

Leaf lipids of *Ribes nigrum*: a plant containing 16:3, α -18:3, γ -18:3 and 18:4 fatty acids

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1 Summary

The total fatty acid composition of *Ribes nigrum* (blackcurrant) leaf lipids was unusual in that α -18:3 occurred together with 16:3 and less of 18:4 and γ -18:3.

Similar to 16:3- plants, 16:3 was present in MGDG with less in DGDG.

Similar to 18:4- plants, γ -18:3 and 18:4 were present in all lipids and 18:4 was always greater than γ -18:3, but the levels were lower. The highest percentages of γ -18:3 and 18:4 were in PC, but PG was particularly low in these acids.

In short, the lipid composition was largely typical of 16:3-plants but there was a minor contribution typical of 18:4-plants.

The possibility of three pathways for galactolipid biosynthesis is discussed.

2 Introduction

Plants have been classified into 18:3-, 16:3- and 18:4-plants depending on the fatty acid composition of the chloroplast lipid MGDG [1,2].

All groups contain α -18:3 but 16:3 occurs only in 16:3-plants, and only 18:4-plants contain 18:4 and γ -18:3.

Members of the Boraginaceae are 18:4-plants and also contain γ -18:3 and 18:4 in varying proportions in the seed storage lipids.

Ribes nigrum, a member of the Saxifragaceae, also contains γ -18:3 and 18:4 in the seed lipids, but the nature of the leaf lipids has not been previously determined. In this preliminary study, the glycerolipid composition, and corresponding fatty acid compositions, of the leaf lipids of *R. nigrum* were determined.

3 Experimental

The glycerolipids from *R. nigrum* were separated by two-dimensional TLC (first direction, chloroform-methanol-water, 75:25:2.5, by vol; second direction, chloroform-methanol-water-acetic acid, 80:9:12:2, by vol) on glass plates of silica gel 60 (20 x 20 cm, 0.25mm thick, Merck) and components were detected by spraying with primulin and observing under UV light.

Spots were scraped off the plates, methyl heneicosanoate was added and direct transesterification in methanolic sulphuric acid was carried out overnight at 50°C as previously described [3]. Fatty acid methyl esters were analysed by GLC.

4 Results and Discussion

The glycerolipid composition of *R. nigrum* leaves (Fig 1) was typical of many plants.

- MGDG > DGDG > SQDG.
- PC, PE, PG > PI > PS, DPG

The total fatty acid composition was unusual in that α -18:3 (56%) occurred together with 16:3 (10%), 18:4 (4%) and γ -18:3 (1%).

The fatty acid compositions of the lipid classes (Fig 2) were typical of 16:3-plants in many respects (Fig 3) [4], e.g. 16:3 was a major acid in MGDG.

In addition, 18:4 and γ -18:3, typical of 18:4-plants [2,5], were in all lipids (Fig 2) but the amounts were at lower levels (up to 7 and 3%, respectively) compared to 18:4 plants (e.g. up to 35 and 7% in *Borago officinalis* (Fig 3)[5]).

The distribution of 18:4 and γ -18:3 was different to 18:4-plants. Notably, whereas in 18:4-plants the highest amount of 18:4 was in MGDG, in *R. nigrum* it was greatest in PC (Fig 2). Similar to 18:4-plants, 18:4 and γ -18:3 were at low levels in PG.

In short, perhaps surprisingly, the lipid composition of *R. nigrum*, and therefore presumably the underlying biosynthetic pathways, was largely typical of 16:3-plants but there was a minor contribution typical of 18:4-plants (Fig 3).

In 16:3-plants, galactolipids are synthesised by two different pathways; eukaryotic producing 16:0/ α -18:3 and α -18:3 / α -18:3 molecular species, and prokaryotic producing α -18:3 /16:3 and α -18:3/16:0 [4]. In 18:4-plants, two eukaryotic pathways, one similar to 16:3-plants and the other producing α -18:3 /18:4, have been postulated [2]. It seems possible that in *R. nigrum* all three pathways may operate.

As for 16:3-plants [4] and 18:4-plants [2,5], respectively, the levels of 16:3 and 18:4 in *R. nigrum* were lower in DGDG than in MGDG (Fig 3), suggesting that in DGDG the common eukaryotic pathway predominates, whereas in MGDG the other two pathways become more significant.

Further information will be derived from future studies on molecular species and fatty acid positional distributions in *R. nigrum* lipids.

Fig 1
Lipid composition of blackcurrant leaf

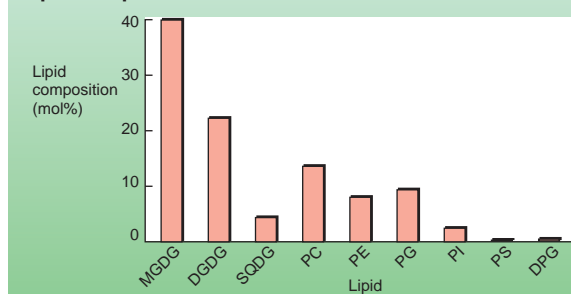


Fig 2
Fatty acid compositions of glycerolipids in blackcurrant leaf

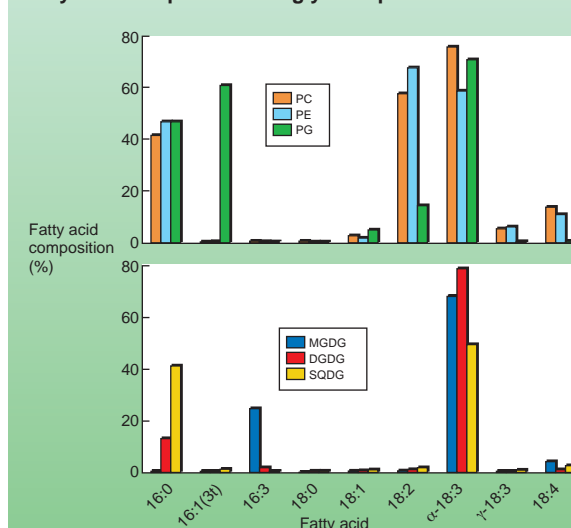
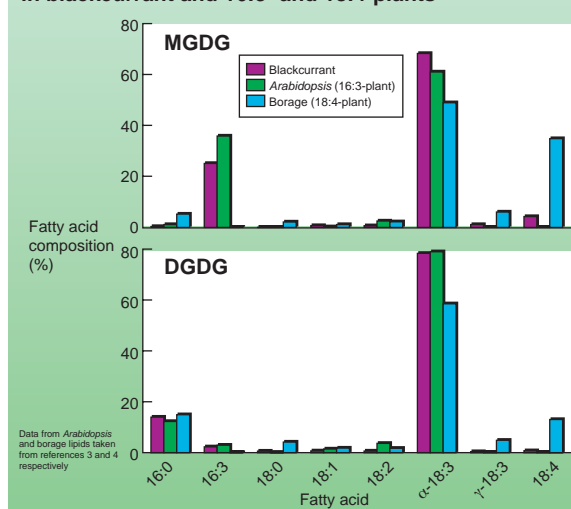


Fig 3
Comparison of leaf galactolipid fatty acid compositions in blackcurrant and 16:3- and 18:4-plants



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6 References

- [1] Jamieson, G.R. and Reid, E.H. (1971) *Phytochem.* 10, 1837-1843
- [2] Williams, J.P. and Khan, M.U. (1996) *Plant Physiol. Biochem.* 34, 93-100
- [3] Christie, W.W. (1989) *Gas Chromatography and Lipids*, Oily Press, Ayr, Scotland
- [4] Browse, J., Warwick, N., Somerville, C.R. and Slack, C.R. (1986) *Biochem. J.* 235, 25-31
- [5] Griffiths, G., Brechany, E.Y., Jackson, F.M., Christie, W.W., Stymne, S. and Stobart, A.K. (1996) *Phytochem.* 43, 381-386