

Less fat, salt and sugar in sauces

Monica Trif, Natalia Perez-Moral, Eva Csutak,
Didier Pintori, Malte Bethke and
Peter Wilde



FP7/2007-2013 under grant agreement
n° 289397 (TeRiFiQ project).

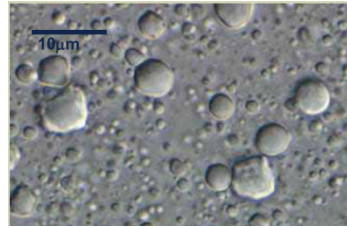
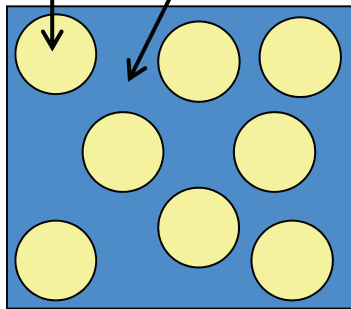


What are Multiple Emulsions?



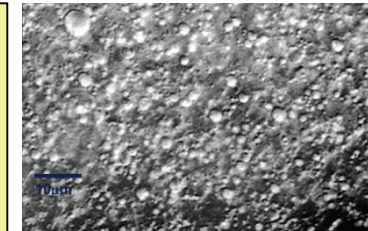
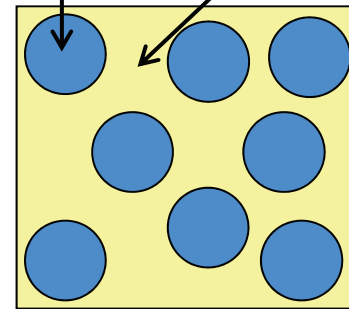
Emulsion

Oil in Water (o/w)



Milk

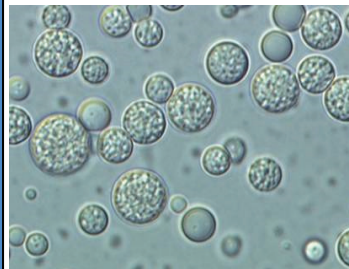
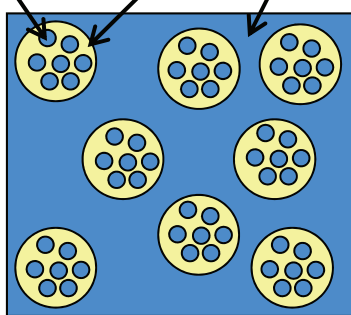
Water in Oil (w/o)



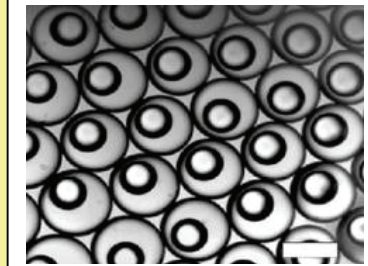
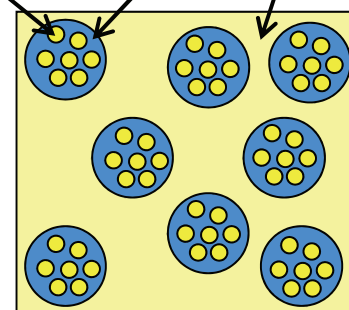
Butter

Multiple Emulsion
(double, duplex, triple etc)

Water in Oil in Water (w/o/w)



Oil in Water in Oil (o/w/o)



w/o/w emulsions more widely studied
Limited application in food for o/w/o emulsions



Food

- Reduced Fat content
- Taste masking
- Encapsulation
- Flavour/aroma release



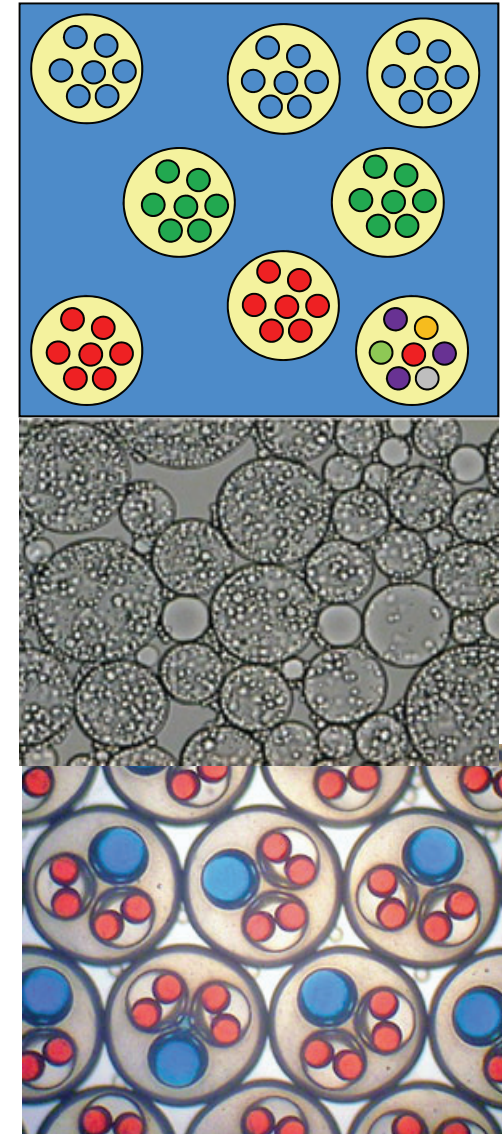
Pharmaceutical

- Controlled Encapsulation / delivery
- Taste masking



Research

- Nano-scale reaction systems
- High throughput reactions

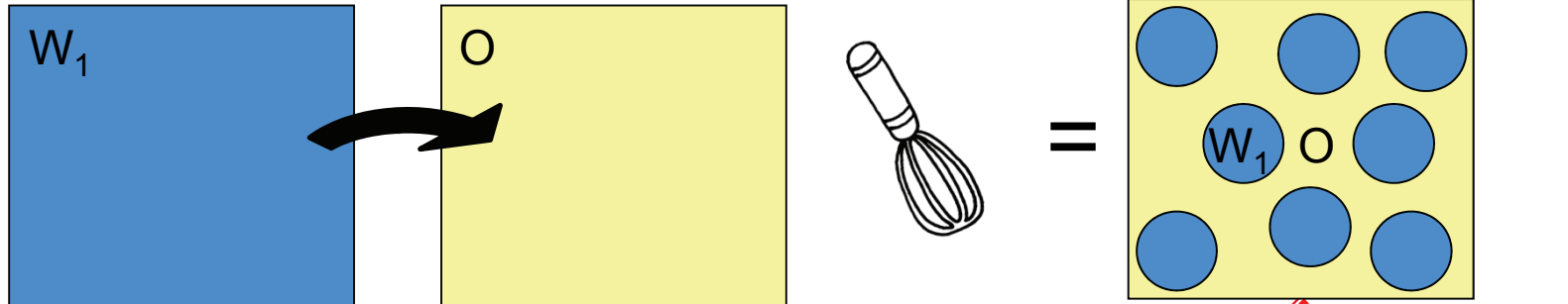


How are they made

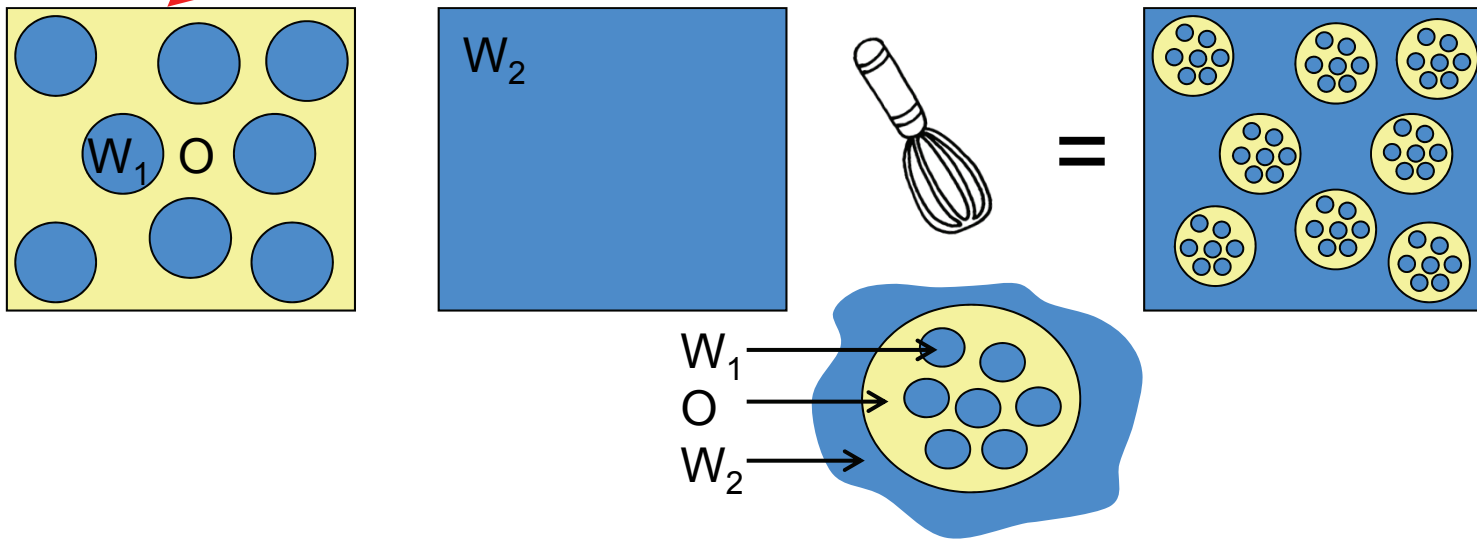


2 stage homogenisation process
eg – w/o/w emulsion

1

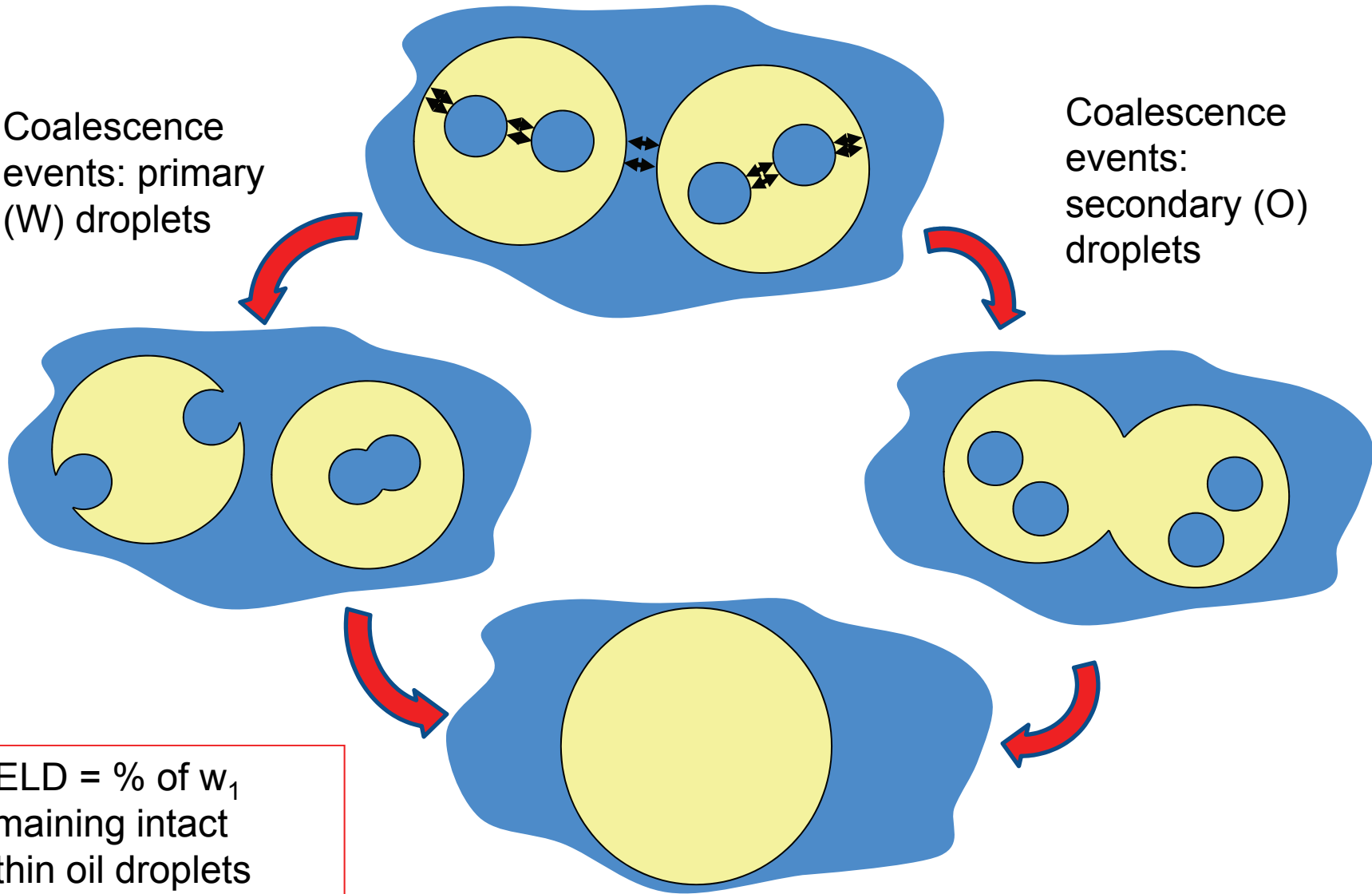


2



Coalescence events: primary (W) droplets

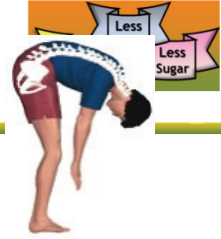
Coalescence events: secondary (O) droplets



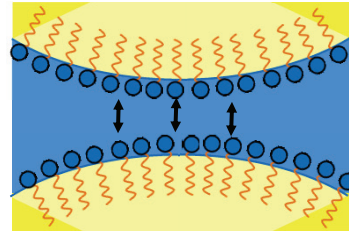
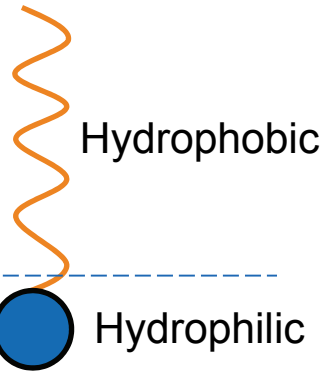
YIELD = % of w_1 remaining intact within oil droplets



Interfacial Stability



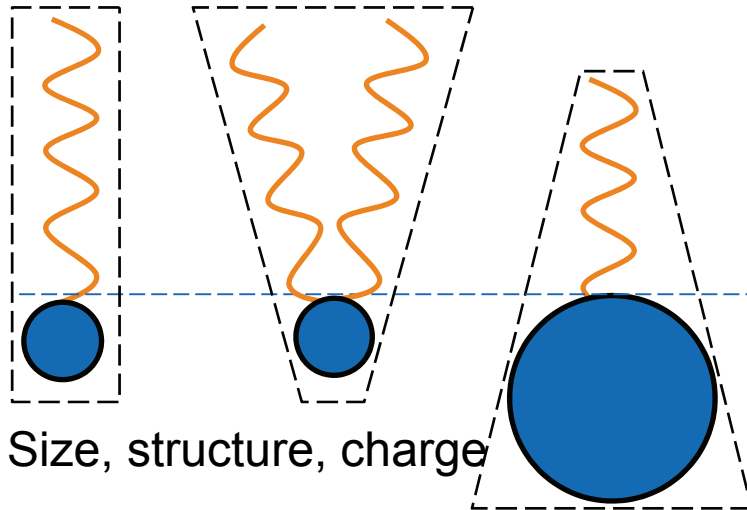
The importance of curvature



HLB = Hydrophilic:Lipophilic Balance

Hydrophobic
Low HLB

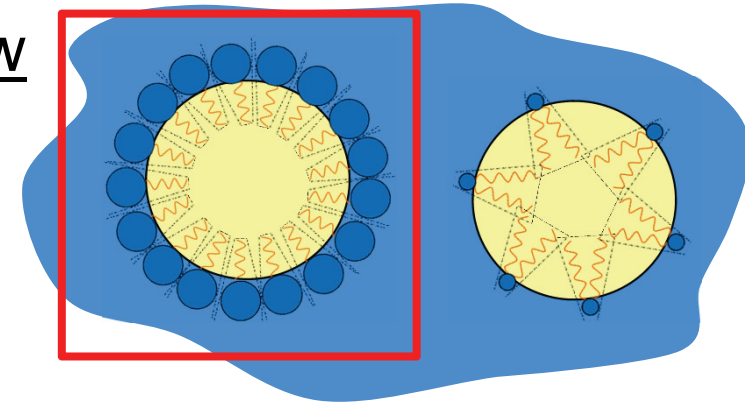
Hydrophilic
High HLB



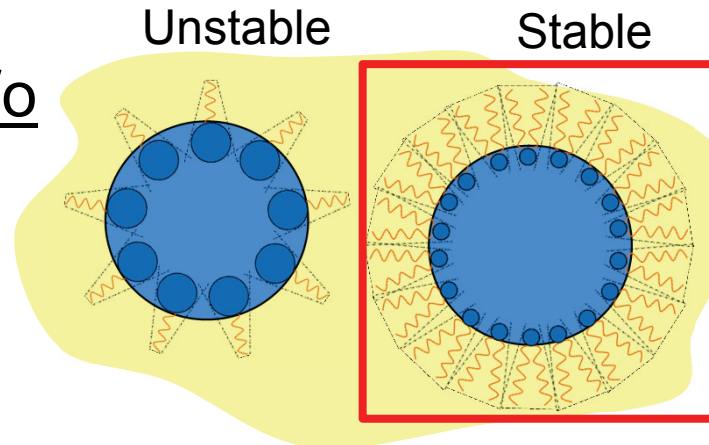
High HLB
Stable

Low HLB
Unstable

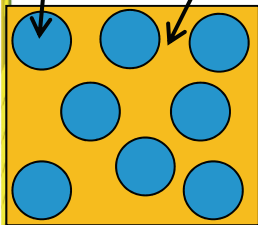
o/w



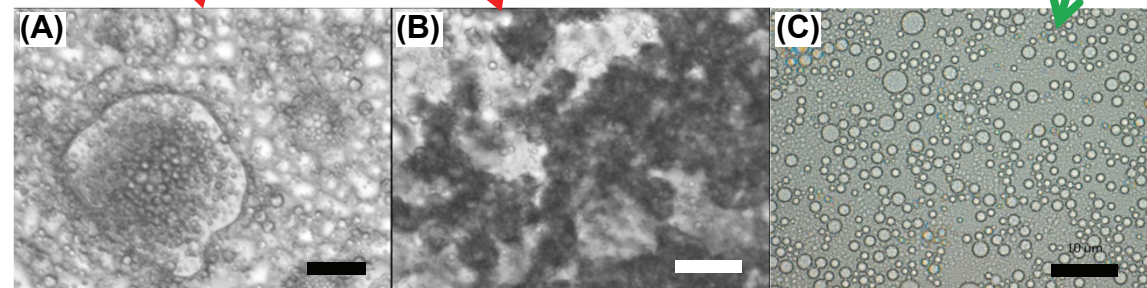
w/o



Water in Oil (w/o)



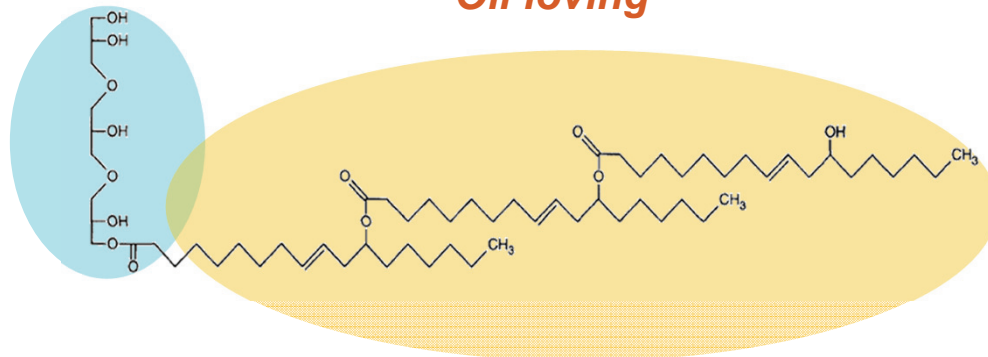
	CITREM	Span 80 / 85	SSL	MG	Lecithin	PGPR
Initial droplet stability	Flocc and Coal below 1 wt%	Flocculation and coalescence	Unstable below 5 wt%	Unstable below 5 wt%	Unstable below 2 wt%	Some coalescence below 1wt%
Storage stability (7 days)	✓	xx	x	x	✓	✓✓



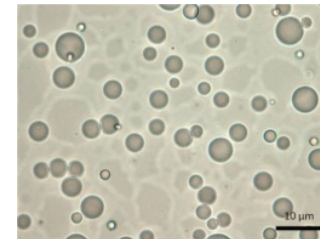
PGPR: Polyglycerol polyricinoleate (E476)

Water loving

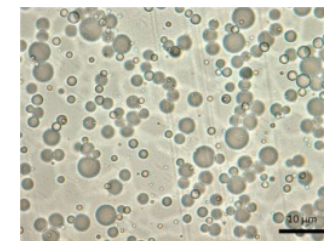
Oil loving



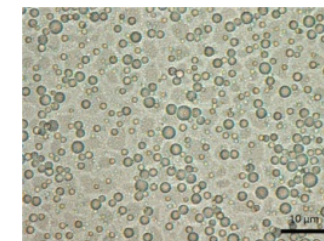
http://www.accessdata.fda.gov/scripts/fcn/gras_notices/grn000266.pdf



0.5% PGPR



1% PGPR

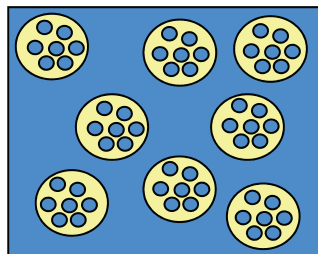
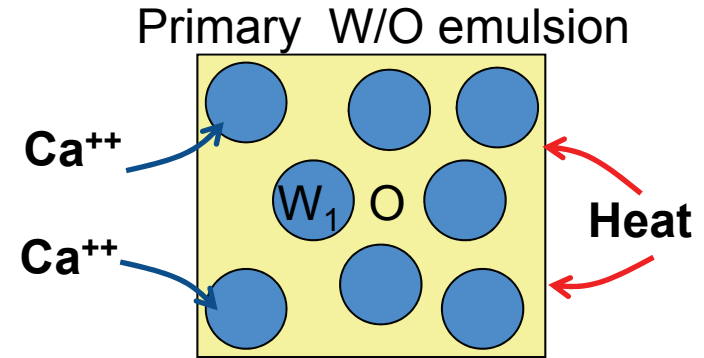


2% PGPR

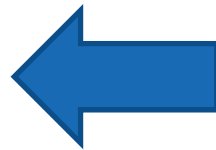
Only permitted in a certain range of food products

Improving stability of W/O droplets:

- Gelling internal water phase
- Gelling agents:
 - alginate, crosslinks with Ca^{++}
 - Carageenan, crosslinks through heating

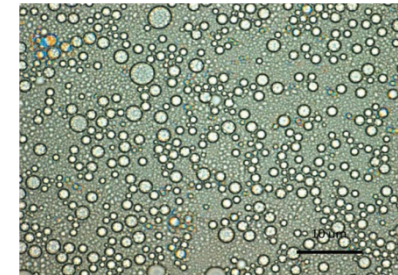


Gel in Oil in Water (GOW) emulsion

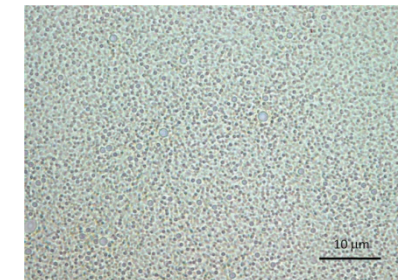


Smaller droplets in G/O due to reduced re-coalescence

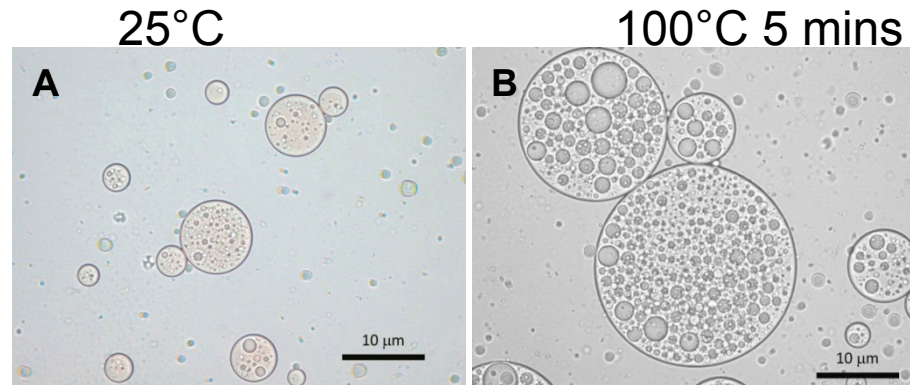
W/O



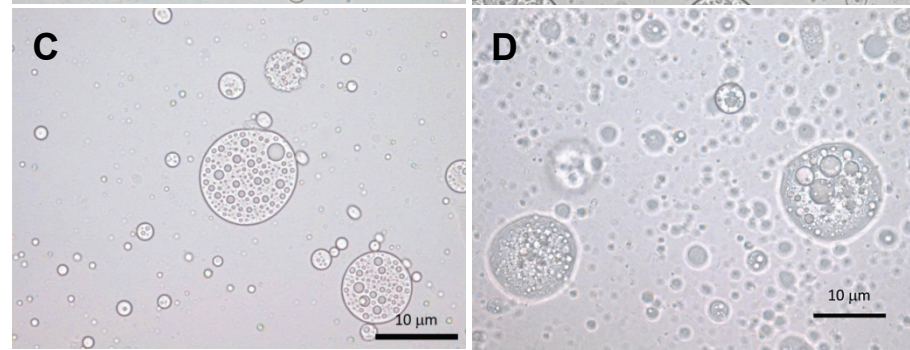
G/O



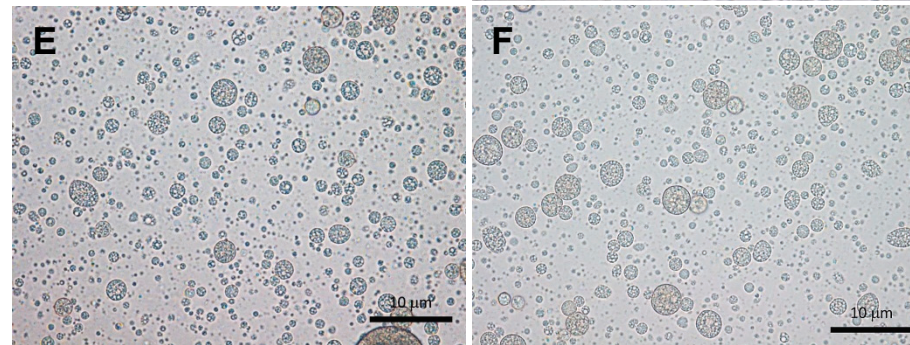
Whey Protein WOW



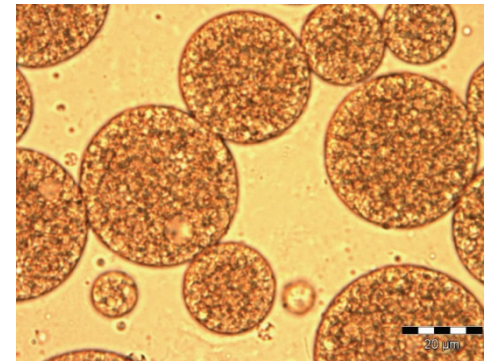
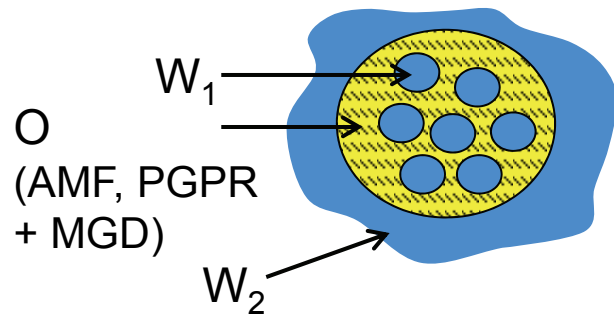
Lecithin WOW



Lecithin GOW

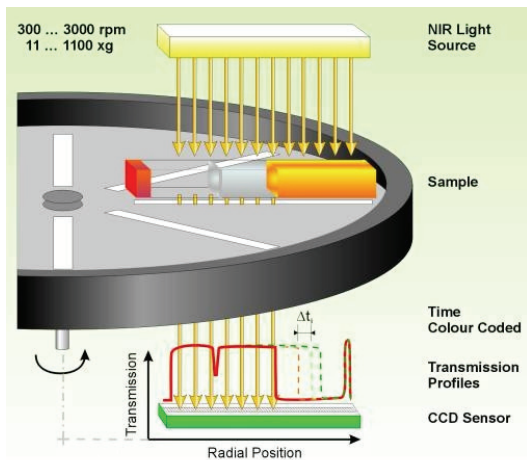


→ W/O/W emulsion using Anhydrous Milk Fat (AMF) was reproduced using 3%w of emulsifiers (1,5% PGPR and 1,5% MDG)



10-30 μm

Lumifuge: Accelerated stability test



After 15 days, the emulsion is stable

→ **0,21% of PGPR in the overall emulsion**
(reduction by a factor 2,7 of the quantity of PGPR in the emulsion compare to the model systems)



Pizza Sauce



Standard = 4 - 13.5% fat, 1.5% salt

- 20% salt reduction achieved using added herbs and garlic aroma and novel salt replacers.
- 30% Fat reduction achieved using GOW multiple emulsions and added pea or rice starch



Sweet Creams for cakes



Standard = up to 35% fat and 30% sugar

- 30% reduction using GOW emulsion and pea starch
- 30% sugar replaced by Stevia extract



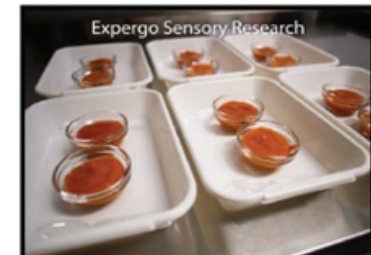
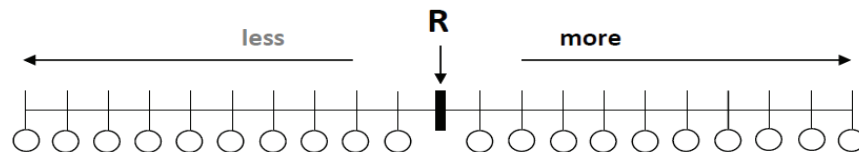
Sensory assesment of pilot scale formuatioms

Sensory evaluation was performed by trained assessors:

- sensory laboratory by Expergo Sensory Research, Romania / samples were evaluated regarding colour attribute on 5500 K light
- 6 assessors / four training sessions before the sensory evaluation
- sensory attributes

PIZZA SAUCE ATTRIBUTES	SWEET CREAM ATTRIBUTES
COLOUR	COLOUR
SMELL	SMELL
SALTY	SWEET
SMOOTHNESS	SMOOTHNESS
FATINESS	FATINESS
AFTER TASTE	AFTER TASTE

- evaluated by rating the intensity of each attribute on a bipolar scale with 10 points



Sensory assessment of pilot scale formulations

Differences in rating of each assessor for replicates were measured by calculating the tolerance between ratings for each attribute. Acceptable tolerance was considered below 10% of scale.

Up to 10% of the scale = $0:\pm 1$ unit > a marginal difference

Between 10%-20% of the scale = ± 2 unit > an acceptable difference

Between 20%- 50% of the scale = $\pm 2:\pm 5$ unit > significant difference

Over 50% of the scale = $\pm 5:\pm 10$ unit > different product

Acceptable tolerance: ± 1 unit (Kemp et al., 2009).

The value set for acceptance tolerance was not exceeded.

PIZZA SAUCE	Colour	Smell	Salty	Fattiness	Smoothness	After taste
Difference	-1,67	0,58	0,58	1,00	1,58	1

SWEET CREAM	Colour	Smell	Sweet	Fattiness	Smoothness	After taste
Difference	-1,83	-1,33	1,5	0,83	1,67	1,33



Small differences only were registered, all $< \pm 2$, and 40% of comparisons scored $\leq \pm 1$.

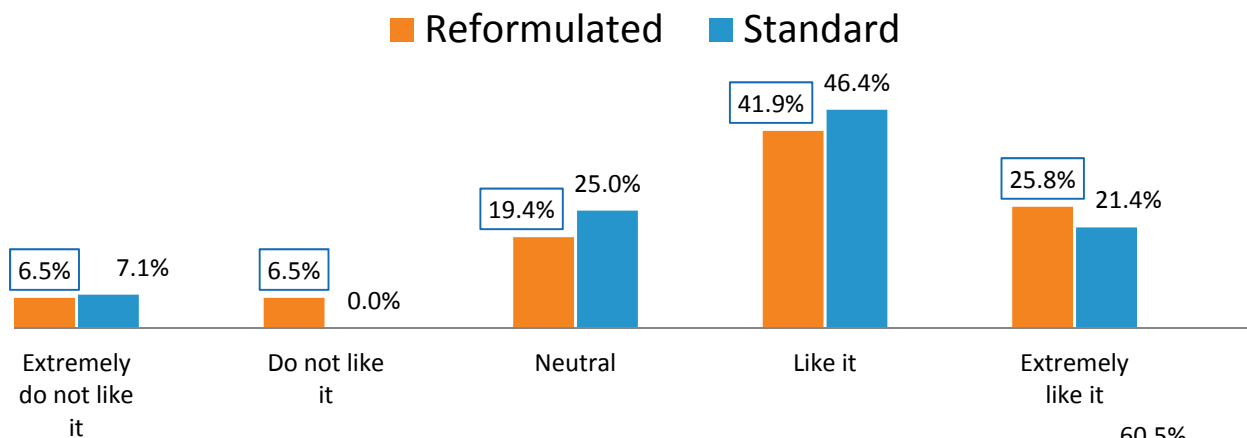
Small and marginal differences can easily be masked with minor adaptations of the recipe (e.g. adding a natural pigment/food colorant etc.).



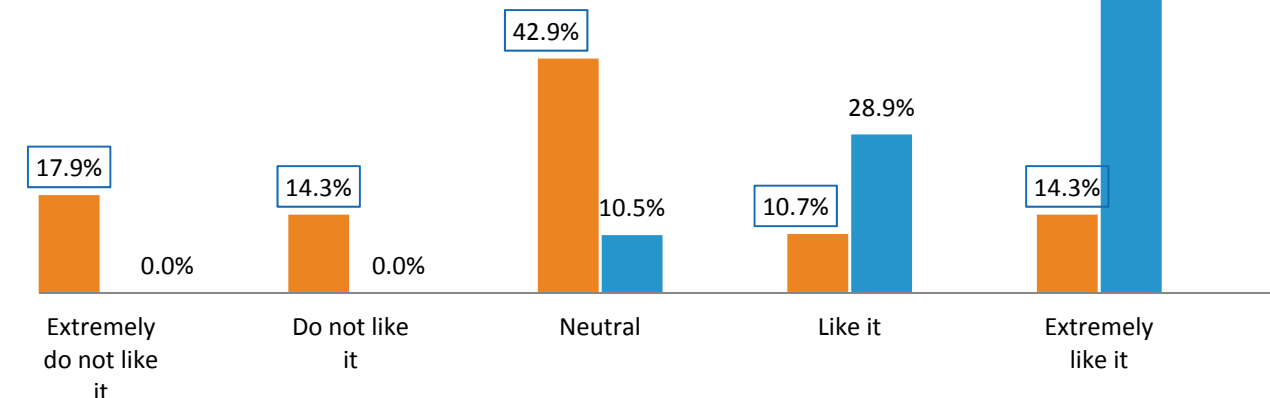
How tasty do you consider?

I do not like										I like very much
1	2	3	4	5	6	7	8	9	10	

PIZZA SAUCE



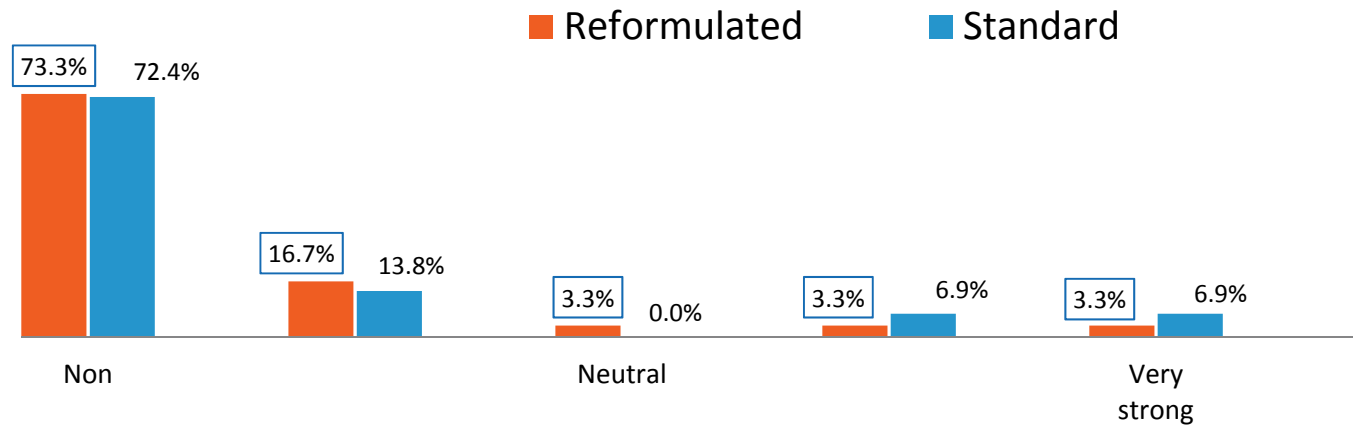
SWEET CREAM



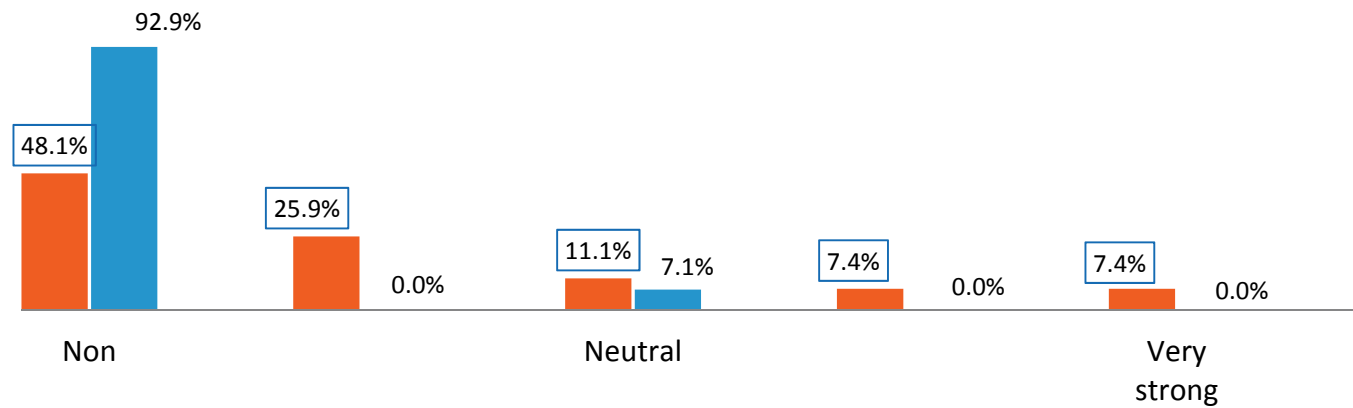
Do you perceive any **unpleasant** aftertaste?

Non									Very strong
1	2	3	4	5	6	7	8	9	10

PIZZA SAUCE



SWEET CREAM



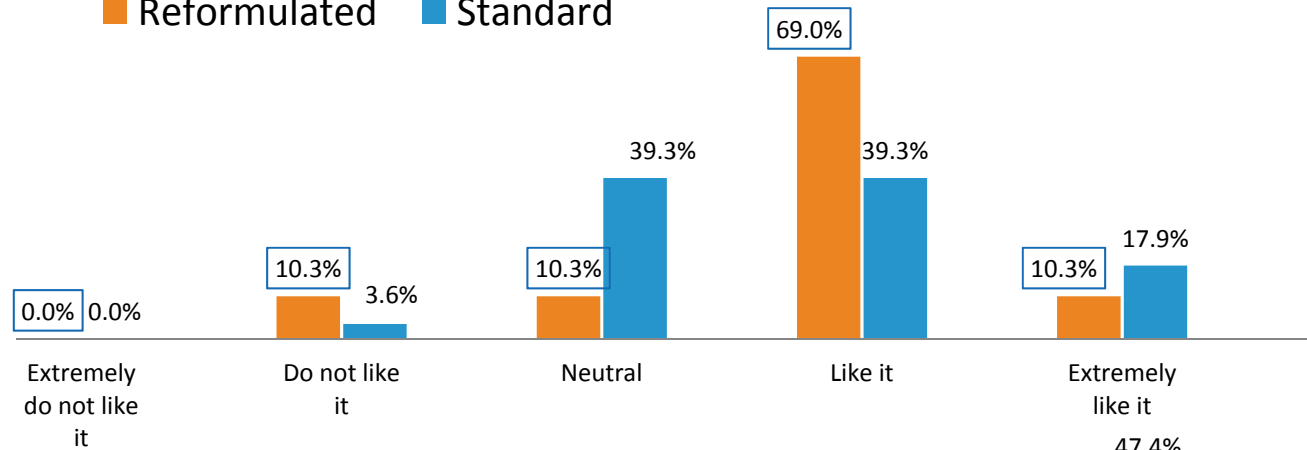
Overall Consumer Acceptance

I do not like

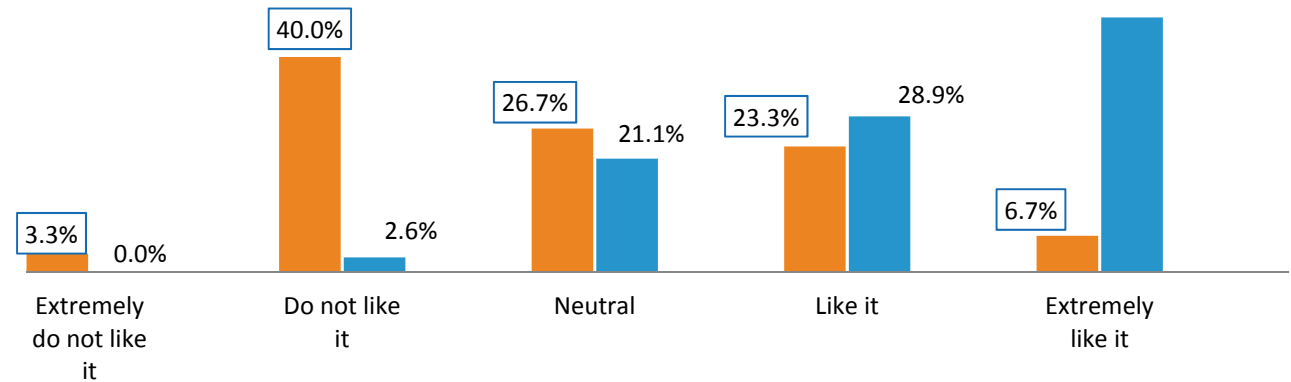
I like very much

Reformulated Standard

PIZZA SAUCE



SWEET CREAM



- Multiple emulsions offer an effective method of reducing fat content in sauces and ready prepared meals
- Stability of W/O droplets is key to stability
- Other strategies can improve stability to processing and formulation changes.
- Consumer and sensory analysis show generally good acceptability of reformulated products
- Milder flavour of sweet creams more sensitive to reformulation and affect of sweetener on aftertaste
- Further reformulation strategies developed to fine tune the sensory properties of products



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Fiona Husband



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