

The Quest for Natural Emulsifiers

Evaluating the Effectiveness of Natural Emulsifiers

Marina Andres-Brull

A Leatherhead Food
Research white paper

11

The Quest for Natural Emulsifiers

In this white paper, Marina Andres-Brull discusses the challenge to find natural emulsifiers which are as effective as their synthetic counterparts. Leatherhead puts a number of natural emulsifiers to the test and rates how they perform.

'Clean label', the term used to describe the consumer demand for minimally processed food and beverage products containing natural ingredients, remains one of the industry's hottest trends.

The use of clean label ingredients presents numerous challenges for any food / drink developer since substituting a synthetic ingredient with a natural equivalent may alter the texture of the product, cause formulation issues and reduce the shelf life of the finished product.

Where substitution is concerned, particular care and attention need to be given to products formed from emulsions (mixtures of two liquids that are normally immiscible, for example oil and water). An emulsion, such as a mayonnaise or a salad dressing, can be very unstable due its inherent tendency to separate over time. To overcome this issue, emulsifiers are added as a stabiliser.

Finding suitable clean label emulsifiers has proved a particular challenge for the industry. The fact that chemical or synthetic emulsifiers still account for 67% of global market volume¹ is testimony to the difficulty in finding suitable natural emulsifiers. To date, natural emulsifiers have simply not been found to be as effective and versatile as their synthetic counterparts as

these need to be used together with other ingredients in order to emulsify effectively. However, as there is more innovation and research in this field, the proportion of synthetic emulsifiers used is decreasing year on year.

Testing the performance of natural emulsifiers

Leatherhead has carried out extensive research into the emulsifying properties of a range of natural ingredients in powder form, including pulses, nuts, fibres, seed flours and cereals. All the ingredients evaluated were plant-derived and traditionally or minimally processed (i.e. the materials have only been subjected to milling and/or heat treatment); these can, therefore, be considered as clean or natural for labelling purposes. These ingredients also boast an additional benefit: they contain fibre, which offers a range of health benefits, such as maintaining bowel health and lowering cholesterol levels.

These ingredients were added to a simple oil and water mixture to understand how well they performed as an emulsifier. Their functionality was assessed by microscopy by evaluating the sizes of the emulsified oil droplets. Those which produced smaller oil droplets and retained that small size over time were

¹ Leatherhead Food Research (2014). The Global Food Additives Market – 6th Edition

assessed as being a more successful emulsifier than those producing larger oil droplets. Each of the ingredients was also evaluated on their stability over time at room temperature – a visual inspection looked for evidence of sedimentation, syneresis (release of water contained within the emulsion) and creaming (oil migration to the top of the emulsion due to its lower density).

Natural emulsifiers to watch

The results are immensely valuable for product developers struggling to find natural alternatives for synthetic emulsifiers. The table below shows some of the evaluation data for some of the ingredients evaluated. If you would like to know more about the full set of ingredients tested and the full set of findings, please contact:

innovation@leatherheadfood.com

A number of materials presented acceptable emulsification performances, namely, cocoa powder, cocoa fibre, pea fibre, peanut flour, rice flour and mustard flour. These ingredients could potentially be used as clean label emulsifiers in a wide range of food and beverage products which manufacturers want to position as ‘natural’.

The crucial question is why do some natural emulsifiers work better than others? Although more research needs to be done, the answer might be down to whether the stabilisation mechanism of the emulsifier is based on protein or particle absorption. Leatherhead hypothesises that different stabilisation mechanisms are taking place in each of these tested emulsions. The following stabilisation mechanisms are proposed: (1) soluble protein absorption at the water-oil interface (2) insoluble particle adsorption at the interface,

| Ingredient | Oil droplet size (µm) of fresh emulsions | Fresh emulsion consistency | Phase separation | | | Did it remain an emulsion after 7 days storage? |
|----------------|--|---|-------------------|----------|--------------------|---|
| | | | Sedimentation | Creaming | Syneresis | |
| Chickpea flour | 2 | Low viscosity, easy pourable | Yes, after 7 days | No | - | No |
| Bamboo fibre | 4 | Very high viscosity, paste-like consistency, non-pourable | No | No | Yes, after 24h | Yes |
| Potato fibre | ~ 8 µm | Very high viscosity, grainy texture and non-pourable | No | No | No | No |
| Peanut flour | 15 | Viscous liquid, easy pourable | No | No | Yes, after 14 days | No |
| Mustard flour | 11 | Very high viscosity, paste-like consistency, non-pourable | No | No | Yes, after 7 days | Yes |

Table I. Emulsification performance of the screened clean label ingredients after 14 days storage

and (3) increase of the viscosity of the continuous water phase by the polysaccharides present in the natural emulsifier, reducing the rate at which particles and oil droplets sediment or cream. The soluble protein absorption and insoluble particle adsorption stabilisation mechanisms are illustrated below.

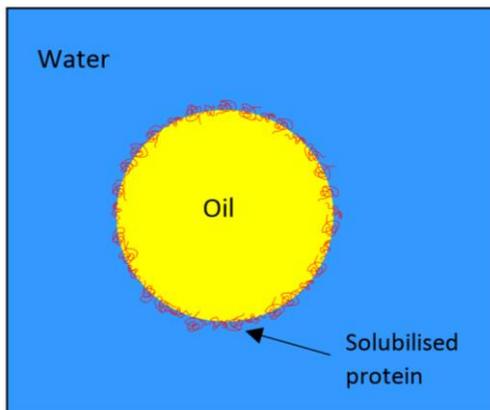


Fig 1. Illustration of emulsion stabilisation by protein absorption

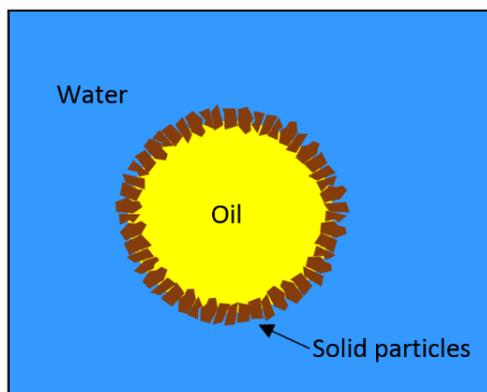


Fig 2. Illustration of emulsion stabilisation by particle absorption

The 'natural' future

'Naturalness' and 'clean label' is set to remain a strong trend among European manufacturers. New product launches (NPL) in

Europe carrying an 'all natural' claim have steadily increased year on year².

Although there is no firm definition of 'natural' from a regulatory perspective, manufacturers should be mindful of what consumers understand it to mean: consumers expect that it denotes a product which contains naturally-occurring ingredients which have been minimally processed. The quest, therefore, for natural ingredients, such as emulsifiers, which offer good functionality while meeting this consumer need remains a key priority for the industry.

² Mintel GNPD

How Leatherhead can help

Leatherhead has expertise in new product development through to scale-up. We have experience developing a wide variety of products, ranging from beverages and confectionery, to desserts and savoury products, taking into consideration the need for specific textural properties, health benefits and stability.

About the author

Marina Andres-Brull, Senior Research Scientist: Ingredients in the Food Innovation Group at Leatherhead Food Research, obtained her BSc degree in Agriculture – Food Industries at Rovira Virgili University (Spain), her MSc in Agriculture – Biotechnology at the University of Lleida (Spain) and University of Bologna (Italy), and her MPhil at the Phillips Hydrocolloids Research Centre (awarded by the University of Wales). Following her MPhil, Marina continued to work at the Phillips Hydrocolloids Research Centre as research assistant concentrating on the physico-chemical properties of polysaccharides and their interactions with proteins. Marina joined Leatherhead Food Research in August 2012, and her current position involves research in collaborative, member-funded and confidential research projects relating to ingredients functionality and their industrial 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.

help@leatherheadfood.com T. +44 1372 376761 www.leatherheadfood.com

About Science Group plc

Science Group plc offers independent advisory and leading-edge product development services focused on science and technology initiatives. Its specialist companies, Sagentia, Oakland Innovation, OTM Consulting and Leatherhead Food Research, collaborate closely with their clients in key vertical markets to deliver clear returns on technology and R&D investments. Science Group plc is listed on the London AIM stock exchange and has more than 350 employees, comprised of scientists, nutritionists, engineers, mathematicians and market experts.

Originally founded by Professor Gordon Edge as Scientific Generics in 1986, Science Group was one of the founding companies to form the globally recognised Cambridge, UK high technology and engineering cluster. Today Science Group continues to have its headquarters in Cambridge, UK with additional offices in London, Guildford, Epsom, Boston, Houston and Dubai.

info@sciencegroup.com

www.sciencegroup.com