Ingredients for margarine and spreads

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DANISCO A/S

World wide production of margarine

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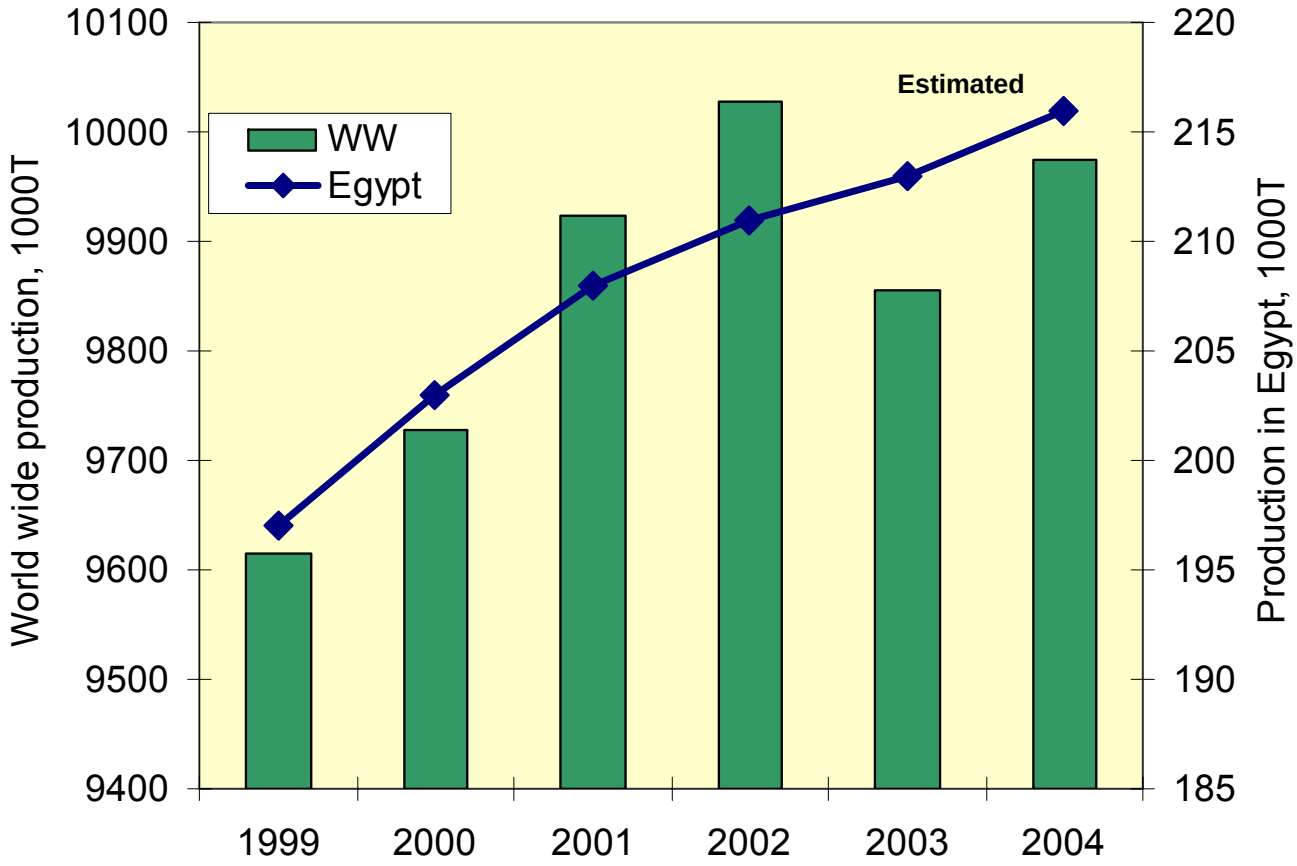

Source: Oil World Annual 2005

Total global oils & yellow fats market, MUSD, by region

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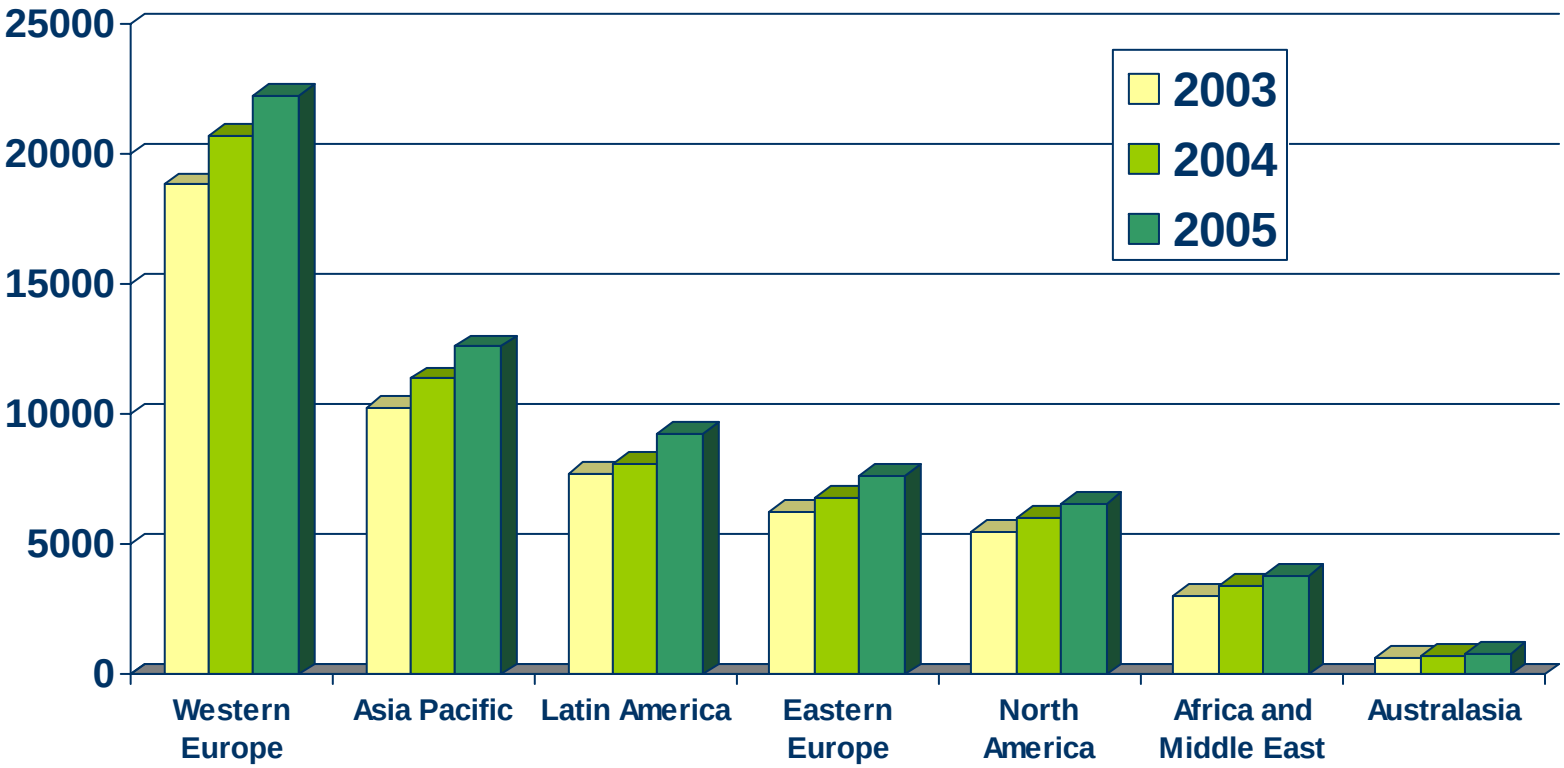

Oils & fats global retail value 2005 in bn USD

Source: EUROMONITOR

Consumer lifestyle trends
Health & wellness

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- Common trends all around the world
- Food is not only fuel but evolving to fulfil consumers' desire to live a longer, healthier life
- Emerging preference for prevention rather than cure
- Increasing consumer awareness of the nutritional qualities and health benefits of food products

Sources: Human Nutrition Research UK, World of Food Ingredients Dec 04

Consumer responsibility for own health

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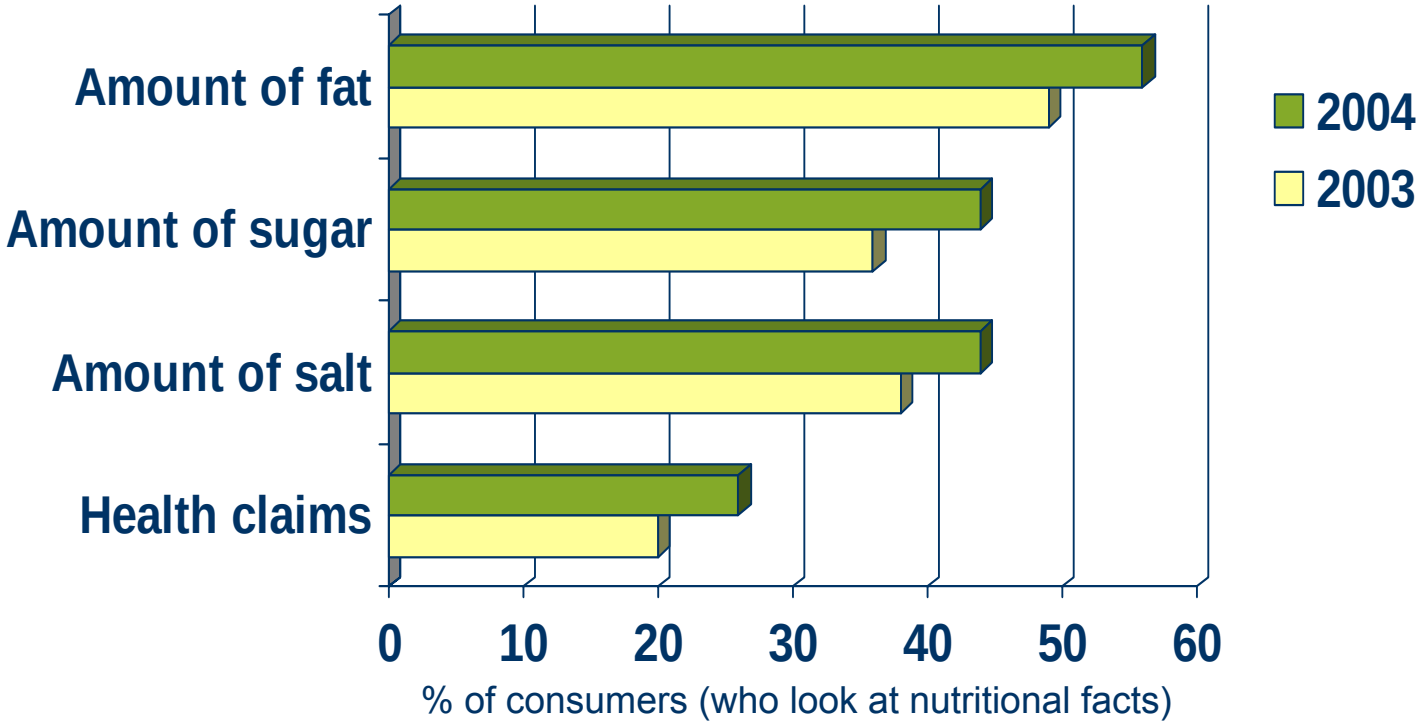
What do consumers look for on a food label?



Sources: MORI, Human Nutrition Research UK

Reduction in trans fat/hydrogenation - market examples

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Unilever, USA

Buttery spread with omega-3 and vitamins B6 and B12 for cardiovascular health, and vitamin E, which helps protect cells and tissues in the heart. Free of trans-fat and cholesterol

Loblaws, Canada

Non-hydrogenated margarine, low in saturated fat

Source: GNPD Mintel. The products shown are not a display of products with Danisco ingredients, but merely examples of common market products.

Omega-3 and 6 oils - market examples

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Unilever, Sweden

Garlic-flavoured butter spread enriched with omega-3 and omega-6 oils

St. Ivel, UK

Margarine spread with omega-3, low in fat and saturated fat, free of hydrogenated oils and rich in vitamins A, D, E, B12

Source: GNPD Mintel. The products shown are not a display of products with Danisco ingredients, but merely examples of common market products.

Very low fat spreads - market examples

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Walter Rau, Germany

Low-fat spread with just 28% fat, cholesterol-free, enriched with vitamins A and D

Unilever, USA

Light vegetable oil spread featuring natural soybean extract. The product is free of trans fat and lowers cholesterol when part of a diet low in saturated fat and cholesterol. Contains 55% less fat and calories than margarine

Source: GNPD Mintel. The products shown are not a display of products with Danisco ingredients but merely examples of common market products.

Salt reduction
- market examples

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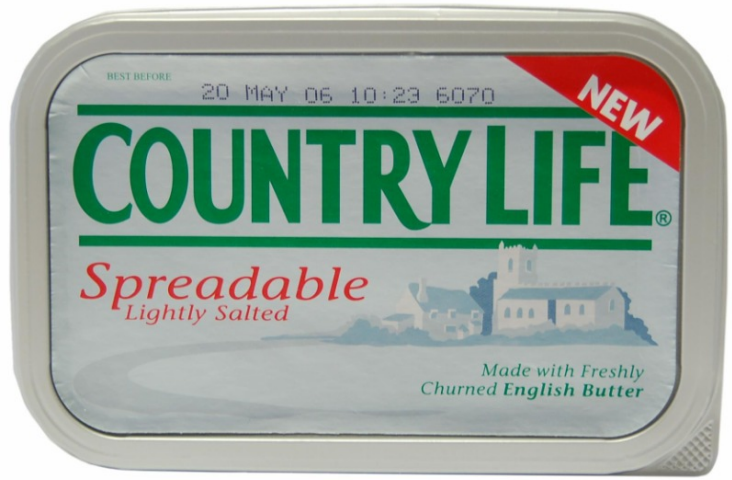

Dairy Crest, Country Life, UK
Spreadable butter with less than 1% salt

Carrefour, Margarina Cremosa, Brazil

Unsalted creamy margarine

Source: GNPD Mintel. The products shown are not a display of products with Danisco ingredients, but merely examples of common market products.

History of margarine

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- Margarine was created by a Frenchman - Mr Hippolyte Mège-Mouriez - from Provence, France, in response to an offer by the Emperor Louis Napoleon III for the production of a satisfactory **substitute for butter**.
- To formulate his entry, Mège-Mouriez used margaric acid, a fatty acid component isolated in 1813 by Michael Chevreul and named because of the lustrous pearly drops that reminded him of the Greek word for pearl - margarites.
- From this word, Mège-Mouriez coined the name margarine for his invention that claimed the Emperor's prize.
- Patented in 1860

Production process - churning

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Recipe of first margarine

- Fractionated beef tallow oleine
- 10% milk
- Water
- 0.4% udder tissue

Churned as butter

Product: 80% fat, hard to spread, wrapped.

Production cycle – 60 hours

Woman churning butter (1808)
Engraver: Pyne, W H (William Henry), 1769-1843
In Collection of Science & Society Picture Library, UK

Votator process

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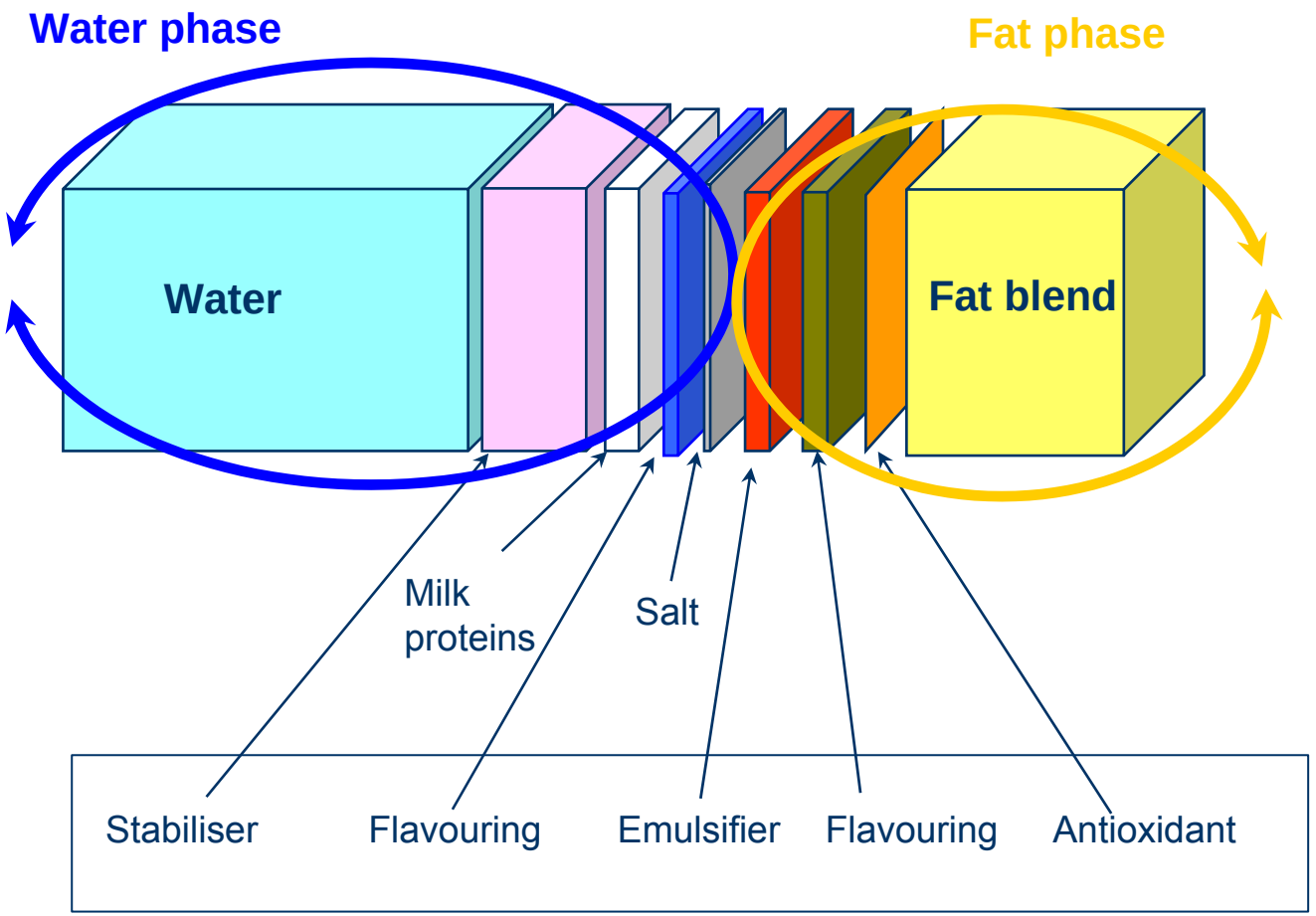
- In the 1940s, the votator, an enclosed dry system, was developed.
- Production cycle of margarine in 2000 was reduced to 10 minutes.

EU REGULATION 2991/94

Shortening	100%
Margarine	80-89%
Reduced-fat spread	60-62%
Low-fat spread	39-41%
Fat spread X%	63-79%
	42-59%
	<39%

Very high requirement to ingredients!

Low-fat spread



Role of emulsifier in emulsion stabilisation

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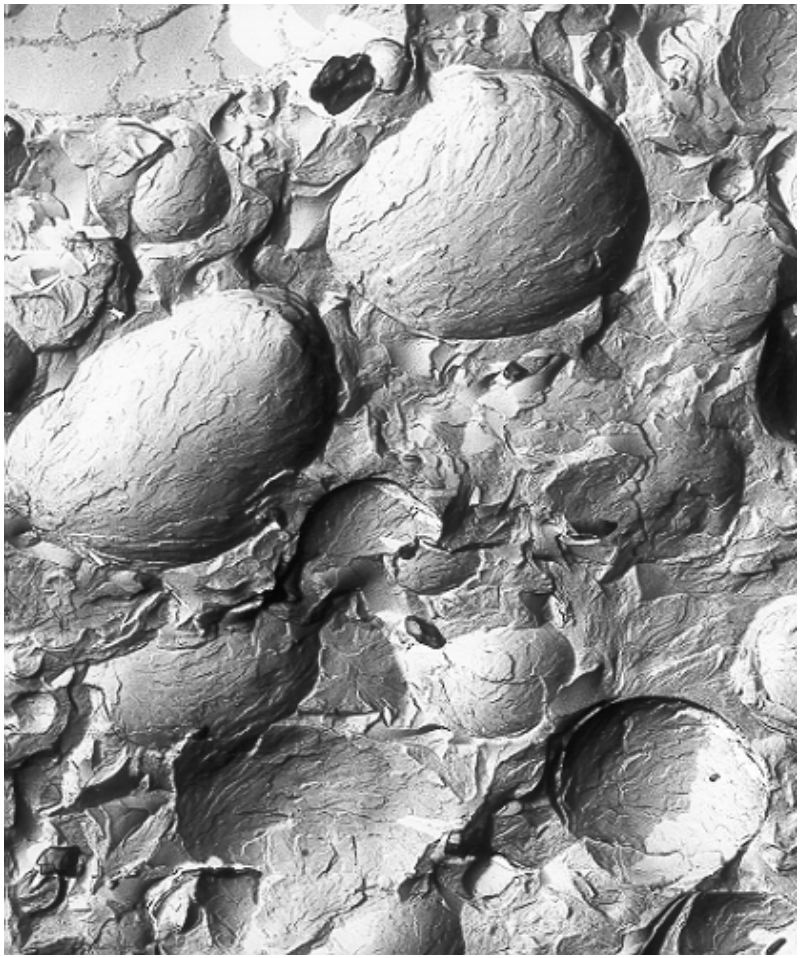
- In emulsion formation, emulsifiers can be involved in mechanisms:
  - Reduction of interfacial tension between oil and water phases
  - Creation of an interfacial film between immiscible phases
  - Charging of droplets of dispersed system

Functions of emulsifier(s)

- Emulsion stabilisation
- Crystal modification
- Aeration and foam stabilisation
- Starch complexing
- Dough strengthening



Magnification x17700

Emulsifiers and their raw materials

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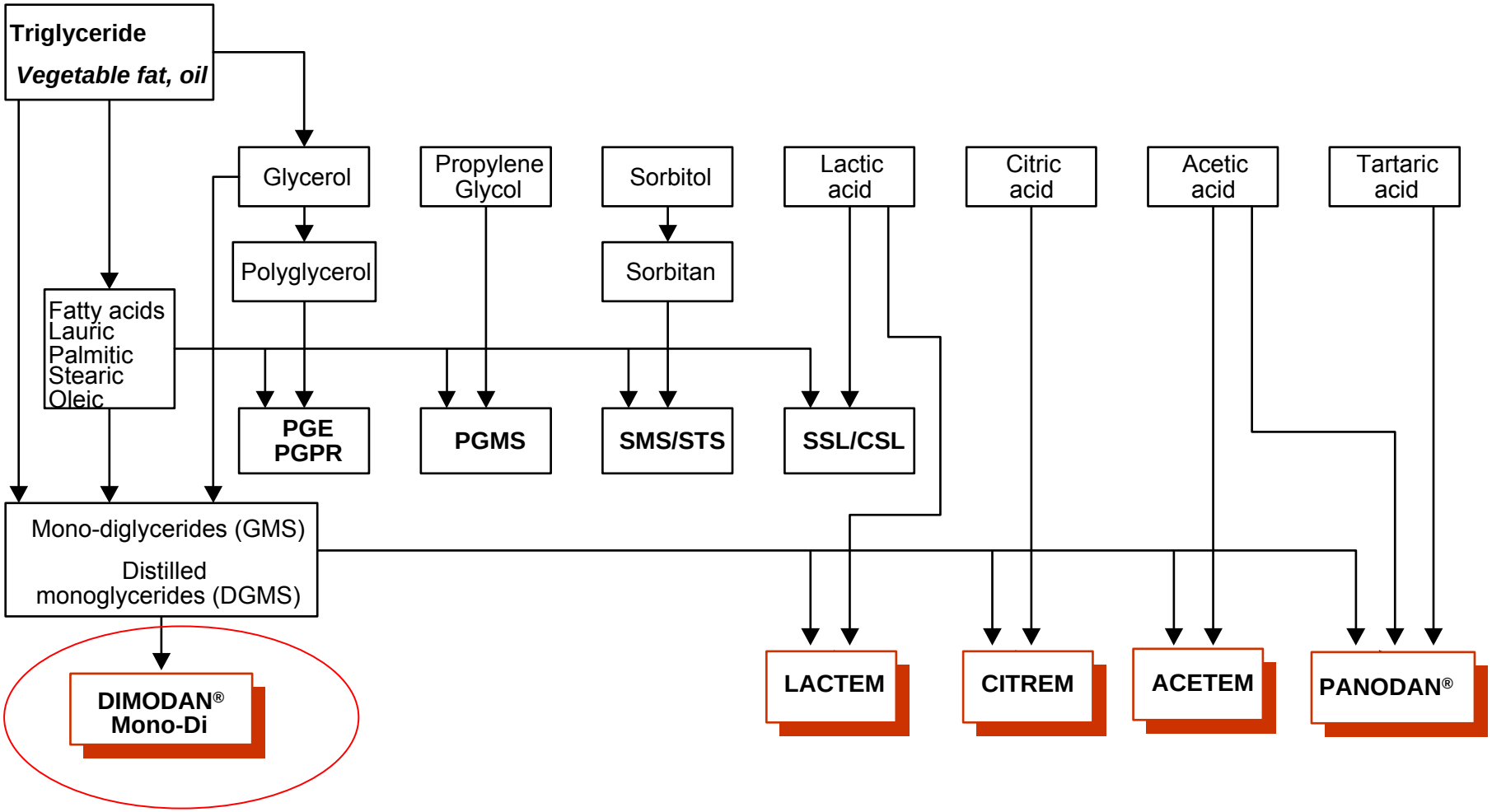

Functional properties and applications of distilled monoglycerides

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DIMODAN® Distilled Monoglycerides

- Stabilise emulsions of margarine and spreads
- Secure even dispersion of the water phase in the fat phase
- Stabilise finished products

DANISCO produces hard and soft distilled monoglycerides with Iodine Value from 2 to 105

Interfacial tension (at 50°C)

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Fat phase	Water phase	I. T. (mN/m)
Soya oil	Water	21.0
0.3% DIMODAN® UP/B Distilled Monoglyceride	Water	16.8

Monoglycerides reduce interfacial tension between oil and water phases.

50% spread

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Trial no.	1	2	3	4	5
WATER PHASE:					
Water	48	48	48	48	48
Salt	0.5	0.5	0.5	0.5	0.5
Skimmed milk powder	1	1	1	1	1
pH	5.5	5.5	5.5	5.5	5.5
FAT PHASE:					
Coconut oil	15	15	15	15	15
Rapeseed oil	15	15	15	15	15
Soya 41°C	50	50	50	50	50
Palm oil	20	20	20	20	20
FAT total	49.8	50	50	50	50
DIMODAN® HP (C16+C18)	**0.4**				***0.2***
DIMODAN® S-T (C18'+C16)		**0.4**			
DIMODAN® UP (C18''+C18'+C16)			**0.4**		
DIMODAN® U/J (C18''+C18')				**0.4**	***0.2***
Lecithin	**0.2**				
ß-carotene (ppm)	6	6	6	6	6
Butter Flavouring T03559 (oil)	0.01	0.01	0.01	0.01	0.01

Evaluation

1. Free water. Discarded.
2. Stable, but free water released when spread.
3. Same as 2.
4. As 1.
5. As 2.

Sample evaluation

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Water droplet dispersion	2.5%	50%	97.5%
2 – (DIMODAN® S-T 0.4%)	<0.62µm	<11.47µm	<225.56µm
3 – (DIMODAN® UP 0.4%)	<0.73µm	<16.14µm	<364.92µm
5 – (DIMODAN® HP 0.2% and DIMODAN® U/J 0.2%)	<0.47µm	<3.95µm	<33.65µm

Water droplet distribution was measured using Bruker NMS 100

25% fat spread

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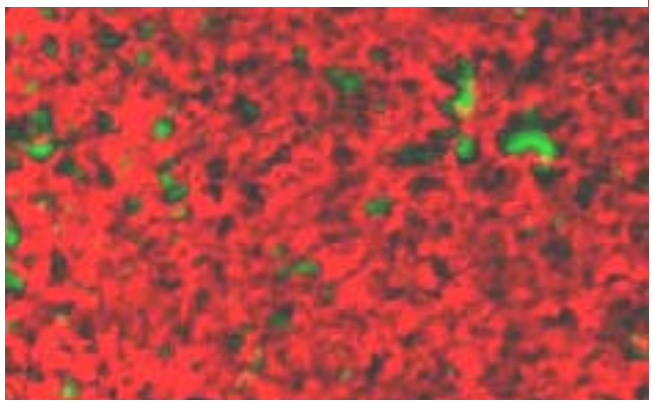
WATER PHASE:	1	2
Water	74.1	74.1
Salt	0.3	0.3
Skimmed milk powder	0.5	0.5
Potassium sorbate	0.1	0.1
EDTA	0.015	0.015
FAT PHASE:		
Liquid oil	30	30
Soya 35	50	50
Soya 41	20	20
DIMODAN® U/J	0.4	0.28
DIMODAN® HR		0.12
GRINDSTED® PGPR 90	0.3	0.3
ß-carotene (ppm)	6	6
Butter flavouring T03559o	0.01	0.01

CLSM:

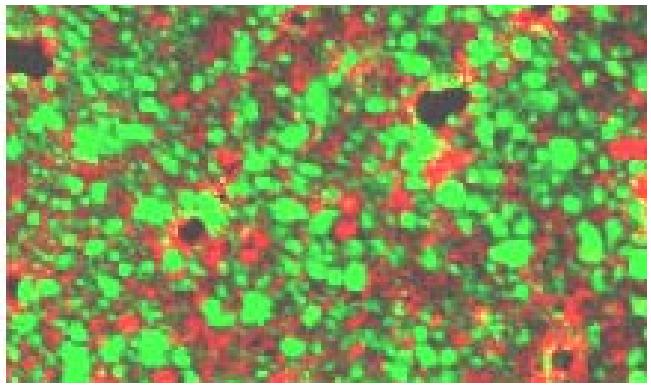
Fat phase: Nile Red

Water phase: FITC



Practically, there is no water phase in the sample 1 (above). Lost during the preparation.

Fine distribution of the water phase in the fat phase (below).



Stabilisation of low fat spread with hydrocolloids

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Objective: to make low-fat spread with good stability and flavour release.

	A	B	C
Water phase	60%		
Water	+	+	+
Milk proteins	-	+	+
Stabiliser system	-	-	+
Fat phase	40%		
Oil/Fat blend	+	+	+
Emulsifier(s)	+	++	+
Flavouring(s)	+	+	+
Stability	Good	Bad	Good
Flavour release	Bad	Good	Good

Low-fat spread - stabilisers

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Composition in %	1	2	3	4
WATER PHASE:				
Water	56	58	57	58
Salt	0.3	0.3	0.3	0.3
Whey powder	1		1	
GRINDSTED® Alginate LFS 200		1	1	
Potassium sorbate	0.1	0.1	0.1	0.1
pH 5.5				
FAT PHASE:				
Fat blend:	39.4	39.4	39.4	39.4
Sunflower oil, parts	75	75	75	75
Soya 41°C, parts	25	25	25	25
DIMODAN® S-T PEL/B	0.5	0.5	0.5	0.5
Beta carotene, ppm	4	4	4	4
FLAVOURINGS:				
Butter Flavouring T04452 F	0.01	0.01	0.01	0.01
Butter Flavouring T02807 W	0.01	0.01	0.01	0.01

Oil phase temp., °C	50
Water phase temp., °C	40
Emulsion temp., °C	40
Capacity, kg / h	40
Cooling both tubes, °C	-10

- No 1 – whey powder in water phase
- No 2 – alginate in water phase
- No 4 – empty water phase
- Nos 2, 3, 4 – combination of protein and stabiliser in water phase

Microscope pictures of samples

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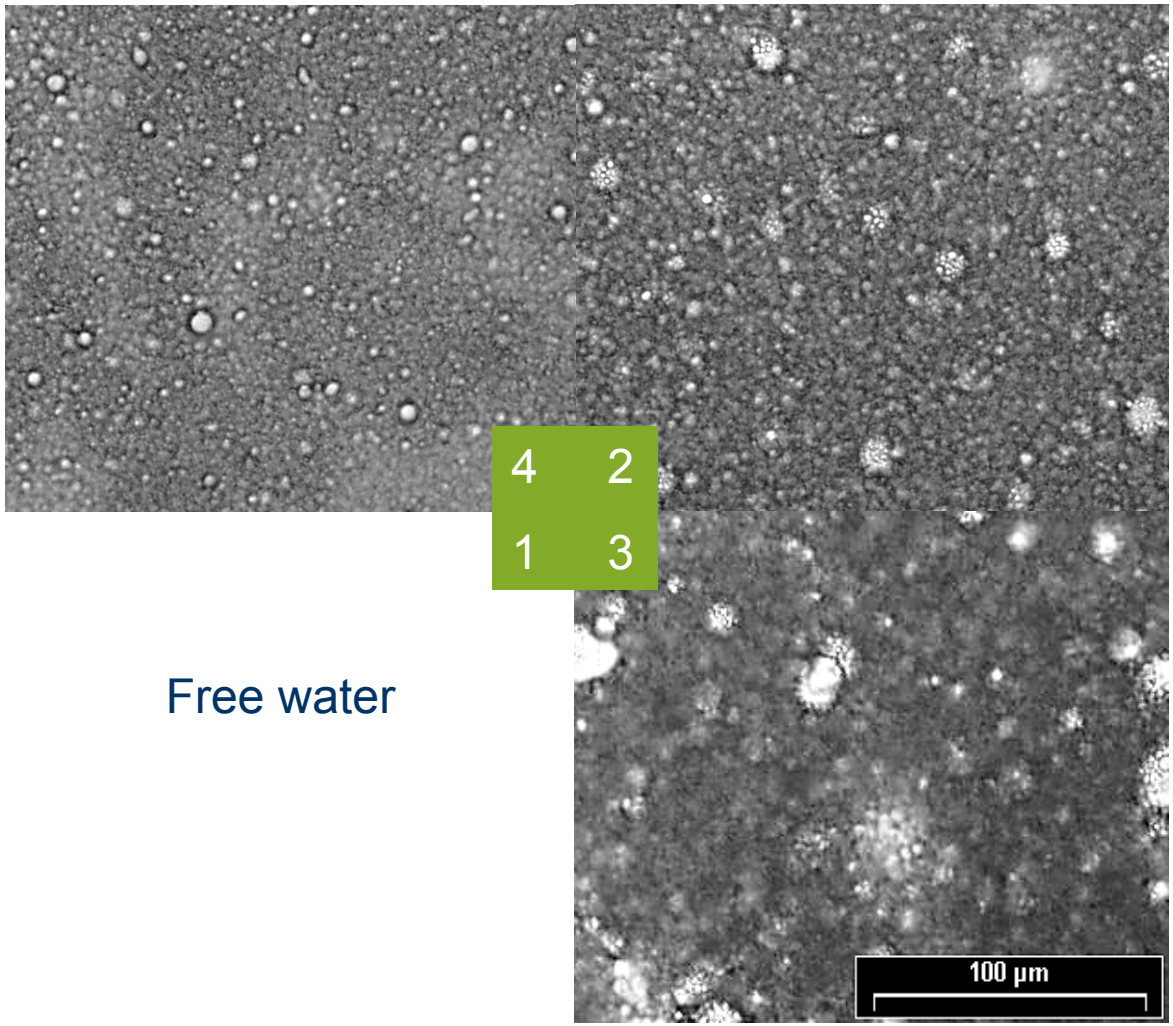

Free water

All samples are 40% fat spread with DIMODAN® S-T.

4 - protein-free and without hydrocolloids

2 – protein-free, with GRINDSTED® Alginate LFS 200

3 - with whey powder, GRINDSTED® Alginate LFS 200

1 - with whey powder and without hydrocolloids

Microscope pictures of samples with different monoglycerides

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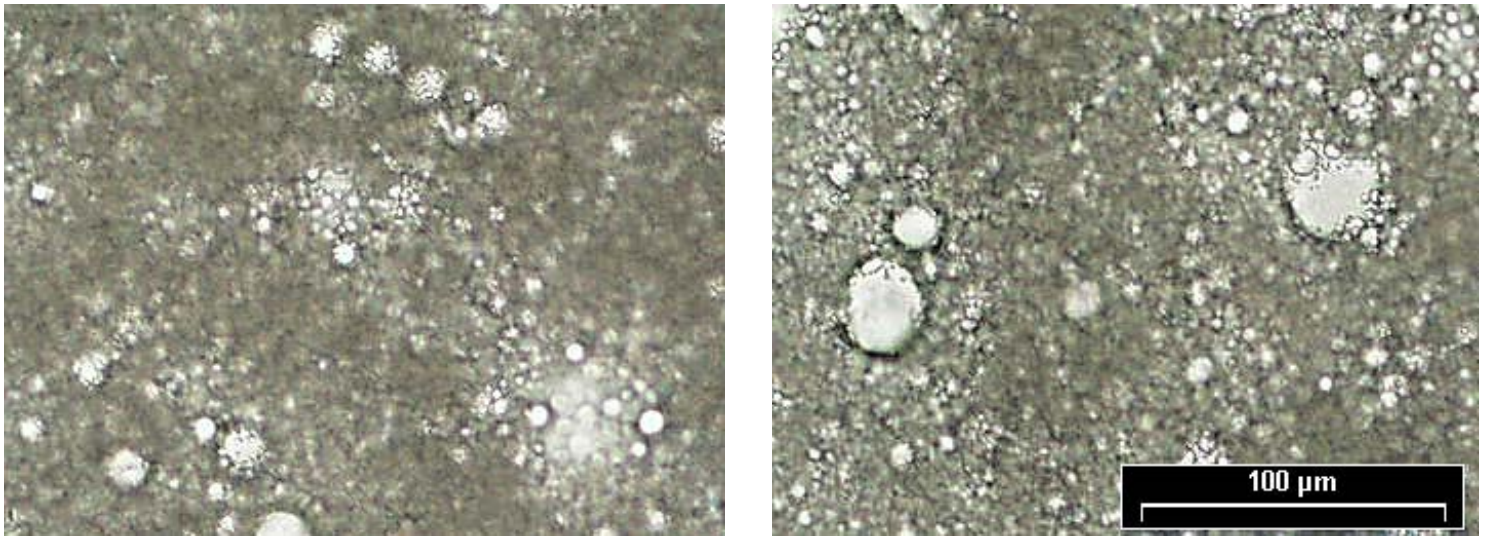
Comparison between samples with different monoglycerides. Both are with whey powder and GRINDSTED® Alginate LFS 200



DIMODAN® S-T(left) lends better stability to spreads containing protein than does DIMODAN® UP/B (right)

Iodine values: 60 and 80 accordingly.

Distribution of water droplets

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Water droplet distribution in samples 3 and 4 measured using Bruker NMS 100

Water droplets distribution	2.5%	50%	97.5%
DIMODAN® S-T 0.4%	<1.9µm	<5.00µm	<13.7µm
DIMODAN® UP/B 0.4%	<2.1µm	<6.8µm	<22.1µm

Sample with DIMODAN® S-T have smaller water droplets than sample with DIMODAN® UP/B

Some conclusions

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- Distilled monoglycerides have to be adjusted to the rest of the composition of low-fat spread.
- In some cases it is beneficial to combine monoglycerides to diversify fatty acid composition, and thus enhance stability of low fat spread.
- Stabiliser systems based on hydrocolloids improve performance of the low-fat spread, enhancing stability and flavour release.

Taste & texture
Range of solutions

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Application / Consumer benefits	Retail margarine	Low fat spreads	Butter spreads
Improved taste	Butter flavourings CREMAROME Flavourings	Butter flavourings CREMAROME Flavourings	Butter flavourings CREMAROME Flavourings
Improved texture & mouthfeel	DIMODAN®	GRINDSTED® LFS DIMODAN® GRINDSTED® PGPR	DIMODAN®
Anti-spattering	GRINDSTED® CITREM GRINDSTED® PS	GRINDSTED® CITREM GRINDSTED® PS	GRINDSTED® CITREM GRINDSTED® PS

Shelf life
Range of solutions

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Application / Consumer benefits	Retail margarine	Low fat spreads	Butter spreads
Delayed oxidative rancidity	GRINDOX™ Antioxidants GUARDIAN™ Rosemary Extract	GRINDOX™ Antioxidants GUARDIAN™ Rosemary Extract	GRINDOX™ Antioxidants GUARDIAN™ Rosemary Extract
Prevention of sandiness	GRINDSTED® STS	GRINDSTED® STS	
Reduced oil separation	GRINDSTED® PS Emulsifier Blends	GRINDSTED® PS Emulsifier Blends	GRINDSTED® PS Emulsifier Blends
Reduced water droplets for improved microbiological shelf life	DIMODAN®	DIMODAN® GRINDSTED® PGPR	DIMODAN®

Health
Range of solutions

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Application / Consumer benefits	Retail margarine	Low fat spreads	Butter spreads
Fat reduction	DIMODAN®, GRINDSTED® PS Emulsifier Blends	GRINDSTED® LFS Stabiliser System Butter flavourings DIMODAN® GRINDSTED® PGPR	DIMODAN®, GRINDSTED® PGPR Butter flavourings
Trans fat reduction	GRINDSTED® CRYSTALLIZER Emulsifier Blends		
Probiotics		HOWARU™ Exclusive Probiotics	

Optimised and efficient production
Range of solutions

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Application / Consumer benefits	Industrial margarine/ shortening	Retail margarine	Low-fat spreads
Faster crystallisation of low-trans margarine/ shortening	GRINDSTED® CRYSTALLIZER Emulsifier Blends	GRINDSTED® CRYSTALLIZER Emulsifier Blends	
Emulsification	DIMODAN®	DIMODAN®	GRINDSTED® LFS GRINDSTED® PGPR DIMODAN®