Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Department of Plant Breeding and Biotechnology
Balsgård

Blackcurrant wine and vinegar

Effects of processing methods on content of beneficial polyphenols
– a pilot study

by

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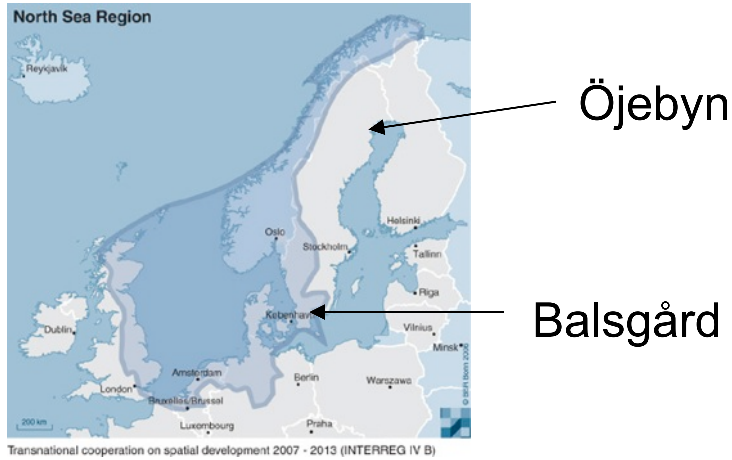
Breeding of black currants in Sweden

- Programme restarted in 2006 (based on previous long term breeding efforts)
- The breeding programme is aimed at developing cultivars primarily for organic black currant growing
- Plants are grown in the north (at Öjebyn) and in the south of Sweden (at Balsgård) – aiming at 2000 plants every second year



Breeding populations at Öjebyn

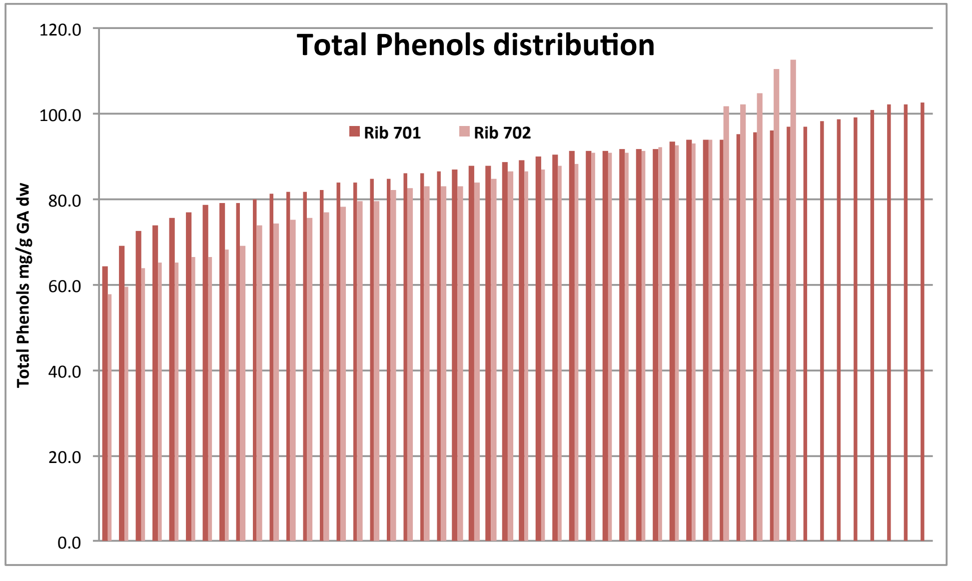
Breeding of black currants, objectives

- Powdery mildew resistance (screening in greenhouse and in the field)
- Gall mite resistance (new DNA-markers and protocol available)

- Black currant reversion virus resistance (new RT-PCR protocol available for virusdetection)
- Leaf curling midge resistance (new sources identified!)
- Field tolerance against septoria, antrachnose, white pine blister rust (annual screening)

Breeding of black currants, objectives

- Mechanical harvesting, organic growing (erect plants, proper berry size, strong skin)
- Annual and high yield (plants being adapted to the climate in the north and south, winter and spring frost tolerance)
- Mild typical black currant taste
- High content of ascorbic acid
- High content of anthocyanins
- High content of total phenols



Some recent selections

BRi0711-54.For fresh market.
Very sweet, pleasant aroma, big berries, easy pick, very healthy leaves.

BRi0702-154. Intended for processing.
High yield, dry pick, no fruit drop, nice plant shape, healthy foliage. Potential resistance against gall mite.

Research projects associated with the black currant breeding programme

- Climafruit. Transnational project between the berry industry and research oganisations in Sweden, Norway, Denmark, Germany and Scotland 2009–2013. Organic and conventional field trials at Balsgård. EU/Interreg.
- Ontogenetic and genetic effects on health-promoting compounds in black currants (buds, leaves and fruits). PhD research project 2010–2013. SLF.
- Intensified quality-breeding of blackcurrants for northern Sweden. 2012–2014. RJF.

The Interreg IVB North Sea Region Programme

Investing in the future by working together for a sustainable and competitive region

Background: Why black currant wine and vinegar?

- Black currants have a pleasant aroma and are rich in polyphenols, especially anthocyanins
- Polyphenols, among them antocyanins – may improve the function of arteries and have several other health benefits
- Different fermentation approaches may increase bioavailability of polyphenols – eg lactobacilli can metabolise polyphenols
- Harmful effects of easily metabolised carbohydrates – significantly reduced during fermentation
- Vinegar consumption – may delay gastric emptying and improve glycaemia

Background: polyphenols in commercial fruit wines

Source of fruit wine	Sample size	Total phenols (mg GAE/L)
Cabernet (grapes)	6	2005a
Elderberry	5	1753a
Blueberry	6	1676a
Black currant	6	1509a
Cherry	6	991b
Raspberry	6	977b
Plum	4	555bc
Apple	6	451c
Chardonnay (grapes)	6	287c
Riesling (grapes)	6	250c

(Vasantha Rupasinghe and Clegg, 2007, J Food Comp Anal)

SLU

Materials and methods for black currant wine and vinegar study

- Frozen black currant berries
- Four different processing methods for purée prepartion
- Standardised method for fermentation of wine
- Standardised method for fermentation of acetic acid
- Analysis of total phenols, total anthocyanins, total sugars and titratable acidity
- Analysis of major anthocyanins and rutin through HPLC-DA

Puree preparation

Puree 1	Puree 2	Puree 3	Puree 4 (mash)
Frozen berries, wash with hot (55°C) tap water	Frozen berries, wash with hot (55°C) tap water	Frozen berries, wash with hot (55°C) tap water	Frozen berries, wash with hot (55°C) tap water
Grind	Grind	Grind	Grind
Enzymatic treatment (Klerzyme 0.3 ml/ kg, 50°C, 1 h)	–	–	–
Heat 80°C, 15 min, then cool	Heat 80°C, 15 min, then cool	–	–
Strain,	Strain	Strain	–
Store at 8°C over night	Store at 8°C over night	Store at 8°C over night	Store at 8°C over night

Alcohol (wine) fermentation

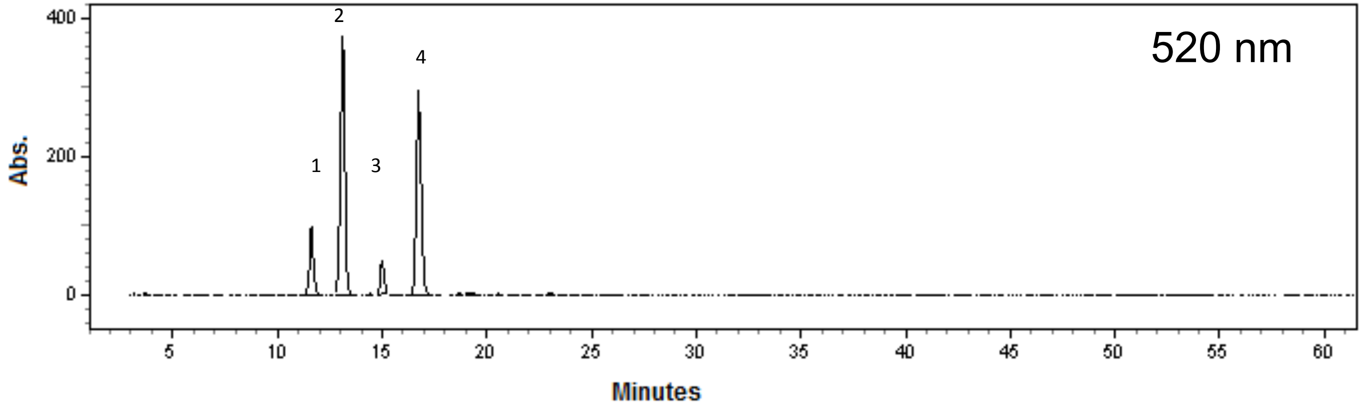
- Puree was diluted 1:1 with water
- Soluble solids adjusted to 7° Brix with dextrose.
- Rehydrated yeast (*S. cerevisiae*) and yeast nutrients were added at 30°C
- Fermentation took place at 24°C.
- Dextrose was added daily during the first four days corresponding to a total amount of 17°Brix.
- Fermentation continued for 7 days then filtration through a 1 mm net was done.
- The wine was then kept at 8° C for another 14 days for sedimentation and was then decanted.

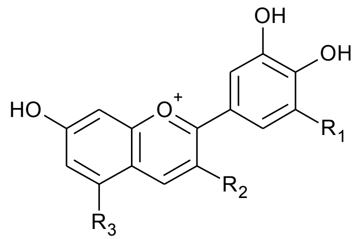
Vinegar (acetic acid) fermentation

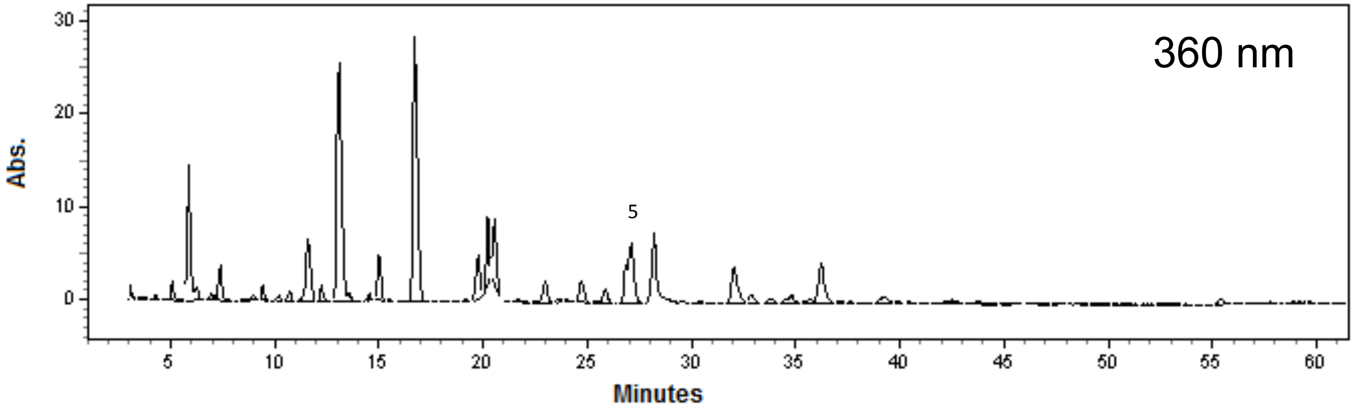
- A submerged method was used
- Air was forced through the black currant wine by use of aquarium pumps, PVC pipes and filter to obtaine fine bubbles
- Acetic acid bacteria were pre-cultured in diluted wine
- Acetic acid fermentation continued for 10 days at 28°C.

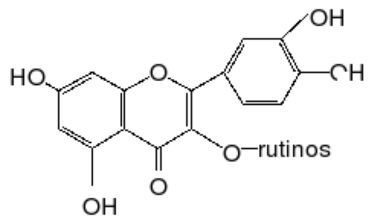
Quantified polyphenols

1 = Delphinidin-3-*O*-glucoside; 2 = Delphinidin-3-*O*-rutinoside; 3 = Cyanidin-3-*O*-glucoside 4 = Cyanidin-3-*O*-rutinoside; 5 = Rutin





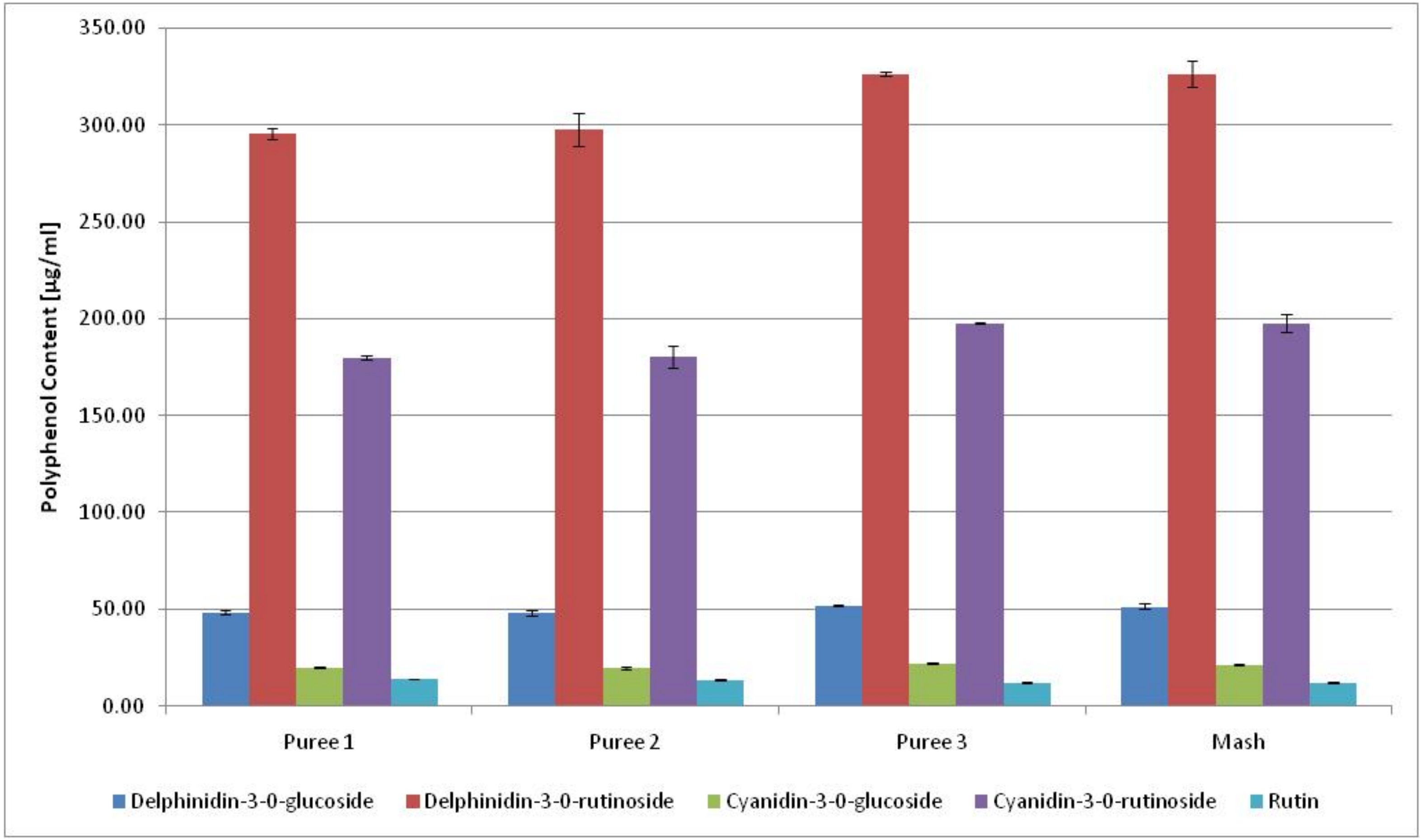




Phenols and anthocyanins in puree (diluted with water 1:1)

	Puree 1	Puree 2	Puree 3	Mash
Total phenols (mg GAE/L)	3506 ± 101	3361 ± 152	2549 ± 21	2349 ± 72
Total anthocyanins (mg/L)	457 ± 25	466 ± 7	474 ± 27	467 ± 25

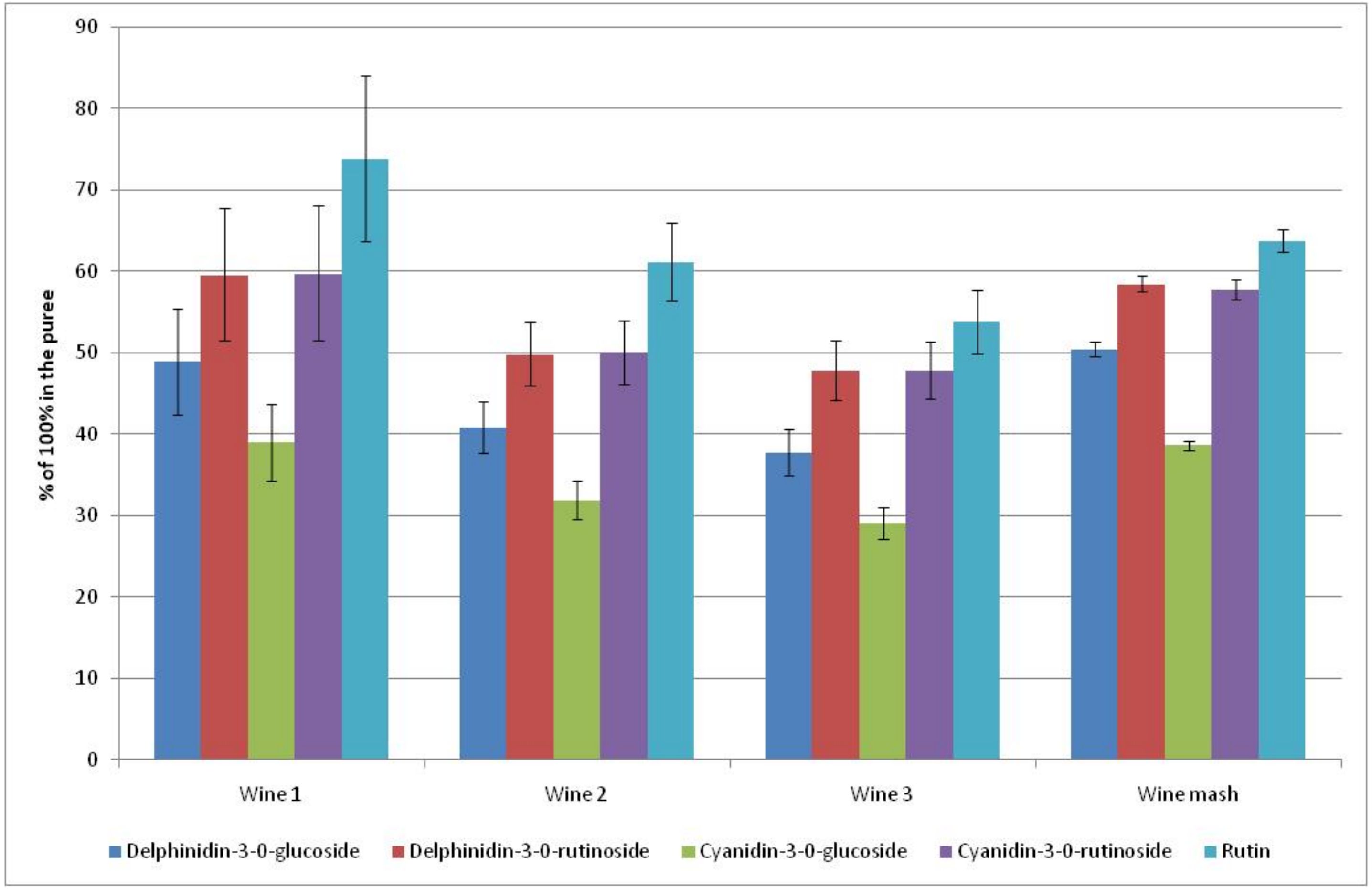
Specific polyphenols in purée (diluted with water 1:1, mg/L)



Alcohol and acidity of the wine

	Wine 1	Wine 2	Wine 3	Wine 4 mash
Alcohol (vol)	9.1 ± 0.3	9.2 ± 0.0	9.4 ± 0.0	9.9 ± 0.2
Acidity (as citric acid, g/100 mL)	4.82 ± 0.03	4.79 ± 0.04	4.63 ± 0.02	4.46 ± 0.02
pH	2.6	2.6	2.6	2.6

Specific polyphenols in wine (% compared to puree)



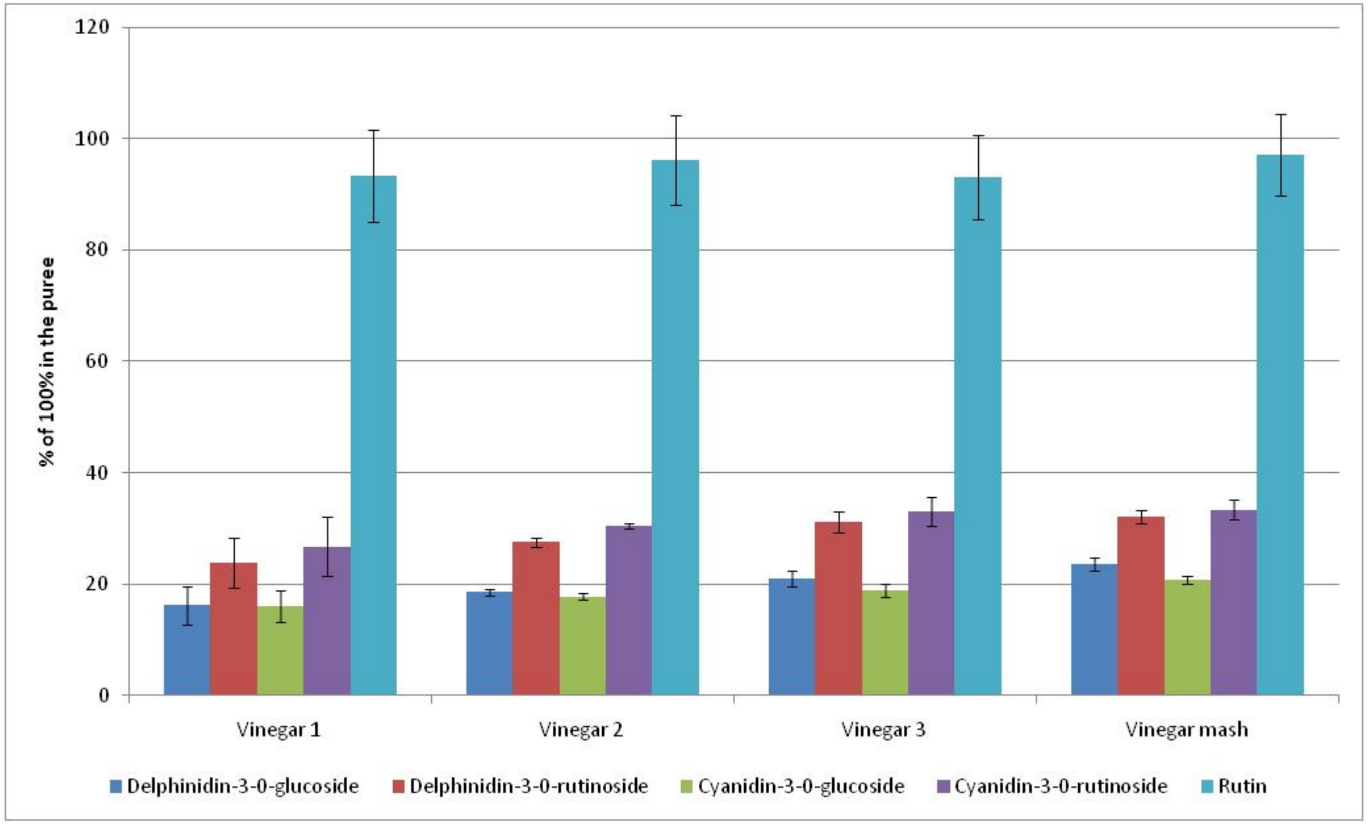
Total polyphenols: 65–80% left

Total anthocyanins: 61–79% left

Acidity of the vinegar

	Vinegar 1	Vinegar 2	Vinegar 3	Vinegar 4 mash
Acetic acid	3.9 ± 0.4	3.9 ± 0.1	4.1 ± 0.3	4.0 ± 0.2
Total acidity (as acetic acid, g/ 100 mL)	5.4 ± 0.4	5.4 ± 0.1	5.5 ± 0.3	5.4 ± 0.2
pH	2.7	2.7	2.7	2.7

Specific polyphenols in vinegar (% compared to puree)



Total polyphenols:
80-105% left

Total anthocyanins:
25-32% left

Conclusions

- It is possible to ferment black currant berries into wine and vinegar with a high content of polyphenols, though the wine will be very acidic.
- Alcohol fermentation decreased the content of all polyphenols – however a large amount remains in the wine.
- Acetic fermentation further decreased the content of anthocyanins
- Rutin seems to be quite resistant to degradation during fermentation compared to the anthocyanins.
- The pre-fermentation processing of fruits significantly influenced the content of total phenols in the puree.
- The different treatments of the puree did not significantly affect the content of acetic acid or total acidity of the vinegar.

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