu\text{g.}$) were present.

The identities of the ubiquinone homologues were established by thin-layer chromatography (reverse-phase; silver nitrate-impregnated Kieselgel G) and u.v.-spectral analysis ($\lambda_{\text{max.}}$ 272nm. in cyclohexane; $\lambda_{\text{max.}}$ 275nm., changing to $\lambda_{\text{max.}}$ 290nm. after sodium borohydride treatment, in ethanol) (Whistance *et al.* 1967, 1969). Further confirmation of the identity of ubiquinone-11 was obtained by mass-spectral analysis. The sample showed peaks at m/e 930 (M), $M-15$ (loss of a methyl group), $M-69$ (loss of a terminal isoprene unit), $M-69-68n$ where n is 1-9 (loss of nine internal isoprene units) and 235 (base peak).

Despite an intensive search we have found no evidence for the presence of ubiquinones-11 and -12 in other higher plants (Whistance & Threlfall, 1969). In addition we have failed to detect these homologues in Gram-negative bacteria (Whistance *et al.* 1969) and animals (F. E. Field, D. R. Threlfall & G. R. Whistance, unpublished work). This suggests that either their distribution in Nature is limited or, in the organisms examined, they are

present in such amounts so as to be undetectable by the analytical procedures employed. Indeed, the only other authenticated report of the occurrence in Nature of isoprenoid quinones with side chains greater than ten isoprene units in length is that of Matschiner & Amelotti (1968), who isolated menaquinones-11 and -12 from bovine liver.

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