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Processing of jam and stewed fruit from sour cherry (*Prunus cerasus* L.)

*Fremstilling af syltetøj og frugtgrød af surkirsebær (*Prunus cerasus *L.)*

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Summary

During maturation of cherries, the content of soluble solids and anthocyanins increases and stone percentage and the capacity of benzaldehyde formation from gluscosides decreases.

The low content of benzaldehyde in jam and stewed fruit can be increased by use of processing water containing benzaldehyde from hot water extraction of cherry kernels.

Several aroma substances are of importance for the cherry flavour, but an increase of benzaldehyde to 10–15 mg/kg in jam or stewed fruit has an important effect on the flavour.

During processing of jam or stewed fruit aroma substances can be lost by evaporation.

The content of anthocyanins is not affected during normal processing conditions.

The surface colour of yoghurt with cherry jam depends on the anthocyanin content of the cherries. CIE–a (redness) increases and CIE–L (lightness) decreases with increasing content of anthocyanins.

Key words: *Prunus cerasus* L., sour cherries, maturation, anthocyanin, benzaldehyde, soluble solids, titratable acids, processing, jam, stewed fruit, yoghurt.

Resumé

Under modning forøges kirsebærrenes indhold af opløseligt tørstof og anthocyanin. Stenprocenten og kapaciteten for dannelse af benzaldehyd i frugtkødet aftager.

Det lave indhold af benzaldehyd i syltetøj og frugtkød kan forøges ved anvendelse af et kerneekstrakt fremstillet ved varmtvandsekstraktion.

Benzaldehyd er ikke det eneste aromastof, som har organoleptisk betydning, men kirsebærsmagen kan forbedres ved forøgelse af benzaldehydkoncentrationen til 10–15 mg/kg. Under fremstilling af syltetøj eller frugtgrød kan aromastoffer forsvinde ved fordampning.

Anthocyaniner i kirsebær nedbrydes ikke under de procesbetingelser, der normalt anvendes ved fremstilling af syltetøj eller frugtgrød. Overfladefarven på frugtyoghurt med tilsat kirsebærsyltetøj afhænger af anthocyaninindholdet. Rød farveintensitet (CIE–a) forøges og lyshed (CIE–L) formindskes ved stigende indhold af anthocyaniner.

Nøgleord: *Prunus cerasus* L., surkirsebær, modning, anthocyaninindhold, benzaldehyd, opløseligt tørstof, titrerbar syre, forarbejdning, syltetøj, frugtgrød, yoghurt.

Table 1. Picking dates. Experiment 2.
Plukkedatoer. Forsøg 2.

Cultivar *Sort*	Picking dates *Plukkedatoer*									
	07.29	08.01	08.03	08.05	08.08	08.10	08.12	08.15	08.17	08.19
'Fanal'	—	—	—	—	—	—				
'Skyggemorel'		—	—	—	—	—	—			
'Crisana 2'			—	—	—	—	—	—		
'Stevnsbær'							—	—	—	—

Introduction

Jam and stewed fruit may be processed from sour cherries (*Prunus cerasus* L.).

In the industrial processed products the variation in quality attributes such as flavour and surface colour can be considerable.

The aim of this paper is to describe the effect of harvesting and processing on quality attributes of jam and stewed fruit processed from sour cherries.

Materials and methods

Fruits were picked from cherry trees in two field experiments carried out at Institute of Pomology. In experiment one with the cultivar 'Fanal' fruits were picked in the period from 27 July to 13 August.

In experiment two cherries of four cultivars were picked randomly from four year old trees on the dates shown in Table 1.

At each date between 1.8 and 2.5 kg of cherries were picked between 8 and 11 a.m. Immediately after picking the cherries were frozen and stored at –25 °C until analysing and processing.

For processing of jam, 600 g of frozen fruits were heated to 30 °C and the pH was adjusted to 3.0 by use of a 50 w/w % citric acid solution. During stirring and further heating a mixture of 4.8 g pectin (LM 101 AS) with 20 g of sugar was added. After heating to boiling point 580 g of sugar, potassium sorbate and sodium benzoate were added and heating to boiling point was repeated. The jam was cooled to 50 °C and canned in 580 cm^3 jars, which were cooled in tap water (12 °C) and finally stored at 12 °C until analyses and sensory evaluation.

Yoghurt with fruit was prepared by addition of 75 g jam to 500 g yoghurt. With the addition of jam the pH of the product changed from 4.0 to 3.8.

Immediately after mixing yoghurt and jam samples were blended in a Waring blender. Samples were prepared in dark dishes and surface colour (CIE–a, CIE–b, CIE–L) was determined by use of a Hunter Lab colourimeter. For each sample 3 replications of the measurements were carried out.

Juices were processed as described earlier (6). For processing of stewed fruit 450 g of frozen stoneless cherries were heated to boiling point with 225 g of water or benzaldehyde extracts. During heating and gentle stirring starch and 250 g of sugar were added and heating to boiling point was repeated. After addition of potassium sorbate and sodium benzoate the product was cooled to 50 °C and stored in 580 cm^3 jars, which were further cooled in tap water (12 °C) and then stored at 12 °C.

After gentle crushing of the seeds with a hammer the kernels were picked out by hand. The extraction of benzaldehyde was carried out in flasks with 100 ml distilled water kept in a water bath at 62 °C. 5–10 g of kernels were extracted in each batch.

Sensory evaluation was carried out by four trained panellists. Ranking by cherry flavour and magnitude estimation was applied.

Methods for determination of soluble solids, titratable acid, anthocyanin and benzaldehyde in fruit products have been described earlier (6). The gas chromatographic method used for determination of benzaldehyde in water extracts of cherry kernels is described in Table 2.

Table 2. Gas chromatographic equipment and parameters for analyses of benzaldehyde extracts.
Gaskromatografisk udstyr og indstillingen af dette ved analyse af benzaldehydekstrakter.

HP 7675A head space sampler:	
Sample size	10 ml extract + 1 ml internal standard
Pure gas	40 ml N_2/min
Prepurge time	5 min
Purge time	5 min
Precolumn	Tenax GC
Precolumn temperature	20 °C
Eluting temperature	200 °C
Eluting time	5 min
Cleaning temperature	250 °C
HP 5840A gas chromatograph:	
Column	10 m, stainless, i.d. 1/8 inch.
Carrier material	Chromosorb W, HP, 80–100 mesh
Stationary phase	Carbowax 20 M, high temp.
Carrier gas	10 ml N_2/min
Column temperature	100–150 °C, 4 °C/min
Detector temperature	250 °C
Paper velocity	1 mm/min
Slope sensitivity	1 microvolt/sec
Attenuator	2 exp (7)
Internal Standard (IS)	amylacetate (20 microgram/ml)

Results

Fig. 1a to 1c shows fruit weight, percentage stones and content of soluble solids in the flesh of ripening 'Fanal' at six picking dates. The maximum amounts of benzaldehyde released from the flesh during juice processing decreased from 6.5 to 3 mg/kg (Fig. 1d).

Results from determination of anthocyanin in raw fruits and jam processed at six levels of ripening are presented in Fig. 2.

Processing of jam had no effect on the content of titratable acid or anthocyanin. During processing of jam the content of soluble solids increases due to addition of sucrose.

Results from analyses of jam and stewed fruit processed from sour cherry and bought in Danish supermarkets are shown in Table 3.

Table 4 shows the results from analyses of samples of raw fruit ('Stevnsbær') and stewed fruit processed in a factory. The figures are averages of three samples taken at intervals of two hours during one day of processing.

Surface colour values CIE–a (redness), CIE–b (yellowness) and CIE–L (lightness) of yoghurt

Table 3. Content of soluble solids, titratable acid, anthocyanin and benzaldehyde in jam and stewed fruit processed from sour cherry and bought in Danish supermarkets.
Indhold af opløseligt tørstof, titrerbar syre, anthocyaniner og benzaldehyd i syltetøj og frugtgrød fremstillet af surkirsebær og købt i danske supermarkeder.

Product *produkt*	Soluble solids *Opl. tørstof* *g/100 g*	Titratable acid *Titrerbar syre* *g/100 g*	Anthocyanin *Anthocyanin* *mg/100 g*	Benzaldehyde *Benzaldehyd* *mg/100 g*
Jam *Syltetøj*	53	1.2	23	0.4
Stewed fruit *Frugtgrød*	28	0.4	14	1.4

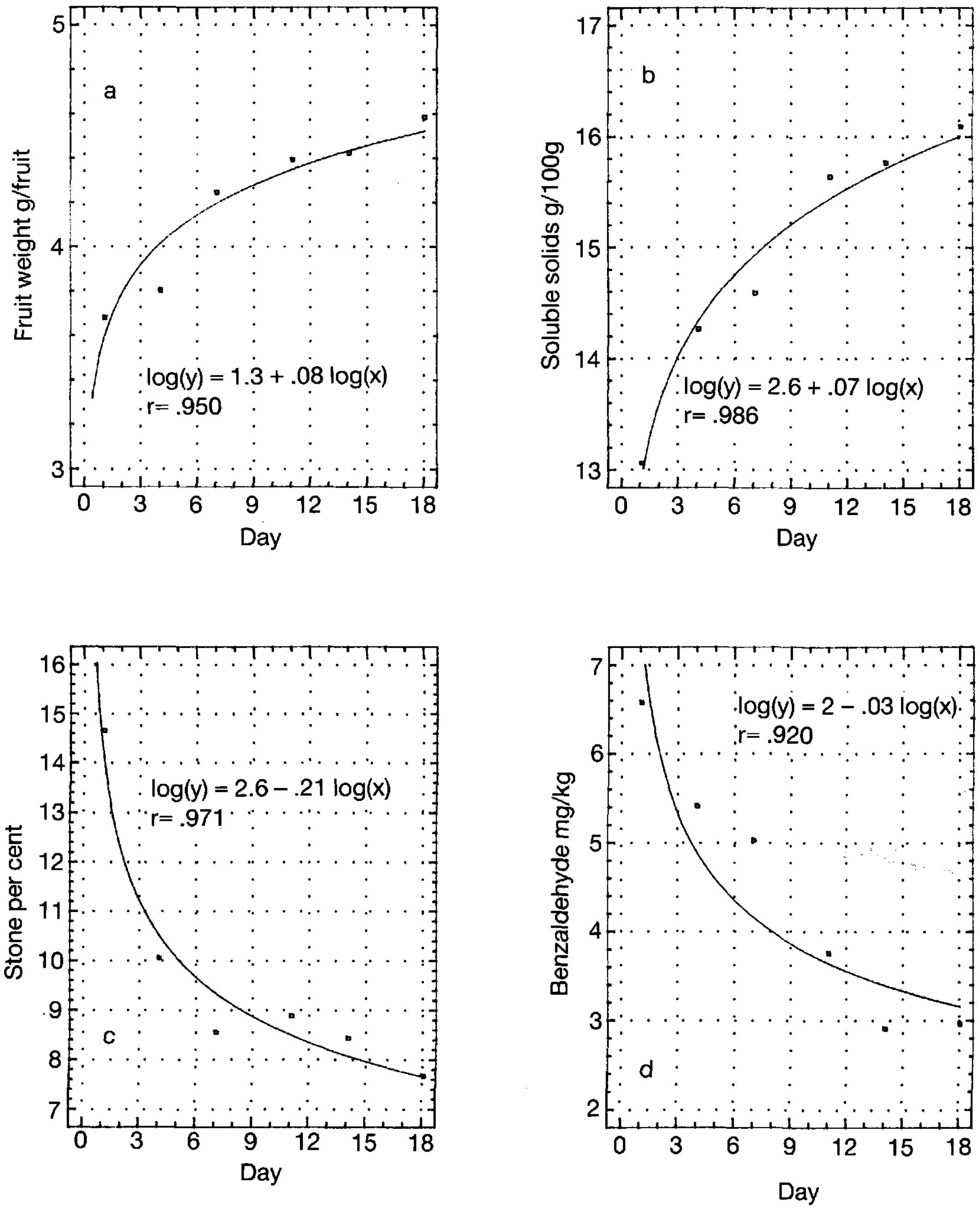

Fig. 1. Fruit weight, soluble solids, percentage stone and benzaldehyde in ripening 'Fanal'. Experiment 1. Day 1 27 July.

Frugtvægt, opløseligt tørstof, procent sten og benzaldehyd i frugtkødet. Forsøg 1. Dag 1 27/7.

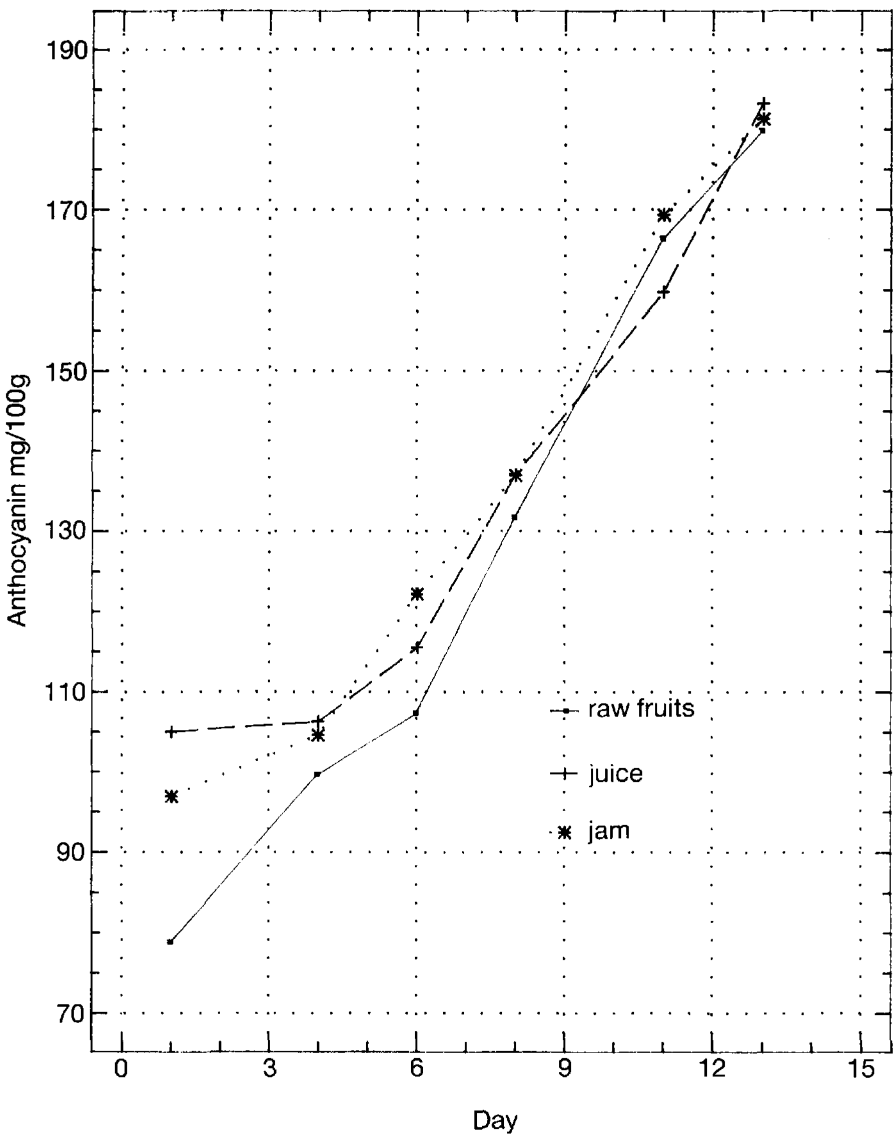

Fig. 2. Content of anthocyanin in raw fruits, juice and jam processed from 'Fanal' harvested 27 July and five times later. Experiment 2.
Indhold af anthocyanin i råvare, saft og syltetøj fremstillet af 'Fanal' høstet 27. juli og fem gange senere. Forsøg 2.

with 13 w/w% jam processed from four varieties ('Crisana 2', 'Fanal', 'Skyggemorel', 'Stevnsbær') harvested at four ('Stevnsbær') or six ripening levels, are being linearly related to the anthocyanin content (Fig. 3).

Most varieties of sour cherry contain from 18 to 31 g/kg of kernels from which it was found that 2500 to 3700 mg/kg benzaldehyde may be extracted.

Benzaldehyde produced in whole or crushed

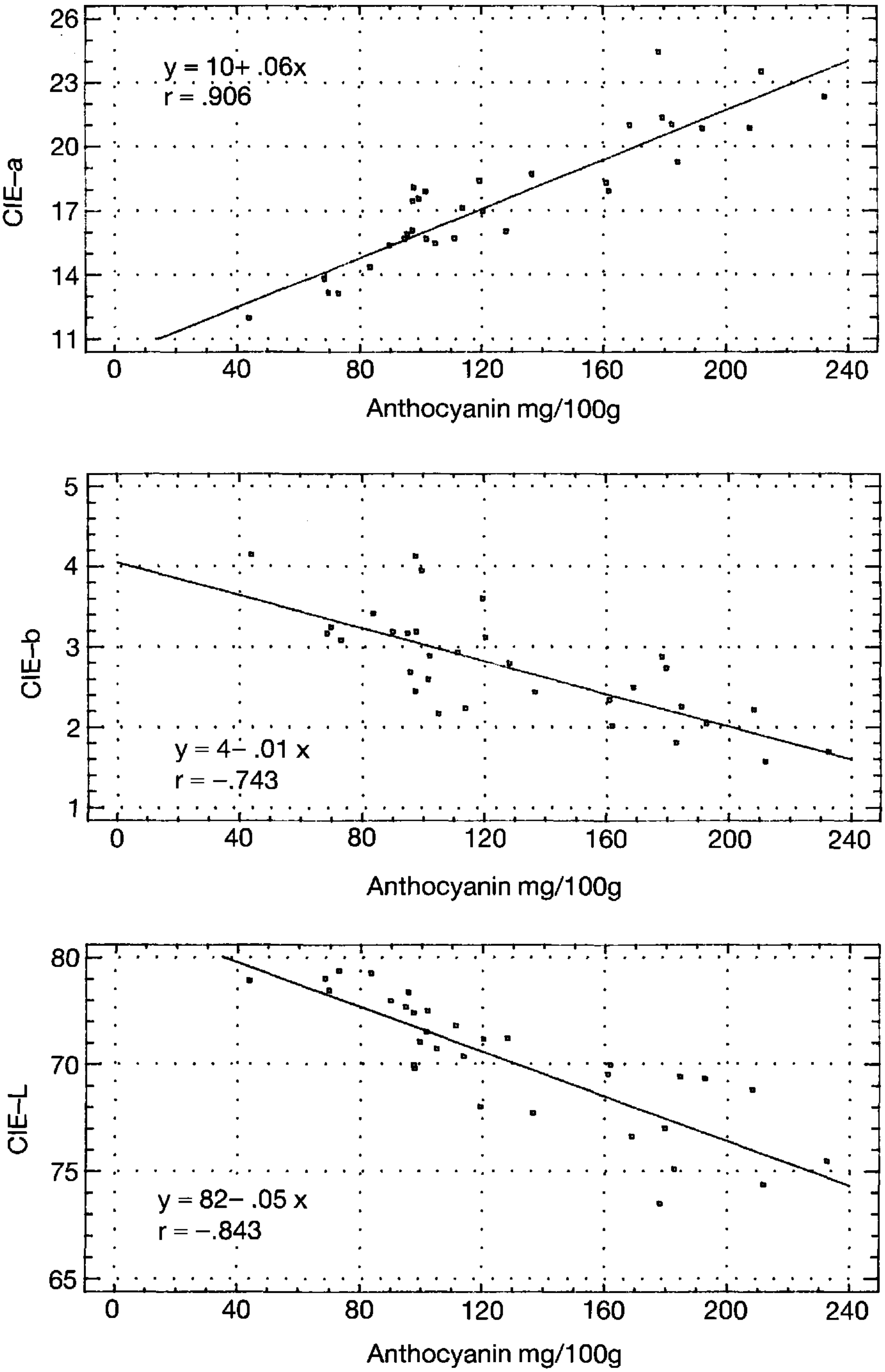

Fig. 3. Relationship between CIE–a (redness), CIE–b (yellowness) and CIE–L (lightness) and the content of anthocyanin in raw fruits. Experiment 2.

Sammenhæng mellem CIE–a (rød farve), CIE–b (gul farve), CIE–L (lyshed) og anthocyaninindholdet i råvaren. Forsøg 2.

Table 4. Average results (three samples) from analyses of samples from a factory processing stewed fruit from 'Stevnsbær'.
Resultater fra analyse af prøver fra en industrivirksomhed, der fremstiller frugtgrød af 'Stevnsbær'.

Product *produkt*	Soluble solids *Opl. tørstof* *mg/100 g*	Titratable acidity *Titrerbar syre* *g/100 g*	Anthocyanin *Anthocyanin* *mg/100 g*	Benzaldehyde *Benzaldehyd* *mg/kg*
Raw fruit *Råvare*	14	1.25	72	4.9
Stewed fruit *Frugtgrød*	25	0.32	19	1.0
LSD	1	0.11	17	0.2

kernels removed from the seeds can be extracted into water. Fig. 4 shows an example of benzaldehyde extraction. The maximum concentration obtained was 155 mg/ml or an extraction of 1550 mg/kg benzaldehyde from the kernels. The amount of benzaldehyde extracted from the kernels was from an average of five determinations 3622 mg/kg with a standard deviation of 250 mg/kg.

Four panellists ranked stewed cherries with different levels of benzaldehyde obtained from cherry kernels and added as processing water (Table 5). A Chi^2 value of 71.1 was found. This means a significant effect of benzaldehyde on cherry flavour. By sensory evaluation of stewed fruit with benzaldehyde extracts added to obtain contents of 0, 5, 10, 15, 20, 25 mg/kg an optimal cherry taste was obtained at a benzaldehyde level of 10–15 mg/kg of stewed fruit.

Discussion

Fruit size, soluble solid content and anthocyanin content increased while stone percentage and benzaldehyde formation capacity decreased during maturation (Figs 1 & 2). Similar results are reported earlier (4,12). The content of anthocyanins increases slowly 7 to 9 weeks after full bloom and then rapidly to week 11 (2). *Vestrheim* (12) found that the content of titratable acid decreases during maturation but an increase has been reported (4,7).

The concentration of seven anthocyanins found in cherries increases with different rates during maturation (5).

Because of low capacity of benzaldehyde formation in the fruit flesh (Fig. 1) a low content of benzaldehylde is found in jam and stewed fruit (Table 3) which is processed using the fruit flesh only. By use of kernel extracts a more intense

Table 5. Results from ranking of stewed fruit with different levels of benzaldehyde.
Resultater fra rækkestilling af kirsebærgrød med varierende indhold af benzaldehyd.

Benzaldehyde *Benzaldehyd* mg/kg	Panellist *Dommer*				Average rank *Gennemsnit*
	1 Rank *Nummer*	2	3	4	
0	1	1	1	1	1
0.2	2	2	2	2	2
1.7	3	3	3	3	3
3.4	4	4	4	5	4.3
5.2	5	5	5	4	4.6

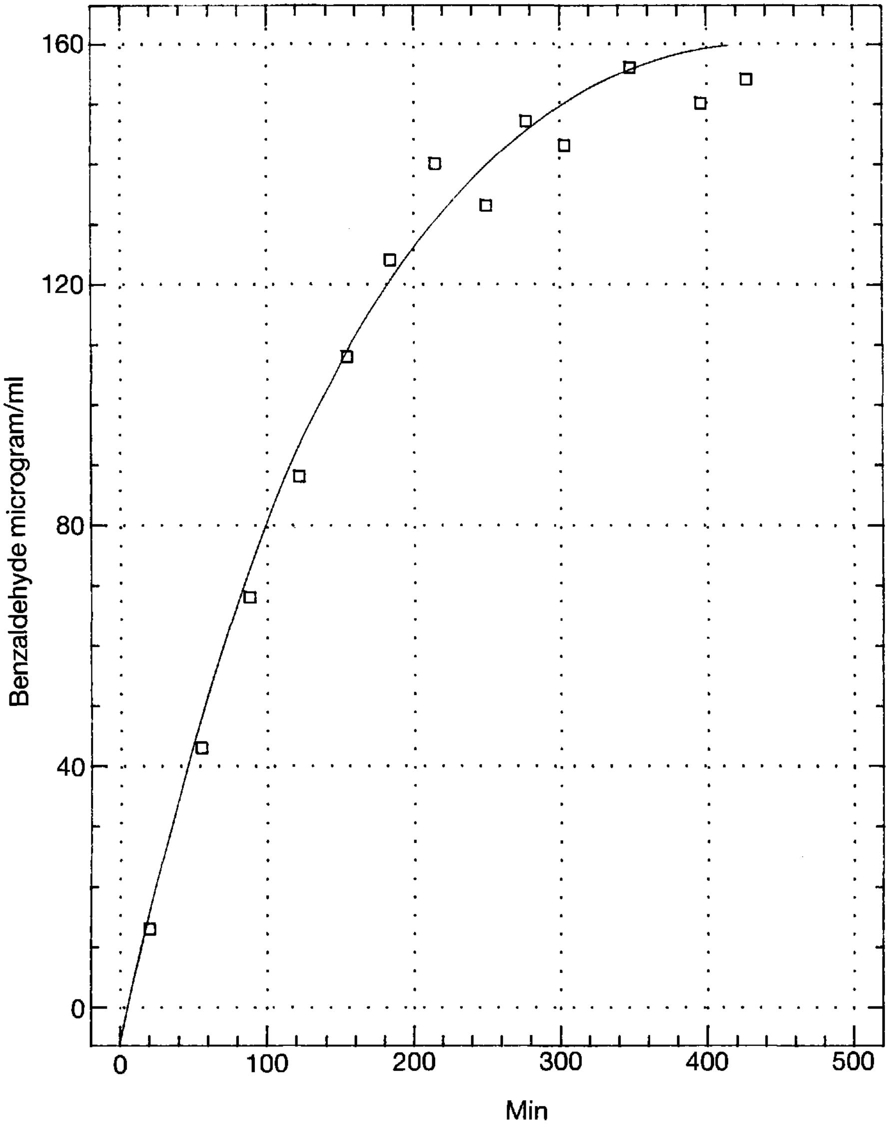

Fig. 4. Concentration of benzaldehyde in the extraction liquid during extraction of 10.00 g seeds in 100 ml liquid at 62°C.

Koncentration af benzaldehyd i ekstraktionsvæsken under ekstraktion af 10,00 g kerner i 100 ml væske ved 62°C.

cherry flavour can be obtained (Table 5). The benzaldehyde can be extracted from the seeds by use of hot water (Fig. 4) or by complete crushing of the kernels in the process water applied by processing of jam and stewed fruit. A benzaldehyde content of 10–15 mg/kg gives the desired cherry flavour. The cherry flavour cannot be ascribed to a few aroma substances. Several carbonyls, alcohols, and esters have been found in cherries, but the relative importance of a single component has not yet been described (1, 3, 8, 9, 10, 11).

The titratable acid in cherry which is mainly malic acid (13) may be assumed constant during processing of stewed fruit. From the proportion between titratable acid in the stewed and raw fruits (0.32/1.25=0.26) the concentration of anthocyanin in the stewed fruit should be 19 mg/100 g. This value was found by analyses (Table 4). Because of this and as shown in Fig. 2 it can be concluded that anthocyanins normally not are destroyed during processing of jam or stewed fruits.

The content of benzaldehyde in the stewed fruits should be 1.3 mg/kg but only 1.0 mg/kg was found (Table 4). Losses of this order may be the result of evaporation (6).

The surface colour of yoghurt processed with use of cherry jam depends on the content of anthocyanin (Fig. 3). By increasing the content of anthocyanin the redness (CIE–a) increases and the lightness (CIE–L) decreases. A decreasing yellowness (CIE–b) by increasing anthocyanin content may partly be a result of decreasing content of carotenoids during maturation.

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