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Investigating Astringency Mechanism of WPI8855 in Acidic Condition

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Abstract

Whey protein isolate is used as a functional ingredient in acidic whey protein beverages, but the associated astringency is a big hurdle to introduce these beverages into the mainstream market. If we can solve the astringency issue, Fonterra would have big advantages over their competitors. Our hypothesis is that whey protein interacts with human saliva proteins and the subsequent precipitation causes astringency.

In the present study, ion exchange whey protein isolates (WPI) 8855, and solutions of pure α -lac and β -lg were used to determine which whey protein fractions are responsible for sedimentation in artificial or human saliva. It has been shown that sedimentation correlates to the level of astringency. Therefore only the level of sedimentation was investigated. The human saliva and artificial saliva were also compared in the astringency titration model in order to determine whether artificial saliva is representative of human saliva.

Heat treatment (85°C, 30s) of whey protein solution was performed to mimic commercial beverage manufacture. The heated and non-heated whey protein solutions were titrated with artificial saliva, human saliva or sodium bicarbonate buffer in the range of pH 3 to 6. The sediment was recovered by centrifugation of the titrated samples, and analysed using liquid chromatography-mass spectrometry (LC-MS/MS) or one and two dimensional polyacrylamide gel electrophoresis (PAGE) with amido black and periodic acid Schiff stain.

This study showed that β -lg is the key sedimentation component in heated acidic WPI8855 beverages due to the heat aggregation, pH change through the isoelectric point and interaction with human saliva proteins, including mucin, proline-rich proteins (PRPS) and α -amylase. BSA also interacted with artificial and human saliva, whereas α -lac did not interact with either artificial or human saliva. Heat treatment caused extensive whey protein aggregation and precipitation. Artificial saliva and human saliva behaved differently in this astringency titration model, therefore it is not

Abstract

recommended to use artificial saliva in an *in vitro* model to predict astringency *in vivo*. Artificial saliva interacted with whey protein and caused additional precipitation compared to titration with sodium bicarbonate, whereas human saliva was able to hinder some whey protein sedimentation caused by titration with sodium bicarbonate. If astringency is caused by the amount of precipitation of protein, heat treatment would be a major factor in the astringency of whey proteins.

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Table of contents

Abstract	i
Acknowledgments	iii
List of Figures	v
List of Tables	ix
List of Abbreviations	x
Chapter 1 : Introduction	1
1.1 Background.....	1
1.2 Research objective.....	2
Chapter 2 : Literature review	4
2.1 Introduction.....	4
2.2 Whey protein.....	4
2.2.1 Whey protein components.....	4
2.2.2 Whey protein processing.....	7
2.2.3 Fonterra WPI.....	9
2.3 Astringency.....	10
2.3.1 Definition of astringency.....	10
2.3.2 Astringent compounds.....	10
2.3.3 Human Saliva protein.....	11
2.3.4 Astringency mechanisms.....	13
2.3.5 Factor affecting astringency.....	16
2.3.6 Reducing astringency.....	20
2.3.7 Astringency measurement.....	21
2.4 Conclusion.....	23
Chapter 3 : Material and methods	25
3.1 Materials.....	25
3.2 Sample preparation.....	26
3.2.1 WPI solution.....	26
3.2.2 Artificial saliva.....	26
3.2.3 Human saliva collection.....	26
3.3 Analytical methods.....	27
3.3.1 Sample titration procedure (mouth model).....	27
3.3.2 pH measurement.....	29
3.3.3 Centrifugation.....	29
3.3.4 Freeze drying.....	30
3.3.5 PolyAcrylamide Gel Electrophoresis (PAGE) analysis.....	30

Table of contents

3.3.6 Quantification of whey protein fractions by Reversed Phase High-performance liquid chromatography (RP-HPLC)	33
3.3.7 Liquid chromatography-MS/MS (LC-MS/MS)	34
3.4 Stastical analysis	36
Chapter 4 : Results and discussion	37
4.1 Introduction	37
4.2 The interaction of artificial saliva and whey protein	37
4.2.1 Interaction of non-heated WPI8855	38
4.2.2 Interaction of heated WPI8855	41
4.2.3 Non-heated 1:1 β -lg/ α -lac	45
4.2.4 Purified α -lac	48
4.2.5 Artificial saliva identification	49
4.3 The interaction of human saliva and whey protein	52
4.3.1 Interaction of non-heated WPI8855	53
4.3.2 Interaction of heated WPI8855	59
4.3.3 Identification of key proteins in human saliva	63
Chapter 5 General discussion	71
Chapter 6 : Conclusions	78
Recommendation	81
References	82
Appendices	91

List of Figures

Figure 2.1: Whey protein isolation processing. (Diagram is modified from Mcleod, 2009; Elgar personal communication, 2010).	9
Figure 2.2: Human saliva multifunctionality. (Diagram is adapted from Levine, 1993).	12
Figure 2.3: Proposed mechanism for PRP-polyphenol binding. (Diagram is form Bajec and Pickering, 2008).	13
Figure 2.4: Processing of drinking an acidic beverage containing whey proteins in the mouth (diagram is adapted from Andrewes, 2009).	16
Figure 2.5: Time intensity of astringency at different protein concentration in model beverages at pH 3.5 (Graph is adapted from Vardhanabhuti, et al., 2010).	18
Figure 2.6: A schematic set-up of the Mini Traction Machine (MTM). (Vardhanabhuti et. al., 2011).	22
Figure 3.1: Titration procedure	28
Figure 3.2: WPI samples titrated with NaHCO ₃ / artificial saliva/ human saliva	29
Figure 3.3: Schematic diagram showing the preparation and running of WPI sample titrated with human saliva in a 2D Native-SDS reduced PAGE system (adapted and modified from Patel, H.A, 2007)	33
Figure 3.4: Diagram of ionization in LC-MS/MS. (Figure adapted from Basic LC/MS hand book, Aligent Technologies, 2001).	35
Figure 4.1(a): Whey protein fractions in the sediment of non-heated WPI8855 titrated with NaHCO ₃ or artificial saliva deterimined by PAGE.	39

List of Figures

Figure 4.1(b): Whey protein fractions in the supernatant of non-heated WPI8855 titrated with NaHCO ₃ or artificial saliva determined by HPLC.	40
Figure 4.2(a): Whey protein fractions in the sediment of heated WPI8855 titrated with artificial saliva determined by PAGE.	42
Figure 4.2(b): Whey protein fractions in the supernatant of heated WPI8855 titrated with artificial saliva determined by HPLC.	43
Figure 4.3: Whey protein fractions in the sedimentation of WPI8855 at pH range of 4.2 to 5.7 with or without heat treatment titrated with sodium bicarbonate determined by PAGE.	44
Figure 4.4(a): Whey protein fraction in the sediment of non-heated protein mixture solution (α -lac/ β -lg, 1:1) titrated with NaHCO ₃ and artificial saliva determined by PAGE.	46
Figure 4.4(b): Whey protein fraction in the supernatant of non-heated mixture solution (α -lac/ β -lg, 1:1) titrated with artificial saliva determined by HPLC.	47
Figure 4.5: α -lac in supernatant of non-heated purified a-lac solution determined by HPLC.	49
Figure 4.6: Micrograph showing cell with prominent mucin-containing intracytoplasmic vacuoles. Rap stain (Nephron, 2010).	50
Figure 4.7: Reduced SDS PAGE of sediment from heated WPI8855 titrated with artificial saliva using periodic acid Schiff stain. Molecular weight (lane 1), sediment of heated 8855 titrated with artificial saliva at pH 4.2, 4.5, 4.8, 5.1, 5.4, 5.7 (lane2-7), porcine mucin standard (lane 8).	51
Figure 4.8(a): Whey protein fraction in the sediment of non-heated WPI8855 titrated with NaHCO ₃ or human saliva determined by PAGE.	53
Figure 4.8(b): Whey protein fractions in the supernatant of non-heated WPI8855 titrated with NaHCO ₃ and human saliva determined by HPLC.	54

List of Figures

Figure 4.9: A possible mechanism of β -lg isoelectric point shifting.	55
Figure 4.10: β -lg in the sediment of non-heated WPI8855 titrated with human saliva. A possible explanation of the shoulder in the β -lg peak.	56
Figure 4.11: Whey protein sedimentation of non-heated WPI8855 titrated with sodium bicarbonate using HPLC (left) and PAGE (right).	58
Figure 4.12(a): Whey protein fractions in the sediment of heated WPI8855 titrated with NaHCO_3 and human saliva determined by PAGE.	59
Figure 4.12(b): Whey protein fractions in the supernatant of heated WPI8855 titrated with NaHCO_3 and human saliva determined by HPLC.	62
Figure 4.13(a): Reduced SDS PAGE (stained with amido black) of sediment from heated 8855 titrated with human saliva. Molecular weight (lane 1), sediment of heated WPI8855 titrated with human saliva at pH 4.2, 4.5, 4.8, 5.1, 5.4, 5.7 (lane2-7), sediment of heated WPI8855 titrated with NaHCO_3 at pH 5.7 as control (lane 8), human saliva standard (lane 9).	64
Figure 4.13(b): Reduced SDS PAGE (stained with periodic acid Schiff) of sediment from heated 8855 titrated with human saliva. Molecular weight (lane 1), sediment of heated 8855 titrated with human saliva at pH 4.2, 4.5, 4.8, 5.1, 5.4, 5.7 (lane2-7), human saliva standard (lane 8).	66
Figure 4.14(a): Sediment of heated WPI8855 titrated with human saliva at pH 4.8 on 2D Native – SDS reduced gel with amido black stain.	68
Figure 4.14(b): Sediment of heated WPI8855 titrated with human saliva at pH 4.8 on 2D Native – SDS reduced gel with amido periodic acid-Schiff stain.	68

List of Tables

Table 2.1: Characteristics of whey proteins. (Table is summarised from Fonterra Whey Product Technology, 2008).	5
Table 3.1: Composition of protein WPI8855, commercial α -lac and β -lg	25

List of Abbreviations

μ l = microlitre

2-ME = 2-mercaptoethanol

BSA = bovine serum albumin

g = gram

GMP = glycomacropeptide

HCl = hydrochloric acid

Histidine-rich proteins = HRP

l = litre

M = molar

mg = milligram

min = minutes

ml = millilitre

mM = millimolar

NaCl = sodium chloride

NaHCO₃ = sodium bicarbonate

pH = measure of acidity

PRP = proline-rich protein

RP-HPLC = reverse phase-high performance liquid chromatography

rpm = revolutions per minute

SDS = Sodium dodecyl sulfate

SDS PAGE = sodium dodecyl sulphate polyacrylamide gel electrophoresis

WPC = whey protein concentrate

WPI = whey protein isolate

α -lac = alpha-lactalbumin

β -lg = beta-lactoglobulin