

The effects of reducing fat, salt and calcium phosphate on the properties of low-moisture Mozzarella cheese

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Content

- Study 1. Effect of fat and salt reduction
- Study 2. Developing a dry-salted Mozzarella method, to enable addition and retention of natural flavour (EMC)
- Study 3. Further development of dry-salted Mozzarella method to increase level of protein hydrolysis *via* increased rennet retention in cheese

Reducing fat and salt

Problems associated with reducing fat in pizza cheese

- Cheese is excessively hard and chewy
- Has poor cooking properties
 - Lacks free oil
 - Limited or no flow
 - Dull, non-glossy colour
 - Poor stretch

Problems associated with reducing salt in cheese

- Relatively little information
- Reported to reduce casein hydration and degree of melt on cooking
- Level of effect depend on actual salt level and % salt reduction

Interactive effects fat and salt reduction

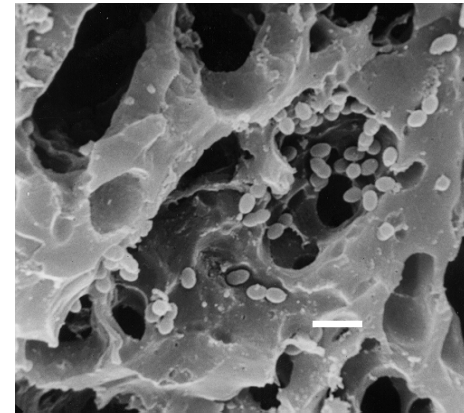
- Unknown

Objectives

- Investigate effects of the following on low moisture part-skim

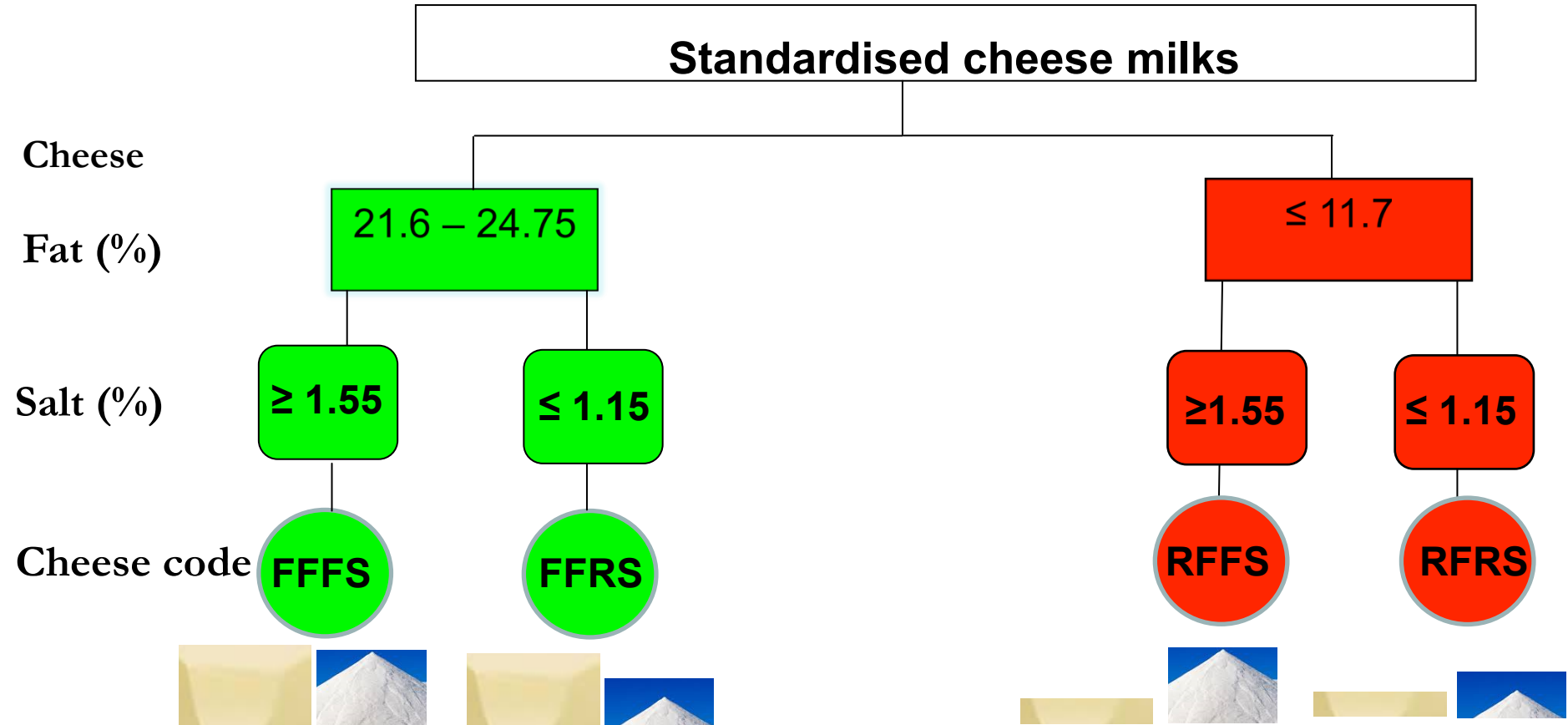
Mozzarella

- reducing fat from ~ 22% to 11% (50% reduction)
 - reducing salt from ~ 1.6 % to 0.95 % (40% reduction)
 - interaction of salt and fat over ripening
- Improve the quality of reduced-fat, reduced-salt Mozzarella (lowering degree of calcium-induced casein cross-linking)
 - Improve the flavour profile of reduced-fat, reduced-salt Mozzarella through the incorporation of EMC paste
 - Increase the levels of protein hydrolysis in cheese through utilisation of increased rennet retention



Materials and Methods

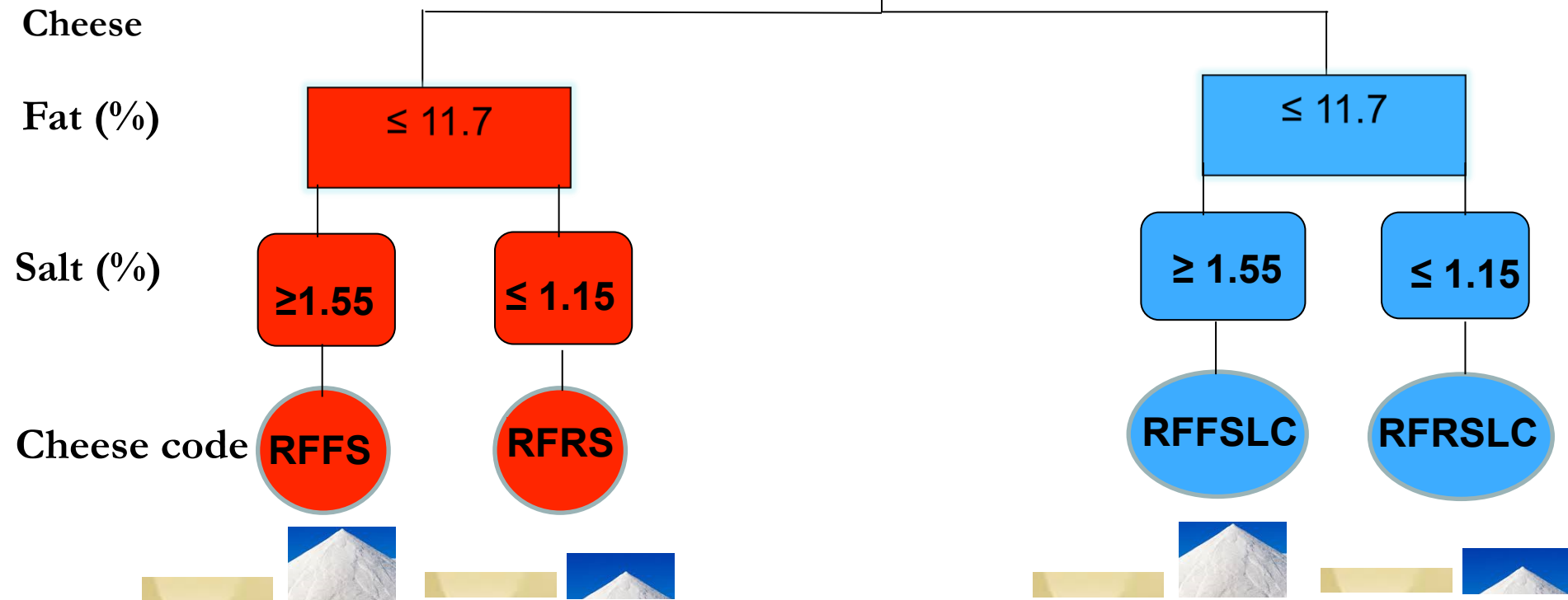
Experimental Design for the effect of fat and salt reduction



Materials and Methods

Experimental Design for the effect of calcium reduction

Standardised cheese milks

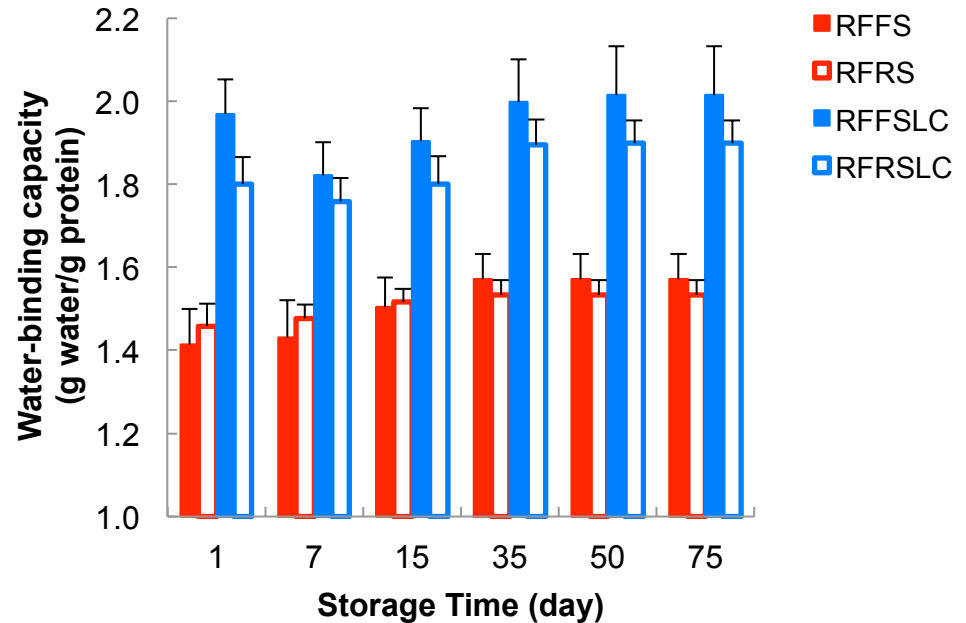
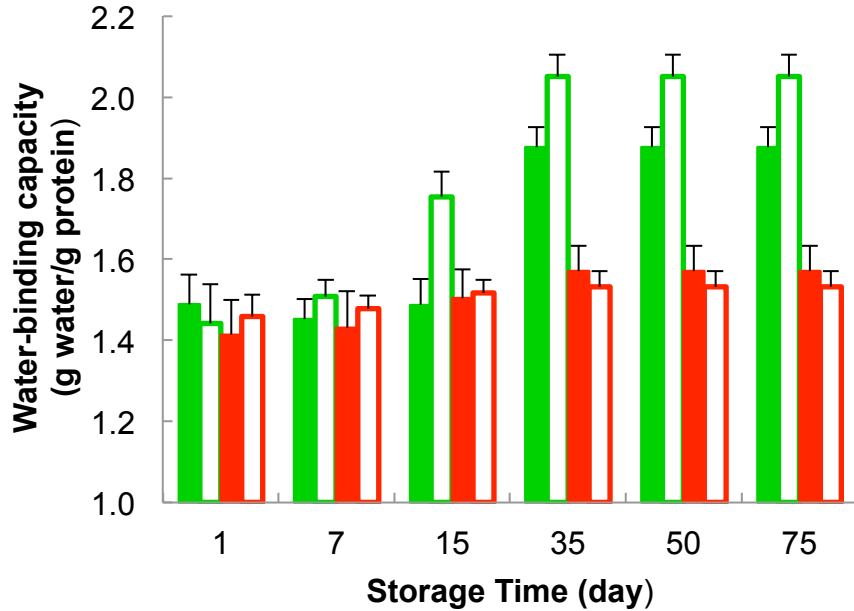


Key to Cheese Codes: **FF** = full fat **RF** = reduced fat **FS** and **RS** = full- and reduced-salt. **LC** = low calcium phosphate Replication: Quadruplicate trials, each with the 6 treatments

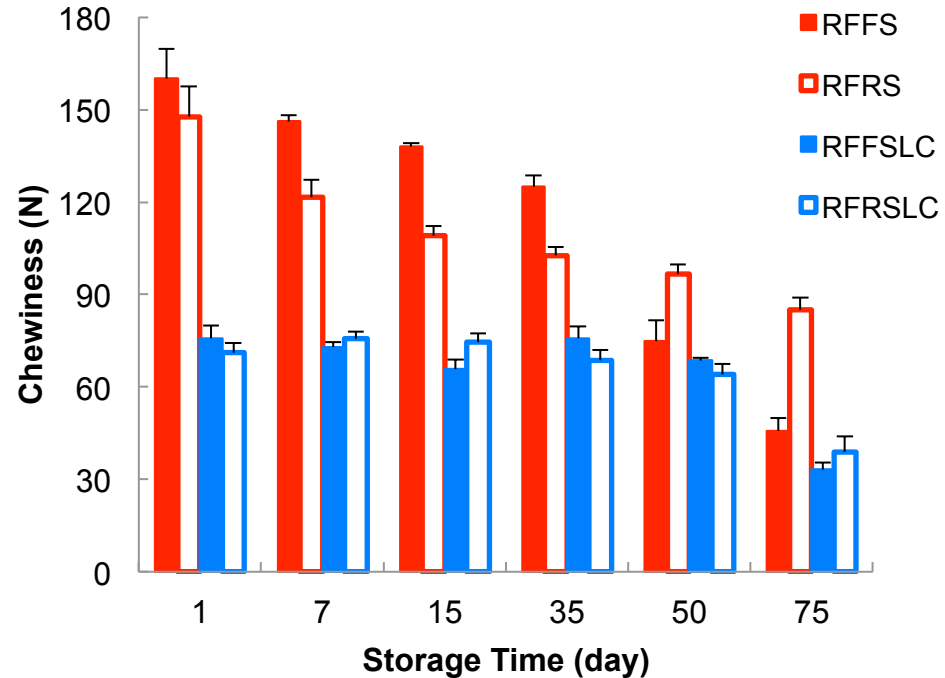
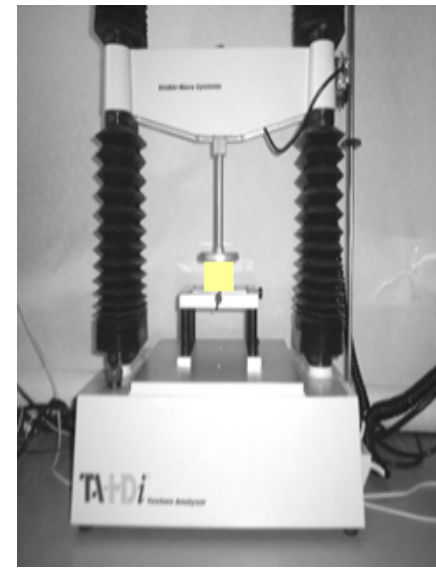
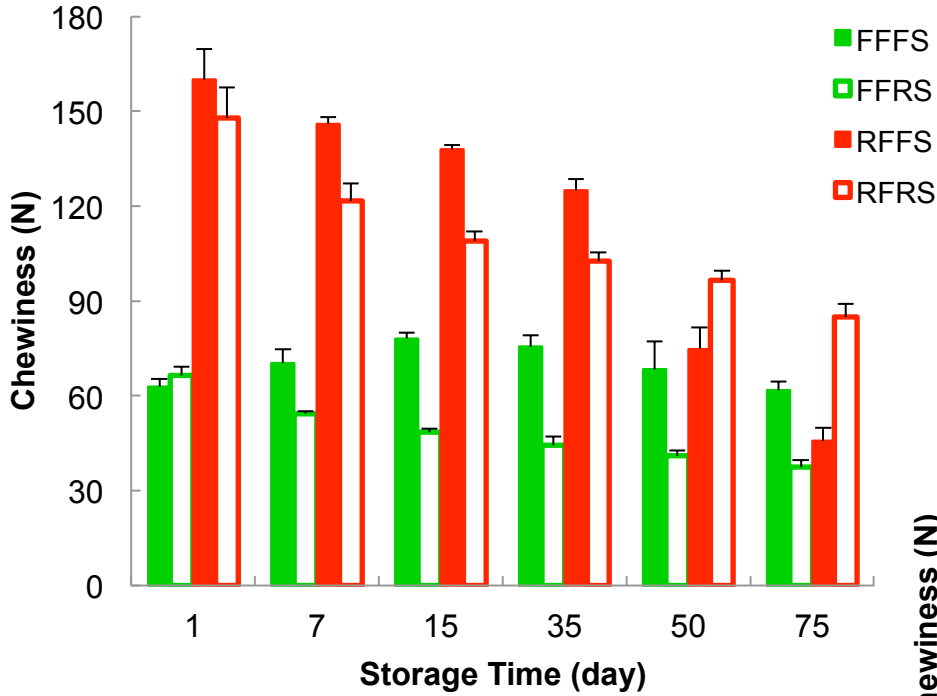
Results - Composition

Composition	FEES	FEES	DEES	DEES	DEESI Ca	DEESI Ca
	Reducing Fat	Reducing Fat	Reducing Salt	Reducing Salt	Interactive effect	Reducing calcium
Moisture (%w/w)	↑	↑	N/S	N/S	↑	↑
Protein (% w/w)	↑	↑	N/S	N/S	↑	↓
Fat (% w/w)	↓	↓	N/S	N/S	↓	↑
MNFS (% w/w)	N/S	N/S	N/S	N/S	N/S	↓
S/M (% w/w)	N/S	N/S	↓	↓	N/S	N/S
S/M (% w/w)	3.39	2.14	3.52	2.26	3.11	1.69

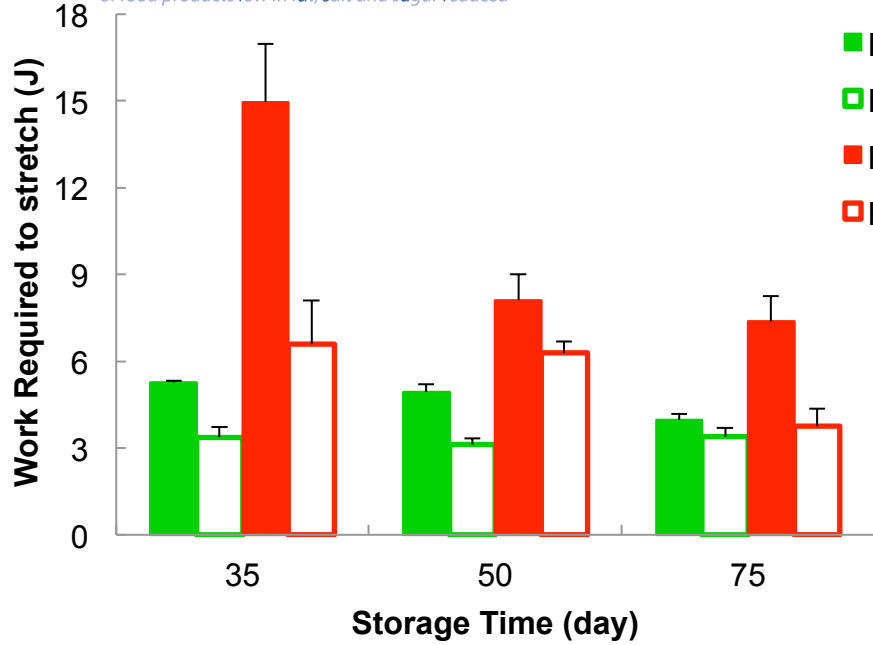
Results - Water-binding Capacity



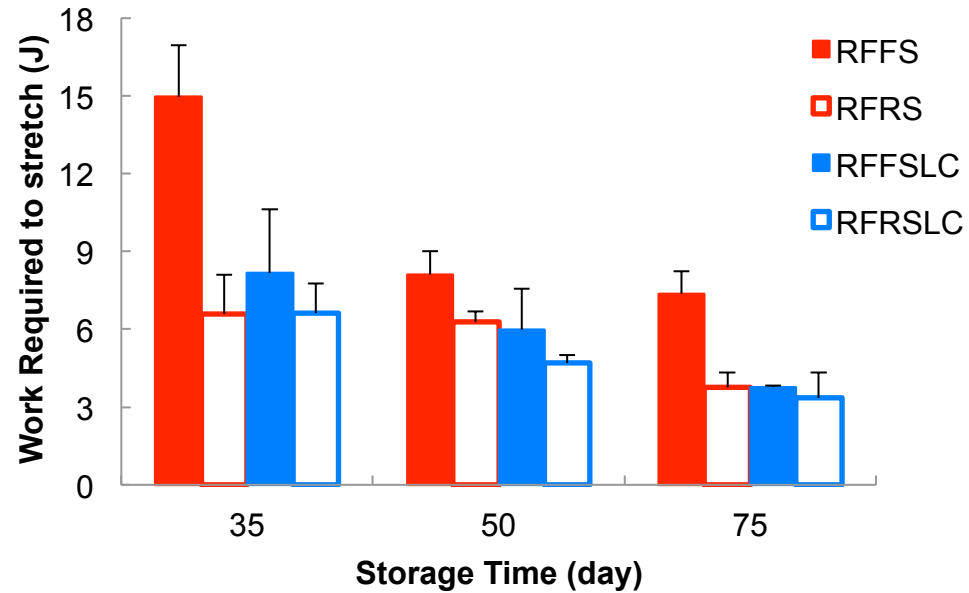
Results - Chewiness



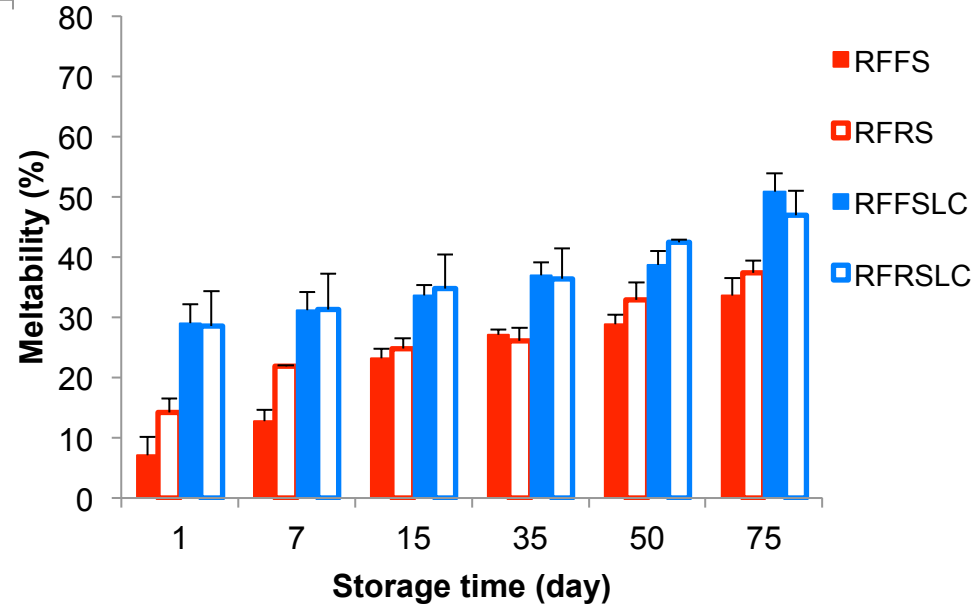
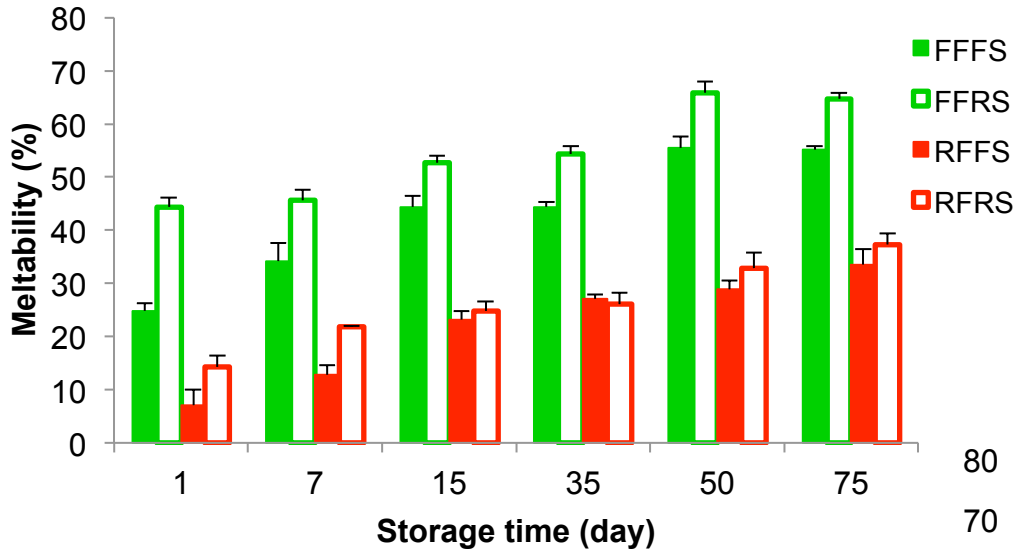
Results - Stretchiness



Energy/work to stretch: energy to pull melted cheese into strings



Results - Meltability



Results

Hedonic scoring of 35 day-old cooked cheese

Liking of attributes	FFFS	FFRS	RFFS	RFRS	RFFSLC	RFRSLC
Aroma	+	+	-	-	NS	NS
Texture	+	+	-	-	NS	NS
Flavour	+	+	-	-	NS	NS
Overall acceptability	+	+	-	-	NS	NS

+ : positively correlated with cheese

- : negatively correlated with cheese

NS : not associated with cheese

Results

Intensity scores of key sensory attributes in 35 day-old cooked cheese

attributes	FFFS	FFRS	RFFS	RFRS	RFFSLC	RFRSLC
Stretchiness	NS	+	-	-	-	+
Fat flavour	+	+	-	-	NS	NS
Stringiness	NS	+	-	-	-	+
Cheese flavour intensity	+	+	-	-	NS	NS
Cooked cheese flavour	+	+	-	-	NS	NS
Salt taste	NS	+	NS	NS	NS	NS

+ : positively correlated with cheese

- : negatively correlated with cheese

NS : not associated with cheese

Conclusions - Study 1

- Reducing fat: Cheese - Firmer, chewier, less meltable, lower sensory acceptability
- Reducing salt: Relatively minor effects compared to fat
- Texture and functionality of reduced-fat, reduced-salt Mozzarella significantly improved by reducing calcium cross-linking of casein
- However, the reduced-fat reduced-calcium cheese was not scored as well in terms of sensory liking
- RFRSLC cheese not as acceptable as FFFS because of lack of flavour!

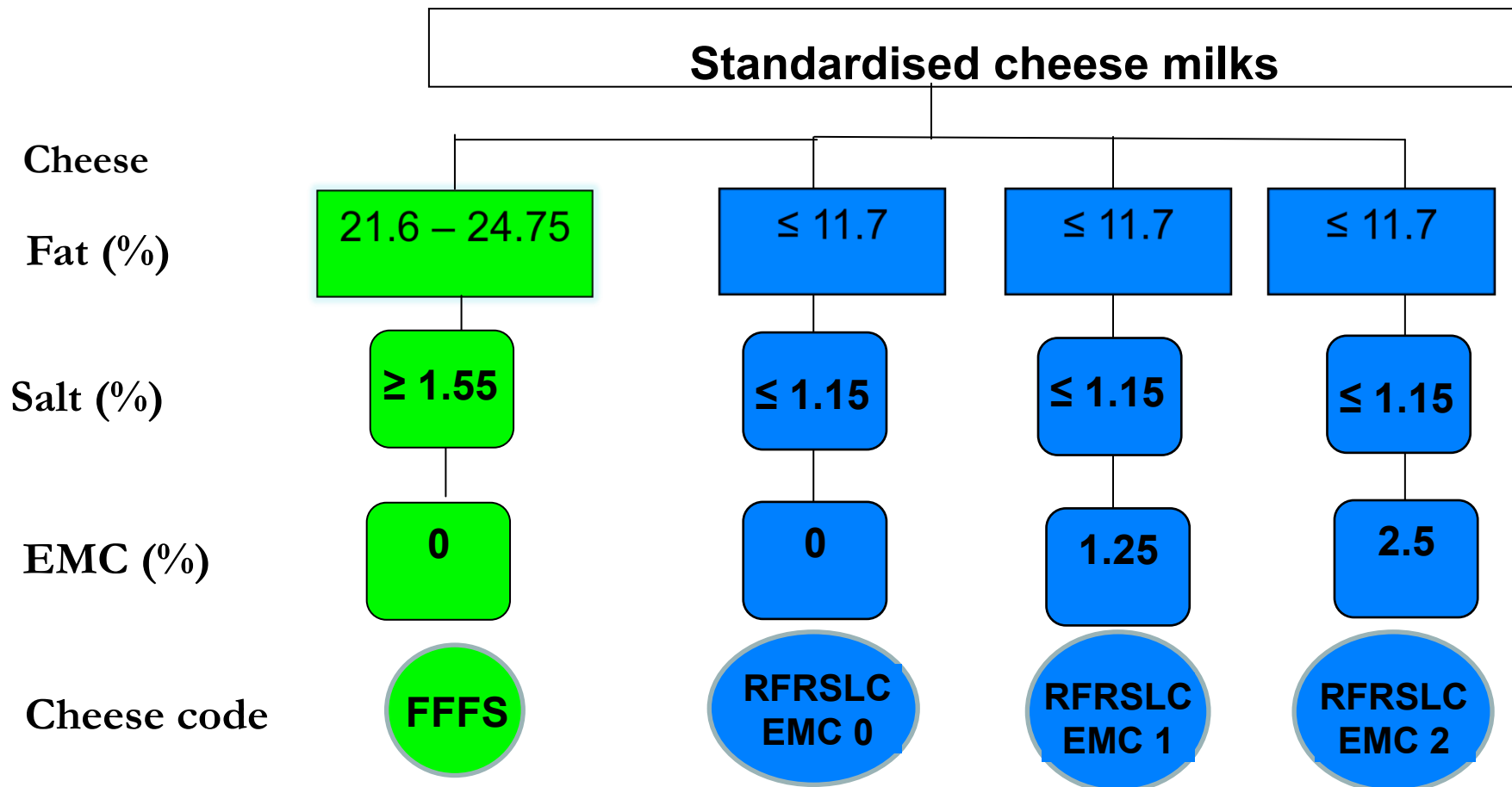


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- Study 3. Further development of dry-salted Mozzarella method to increase level of protein hydrolysis *via* increased rennet retention in cheese

Materials and Methods

Experimental Design for the effect of EMC incorporation

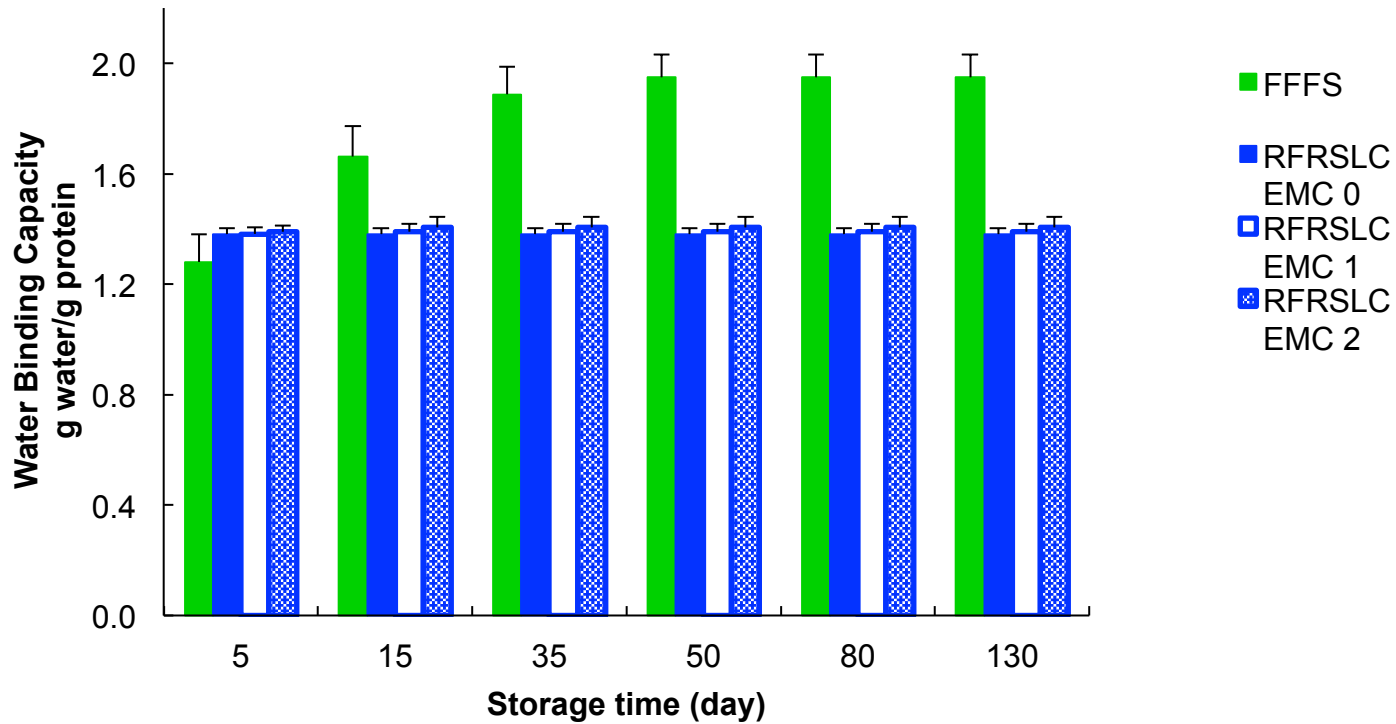


Key to Cheese Codes: **FF** = full fat FS and RS = full- and reduced-salt.
EMC = cheese with EMC incorporated

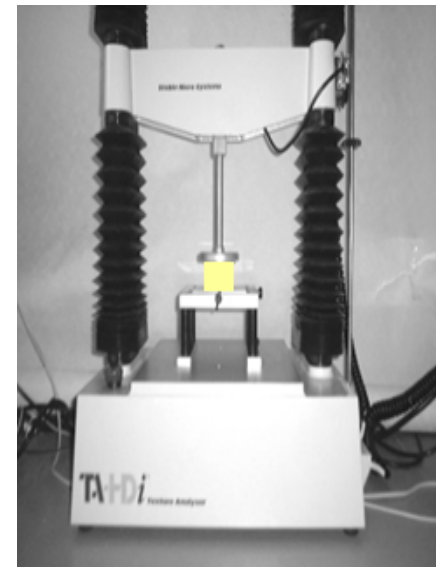
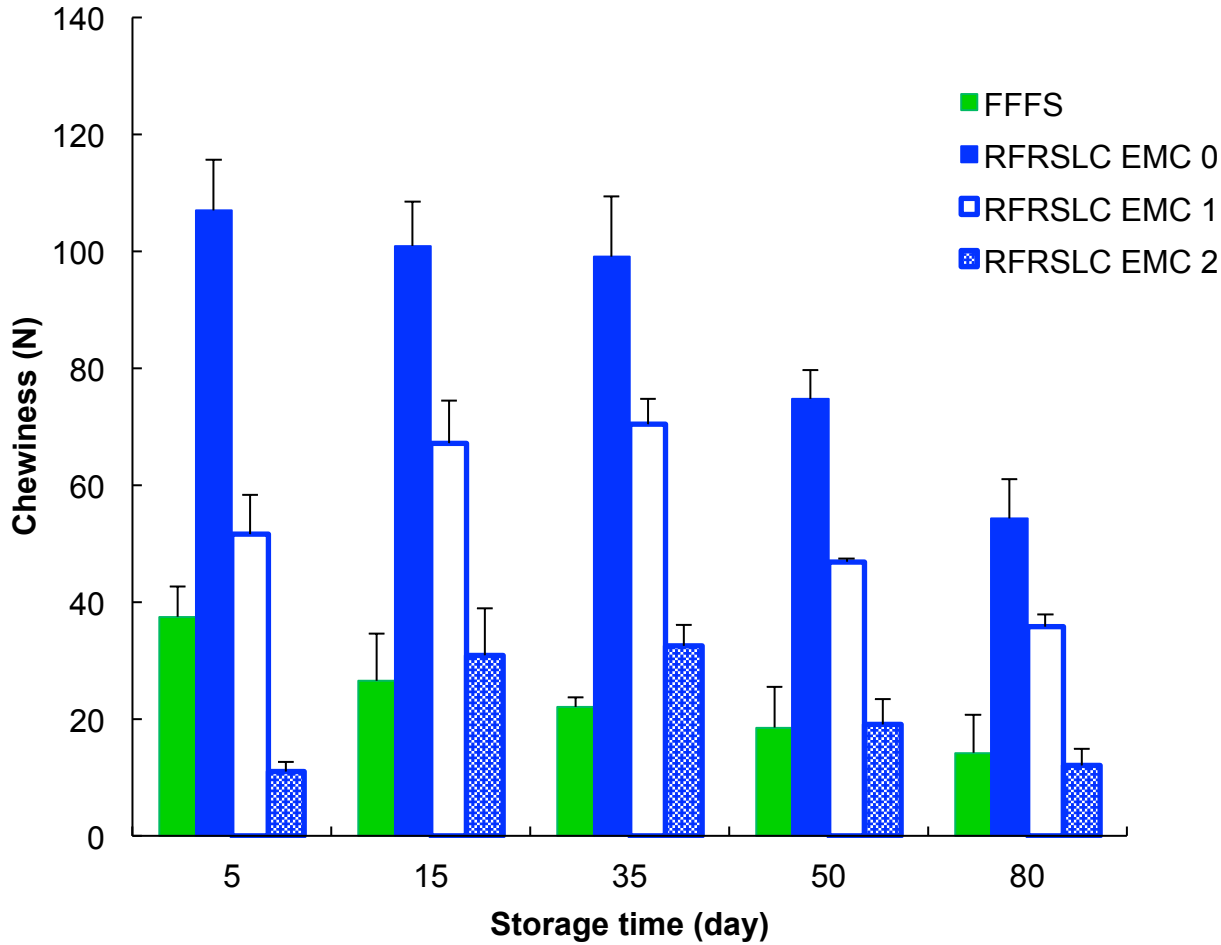
Composition

Composition	FFFS	RFRFLC EMC 0	RFRSLC EMC 1	RFRSLC EMC 2
Moisture (% _{w/w})	48.3	48.2	48.5	49.0
Protein (% _{w/w})	25.7	35.0	35.2	34.2
Fat (% _{w/w})	21.9	11.5	11.5	11.6
Salt (% _{w/w})	1.6	1.0	1.0	1.0
S/M (% _{w/w})	2.7	2.1	2.1	2.1

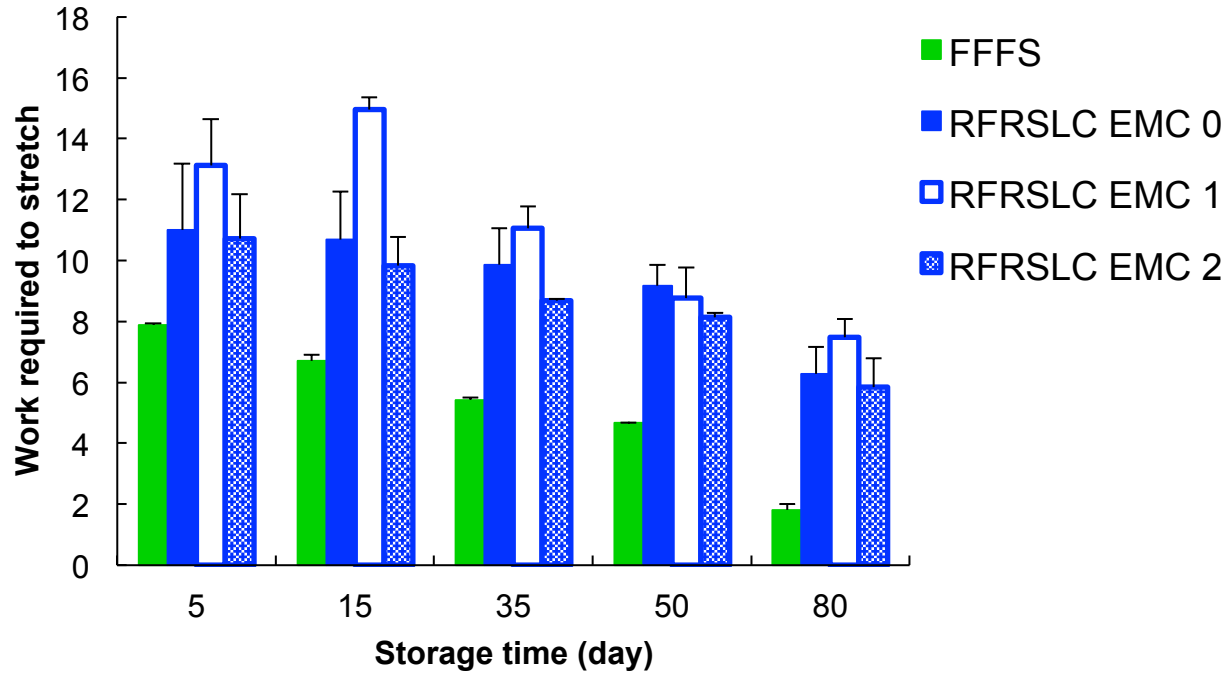
Results- Water-binding Capacity



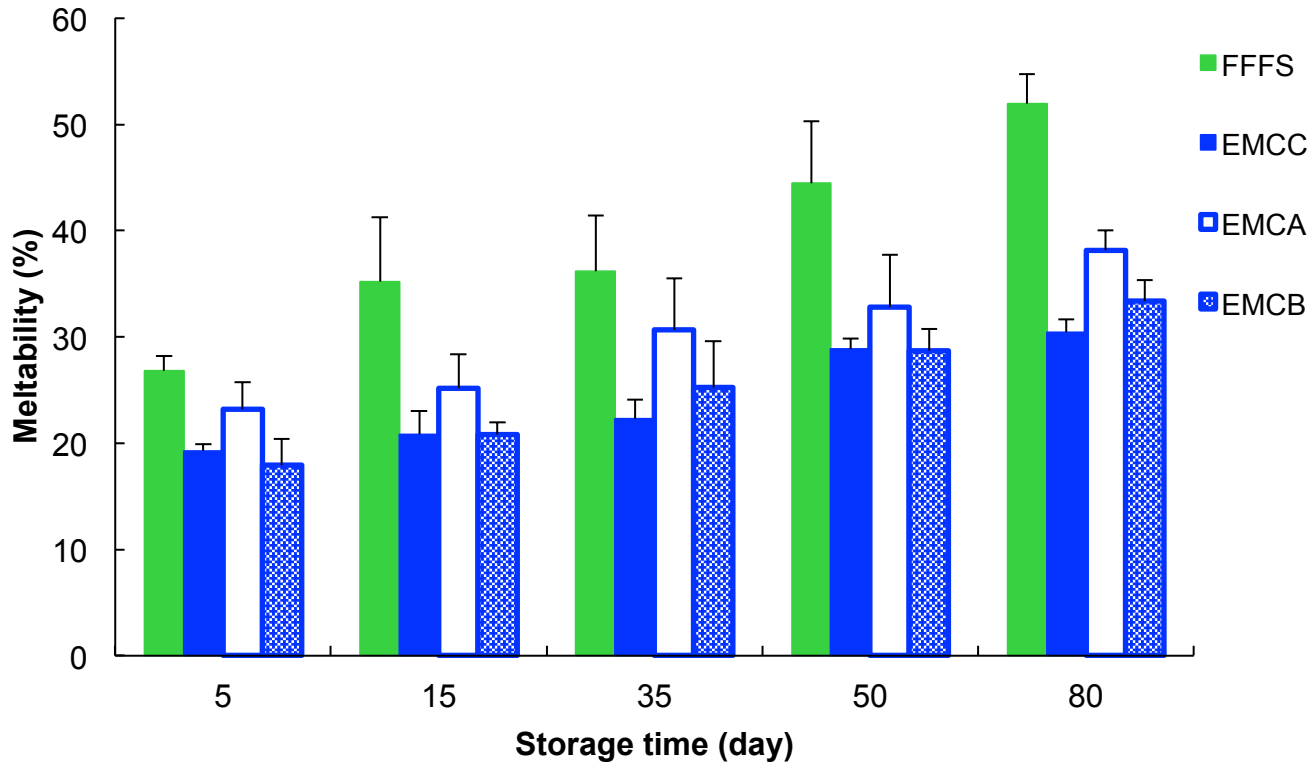
Results - Chewiness



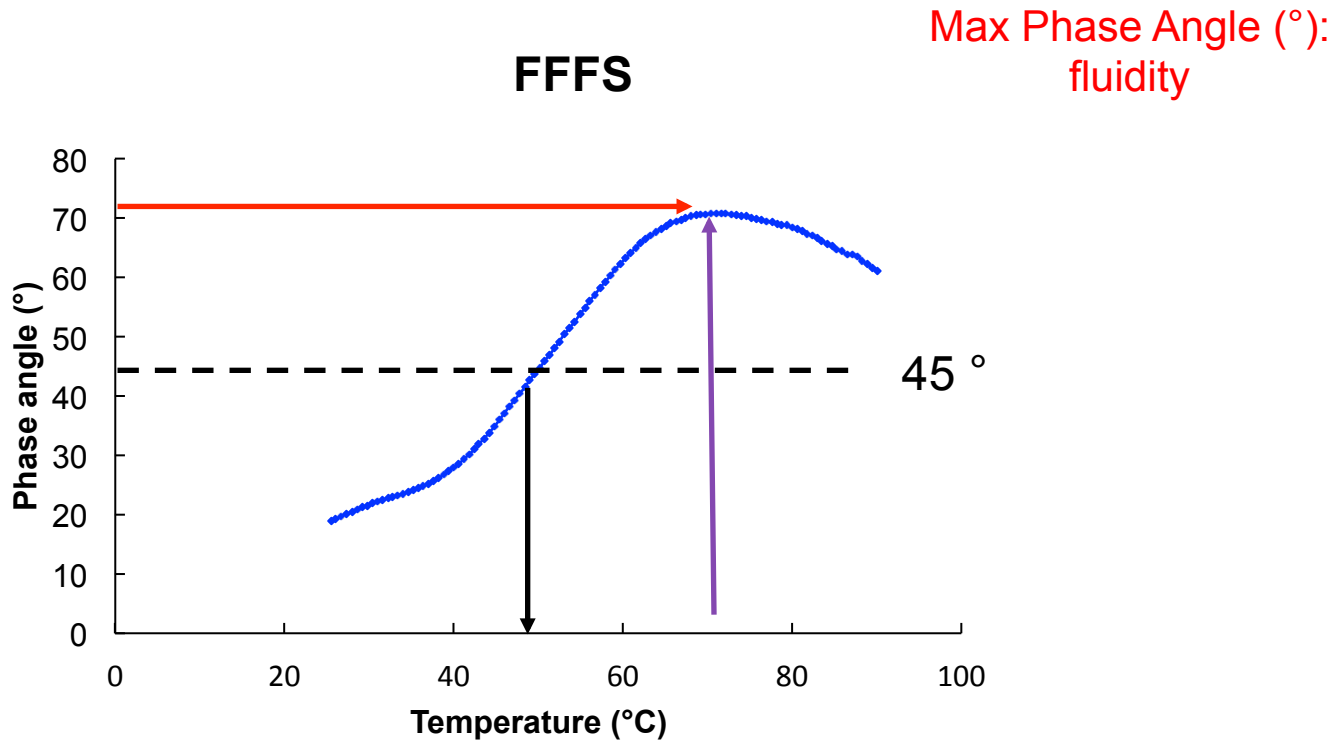
Results - Stretchiness



Results - Meltability



Results - Changes in viscoelasticity during heating of cheese

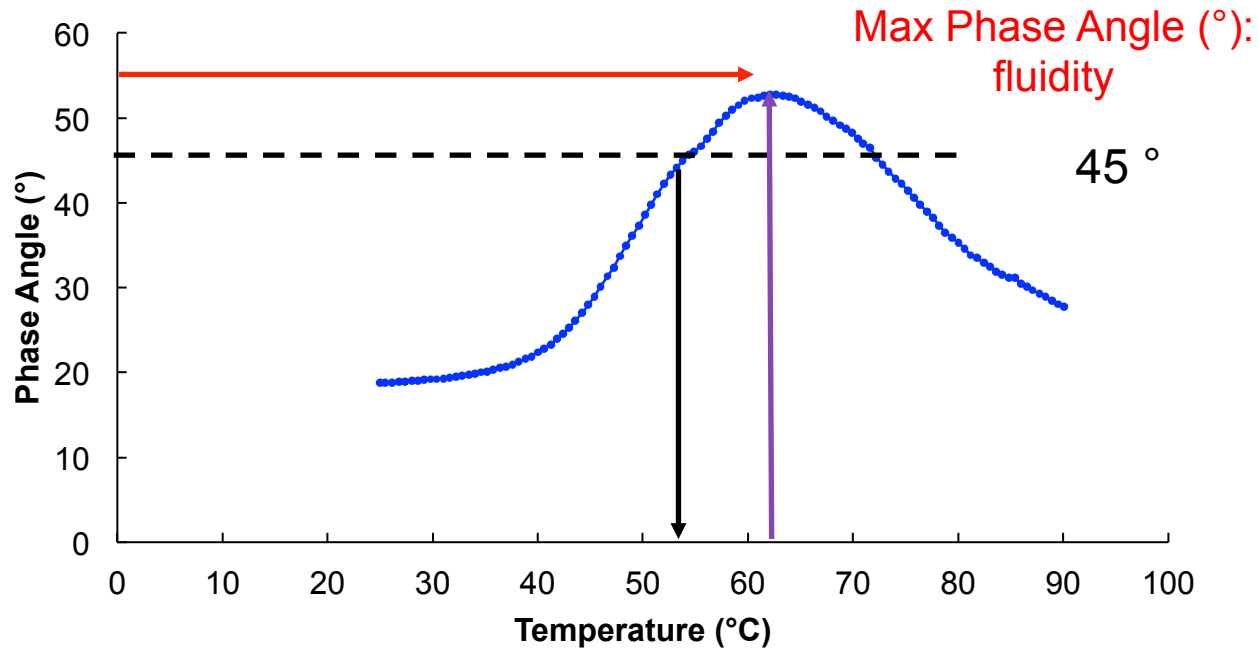


Temperature for
phase angle =
45° (°C)

Temperature at
maximum phase
angle (°C)

Results - Changes in viscoelasticity during heating of cheese

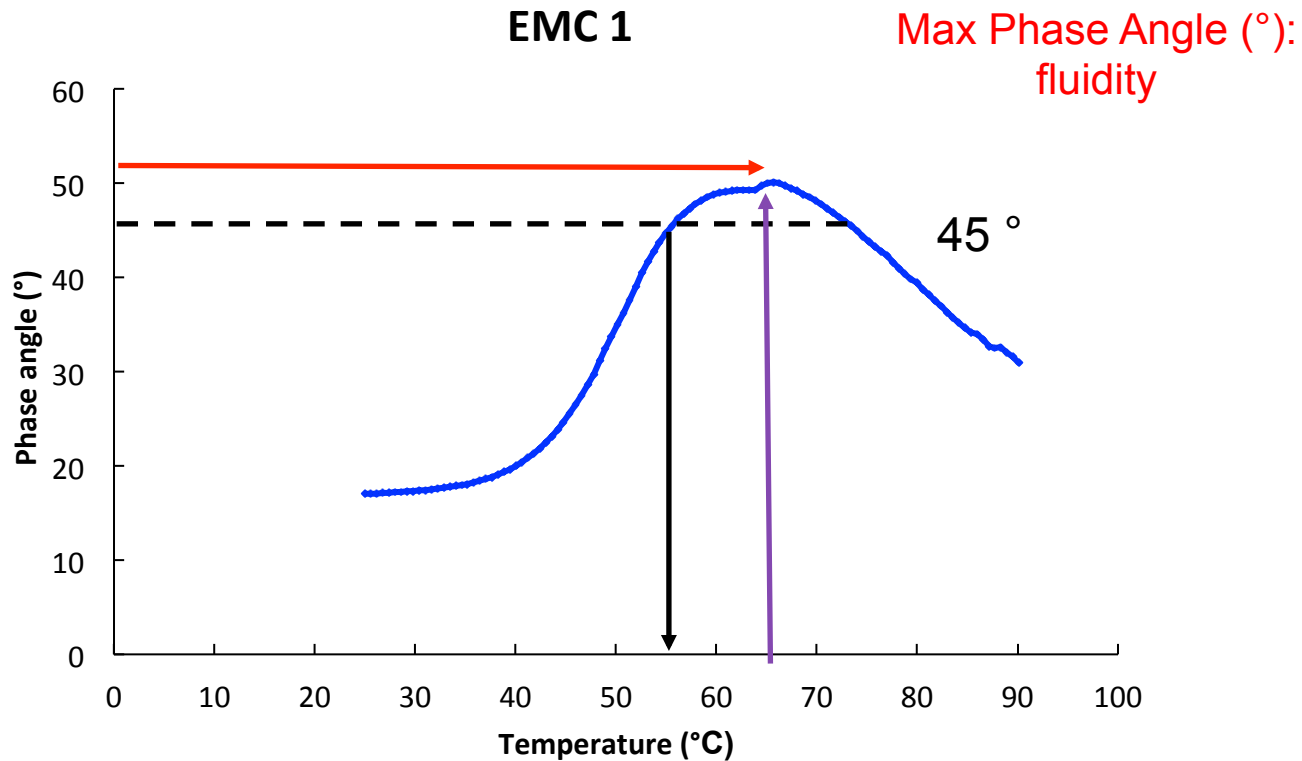
RFRSLC EMC 0



Temperature for phase angle = 45° (°C)

Temperature at maximum phase angle (°C)

Results - Changes in viscoelasticity during heating of cheese



Temperature for
phase angle =
45° (°C)

Temperature at
maximum phase
angle (°C)

Results- Rheology

Day 50	Temperature for phase angle = 45° (°C)	Max Phase Angle (°)	Temperature at maximum phase angle (°C)
FFFS	50	72	73
EMC 0	55	48	61
EMC 1	55	49	63
EMC 2	54	57	66

Conclusions

- Effect of reducing calcium content of RFRS dry-salted Mozzarella:
 - ↓ Chewiness and firmness of unheated cheese at highest EMC level (EMC2)
 - ↑ Heat induced flow of heated cheese
 - ↓ Reduced energy required to stretch the heated cheese
- Adding EMC to cheese enabled improvement of flavour through increase in cream and fat flavour compounds
 - Slight negative impact to some functional attributes though utilisation of new make procedure
- Increased levels of rennet retention to address these issues



Content

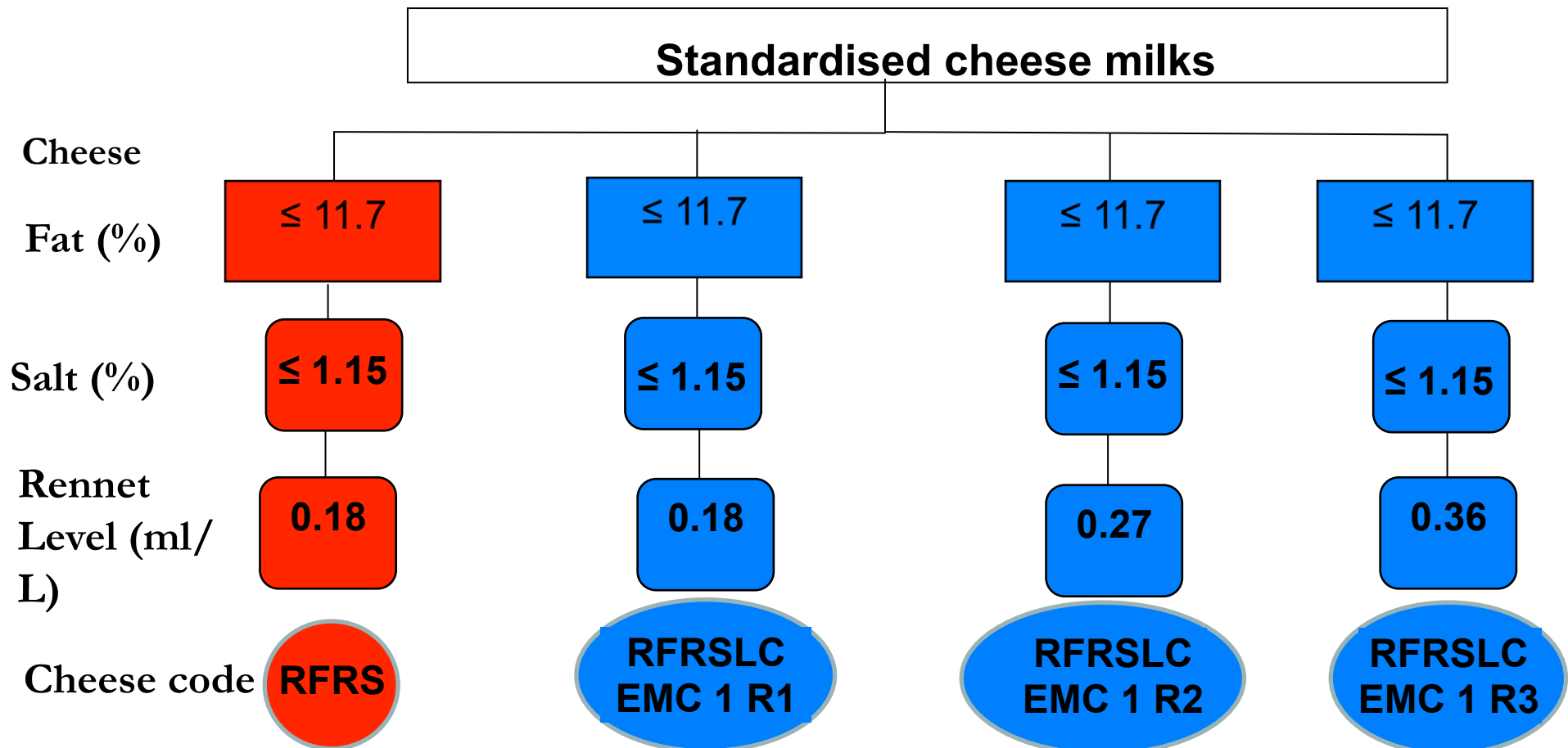
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Study 3

- Further development of dry-salted Mozzarella method to increase level of protein hydrolysis?
- Approach: Increase the level of residual chymosin in the cheese through higher addition rates and modification of procedure

Materials and Methods

Experimental Design for the effect of increased rennet retention



Key to Cheese Codes: **RF** = reduced fat FS and RS = full- and reduced-salt. **EMC** = cheese with EMC incorporated

Study 3

- Results
 - In progress

Thanks For Listening

Questions???