The Aroma of Cloudberries (Rubus chamaemorus L.)

Erkki Honkanen and Tapani Pyysalo
Technical Research Centre of Finland, Food Research Laboratory, SF-02150 Espoo 15, Finland

Introduction

Several species of wild and cultivated berries belonging to the genus Rubus (Rosaceae) are found in temperature regions of the northern hemisphere. Many of these have a very pleasing aroma and therefore are widely used in the food and beverage industries. The most important are the forest raspberry (Rubus idaeus L.) and blackberry (R. fruticosus L. coll.) and their different garden varieties. In Northern Europe and North Asia there are two other important Rubus berries: the arctic bramble (R. arcticus L.) and the cloudberry (R. chamaemorus L.). Because of their exceptionally pleasant and unique aroma, these berries have become valuable raw materials for the famous Finnish liqueurs „Mesimarja“ and „Lakka“, respectively. Arctic bramble and cloudberry are widespread, mainly in Finland.

The volatile components of raspberry have been studied in detail by Winter et al. [1, 2] and Schinz and Seidel [3, 4]. The character-impact compounds of raspberry aroma are α- and β-ionone and the so-called raspberry ketone, 4-(p-hydroxyphenyl)-2-butanone. The blackberry has a musty odour, arising perhaps from 3,4-dimethoxyallylbenzene [5, 6].
The aroma of the arctic bramble is strong and distinctive, and differs markedly from those of other *Rubus* berries. Recently Kallio and Honkanen [7] have shown that the main volatile aroma component in arctic bramble is 2,5-dimethyl-4-methoxy-3(2H)-furanone, which is also the most important compound in producing the distinctive odour of these berries.

The odour of the cloudberry is very mild and not as distinctive as the odours of raspberry and arctic bramble. The taste, however, is very pleasant and therefore cloudberrries are well suited for the flavouring of ice cream, youghurt, bakery products, etc. In Finland, large quantities of cloudberrries are also frozen for use in whole-erry form. The cloudberry grows in swamps, principally in Northern Finland. The berries resemble raspberries, but are larger and yellow in colour. The natural growing areas of the cloudberry have been reduced considerably during the last few decades. Though cultivation has proved difficult and not yet profitable, good results have been obtained by the fertilization of its natural growing areas. No reports of the aroma composition of cloudberry have yet appeared in the literature, but some preliminary studies have been completed by the present authors [8—10].

### Experimental

Ripe cloudberries (*Rubus chamaemorus* L.) were harvested in July-August and stored at $-30^\circ$ C until used. The juice was extracted in a hydraulic press and the volatile compounds were isolated in a continuous vacuum evaporator below $30^\circ$ C. After neutralization with sodium hydrogen carbonate and saturation with sodium chloride, the distillate was extracted with a mixture of redistilled pentane-ethylether (1:2) in a Kutscher-Steudel extraction apparatus. The extract, containing the neutral part of the volatile oil, was concentrated to a small volume, and fractionated in a preparative gas-chromatography column using silicone oil SE-30 as a stationary phase. The steam distillate, from which the neutral part was removed, was acidified, and the free fatty acids were extracted with the same solvent. The neutral part and the free fatty acids were analyzed in a combined gas chromatograph-mass spectrometer, Perkin-Elmer 207B and/or JEOL JMS-D100, using glass capillary columns (50 m) coated with FFAP. The mass spectra were recorded at 70 eV. For the quantitative determination of the individual compounds, the same capillary columns and an Autolab System IV computing integrator were used. The temperature was programmed from 75$^\circ$ C to 200$^\circ$ C at 2$^\circ$ C/min. A typical gas chromatogram of the neutral volatile oil of cloudberry is shown in Figure 1.

4-Vinylphenol (IIa), 2-methoxy-5-vinylphenol (IIb) and 2-methoxy-4-vinylphenol (IIc) were synthesized according to Sovish [11] by the thermal decarboxylation of 4-hydroxy-, 4-methoxy-3-hydroxy- and 3-methoxy-4-hydroxy-cinnamic acids, respectively. The mass spectra of these phenols are presented in Figures 2, 3, and 4.

cis-Cinnamyl alcohol was prepared by catalytic hydrogenation of 3-phenylpropynol [12]. The mass spectra of cis- and trans-cinnamyl alcohols are seen in Figures 5 and 6.