

## Processing of preserved crab apples

### *Fremstilling af syltede paradisæbler*

**BIRKA FALK KÜHN and KARL KAACK**

---

### Summary

The experiment encompassed application of blanching conditions of fruits from eight cultivars of crab apples harvested at different ripeness. Fresh fruit of the eight varieties differed in content of soluble solids and titratable acid. During ripening the content of soluble solids increased while the titratable acid content was nearly constant.

The preserved crab apples differed especially in drained weight, appearance, texture and flavour. Processing of high quality preserved crab apples requires harvest after development of colour and flavour during ripening of the apples on

the trees.

Especially for large-fruited varieties, a low drained weight was obtained. The reason for the shrinking is the great difference in sugar content of the brine and the blanched fruits. Using long blanching time counteracted the shrinking effect.

Using the results from determining of flavour, texture, and appearance including colour, four cultivars were found suitable for preserving. 'Brandkjaer', 'Gorgeous', 'John Downie' and 'Dolgo' are suitable for processing of dessert fruits. Preserved fruits of 'Brandkjaer' can also be used as an accessory to meat.

**Key words:** Crab apples, harvesting time, processing, quality, product development.

### Resumé

Med henblik på fremstilling af syltede paradisæbler blev der udført forarbejdningsforsøg med otte små- eller storfrugtede sorter, der er blevet vurderet egnede til dyrkning i Danmark.

Der blev udført blancheringsforsøg med paradisæbler, som blev høstet på forskellige udviklingsstrin. Ved analyse af råvaren blev der fundet betydelige forskelle på indhold af opløseligt tørstof og titrerbar syre.

Under modningen, hvor frugtvægten generelt tiltog, forøgedes indholdet af opløseligt tørstof i

frugterne betydeligt, hvorimod koncentrationen af titrerbar syre var næsten konstant.

Produkter fremstillet af de forskellige sorter varierede betydeligt med hensyn til udseende, drænet vægt, aroma og smag. De bedste produkter blev fremstillet ved anvendelse af frugter med veludviklet farve og aroma.

På grund af den osmotiske forskel på lage og frugter blev der især for de storfrugtede sorter opnået et lavt udbytte af drænet vægt på færdigvaren. Ved anvendelse af stigende blancheringstid

blev der opnået tiltagende drænet vægt.

Efter vurdering af smag, tekstur, udseende, herunder farve blev udvalgt fire sorter, der må anses for velegnede til fremstilling af syltede para-

disæbler. 'Brandkjaer', 'Gorgeous', 'John Downie' og 'Dolgo' er velegnede som dessertfrugter. Produkter af 'Brandkjaer' kan også anvendes som tilbehør til kød.

**Nøgleord:** Paradisæbler, høsttidspunkt, syltning, kvalitet, produktudvikling.

## Introduction

Crab apples are eminent ornamental plants. Most crab apples have two ornamental seasons, flowers in the spring and fruits in the fall.

In Danish gardens crab apples are common plants and fruits are often picked for several purposes (2,3).

Commercial orchards are not known in Denmark, but if a valuable product could be processed a minor culture might be established. In order to keep the price of the fresh fruit at an acceptable level mechanical harvesting is necessary.

The aim of this study was to evaluate the quality of preserved crab apple processed from varieties suitable for growing in Denmark.

## Materials and methods

In 1988 preserved crab apples were processed from 10 varieties, and the products were screened. The most promising of these varieties 'Brandkjaer', 'Gorgeous', 'Hyslop', 'John Downie' and 'Makamik' were planted in autumn 1988. 20 trees of each variety were planted in four blocks.

Fertilizing, control of pests and diseases were in accordance with commercial practice for dessert apple (1).

Because the field experiment did not include 'Dolgo', 'Wierdakii' and 'Redflesh', fruits of these cultivars were picked from trees planted for ornamental purposes near the experimental field. Because of limited amount of fruits only few data were obtained for these varieties.

Fruits were picked on four dates. At each date all fruits from five trees were mixed and samples were taken for analyses and canning. First picking took place when skin ground colour started changing from green to yellow or when brown seeds appeared. The following pickings were carried out at seven days interval. Fruit size was determined by weighing 25 fruits per tree.

Samples for analyses of fresh crab apples were

prepared by treating the whole fruits with water in a Waring blender. The content of soluble solids was determined by refractometry and expressed as g/100 g fresh fruit.

Titrateable acid was determined by titration to pH 8.1 with 0.1 N NaOH and calculated as grams of malic acid in 100 grams of fresh crab apples. In connection with the titration for content of titrateable acid the pH was determined.

For blanching the stems were removed immediately after picking, and the crab apples were washed in cold tap water. In 1990 the core of the cultivar 'Hyslop' was removed. The following treatments were applied:

1988: 100°C for 5 minutes

1989: 80°C for 5, 10, 15 or 20 minutes

1990: 80°C for 15 or 20 minutes

After blanching the crab apples were packed in glass jars and hot (80°C) brine was added before pasteurization at 80°C. For the small fruited varieties 'Brandkjaer', 'Gorgeous', 'Makamik' and 'Wierdakii' jars of 570 cm<sup>3</sup> were used while jars of 1100 cm<sup>3</sup> were used for the large fruited varieties 'Dolgo', 'Hyslop', 'John Downie' and 'Redflesh'.

By packing the proportion between brine and fresh fruits was kept at 1.1. The brine was a 50 w/w% sugar solution with 0.1 w/w% of potassium sorbate and 0.1 w/w% sodium benzoate. Finally, the jars were cooled in cold tap water and stored at 4°C for four months in 1989 and three months in 1990. After draining of the stored crab apples on a sieve the drained weight was determined.

The organoleptical quality was determined by four panelists, who evaluated the products for several characteristics as described in the section with the results. The colour of preserved crab apples was evaluated in accordance with R.H.S. Colour Chart.

Analyses of variance with multiple range test and linear regression were applied by data analysis.

## Results

As shown in Table 1 'Dolgo' ripened earliest followed by 'Brandkjaer', 'Hyslop', 'John Downie', 'Redflesh', and 'Makamik'. 'Gorgeous' was the latest ripening cultivar. 'Wierdakii' was only picked in 1990 and then only once. The estimated date for fully ripened fruits was 5 September. Fully ripened fruits were obtained 6-12 days later in 1989 than in 1990.

The size of fruits ranged from 45.2 g in 'Hyslop' to 3.3 g in 'Brandkjaer' (Table 2). For varieties not included in the statistical analysis, the following mean fruit sizes were found: 'Dolgo' 13.3,

**Table 1.** Dates for beginning of ripening and for full ripen fruits, aver. 1989-90.

*Dato for begyndende modning og for fuldt modne frugter, gns. 1989-90.*

Cultivar Sort	Date Dato	
	Beginning of ripening <i>Begyndende modning</i>	Full ripening <i>Fuld modning</i>
'Dolgo'	14/8	4/9*
'Brandkjaer'	22/8	12/9
'Hyslop'	22/8	12/9
'John Downie'	22/8	12/9
'Redflesh'	21/8	13/9*
'Makamik'	26/8	15/9
'Gorgeous'	1/9	22/9

\* Dates are estimated.

*Dato er beregnet.*

**Table 2.** Weight of fruits, g/fruit, average 1989-90.

*Frugtstørrelse, g/frugt, gns. 1989-90.*

Variety Sort	Picking No. Plukning nr.				Aver. Gns.
	1	2	3	4	
'Hyslop'	35.9 c*	44.3 b	49.9 a	50.6 a	45.2 a**
'John Downie'	16.2 a	16.2 a	17.6 a	18.1 a	17.0 b
'Gorgeous'	8.2 b	8.2 b	9.5 a	9.3 a	8.8 c
'Makamik'	7.6 b	8.0 ab	7.9 ab	8.5 a	8.0 c
'Brandkjaer'	3.1 b	3.6 a	3.2 b	3.5 a	3.3 d

\* Picking no.: horizontal comparison.

\*\* Cultivars: average, vertical comparison.

Figures not followed by same letter differ significantly at  $p \leq 0.05$ .

\* *Plukning nr.:* Horisontal sammenligning.

\*\* *Sorter:* Gennemsnit, vertikal sammenligning. Tal med forskelligt bogstav er signifikant forskellige ( $p \leq 0,05$ ).

'Wierdakii' 9.5 and 'Redflesh' 18.9 g/fruit. During the chosen harvest period the size of fruit from the variety 'John Downie' was constant, but in other varieties the size of fruit increased during ripening.

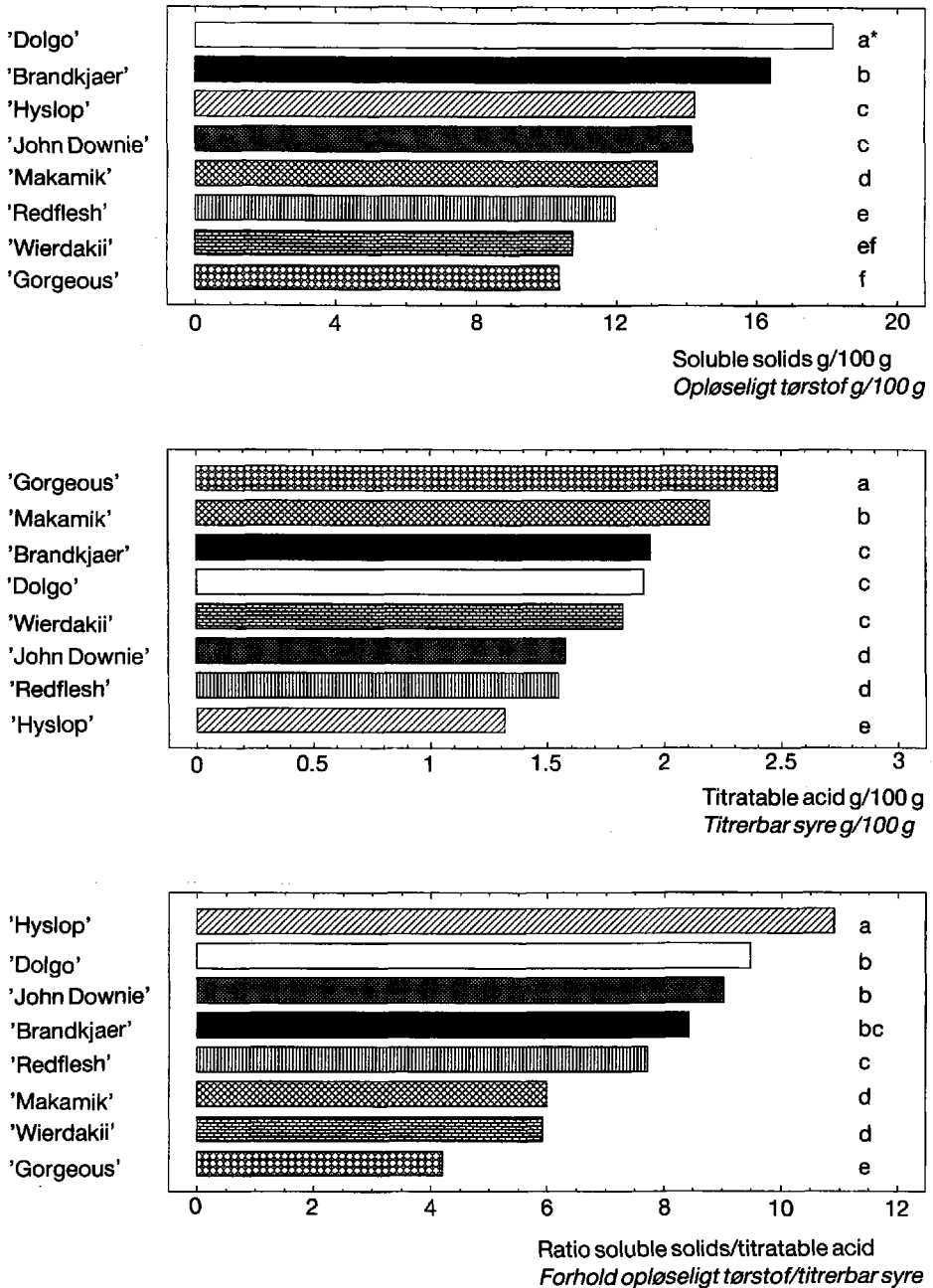
The pH values ranged from 2.9 in 'Gorgeous' to 3.3 in 'Hyslop'. Averages from two years (1989, 1990) of the content of soluble solids, titratable acid and the ratio between soluble solids and titratable acid in fresh fruits are shown in Fig. 1. The content of soluble solids was highest in 'Dolgo' and lowest in 'Gorgeous'. 'Hyslop' and 'John Downie' had equal content of soluble solids. The content of titratable acid ranged from 2.5 g/100 g in 'Gorgeous' to 1.3 g/100 g in 'Hyslop' (Fig. 1).

The ratio between soluble solids and titratable acid decreased from 11 in 'Hyslop' to 4 in 'Gorgeous'.

Fig. 2 shows the change in content of soluble solids with day of harvest by fitted lines of linear regression. The values of intercept, slope and correlation coefficient are given. The content of soluble solids increased significantly with harvest time. Because of too few data, 'Makamik' was not taken into consideration in 1989 in this connection.

Similar statistical analyses by linear regression were carried out for the titratable acid content. For all cultivars small slopes were found indicating no changes during ripening. Different levels of content were found as shown in Fig. 1, but no important changes by time were detected.

Fig. 1.



\* Cultivars not followed by same letter differ significantly at  $p \leq 0.05$ .  
 Sorter med forskellig bogstav er signifikant forskellige ( $p \leq 0,05$ ).

Fig. 1. Soluble solids, titratable acid and ratio between soluble solids and titratable acid in the fresh fruit in different varieties.

*Opløseligt tørstof, titrerbar syre samt forholdet opløseligt tørstof og titrerbar syre i forskellige sorter.*

Fig. 2.

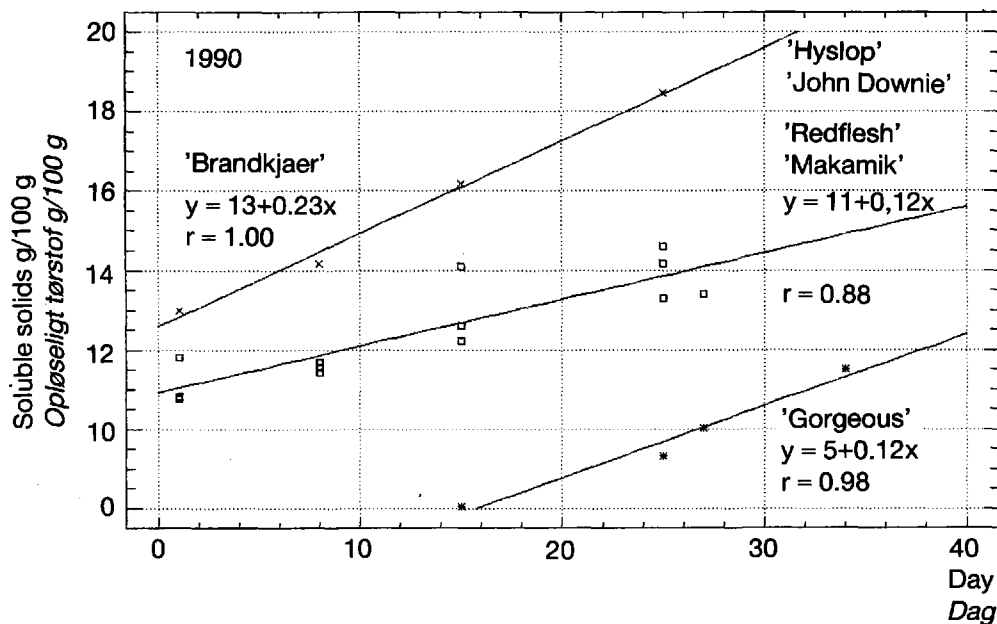
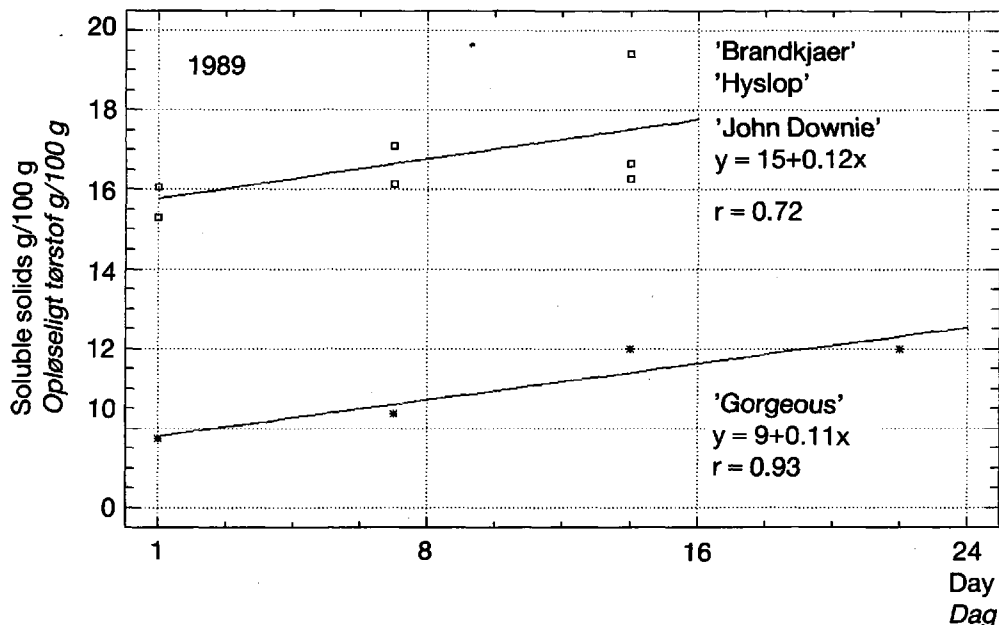


Fig. 2. Soluble solids in different varieties in proportion to time of harvest. First day of harvest was 28 and 16 August in 1989 and 1990 respectively.

Opløseligt tørstof i forskellige sorter ved forskellige høsttider. Første høstdag var 28. august og 16. august i henholdsvis 1989 og 1990.

Fig. 3.

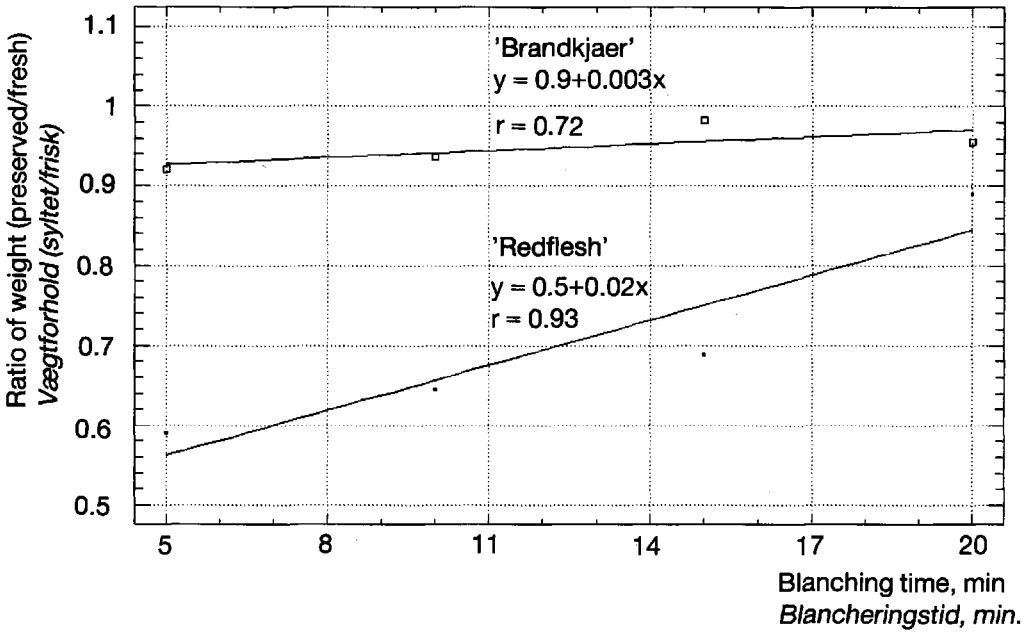
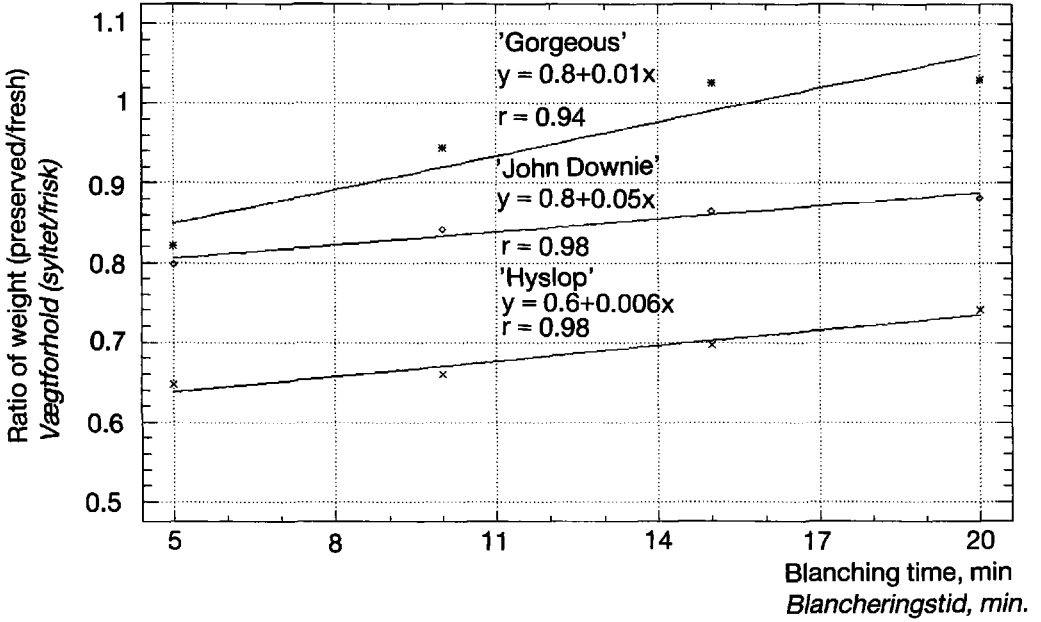


Fig. 3. Ratio of weight (preserved/fresh) in proportion to blanching time for different varieties, 1989.  
Vægtforhold (syltet/frisk) ved forskellige blancheringstider for forskellige sorter, 1989.

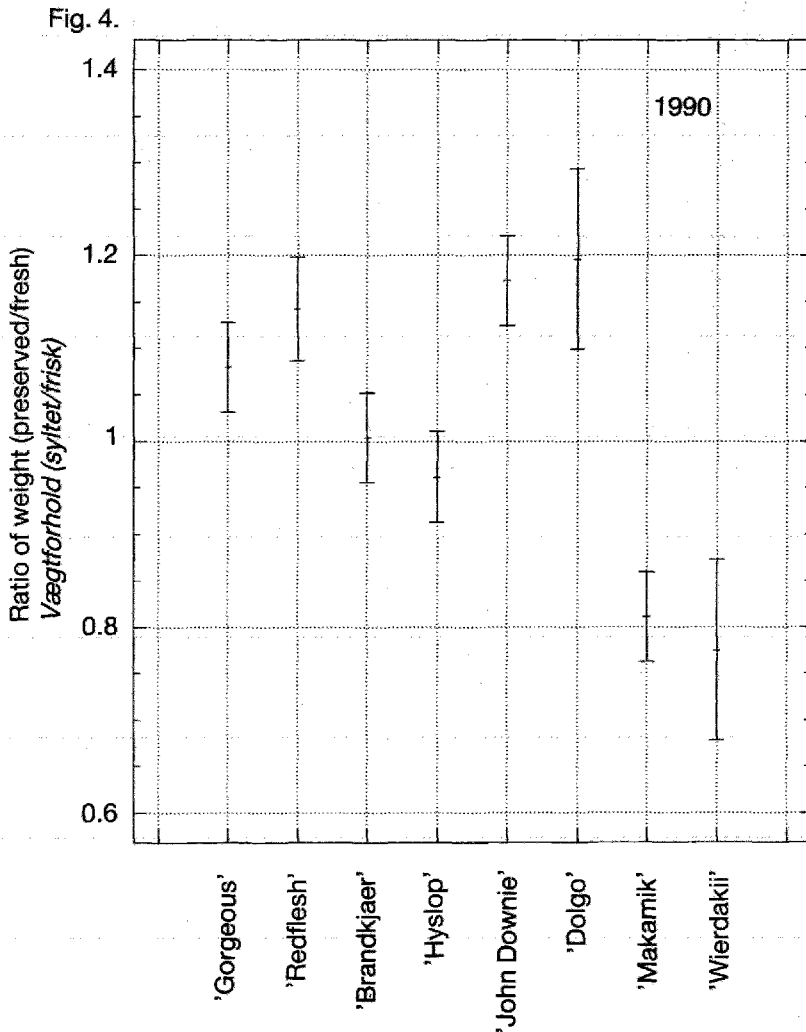


Fig 4. Ratio of weight (preserved/fresh). Average of 15 and 20 minutes blanching, 1990.  
*Vægtforhold (syltet/frisk) for flere sorter. Gennemsnit af 15 og 20 min. blanchering, 1990.*

Fig. 3 shows the effect of blanching time on the ratio between the weight of preserved and fresh fruits. The highest ratio of weight was generally obtained for blanching in 15 or 20 minutes. In 1990 blanching resulted in significant differences in ratio of weight for different varieties (Fig. 4).

The ratio of weight was less than 1 for 'Hyslop', 'Makamik' and 'Wierdakii'.

For 'Brandkjaer' the yield of drained fruits were almost equal to the amount of fresh crab apples. For 'Gorgeous', 'Redflesh', 'John Downie' and 'Dolgo' a ratio above 1 was obtained.

In 1988 the method of processing resulted in cracking of processed crab apples in all varieties but 'Hyslop'. Apples of this cultivar on the other hand were wrinkly and the appearance was very

unattractive. In 1989 the tendency to wrinkling or cracking was less than in 1988. In 1990 cracking occurred to a small extent and 'Hyslop' still was rather wrinkly.

As shown in Fig. 5 the colour of the preserved crab apples depended very much on the time of harvest. The surface colour of mature preserved fruits is described in Table 3.

Mainly because of better flavour in well ripened fruits, the taste panel preferred products from the third and fourth harvests. Organoleptical characteristics of the preserved fruits are shown in Table 3. The cultivar 'Hyslop' was discarded because of the preserved fruits were too wrinkled and too large.

Products processed from 'Makamik' and 'Wierdakii' were unacceptable because of a bitter taste and 'Redflesh' had an unsatisfactory colour.

## Discussion

The period of beginning ripening dates for crab apples is from about 15 August to 1 September (Table 1). Three groups of varieties appeared:

1. 'Dolgo'
2. 'Brandkjaer', 'Hyslop', 'John Downie', 'Redflesh',
3. 'Makamik', 'Gorgeous'.

The varieties differed from 3.3 to 45.2 g/fruit according to fruit size. The large fruited varieties were 'Hyslop', 'Redflesh', 'John Downie', and 'Dolgo' (Table 2). A group with medium sized fruits encompassed 'Wierdakii', 'Gorgeous' and 'Makamik'. 'Brandkjaer' had very small fruits.

Except for 'John Downie', the fruit weight increased significantly during the picking period (Table 2).

During the ripening period the colour of the crab apples changed from yellow-green to more intense red or yellow. The varieties with an all-over red colour were 'Brandkjaer', 'Makamik', 'Gorgeous', 'Redflesh', 'Dolgo' and 'Wierdakii' (Table 3). In the mature state 'Hyslop' was yellow-red and 'John Downie' was yellow. The consumers preference for the products is individual, but it probably depends on the purpose or meal at which the preserved crab apples are served.

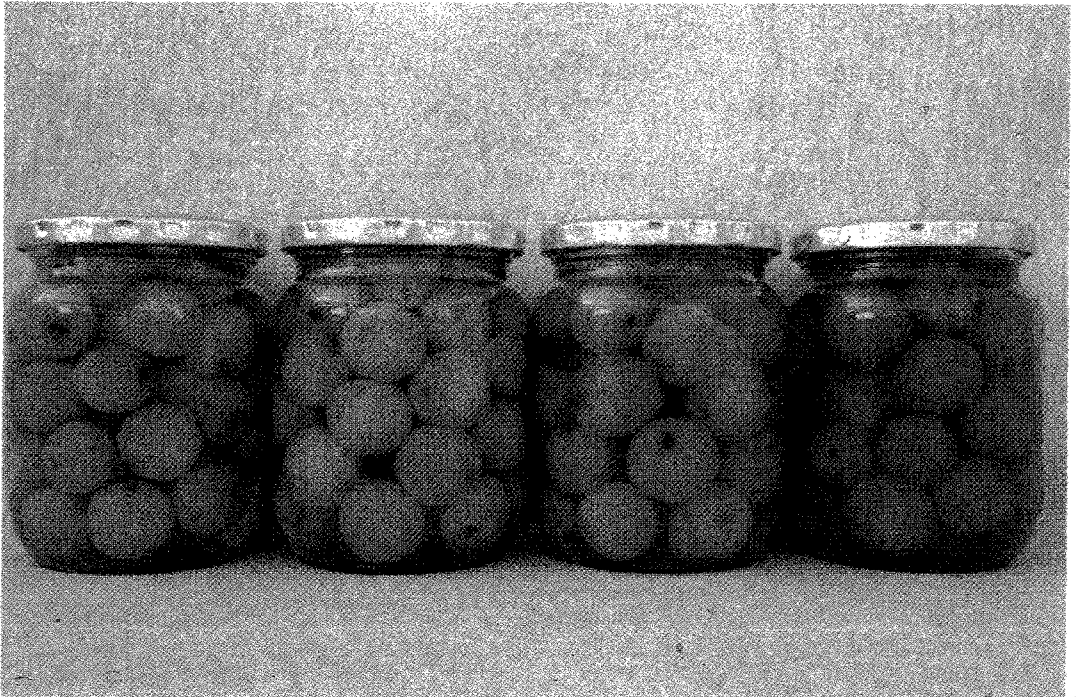


Fig. 5. Preserved 'Gorgeous' apples harvested on different dates. Left = 1st harvest. Right = 4th harvest.

*Syltede 'Gorgeous' æbler høstet på forskellige datoer. Venstre = 1. høst. Højre = 4. høst.*



**Table 3.** Results from evaluation of organoleptical characteristics, and colour of ripen canned fruits 1989-90. *Resultater af den organoleptiske vurdering, og farve på modne syltede æbler, 1989-90.*

Cultivar/Sort	Results/Resultater
'Brandkjaer'	Fine apple flavour, but the core might bother. Carrot red – nasturtium red. <i>God æblesmag, dog kan kernehuset være generende. Gulerodsfarvet – tropaeolum rød.</i>
'Hyslop'	Apple flavour, but shrivelled, wrinkly apples. Discarded because of fruit size and appearance. Apricot – nasturtium orange. <i>God aromatisk smag. Æbler kan være indskrumpne. Kasseret pga. frugtstørrelse og udseende. Abrikos – tropaeolum orange.</i>
'Georgeous'	Fine marzipan-like taste, attractive appearance, especially a very nice colour: yellow ochre – nasturtium red. <i>God, marcipanagtig smag, tiltalende udseende. Fin farve: Okkergul – tropaeolum rød.</i>
'John Downie'	Fine marzipan-like taste, attractive appearance, fine colour: lemon yellow – chrome yellow. <i>God marcipanagtig smag, tiltalende udseende. Fin farve: Citron gul – krom gul.</i>
'Makamik'	Bitter taste, discarded. Greyish red. <i>Bitter smag, kasseret. Grålig rød.</i>
'Dolgo'	Very delicious, plum-like taste. Very attractive appearance, very nice colour: vermillion. <i>Meget lækker, blommeagtig smag. Meget tiltalende udseende, raffineret farve: Højrød – zinnober rød.</i>
'Redflesh'	Sweet watery taste, soft consistency, unattractive colour: greyish red. Discarded. <i>Sød, vandet smag, blød konsistens. Kedelig farve: Grålig rød. Kasseret.</i>
'Wierdakii'	Bitter unpleasant taste. Greyish red. <i>Bitter, ubehagelig smag. Grålig rød.</i>

During ripening an increase of the content of soluble solids occurred, but the content of titratable acid was rather constant. The average increase of soluble solids in the five groups of varieties shown in Fig. 2 was 0.15 g/day.

The content of soluble solids and titratable acid is to some extent of importance for the flavour, but aroma substances probably have the greatest importance for the flavour of apples. The characteristic flavour is most developed in the mature fruits from which the preferable products were processed.

In the orchard fruits are assumed to be well ripened when ground colour have changed from green to yellow. For varieties with red colour the optimum time for harvest can be determined only by examination of the score. Well ripened fruits have brown seeds.

As shown in Fig. 3 the drained weight of the products increased by increasing blanching time. The explanation of this is that the diffusiveness of the brine is increased by more intense heat treatment which cause breakdown of the membranes of the cells. The best quality of processed crab apples was obtained by a blanching temperature of 80°C and blanching times of 15 to 20 minutes.

A weight ratio between preserved and fresh fruit below 1 was obtained in three varieties (Fig. 4). This indicates that shrinking has occurred because large osmotic differences between crab apples and brine not were equilibrated. Varieties with a ratio of weight above 1 are considered as suitable for preserving.

## Conclusion

The cultivar 'Hyslop' was discarded because the preserved fruits were too large and wrinkled and the ratio of weight (preserved/fresh) was less than 1. Products processed from 'Makamik' and 'Wierdakii' were unacceptable because of a bitter taste. 'Wierdakii' has not yet been discarded because the bitter taste might be a result of too early harvest. 'Redflesh' had an unsatisfactory colour and a very poor flavour (Table 3).

According to the results of this experiment, four varieties might be useful for processing for dessert and accessories to meals including meat. 'Brandkjaer', 'Georgeous', 'John Downie' and 'Dolgo' are suitable for processing of dessert fruits. 'Brandkjaer' is also suitable as an accessory to meat. Products processed from 'Brandkjaer' and 'Dolgo' have a typical apple and

plumlike flavour respectively. Preserved crab apples with marzipan-like flavour can be processed from 'Gorgeous' and 'John Downie' (Table 3).

2. *Poulsen, J.* 1984. Malus den alsidige. Haven 84, 436-438.
3. *Rønnow, A.* 1984. Paradisæbler i køkkenet. Haven 84, 439-440.

## References

1. *Christensen, J. Vittrup; Hansen, P. & Burgård, E.* 1987. Frugt og Bær dyrkning. Gartnerinfo. Copenhagen 194 pp.

Manuscript received 25 March 1991.