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Phytochemical Optimisation of Blueberry Juice

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Abstract

Blueberries contain a high concentration and diversity of anthocyanins which are responsible for the blue/purple pigment of their skin. Like many other fruits and vegetables they also contain a large amount of chlorogenic acid (CGA) within the fruit flesh and seeds. Together these phytochemicals appear to account for most of the high antioxidant activity of the fruit, although within the scientific community a consensus has not been reached as to their effects on human health. Fresh blueberries have a limited season and are perishable unless stored frozen. Processing of blueberries into juice allows year round sale, and importantly less market-driven pricing. Therefore the aim of this research project was to investigate and optimise factors which may be significant in producing a high phytochemical blueberry juice.

The pigment of blueberries is concentrated in the skin, and therefore smaller blueberries have the highest anthocyanin concentrations on a weight basis. Consequently the three highest concentrations were found in cultivars 'Elliot', 'Burlington' and 'Duke'. Conversely chlorogenic acid is not restricted to the blueberry skin; 'Elliot', 'Bluecrop' and 'Burlington' had the three highest concentrations, while 'Duke' had the lowest. The profile of individual anthocyanins was also found to be diverse amongst cultivars. Therefore if individual anthocyanin(s) are shown to be important for specific health conditions further consideration should be given to cultivar selection.

Upon review of the current blueberry juice manufacturing process, large anthocyanin losses were seen at three key steps: after thawing of the fruit, removal of the press cake and holding of the juice between pressing and pasteurisation. Two alternative processes were compared where a slightly higher anthocyanin concentration was achieved for 'hot press juice' but a lower chlorogenic acid concentration than the alternative 'cold press' juice.

Modifications to the manufacturing process were investigated using the pilot plant at Massey University. It was found that blanching of frozen blueberries before pressing was successful in significantly increasing the anthocyanin and chlorogenic acid concentration of the juice (about a 5 fold increase of anthocyanins and a 4 fold increase in chlorogenic acid from previous levels). However, this did alter the sensory properties of the juice significantly, with a more cooked flavour and thicker texture. Other variations that were trialled, such as milling,

variation in holding time and temperature between pressing and pasteurising, had comparatively little effect on the anthocyanin and chlorogenic acid concentration.

Storage tests on blueberry juice showed a clear relationship between the storage temperature and anthocyanin retention, where warmer temperatures resulted in larger anthocyanin degradation. At the end of the six month storage period, juice storage at 5°C gave 63% anthocyanin retention while juice storage at 25°C gave only 8% retention. Some protection was also afforded to juice packed in glass bottles rather than plastic and stored in the dark rather than the light; but this difference was far smaller than the effect of temperature. Chlorogenic acid levels appeared to be comparatively less affected; only relatively small amounts of degradation were observed. It is important to note that when the antioxidant capacity was measured for stored juice at six months under the various treatments, there was only a small degree of degradation for all samples as compared with at time zero. Previously researchers had encountered a similar phenomenon and suggested that unknown anthocyanin degradation products may still be able to contribute to the juice's antioxidant capacity. However, here it is also suggested that chlorogenic acid may have had a more significant contribution to the antioxidant capacity that it is usually credited with, due to the large amount present with relatively little degradation throughout the storage period.

This information may be used to produce and market a juice with high anthocyanin, chlorogenic acid and/or antioxidant properties. Of the health effects evaluated here, currently, research in cardiovascular disease and neuroprotection effects are looking the most promising with regard to dietary blueberry supplementation in humans, although there is still a lack of double blind randomised placebo controlled studies to come to any consensus within the scientific community. Additionally, at the present time, the use of health claims on food products in New Zealand is being revised (Food Standards Authority proposal P293). As the current state of nutrition research surrounding plant polyphenols is inconclusive it may be important to use generic statements such as 'high in antioxidants' rather than statements about specific compounds.

Table of Contents

CHAPTER 1	1
Introduction	1
1.1 Background.....	1
1.2 Purpose	2
1.3 Objectives	2
CHAPTER 2	3
Literature Review	3
2.1 Chemistry of Phytochemicals	3
2.1.1 Classification	3
2.1.2 Structure	4
2.1.3 Occurrence of Phytochemicals	7
2.1.4 Phytochemical Diversity in Berries	9
2.1.5 Phytochemical Diversity of Blueberries	10
2.1.6 Chemical composition of blueberries	13
2.1.7 Summary for Phytochemicals in Blueberries	15
2.2 Potential Health Benefits of Blueberry Consumption	17
2.2.1 Antioxidant Power	18
2.2.2 Absorption and Metabolism	20
2.2.3 Evidence for Potential Health Benefits	24
2.2.4 Recommended Intake	36
2.2.5 Summary of Potential Health Benefits.....	37
2.3 Juice Manufacture and Storage.....	39

2.3.1 Chemical Stability of Anthocyanins.....	39
2.3.2 Unit Operations in Juice Manufacturing	42
2.3.3 Retention of Phytochemicals during Processing	47
2.3.4 Storage Trials – Retention of Phytochemicals	55
2.3.4 Bioactivity of Blueberry Juice	57
2.3.5 Summary of the Effects of Juice Processing	59
2.4 Chromatographic techniques	60
2.4.1 Extraction.....	61
2.4.2 Separation.....	61
2.4.3 Detection & Quantification	62
2.5 Summary	63
CHAPTER 3	64
Materials & Methods.....	64
3.1 Research Plan	64
3.2 Material collection	65
3.3 Experimental design.....	67
3.4 Analytical Methods	73
3.4.1 Anthocyanin and Chlorogenic acid analysis	73
3.4.2 Spectrophotometric analysis (Total polyphenol content & antioxidant power)	77
3.4.3 Physical Parameters	79
CHAPTER 4	81
Results & Discussion	81
4.1 Varietal and Material Differences in Eight Blueberry Cultivars	81

4.1.2 Varietal Differences.....	81
4.1.2 Maturational differences.....	90
4.1.3 Implications for juice manufacture.....	92
4.2 Juice Production Analysis	93
4.2.1 Standard Manufacturing Analysis.....	93
4.2.2 Alternative Processes	105
4.2.3 Implications for juice manufacture.....	113
4.3 Changes during Juice Storage.....	114
4.3.1 Stored Blueberry Juice	114
4.3.2 Storage Experiment.....	115
4.3.3 Implications for juice manufacture.....	120
4.4 Analytical Improvements	122
CHAPTER 5	124
Conclusions & Recommendations.....	124
5.1 Blueberry Juice Manufacture	124
5.2 Further Research	125
References	127
Appendix	138

List of Tables

Table 2-1: Phenolic diversity of various berry fruits. Adapted from Beattie et al (2005).....	9
Table 2-2: Total contents of various phenolic compounds found in blueberries (mg/100g) (Howard and Hager, 2007).	11
Table 2-3: Antioxidant capacity (ORAC), total phenolic and anthocyanin content for eight highbush blueberry cultivars (Ehlenfeldt & Prior 2001).	12
Table 2-4: Chemical composition of fresh blueberry.....	13
Table 2-5: Types of nutrition research (Rolfes et al, 2009).	24
Table 2-6: Blueberry Juice Manufacture; Reported Methods.....	49
Table 2-7: Anthocyanin recovery during processing as reported by various research groups.....	49
Table 3-1: Stored juice details	66
Table 3-2: Comparison of different solid extraction methods.	73
Table 4-1: Anthocyanin Contents Reported by Various Researchers (mg/kg FW).....	82
Table 4-2: Individual anthocyanins for various blueberry cultivars measured using HPLC, based on elution order.	84
Table 4-3: Anthocyanin concentrations at various points of blueberry juice processing as seen in juice produced using different methods and measured using HPLC.....	106
Table 4-4: Properties of Juice stored under varying conditions.....	115

List of Figures

Figure 2-1: Classification of major phytochemicals (Erdman et al, 2007).	5
Figure 2-2: Structures of anthocyanidins occurring in grapes and berry fruits (Skrede & Wrolstad, 2002).....	6
Figure 2-3 The skeletal structure of an acylated anthocyanin malvidin-3-(6''acetoyl)glucoside (Adapted from Barnes et al, 2009).....	6
Figure 2-4: Potential cardiovascular benefits of blueberry phytochemicals (Meskin et al, 2002)	29
Figure 2-5: Variation in the anthocyanin structure and pigmentation with changes in pH of a solution (Barnes et al, 2009).....	40
Figure 3-1 Juice production using alternative processes, experimental details in text.	69
Figure 3-2: Overview of treatments in 6 month storage experiment - storage temperature, packaging type & light exposure.....	71
Figure 4-1: Total anthocyanin concentrations of eight different Highbush Blueberry cultivars measured using HPLC. Cultivars labelled with different letters are significantly different. ..	81
Figure 4-2: MINITAB score plot of individual anthocyanins of eight blueberry varieties (with duplicate data).	85
Figure 4-3: Excel scatter plot of latent vector coordinates produced by MINITAB.....	86
Figure 4-4: Total anthocyanin concentration for different cultivars with different extraction solutions, measured using HPLC	89
Figure 4-5: Chlorogenic acid contents for various highbush blueberry varieties measured using HPLC.....	89
Figure 4-6: Cold press blueberry juice production - flow diagram with chemical and material losses.	94
Figure 4-7: Hot press blueberry juice production - flow diagram with chemical and material losses.	96
Figure 4-8: Anthocyanin concentrations of berry and press cake samples during 'hot press' processing.	99
Figure 4-9: Anthocyanin concentrations in blueberry juice during processing as measured by HPLC.....	100

Figure 4-10: Changes to individual anthocyanins before and after thawing of blueberries	101
Figure 4-11: Changes to individual anthocyanins in blueberry juice at different stages of processing	102
Figure 4-12: Changes to the concentration of chlorogenic acid during juice processing.....	103
Figure 4-13: Antioxidant activity of blueberry juice samples immediately after pressing, as measured by DPPH inhibition	105
Figure 4-14: Anthocyanin levels in juice held between pressing and pasteurisation for an extended period of time; TOP: Juice produced using slow defrost; BOTTOM: Juice produced using fast defrost.....	109
Figure 4-15: Individual anthocyanins in juice produced using alternative processes; TOP: juice produced in trial 1 using slow defrost. BOTTOM: Juice produced in trial 5 using fast defrost.	111
Figure 4-16: Total anthocyanin concentrations of five juice samples measured using HPLC.....	114
Figure 4-17: Blueberry juices stored under different conditions for six months LEFT HAND SIDE: Anthocyanin concentrations of blueberry juice RIGHT HAND SIDE: Chlorogenic acid concentrations of blueberry juice.	116
Figure 4-18: The profile of individual anthocyanins as seen as seen in juice packaged in glass bottles and stored for 6 months at 25 °C in the light.	118
Figure 4-19: 'Cold press' juice stored at 15 °C in plastic bottles LEFT HAND SIDE: Anthocyanin concentrations of blueberry juice RIGHT HAND SIDE: Chlorogenic acid concentrations of blueberry juice.	118
Figure 4-20: TOP: Total phenolic content of blueberry juice measured in Gallic acid equivalents; MIDDLE: FRAP antioxidant measured in FeSO ₄ equivalents; BOTTOM: DPPH antioxidant measure as % inhibition.	119
Figure 4-21: Anthocyanin contents of juice and juice sediment, from juice stored for six months at different temperatures.....	120

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