i-iii
iv
V
vii-vii
viii-xvi
xvii-xviii
xix-xxiv
xxv-xxvii
xxviii-xxix
1-7
1
4
4

Chapter 2	8-43
Review of literature	
2.1 Plant based milk and its health benefits	8
2.2 Coconut milk and its use in different products	8
2.3 The effect of fat content on coconut milk stability	9
2.4 Digestibility of coconut fat and protein	9
2.5 Effect of different emulsifiers on stability of coconut milk	10
2.6 Extraction of coconut oil using different methods	10
2.7 Nutritional benefits of coconut milk	11
2.8 Biochemical and nutritional properties of pineapple juice	12
2.9 Blended beverages	12
2.10 Effect of citric acid addition in low pH fruit juices	13
2.11 Thermal treatment of juice	14
2.12 High pressure homogenization of juice	15
2.13 Serum separation in blended beverage	16

2.14 Bioaccessibility and stability of blended beverages	17
2.15 Bioactive properties and bioavailability of curcumin	18
2.16 Solubility of curcumin	19
2.17 Antimicrobial activity of curcumin	19
2.18 Curcumin nanoemulsion	20
2.19 Processing conditions for nanoemulsions	21
2.20 Nanoemulsion destabilizing mechanisms	22
2.21 Coconut oil nanoemulsion	23
2.22 Effect of particle size on nanoemulsion stability	24
2.23 Pickering emulsions stabilized by different shapes of food grade particles	25
2.24 Food applications of Pickering emulsions	26
2.25 Plant-based emulsifier to reduce Tween level in emulsion	27
2.26 Nanocellulose	27
Bibliography	30

Chapter 3	44-67
Development and evaluation of defatted coconut milk and pineapple juic	ce-
based blended beverage	
3.1 Introduction	44
3.2 Materials and methods	45
3.2.1 Development of blended beverage of defatted coconut milk and pineapple juice	45
3.2.1.1 Extraction of pineapple juice	45
3.2.1.2 Extraction of coconut milk	45
3.2.1.3 Fat estimation in coconut milk	45
3.2.1.4 Blending of defatted coconut milk and pineapple juice	46
3.2.2 Biochemical analysis	46
3.2.2.1 Determination of soluble solids	46
3.2.2.2 Determination of pH	46
3.2.2.3 Determination of titratable acidity	46
3.2.2.4 Determination of ascorbic acid content	47
3.2.3 Phytochemical content and antioxidant properties of blended beverages	47
3.2.3.1 Determination of total phenolic content (TPC)	47

Chapter 4	68-100
Bibliography	61
3.4 Conclusion	61
3.3.8 Fourier Transform Infrared spectroscopic (FTIR) analysis of blended beverages	60
3.3.7 RP-HPLC analysis of phenolic compounds in blended beverages	57
3.3.6 Sensory analysis of the blended beverages	56
3.3.5 Mineral content in blended beverage	54
3.3.4 Colour analysis of blended beverages	54
3.3.3.3 Antioxidant properties	52
3.3.3.2 Total flavonoids content (TFC)	51
blended beverages 3.3.3.1 Total phenolic content (TPC)	51
3.3.3 Phytochemical content and antioxidant properties of the	51
3.3.2 Biochemical analysis of the blended beverages	51
3. 3.1 Fat content in coconut milk	50
3.3 Results and discussion	50
3.2.9 Statistical analysis	50
3.2.8 Fourier transform-infrared spectroscopic (FTIR) analysis	50
3.2.7 RP-HPLC of phenolic compounds	49
3.2.6 Sensory analysis of blended beverages	49
3.2.5 Minerals content in blended beverages	49
(MCC) 3.2.4 Color analysis of blended beverages	48
power assay (FRAP) 3.2.3.5 Determination of metal chelation capacity	48
3.2.3.4 Determination of ferric reducing antioxidant	48
3.2.3.3 DPPH (2,2-diphenylpicrylhydrazyl) radical scavenging activity	48
3.2.3.2 Determination of total flavonoid content (TFC)	47
2.2.2.2 Determination of total flavonoid content (TEC)	17

## Studying the effect of pasteurization and high-pressure homogenization on microbial stability of the blended beverage

4.1. Introduction	68
4.2. Material and methods	69

4.2.1. Processing of blended beverage	69
4.2.2. Test bacteria standardization	70
4.2.3. Thermal pasteurization of blended beverage	70
4.2.4. Optimization of high-pressure homogenised blended beverage	70
4.2.5. Stabilization of best selected blend and serum separation	71
4.2.6. Determination of ascorbic acid content	71
4.2.7. Phytochemical content and antioxidant properties of blended beverages	72
4.2.7.1. Determination of total phenolic content (TPC)	71
4.2.7.2. Determination of total flavonoid content (TFC)	72
4.2.7.3. DPPH (2,2-diphenylpicrylhydrazyl) radical scavenging activity	72
4.2.8. Microbial characterization of blended beverage	72
4.2.9 Peroxidase activity of blended beverage	72
4.2.10 Sensory analysis of freshly treated blended beverages change order	73
4.1.2.7. Statistical analysis	73
4.3 Results and discussion	73
4.3.1. Microbiological quality of thermally pasteurized blended	73
beverage 4.3.2. Effect of thermal treatment on enzyme activity of blended	74
beverage 4.3.3. Effect of thermal treatment on antioxidant property of blended beverage	75
4.3.4. Optimization of high-pressure homogenization for blended beverage	76
4.3.5.1 Modelling and validation	80
4.3.5. Serum separation (SS) of blended beverage	83
4.3.6. Phytochemical and antioxidant properties of treated blended beverage	85
4.3.7. Ascorbic acid content of treated blended beverages	85
4.3.8. Peroxidase activity of treated blended beverages	85
4.3.9. Sensory analysis of treated blended beverages	87
4.3.10. Microbial safety of treated blended beverages during storage	88
4.3.11. Antioxidant property of treated blended beverages during storage	89
4.3.12. Physicochemical properties of treated blended beverages during storage	91

4.3.13. Peroxidase (POD) activity of treated blended beverages during	94
storage	
4.4. Conclusions	95
Bibliography	95

Chapter 5

101-144

Characterization of curcumin-enriched Pickering nanoemulsion stal	bilized
with nanocellulose synthesized from coconut milk residue	

5.1.1. Introduction	101
	-
5.2. Materials and methods	103
5.2.1. Processing of coconut milk to obtain waste residue	103
5.2.2. Processing of coconut milk to obtain waste residue	103
5.2.2.1. Hemicellulose content in coconut milk waste residue	103
5.2.2.2. Lignin content in coconut milk waste residue	103
5.2.2.3. Cellulose content in coconut milk waste residue	104
5.2.3. Preparation of nanocellulose	104
5.2.3.1. Acid hydrolysed nanocellulose	104
5.2.3.2. Ultrasound treated nanocellulose	105
5.2.4. Nanoemulsion preparation	105
5.2.5. Optimization of nanoemulsion	105
5.2.6. Pickering nanoemulsion preparation	106
5.2.7. Particle size measurement by dynamic light scattering (DLS)	106
5.2.8. Characterisation of nanocellulose using FTIR analysis	107
5.2.9. Characterisation of nanocellulose using XRD analysis	107
5.2.10. Thermogravimetric analysis	107
5.2.11. Morphology of nanocellulose	108
5.2.12. Analysis of virgin coconut oil using gas chromatography-high resolution mass spectrometry (GC-HRMS)	108
5.2.13. Solubility of curcumin	108
5.2.14. RP-HPLC analysis of curcumin-enriched Pickering nanoemulsion	108
5.2.15. Stability test of curcumin-enriched Pickering nanoemulsion	109
5.2.16. Storage stability of curcumin-enriched Pickering nanoemulsion	109
5.2.17. Statistical analysis	109
5.3. Results and discussion	110

5.3.1. Cellulose, hemicellulose, and lignin content	110
5.3.2. Particle size and PDI analysis	110
5.3.3. Characterisation of nanocellulose using FTIR analysis	112
5.3.4. Crystallinity index of nanocellulose	114
5.3.5. Thermogravimetric analysis	116
5.3.6. Morphology of nanocellulose	118
5.3.7. Composition of virgin coconut oil	120
5.3.8. Solubility of curcumin	121
5.2.9. Optimization of nanoemulsion	122
5.3.9.1. Effect of oil content, surfactant content, and homogenization pressure on particle size and PDI value of nanoemulsion	122
5.3.9.2. Modelling and validation	124
5.3.10. Particle size of Pickering nanoemulsion (PE)	129
5.3.11. Evaluation of curcumin stability in Pickering nanoemulsion	131
5.3.12. Creaming index of Pickering nanoemulsion	135
5.4. Conclusion	137
Bibliography	138

Chapter 6	145-202
-----------	---------

## Characterization of blended beverage incorporated with curcumin-enriched

#### Pickering nanoemulsion

6A.1. Introduction	145
6A.2. Materials and Methods	146
6A.2.1. Pickering nanoemulsion preparation	146
6A.2.2. Development of nanoemulsified blended beverage	146
6A.2.3. Morphology of Pickering nanoemulsion and curcumin- enriched nanoemulsified blended beverage	147
6A.2.4. RP-HPLC analysis of curcumin-enriched nanoemulsified	147
blended beverage	
6A.2.5. Microbial characterization of curcumin-enriched	147
nanoemulsified blended beverage	
6A.2.6. Peroxidase residual activity in curcumin-enriched	148
nanoemulsified blended beverage	
6A.2.7. DPPH radical scavenging activity of curcumin-enriched	148
nanoemulsified blended beverage	

6A.2.8. Determination of soluble solids	148
6A.2.9. Determination of pH	148
6A.2.10. <i>In vitro</i> bioaccessibility of curcumin from curcumin-e nanoemulsified blended beverage	enriched 149
6A.2.11. Statistical analysis	149
6A.3. Results and Discussion	150
6A.3.1. Effect of pasteurization on curcumin stability in curcur enriched nanoemulsified blended beverage during stora	
6A.3.2. Effect of addition of curcumin-enriched Pickering nanoemulsion in blended beverage on microbial load du storage	151 uring
6A.3.3. Effect of addition of curcumin-enriched Pickering nanoemulsion in blended beverage on physicochemical properties during storage	154
6A.3.4. Effect of addition of curcumin-enriched Pickering nanoemulsion in blended beverage on POD activity dur storage	156 ring
6A.3.5. Effect of addition of curcumin-enriched Pickering nanoemulsion in blended beverage on antioxidant prop- during storage	157 erty
6A.3.6. Morphology of curcumin-enriched nanoemulsified bler beverage	nded 159
6A.3.7. <i>In vitro</i> bioaccessibility of curcumin-enriched nanoemu blended beverage	ulsified 160
6A.4. Conclusion	162
6B.1. Introduction	163
6B.2. Materials and methods	164
6B.2.1. Beverage preparation of defatted coconut milk and p juice	ineapple 165
6B.2.2. Preparation of nanocellulose	165
6B.2.3. Curcumin-enriched Pickering nanoemulsion blended be	everage 165
6B.2.4. Particle size measurement by dynamic light scattering (	(DLS) 165
6B.2.5. Morphology of curcumin-enriched blended beverage	165
6B.2.6. RP-HPLC analysis of curcumin-enriched blended beve	rage 165
6B.2.7. Thermal stability of curcumin-enriched blended bevera	ge 166
6B.2.8. Creaming index of curcumin-enriched blended beverag	ge 166
6B.2.9. In vitro bioaccessibility of curcumin-enriched blended l	beverage 166
6B.2.10. Storage study of curcumin-enriched blended beverage	166

6B.2.10.1. Microbial characterization of curcumin-enriched blended beverage	166
6B.2.10.2. Peroxidase residual activity of curcumin-enriched	166
blended beverage	
6B.2.10.3. DPPH radical scavenging activity of curcumin-	167
enriched blended beverage	
6B.2.10.4. Determination of soluble solids	167
6B.2.10.5. Determination of pH	167
6B.2.11. Antimicrobial activity of curcumin-enriched blended beverage	167
6B.2.12. Statistical analysis	167
6B.3. Results and discussion	168
6B.3.1. Particle size of curcumin-enriched blended beverage	168
6B.3.2. Creaming index of stability of curcumin-enriched blended beverage	170
6B.3.3. Curcumin stability in curcumin-enriched Pickering	172
nanoemulsified blended beverages stored at different	
temperatures	
6B.3.4. <i>In vitro</i> bioaccessibility of curcumin-enriched Pickering nanoemulsified blended beverages	175
6B.3.5. Morphology of curcumin-enriched Pickering nanoemulsified	177
blended beverage during <i>in vitro</i> bioaccessibility	100
6B.3.6. Effect of pasteurization on curcumin stability of curcumin-	180
enriched Pickering nanoemulsified blended beverages 6B.3.7. Effect of processing treatments on microbial load of curcumin-	182
enriched Pickering nanoemulsified blended beverage during storage	162
6B.3.8. Effect of processing treatments on physicochemical properties	185
of curcumin-enriched Pickering nanoemulsified blended beverage during storage	
6B.3.9. Effect of processing treatments on POD activity curcumin-	187
enriched Pickering nanoemulsified blended beverage during	
storage	
6B.3.10. Effect of processing treatments on antioxidant properties	188
curcumin-enriched Pickering nanoemulsified blended beverage	
during storage 6B.3.11. Antimicrobial activity of blended beverages	190
6.B.4. Conclusion	191
Bibliography	192

# Chapter 7

### Conclusions and future scope

7.1. Conclusions	203
7.1.1. To develop and evaluate defatted coconut milk and pine juice-based blended beverage	eapple 203
7.1.2. To study the effect of pasteurization and high-pressure homogenization on microbial stability during storage of beverage	204 Eblended
7.1.3. To characterize curcumin-enriched Pickering nanoemul stabilized with nanocellulose synthesized from coconut residue	
7.1.4. To characterize the blended beverage incorporated with curcumin-enriched Pickering nanoemulsion	a 206
7.2. Future scope	208
List of Publications	210