



Ingredient Affairs: Attraction or Repulsion?

How to Exploit or Troubleshoot Ingredient Interactions

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Ingredient Affairs: Attraction or Repulsion?

Knowledge of ingredient interactions is vital for successful product development. These interactions can be exploited to create different product textures but in the wrong hands lead to unstable products. Proteins and polysaccharides are a particularly problematic pairing.

The textural and sensorial properties of food and drink products are controlled by the presence of ingredients and additives, such as thickening and gelling agents. Different ingredients interact with each other in multifarious ways and exploiting these interactions requires significant knowledge and expertise.

Take ice cream, for example – a product enjoyed by millions of people globally. With no added ingredients or additives, ice cream can have a gritty mouth feel due to the development of ice crystals. The addition of locust bean gum and/or cellulose and/or gelatin can control the rate at which ice crystals develop. The downside of this ingredient combination is that this may induce ‘wheying-off’ (the process which causes the milk to separate into curds and whey). To overcome this, carrageenan can be added.

When developing a product, the experienced technician is considering all the potential interactions between the different ingredients in order to reap the benefits of the individual ingredient interactions without having any negative side-effects.

It's a 'love / hate' relationship

Proteins (such as gelatin, whey and soya) and polysaccharides (such as carrageenan and starch) make up the majority of thickening and

gelling agents. The relationships between the two ingredient groups, in particular, is a complex one.

Combining proteins and polysaccharides can lead to a wide spectrum of molecular interactions depending on the particular ingredients used and the preparatory and/or processing conditions. The way these ingredients behave in turn controls the product microstructure, texture and functionality.

Depending on the conditions used during manufacture, the interaction of proteins and polysaccharides can be classed as *segregative* (where they repel each other) or *associative* (where they attract each other). In addition, there can be situations where these ingredients simply co-exist.

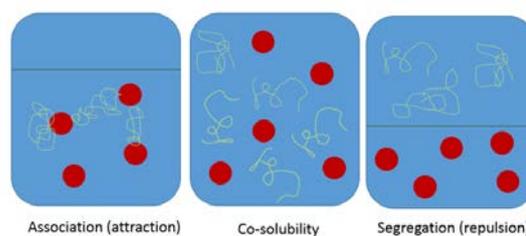


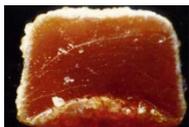
Fig. 1: Diagram showing the interactions of proteins and polysaccharides

When they repel each other, the proteins and polysaccharides are enriched in separate parts of the product. When they attract each other, proteins and polysaccharides are condensed

into the same part of the product leaving the other part depleted.

Exploiting the relationship

Manipulation of ingredient interactions can lead to products with different textural and mouth feel properties. Jelly sweets, for example, exploit the different protein-polysaccharide interactions. The examples below demonstrate how protein and starch can be mixed with syrup in different ratios to yield different textural properties.



Texture: Chewy, rubbery and firm



Texture: Soft, moist and breaks down easily



Texture: Soft, moist and jelly-like

Fig. 2: Photographs of jelly sweets with different textural properties

Troubleshooting when it goes wrong

Incorrect use of ingredients can lead to products separating and the appearance of undesirable lumps, pieces and/or crystals, which is enough to worry any product developer. With most products containing various ingredients and additives, pinpointing the cause of instability can be a tortuous experience.

Leatherhead is frequently called in to troubleshoot for clients when ingredient interactions go wrong. We use a multidisciplinary approach to characterise the

ingredient interactions in the food or drink product in question, in order to identify the cause of the separation. The powerful, investigative techniques we use include:

- **Electrophoresis:** the science of separating proteins and polysaccharides
- **Rheology:** the art of measuring viscosity and gelling characteristics
- **Microscopy:** the visualisation of the product micro- and macrostructures

Troubleshooting is like solving a crime – you have to consider each variable during the manufacture process to understand how that variable is affecting the end product.

There might, for example, be ingredient blends to consider. While using blends can reap enormous benefits, incorrect usage, whether it be in the form of incorrect chemical compositions or incorrect ratios, can bring disastrous problems.

The problem might be originating from the processing, manufacturing or packaging conditions. Some of the stability issues may not appear at point of production, but perhaps later in the product shelf life, possibly even in the hands of the consumer. It is common in beverage applications for proteins and polysaccharides to clump together during product shelf life to form unsightly particulates which may stay suspended or sediment.

Investing in a rigorous, investigative process to troubleshoot problems when ingredient-related problems do occur, means manufacturers can be confident products will meet quality standards throughout their shelf lives.

How Leatherhead can help

With many years of expert knowledge, Leatherhead can advise food and beverage developers and manufacturers in creating desirable textures by manipulating protein-polysaccharide interactions or troubleshooting problematic issues arising from these interactions. Leatherhead uses a combination of techniques, including electrophoresis, rheology, and microscopy, to investigate ingredient interactions.

About the author

Dr Pretima Titoria is the Head of Food Ingredients within the Food Innovation Department at Leatherhead Food Research. She obtained her BSc (Hons) in Food Technology from the University of Reading, and her PhD from the University of Cranfield. Her PhD was focused on rheological properties of thickening and gelling agents for food applications. At Leatherhead, Pretima is responsible for managing confidential client projects, which involve physico-chemical characterisation of ingredients and additives in a wide range of food and beverage applications.

About Leatherhead Food Research

Leatherhead Food Research provides expertise and support to the global food and drink sector with practical solutions that cover all stages of a product's life cycle from consumer insight, ingredient innovation and sensory testing to food safety consultancy and global regulatory advice. Leatherhead operates a membership programme which represents a who's who of the global food and drinks industry. Supporting all members and clients, large or small, Leatherhead provides consultancy and advice, as well as training, market news, published reports and bespoke projects. Alongside the Member support and project work, our world-renowned experts deliver cutting-edge research in areas that drive long term commercial benefit for the food and drink industry.

Leatherhead Research is a Science Group (AIM:SAG) company. Science Group provides independent advisory and leading-edge product development services focused on science and technology initiatives. It has six offices globally, two dedicated, UK-based R&D innovation centres and more than 350 employees. Other Science Group companies include Oakland Innovation, Sagentia and OTM Consulting.

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