γ-linolenic acid content of the seeds of blackcurrant genotypes

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Summary

The γ-linolenic acid (GLA) content of the seed oils of 36 blackcurrant genotypes were determined. Other nutritionally important fatty acids, α-linolenic acid (ALA) and stearidonic acid (SA), were also examined. A rapid small-scale procedure, involving homogenisation of seeds in toluene followed by sodium methoxide transesterification and gas chromatography, was used. The GLA content varied from 11 to 24%, and three genotypes had particularly high levels (22-24%), previously not reported for blackcurrant oil. The ALA and SA contents varied from 10-19% and 2-4%, respectively. The study shows the potential for developing blackcurrant genotypes with 'added value'.

Introduction

γ-linolenic acid (GLA, 18:3 *n*-6) is a nutritionally important fatty acid present in the seed oils of a restricted number of plant taxa [1]. The oils are used as nutritional supplements and are beneficial for a range of conditions including atopic eczema and rheumatoid arthritis [2]. Evening primrose (*Oenothera biennis*) and borage (*Borago officinalis*) oils are the major sources of GLA, and contain 7-10% and 17-25% GLA, respectively.

Blackcurrant (*Ribes nigrum*) oil contains GLA (15-19%) together with other nutritionally important fatty acids, namely α-linolenic acid (ALA, 18:3 *n*-3, about 13%) and stearidonic acid (SA, 18:4 *n*-3, about 3%), which are either absent or at insignificant levels in evening primrose and borage oils. Consequently, blackcurrant oil is potentially valuable, particularly because blackcurrant seeds are by-products from juice production. The development of blackcurrant genotypes with enhanced levels of these fatty acids may have commercial importance.

In the present study, the fatty acid compositions of the seed oils from 36 blackcurrant genotypes developed at SCRI were analysed with a view to determining the variation in GLA, ALA and SA contents.

Experimental

Samples of fruit were taken from four year-old blackcurrant plants grown in the field at SCRI. The fruit was liquidised and the supernatant was decanted to leave the seeds.

Preparation of fatty acid methyl esters

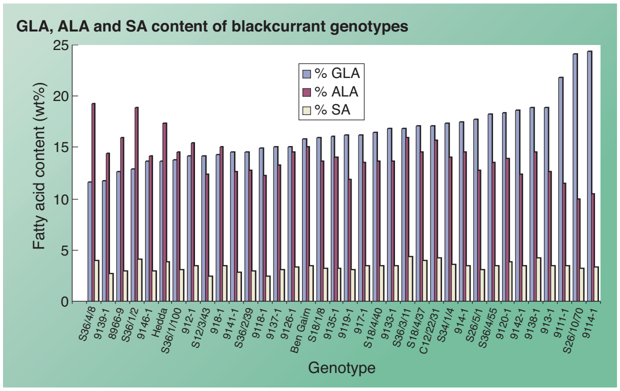
Each sample was analysed at least in triplicate. To a sample of seeds (100 mg) was added methyl heneicosanoate (25 mg in 20 ml toluene; 2 ml) as an internal standard. The sample was homogenized for 4 min, the solution was decanted and 0.5 M sodium methoxide (2 ml) was added. After heating at 50°C for 10 min, acetic acid (100μl) and saturated sodium chloride (3 ml) were added and the solution was extracted with isohexane (2 x 3 ml) containing butylated hydroxytoluene (50 ppm). After passing through a column of anhydrous sodium sulphate, the sample was analysed by gas chromatography.

Analysis of fatty acid methyl esters by gas chromatography

Samples were analysed by gas chromatography using a capillary column of fused silica coated with CP-Wax 52CB™ (0.25 mm i.d. x 25 m in length, 0.2 μm film thickness; Chrompack UK Ltd, London). After holding the temperature at 170°C for 3 min, the column was temperature-programmed at 4°C min^{-1} to 220°C, and was finally held at this point for a further 15 minutes. Hydrogen was the carrier gas at an initial flow rate of 1ml $min^{-1}$and a split ratio of 50:1 was used.

Results and Discussion

- Qualitatively, the fatty acid compositions of all 36 genotypes was as expected.
  Linoleic acid > GLA, ALA > oleic acid > palmitic acid > SA > stearic acid
- The GLA, ALA and SA contents ranged from 11.6 - 24.3%, 10.0 - 19.2% and 2.4 - 4.3%, respectively, of the total fatty acids.
- Three genotypes (9111-1, S26/10/70 and 9114-1) had particularly high GLA values (21.8, 24.1 and 24.3%, respectively). Such levels have not been reported previously for blackcurrant oil, and were similar to those in borage oil.
- Genotypes with high GLA contents tended to have lower ALA contents and *vice versa*, possibly indicating competitive Δ6 and Δ15 desaturation activities on linoleic acid, the common precursor. However, an absolute inverse trend was not apparent across the full range of genotypes.
- Total oil content is another important parameter. However, the results are not reported because within sample variation was large, presumably due to substantial variation in oil content between individual seeds and the small number of seeds required for the analysis.
- The study shows the potential for developing blackcurrant genotypes with 'added value', particularly because blackcurrant seeds are by-products from juice production. Obviously, agronomic parameters and other properties of the juice, such as ascorbic acid and anthocyanin levels, would have to be considered concurrently.



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