CONCENTRATION OF FEIJOA AND BOYSENBERRY FRUIT AROMA CONDENSATES USING PERVAPORATION

A thesis presented in partial fulfillment of the requirements for the Degree of Master in Food Technology at Massey University

Mei Fang Yang
2000
**ERRATA**

Page 64  The $r^2$ for the ethanol calibration curve was 0.64.

Page 74  Table 4.4, the ATV of ethanol should be changed from “NF” to “0.28-9%”. ATV of ethanol is 0.28-9 g/100g; it is different from other aroma compounds such as geraniol (ATV: 0.001-0.01 mg/kg), linalool (ATV: 0.001-0.01 mg/kg).

Page 74  Table 4.4, the AV of ethanol should be changed from “NF” to “2.2”.

Page 107  Table 4.22, the concentration of ethanol at the flow rate of $1.4\times10^{-5}$ m$^3$s$^{-1}$ should be changed from “10044” to “10044*”.

Page 108  Table 4.23, the enrichment factor for ethanol at the flow rate of $1.4\times10^{-5}$ m$^3$s$^{-1}$ should be changed from “8.6 ± 0.5” to “8.6 ± 0.5*”. 
Abstract

This present work aimed to investigate pervaporation for aroma recovery and concentration from fruit aroma condensate collected during evaporation of fruit juices. A 5% ethanol solution, feijoa and boysenberry aroma condensates were concentrated in a pervaporation apparatus fitted with polydimethyl siloxane (PDMS: GFT1060, GFT1070) and poly-ether-block-amide (PEBA, GKSS) membranes, under the following operating conditions: feed temperature of 30°C, feed flow rate of $8.3 \times 10^{-6} \text{ m}^3 \text{s}^{-1}$, $1.1 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$ or $1.4 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$, and permeate pressures of 100 Pa or 1000 Pa. Feijoa and boysenberry aroma condensates were also concentrated by vacuum distillation. Aroma compounds and their concentrations in the feed, retentate and permeate were identified and determined by gas chromatography (GC) and a mass spectrometer coupled to a GC.

The three membranes investigated for pervaporation gave different total fluxes, partial fluxes, mass transfer coefficients, enrichment factors and aroma compositions for feijoa and boysenberry condensate. PEBA membranes proved to have best performance for concentration of feijoa and boysenberry aroma due to high enrichment factors and mass transfer coefficients for the important aroma compounds of both feijoa and boysenberry.

Increasing the feed flow rate from $1.1 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$ to $1.4 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$ did not affect the total flux, but increased significantly the partial fluxes and enrichment factors of preferentially permeating compounds such as methyl benzoate, ethyl benzoate and linalool. Decreasing permeate pressure significantly increased the total flux, the partial fluxes and enrichment factors for higher boiling aliphatic alcohols. The mass transfer resistances of methyl benzoate, ethyl benzoate and linalool was dominated by the boundary layer effects. The mass transfer resistances of high boiling aliphatic alcohols, hexanol, Z-3-hexenol and E-2-hexenol were strongly influenced by permeate pressure.

Compared with vacuum distillation, pervaporation showed better performance for producing concentrated feijoa and boysenberry aromas which were highly enriched in the important flavour compounds for each fruit.
Acknowledgments

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Table of Contents

Abstract .............................................................................................................. i
Acknowledgments ............................................................................................ ii
Table of Contents ............................................................................................ iii
List of figure ................................................................................................... vii
List of Table ..................................................................................................... ix
List of nomenclature ..................................................................................... xiii

Chapter One

Introduction...................................................................................................... 1

Chapter Two

Literature Review ............................................................................................ 4

2.1 Fruit aromas and volatile constituents of feijoa and boysenberry .......... 4
  2.1.1 Fruit aromas ......................................................................................... 4
  2.1.2 Fruit aroma biogenesis, post-harvest change and processing change ....... 5
  2.1.3 Volatile constituents of feijoa fruit ......................................................... 6
  2.1.4 Volatile constituents of boysenberry fruit ............................................. 7
  2.1.5 Review of techniques for analysis of aroma compounds ..................... 10

2.2 Aroma recovery during beverage processing ........................................... 12
  2.2.1 Aroma recovery by evaporation and distillation .................................. 12
  2.2.2 Aroma recovery and concentration by partial condensation ............... 13
  2.2.3 Aroma recovery and concentration by gas injection techniques .......... 14
  2.2.4 Aroma recovery by adsorption ............................................................ 14
  2.2.5 Aroma recovery by supercritical fluid extraction .............................. 15
  2.2.6 Aroma recovery by reverse osmosis ................................................... 15
  2.2.7 Aroma recovery by pervaporation ..................................................... 15
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>Mass transfer process in pervaporation</td>
<td>17</td>
</tr>
<tr>
<td>2.3.1</td>
<td>Review of mass transfer models</td>
<td>17</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Mass transfer on the feed side of the membrane</td>
<td>19</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Mass transfer through the membrane</td>
<td>21</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Mass transfer on the permeate side of the membrane</td>
<td>24</td>
</tr>
<tr>
<td>2.4</td>
<td>Factors affecting performance of pervaporation membranes</td>
<td>25</td>
</tr>
<tr>
<td>2.4.1</td>
<td>Pervaporation membranes</td>
<td>26</td>
</tr>
<tr>
<td>2.4.2</td>
<td>The nature of the aroma compounds</td>
<td>28</td>
</tr>
<tr>
<td>2.4.3</td>
<td>Feed composition</td>
<td>29</td>
</tr>
<tr>
<td>2.4.4</td>
<td>Feed temperature</td>
<td>30</td>
</tr>
<tr>
<td>2.4.5</td>
<td>Feed flow velocity</td>
<td>31</td>
</tr>
<tr>
<td>2.4.6</td>
<td>Permeate pressure</td>
<td>32</td>
</tr>
<tr>
<td>2.4.7</td>
<td>Condensation conditions</td>
<td>33</td>
</tr>
<tr>
<td>2.5</td>
<td>Applications of pervaporation</td>
<td>33</td>
</tr>
<tr>
<td>2.5.1</td>
<td>Solvent dehydration</td>
<td>35</td>
</tr>
<tr>
<td>2.5.2</td>
<td>Wastewater treatment</td>
<td>36</td>
</tr>
<tr>
<td>2.5.3</td>
<td>Pervaporation in biotechnology processes</td>
<td>37</td>
</tr>
<tr>
<td>2.5.4</td>
<td>Pervaporation aroma recovery in beverage processing</td>
<td>39</td>
</tr>
<tr>
<td>2.6</td>
<td>Conclusion</td>
<td>41</td>
</tr>
</tbody>
</table>

Chapter Three

Experimental .................................................................................................. 43

3.1 Terms and Definition ............................................................................ 43

3.2 Materials .............................................................................................. 46

3.2.1 Aroma condensate ............................................................................ 46

3.1.2 Liquid nitrogen and dry ice ........................................................ 46

3.1.3 Membranes ....................................................................................... 46

3.2.4 Pervaporation apparatus .................................................................. 47

3.2.5 Vacuum distillation apparatus ..................................................... 51

3.2.6 Materials for analytical techniques ............................................. 55
3.3 Vacuum distillation procedure ................................................................. 56
3.4 Pervaporation operating procedure .......................................................... 57
3.5 Pervaporation experimental procedure ....................................................... 58
  3.5.1 Influence of membrane type on pervaporation performance ................. 58
  3.5.2 Effect of permeate pressure on pervaporation performance .................. 59
  3.5.3 Effect of feed flow rate on pervaporation performance ......................... 59
  3.5.4 Vacuum distillation for aroma recovery ................................................. 59
3.6 Procedure for the analysis of the aroma solutions ....................................... 60
  3.6.1 Solid phase extractions (SPE) ................................................................. 60
  3.6.2 Direct solvent extraction ....................................................................... 60
  3.6.3 Gas chromatographic analysis ............................................................... 61
  3.6.4 Gas chromatograph – mass spectrometer (GC-MS) .............................. 61
  3.6.5 Identification of aroma compounds ...................................................... 61
  3.6.6 Quantitative analysis by gas chromatogram .......................................... 63
3.7 Statistical analysis of data ........................................................................... 65

Chapter Four

Results and Discussion ................................................................................ 66

4.1 Identification of aroma composition in aroma condensate ......................... 66
  4.1.1 Feijoa ................................................................................................. 66
  4.1.2 Boysenberry ....................................................................................... 71
4.2 Membrane evaluation ................................................................................ 76
  4.2.1 Feijoa ................................................................................................. 77
  4.2.2 Boysenberry ....................................................................................... 85
  4.2.3 Discussion .......................................................................................... 91
4.3 Influence of permeate pressure ................................................................... 95
  4.3.1 Feijoa aroma ....................................................................................... 95
  4.3.2 Boysenberry: ...................................................................................... 99
  4.3.3 Discussion .......................................................................................... 102
List of figure

Figure 3.1 Schematic diagram of pervaporation cell .................................................. 49
Figure 3.2 Pervaporation membrane cell ................................................................. 50
Figure 3.3 Schematic diagram of pervaporation apparatus ....................................... 52
Figure 3.4 Permeate side of pervaporation apparatus ............................................... 53
Figure 3.5 Vacuum distillation apparatus .................................................................. 54
Figure 4.1 Gas chromatogram of the feijoa aroma condensate (feed sample) ............ 67
Figure 4.2 Gas chromatogram of boysenberry aroma condensate (feed sample) ....... 72
Figure 4.3 Mass transfer coefficients of aroma compounds for feijoa aroma pervaporation with membranes: GFT1060, GFT1070 and PEBA; at a feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ and permeate pressure of 100 Pa absolute pressure .................................................. 83
Figure 4.4 Enrichment factors of aroma compounds of feijoa aroma after pervaporation using three different membranes; GFT1060, GFT1070 and PEBA, at a feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ and permeate pressure of 100 Pa absolute pressure .................................................. 84
Figure 4.5 Mass transfer coefficients of aroma compounds for boysenberry aroma pervaporation with membranes: GFT1060, GFT1070 and PEBA, at a feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹, permeate pressure of 100 Pa absolute pressure .................................................. 90
Figure 4.6 Enrichment factors for aroma compounds of boysenberry aroma after pervaporation using three different membranes; GFT1060, GFT1070 and PEBA, at a feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ and permeate pressure of 100 Pa absolute pressure .................................................. 92
Figure A1 Gas chromatogram of the feijoa aroma permeate after pervaporation with GFT1060 membranes at a feed temperature of 30°C, permeate pressure of 100 Pa, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ ................................................................. 139
Figure A2 Gas chromatogram of the feijoa aroma permeate after pervaporation with GFT1070 membranes at a feed temperature of 30°C, permeate pressure of 100 Pa, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$. ................................................................. 140

Figure A3 Gas chromatogram of the feijoa aroma permeate after pervaporation with PEBA membranes at a feed temperature of 30°C, permeate pressure of 100 Pa, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$. ................................................................. 141

Figure A4 Gas chromatogram of the boysenberry aroma permeate after pervaporation with GFT1060 membrane, at feed temperature of 30°C permeate pressure of 100 Pa, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$. ................................................................. 142

Figure A5 Gas chromatogram of boysenberry aroma permeate after pervaporation with GFT1070 membrane at a feed temperature of 30°C. permeate pressure of 100 Pa, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$. ................................................................. 143

Figure A6 Gas chromatogram of boysenberry aroma permeate after pervaporation with PEBA membranes at feed temperature of 30°C, permeate pressure of 100 Pa, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$. ................................................................. 144

Figure A7 Gas chromatogram of the feijoa aroma concentrate concentrated by vacuum distillation at 30°C. ................................................................. 145

Figure A8 Gas chromatogram of boysenberry aroma concentrate by vacuum distillation at 30°C ................................................................. 139
List of Table

Table 2.1 Volatile aroma compounds in feijoa fruit flesh ......................................................... 8
Table 2.2 Major volatile composition of boysenberry fruit by headspace trapping and vacuum distillation .................................................................................................................. 9
Table 3.1 Membrane characteristics .............................................................................................. 47
Table 3.2 External standards for feijoa volatile compounds .......................................................... 62
Table 3.3 External standards for boysenberry volatile compounds .............................................. 62
Table 4.1 The volatile compounds in feijoa aroma condensate .................................................... 68
Table 4.2 Aroma threshold value, aroma value and properties of aroma compounds identified and studied in feijoa aroma condensate .............................................................................. 69
Table 4.3 The volatile compounds in boysenberry aroma condensate ......................................... 73
Table 4.4 Aroma threshold value, aroma value and properties of aroma compounds identified and studied in the boysenberry condensate ................................................................. 74
Table 4.5 The influence of membrane type on total flux and enrichment factor for 5% (w/w) ethanol solution after pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$ and permeate pressure of 100 Pa absolute pressure ........................................................................................................... 76
Table 4.6. Yield, pervaporation experiment duration and total flux for feijoa aroma solution after pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$ and permeate pressure of 100 Pa absolute pressure ........................................................................... 77
Table 4.7 The influence of different pervaporation membranes on the individual concentrations of aroma compounds in the feed, retentate and permeate for feijoa aroma pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$ and permeate pressure of 100 Pa absolute pressure ................................................................................................................ 78
Table 4.8 The influence of membrane type on relative concentrations of aroma compounds in the permeate obtained from feijoa aroma pervaporation, at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5}$ m$^3$ s$^{-1}$ and permeate pressure of 100 Pa........................................................................ 80
Table 4.9 The influence of membrane type on the partial flux of aroma compounds for feijoa aroma pervaporation, at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ and permeate pressure of 100 Pa absolute pressure. ........................................... 81

Table 4.10 Yield, pervaporation experiment duration and total flux for boysenberry aroma solution after pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ and permeate pressure of 100 Pa absolute pressure. ........................................... 85

Table 4.11 The influence of membrane type on the concentrations of aroma compounds in the feed, retentate and permeate for boysenberry aroma pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ and permeate pressure of 100 Pa absolute pressure. ........................................... 86

Table 4.12 The influence of membrane type on the relative concentrations of aroma compounds in the permeate obtained from boysenberry aroma pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ and permeate pressure of 100 Pa absolute pressure. ........................................... 88

Table 4.13 The influence of membrane type on the partial fluxes of aroma compounds for boysenberry aroma pervaporation at a feed temperature of 30°C, feed flow rate of $1.4 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ and permeate pressure of 100 Pa absolute pressure. ........................................... 89

Table 4.14 The effect of permeate pressure on the total flux and enrichment factor for 5% (w/w) ethanol solution after pervaporation with GFT1060 membranes at a feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ ........................................... 95

Table 4.15 Yield, pervaporation experiment duration and total flux for feijoa aroma solution after pervaporation with GFT1060 membranes at feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ ........................................... 96

Table 4.16 The effect of permeate pressure on the individual concentrations of aroma compounds in the feed, retentate and permeate for feijoa aroma pervaporation, with GFT1060 membrane at a feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3\text{s}^{-1}$ ........................................... 97
Table 4.17 The effect of permeate pressure on the partial fluxes and enrichment factors of aroma compounds for feijoa aroma pervaporation, with GFT1060 membranes at a feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$. ................................................................. 98

Table 4.18 Yield, pervaporation experiment duration and total flux for boysenberry aroma solution after pervaporation with GFT1060 membranes at feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$. ........................................................................................................ 99

Table 4.19 The effect of permeate pressure on the concentration of aroma compounds in the feed, retentate and permeate for boysenberry aroma pervaporation, with GFT1060 membranes at feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$. .................................... 100

Table 4.20 The effect of permeate pressure on the partial flux and enrichment factor of aroma compounds for boysenberry aroma pervaporation with of GFT1060 membranes at feed temperature of 30°C, feed flow rate of $0.83 \times 10^{-5} \text{ m}^3 \text{s}^{-1}$. ................................................................. 101

Table 4.21 Yield, experiment duration and total flux for feijoa aroma after pervaporation with GFT1060 membranes, at a feed temperature of 30°C, permeate pressure of 100 Pa absolute pressure. ........................................................................................................ 105

Table 4.22 The effect of feed flow rate on the individual concentration of aroma compounds in the feed, retentate and permeate for feijoa aroma pervaporation with GFT1060 membranes at feed temperature of 30°C, permeate pressure of 100 Pa. .......................................................................................... 107

Table 4.23 The effect of feed flow rate on the partial fluxes and enrichment factors of aroma compounds for feijoa aroma after pervaporation with of GFT1060 membranes, at a feed temperature of 30°C, permeate pressure of 100 Pa. ................................................................. 108

Table 4.24 The individual concentration of aroma compounds in the feed, retentate and aroma concentrate for feijoa aroma vacuum distillation at 30°C and yield of 5%. ........................................................................ 111

Table 4.25 The relative concentrations of aroma compounds in the feijoa aroma concentrate obtained by pervaporation (PV) and by vacuum distillation (VD). .................................................................................. 112

Table 4.26 The concentration factors of aroma compounds for the feijoa aroma pervaporation and vacuum distillation with a 5% yield. ........................................................................................................ 113
Table 4.27 The individual concentration of aroma compounds in the feed, retentate and aroma concentrate for boysenberry aroma vacuum distillation with yields of 5% and 10% at feed temperature of 30°C. ................................................................. 115

Table 4.28 The relative concentrations of aroma compounds in boysenberry aroma concentrate obtained by pervaporation (PV) and by vacuum distillation (VD) with 5% yield. .............................................................................................................. 116

Table 4.29 The concentration factors of aroma compounds for boysenberry aroma pervaporation and vacuum distillation with a 5% yield. ................................................................. 118

Table 4.30 Percent recovery of feijoa aroma compounds in permeate and retentate after different pervaporation experiments under the same operating conditions: feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ and permeate pressure of 100Pa. ......................... 120

Table 4.31 Percent recovery of boysenberry aroma compounds in permeate and retentate after different pervaporation experiments under the same operating conditions: feed temperature of 30°C, feed flow rate of 1.4×10⁻⁵ m³ s⁻¹ and permeate pressure of 100Pa. . 121
# List of nomenclature

## Roman letters

<table>
<thead>
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<th>Symbol</th>
<th>Definition</th>
<th>Unit</th>
</tr>
</thead>
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<tr>
<td>$A_m$</td>
<td>membrane area</td>
<td>m$^2$</td>
</tr>
<tr>
<td>$ATV$</td>
<td>aroma threshold value</td>
<td>kg m$^{-3}$</td>
</tr>
<tr>
<td>$AV$</td>
<td>aroma threshold</td>
<td>-</td>
</tr>
<tr>
<td>$C_i$</td>
<td>mass concentration of component $i$</td>
<td>kg kg$^{-1}$(wt/wt)</td>
</tr>
<tr>
<td>$CF$</td>
<td>concentration factor</td>
<td>-</td>
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<tr>
<td>$D$</td>
<td>diffusion coefficient</td>
<td>m$^2$ s$^{-1}$</td>
</tr>
<tr>
<td>$J$</td>
<td>flux</td>
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<td>$k$</td>
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<td>kg</td>
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<tr>
<td>$\Delta x$</td>
<td>membrane thickness</td>
<td>m</td>
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<tr>
<td>$Y$</td>
<td>yield</td>
<td>%</td>
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</table>
Greek symbols

$\alpha$ separation factor, selectivity

$\beta$ enrichment factor

$\varphi_i$ partition coefficient of component $i$. kg kg$^{-1}$

subscripts

$bl$ boundary layer

$f$ feed

$fm$ membrane at its feed side

$i$ preferentially permeating component $i$

$j$ non-preferentially permeating component $j$

$m$ membrane

$over$ overall

$p$ permeate

$pm$ membrane at its permeate side