TECHNICAL ARTICLE

# How to keep your frying margarines under control

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Discover the fascinating world of frying margarine and the intricate balance required to achieve optimal spattering performance. In this in-depth exploration, we delve into the complexities that can transform a kitchen essential into a culinary tyrant, leaving a trail of chaos and cleanup. At the heart of this technical journey lies a critical factor: the interplay between ingredients, emulsifier systems, and processing methods. Join us as we unravel the secrets behind the 'Category 5' frying margarine and unveil a groundbreaking solution engine that paves the way for controlled spattering, enhanced functionality, and unparalleled culinary experiences.

A 'Category 5' frying margarine isn't something you want in your kitchen. Crackling and spitting like a fire in a pine forest, it can clear a radius of five meters in under a minute, and demand hours of cleaning once the heat has died down. Of course, no manufacturer would ever want its product to act so aggressively – yet at Palsgaard over the past year or so, we've seen more than one customer's formerly peaceful margarine turn into a kitchen tyrant. The cause? Most often, it is the result of relatively minor changes in salt, lecithin type and/or milk solids content. One small step for frying margarines, it seems, can be a giant step for their frying performance.

## Spitting image

Frying margarines – either in stick or liquid form – contain combinations of mono-diglycerides, lecithin, citric acid esters and salt in order to reduce 'spattering' – the spitting of hot fat that occurs when the margarine, or other frying aid such as oil or frying fats, melts in the pan. As vapor pressure increases, spattering occurs when coalesced droplets sink to the pan's hot surface, rapidly converting to steam, and causing small explosions that send fat globules flying.

In the vast majority of frying margarines, lecithin or alternatively citric acid esters are used both as emulsifiers and for their anti-spattering properties, along with a number of other functionalities. Both products emulsify water droplets, reducing their tendency to coalesce, and facilitating fast evaporation before gravity can bring them into contact with the pan.

Is spattering a problem solved, therefore? Not for European manufacturers, especially – and even less so as time goes on.

## GMO and allergen troubles

To begin with, an increasing proportion of lecithin production is based on genetically modified (GMO) crops. That's hardly a problem in North America, for example, where GMO-based products are commonly accepted. Manufacturers in that part of the world, therefore, continue to reap the advantages of highly functional soy lecithin.

For European and American manufacturers, however, allergens such as lecithin won from soybean oil must be declared in foods. And in Europe genetically modified products are widely viewed with suspicion by consumers, activists and politicians alike. So using high-quality North American lecithin isn't an option. In its place comes products sourced from South America or India. Typically inferior across a broad spectrum of attributes, these products rarely have the same power to reduce spattering.

The simple reaction, for the majority of European manufacturers, has been to increase salt levels. Anti-spattering properties are positively influenced by salt content in the margarine because of its effect on partial steam pressure in the water droplets.

## Down with salt

Maintaining high salt content in markets that are increasingly demanding salt reduction is, however, hardly a strategy for long-term success. Instead, manufacturers have started down the path to creating frying margarines with 'normal' salt levels – while still using lower-grade lecithin. And many are finding the going tough, with increased spattering as a result.

But salt reduction isn't the only demand from the Marketing departments of leading manufacturers. With buyers beginning to favour lecithin-free, non-allergenic solutions, too, requiring the removal of milk solids or the replacement of soy lecithin with less efficient rapeseed or sunflower lecithin, developing low-spatter frying margarines is becoming increasingly difficult.

R&D teams are finding themselves caught between a rock and a hard place. And many are surprised when they make a comparatively simple change with, quite frankly, horrible results. Who would have thought it would make such a difference?

## New solution 'engine'

To assist manufacturers with these challenges, Palsgaard has invested almost two years in compiling more than 1,000 multi-parameter trials into a comprehensive 'solution engine' that can determine how best to maintain or improve frying performance when swapping out ingredients, altering their proportions or changing process equipment and parameters.

While similar testing has been carried out in the past, this is the first time the task has been approached with such diligence. Palsgaard used, for example, an extremely sensitive 'worst-case' test methodology that put recipes through their paces using electric, induction and gas stoves, different frying pan types (steel pans on gas turned out to be the toughest challenge) and different quantities of margarine (see figure 1).

The company's application specialists have systematically documented, for example, the effects of:

- Reducing or increasing salt content from 0.2% up to 1.5%
- Altering production parameters
- Optimising emulsifier systems

The results of the many tests are now being used to support real-life trials at Palsgaard's application labs or on site at customers' manufacturing plants, speeding up the time it takes to identify the best recipe for the lowest possible spattering.

Additionally, as part of the research effort, five distinct categories were created defining different levels of spattering. These range from mild-mannered Category 1 frying margarines to Category 5 (see figure 2) recipes with fat-spitting qualities so aggressive they could only be used with special protection. Manufacturers trying to reduce salt content, for example, while using the same emulsifier system as for their regular recipe, are almost without exception certain to go a category or two in the wrong direction – most likely at the expense of market share.

**Figure 1:** Palsgaard's test set-up for evaluating the spatter of frying margarines. The 'spatter collector' is placed 30 cm above the frying pan. 60 grammes of margarine is heated at max. temperature until all the water has evaporated. Subsequently, the spatter marks on the collector are marked an counted. Tests are performed on various heat sources and with different types of frying pans.

## Complex interdependencies

As any margarine application specialist worth his or her salt knows, the effect of salt in a frying margarine, for example, also depends on the emulsifier system and the milk solids present in the margarine. The processing setup, however, also has an influence as pressure, capacity, cooling and the actual setup of pin machines, crystallizer and tube chillers will affect the spattering performance of the frying margarine.

It's such interdependencies that make the job of maintaining spattering performance so tough. And the list is long, indeed.

Consider the role of milk solids, for example. Their inclusion in frying margarine has a number of beneficial effects, ranging from the desirable browning effect of the Maillard reaction to improved taste and smell. Milk solids also destabilise the margarine, causing water droplets to become less regular, which reduces the tendency to spatter. And deposits of tiny particles on the base of the pan attract heat to enable the creation of small 'chimneys' that channel steam from the base of the pan safely up to the surface.

Removing milk solids as part of creating a non-allergen product, therefore, has a profound effect on margarine performance.

## Control strategies

To control spattering, you need to enable gradual rather than rapid evaporation of the water droplets released as the margarine heats up. Additionally, foam formed as the frying margarine heats up, and generated by citric acid ester or lecithin, also helps to keep a lid on the flying fat droplets resulting from the small explosions of heated water.

A good emulsifier system is essential to distribute the inevitable explosions in a delayed pattern. For example, mono-diglycerides can be used to achieve a good emulsion, then hydrolysed or native lecithin can be added to make the emulsifier blend more hydrophilic. Lecithin, in particular, supports the creation of an emulsion that isn't strong enough to form uniform water droplets that can simultaneously

**Figure 2:** *A 'Category 5' margarine with fat-spitting quantities so aggressive that our technologists needed special protection to test them.*

evaporate – and helps to avoid the extreme situation where larger droplets agglomerate to trigger massive explosions. See figures 3 and 4 for tests of emulsifier systems with IP soy lecithin and rape seed lecithin respectively. From the two figures it is evident that the type of lecithin plays a huge role in anti-spattering behaviour, especially when the salt content is reduced.

Used in isolation, however, lecithin is likely to cause problems, so it is usually necessary to combine it with mono-glycerides and a little citric acid ester.

Removing lecithin altogether calls for careful selection of a new emulsifier system as a key aspect

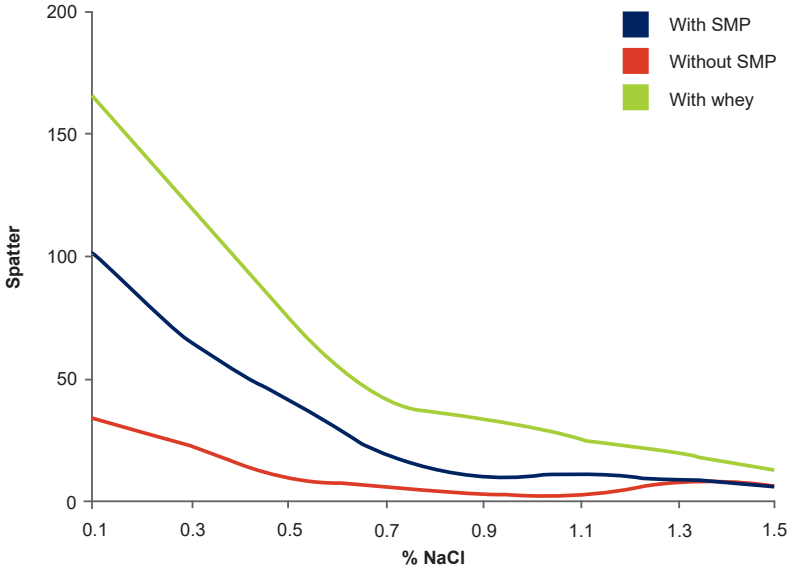


**Figure 3:** Results of frying tests of a brick margarine made with an emulsifier made from a mixture of mono- and diglycerides of edible fatty acids, rapeseed lecithin and citric acid esters. With this emulsifier system the best results are achieved without milk solids - either SMP (skim milk powder or whey) and with a high salt content.

of the recipe, but also requires the balancing of multiple other elements in the ingredients and production mix.

## Copy/paste won't do it

For manufacturers making frying margarine recipe changes, our solution engine tells a clear story: The copy/paste product development model, where R&D takes an existing recipe and 'tweaks' it by removing or replacing an unpopular substance (salt, milk solids or soy lecithin), then adjusts the content of the remaining ingredients to combat the inevitable increases in spattering, simply isn't good enough. A few hundred hours later, at least, the product is still likely to be one, two or more categories higher up the spattering ladder – and probably failing to live up to other functional requirements, too.

In fact, selecting the right emulsifier system is the one thing every R&D team should be focused upon to effectively control spattering.

## What works best?

The many screenings have, for the first time, revealed exactly why manufacturers have been encountering such difficulties every time they want to make a change. Of course, it's not possible to summarise the results of so many trials with so many different parameters and values. Key insights, however, from Palsgaard's work include:

- Soy lecithin, used together with specific emulsifier systems, gives the best spattering performance of the different lecithin types (See figure 4)
- Combining mono-/diglycerides and lecithin reduces some spattering in margarines with low salt content
- Pressure, capacity, cooling and the actual set-up of pin machines, crystallizer and tube chillers also have an influence
- Adding citric acid esters of mono- and diglycerides (Citrem) is perhaps the most effective solution (See figure 5)

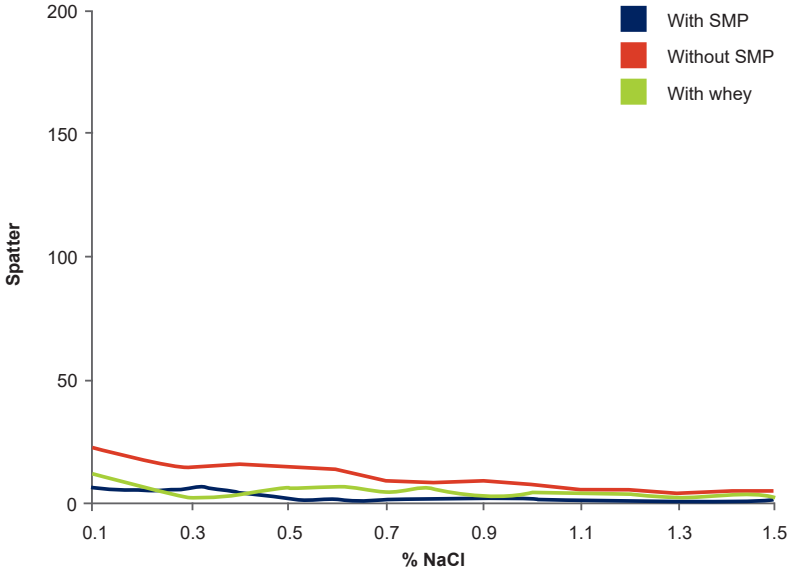


**Figure 4:** Results of frying tests of a brick margarine made with an emulsifier made from mixture of mono- and diglycerides, IP soy lecithin, and citric acid esters. Compared to Figure 3 it is evident to see that this emulsifier system with and without milk solids and with low or high salt content offers much better frying results.

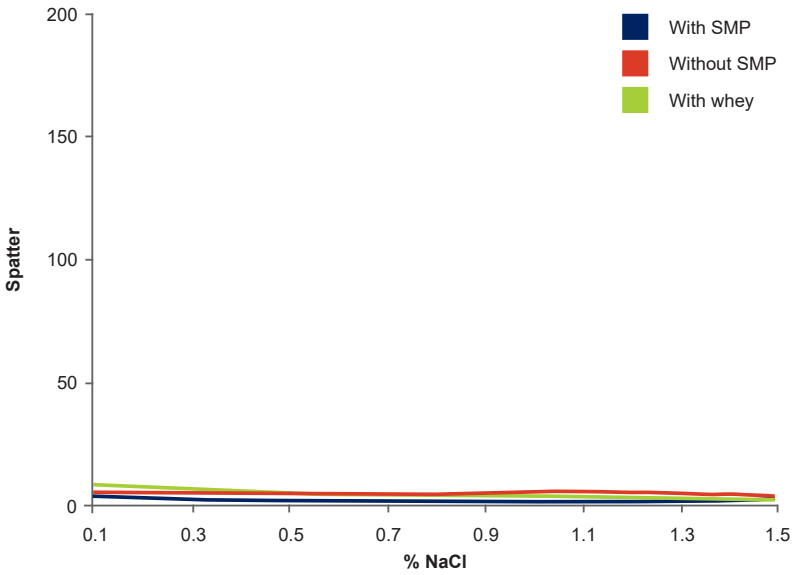


**Figure 5:** Results of frying tests of a liquid margarine made with an emulsifier made from pure citric acid esters. Compared to Figure 3 it is evident to see that this emulsifier system with and without milk solids and with low or high salt content offers much better frying results. As opposed to the emulsifier system tested in Figure 3, this system does not contain any lecithin, which makes it a good choice for an allergen-free margarine.

## An effective new tool

Naturally, this focused effort around frying margarine trials has enabled Palsgaard to build a huge base of analytical data and spattering know-how. Having uncovered the key role emulsifier systems can play in countering spattering, along with greater clarity around the mix of other ingredients, the solution engine has become an effective new tool for adjusting frying margarine recipes to meet a wide variety of demands.

In our application labs, the focus is to move manufacturers back down the categories to a safe place – or to help them keep their product's performance within the same category. The weapon of choice is typically a combination of emulsifier systems based on citric acid esters with or without lecithin (based on soy, sunflower or rapeseed, hydrolysed and non-hydrolysed) – guided by the solution engine's vast library of test results.

In this way, frying margarine manufacturers have a new opportunity to use their emulsifier partner as a sounding board, sending samples to assess and repair spattering performance and speeding up the new product development process.

Find out more at **www.palsgaard.com** and contact us today to order samples of our frying margarine emulsifiers and try them in our extensive library of recipes.

**CONTACT US**