oleon
a natural chemistry
NUTRITION

# Emulsifier functionality in tortillas

TIA Valencia 22th October 2024

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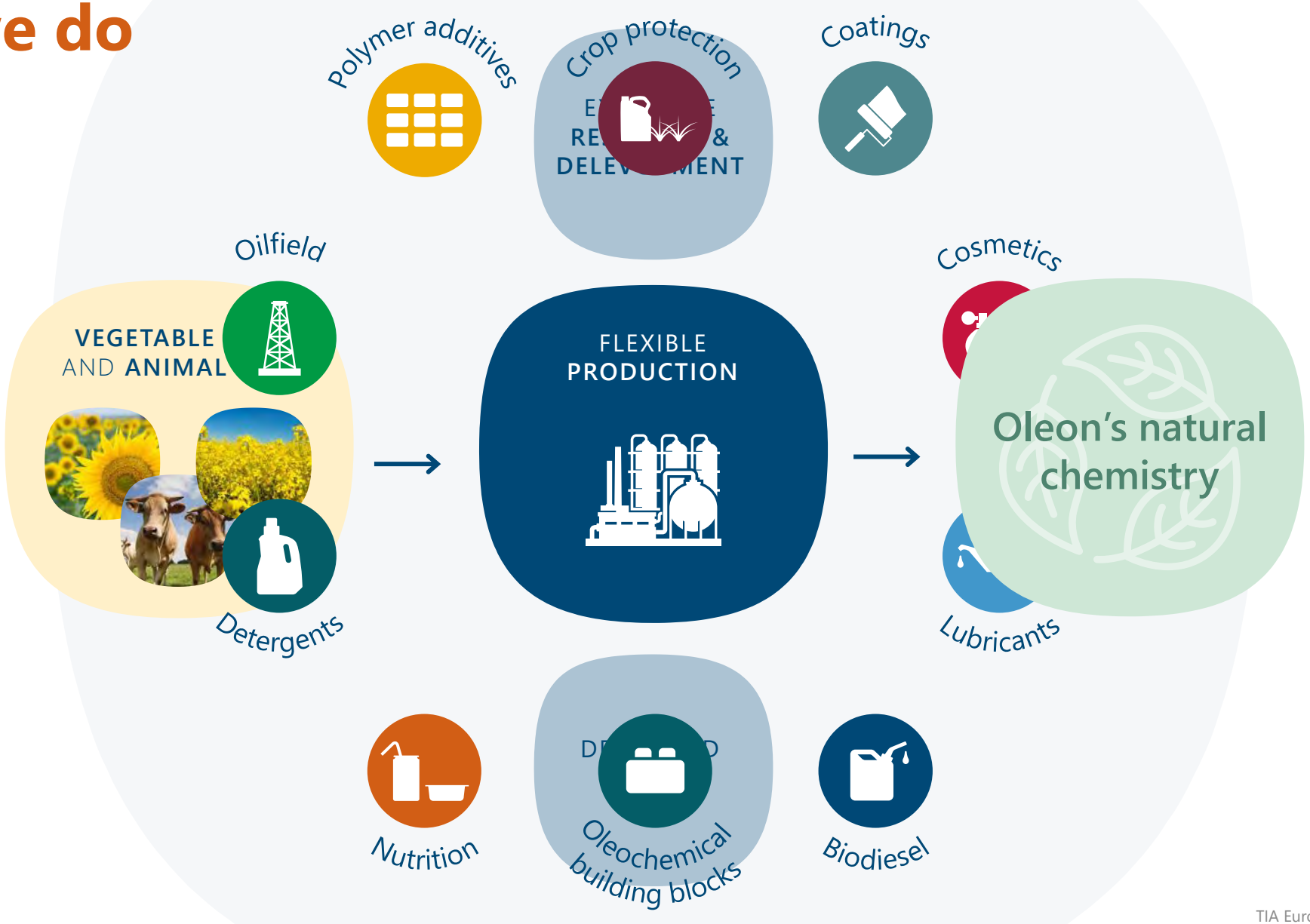
# Outline of presentation

1. Oleon
2. Challenges & Emulsifier functionality
3. Trials & results
4. Conclusion

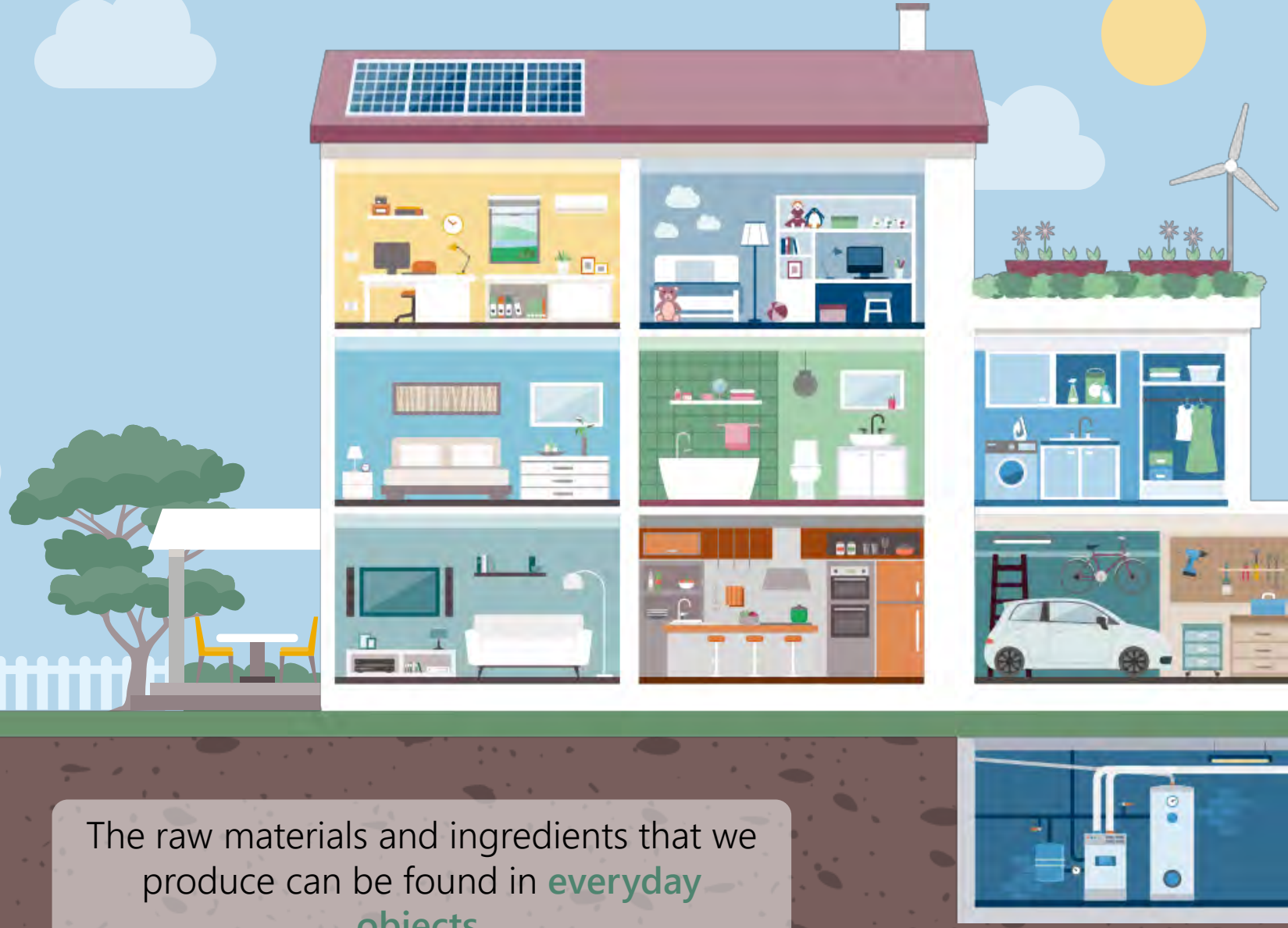
# 01 Oleon

# What we do


Polymer additives
Crop protection
Coatings
Oilfield
VEGETABLE
AND ANIMAL
FLEXIBLE
PRODUCTION
Cosmetics
Oleon's natural
chemistry
Detergents
Lubricants
Nutrition
Oleochemical
building blocks
Biodiesel

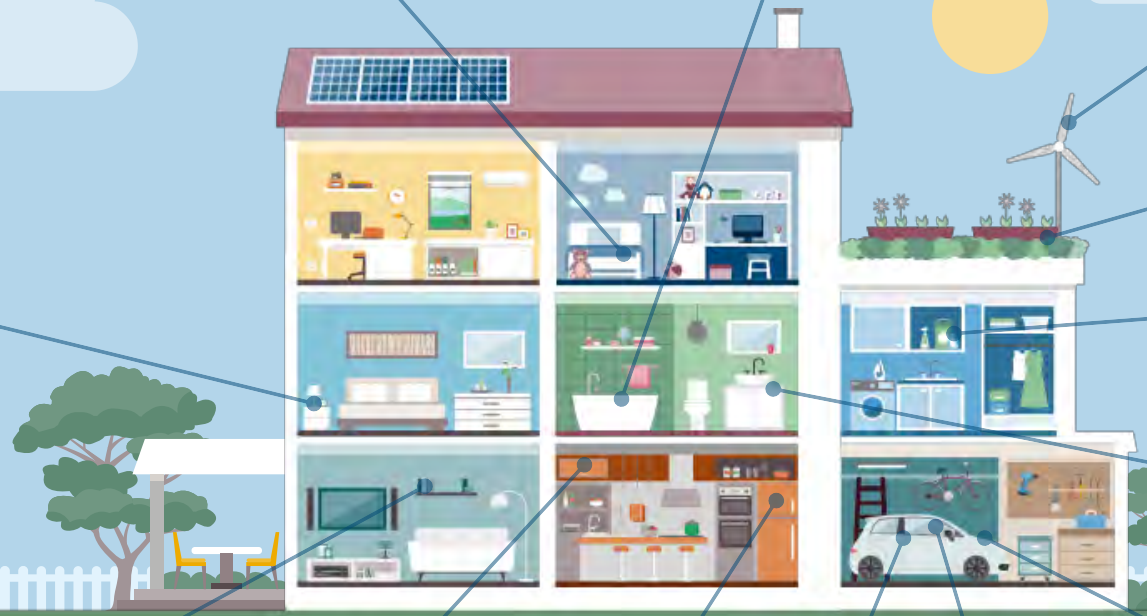
# What we do

**Oleon's natural chemistry** is everywhere



The raw materials and ingredients that we produce can be found in **everyday objects.**

# What we do



INFANT NUTRITION

SHAMPOO SHOWER GEL

LUBRICANTS FOR WINDMILLS

HERBICIDES

LAUNDRY SOFTENER

TOOTHPASTE DAY CREAM

LUBRICANTS FOR CARS

LUBRICANTS FOR OIL AND GAS EXTRACTION

CAR SEAT FOAMS

CAR COATINGS

ICE CREAM

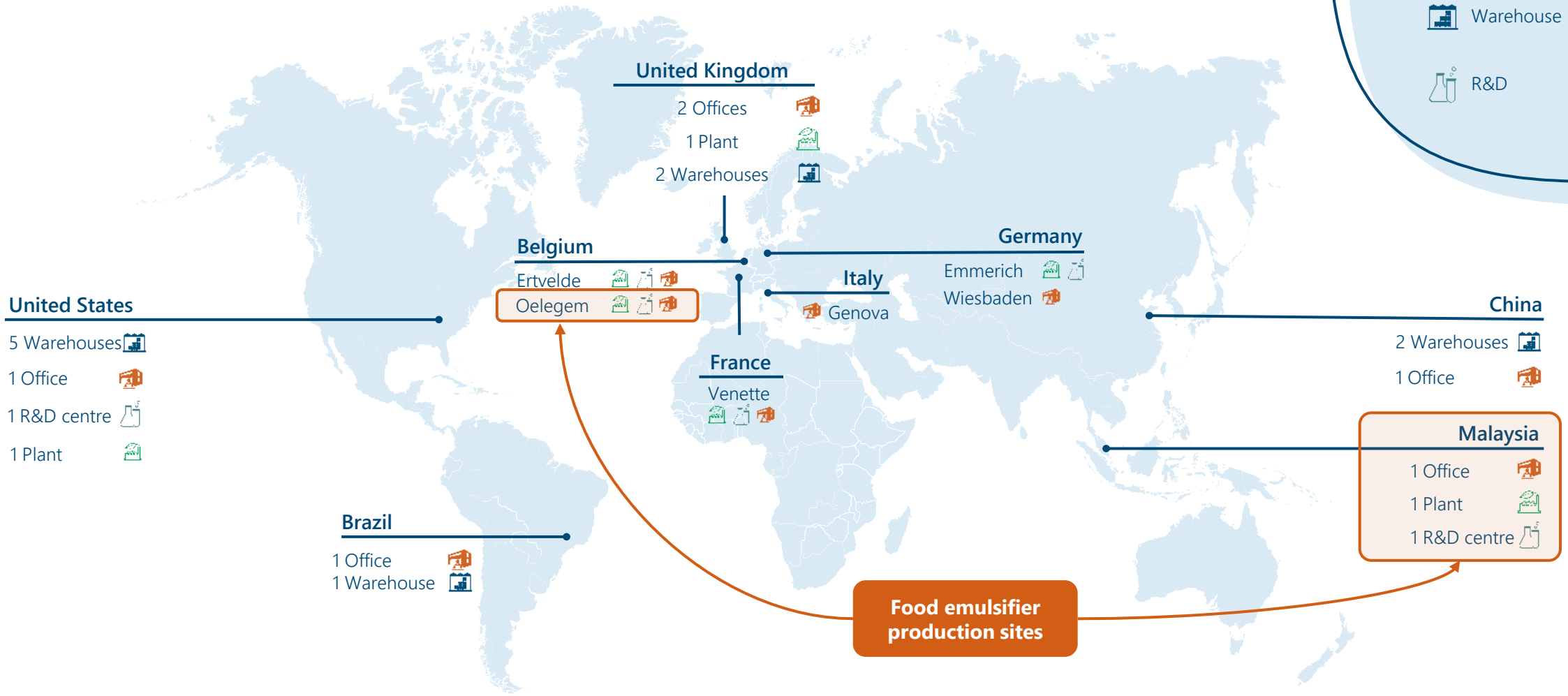
BREAD PASTRY

INK

WOOD COATINGS

CANDLES

# Worldwide presence



# WE KNOW IT'S **MORE THAN** Mono & diglycerides

- Reduced product **stickiness**
- Enhanced **rollability & flexibility**
- Improved **softness & texture**

radiamuls

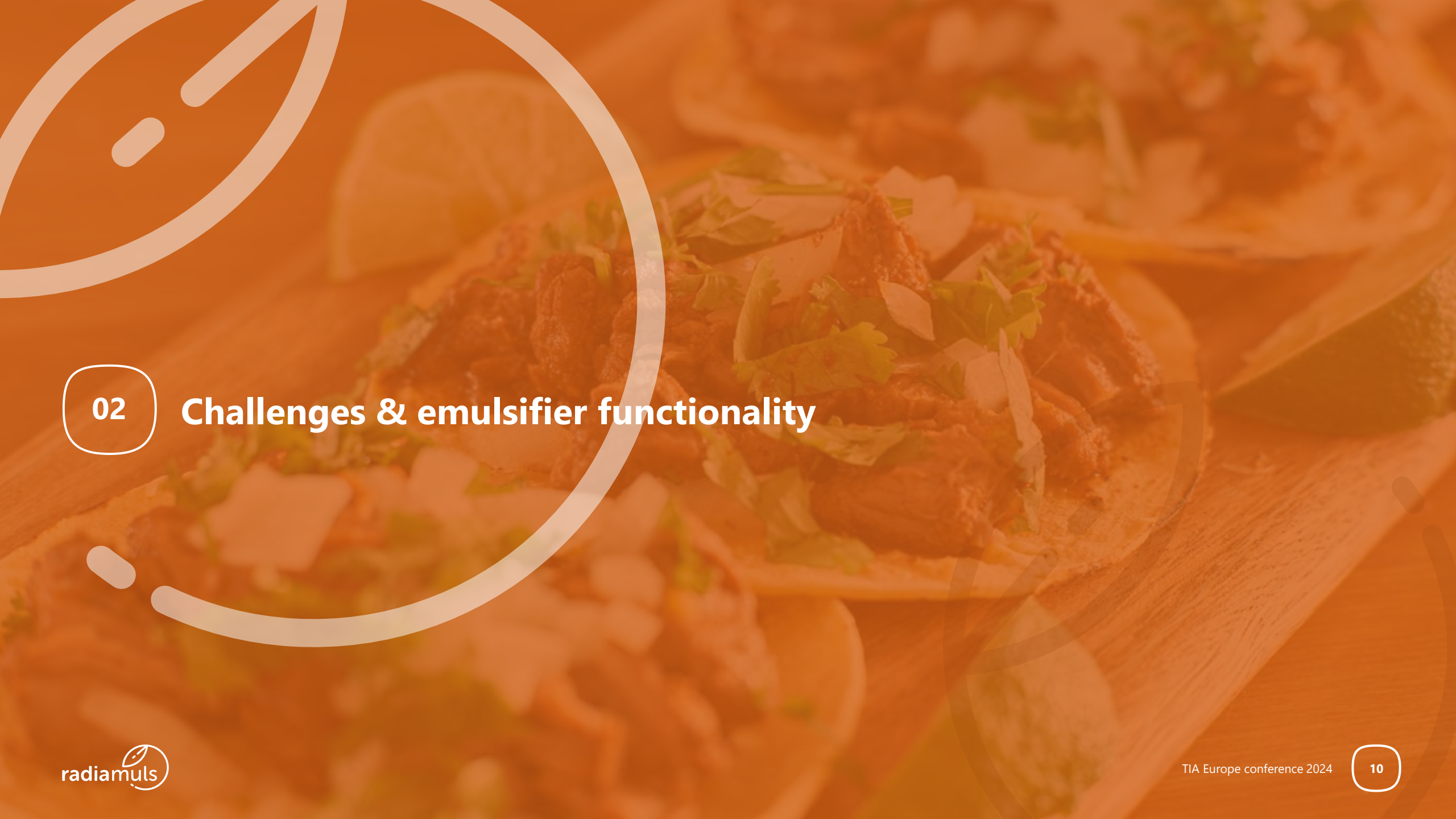
# PRODUCT RANGE
# HUMAN NUTRITION

| Radiamuls portfolio | | |
|---|---|---|
| | EU | US |
| **Mono- and diglycerides** | Food additive **E471** | CFR 184.1505 = affirmed GRAS |
| Acetic acid esters | Food additive **E472a** | CFR 172.828 |
| Lactic acid esters | Food additive **E472b** | CFR 172.852 |
| Citric acid esters | Food additive **E472c** | GRAS (899, 511, 222) |
| Diacetyl tartaric acid esters | Food additive **E472e** | CFR 184.1101 |
| Polyglycerol esters | Food additive **E475** | CFR 172.854 |
| Polyglycerol polyricinoleate | Food additive **E476** | GRAS (266) |
| Sodium stearoyl lactylate | Food additive **E481** | CFR 172.846 |
| Sorbitan esters | Food additives **E491** (SMS)-**E492** (STS)-**E493** (SML)-**E494** (SMO) | 172.842 (SMS) – 173.75 (SMO)<br>GRAS needed for STS & SML |
| Polysorbates | Food additives **E432** (PS20)-**E433** (PS80)-**E435** (PS60) | CFR 172.515 (PS20) – CFR 172.836 (PS60) – CFR 172.840 (PS80) |
| Lecithin (std, deoiled, hydrolyzed) (rapeseed, sunflower and soy) | Food additives **E322**, **E322i** | 21 CFR 184.1400 = affirmed GRAS |

radiamuls
Beyond ingredients

**EU food**: Regulation (EU) No 231/2012 laid down specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008

**US food**: 21 CFR parts 170-190 lay down provision for use of food additives in foodstuffs. In the absence of a specific regulatory reference, a substance may only be used on foods if its use is generally recognised as safe (GRAS). A manufacturer may independently determine that the use of a substance is GRAS.

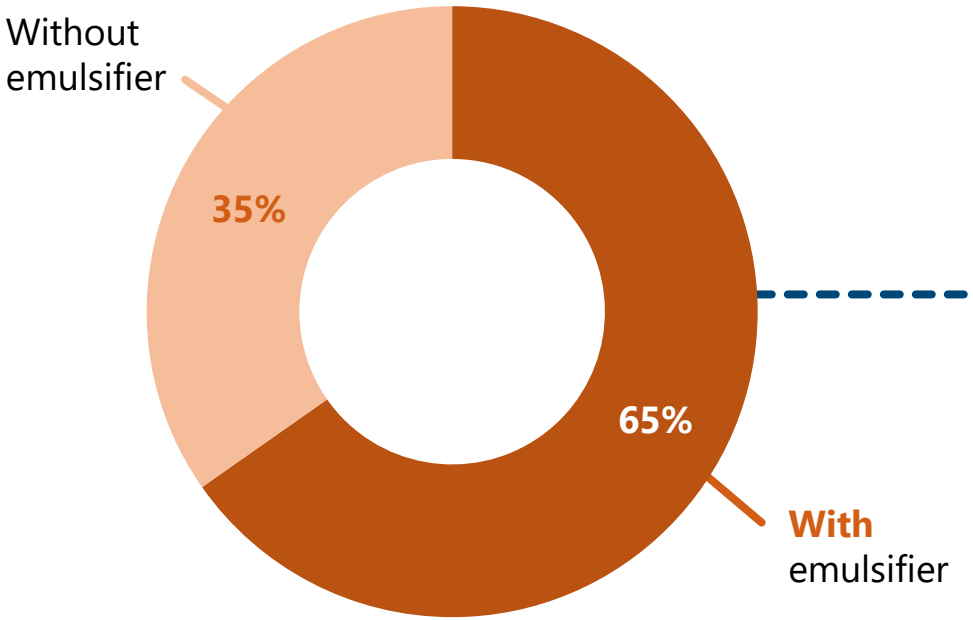


02

# Challenges & emulsifier functionality

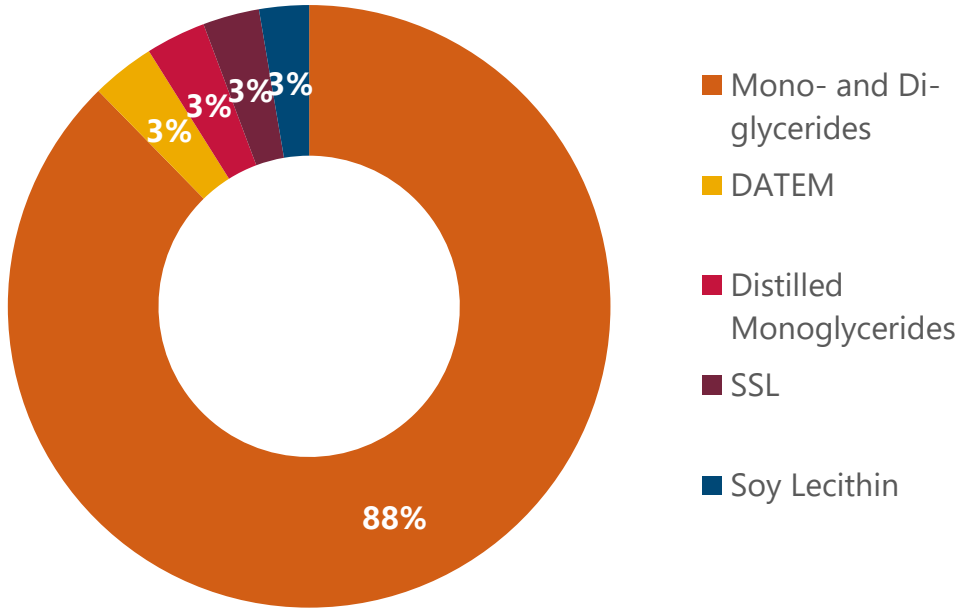
# Emulsifier Usage in New Tortilla Products (2019-2024)

## PERCENTAGE OF NEW TORTILLA PRODUCTS WITH EMULSIFIERS *(2019-2024)*




Whereof

## DISTRIBUTION OF EMULSIFIER TYPES IN NEW TORTILLA PRODUCTS *(2019-2024)*




Source: Mintel (2024) – results last 5 years

# Desired Qualities of **Tortilla**

**Folding**
low tendency to break upon folding

**Breaking**
good resistance against tearing

**Rolling**
without showing cracking and/or breaking.

**Springiness**
when crumpling it, it springs back freely and unfolds completely

**Colour**
uniform, small & evenly distributed blisters

**Layering/ lamination**
a layered structure is desired.

**Dryness**
not too dry mouthfeel

**Uniformity size/shape**
uniform in shape and size.

**Stacking Stickiness**
no or a low tendency to stick to one another.

**Opacity**
opacity is a desired quality attribute.

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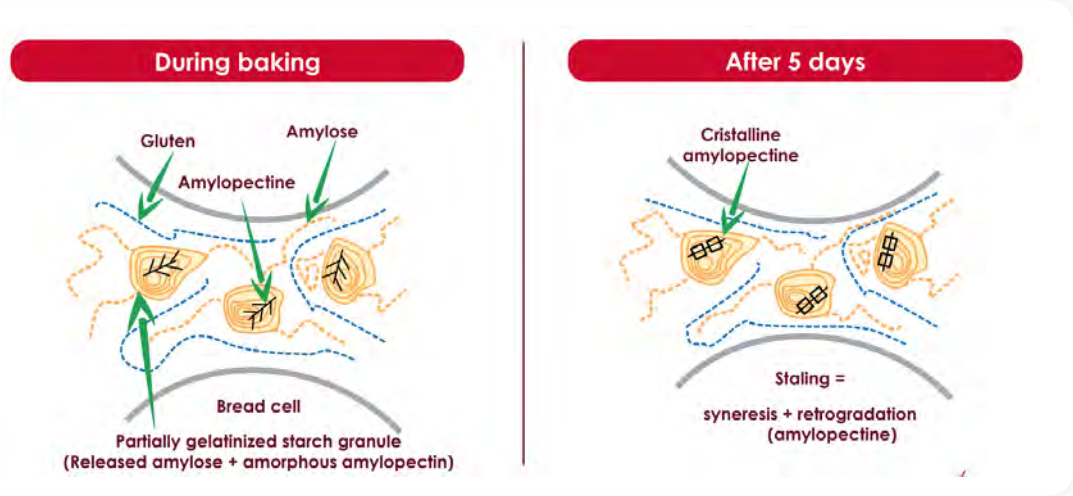
# Major Challenges in Tortilla Manufacturing

## **DETERIORATION OF TEXTURE** WITH TIME DUE TO STALING




Consequences of starch retrogradation:

- Increased hardness
- Increased dryness
- Decreased rollability

## **STICKINESS** OF TORTILLAS

- Lower consumer acceptance
- Damage caused by attempting to peel tortillas from a stack

# Ingredients & functionalities

### Corn or wheat flour + water

- As base ingredients

### Fats (vegetable oils or shortening)

- Softness
- Flavor
- Flexibility

### Preservatives / Salt

- Shelf-life extension by preventing mold growth and spoilage
- Taste and control fermentation

### Leavening agents

- Dough rise
- Fluffiness
- Chewiness

### Emulsifiers

- Dough consistency
- Smoother texture
- Prevent from drying and staling

### Acidulants

- As pH regulator for preservation freshness

### Gums & stabilizers

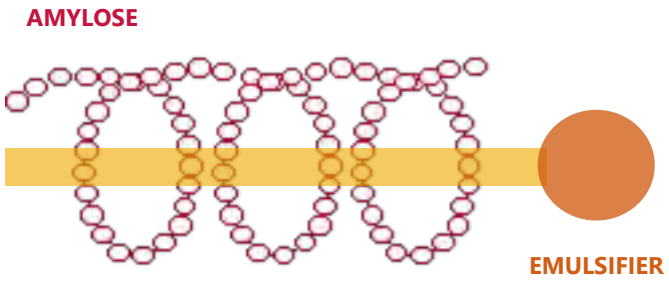
- Dough elasticity
- Water retention
- Soft texture remains over time

### Enzymes

- Dough handling properties
- Shelf-life improvement (staling prevention)

# Emulsifier functionality (mono-diglycerides)

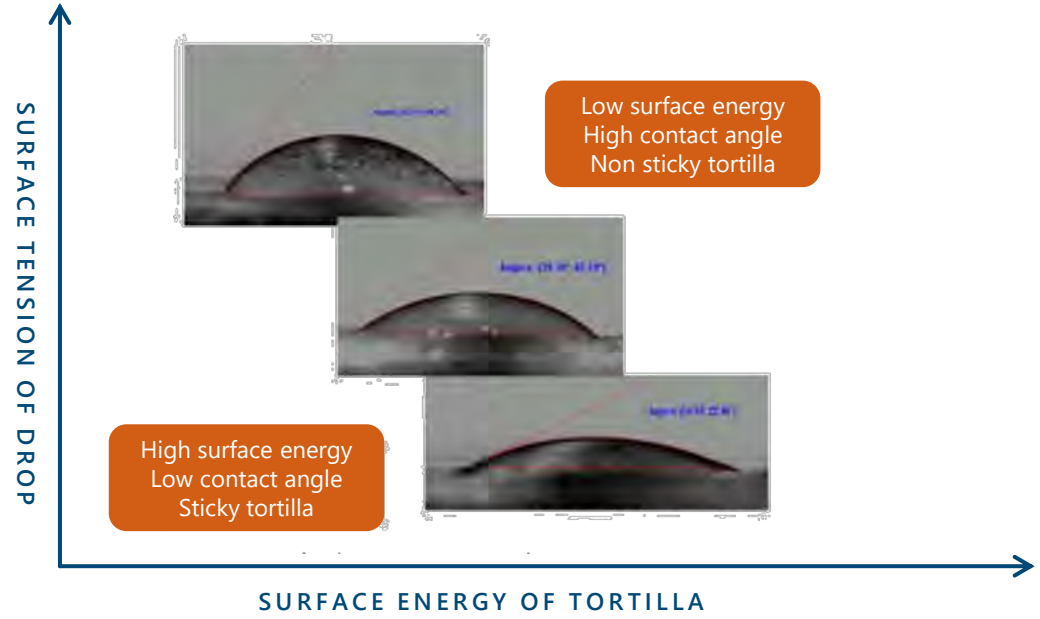
- Interact with **gluten** during mixing to improve dough machinability
- Interact with **starch** to reduce retrogradation
  - Extend shelf life (anti-staling)
  - Improve softness
  - Improve rollability




**LIPOPHILIC PART** OF EMULSIFIER PENETRATES INTO **LIPOPHILIC HELIX** OF THE AMYLOSE

Starch-lipid complex formation: retarding starch crystallization and slowing the staling process

- Improve **moisture retention**
- Reducing the **surface energy** of tortilla to **reduce stickiness**




*Rathod, J. H. (2008). Understanding the origins of stickiness in wheat flour tortillas and devising strategies to reduce It (Doctoral dissertation, Rutgers University-Graduate School-New Brunswick).*

# Differentiating factors

## Total monoglycerides

- Reaction stops at total monoglycerides ca. 45%
- Further increase by distillation until:
  - Total monoglycerides ca. 60%
  - Total monoglycerides ca. 90%
  - Total monoglycerides ca. 95%

## Raw materials

- Fatty acid profile may influence functionality
- Most used raw materials:
  - Triglycerides
    - Hydrogenated palm stearin
    - Hydrogenated palm oil
    - Palm oil
  - Fatty acids
    - Oleic acid
    - Stearic acid

## Particle size

- May influence functionality in certain bakery applications
- Typical ranges:
  - Very fine powder ca. 60 µm
  - Fine powder ca. 105 µm
  - Powder ca. 180 µm
  - Coarse powder ca. 400 µm

## Iodine value

- Linked to the raw material used
- Influences the melting point

# Mono- and diglycerides

# 03 Trials & results

# Emulsifiers tested

| | | Total monoglycerides (%) | Iodine value ($gI_2$/100g) | Particle size (µm) |
|---|---|---|---|---|
| Mono- and diglycerides of fatty acids - Tested at 1% | Radiamuls MG 2120K | 15-25 | ≤4 | 350 |
| | Radiamuls MG 2644K | 56-60 | ≤2 | 350 |
| | Radiamuls MG 2918K | ≥90 | ≤2 | 350 |
| | Radiamuls MG 2903K | ≥93 | 18-26 | 150 |
| | Radiamuls MG 2908K | ≥90 | 35-45 | paste |

*Each batch produces 15 tortillas*
*3 batches are repeated for each emulsifier which results in 45 tortillas*

# Recipe - Application test

| Ingredient | Control % | With emulsifier % |
|---|---|---|
| All-purpose flour | 100 | 100 |
| Water | 49 | 49 |
| Glycerin | 4 | 4 |
| Sunflower oil | 10 | 10 |
| Salt | 1.25 | 1.25 |
| Sugar | 3 | 3 |
| Sodium bicarbonate | 0.9 | 0.9 |
| Sodium Acid Pyrophosphate (SAPP) | 1.3 | 1.3 |
| Preservative (calcium propionate) | 0.38 | 0.38 |
| Preservative (potassium sorbate) | 0.3 | 0.3 |
| Emulsifier | - | 1 |
| TOTAL | 170.1 | 171.1 |

# Protocol - Application test

PRODUCTION PROCESS

| | | |
|---|---|---|
| 1 | Dry mixing | *30 sec at speed 1* |
| 2 | Add water at 35°C | *during 2 min at speed 1* |
| 3 | Add oil | |
| 4 | Mix dough | *4 min at speed 2* |
| 5 | Rest dough | *10 min at room temperature* |
| 6 | Divide dough into 40g balls & let it rest | *10 min* |
| 8 | Pressing | *5 sec at 80°C* |
| 9 | Bake in pan | *surface A 20 sec → surface B 30 sec →*<br>*surface A 10 sec → surface B 10 sec* |
| 10 | Cool before packing in plastic bags | *5 min* |

# Application Testing

## Physical properties

- Weight
- Thickness
- Diameter

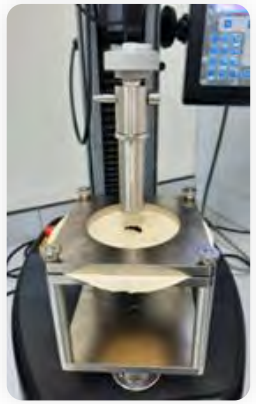
## Stacking stickiness (vacuum packaging)

**Rate the stickiness when separate the tortillas from each other**

- 1 = stick together cause tearing
- 5 = can be separated easily

## Rupture strength & extensibility

- **Rupture strength (N):** maximum force (peak) needed to break the sample
- **Extensibility (mm):** displacement reached at peak force (distance until rupture)



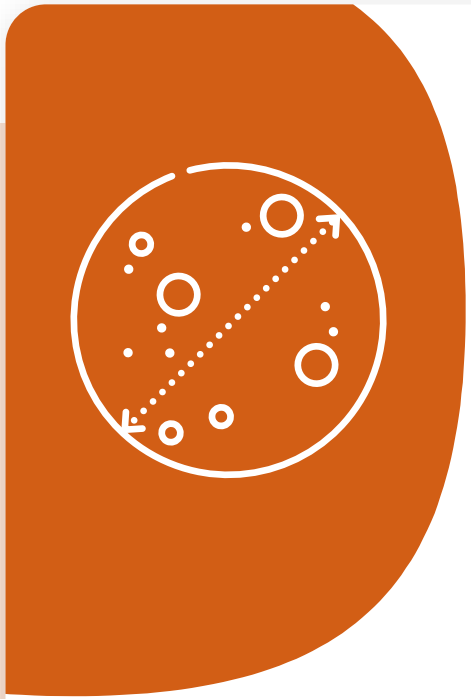
## Rollability

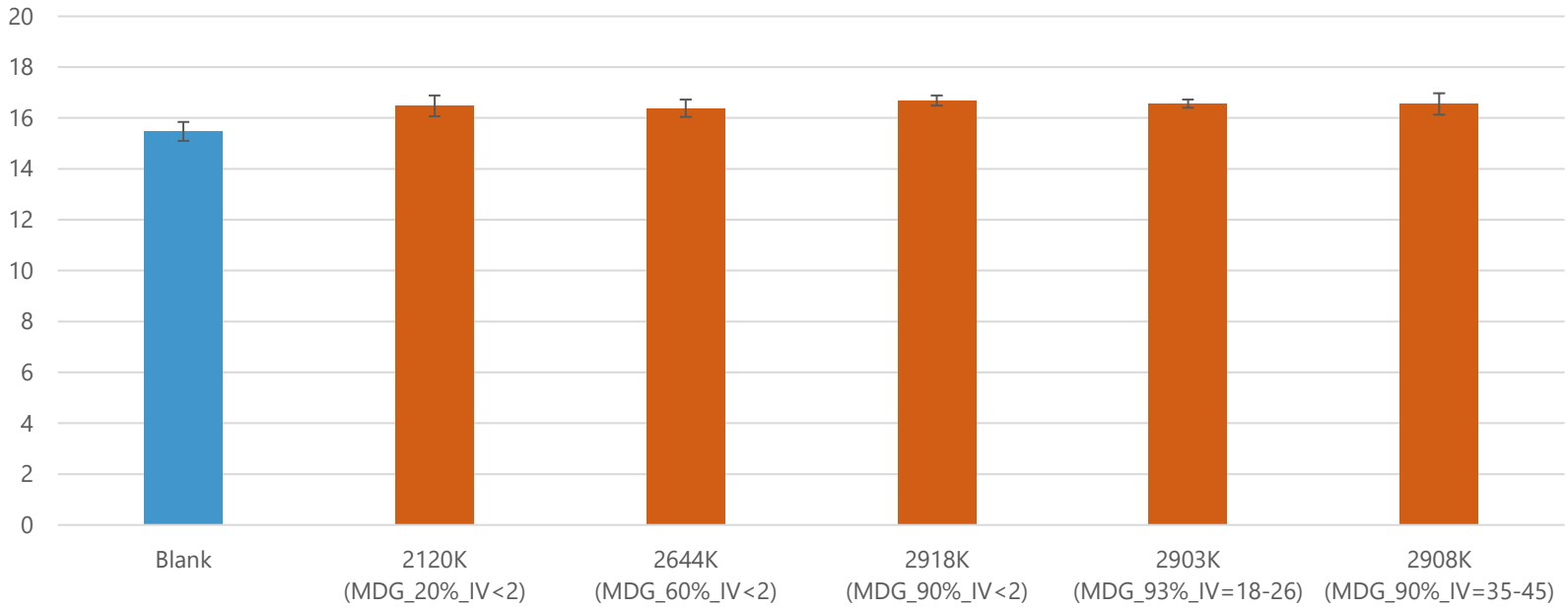
**Evaluate the cracking and breaking of both sides of the tortillas on a scale of 1 to 5**

- 1 = unrollable, breaks easily.
- 5 = no cracking, very flexible

score 3 | score 2 | score 1

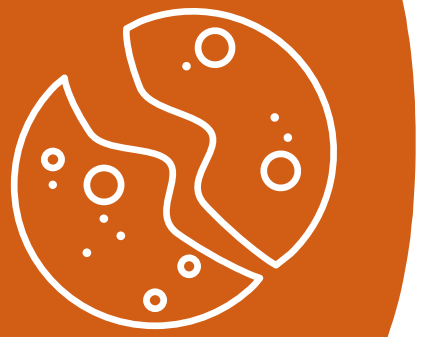
# Diameter

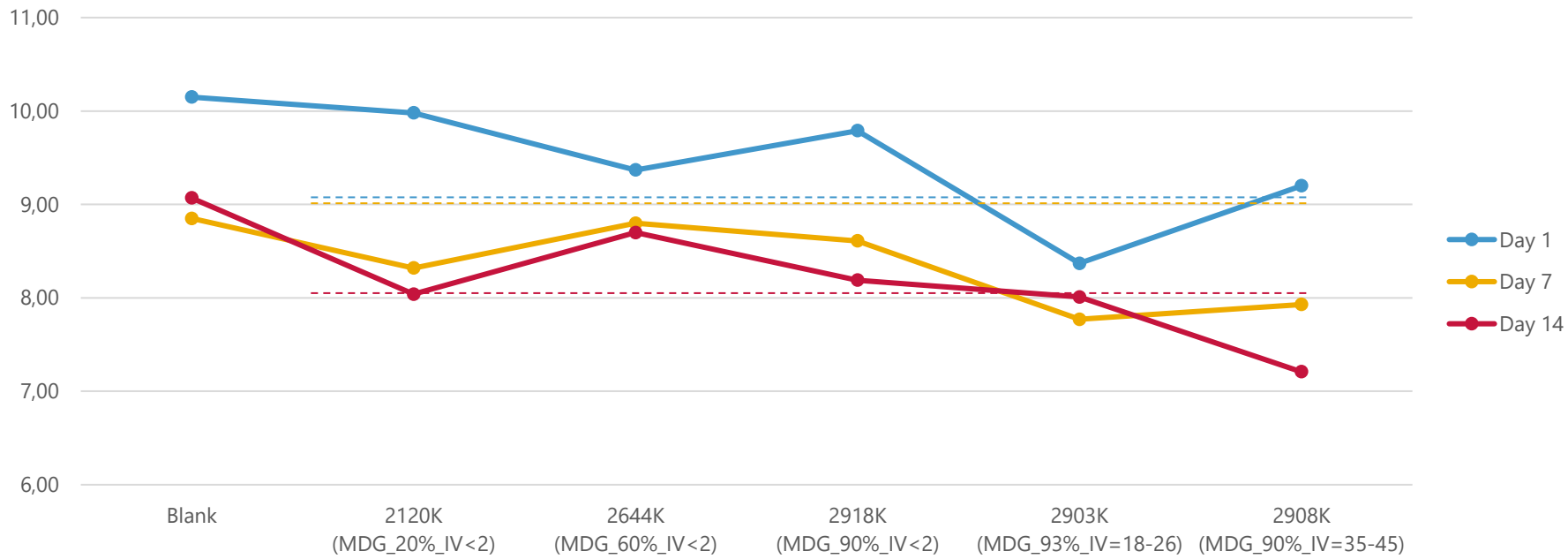





- All emulsifiers tested show significant increase of diameter with circa 1 cm
- No significative difference between all references regarding mono-content or saturation

# Rupture strength



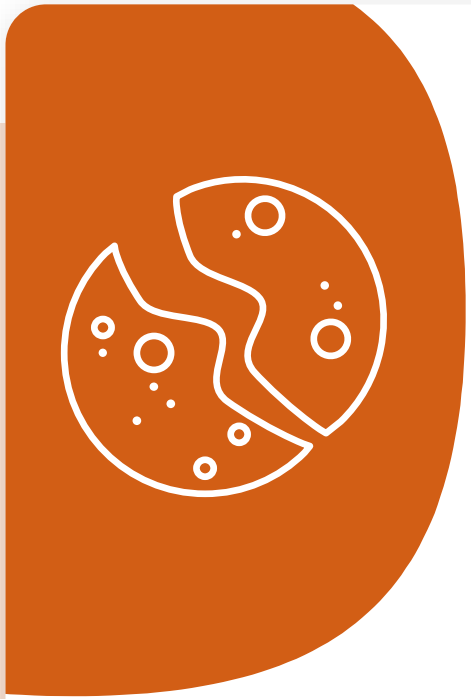


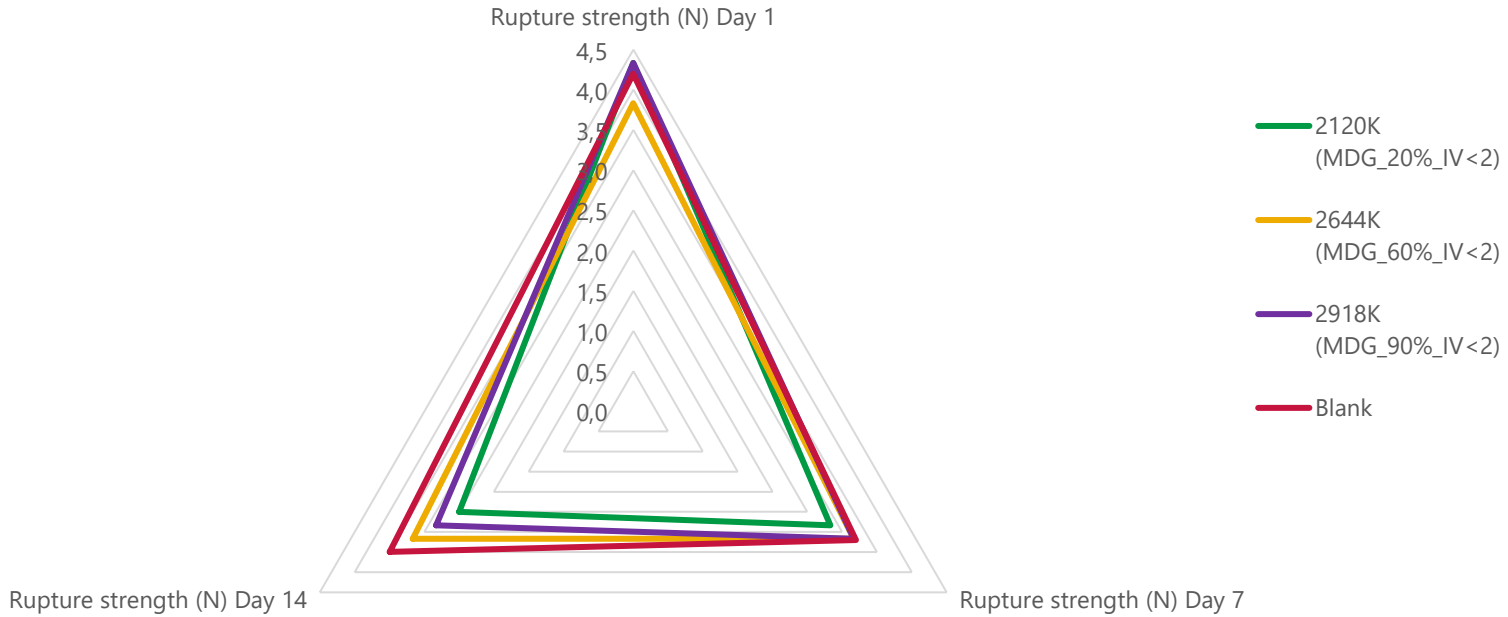

| | Blank | 2120K (MDG_20%_IV<2) | 2644K (MDG_60%_IV<2) | 2918K (MDG_90%_IV<2) | 2903K (MDG_93%_IV=18-26) | 2908K (MDG_90%_IV=35-45) |
|---|---|---|---|---|---|---|
| *Average 3 timings* | 9.36 | 8.86 | 8.78 | 8.05 | 8.96 | 8.11 |

- Dotted lines indicate the market reference
- Unsaturated monoglycerides (2903K and 2908K) resulted in overall lower rupture strength

# Rupture strength

IMPACT OF MONOGLYCERIDES CONTENT

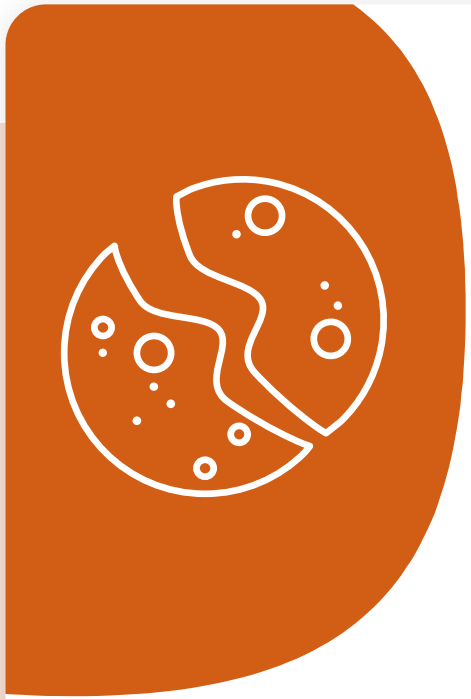


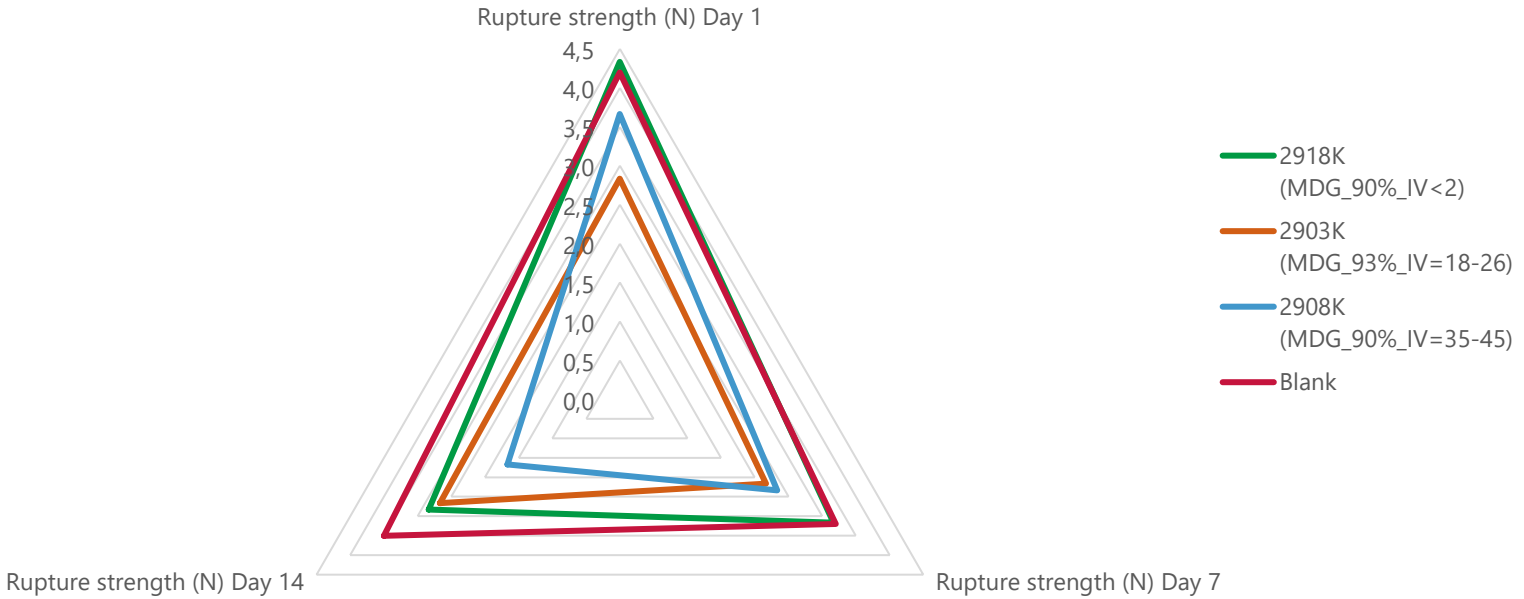



- Low rupture strength = softer texture
- Low monoglycerides content resulted in lower rupture strength on day 1 (2644K) and on days 7 & 14 (2120K)

# Rupture strength

IMPACT OF UNSATURATION






- Low rupture strength = softer texture
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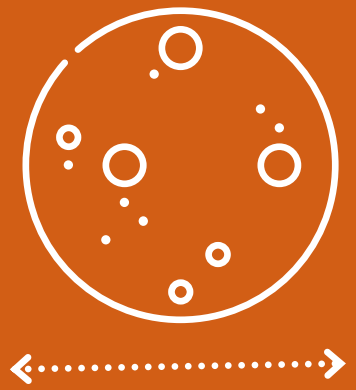
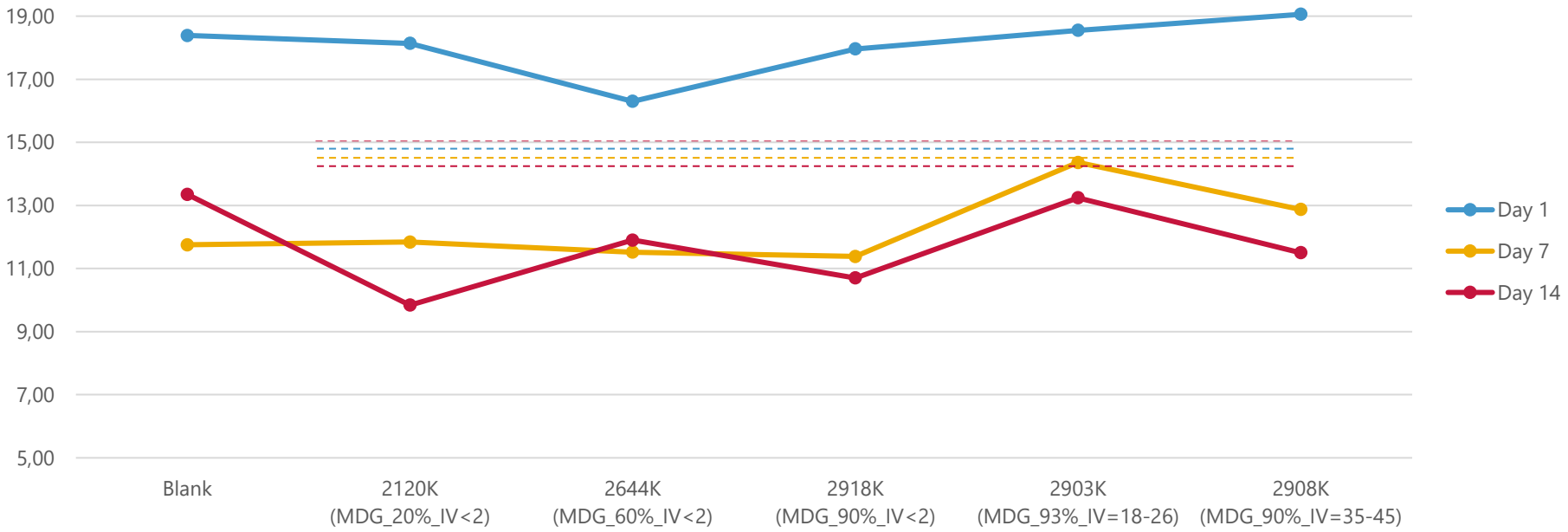
# Extensibility



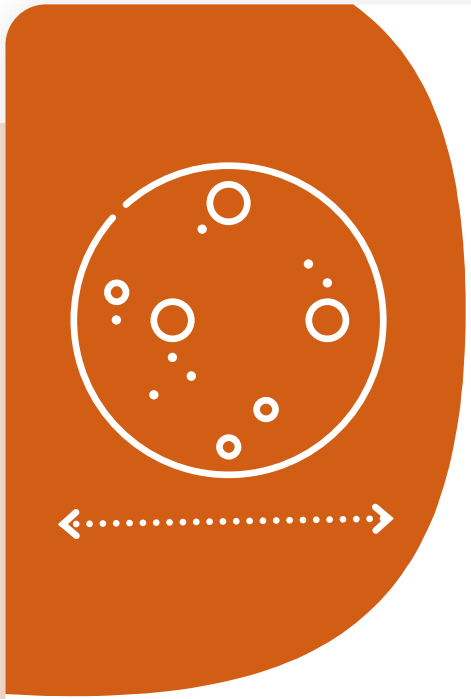


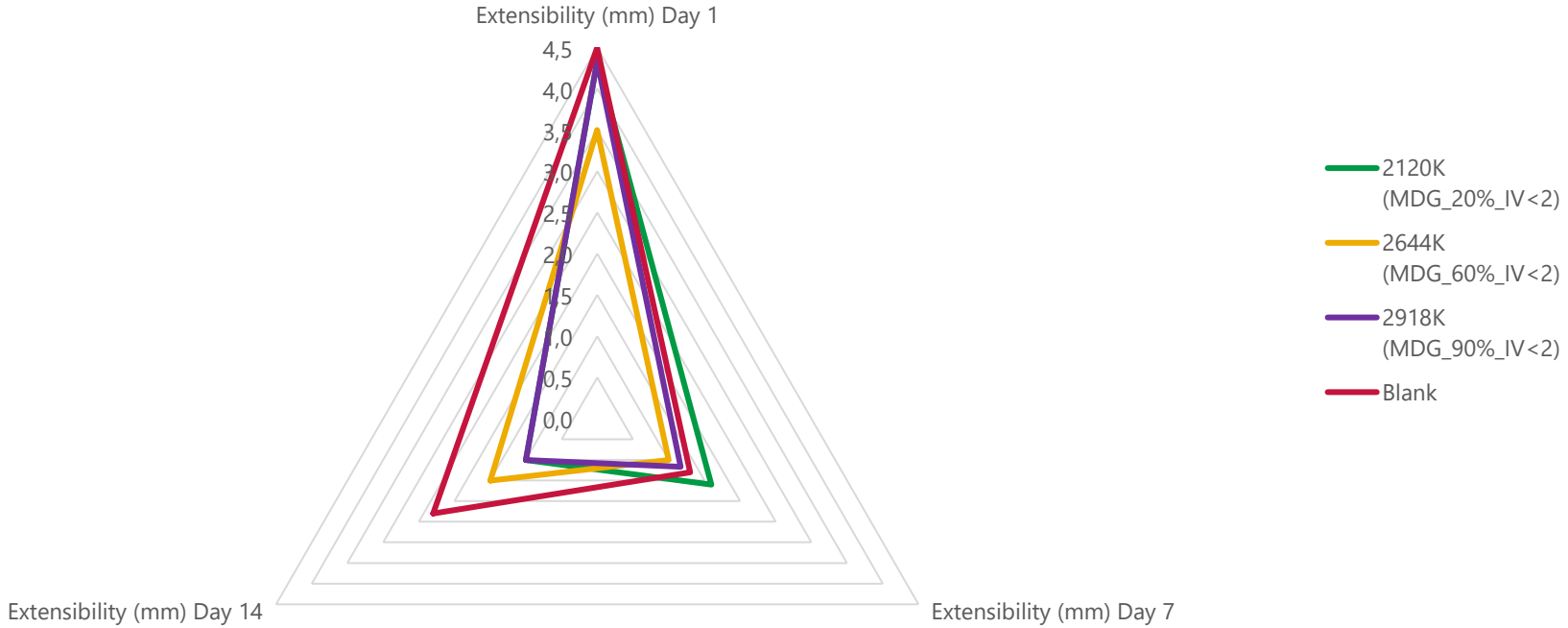

| *Average 3 timings* | 14.50 | 13.35 | 13.27 | 15.38 | 13.24 | 14.48 |
|---|---|---|---|---|---|---|

- Main decrease during day 1 to day 7. Stable during day 7 to day 14.
- Unsaturated monoglycerides (2903K and 2908K) resulted overall in higher extensibility, with 2903K performing the best.

# Extensibility

IMPACT OF MONOGLYCERIDES CONTENT

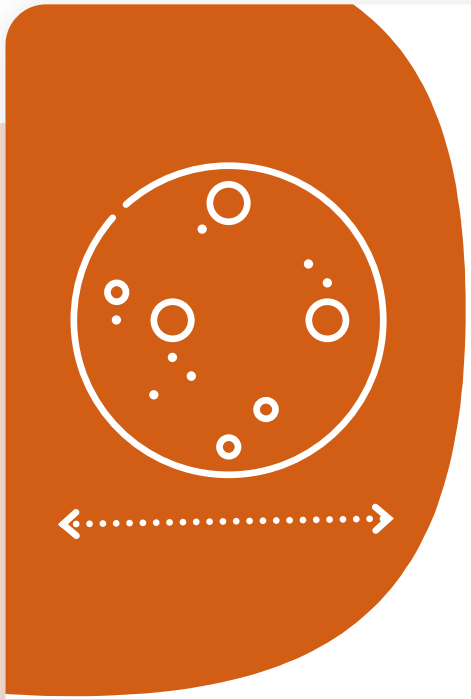


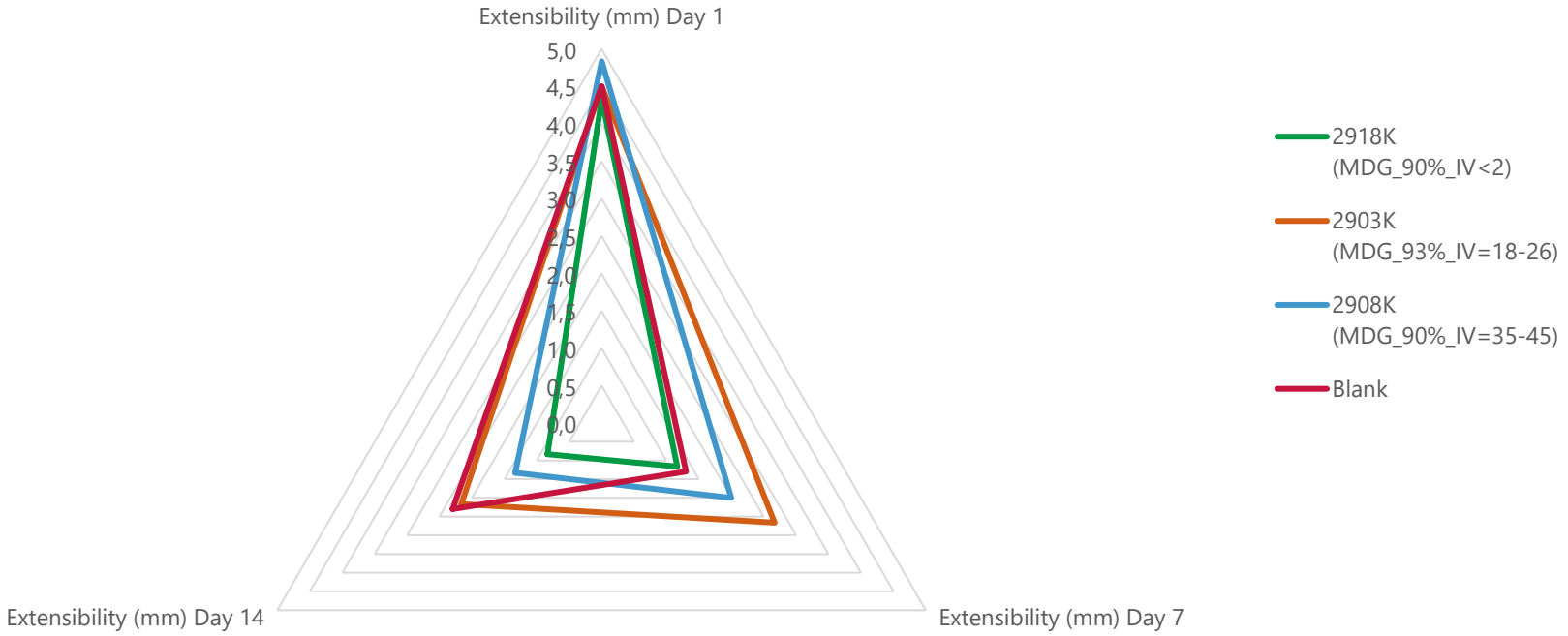



- Higher extensibility = more stretchable
- 2644K resulted in lower extensibility on days 1 and 7 ; 2120K results in larger extensibility at day 7
- variations in monoglyceride-content do not significantly impact average extensibility

# Extensibility

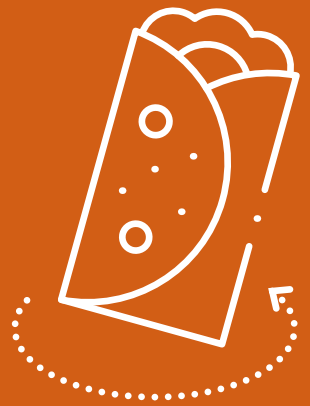
IMPACT OF UNSATURATION

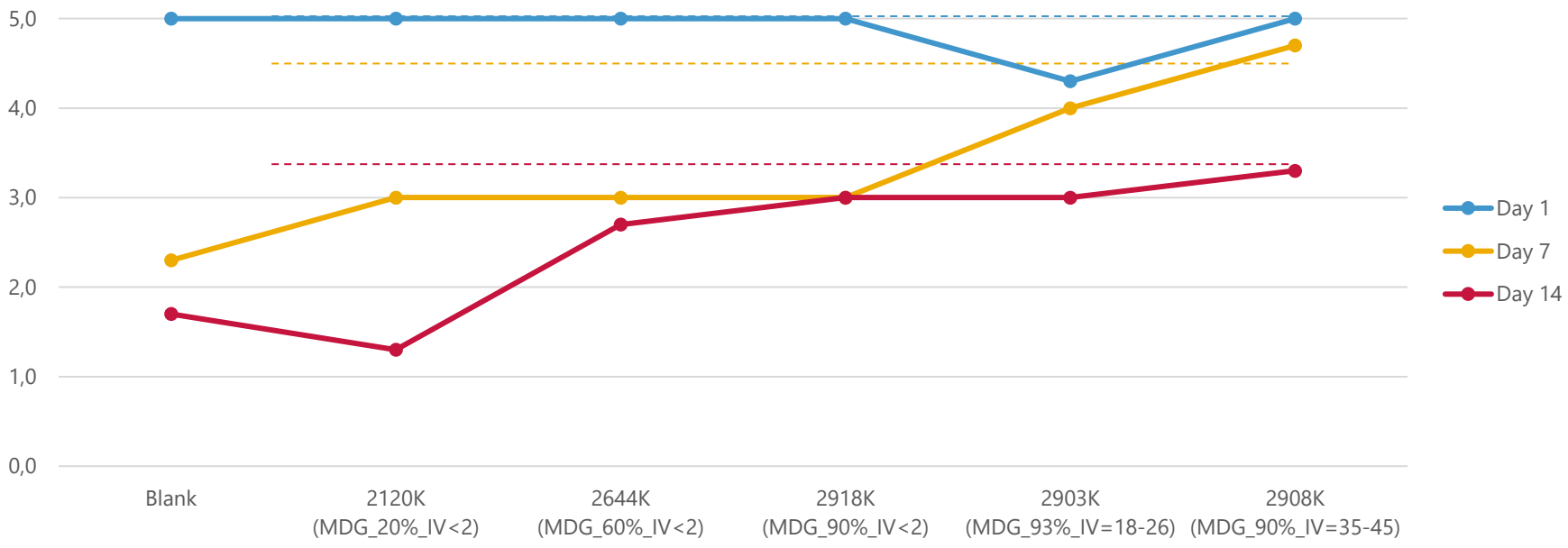





- Higher extensibility = more stretchable
- Unsaturated monoglycerides (2903K and 2908K) led to greater extensibility, with 2903K having the highest

# Rollability



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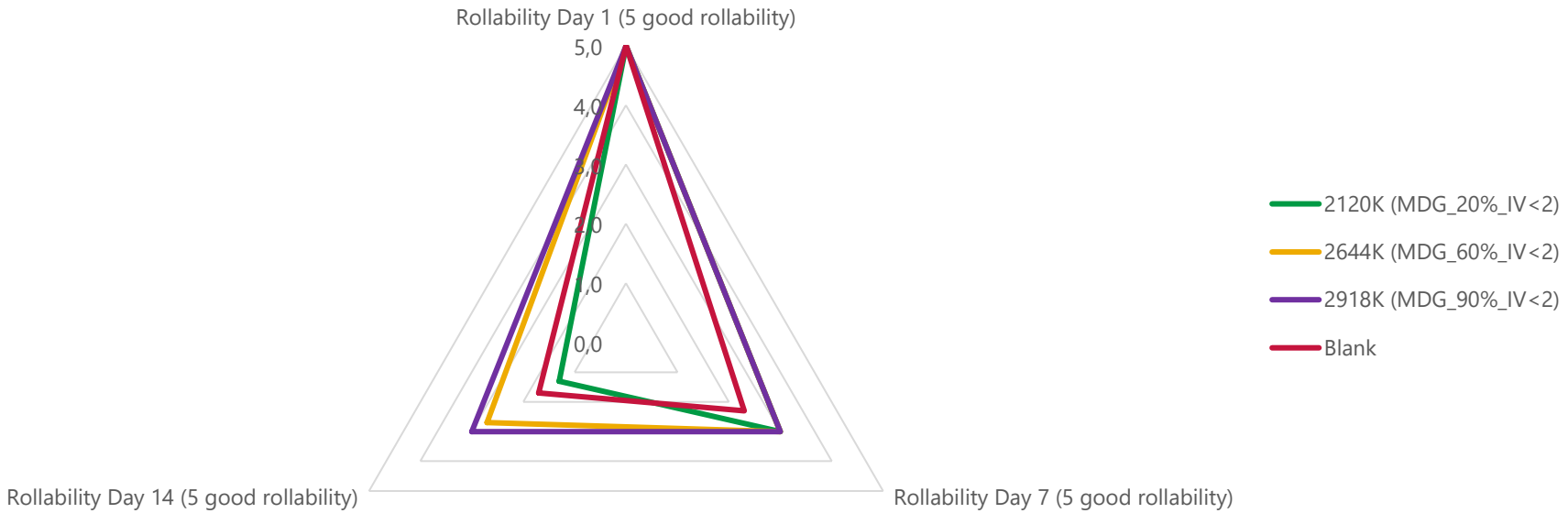
|---|---|---|---|---|---|---|
| *Average 3 timings* | 3.0 | 3.7 | 3.1 | 3.8 | 3.6 | 4.3 |

- Distilled monoglycerides (>90% monoglycerides, 2918K, 2903K and 2908K) score higher on rollability
- With 2908K having overall best rollability

# Rollability

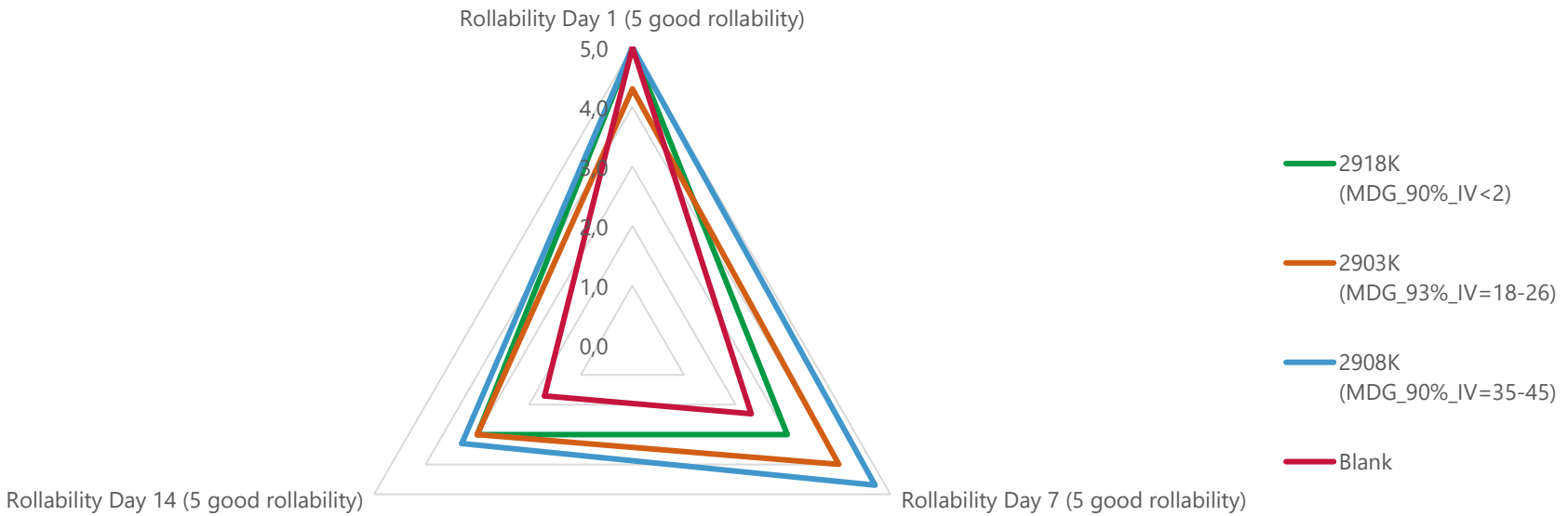
IMPACT OF MONOGLYCERIDES CONTENT




- Distilled monoglycerides (>90% monoglycerides) score higher on rollability
- With the 2918K having the highest

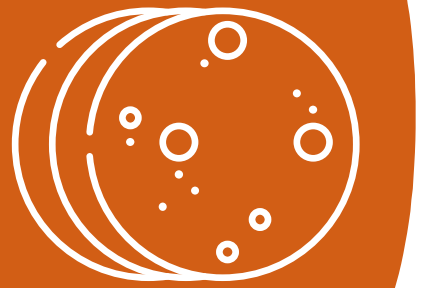
# Rollability

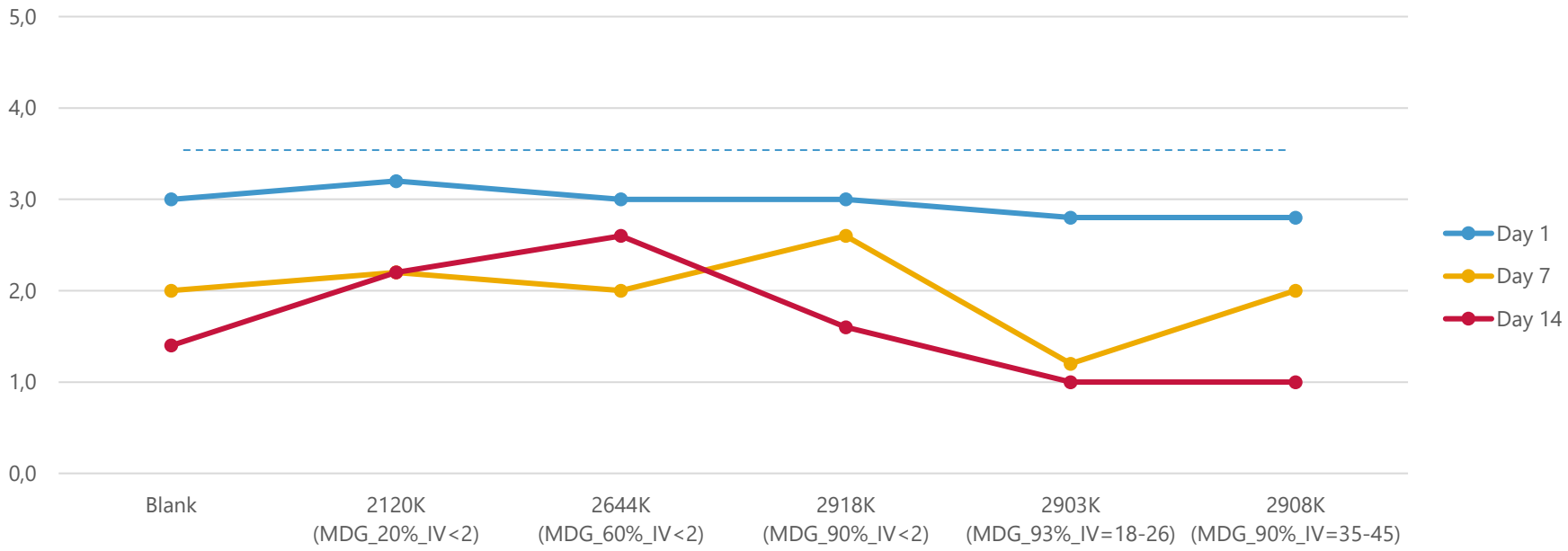
IMPACT OF UNSATURATION




- Unsaturated monoglycerides score higher on rollability
- With the 2908K having the highest

# Stacking stickiness



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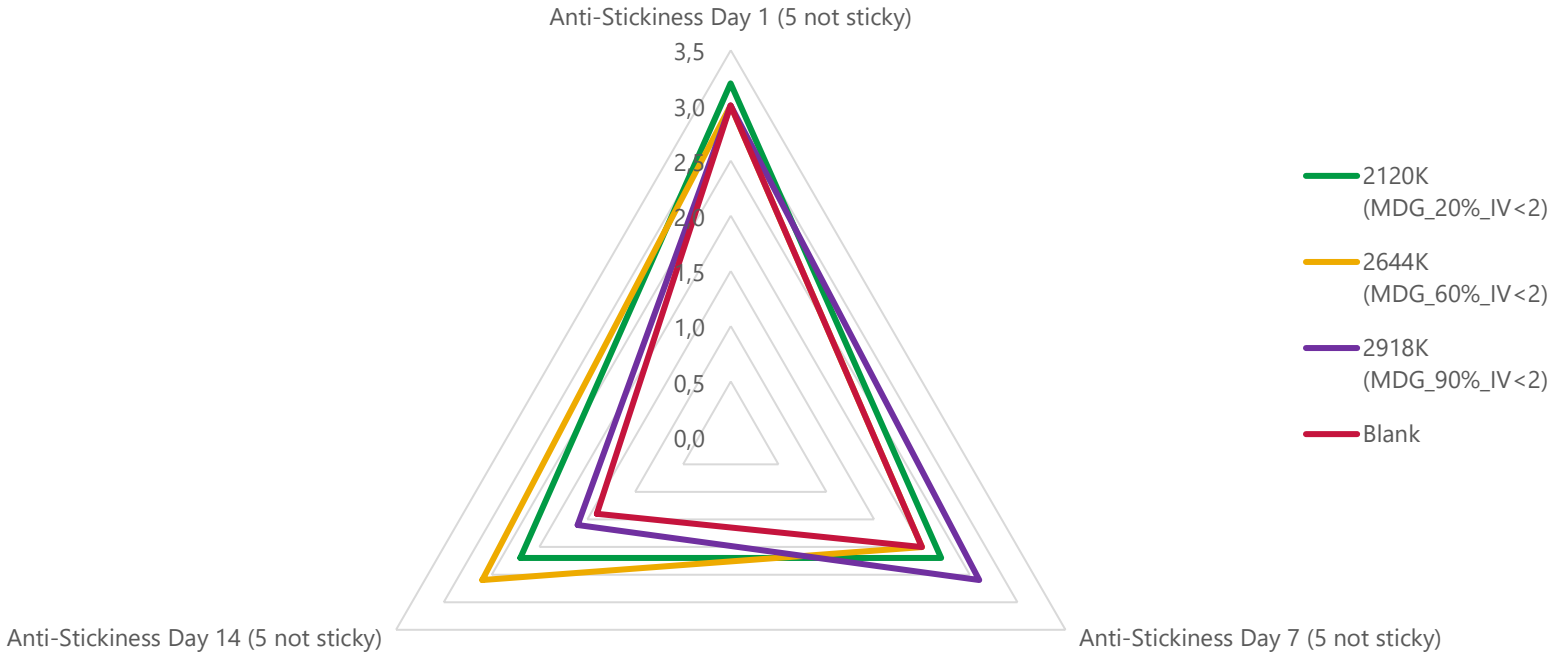
|---|---|---|---|---|---|---|
| *Average 3 timings* | 2.1 | 2.4 | 2.5 | 1.7 | 2.5 | 1.9 |

- Saturated monoglycerides (2918K, 2120K and 2644K) reduce stacking stickiness
- Higher diglycerides (2120K & 2644K) score better

# Anti-Stickiness

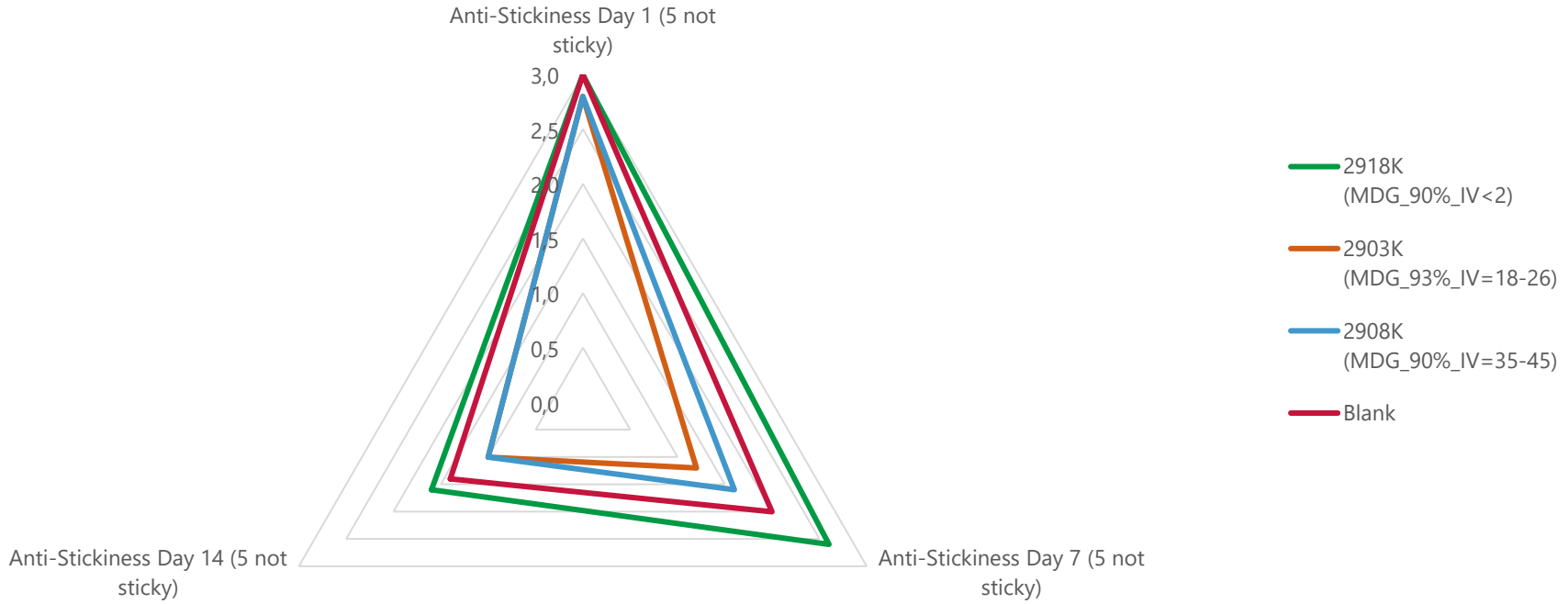
IMPACT OF MONOGLYCERIDES CONTENT




- Higher diglycerides (2120K & 2644K) score better in reducing stacking stickiness

# Anti-Stickiness

IMPACT OF UNSATURATION




- Saturated monoglycerides (2918K) reduce stacking stickiness

# 04 Conclusion

# Conclusion

Scoring code

| | |
|---|---|
| + | Higher value than blank |
| – | Lower value than blank |

+ > 0 to 0.6
+ + ≥ 0.6 to 1.3
+ + + > 1.3

| | Diameter | Rupture strength | Extensibility | Rollability | Stacking stickiness |
|---|---|---|---|---|---|
| 2918K (90%, IV<2) | + + | - | - - | + + | + |
| 2644K (60%, IV<2) | + + | - | - - | + + | + |
| 2120K (20%, IV<2) | + + | - | - - | + | + |
| 2903K (90%, IV=18-26) | + + | - - - | + + | + + | - |
| 2908K (90%, IV=35-45) | + + | - - | - | + + + | - |

Diameter: + bigger diameter
Rupture strength: - softer
Extensibility: + more stretchable
Rollability: + more flexible to roll
Anti-stickiness: + improved anti-stick / - worse antistick

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# Hypothesis

- Unsaturated monoglycerides
  - superior dispersion properties in dough → softer texture

  **= lower rupture strength**

  - More loosely packed arrangement may contribute to softer and more pliable texture

  **= improved rollability**

- Saturated monoglycerides
  - May lead to a firmer tortilla and less prone to stickiness

  **= higher rupture strength + reduced anti-stickiness**

- Monoglycerides versus diglycerides
  - Diglycerides more hydrophobic
  - Interact stronger with fat phase → limit migration/mobility of water

  **= reduced anti-stickiness**

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# Tortilla

| Chemical name | Product name | Indicative dosage |
|---|---|---|
| Mono- and diglycerides | **RADIAMULS MG 2120K, 2644K, 2918K, 2903K, 2908K.** | **0.5-2.0%** |

## Emulsifier functionality

- Shelf-life extension
- Improved softness
- Improved rollability
- Reduced stickiness

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# Thank you !

OLEON Nutrition Team