



Plant-based egg alternatives for bakery applications

Closing Event – 17/09/26

Ferre Rebry – Project coordinator NovoBake – ferre.rebry@hogent.be



**AGRO
FOOD
NATURE**

**HO
GENT**



VLAIO



**FLANDERS'
FOOD**



Welcome to the NovoBake Closing Event

NovoBake Closing Event Programme

Understanding the challenge

13:10-13:25	Why replace eggs? The challenge behind NovoBake
13:25-13:45	Functions of Egg & Challenges of Replacement
13:45-14:05	From ingredient to egg replacer: Techno-Functional Insights

14:05-14:15 Break

From research to bakery product

14:15-14:45	What works in bakery? Results from four applications
14:45-15:00	Sensory & Consumer acceptance: Does the consumer taste the difference?
15:00-15:15	From Product to Market: Opportunities for Egg-Replaced Bakery Products

Bringing it all together

15:15-15:20	Key takeaways from NovoBake
15:20-15:30	Closing, feedback & Acknowledgements

15:30-16:00 Tasting session with Madam Bakster





Why replace eggs? The challenge behind NovoBake

Ferre Rebry



Context & current relevance



Products

Concepts

Inspiration & Knowledge

Contact

About us

Search...

Why bakeries should enter the market of plant based & vegan bakery products

September 27, 2023



Tot Pasen blijft vraag naar eieren hoger dan aanbod

ACHTERGROND PLUIMVEE JOHN LAMERS 26 JAN 2024 OM 06:30UUR



Wereldwijd is de productie van eieren gedaald door met name vogelgriep, waardoor vraag en aanbod dicht bij elkaar liggen. Voor de productie van OKT- en biologische eieren zijn minder hennen opgezet en nu is er een tekort.



Report Egg Replacement Ingredient Market

Egg Replacement Ingredient Market

A Comprehensive Research Analysis of the Egg Replacement Ingredient types such as Egg Whites, Egg Yolks, and Egg Replacer to 2034

Know Why Using Egg Replacement Ingredients in Bakery Items and Other Food Products is Beneficial

Report Preview

View T

Egg Replacement Ingredient Sales Outlook from 2024 to 2034

The global egg replacement ingredient market size is projected to increase from USD 1,399.2 million in 2024 to USD 2,478.2 million by 2034. Global sales of egg replacement ingredients are anticipated to expand with a CAGR of 5.9% over the assessment period. Many consumers are seeking plant-based protein sources and egg replacements fit well into these dietary choices.



Charlie Holt | Senior Marketing Executive

22 May, 2023

As egg reduction in bakery products becomes a bigger priority, the need for high-performing egg reduction solutions is growing

Uitbraak van Salmonella Enteritidis door geïmporteerde eieren uit Oekraïne

Annemiek Jorritsma | 22 okt. 2024 | Laatste update: 28 okt. 2024

Delen

Opslaan

Voorlezen

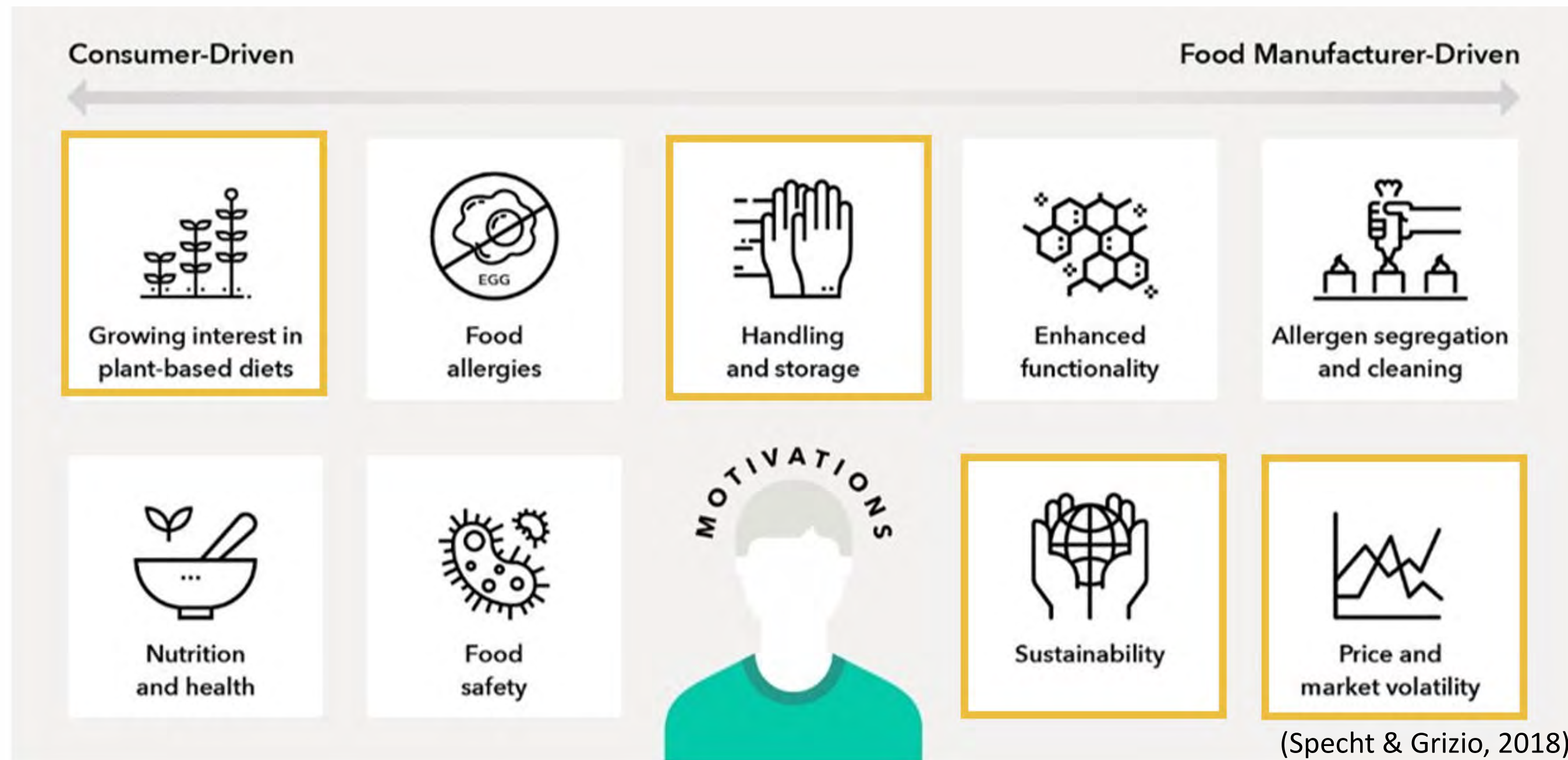


Foto: Pixabay

In Zweden is de afgelopen maanden een uitbraak van Salmonella Enteritidis vastgesteld, vermoedelijk veroorzaakt door de consumptie van eieren geïmporteerd uit Oekraïne.

Drivers of egg-replacement

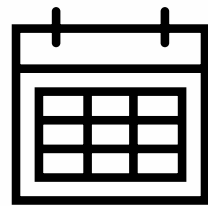
For each company, the motivation can be different.



Can we replace egg while keeping a product that still works for the producer and the consumer?

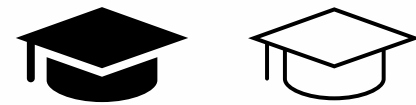
NovoBake: research designed for transfer to practice

A 2 year **TETRA**-project focused on **Technology Transfer**



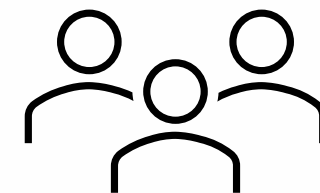
2 year project

Oct 2024 – Oct 2026



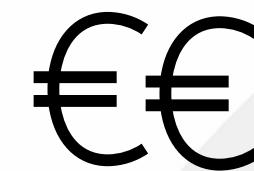
Collaboration

HOGENT & UGent



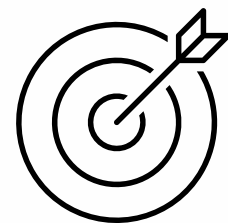
Who is it for?

Industry & education



Funding

*VLAIO & steering
group companies*



Goal: translate recent research and knowledge into practical tools for the bakery sector.



One project, five bakery applications

Project scope



Pound cake



Soft waffles



Sponge cake



Choux pastry



Egg wash

1 Ingredient functionality

What can the ingredient do?

Foaming · emulsification · water/oil binding · solubility · gelation

2 Bakery performance

Does it work technically?

Volume · batter behaviour · structure/cohesion · release

3 Sensory quality

Does the product still look, taste and feel right?

Taste · aroma · texture · colour/gloss

4 Consumer & market fit

Would people actually choose it?

Acceptance · purchase drivers · price · positioning

Successful egg replacement has to work at several levels: from ingredient functionality to product performance, sensory quality and consumer relevance.

NovoBake in 3½ minutes



The film gives a compact overview of the project, the people involved and the different research angles.

[Novobake. - YouTube](#)



From the challenge to the science

Why is replacing egg so difficult in the first place?

Next presentation

Functions of Egg & Challenges of Replacement

Prof. Filip Van Bockstaele

Before looking at the baking results, it helps to understand what egg actually does in the product.

And that is where the challenge starts: egg does several jobs at once.





The functions of egg and challenges of egg replacement

Prof. Dr. Ir. Filip Van Bockstaele
Ana Gabriela Ramos Batres



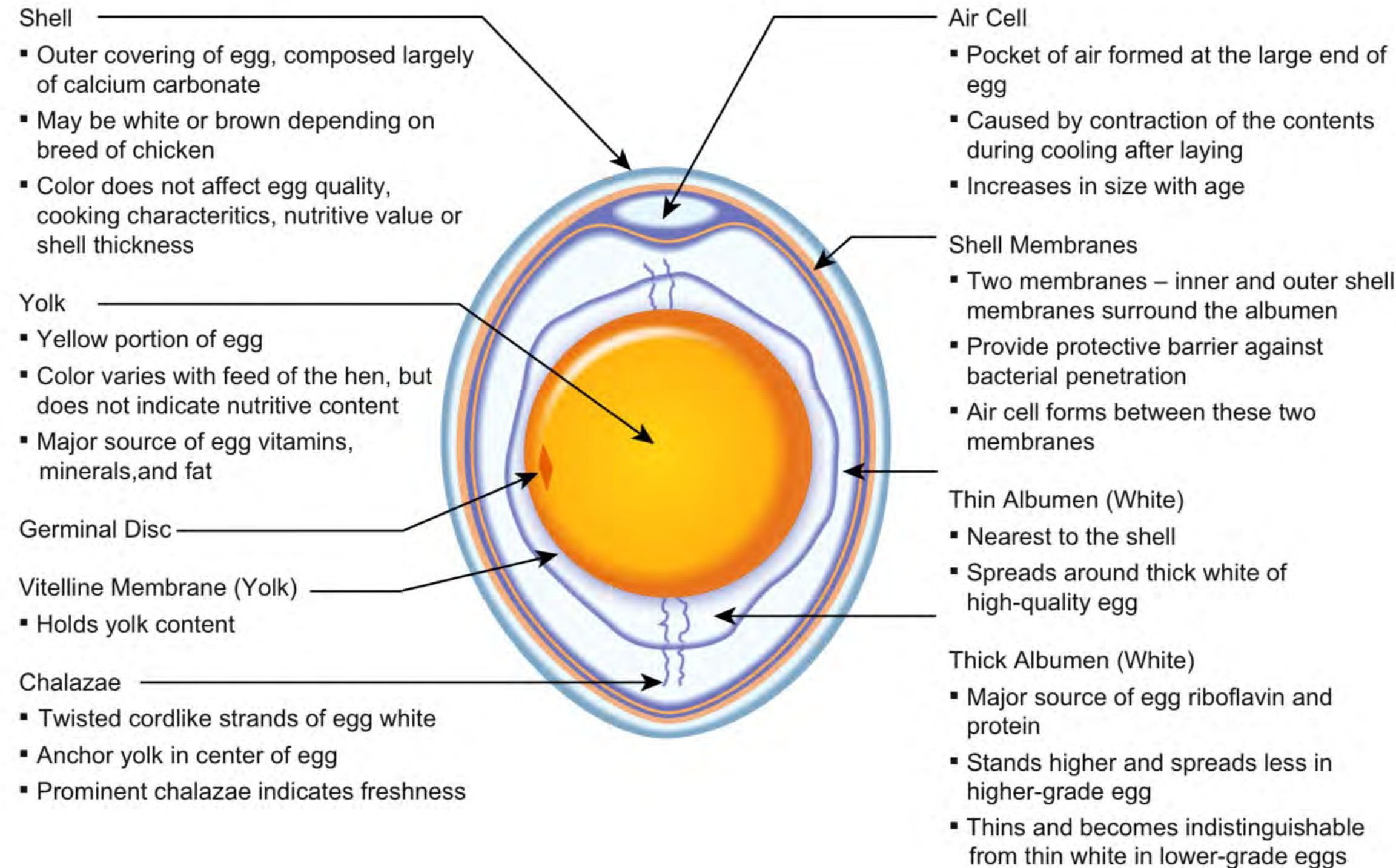
EGG STRUCTURE

Its three main constituents are:

- Egg shell (9-11%)
- Albumen (60-63%)
- Yolk (28-29%)

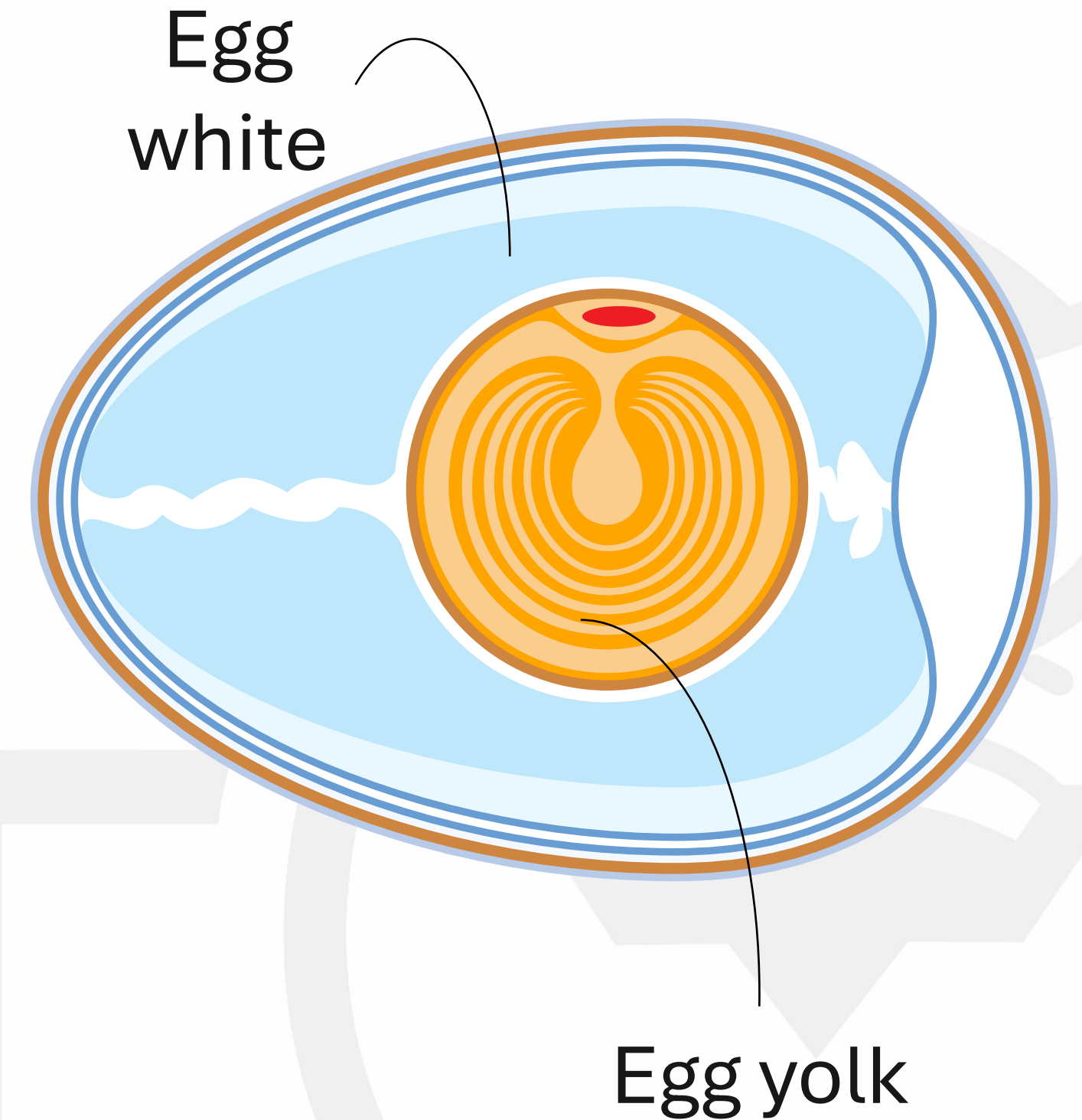
Other components

- Chalazae (stability, freshness)



COMPOSITION OF EGGS

- Compositionally and structurally complex materials
 - Among its constituents:
 - Water (75%)
 - Lipids (12%)
 - Proteins (12%)
 - Carbohydrates
 - Vitamins and minerals
- Organized into different structures located in the egg yolk and egg white



EGG WHITE

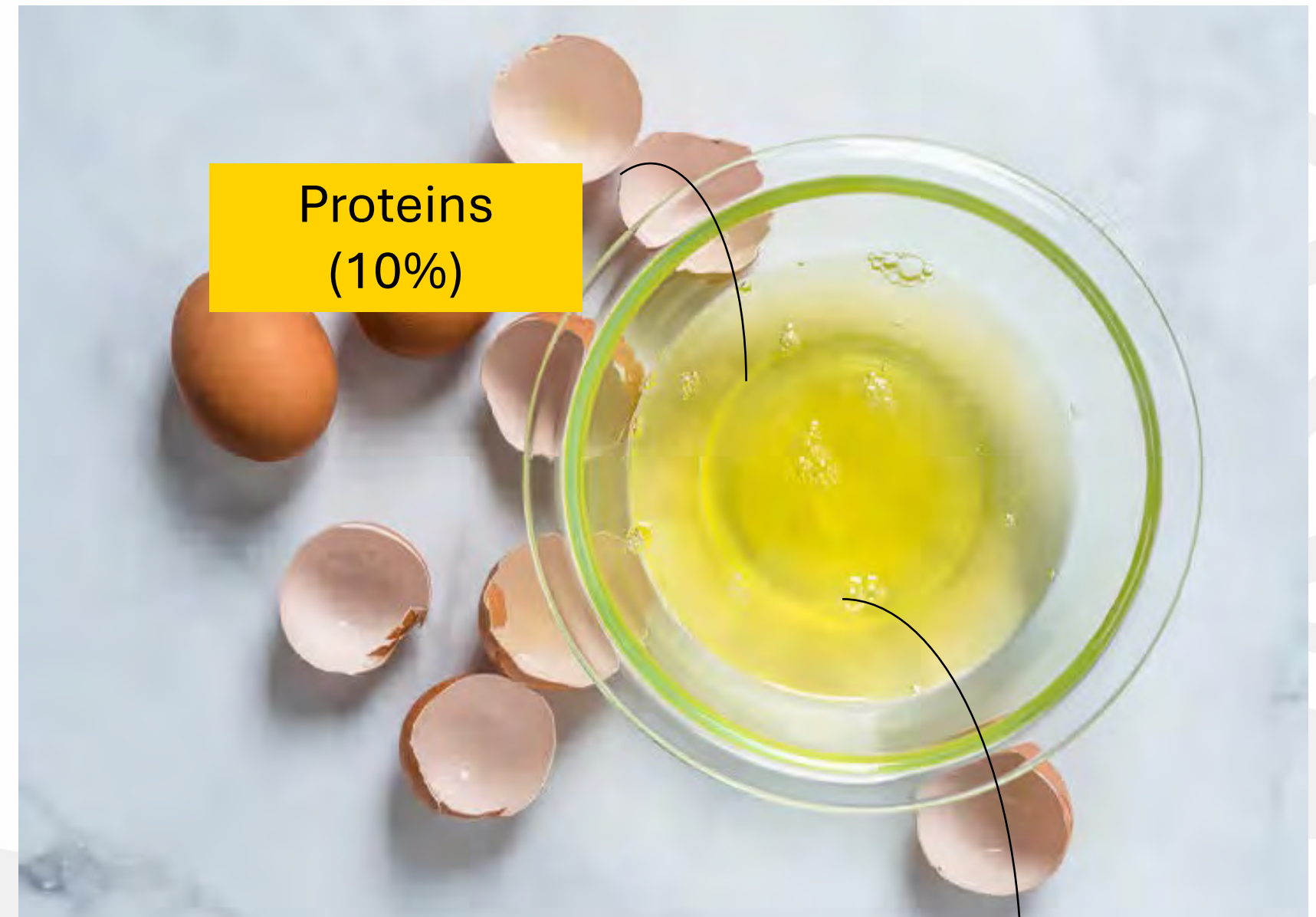
Viscoelastic solution that contains proteins, glycoproteins, vitamins and minerals dissolved in water (pH 7.6-9.3).

Main proteins:

- Ovalbumin (58%)
- Ovotransferrin (13%)
- Ovomucoid (11%)
- Lysozyme (3.5%)
- Ovomucin (1.5%)

Functional properties:

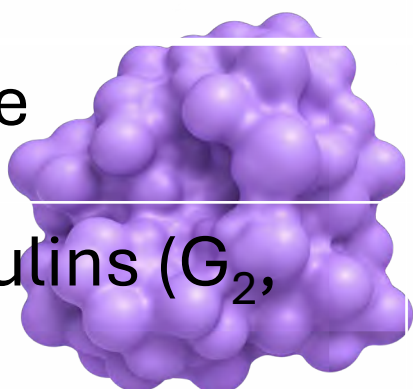
- Foaming, gelling, thickening



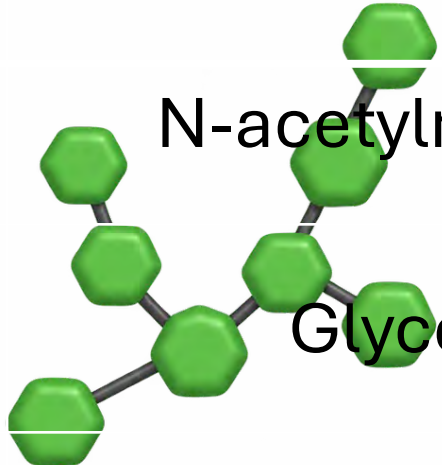
ALBUMEN PROTEINS

Egg white proteins are characterized for having a globular and rigid conformation:

	Composition	% DM of total protein	Type	Functional properties
Major	Ovalbumin	54.0	Phosphoglycoprotein	Gelling, foaming, emulsifying
	Ovotransferrin	12.0-13.0	Glycoprotein	Metal binding
	Ovomucoid	11.0	Glycoprotein	Trypsin inhibitor
Minor	Ovomucin	1.5-3.5	Sulphated glycoprotein	Foam stabilizer, emulsifying
	Lysozyme	3.4-3.5	N-acetylmuramidase	Bactericide, foam stabilizer
	Ovoglobulins (G ₂ , G ₃)	4.0	Glycoprotein	Foaming
	Avidin	0.05	Glycoprotein	Biotin binder

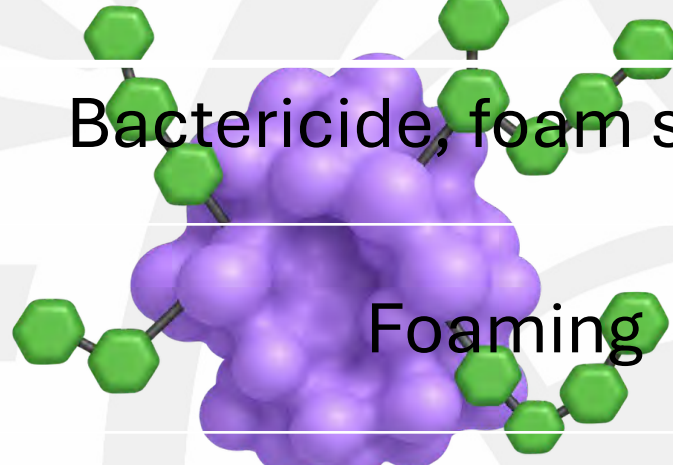


Protein



Carbohydrate chain

Carbohydrates are short or long chains of sugar molecules (such as glucose, galactose..)



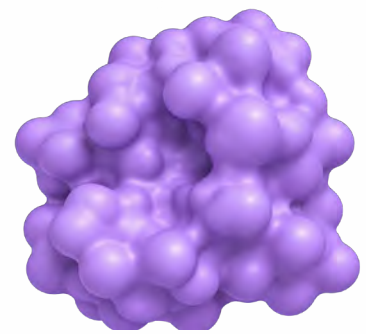
Glycoprotein

A glycoprotein is a protein with a carbohydrate chains covalently attached to it.

IMPORTANT APPLICATIONS

Ovalbumin

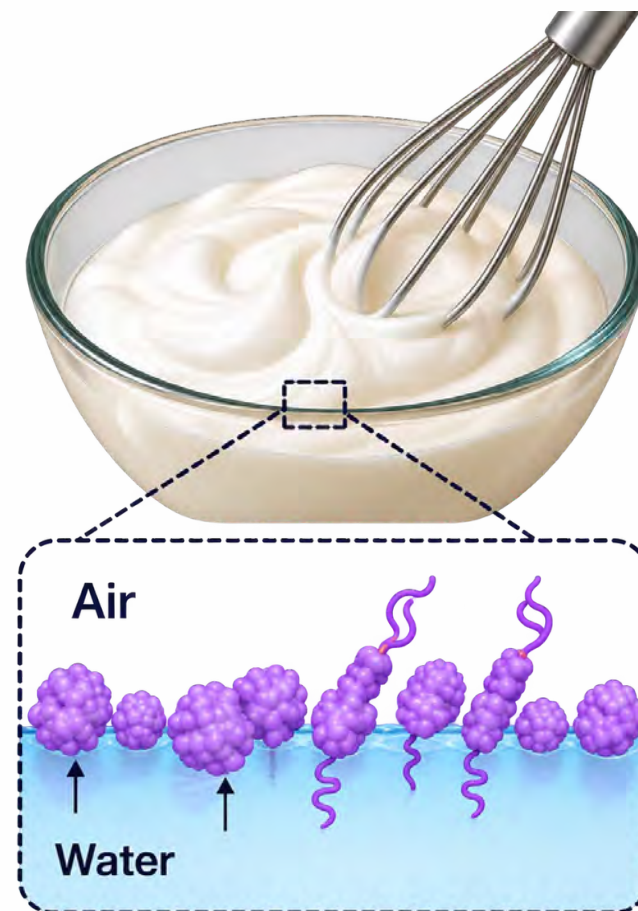
Major egg white protein
(~54% of total protein.)



- Globular protein (~45 kDa)
- Amphiphilic (hydrophobic and hydrophilic regions)
 - Denaturation temperature (84°C)

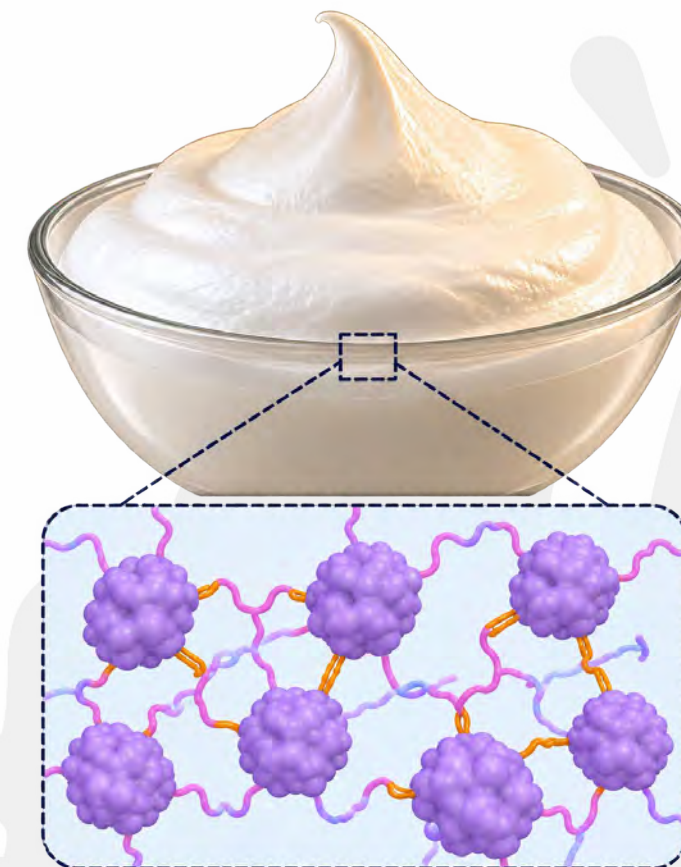
Whipping (foam formation)

Ovalbumin adsorbs at the A/W interface and partially unfolds.



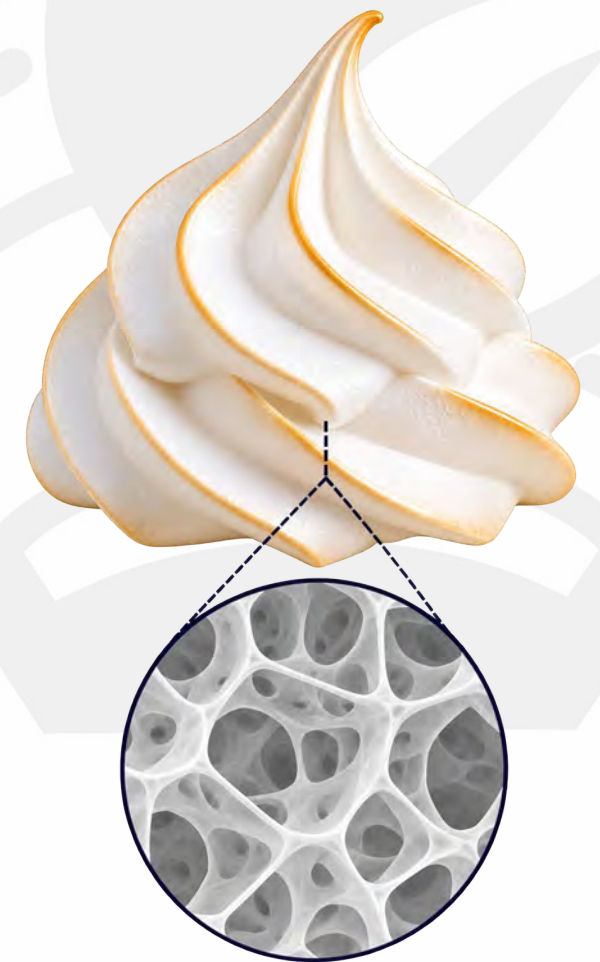
Heating (denaturation and aggregation)

Further unfolding and protein-protein interactions lead to a gel network that stabilizes the foam.



Meringue

A stable, light, and aerated structure formed by a heat set protein network.



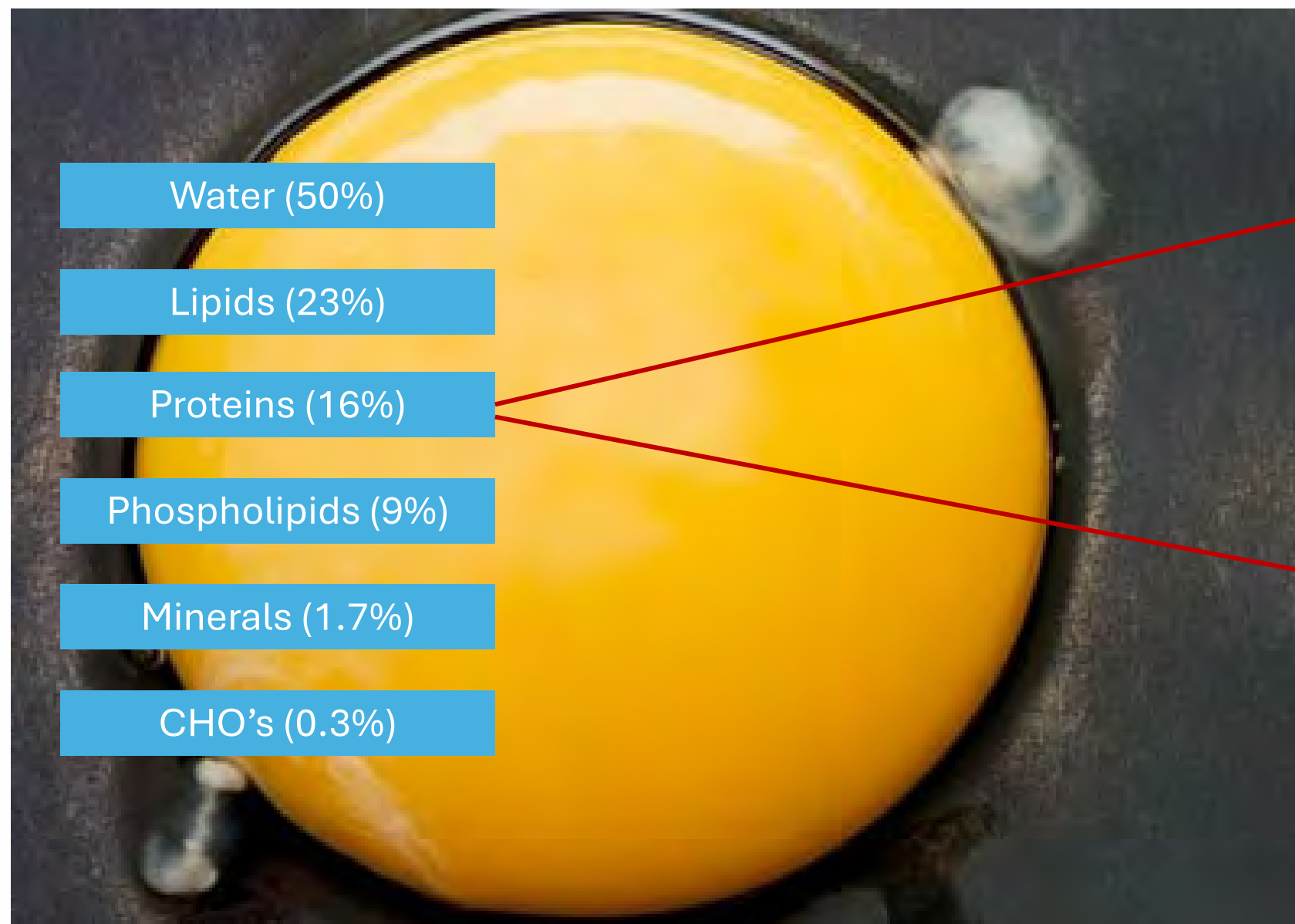
 Disulfide bond

 Non-covalent interactions
(hydrophobic, electrostatic, H-bonds)



EGG YOLK

Structure similar to an **O/W emulsion** made up of lipid rich droplets dispersed in an aqueous solution



Main fractions:

GRANULES

HDL (70%)
LDL (12%)
Phosvitin (7%)

PLASMA

LDL (85%)
Livetin (15%)

HDL and LDL:

- Natural colloids ($\varnothing < 1000$ nm)
- Hydrophobic core containing TAG's and cholesterol molecules
- Surrounded by amphiphilic shell containing a phospholipid bilayer with proteins embedded.

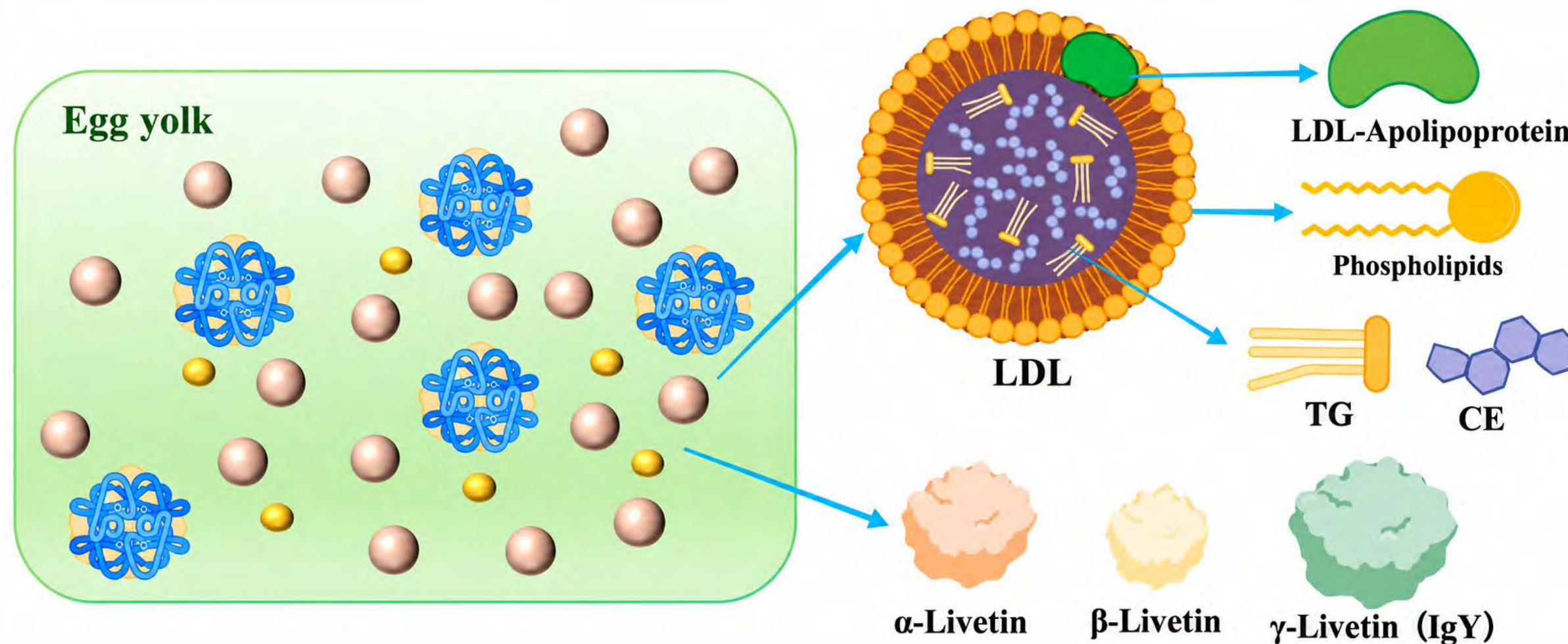
Functional properties: gelling, emulsifying



EGG YOLK FRACTIONS

Plasma

This fraction corresponds to the aqueous phase in which the egg yolk solids are suspended. It consists of 85% low-density lipoproteins (LDL) and 15% livetins.



Livetins are water-soluble, globular proteins which have been categorized into three subtypes according to their main constituents

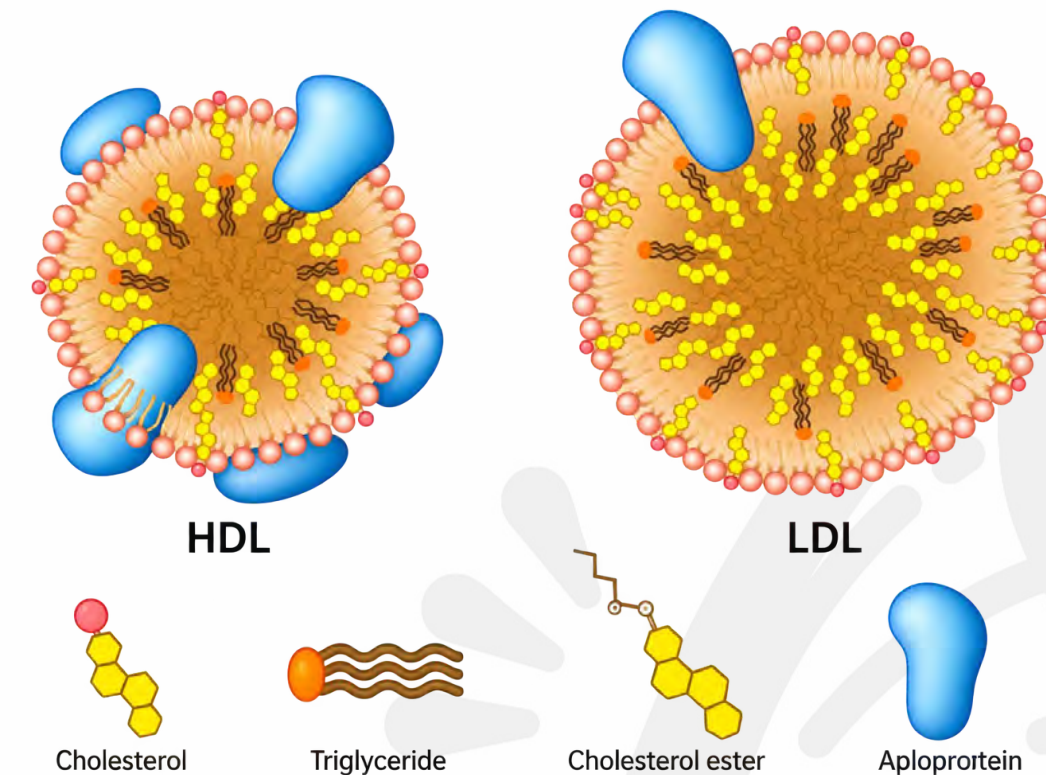
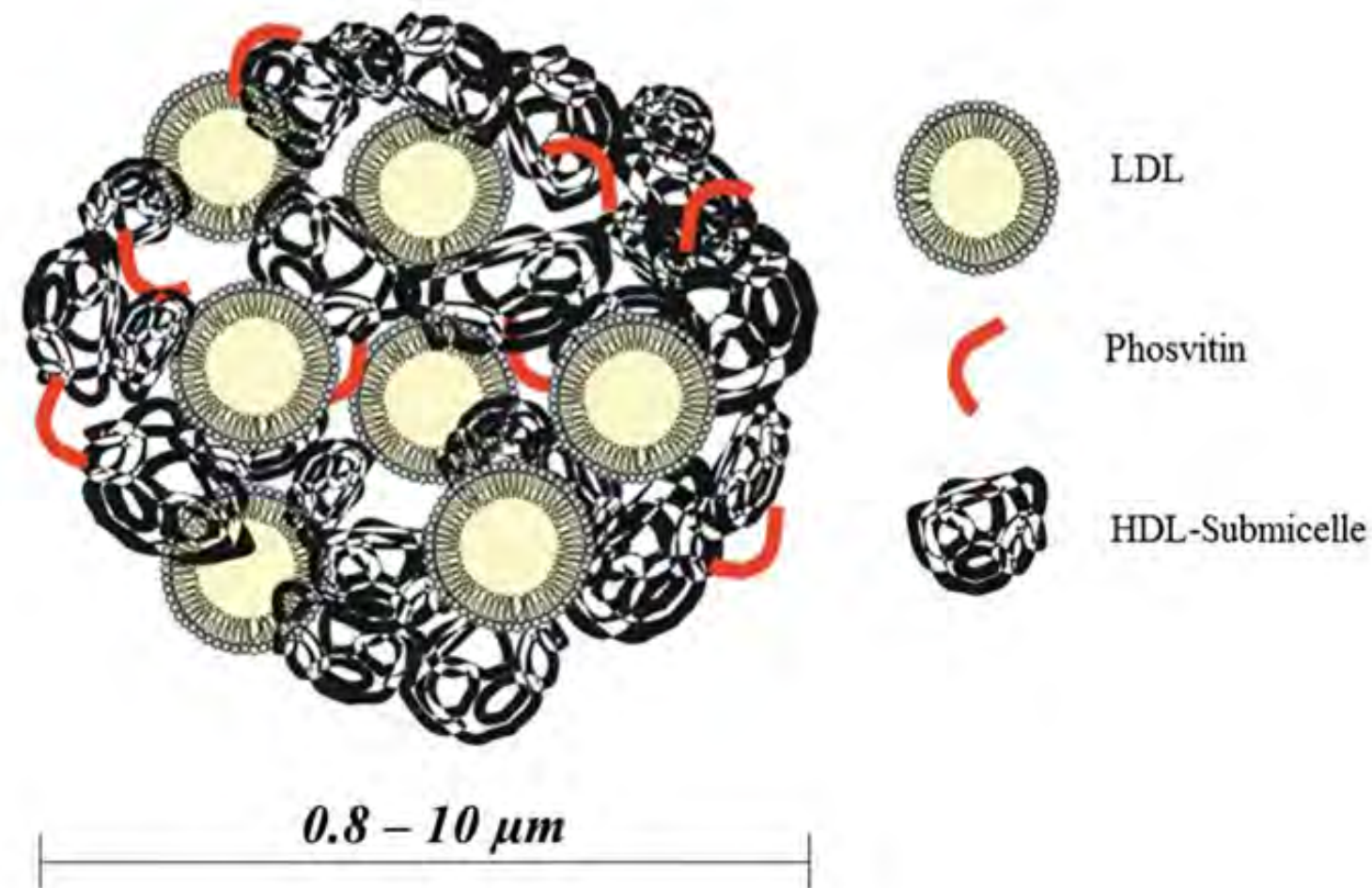
Along with ovotransferrin and lysozyme, α -livetins, is responsible for the allergic properties of the egg.



EGG YOLK FRACTIONS

The egg yolk can be separated, via dilution and centrifugation, into two main fractions which are the plasma and granules

Egg yolk granule

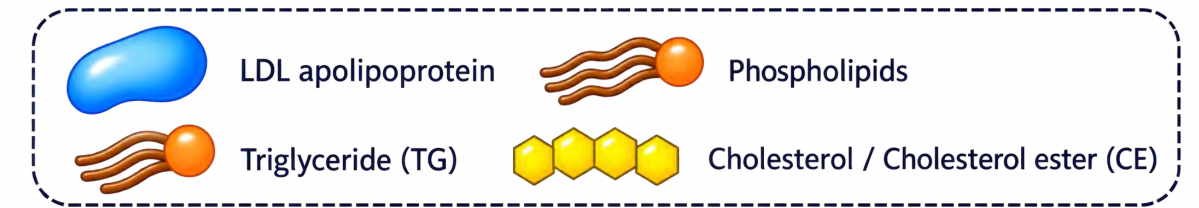


HDL's and LDL's have similar structures but the HDL's have more proteins embedded.

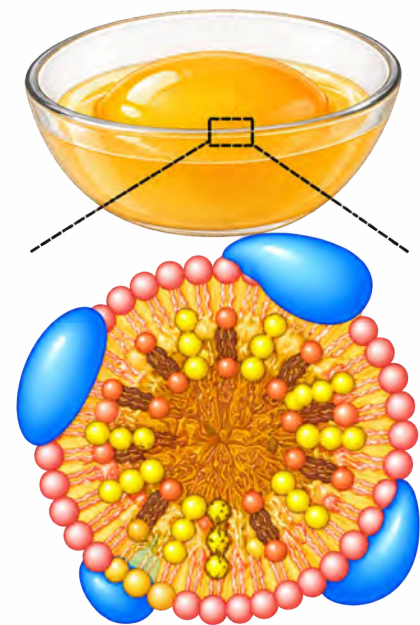
In the granules, HDL submicelles are linked to phosvitin via calcium phosphate bridges



IMPORTANT APPLICATION



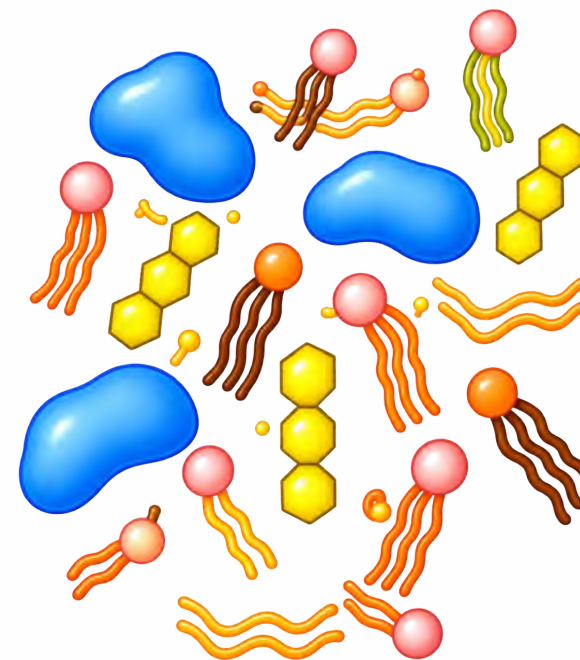
1. Egg yolk



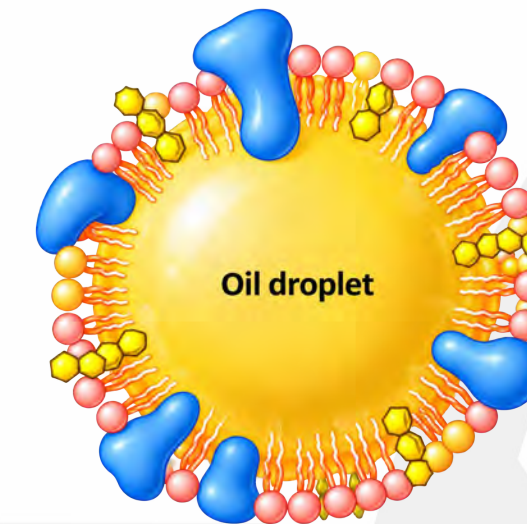
2. Mixing with oil
(homogenization)



3. LDL disruption
and adsorption



4. Stabilized oil
droplets



5. Mayonnaise
(O/W emulsion)



During mixing, LDL particles are disrupted and lipids/proteins are released into the aqueous phase.

Surface-active components (phospholipids and apoproteins) adsorb and re-organize at the O/W interface.

A viscoelastic interfacial film prevents droplet coalescence, resulting in a stable emulsion.

Mayonnaise: a food application that mainly relies on egg yolk functionality for emulsification and stability.



EGGS IN BAKERY APPLICATIONS



Functional properties:

- Thickening, gelling, binding
- Coagulation, structure
- Foaming, aeration
- Emulsification
- Sensory (color, flavor)



WHAT DO WE WANT TO REPLACE?

Shell eggs



Washing



Grading and sorting



Breaking



Homogenization



Pasteurization



Drying

Liquid egg ingredients

- Liquid whole egg
- Liquid egg white
- Liquid egg yolk

Dried (powdered) egg ingredients

- Whole egg powder
- Egg white powder
- Egg yolk powder

Liquid egg ingredients are pasteurized and packaged in appropriate cartons or containers.

- Shorter shelf life (refrigerated/frozen)

Dried (powdered) egg ingredients are pasteurized and dried (e.g. spray drying).

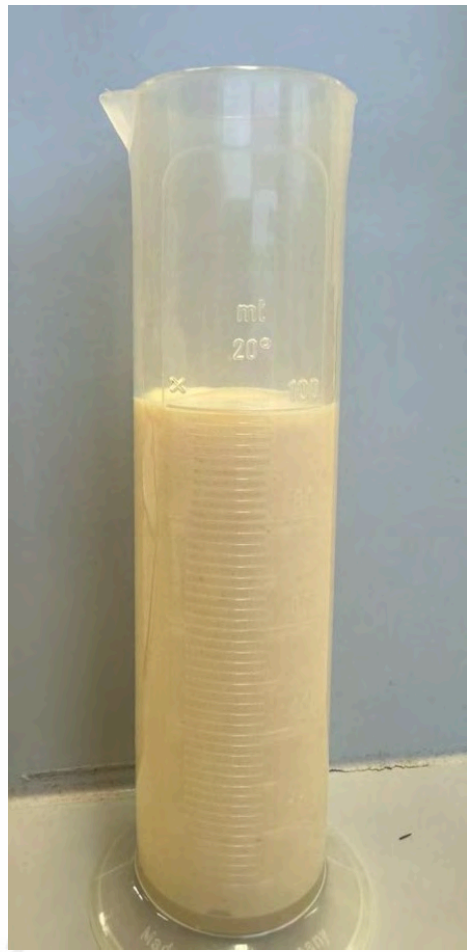
- longer shelf life and easier handling

Egg can be commercially available as shell eggs, liquid egg ingredients, or dried (powdered) egg ingredients)



Sample	Foam volume (mL)	
	t = 0 min	t = 30 min
Frozen egg	100	100
Fresh egg	100	78
Powdered egg	90	90

The processing steps required to obtain these ingredients, particularly **pasteurization and drying**, may modify protein structure and consequently influence their techno-functional properties



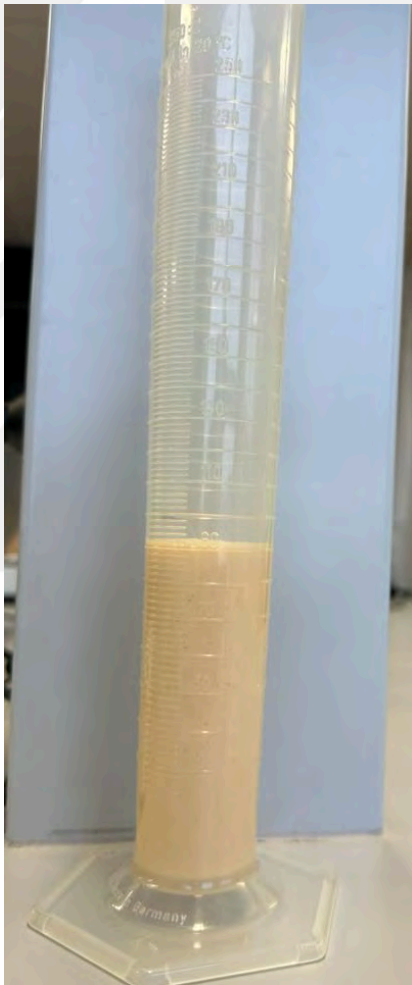
Frozen whole egg



Fresh whole egg



Powdered whole egg

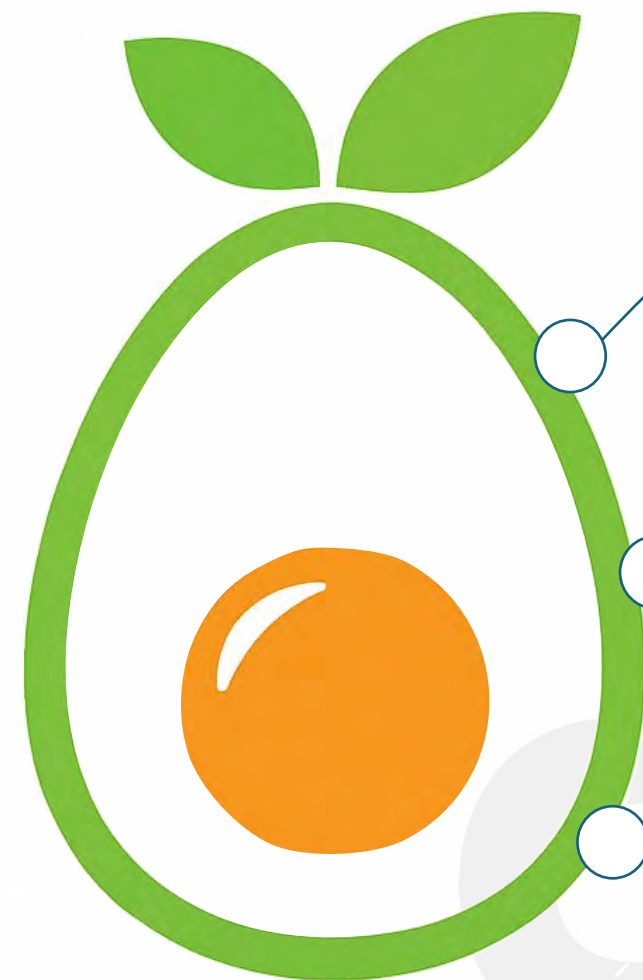


EGG ANALOGS

Food products designed to replicate the sensory and functional properties of real chicken eggs.

Can be formulated using a range of food ingredients and can be divided into three categories:

Categories



Protein based (animal or plant origin)

Food additives (hydrocolloids, emulsifiers)

Others (flaxseeds, chia seeds)



PLANT-BASED EGG ANALOGS

Reconstructing egg functionality requires multiple ingredient classes

PLANT PROTEINS

Provide interfacial and structural stability

- Foaming
- Emulsification
- Gelation
- Nutritional contribution

Examples: soy, pea, mung bean, faba bean, lentil, chickpea, potato.

FATS AND OILS

Provide the lipid phase and carry lipophilic compounds.

- Form a hydrophobic core of fat droplets
- Solubilize non-polar flavors, colors, and vitamins

Examples: canola, corn, olive, sunflower oils.

PHOSPHOLIPIDS

Surface active components contributing to:

- Emulsification
- Interfacial stabilization
- Foaming

Examples: soy and sunflower lecithin

POLYSACCHARIDES

Increase continuous-phase viscosity and contribute to:

- Thickening
- Gelation
- Stabilization

Examples: HPMC, starches, xanthan gum.



CHALLENGES

Plant proteins display undesirable functional properties:

- Low solubility
- Limited emulsifying activity
- Weak foaming ability
- Unsatisfactory gel property

These properties are a result of their structure; thereby different techniques are being applied to modify their structure.



No single ingredient reproduces the multifunctionality of egg

A combination of plant proteins, phospholipids and polysaccharides is needed to achieve egg-like functionality.





From ingredients to egg replacer: Techno-functional insights

Ana Gabriela Ramos Batres



NOVOBAKE – FROM INGREDIENT FUNCTIONALITY TO APPLICATION

INGREDIENT SET

Plant-based ingredients with potential egg-replacing functionality

Egg replacer blends

Commercial multi-ingredient systems

Single protein ingredients

Protein isolates, concentrates and flours

FUNCTIONAL CHARACTERIZATION

Assessment of key functional properties relevant for egg replacement



WHC



OHC



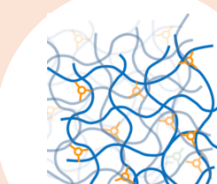
Foaming



Emulsification



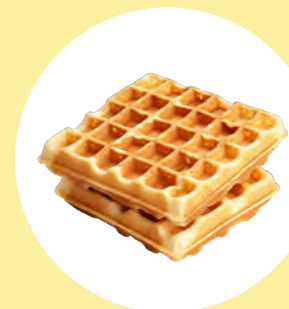
Solubility



Gelation

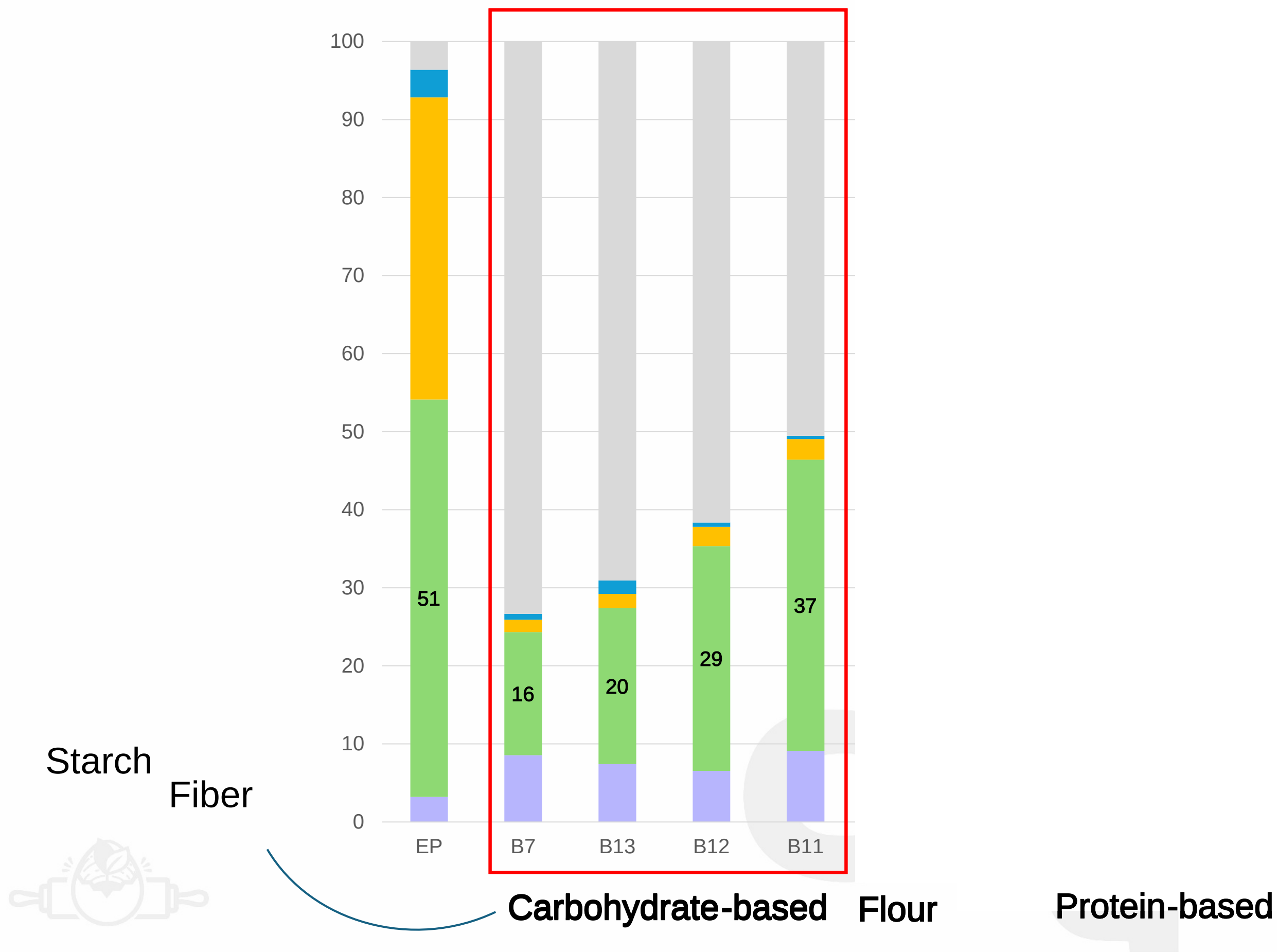
BAKERY APPLICATIONS

Evaluation of ingredient performance in different bakery products.



WHC: Water Holding Capacity; OHC: Oil Holding Capacity

BLEND MACRO-COMPOSITION



FUNCTIONALITY ASSESSMENT

Sample	FC (% 2 min)	FC (% 5 min)	FC (% 10 min)	FS (% 2 min)	FS (% 5 min)	FS (% 10 min)	EC (%)	ES (%)	LGC (%)	WHC (g/g)	OHC (g/g)	SP40 (g/g)	SP60 (g/g)	SP80 (g/g)
→ B5	302,7	280,0	253,3	0,0	0,0	0,0	0	0,0	16	1,49	0,86	1,57	2,58	3,77
B6	177,3	168,0	162,7	10,6	19,0	58,1	0,0	0,0	16	1,43	0,53	1,18	3,06	4,47
B7	74,7	106,7	141,3	0,0	0,0	7,1	0,0	0,0	20	1,57	0,66	2,18	3,69	3,91
→ B8	210,7	337,3	460,0	79,0	81,6	90,0	56,7	55,6	18	1,82	0,66	2,06	1,66	2,44
→ B9	320,0	396,0	392,0	107,6	58,9	62,6	58,3	0,0	20	1,54	0,85	1,53	1,85	2,21
B10	40,0	51,3	56,0	30,0	35,2	36,7	52,8	51,4	14	1,63	0,76	1,84	1,92	2,51
B11	164,0	165,3	165,3	31,3	29,0	58,5	54,2	0,0	18	1,25	0,55	1,18	2,51	4,86
B12	120,0	136,0	131,3	58,9	63,7	63,4	56,9	59,7	14	1,62	0,73	1,62	2,73	3,84
→ B13	0,0	0,0	0,0	0,0	0,0	0,0	100,0	100,0	14	0,00	0,92	0,00	0,00	0,00
→ B14	117,3	134,7	104,7	54,6	61,6	63,1	61,1	61,1	12	1,83	0,99	1,88	1,81	2,01

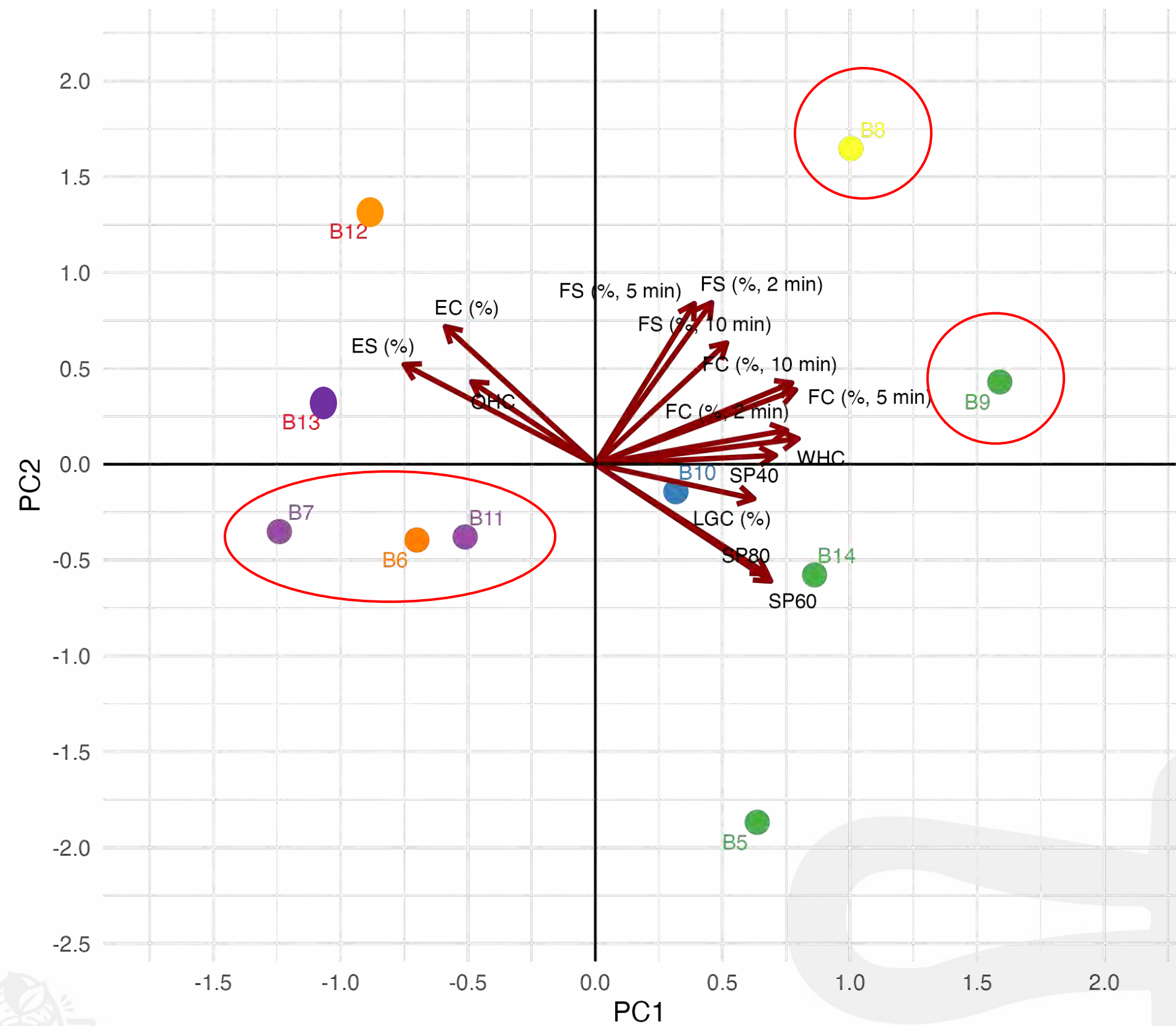
Foaming behavior varies dramatically between blends

- B5 and B9 show the highest foaming capacity, while B13 shows essentially no foaming
- High foaming capacity does not necessarily mean good foam stability

B8 looks particularly interesting for aerated applications

B14 seems one of the more balanced blends (reasonable foam stability, good EC/ES, highest WHC and OHC).

PCA OF FUNCTIONAL PROPERTIES



B8 is strongly separated in the direction of foam stability related vectors.

B9's position is consistent with its high foaming capacity and relatively high emulsifying capacity

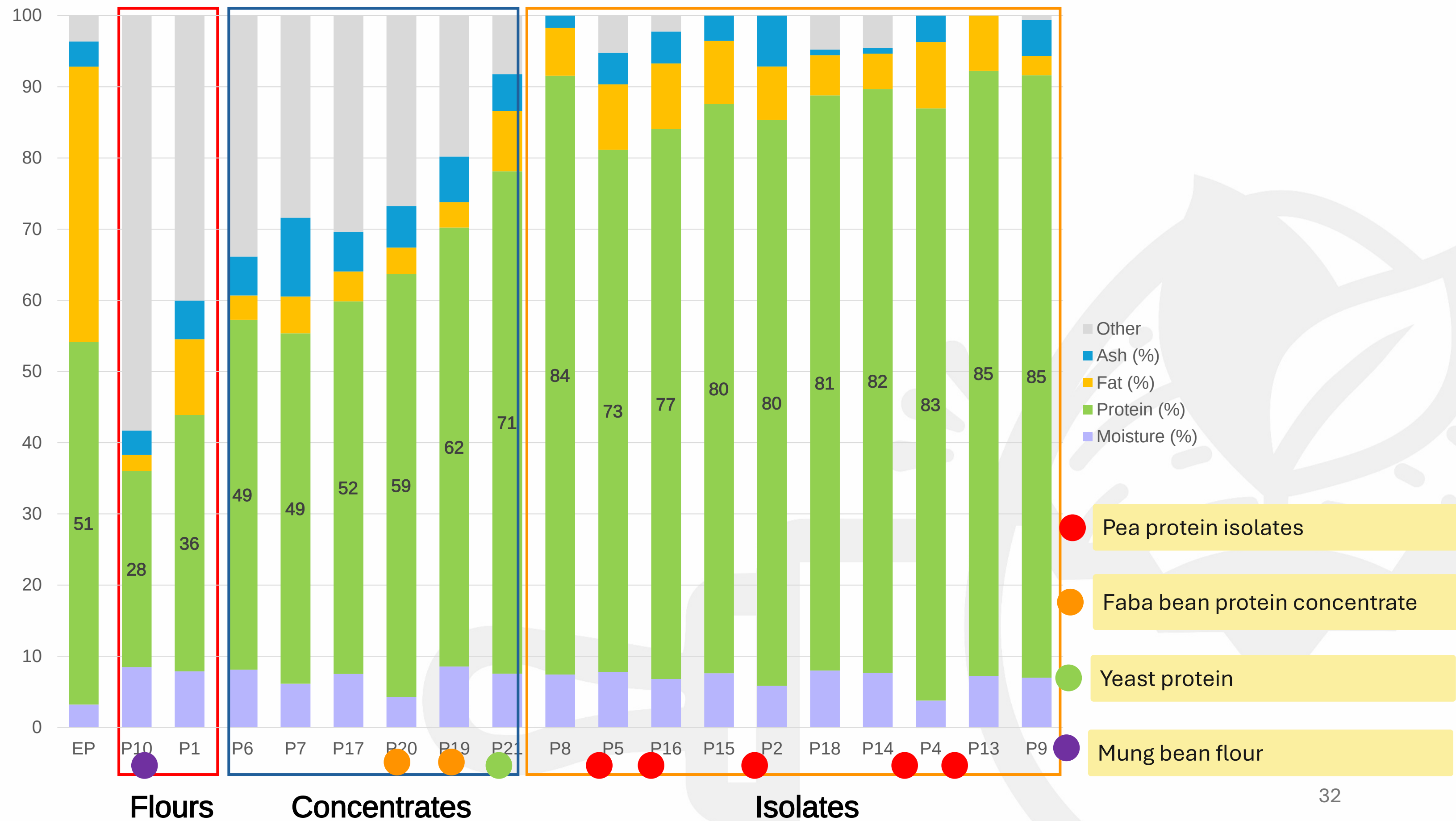
Sample Type

- Protein + starch
- Protein based
- Starch + protein
- Wheat flour
- Wheat protein

B6, B7, B11 cluster relatively together. Their foam stability is moderate. They have relatively high swelling power at high temperatures. WHC/ OHC are not especially high. They require higher concentrations in order to gel.



PROTEIN INGREDIENTS MACRO-COMPOSITION



PCA OF FUNCTIONAL PROPERTIES

Key findings

Wide diversity in functional profiles

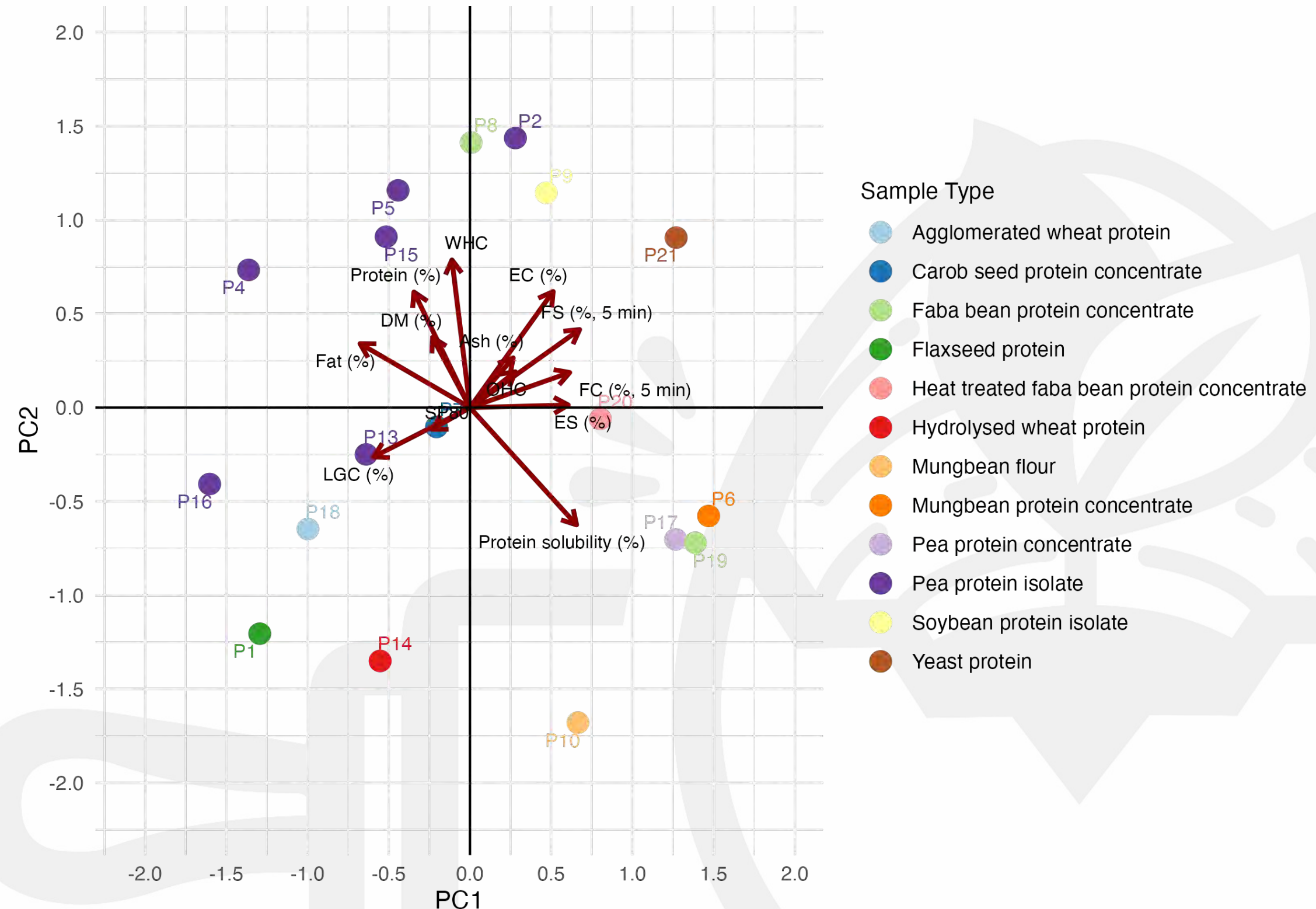
Ingredients are distributed across all quadrants indicating variation in their functional properties.

No single ingredient excels across all functionalities

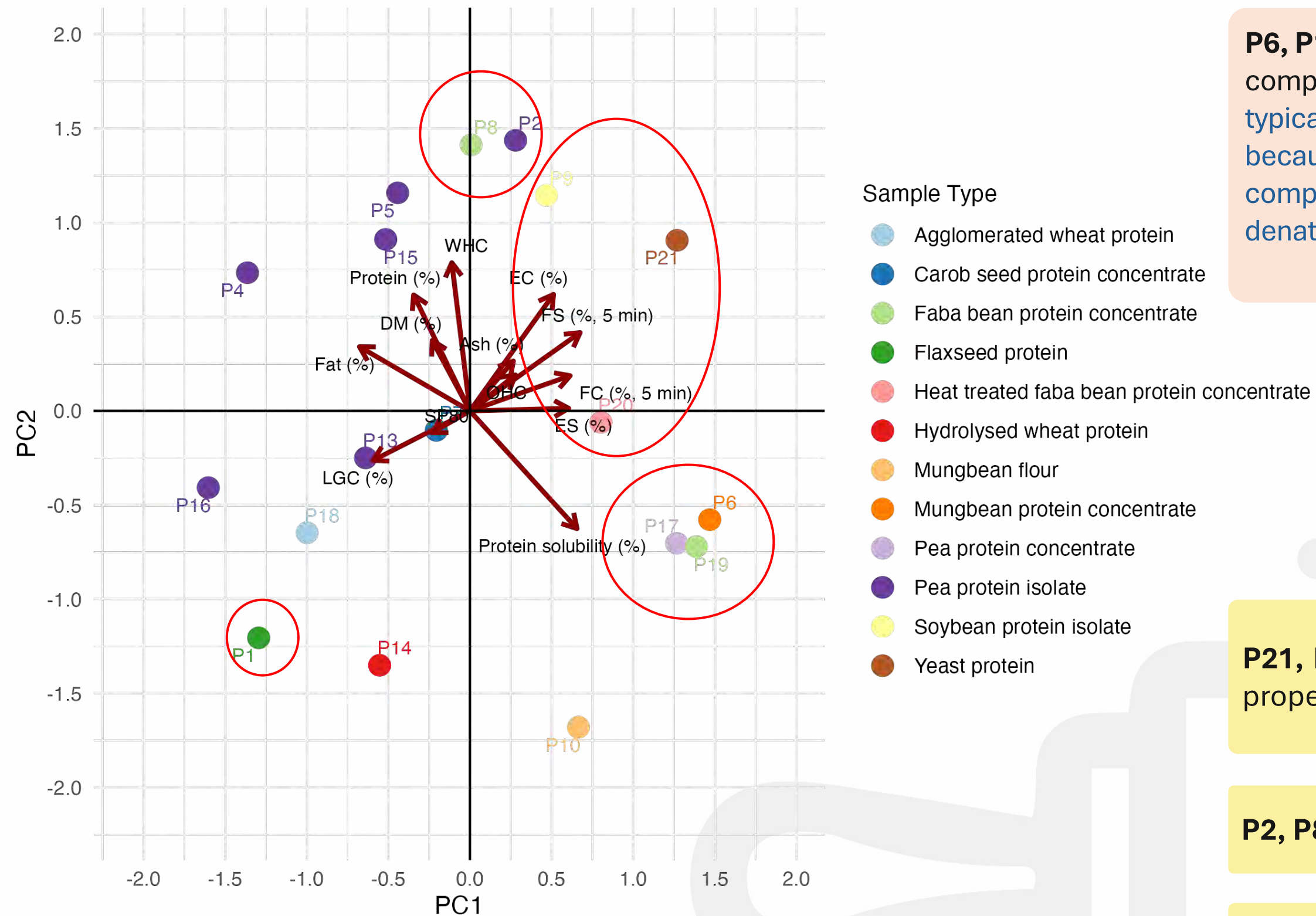
Samples with different functional profile highlight the multifaceted nature of egg replacement.

Different functional properties may be suited for different bakery applications

Ingredient selection should be driven by the specific functionality required by the target application.



PCA FUNCTIONAL PROPERTIES



P6, P17 and P19 (protein concentrates) have a high solubility compared to that of the protein isolates. Protein isolates typically have lower solubility than concentrates because their purification process removes other non-protein components, but can also increase protein aggregation and denaturation, which reduces solubility

P21, P20, P9 have a strong association with interfacial properties such as foaming and emulsification

P2, P8 have a high WHC

P1 didn't show foaming capacity or emulsion capacity (flaxseed -> high fiber content).



FROM INGREDIENT FUNCTIONALITY TO APPLICATION

INGREDIENT CHARACTERIZATION



DO FUNCTIONAL PROPERTIES TRANSLATE INTO PRODUCT PERFORMANCE?

50% egg replacement in sponge cake



Why 50% replacement?

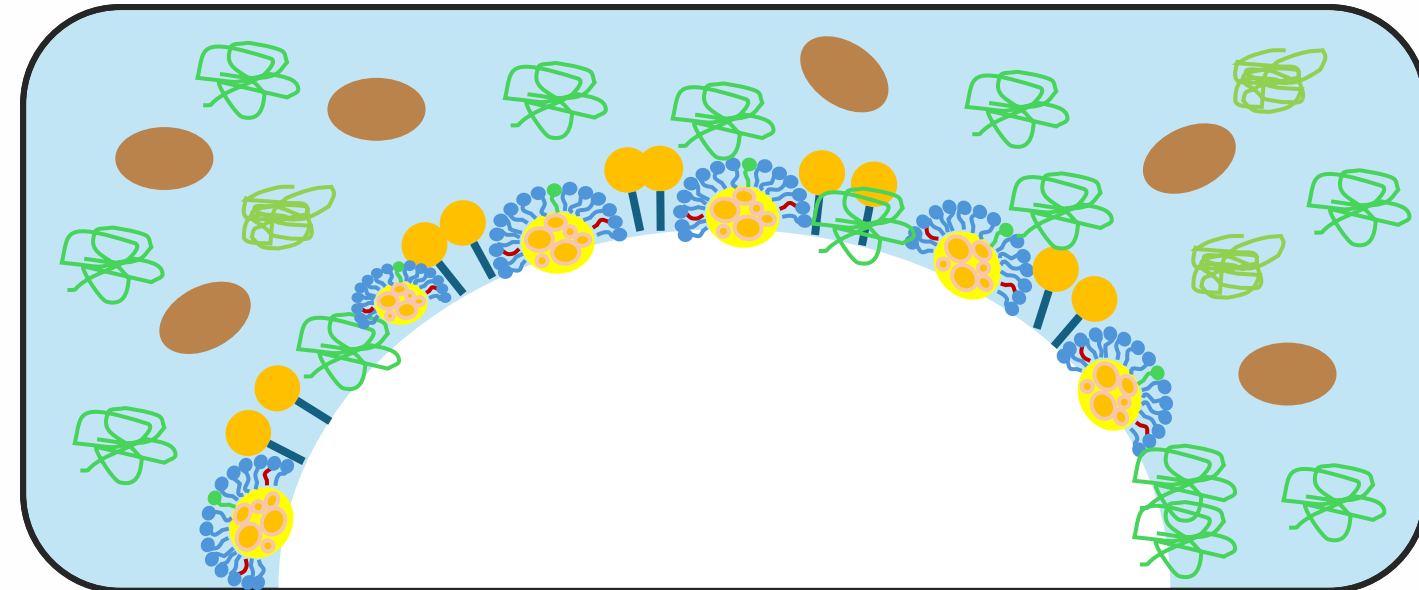
- Partial reduction of egg functionality
- Plant proteins introduced into a complex batter system
- Allowed comparison with the full-egg reference



AIR-WATER INTERFACE IN BATTERS

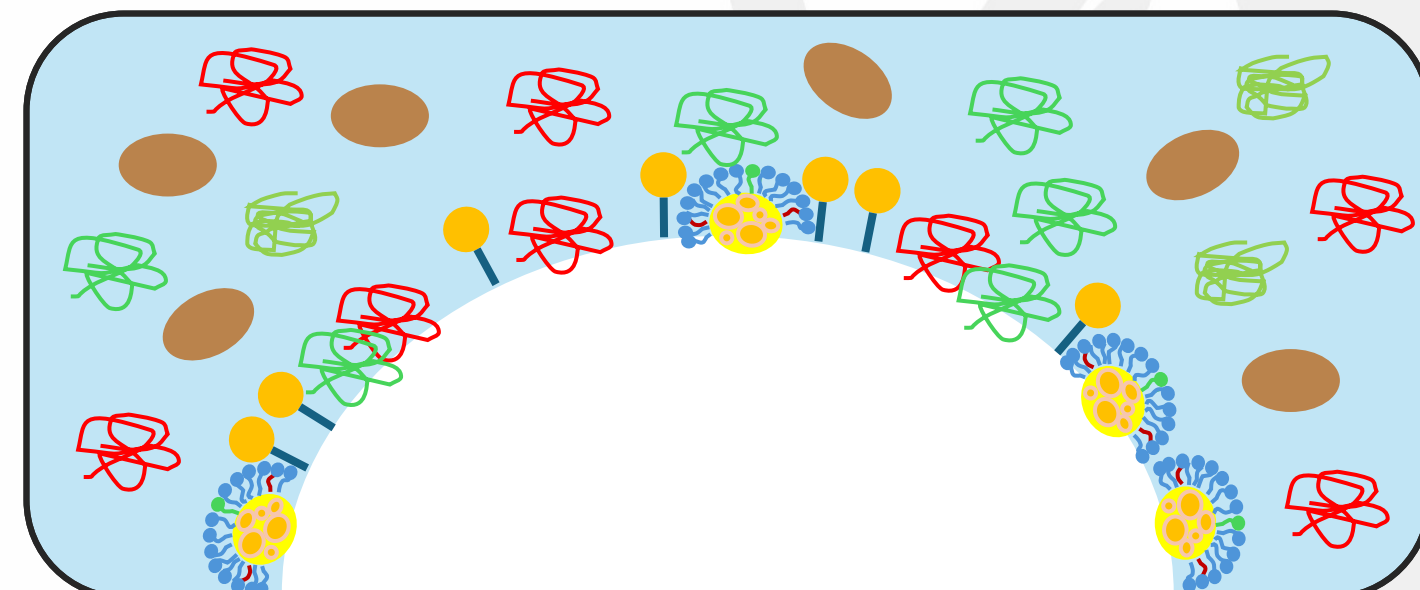
100% egg reference

- ✓ Full yolk lipid fraction
- ✓ Full phospholipid fraction
- ✓ Full egg proteins / lipoproteins



50% egg replacement

- ↓ Yolk lipid fraction
- ↓ Phospholipid fraction
- ↓ Egg proteins / lipoproteins
- ↑ Plant protein contribution



 Egg yolk LDL
 Phospholipids

 Wheat proteins
 Egg white proteins

 Starch granules
 Plant proteins



Key point
Partial egg replacement changes the composition of the interfacial film and the amount of egg derived surface active components.

TECHNIQUES USED TO INVESTIGATE THE EFFECT OF EGG REPLACEMENT

1. Batter formation and aeration



Mixing stage:

Batter viscosity increases, partly due to protein hydration and structural modification, starch hydration and air incorporation.

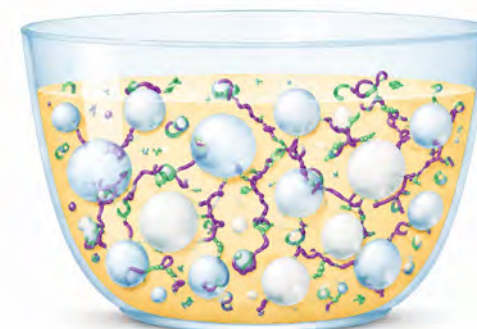
Technique applied:

- Batter density
- Microscopy (PLM)

Heating



2. Structure development



Baking stage:

Gas expansion, protein aggregation and starch gelatinization occur as overlapping events (modulated by the sugar).

Technique applied:

- Rheology (oscillatory)
- DSC (thermal transitions due to starch gelatinization and protein denaturation)

3. Setting



Ending of baking stage:

Water evaporation causes the formation of a rigid network, leading to the final setting of the cake matrix.

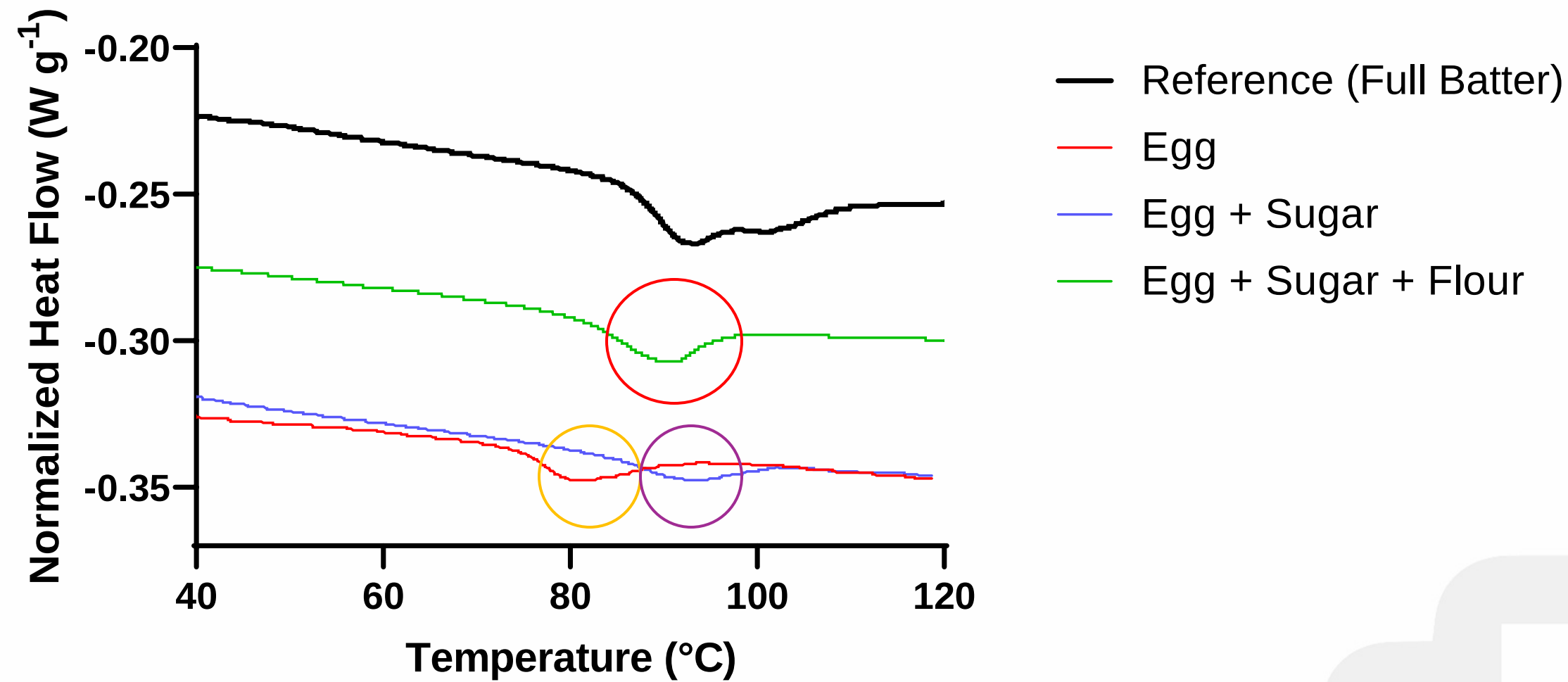
Technique applied:

- Volume, height, weight
- Texture profile analysis
- Crumb and crust color



BAKING – DYNAMIC STRUCTURAL TRANSFORMATION

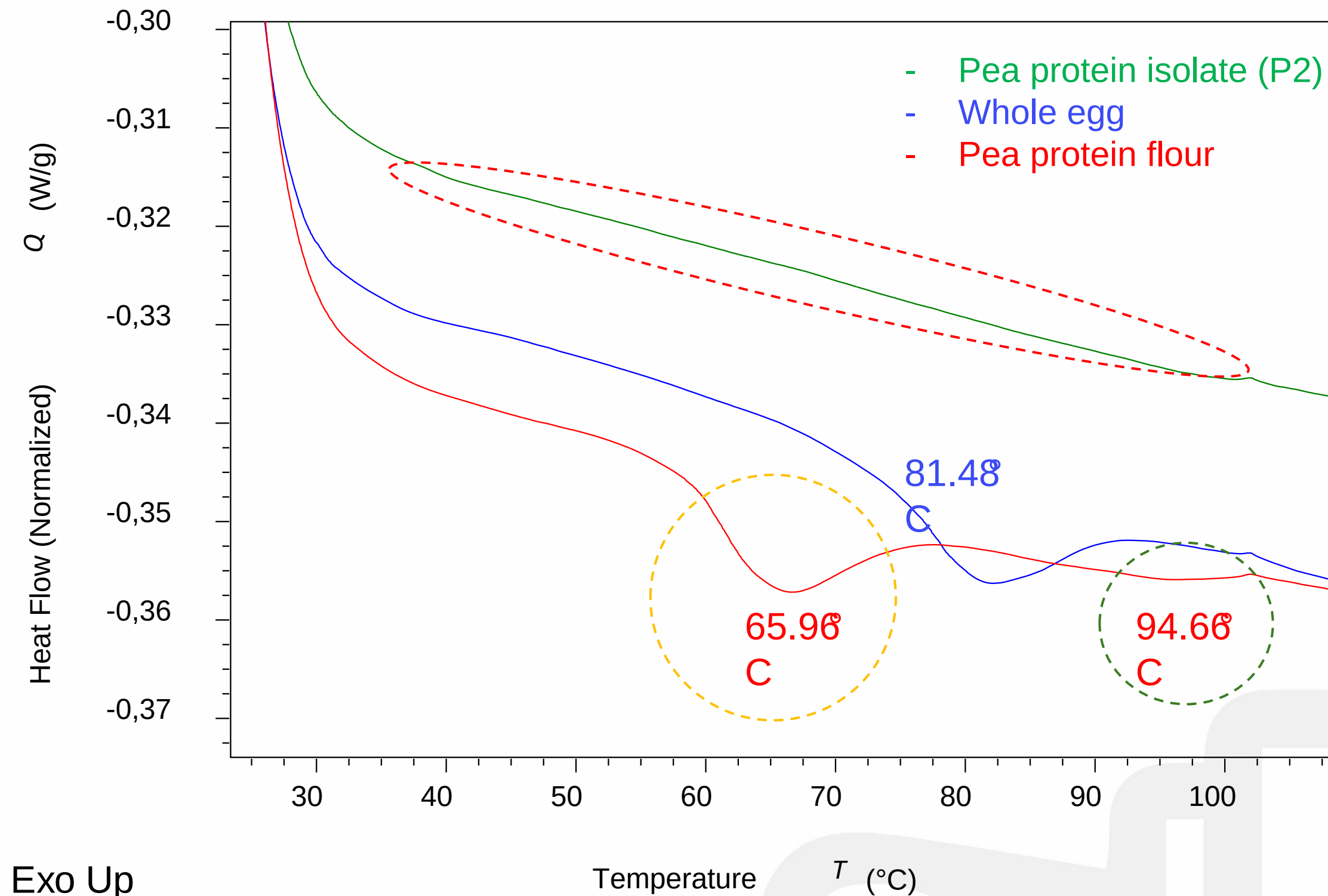
What happens during baking?



DSC revealed the effect of sugar on thermal transitions:

- Sugar shifted starch gelatinization to higher temperatures
- Sugar also affected temperature range of protein denaturation





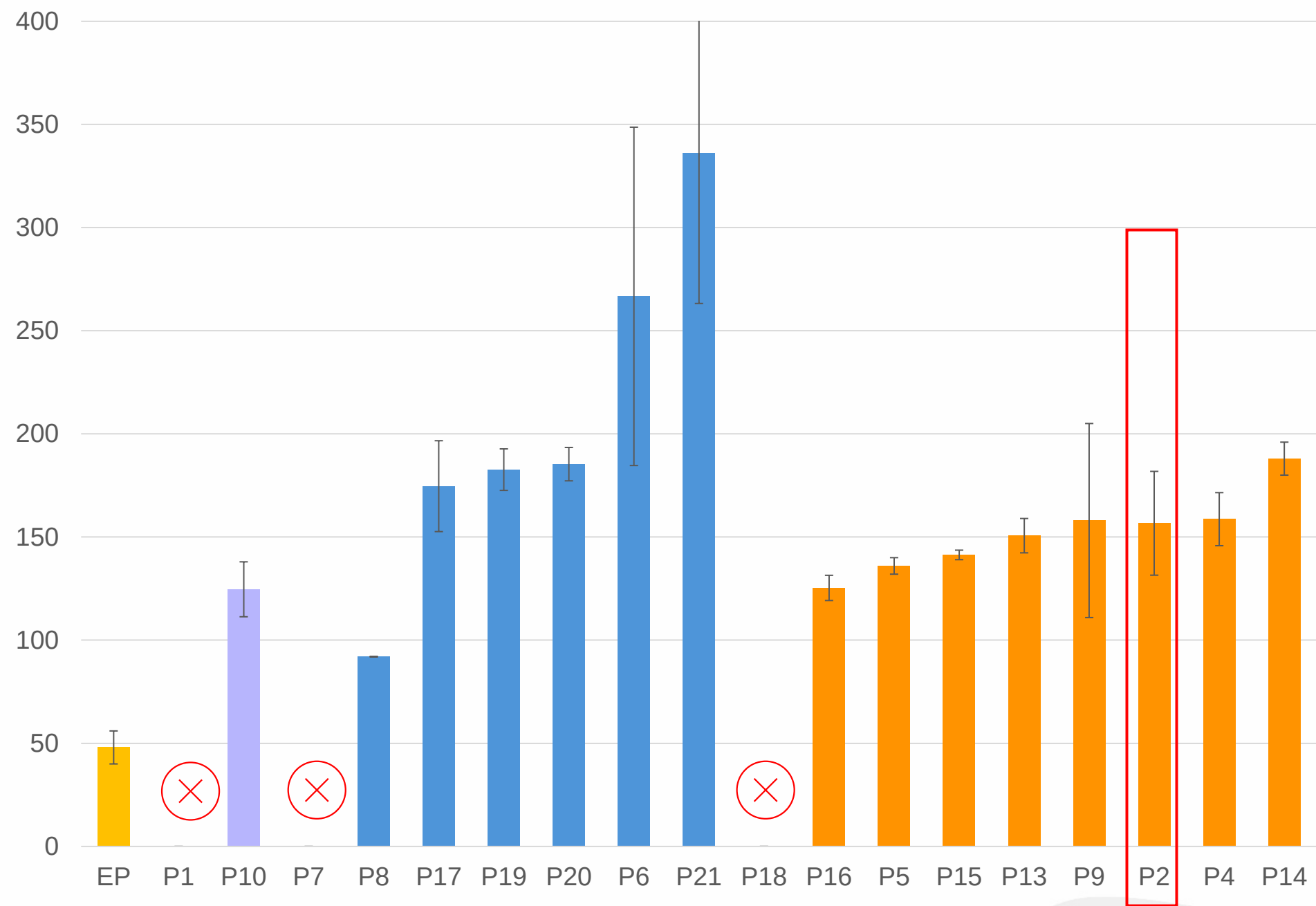
Observations:

- Starch gelatinization (60-70°C)
- Protein extraction methods (e.g. isoelectric precipitation, salt extraction) lead to denaturation and aggregation of proteins which makes it difficult to observe a transition in the DSC thermogram
- Legumin (11S) denaturation

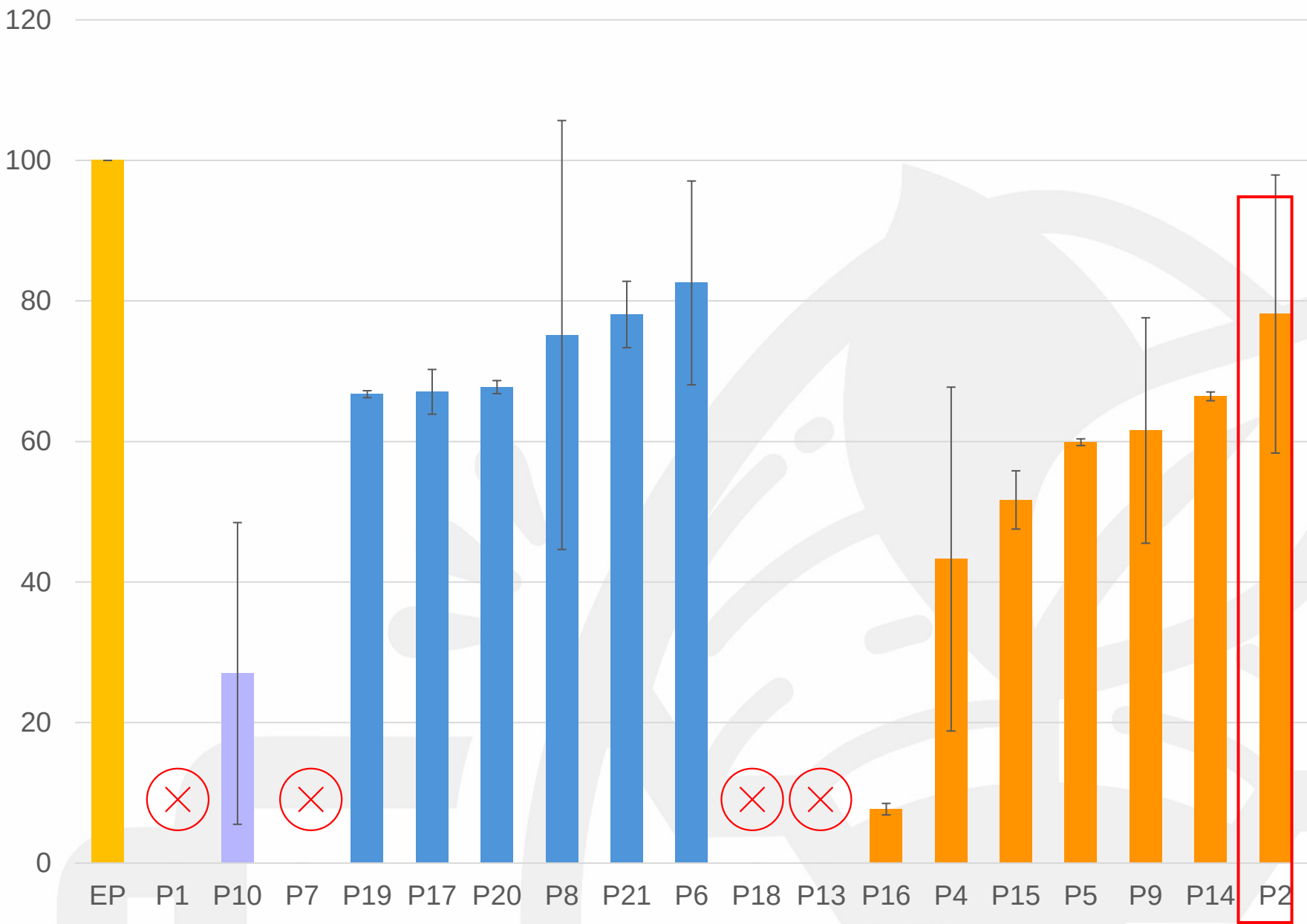
Unlike whole egg, the PPI does not show a denaturation transition. Consequently they don't have the same native molecular structure and flexibility which can affect their ability to adsorb or rearrange at interfaces.

FOAMING PROPERTIES

Foaming capacity (5 min, %)



Foaming stability (5 min, %)



SPONGE CAKE BATTER

Properties – density

Sample	Batter density (g/ml)	pH
Ref	0.557	7.1
P2	0.759	6.6
P4	0.488	6.3
P5	0.688	6.7
P13	0.823	6.6
P16	0.510	6.9
P17	0.560	6.4

Density significantly higher compared to the reference
(100% egg)

Observations:

Hydration step (20 min):

- P2: thickening
- P4: no thickening
- P5: thickening
- P13: slight thickening
- P16: no thickening
- P17: foam formation

Ribbon stage:

- P2: good consistency
- P4: good consistency
- P5: not enough air incorporation
- P13: lack of firmness
- P16: runny lacking aeration
- P17: good consistency



Key point

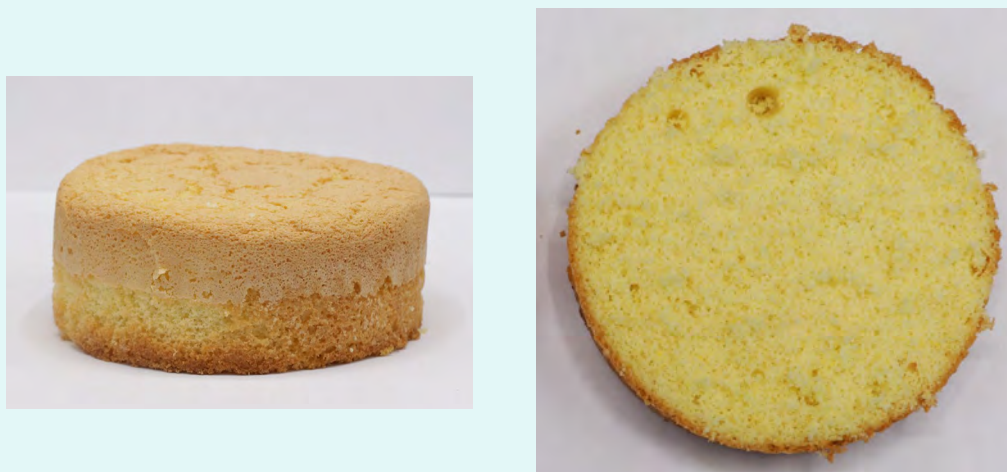
Incorporation and stabilization of gas are necessary for the cake to expand without collapsing.



FUNCTIONALITY DID NOT FULLY TRANSLATE INTO SPONGE CAKE PERFORMANCE

At 50% egg replacement, clear differences in cake quality were observed.

100% EGG REFERENCE



- ✓ High volume (100%), height (51.8 mm)
- ✓ Fine and uniform crumb
- ✓ Soft structure

50% EGG REPLACEMENT (P16)



- ⬇ Lower volume (78 %)
- ⬇ Height (41.7 mm)
- ⬇ Dense structure

50% EGG REPLACEMENT (P2)



- ⬇ Lower volume (68%)
- ⬇ Height (28.1 mm)
- ⬇ Dense structure



KEY POINT

Replacing egg changes more than individual functional properties, it affects the interactions within the complex batter system that are responsible for building and stabilizing the structure



CONCLUSIONS

- Egg replacing ingredients exhibit highly diverse techno-functional properties, reflecting differences in composition.
- No single ingredient provides all the functionalities associated with egg, highlighting the complexity of the egg.
- Functional properties (at ingredient level) alone do not predict the performance in bakery applications.
- At 50% egg replacement, changes in batter and sponge cake properties were already evident, indicating that partial replacement alters structure development.
- Successful egg replacement requires understanding functionality within the food matrix (air incorporation and stabilization, batter rheology, and structure setting).



NovoBake Closing Event Programme

Understanding the challenge

13:10-13:25	Why replace eggs? The challenge behind NovoBake
13:25-13:45	Functions of Egg & Challenges of Replacement
13:45-14:05	From ingredient to egg replacer: Techno-Functional Insights

14:05-14:15 Break

From research to bakery product

14:15-14:45	What works in bakery? Results from four applications
14:45-15:00	Sensory & Consumer acceptance: Does the consumer taste the difference?
15:00-15:15	From Product to Market: Opportunities for Egg-Replaced Bakery Products

Bringing it all together

15:15-15:20	Key takeaways from NovoBake
15:20-15:30	Closing, feedback & Acknowledgements

15:30-16:00 Tasting session with Madam Bakster





What works in bakery? Results from four applications

Ferre Rebry

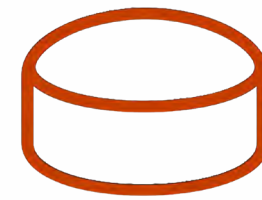
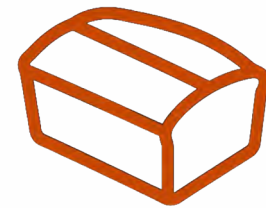


What works in bakery?

Results from four applications

Four applications, four different challenges:

Pound cake | soft waffles | sponge cake | choux pastry



The practical question is not “Which egg replacer is best?”, but “What problem am I trying to solve in this product?”

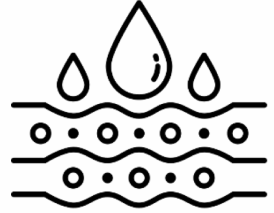


One ingredient, several jobs



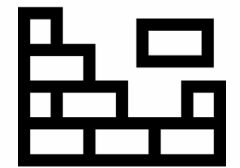
Foaming

The proteins in **egg white** help form and stabilise small air bubbles when the batter is whipped.



Emulsifying

The proteins and phospholipids in **egg yolk** help water and fat mix evenly, resulting in a smooth and stable batter.



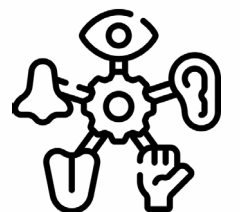
Structure

During baking, **egg proteins** gel and help set the structure, allowing the product to better retain its shape and volume.



Water-binding

The water-binding capacity of **egg proteins** helps retain moisture and contributes to a moist crumb.



Sensory

Egg yolk contains yellow pigments that give batters a yellow colour. Maillard reactions also contribute to aroma and flavour development..



What does success look like in each product?



Pound cake

- Stable rise
- Fine crumb
- Good moisture and fat retention



Soft waffles

- Good batter flow
- Full mould filling
- Clean release and good integrity



Sponge cake

- High volume
- Fine, even and stable crumb



Choux pastry

- Strong expansion
- Large hollow cavities
- Thin but stable shell

Each application is different. Egg does not need to do the same job in every product.



Four products, four different bottlenecks



Pound cake

Main challenge:

Keeping the cake stable while it rises



Soft waffles

Main challenge:

Batter must spread well, while the baked waffle must hold together and not stick



Sponge cake

Main challenge:

Creating enough air, and retaining it until the structure is set, with a fine dispersion of air cells



Choux pastry

Main challenge:

The batter must expand freely, then form a thin but stable wall, and leave the inside of the choux hollow

Same ambition, different product logic: each application needed a different route to a useful result.



A robust method for testing an egg-replacer

- 1 Start with a stable reference recipe with egg
- 2 Determine what you remove with the egg
- 3 Choose a well-founded starting dosage for the egg-replacer and water

What are the 'well-founded' options?

- Supplier recommendation
- Approximate egg water/dry matter content
- Approximate egg protein content

But these are only starting points. The oven tells us whether they actually work.

- 4 Evaluate both the batter and the baked product



Approx. Composition of a medium sized egg (~50g):

- ~ 38 g water
- ~6 g protein
- ~5 g fat
- ~0.5 g carbohydrates



A pound cake case study: 100% egg replacement with B10

B10: a blend based on faba bean protein and tapioca starch

Egg-reference	100% B10 – dry matter recipe
	
	

4

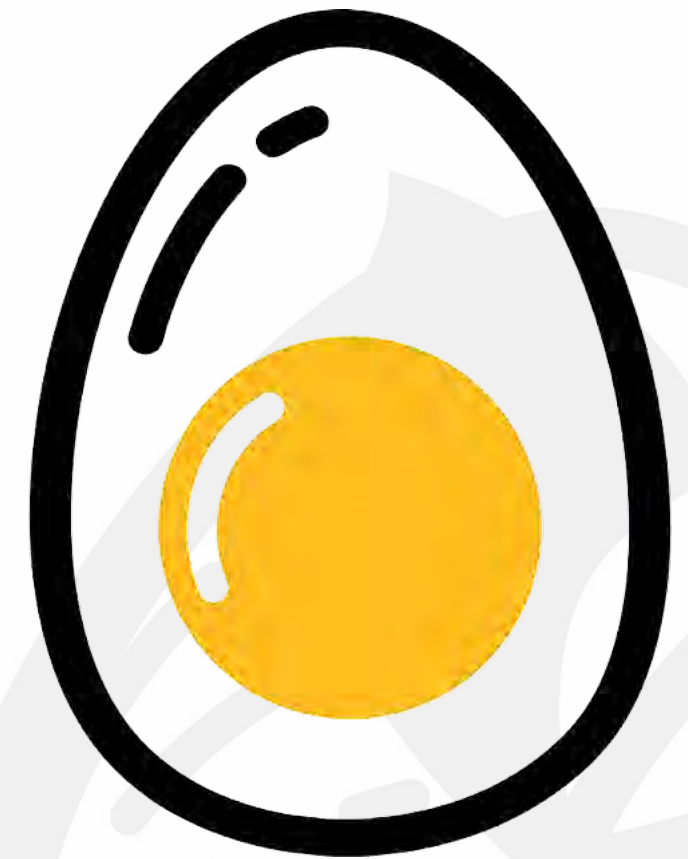
Evaluate both the batter and the baked product

- Lower cake volume
- Cake collapse during cooling
- Greasy crumb or visible fat print on paper
- Crumb structure less cohesive
- Cake is less yellow



A robust method for testing an egg-replacer

- 1 Start with a stable reference recipe with egg
- 2 Determine what you remove with the egg
- 3 Choose a well-founded starting dosage for the egg-replacer and water
- 4 Evaluate both the batter and the baked product
- 5 Adjust the process and egg-placer-to-water ratio if needed
- 6 Only then make targeted adjustments with functional ingredients



Practical tip:

When adjusting the recipe, change one variable at the time and reevaluate.



A pound cake case study: 100% egg replacement with B10

B10: a blend based on faba bean protein and tapioca starch

Egg-reference	100% B10 – dry matter recipe	100% B10 – protein recipe	100% B10 – protein recipe + 20 min hydration
			
			

5

Adjust the process and egg-placer-to-water ratio if needed

Try a different B10/water ratio:

- Replace egg on protein basis (~15% less B10)

Adjust the process:

- Allow the B10 and water mixture to hydrate for 20 minutes.

Even with the same egg replacer, the replacer-to-water ratio and powder hydration affect cake shape and structure.



A pound cake case study: 100% egg replacement with B10

B10: a blend based on faba bean protein and tapioca starch

100% B10 – protein basis	100% B10 – protein basis + extra leavening	100% B10 – protein basis + sunflower lecithin	B10 – dry matter basis	B10 – dry matter basis + HPMC**
				
				

*pound cake reference dosage is ~10g baking powder for 350g flour

** Hypromellose (E464)

6

Only then make targeted adjustments with functional ingredients

Leavening agent

- 20% extra on top of reference dosage*
- No clear volume gain; collapse increased at higher dosages.

Sunflower lecithin

- No clear effect on fat imprint; higher dosages caused increasing collapse.

HPMC

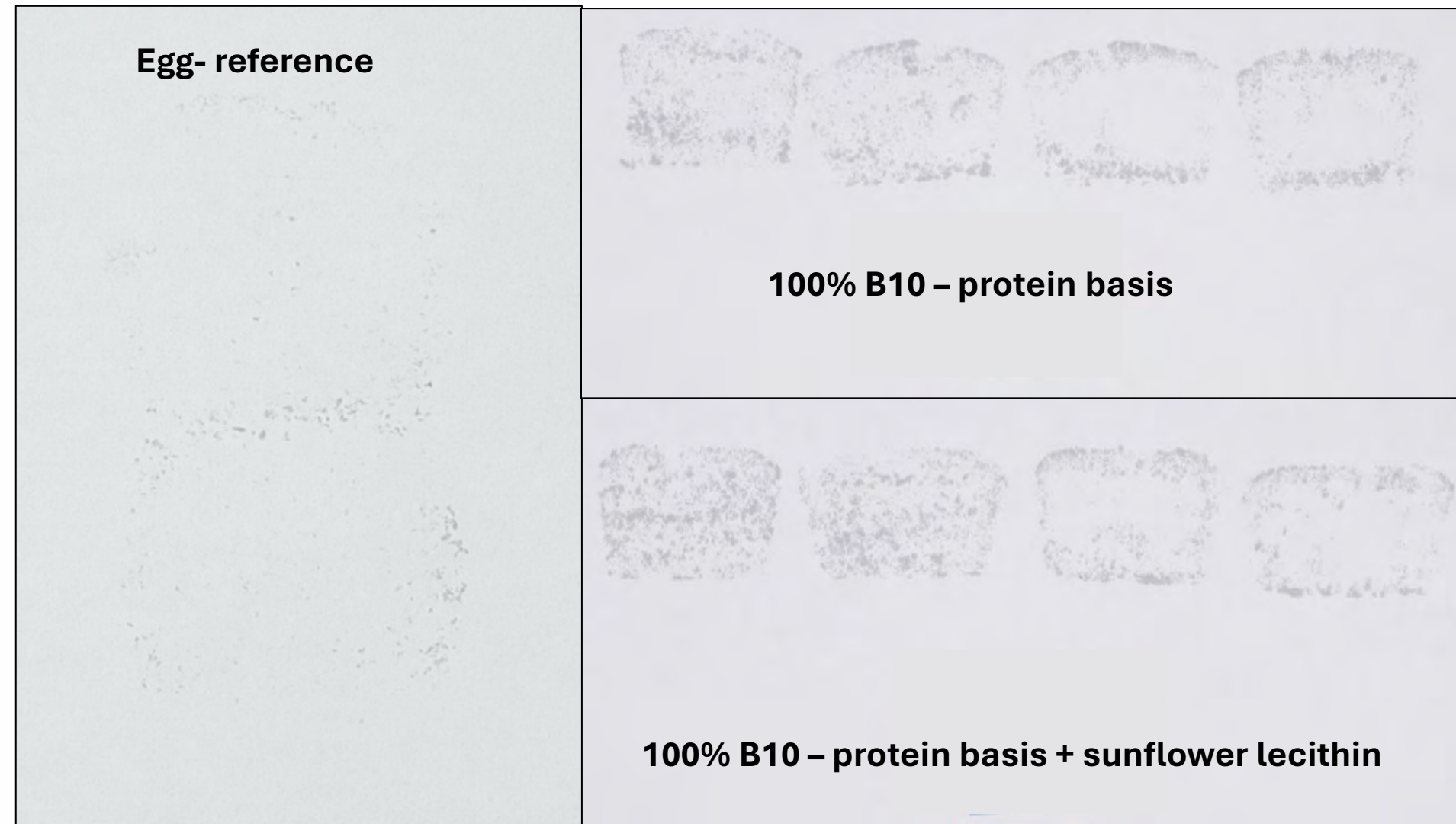
- Improved shape stability, but not necessarily volume; the cake was slightly firmer.

Extra leavening and lecithin did not improve the result; 0.5% HPMC improved shape stability, with no added benefit from combining it with lecithin or leavening.



A pound cake case study: 100% egg replacement with B10

B10: a blend based on faba bean protein and tapioca starch



6

Only then make targeted adjustments with functional ingredients

Leavening agent

- 20% extra on top of reference dosage*
- No clear volume gain; collapse increased at higher dosages.

Sunflower lecithin

- **No clear effect on fat imprint;** higher dosages caused increasing collapse.

HPMC

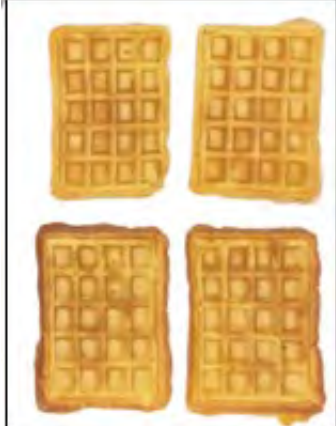
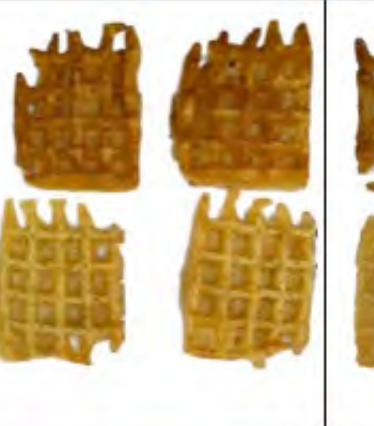
- Improved shape stability, but not necessarily volume; the cake was slightly firmer.

Adding lecithin did not clearly reduce the greasy imprint.



A soft waffle case study: 100% egg replacement with B8

B8: an egg replacer based on wheat protein

Egg-reference	100% B8 – dry matter recipe	100% B8 – 1:4 ratio soy milk	100% B8 – 1:4 ratio water	100% B8 – protein recipe
				
				

Note: The protein-based formulation contained ~40% less B8; the 1:4 water formulation ~25% less B8.

5

Adjust the process and egg-replacer-to-water ratio if needed

Testing different B8/water ratios:
More replacer was not necessarily better.

- The supplier recommended a 1:4 ratio with soy milk
- Reducing the amount of B8 and adding more water improved batter flow and mould filling
- The protein-based formulation gave the best overall shape

Adjust the process:

- Slightly underbaked waffles with B8 showed much more sticking than the reference
- Ensure sufficient baking before opening the waffle iron

The replacer-to-water ratio strongly affected batter flow and mould filling. The protein-based formulation gave the best shape, but still did not match the egg reference for flow and release. At the same 1:4 ratio, soy milk also produced a harder waffle than water.



A soft waffle case study: 100% egg replacement with B8

B8: an egg replacer based on wheat protein



100% B8 – protein recipe + 3 g leavening agent /100g flour

6 Only then make targeted adjustments with functional ingredients

Potato starch:

- Replaced 8% of the wheat flour
- Slightly improved batter flow; other properties changed little.

Leavening agent:

- Tested at ~1.5 and ~ 3 g/100g flour
- Low dosage gave no clear structural benefit
- higher dosage reduced waffle integrity

Sunflower lecithin:

- 0x, 2x and 3x the reference dosage (=0.15% of batter)
- Without lecithin, sticking was severe
- higher dosages did not further improve release or fat print

Potato starch slightly improved flow, extra leavening weakened waffle integrity, and lecithin was important for release, but more was not better.



A sponge cake case study: 50% egg replacement with P19

P19: a faba bean protein concentrate used as an egg replacer

Egg-reference	50% P19	50% P19 + whipping agent	50% P19 + leavening agent
			
			
Height = 60.7 mm	Height = 41.1 mm	Height = 43.4 mm	Height = 46.8 mm

***Whipping agent:** a commercial bakery improver used to help incorporate and stabilise air during whipping. Most of the aeration gain occurred within ~10 min of whipping; higher dosages showed diminishing returns.

50% P19 – protein recipe

- Lower height and volume
- Darker, more brown crumb

6 Make targeted adjustments with functional ingredients

Whipping agent*

- 5% of dry ingredients; ~10 min whipping
- Very good batter eardation, but only limited gain in final height and volume
- Crumb was lighter and less cohesive

Leavening agent

- ~4.5 g baking powder/100 g flour + starch
- Clearly improved height and volume, but not to the level of the reference
- Crumb was darker and less yellow, and less cohesive

More air in the batter does not automatically mean a higher sponge cake; it must also be retained during baking.

Sponge cake: crumb differences at 50% P19 replacement

P19: a faba bean protein concentrate used as an egg replacer

Egg-reference



50% P19



50% P19
+ whipping agent



50% P19
+ leavening agent



Whipping agent gave a lighter but less cohesive crumb, while leavening improved height and springiness, although the crumb remained darker than the egg reference.



What about 100% egg replacement?

P19: a faba bean protein concentrate used as an egg replacer

100% egg replacement remained more difficult

The batter could still be well aerated, but the structure could not retain enough air during baking. Even with a whipping agent, leavening agent and HPMC, the sponge remained clearly lower than the egg reference.



100% P19 + whipping agent + leavening + HPMC
Height: 28.4 mm

Practical tip – adapt the product format if needed

A tall sponge cake is more difficult to keep stable during baking when replacing egg. A thinner sponge sheet is often more forgiving and can give a better result.



A choux pastry study: 50% egg replacement with P21

P21: a yeast protein concentrate used as an egg replacer

Egg-reference	50% P21	50% P21 + 8% potato starch
		
		

50% P21 – protein recipe

- More compact internal structure
- Fewer large hollow cavities

6 Make targeted adjustments with functional ingredients

Potato starch*

- 8% and 16% of the wheat flour was replaced
- 8% more consistently produced larger cavities and was the most promising level

Watch out – balance expansion and shell strength

A strong protein structure can restrict expansion. Replacing flour with starch can make the structure more flexible and promote larger cavities, but weaken it too much and the shell becomes brittle.

Aim for a balance between expansion and shell strength. A stronger structure is not always better.



What about 75% of egg replacement?

P21: a yeast protein concentrate used as an egg replacer

75% P21	75% P21 + high dose of leavening agent
	
	

Could extra gas compensate for the higher replacement level?

Leavening agent

- At 50% P21, ~3 g baking powder/100 g flour gave no clear improvement in volume or cavity size
- At 75% P21, a high dose still did not create larger cavities or
- Instead, it produced a finer, more cake-like internal structure

More gas does not automatically mean better expansion.

If the structure cannot expand in the right way, extra leavening may create many small pores instead of larger cavities.



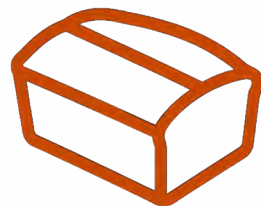
So, what works in bakery?

Four product-specific lessons from NovoBake

Pound cake

Stability first.

More gas does not help if the structure cannot hold it. Get the replacer–water balance right first; HPMC improved shape stability in our formulation.



Soft waffles

Batter and process first.

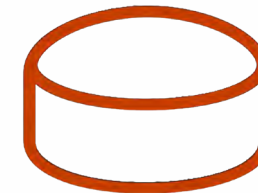
The batter must spread, release and hold together. More egg replacer was not necessarily better, and sufficient baking was important for release.



Sponge cake

Air must survive baking.

Whipping agents and leavening can help with aeration and expansion, but good aeration does not guarantee final height. Air must be retained until the structure sets.



Choux pastry

Expansion versus shell strength.

Partially replacing flour with starch made the structure more flexible and promoted larger cavities, but too much weakening can make the shell brittle.



Across all four applications: get the egg-replacer–water balance and process right first. Only then use functional ingredients to target a specific remaining problem.

The practical question stays the same: not “Which egg replacer is best?”, but “What problem am I trying to solve in this product?”



Next question: if the product works technically, how does the consumer perceive it?



**Sensory and consumer acceptance:
Does the consumer taste the difference?**

Simoun Rainier Bayudan



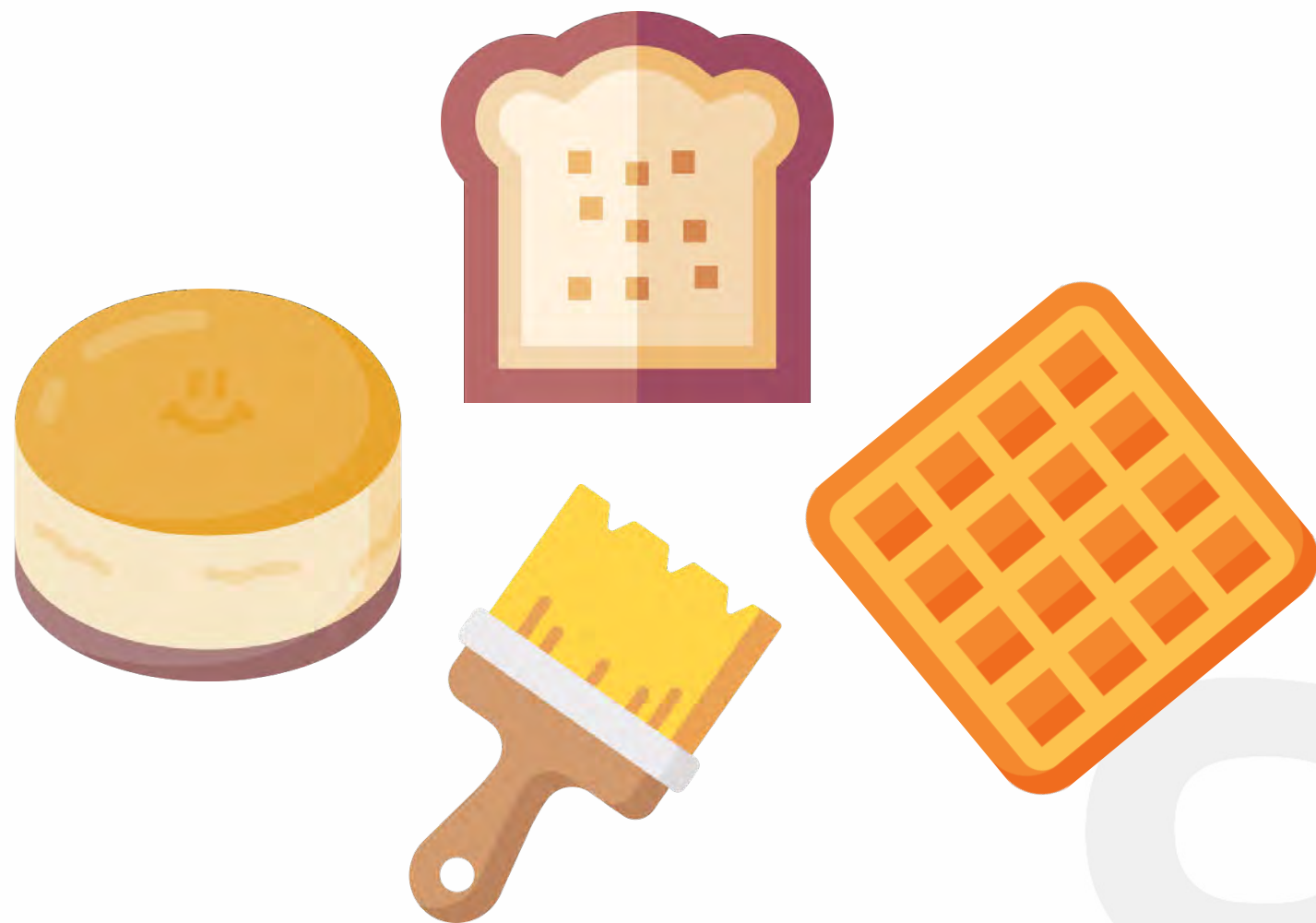


Overview of Sensory Tests Conducted and Main Findings



Bridging Technology to the Consumer

- Consumer tests done on different model systems and with different approaches (via trained or untrained panels)

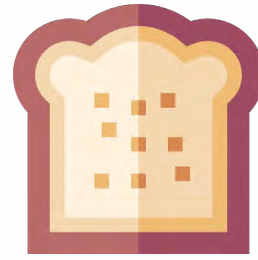


Trained panel for
characterizing
descriptively
product attributes

Untrained panels for
general acceptance
measurements



Case: Pound Cake



- Two types of tests for a basic pound cake matrix → Testing different egg replacers and different gradients



Sensory
analysis



Ref



Blend B9



Blend B8



Blend B14



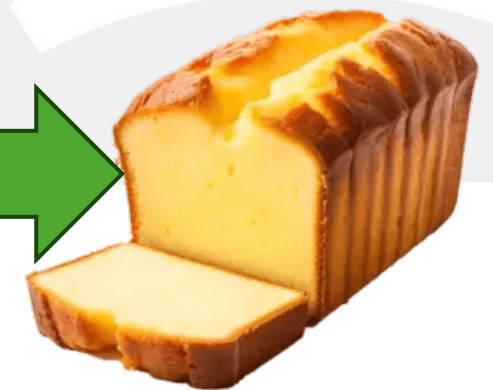
Sensory
analysis



Ref



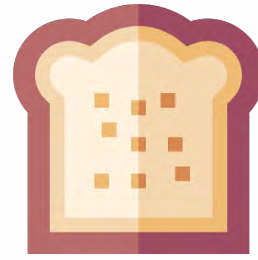
10% Sub.



50% Sub.

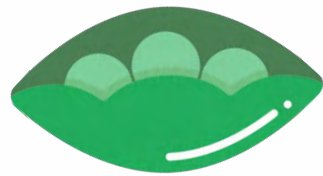


Case: Pound Cake



Testing Different Types

- Legume based egg alternatives generated more off-flavors and were deemed less desirable

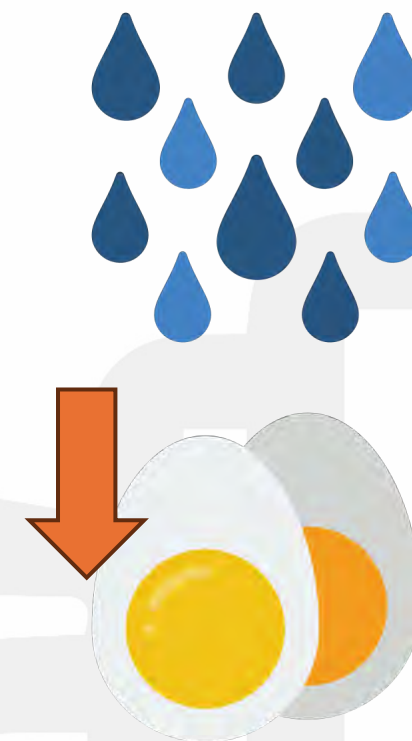


- Wheat proteins and starches seem to be comparable with eggs for making pound cakes



Testing Different Gradients

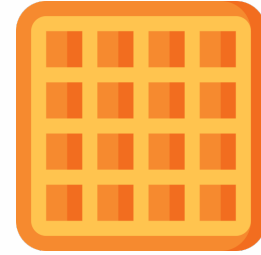
- Noticeable differences were observed up to 50% substitution of egg alternatives:



- Stickier, more moist textures
- Lesser egg flavor, more aftertastes



Case: Waffle



- Egg waffles follow a similar recipe with pound cakes but have different preparation techniques for different end points.

Consumer Considerations:

Appearance – Structure, color

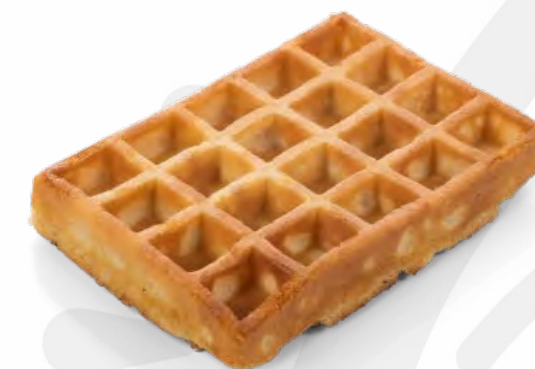
Aroma – Sweet and buttery aroma

Texture – Crisp exterior and softer or fluffier interior

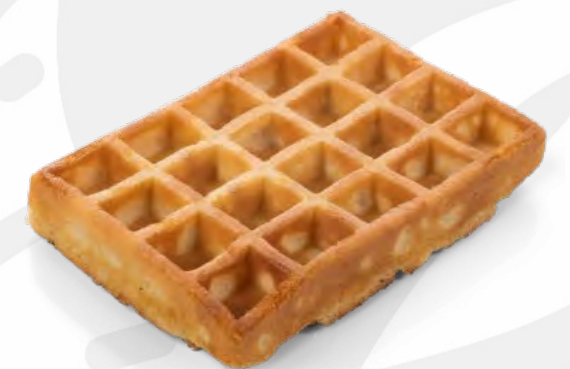
Taste/Flavor - Characteristic egg waffle



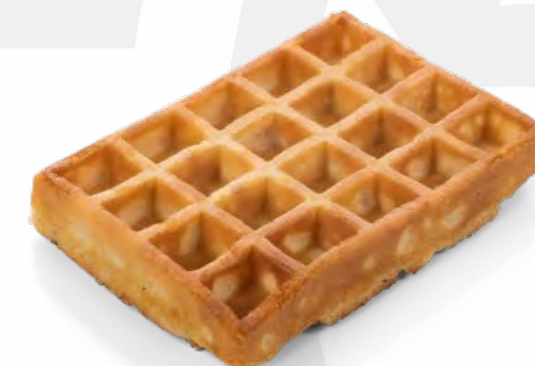
Sensory
analysis



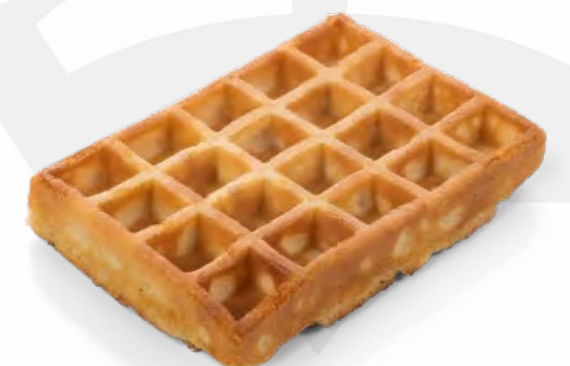
Ref



Blend B9



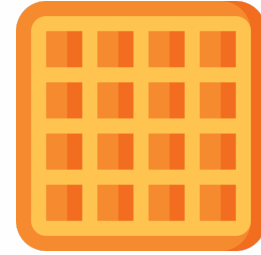
Blend B8



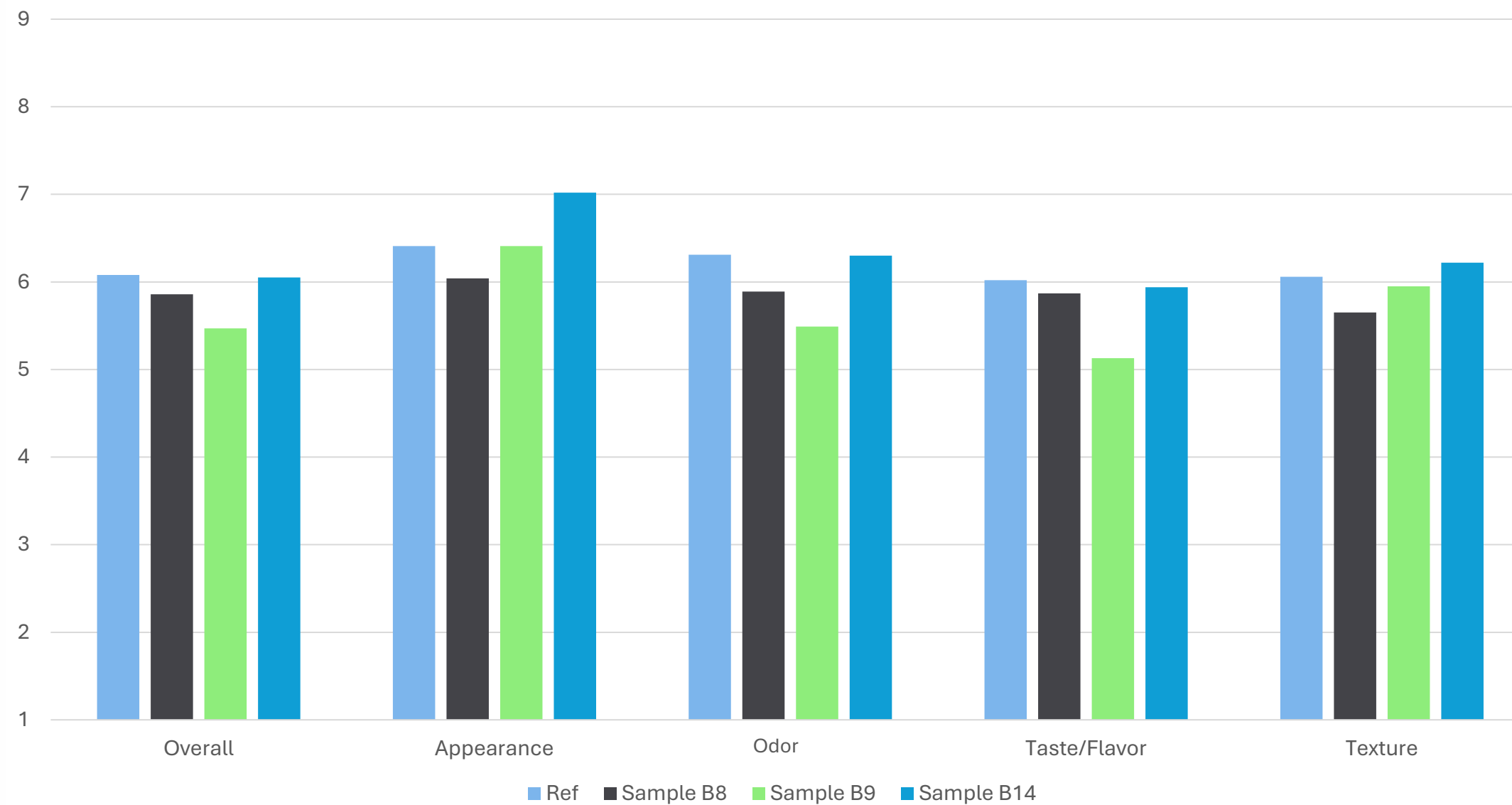
Blend B14



Case: Waffle



- Fewer differences observed when it comes to appearance, aroma, taste/flavor, and texture.



Case: Sponge Cake



- Sponge cakes eventually rely on sufficient aeration to generate sufficient volume for a typical sponge recipe.

Consumer Considerations:

Appearance – Structure, color, matte surface

Aroma – Eggy

Texture – Light sponge with a springy feel

Taste/Flavor - Eggy



Sensory analysis



Ref



Commercial
Mix (100%)



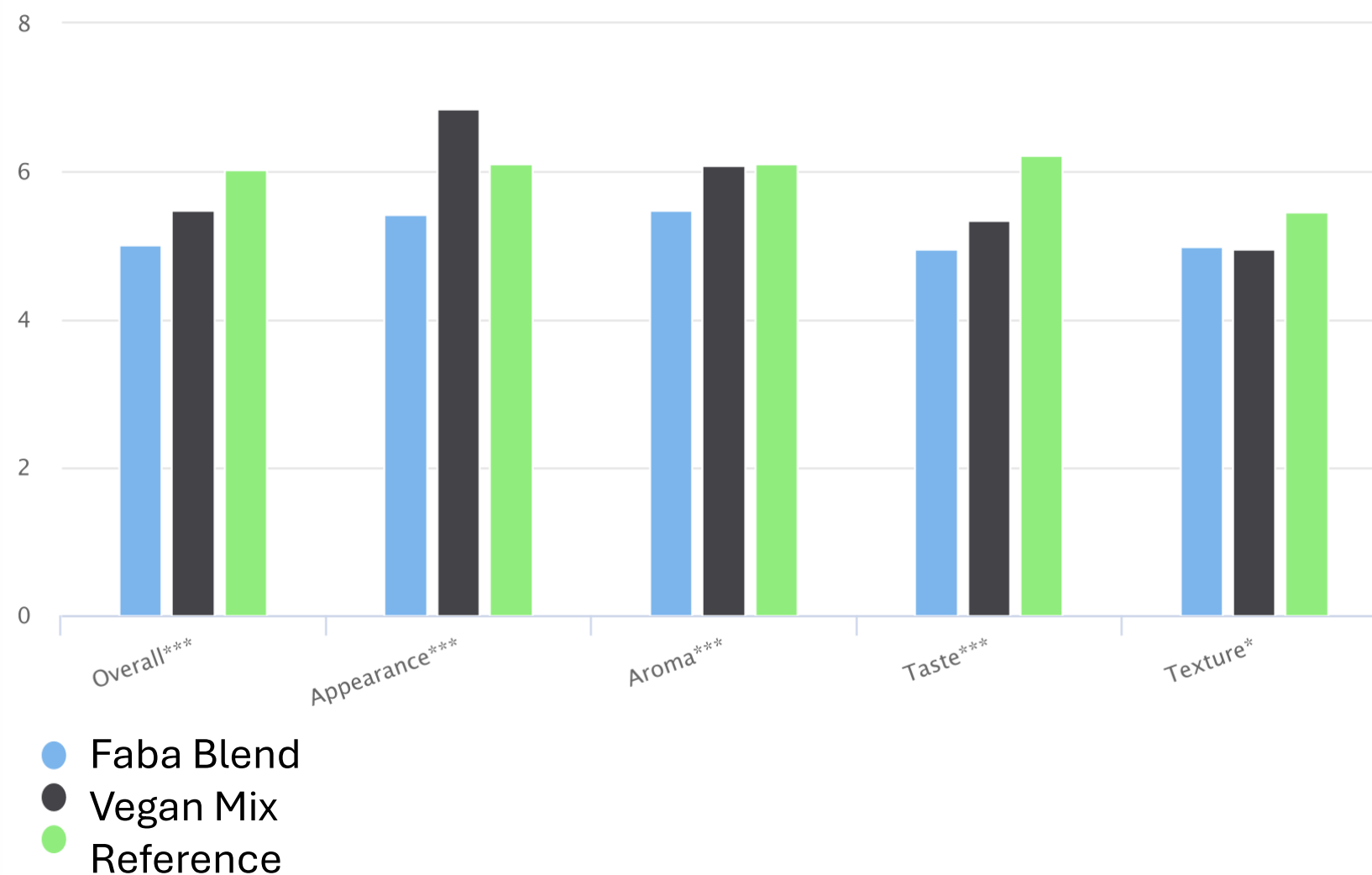
Faba
Blend (50%)



Case: Sponge Cake



- The performance of alternatives compared relatively inferior with the reference formulation.



Future orientation:

- Combination with other sponge cake components/ingredients for potential masking effects

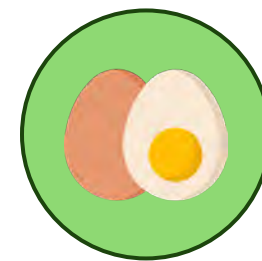


Case: Egg Wash

- Special application of egg alternatives for egg washes, focusing on visual impact for bakery products (sandwich)



Four washes compared:



Ref



1



2



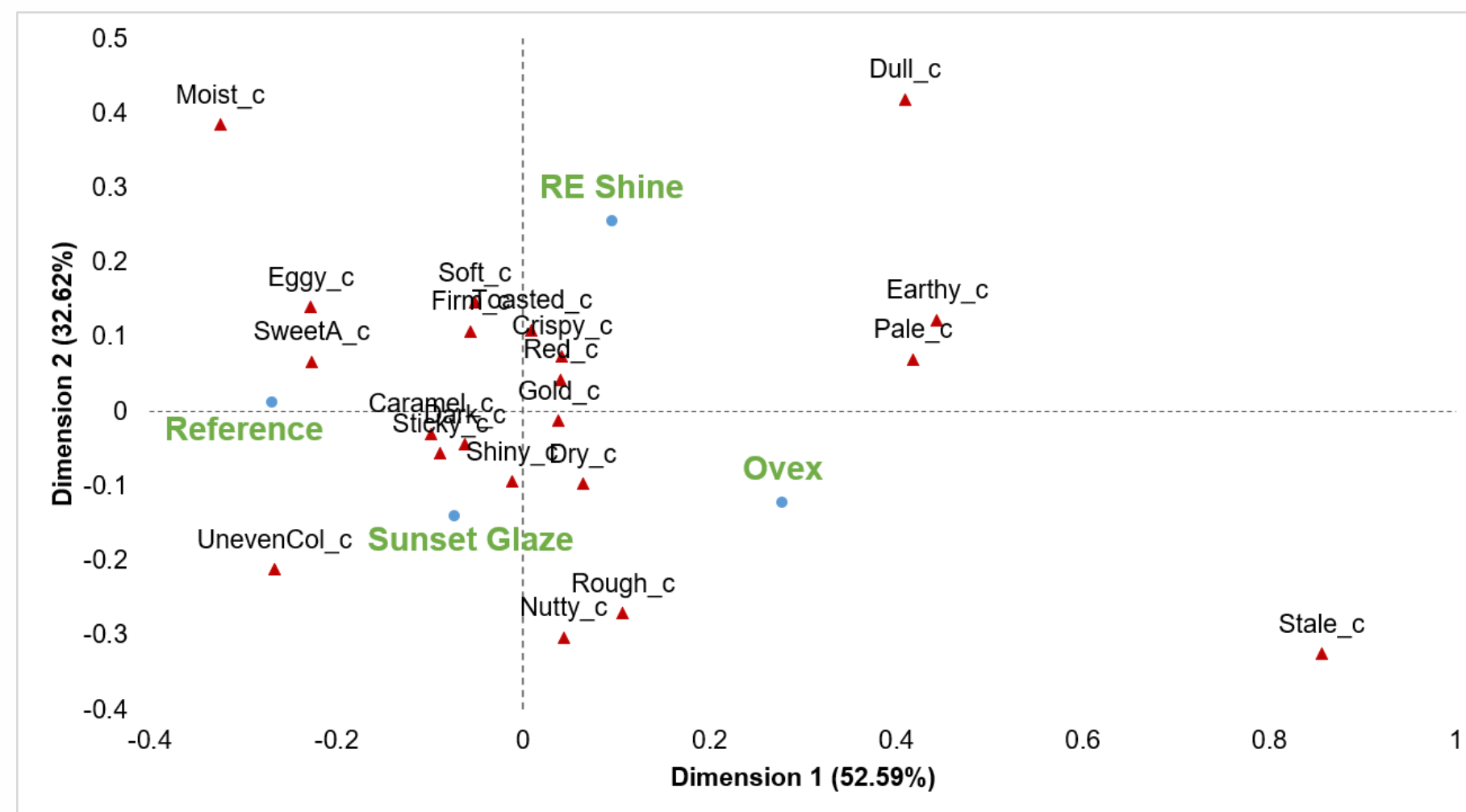
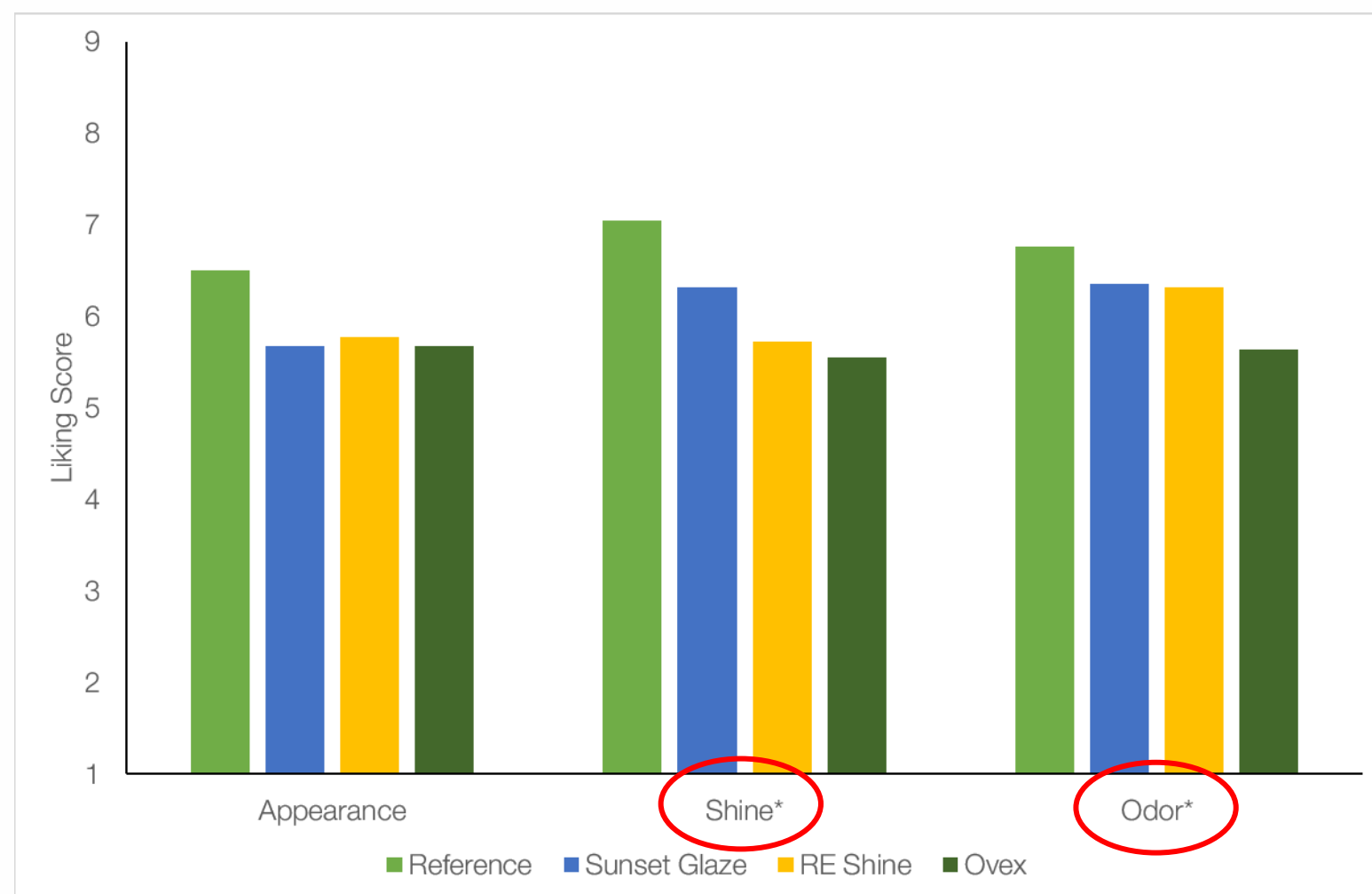
3



Main variables observed:
Appearance, Shine, Odor,
Sample characteristics



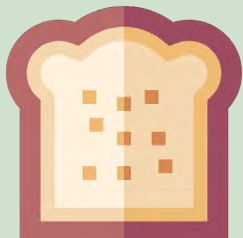
Case: Egg Wash



- Overall appearance seemed comparable across washes; shine and odor had varying results.



Summary – How do egg alternatives perform?

Product	Overall Liking	Appearance	Odor	Taste/Flavor	Texture
 Pound Cake					
 Waffle					
 Sponge Cake					
 Egg Wash				X	X

**Depends on blend amount*

**Depends on blend type*

**Color*



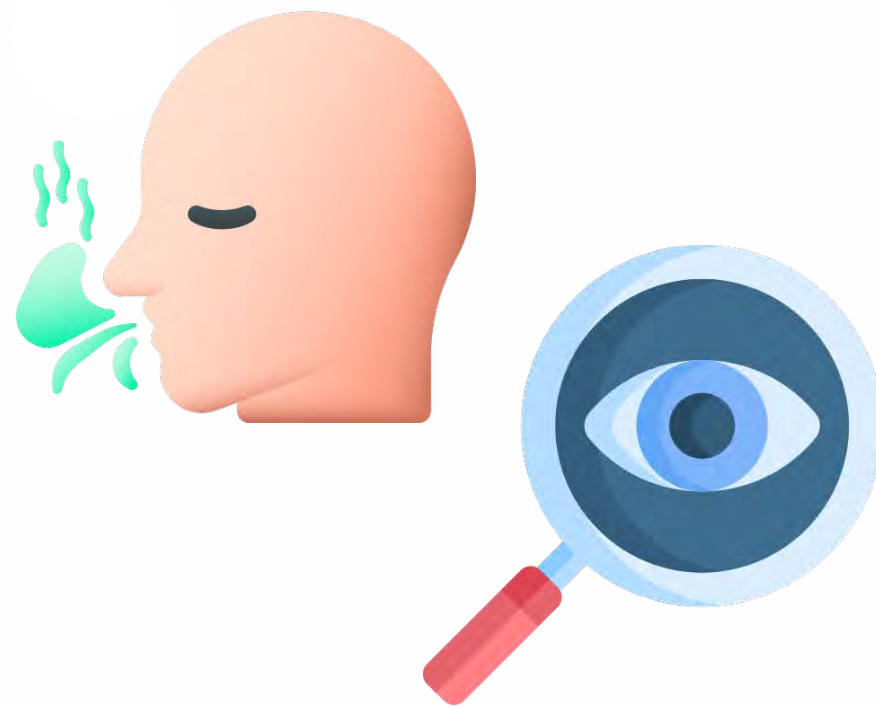


Application and Implications

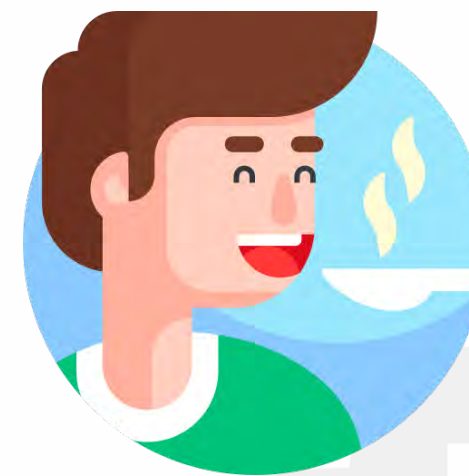


The Niche for Egg Alternatives

- Across various sensory modalities, egg alternatives provide different ranges of impact:



Visual and
Olfactory
modalities
~



Taste/Flavor and
Texture modalities
~~~



*Overall acceptance remains a function of how different modalities have been perceived.*



# Finding a Working Gradient

- Varying optimal thresholds for incorporating egg alternatives in bakery recipes → Considering trade-offs in the finished product and sensory acceptance



*Egg alternative blends can compete with 100% egg recipes*



*Implications on how to introduce egg alternatives to consumers*





**The Way Forward**



# Does the consumer taste the difference?

- Consumers can indeed taste the difference, across certain sensory modalities.



Texture / Mouthfeel  
Differences



Taste / Flavor  
Differences

- Beyond consumer-level differences from egg alternatives, the role of presentation and communication affects perceptions.



# Does the consumer taste the difference?

- Is the difference perceived a desirable difference? A desirable difference perceived by whom?



Ethics and  
Animal Welfare



Health and  
Sustainability



Quality  
Orientations



General Market  
Preferences





# From Product to Market: Opportunities for Egg-Replaced Bakery Products

Freek Van Baelen



# Aim

- Gain insights into current use of egg replacement in the biscuits and bakery market
- Gain insights into consumer perceptions of egg replacement
- Describe the key consumer segments with regards to egg replacement

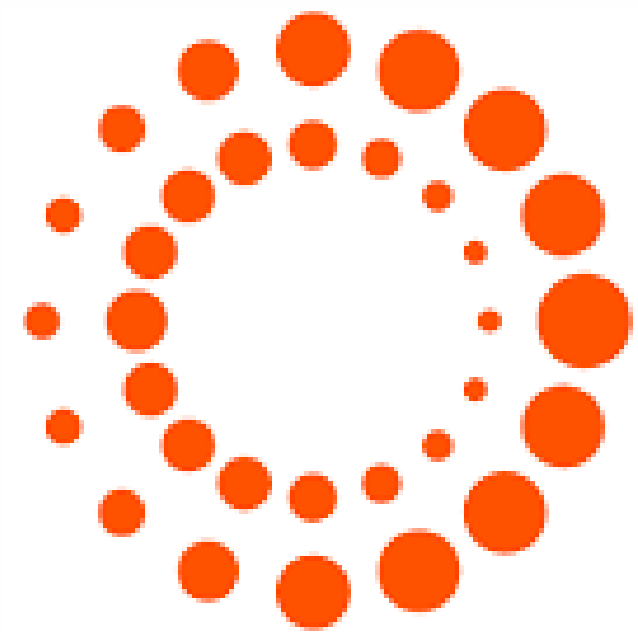


# Methodology

- Market insights:
  - Innova database
  - Cakes – pastries & sweet goods
  - Introduced in Western Europe 2022 - 2024
  - 19 435 products
  - Information on ingredients, packaging, price, ...
- Consumer insights:
  - Quantitative survey study
  - Adult inhabitants of Flanders
  - September – December 2025
  - 4 608 respondents



# Market Insights



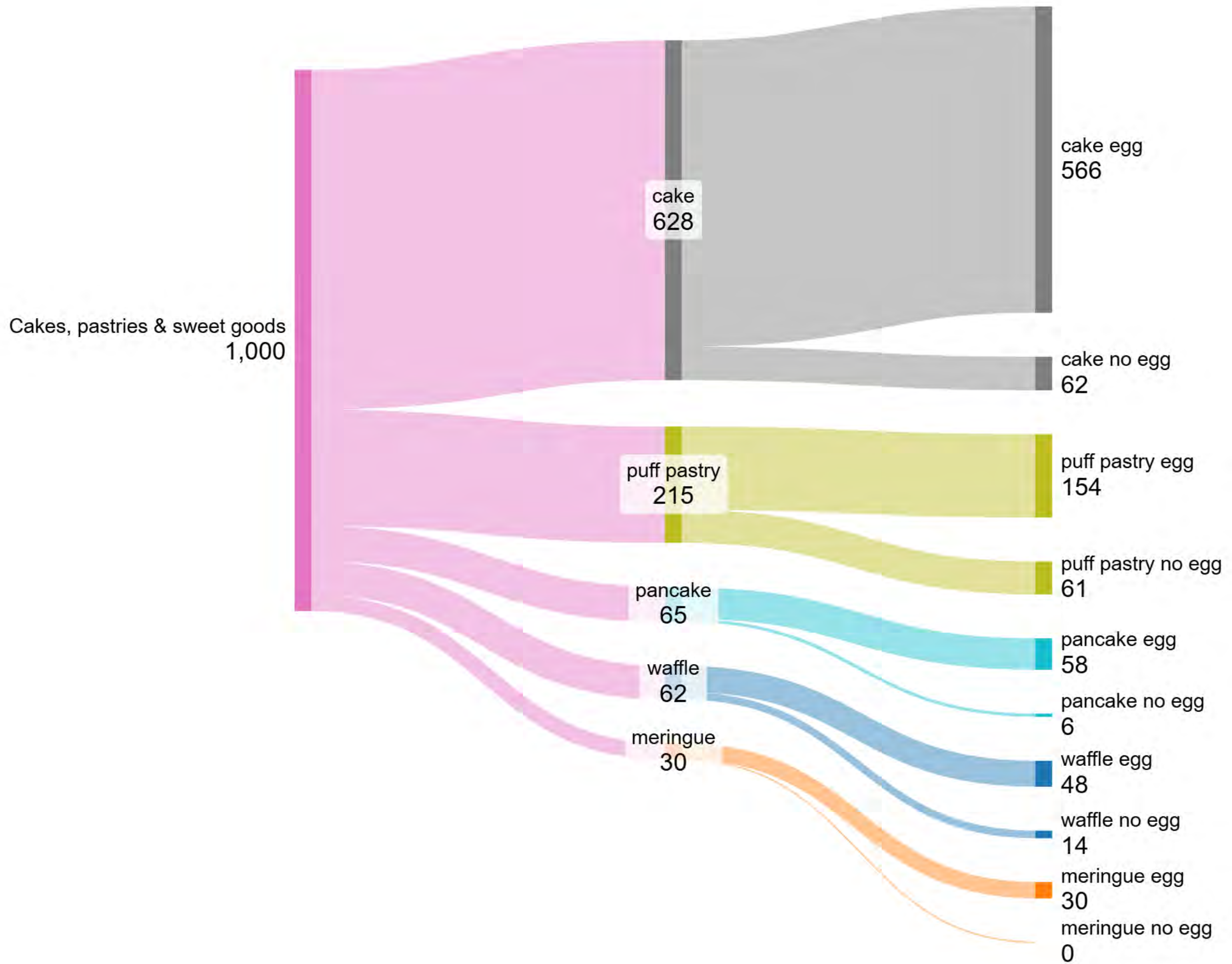
**INNOVA  
MARKET  
INSIGHTS**



# Results

- 14,3% of products contain no eggs

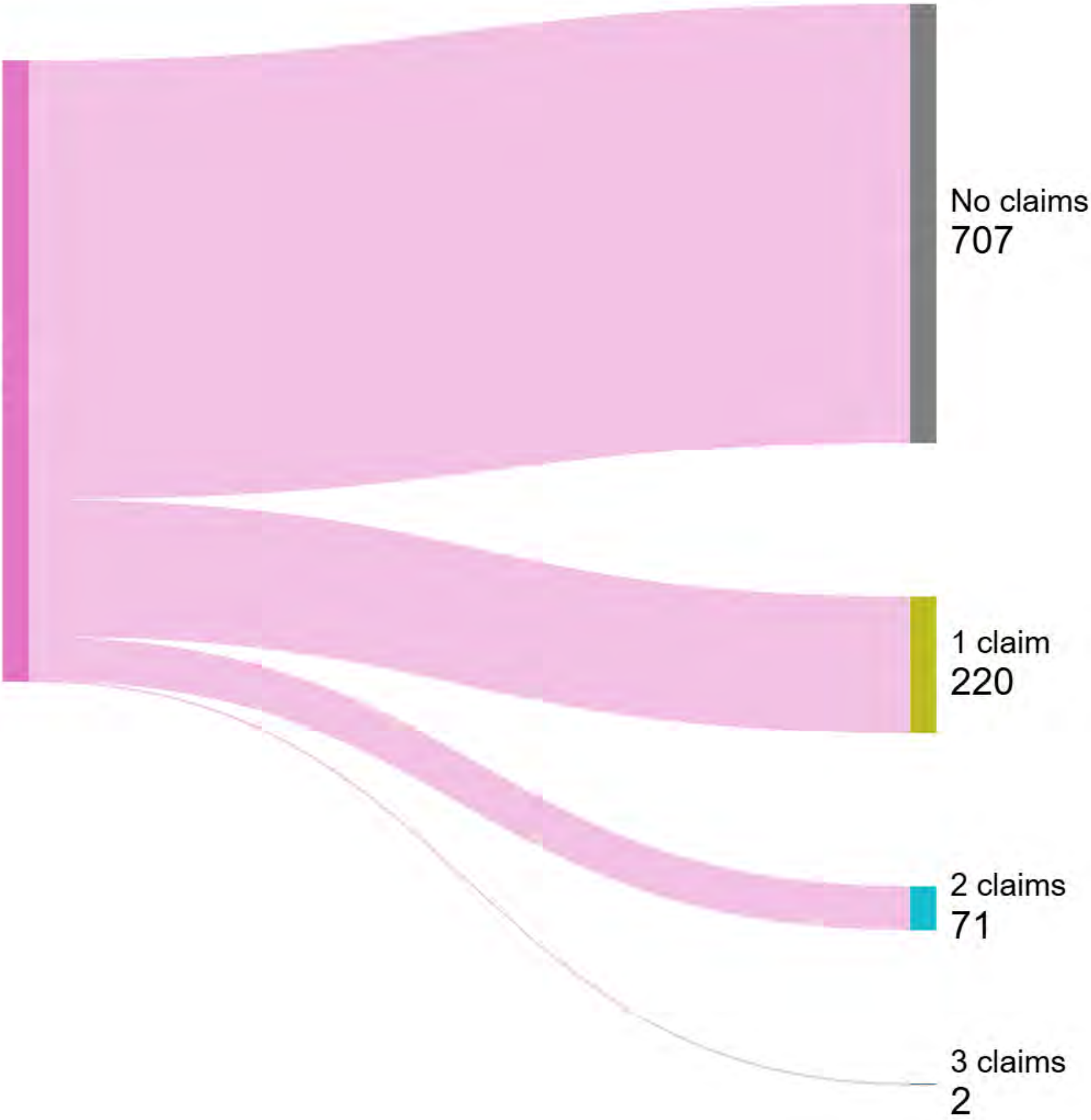
| Product     | No eggs |
|-------------|---------|
| Puff pastry | 28,4%   |
| Waffle      | 22,6%   |
| Cake        | 9,9%    |
| Pancake     | 9,4%    |
| Meringue    | 0,4%    |



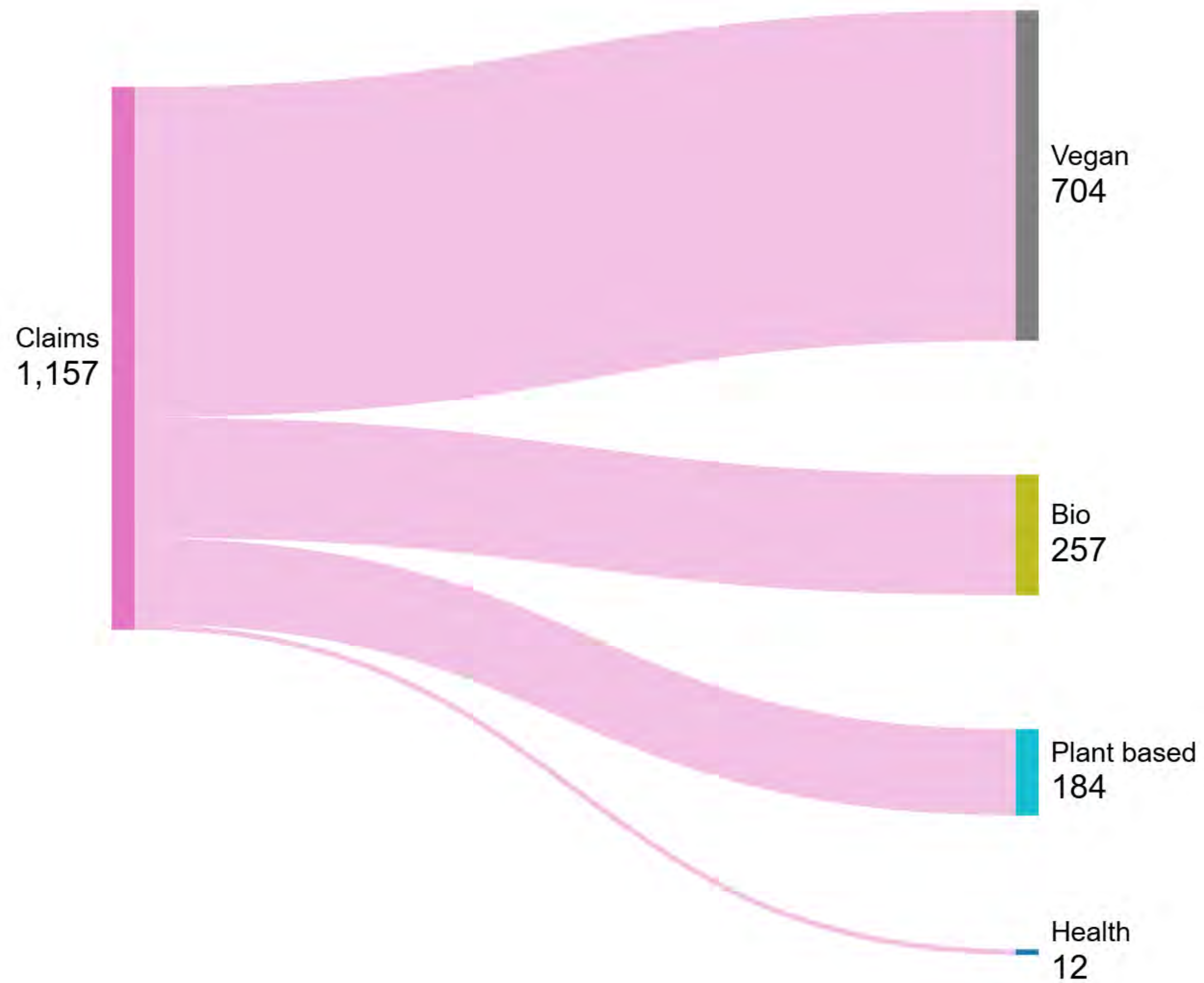
# Claims

| Product     | Contains claims |
|-------------|-----------------|
| Cake        | 41,2%           |
| Puff pastry | 25,6%           |
| Pancake     | 11,8%           |
| Waffle      | 25,8%           |

Egg-free products  
1,000



# Claims



- Most egg-free bakery products are not marketed as egg-free
- When egg-free claims are made, most products are marketed as vegan/plant based.
- There is no significant price difference between products containing eggs and egg-free alternatives.

# Consumer Insights

|                                                   | Left Anchor                 |                       |                        |                       | Right Anchor          |                       |                       |
|---------------------------------------------------|-----------------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                                                   | Helemaal<br>niet<br>akkoord | Niet<br>akkoord       | Eerder niet<br>akkoord | Neutraal              | Eerder<br>akkoord     | Akkoord               | Helemaal<br>akkoord   |
| Eieren zijn gezond                                | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn lekker                                | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| De productie van eieren veroorzaakt dierenleed    | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn ecologisch                            | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn slecht voor het klimaat               | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn te duur                               | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren maken deel uit van mijn cultuur            | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn slecht voor je cholesterol            | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Eieren zijn onderdeel van een gezonde levensstijl | <input type="radio"/>       | <input type="radio"/> | <input type="radio"/>  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |



# Survey structure

- Consumer behaviour (use frequency, ...)
- Image of eggs
- Buying motives for bakery products
- Perceptions on egg-replacement
- Socio-demographic variables



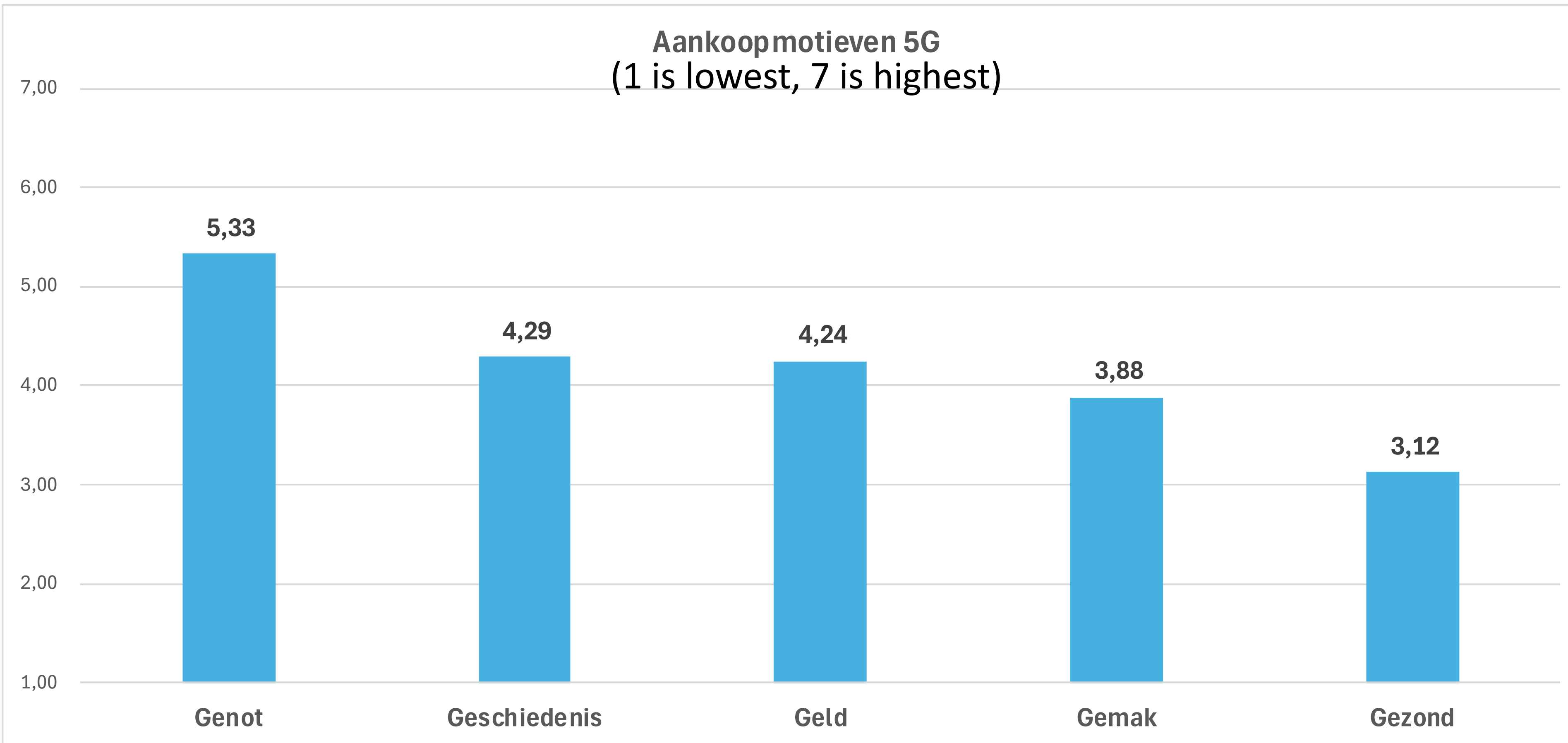
# Results – buying motives bakery goods

Factor analysis (with varimax rotation) reduces the motives to 5 higher level buying motives:

- Genot → Taste, texture, smell, color, ...
- Gezond → Health, ecological and sustainability motives
- Geld → Importance of price and promotions
- Gemak → Convenience and habits
- Geschiedenis → Tradition and nostalgia in sweet pastry



# Results – buying motives bakery products



# Results – consumer perceptions on eggs

Respondents were asked to rate 9 statements about **associations** made with eggs. These statements can all be related to the 5 higher level buying motives, with the exception of gemak (convenience).

Example statements are:

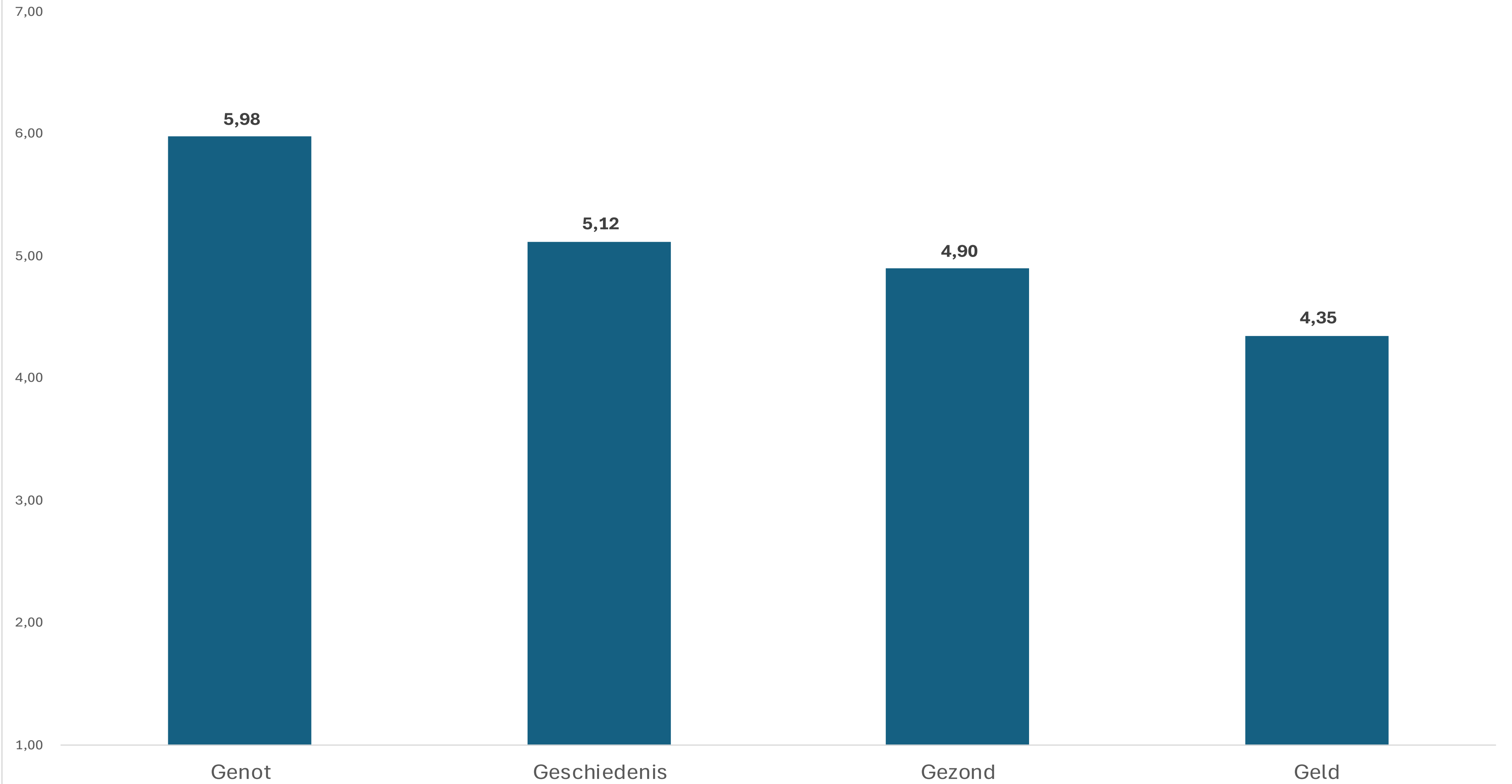
*“Eggs are healthy”*

*“Eggs are too pricey”*

*“Eggs are a part of my culture”*



# Egg associations



- Eggs have an image that aligns very well with the buying motives for bakery goods
- For most consumers, eggs are a logical and appreciated ingredient of bakery goods

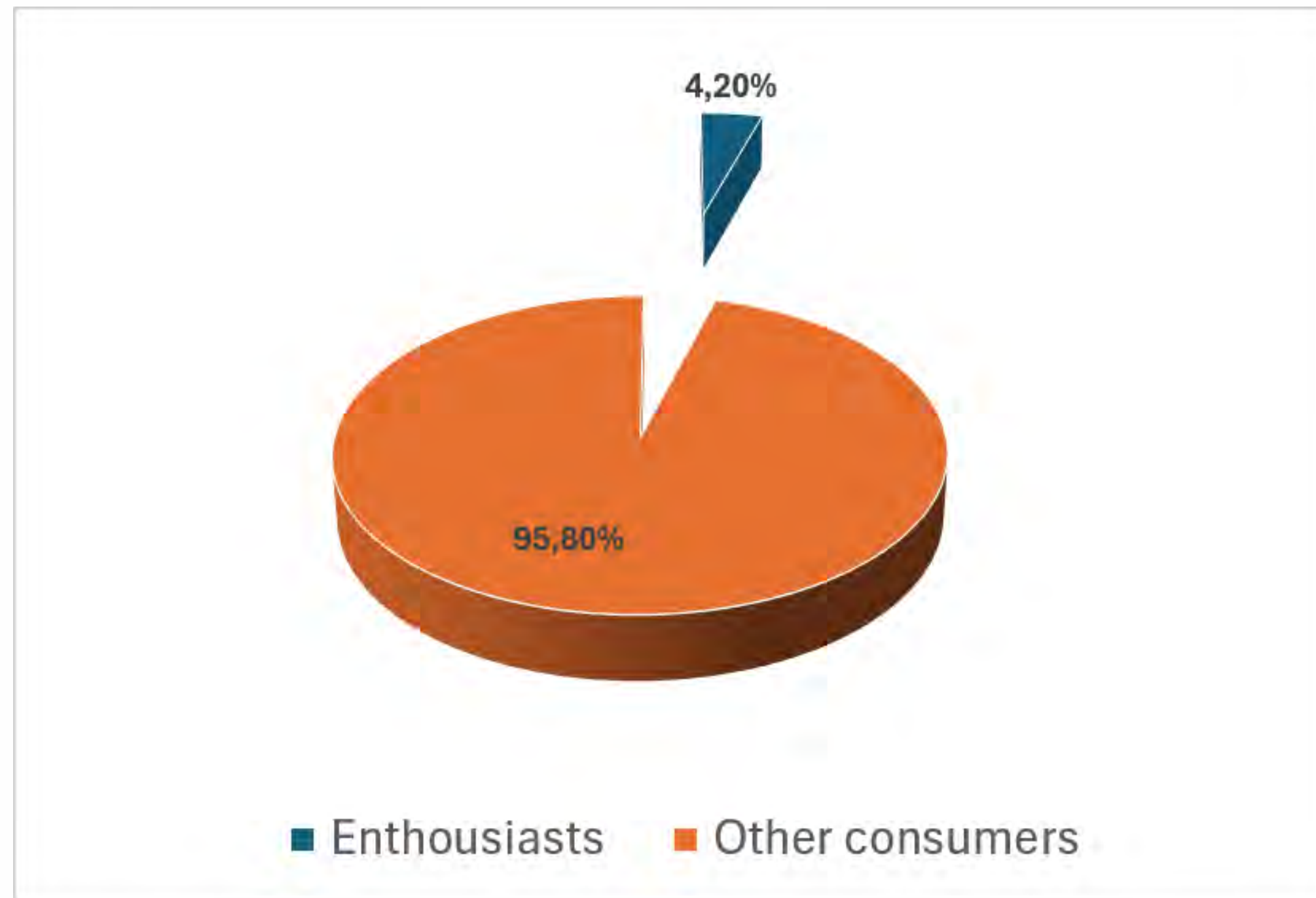
# Results – describing enthusiasts

We use the data on enthusiasm about (partial) egg replacement to identify people who are **actively searching** for pastry with egg replacement.



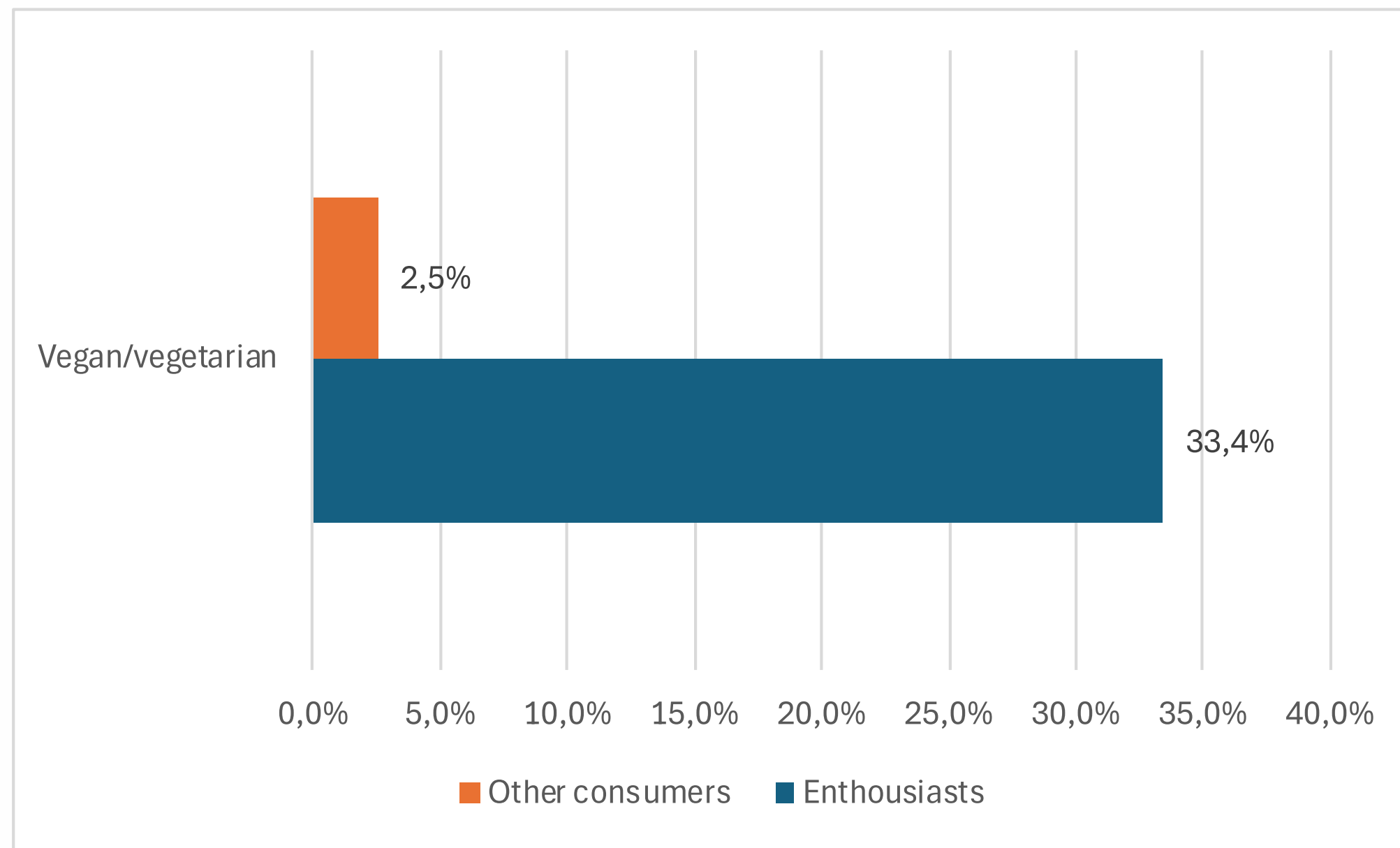
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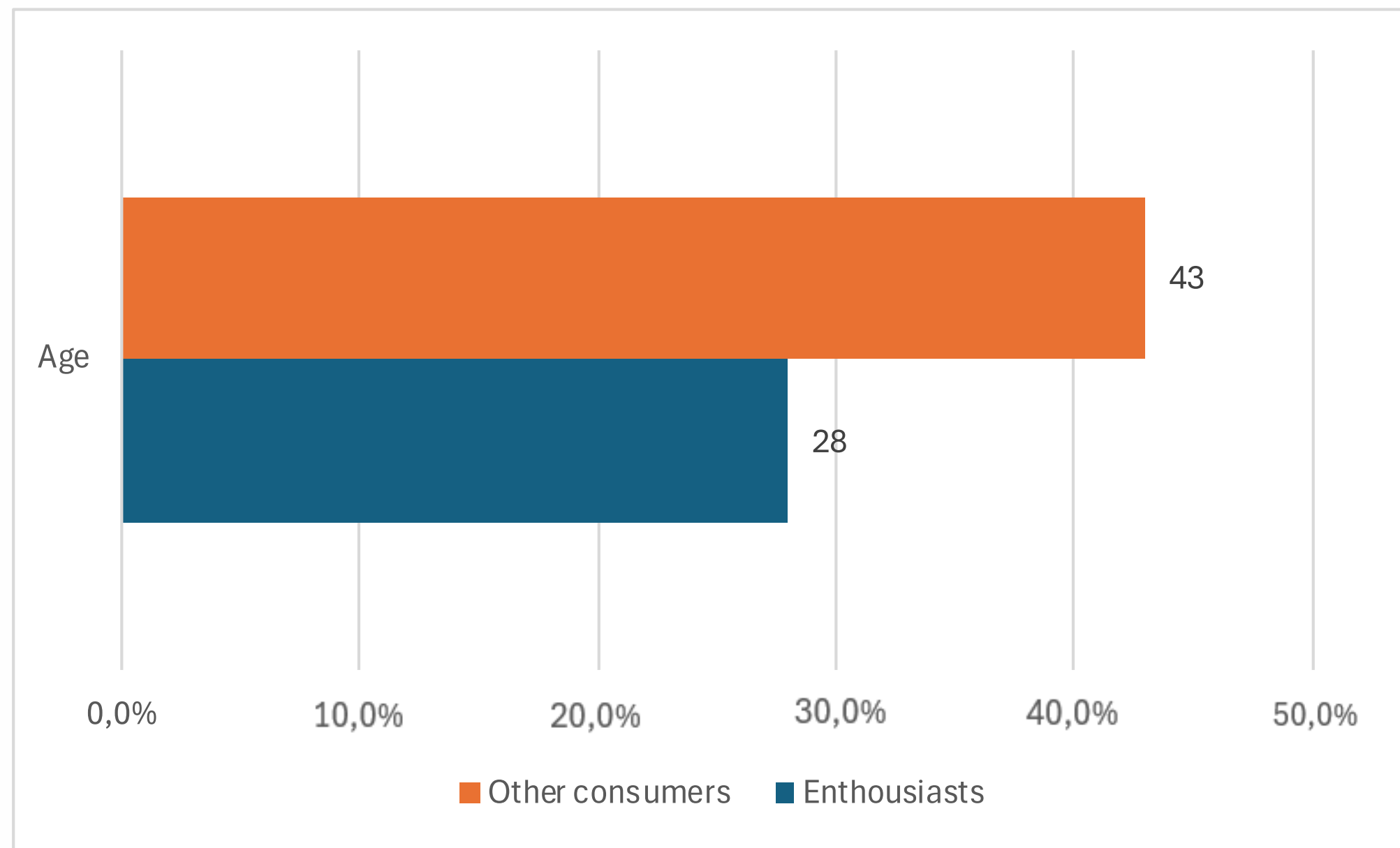
# Results – describing enthusiasts

Enthousiast are much more likely to be vegetarian/vegan.



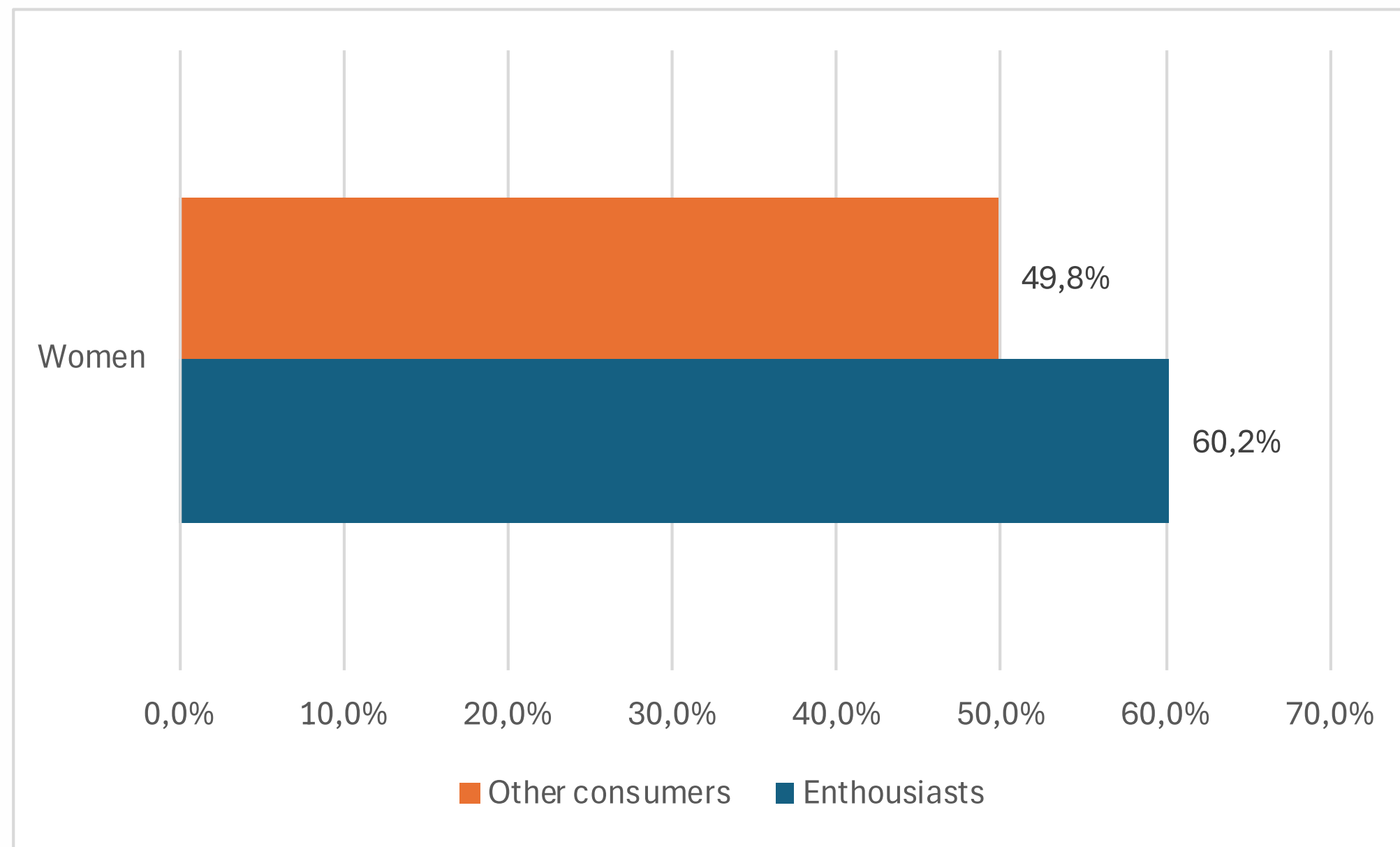
# Results – describing enthusiasts

Enthusiast are much more likely to be younger.



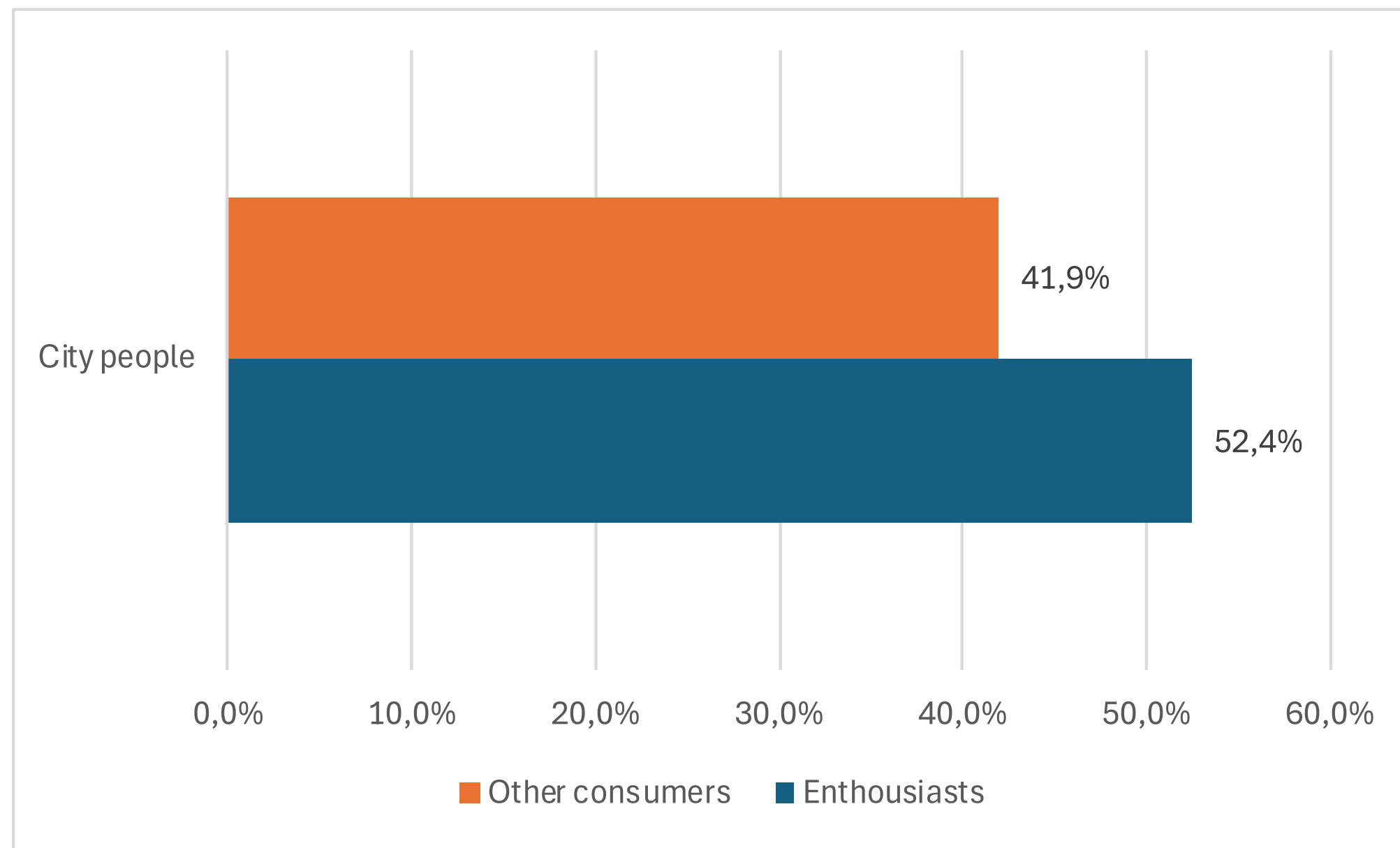
# Results – describing enthusiasts

Enthusiast are more likely to be female.



# Results – describing enthusiasts

Enthusiast are more likely to live in an urban environment.



# Results – describing enthusiasts

Enthusiast are the most likely early adopters of egg free pastry. They are the same people who are currently already looking for plant based pastry and make up the core clientele of plant based bakeries and coffee shops in large cities.



# Results – customer segments

Using cluster analysis (K-means), respondents were classified in customer segments according to similarities in buying motives.

Cluster analysis allows to define (1) the main ways in which consumers can differ from each other and (2) which consumer profiles are present on the market.

**4 clusters were identified.**



# Results – customer segments

## Nostalgic

24% of all consumers



### Enthusiasm about egg replacement

10%

#### Main motivators

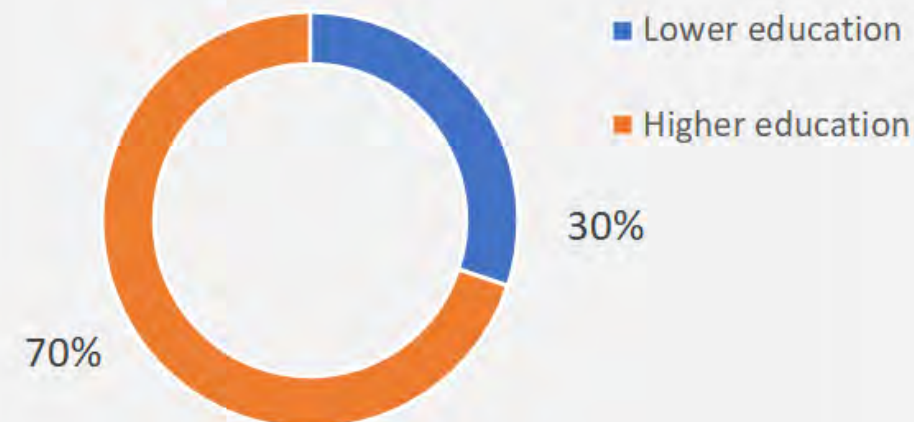
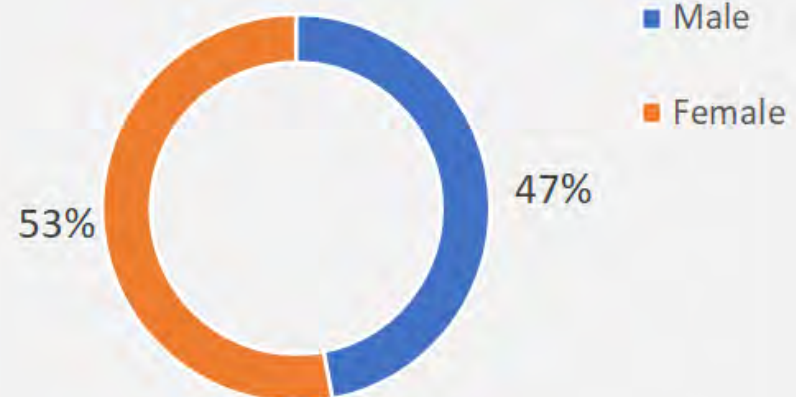
ecological benefits  
trusted brands

#### Main barriers

reject innovation  
it will be less tasty  
don't trust egg replacement

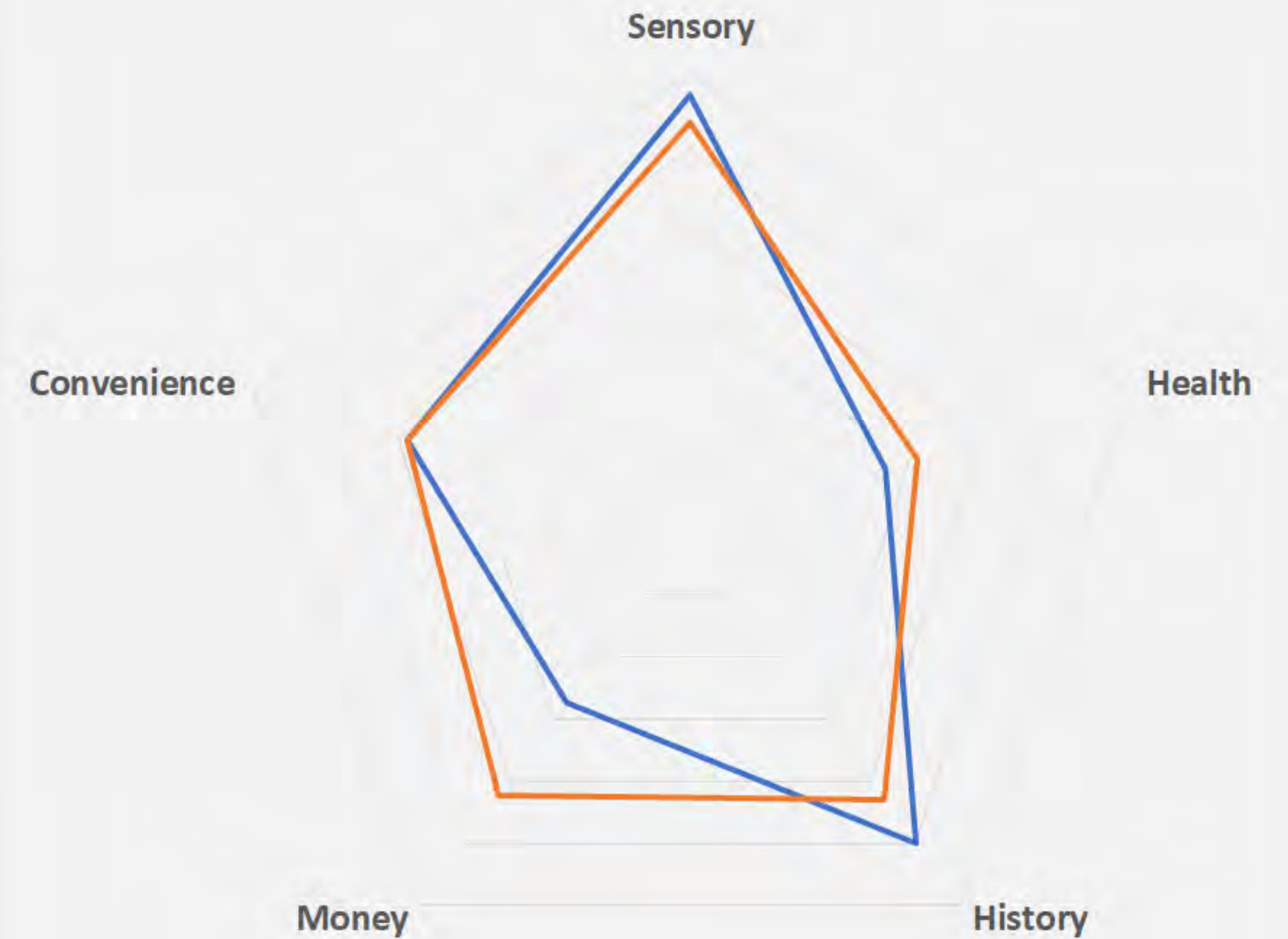
### Age

51 years



## Buying and Consumption Motives

— Nostalgic — Average consumer



# Results – customer segments

## Convenience Seeker

26% of all consumers



### Enthusiasm about egg replacement

12%

#### Main motivators

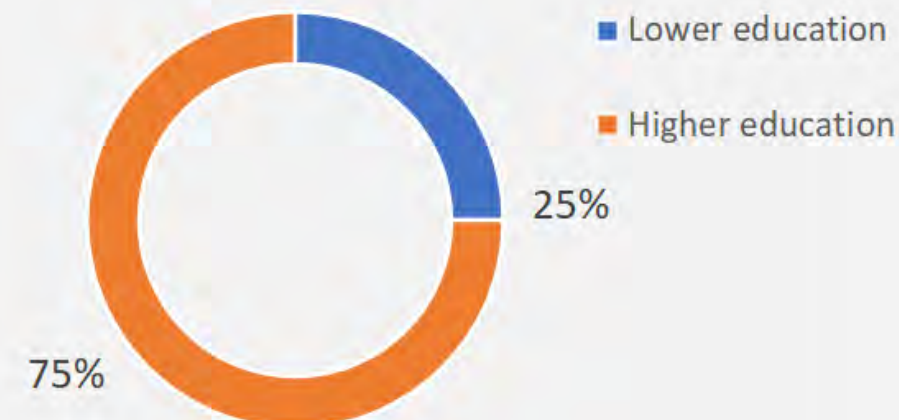
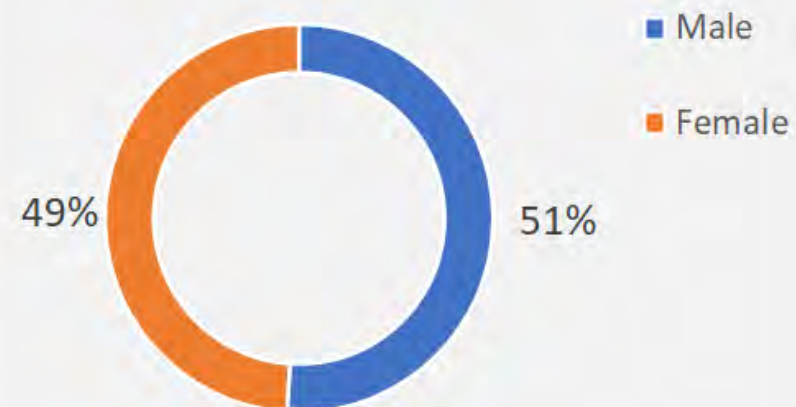
- ecological benefits
- trust in egg replacement
- trusted brands

#### Main barriers

- not cheaper
- it will be less tasty
- not healthier

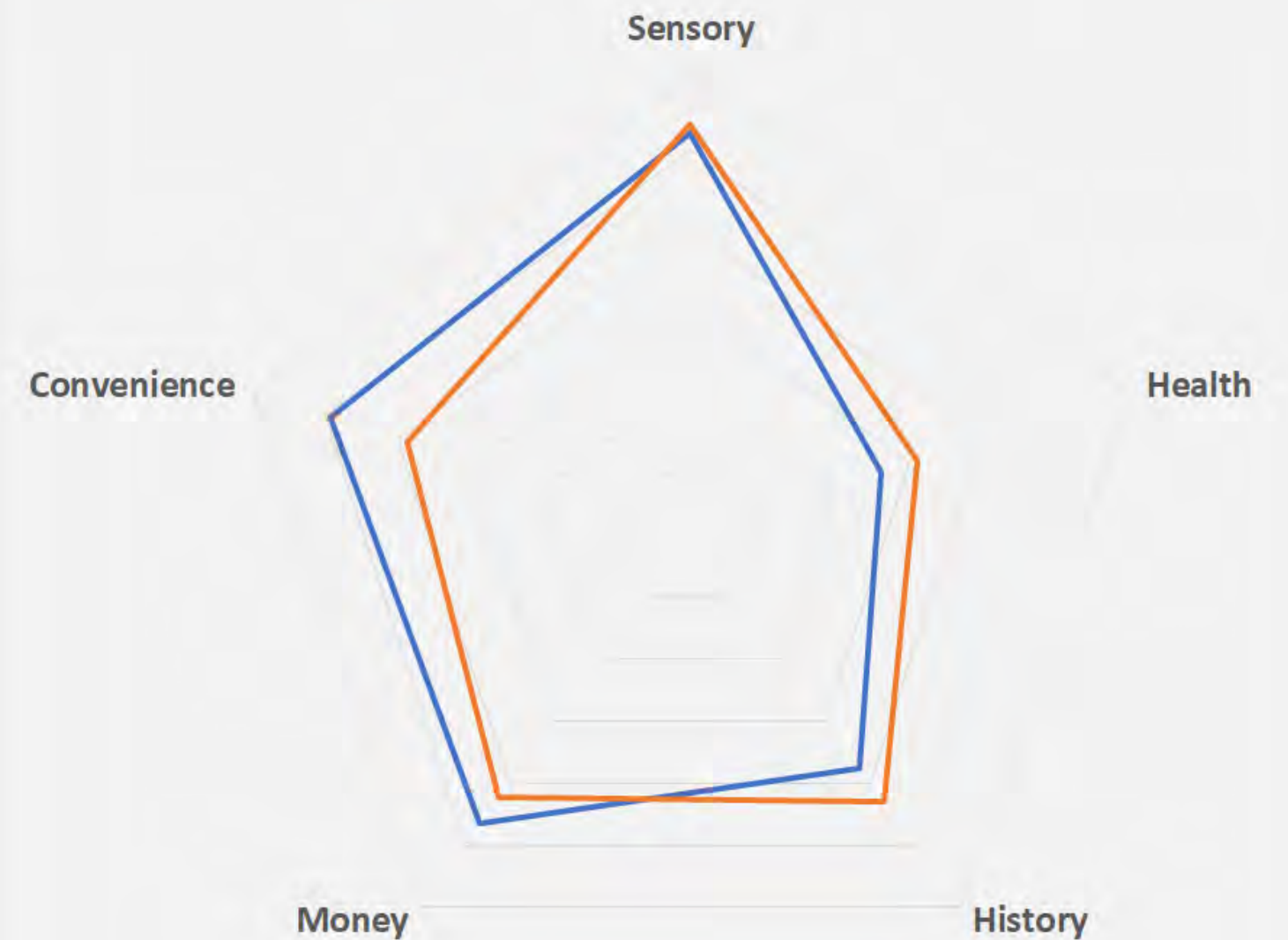
### Age

38 years



## Buying and Consumption Motives

— Convenience Seeker — Average consumer



# Results – customer segments

## Guilty Pleasure

27% of all consumers



## Enthusiasm about egg replacement

17%

### Main motivators

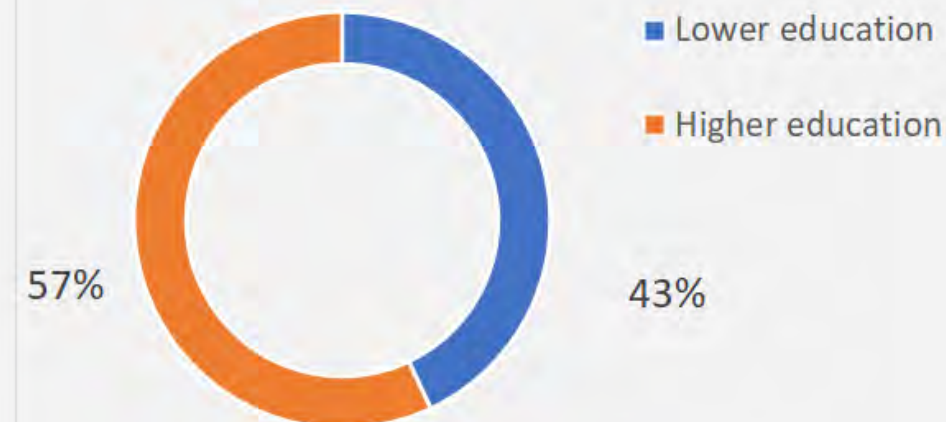
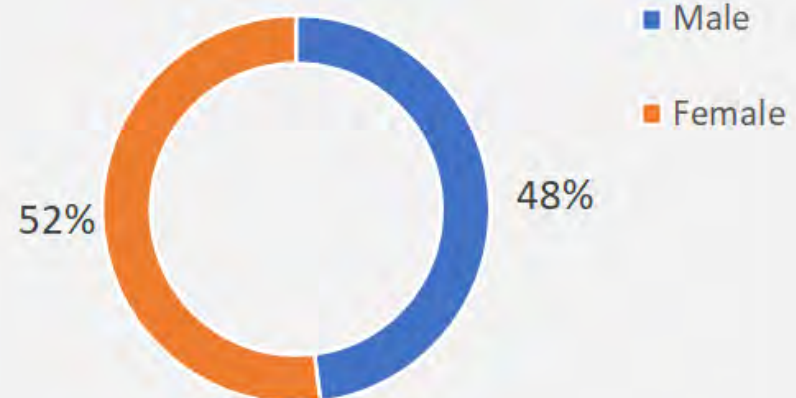
- ecological benefits
- good concept
- trusted brands

### Main barriers

- not convinced of health benefits
- it will be less tasty

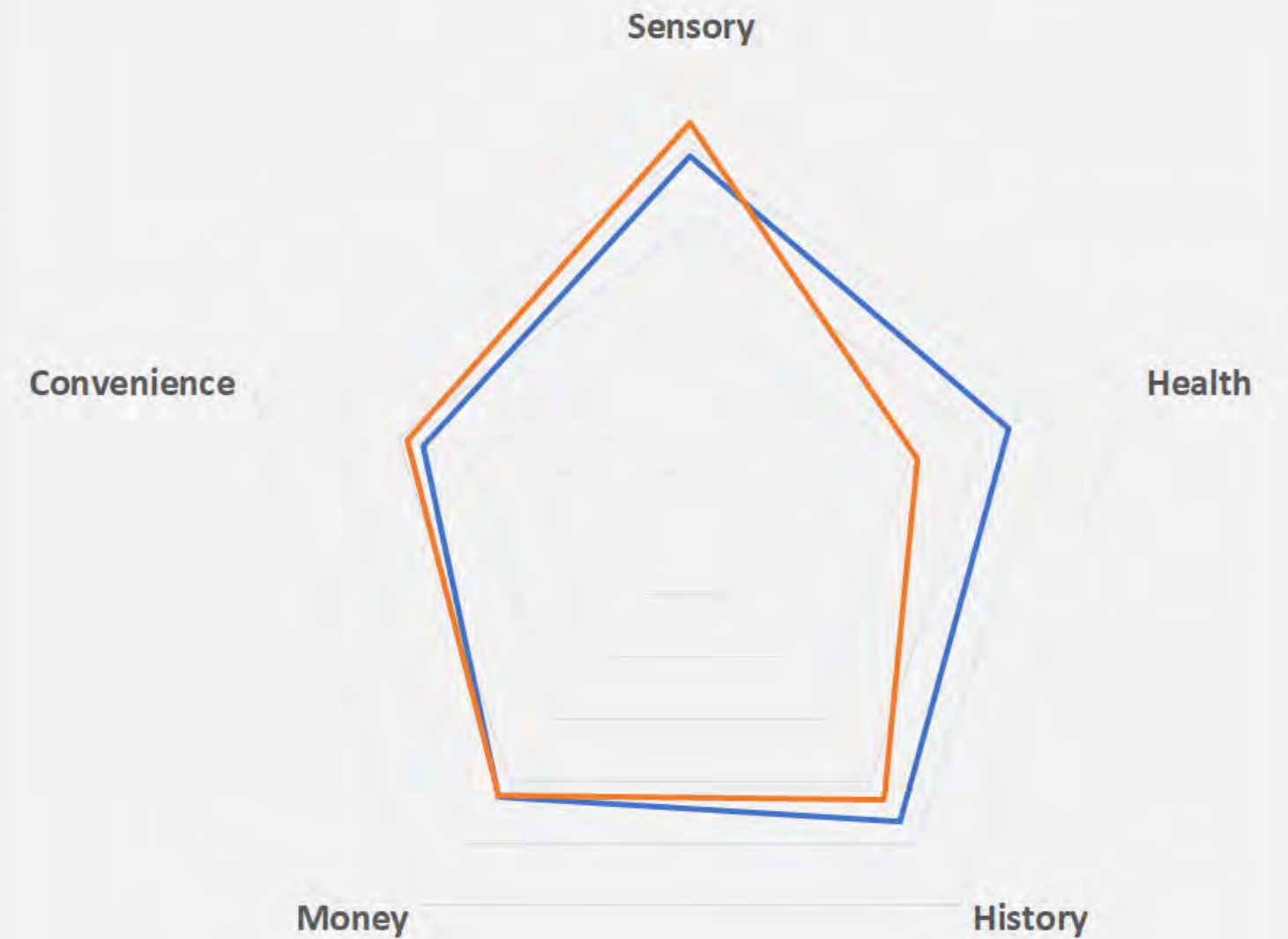
## Age

53 years



## Buying and Consumption Motives

— Guilty Pleasure — Average consumer



# Results – customer segments

## Price Hunter

23% of all consumers



## Enthusiasm about egg replacement

18%

### Main motivators

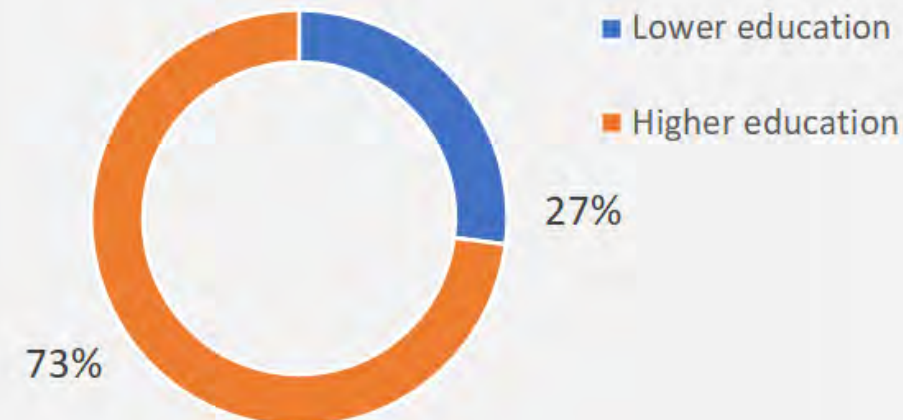
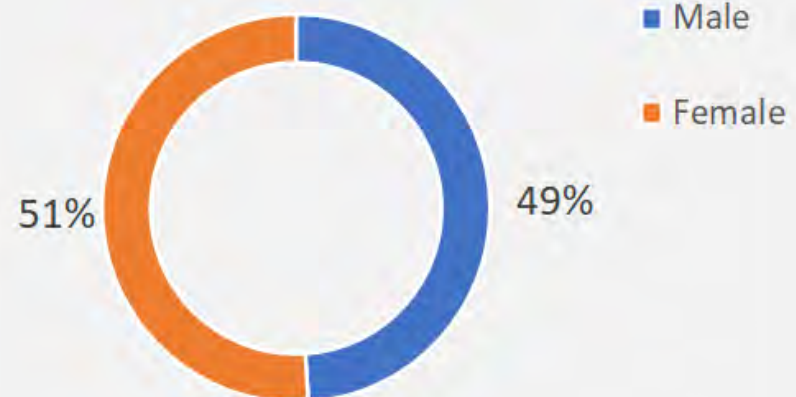
- ecological benefits
- trust in egg replacement
- trusted brands

### Main barriers

- not cheaper
- it will be less tasty
- not healthier

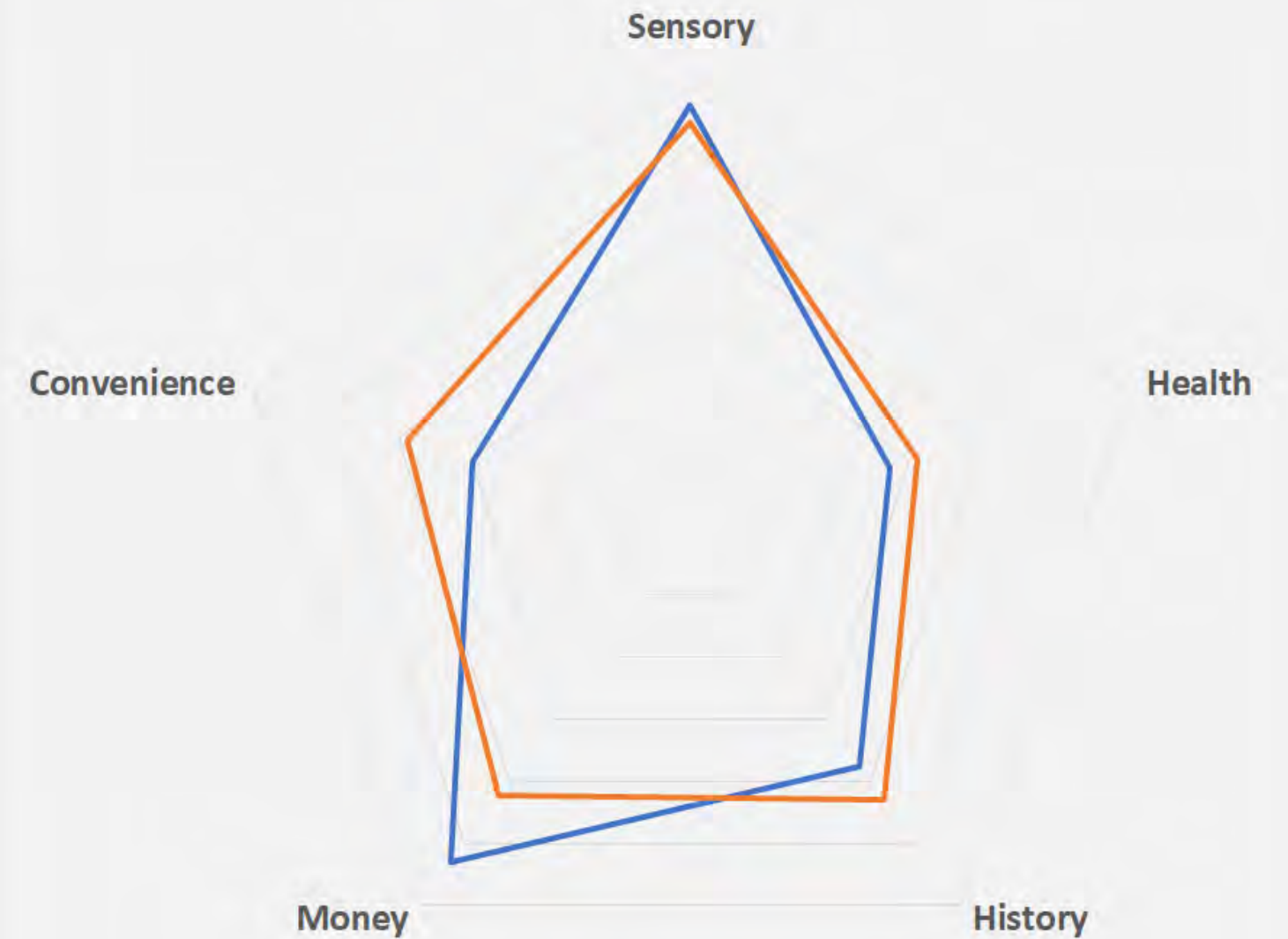
## Age

41 years



## Buying and Consumption Motives

— Price Hunter — Average consumer



# Key take aways

From a consumer perspective, the **ecological benefits** of egg replacement are its main advantage. However, most consumers don't care much about ecological considerations when buying pastry.

**Early adoption** of egg replacement by consumers is highly likely to be done by vegans/vegetarians. Claims and labels are essential for this consumer group.

**Wider adoption** will be made by consumers who are convinced by health and ecological claims.

**Broad adoption** of egg replacement by consumers requires introduction by known and trusted brands of products that have a sensory profile that is not easily distinguishable from traditional pastry at a same price level.

# NovoBake Closing Event Programme

## Understanding the challenge

|             |                                                             |
|-------------|-------------------------------------------------------------|
| 13:10-13:25 | Why replace eggs? The challenge behind NovoBake             |
| 13:25-13:45 | Functions of Egg & Challenges of Replacement                |
| 13:45-14:05 | From ingredient to egg replacer: Techno-Functional Insights |

## 14:05-14:15 Break

## From research to bakery product

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| 14:15-14:45 | What works in bakery? Results from four applications                   |
| 14:45-15:00 | Sensory & Consumer acceptance: Does the consumer taste the difference? |
| 15:00-15:15 | From Product to Market: Opportunities for Egg-Replaced Bakery Products |

## Bringing it all together

|             |                                           |
|-------------|-------------------------------------------|
| 15:15-15:20 | <b>Key takeaways from NovoBake</b>        |
| 15:20-15:30 | Closing, feedback & Acknowledgements      |
| 15:30-16:00 | <b>Tasting session with Madam Bakster</b> |





# Key takeaways from NovoBake

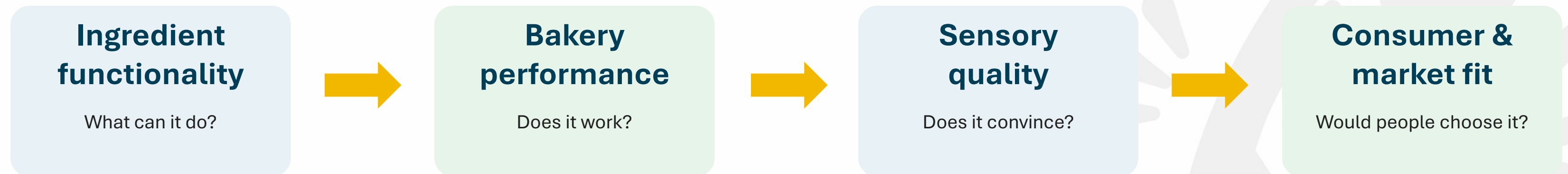
Ferre Rebry



# Key takeaways from NovoBake

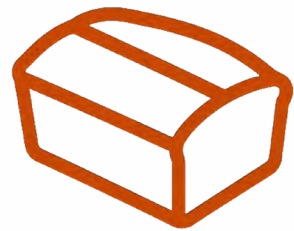
## What should remain after today?

From ingredient functionality to bakery performance, sensory quality and consumer relevance.



# 1. There is no universal egg replacer

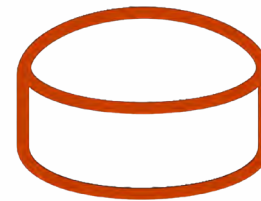
The right solution depends on the product.



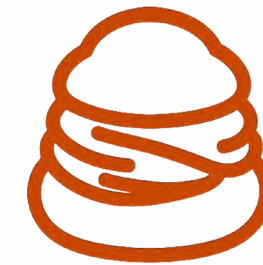
Pound cake



Soft waffles



Sponge cake



Choux pastry



Egg wash

**Egg does not perform the same critical function in every bakery product.**

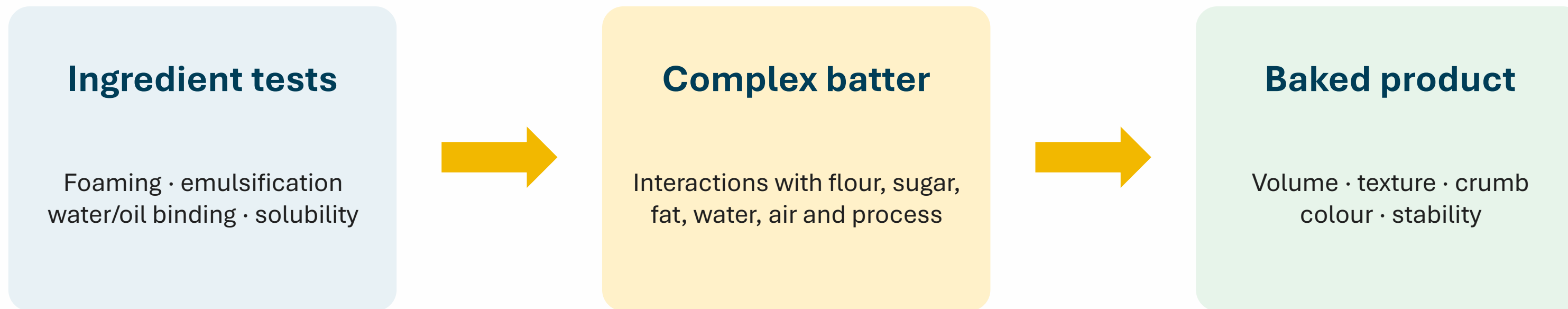
An ingredient that helps in one application can be irrelevant, or even counterproductive, in another.

**Start from the product — not from the replacer.**



## 2. Ingredient tests show potential — application testing shows whether it really works.

A good result in a lab test is not automatically a good result from the oven.



**Ingredient-level tests help us understand potential — but they do not replace application testing.**

Egg replacement happens in a food matrix, not in a test tube.



# 3. Get the base formulation right before trying to fix it

Functional ingredients are tools — not universal fixes.

- 1 Replacer + water**  
Correct for the water and solids removed with egg
- 2 Process**  
Hydration, mixing/whipping, baking time and temperature
- 3 Evaluate**  
Look at both batter and baked product
- 4 Targeted tool**  
Use starch, lecithin, HPMC, leavening or whipping agents only for a specific problem

**Change one main variable at a time, so the effect of each adjustment remains clear.  
More is not always better.**



## 4. Wider adoption needs a shorter route

Most bakeries cannot run a full R&D project for every new product.

### **NovoBake provides a method**

- start from a reference recipe
- adjust the chosen replacer and water dosing
- evaluate batter and product
- optimise step by step

### **What the ordinary bakery needs**

- application- and egg-replacer specific recipes
- realistic ingredients and process
- standard bakery equipment
- clear dosage and water guidance

**For broader uptake, egg replacers need robust, realistic and application-specific recipes.**



# 5. Full replacement is not always the best starting point

Partial egg replacement can be a strong first step.



## 1 Technically more forgiving

Part of the egg functionality remains

- Easier to maintain volume, structure and processing behaviour
- Useful when full replacement makes the product unstable

## 2 Sensorially promising

Quality can stay close to the reference

- In NovoBake, partial replacement gave clear opportunities in cakes and waffles
- The product still needs to convince on taste, texture and appearance

## 3 Still a meaningful reduction

Less egg without taking on all the technical risk

- Substantial egg reduction can already be valuable
- The replacement level should fit the product goal

**The target does not always have to be 100%. Choose the replacement level that fits the product and the objective.**



## 6. Demand is selective — quality and positioning matter

Egg replacement is not yet a mass-market demand for everyone.

**4.2%**

**actively looking for bakery  
products  
with egg replacement**

### Target claims carefully

A vegan or plant-based claim helps the interested audience but can discourage others.

### Keep the product familiar

For a broad audience, taste, texture and appearance should remain recognizable.

### Product quality comes first

Sustainability and a healthy image can spark interest, but are rarely decisive.

**The product does not have to be identical to the egg-based reference — but it has to convince your target consumer.**



# If you remember one thing...

Do not ask:

*“Which egg replacer is best?”*

Ask:

***“What does this specific product need — and what is preventing it from working?”***

*For research and product development: test and optimise.  
For wider bakery adoption: turn that knowledge into robust, ready-to-use solutions.*



# Continue with NovoBake

The project is ending, but the knowledge remains available.



## Practical guide

Step-by-step approach, troubleshooting and application-specific lessons.



## NovoBake results

Website with project output, updates and materials for the sector.



## Project film

A short introduction to the project and the people behind it.

**Contact: Ferre Rebry · HOGENT – AgroFoodNature · [ferre.rebry@hogent.be](mailto:ferre.rebry@hogent.be)**  
**[NovoBake - Hogeschool Gent](#)**



# Continue with NovoBake

## Coming soon on de NovoBake webpage: Interactive results explorer

- Explore by application
- Compare recipes
- Link analytical results to product images

### Product Graphs

Select an application

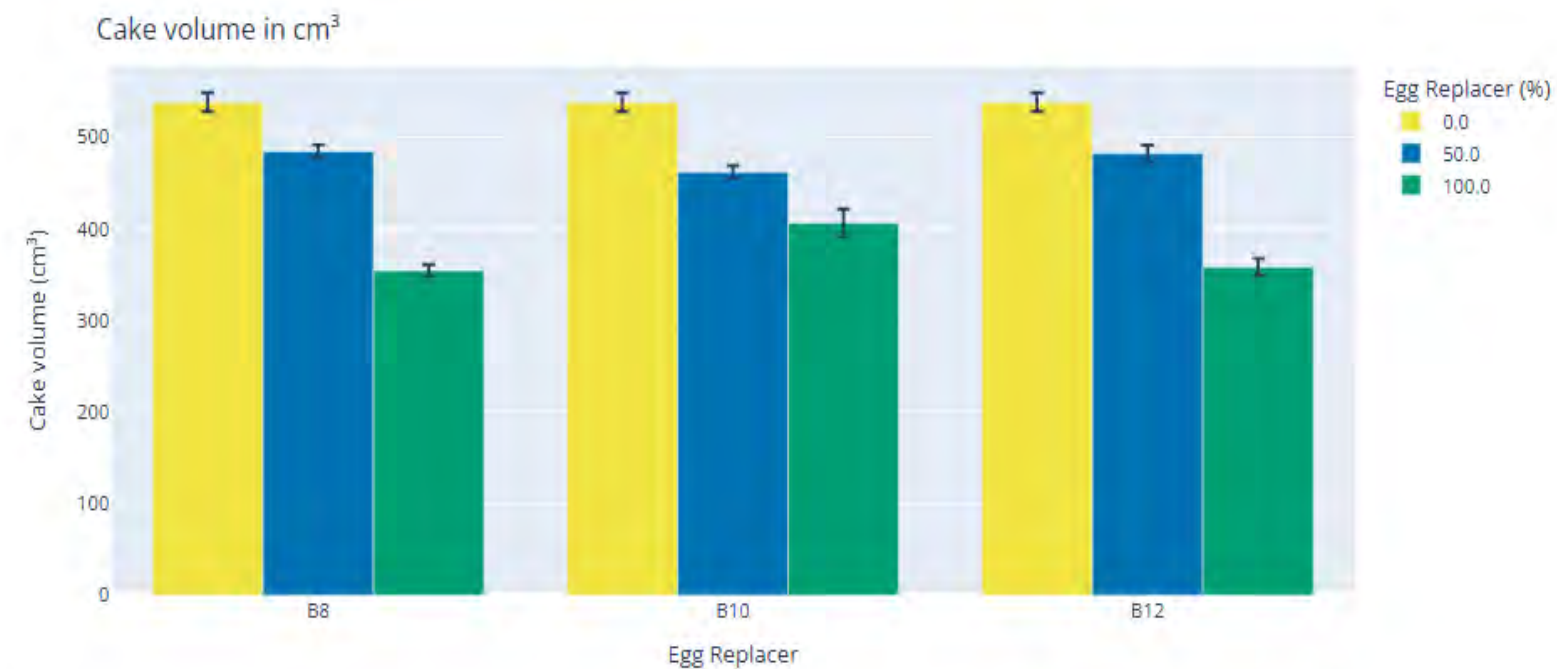
Pound Cake

Select graphs to display

Cake volume ×

Select egg replacers to display ⓘ

B8 × B10 × B12 ×



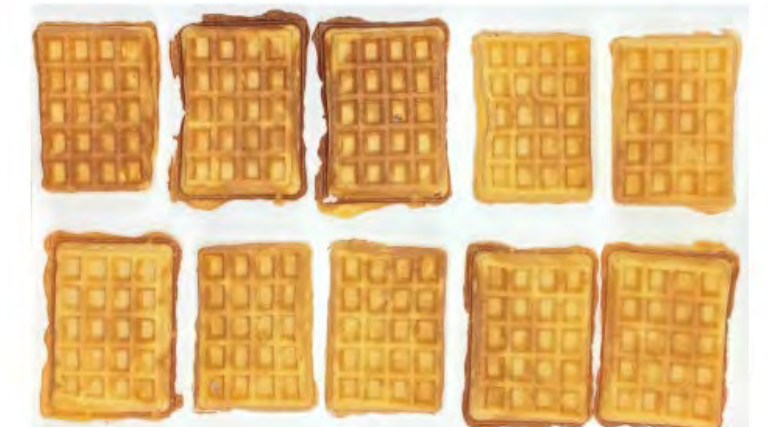
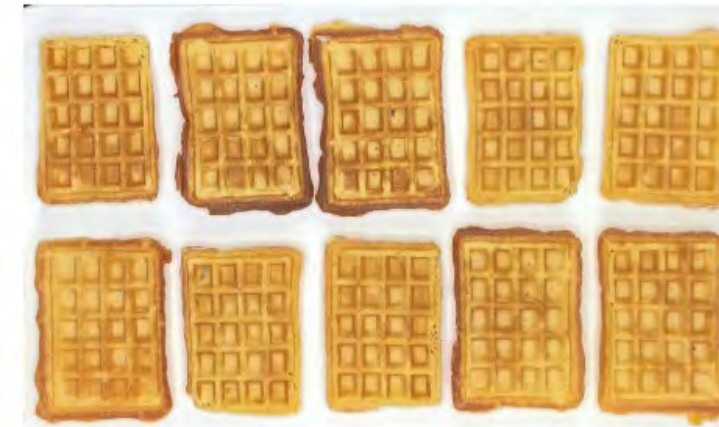
Waffle

Select an egg replacer ⓘ

Reference Egg

Select percentage of egg replacer

### Application Images



### Waffles - B8 - 100% egg replacement

Explore how the 100% B8 formulation was developed and how lecithin, leavening and potato starch affected the final product.

To explore optimization study → select B8 → 100%

# Feedback moment

Guided by Flanders' FOOD



**Before we close, we would like to hear from you.**



# Thank you

NovoBake was a team effort.



## The NovoBake Research team:

- |                                    |                           |
|------------------------------------|---------------------------|
| Prof. Filip Van Bockstaele – UGent | Griet Spaepen – UGent     |
| Prof. Joachim Shouteten – UGent    | Freek Van Baelen – HOGENT |
| Simoun Rainier Bayudan – UGent     | Trui Cambie – HOGENT      |
| Ana Gabriela Ramos Batres – UGent  | Ferre Rebry – HOGENT      |

## Steering group

Bakeries, ingredient suppliers and sector organisations

## Project partners

VLAIO · Flanders' FOOD · Alimento

## Participants

Bakers, consumers and students

Thank you to everyone who helped bring NovoBake research into practice.



# Time to taste!

Tasting session with Madam Bakster

**Thank you for joining the NovoBake closing event.**

The formal presentations are finished — now you can taste some of the products and continue the discussion informally.

**Enjoy the tasting and reception.**

