

TECHNICAL ARTICLE

How to make low-fat margarine spreads with only 10% fats

BRINGING GOOD THINGS TOGETHER

Palsgaard®

It is a well known fact that consumers are requesting healthier foods with an increasingly lower fat content. This is also true for margarine spreads. Based on 100 years of experience creating emulsifiers for the margarine industry Palsgaard is therefore pleased to present an emulsifier system which makes it possible to lower the fat content to as low as 10%. This article explains both how the emulsifier system works but equally important how to get the correct processing conditions.

Traditionally margarine, dairy and other spread producers have been cautious about developing and producing low fat spreads due to the problems it could generate in the production, such as an increased risk of unstable products and insecure production parameters.

Benefits from reducing the fat content to 10%

The fact is that there is an increasing focus on fat reduction from a nutrition point of view due to the increasing number of people with a BMI above 30 and the subsequent potential risk of coronary heart disease, diabetes etc. Reducing the fat content in a margarine spread beyond the traditional 40% allows for additional nutritional benefits such as the possibility for a reduction of saturated fat in the food intake together with a reduction of the total fat intake. At the same time the total cost of raw materials for low fat spreads are lower than for normal margarines.

Why use spreads?

Why not just leave out the spread and make a healthier sandwich? Because the spread has a positive influence on the overall eating quality of the sandwich. As the sandwich is eaten the spread will be mixed with the crumb structure during the chewing and give a better mouth-feel and swelling. At the same time it will improve the mouth-feel and flavour release.

Additionally, it also reduces the migration of water into the crumb structure in the sandwich - typically water from vegetables like tomatoes or cucumbers will soften the crumb structure in the bread, making the sandwich soggy and thus reducing the eating quality significantly. Making sandwiches without applying a thin layer of margarine spread is therefore not an option. Especially not if the sandwich is to be stored for a while before being eaten.

How to make a 10% low fat spread

At Palsgaard we therefore decided to see if it were possible to successfully create a low fat spread with only 10% fat content with the boundaries listed below:

- 10% fat content
- No hydrogenated oils or fats
- No hydrogenated emulsifiers
- Possibility to use sustainable palm oil (RSPOcertified)
- No allergenic ingredients
- Non GMO
- No trans fatty acids (<1 %)

In order to do so, we created the recipe, shown across in table 1, which was subsequently tested in our large scale margarine pilot plant in order to specify the right processing parameters.

The following explains how we were able to achieve the desired results.

The emulsion type used in the recipe is W/O (water in oil) as used in other margarine and spread products. In theory it is difficult to reduce the fat content to lower than 25.4% if the water droplets have exactly the same size in a W/O emulsion, as shown in figure 1a. In practice, however, by utilizing the combined benefits of emulsifiers **Palsgaard® DMG 0298** and **Palsgaard® PGPR 4175** it is possible to create water droplets with different sizes. By so doing the emulsion can be much more closely packed as shown in figure 1b. This is the reason why it is possible to produce 20% - 15% or even 10% low fat spreads.

Instability problems in low fat spreads

When creating a low fat spread it is important that the fat composition contains more liquid oil than similar high fat products, due to the fact that the oil phase needs to cover a higher amount of water droplets. If the fat phase contains too much solid fat the smoothness of the product will disappear. Equally, if the emulsion contains too much palm stearin it will tend to become more unstable in 10% low fat spreads compared to palm oil. The reason is probably more brittleness during and after production.

Figures 2a and 2b demonstrate the buildup of primary crystal bond structure and how the fat, if it is brittle more or less, squeezes out the water with mechanical treatment. The emulsifiers that are located at the surface between water- and oil phase cannot avoid this phenomena. Only a combination of the right process parameters and fat composition can solve this problem. It is therefore not always an emulsifier problem when free water is found.

Figures 2a and 2c show the effect of crystallization and the development of crystals and the formation of crystal network. Mechanical treatment will break

Emulsifier	Palsgaard® DMG 0298	0.60%
	Palsgaard® PGPR 4175	0.40%
	Palsgaard® 6118	0.70%
Oil blend	RDB palm oil	2.00%
	Rape seed oil	6.26%
	Flavour	0.02%
	Colour Anatti 3525-OSS	0.02%
Water phase	Salt	0.60%
	Potassium sorbate	0.20%
	Maltodextrine	1.50%
	Sodium alginate	0.55%
	Water	87.15%
	Adjusted to pH 4,5 with citric acids	
Total content		100%

Table 1: Recipe suggestion for a 10% low fat spread

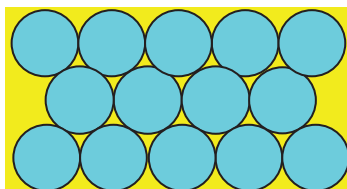


Figure 1a: Water droplet size in a traditional 25.4% spread

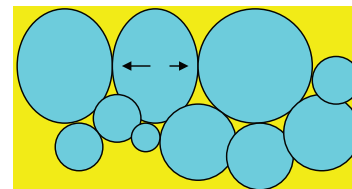


Figure 1b: Water droplet size in a 10% spread made with Palsgaard® DMG 0298 and Palsgaard® PGPR 4175.

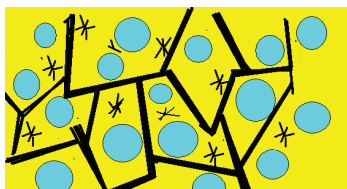


Figure 2a: Primary crystal bond structure.



Figure 2b: Free water after squeezing

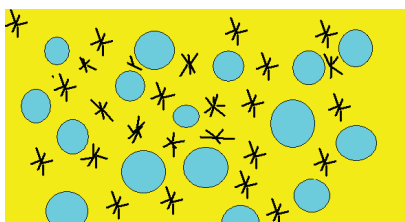


Figure 2c: Secondary crystal bond structure.

down the primary crystal bond structure and give a more smooth structure with plasticity mainly based on van der Waals forces (Secondary crystal bond structure).

Creating an emulsifier system for 10% low fat spreads

In order to face the challenge of oil separation and secure the right mouth-feel of the spread we used two different types of emulsifiers:

Palsgaard® DMG 0298, which is a mono-diglyceride (E471) but atypical in comparison to many other mono-diglycerids since the fatty acid combination is mainly based on oleic acids. The unsaturated fatty acids offer better emulsification and emulsion stability for reduced and low fat spreads compared to standard mono-diglycerides.

Palsgaard® PGPR 4175 is made from polyglycerol polyricineolate (E476) but is more polymerised than normal PGPR types.

PGPR is a co-emulsifier, meaning that you will only obtain the desired effect if it is used in combination with another type of emulsifier. In low fat spreads PGPR is exceptionally good at coating water droplets, fat crystals and increasing viscosity in low fat emulsions. Without PGPR it is not possible to make the very low fat spreads.

Palsgaard® PGPR 4175 is therefore necessary for stabilizing the 10% low fat spread as it helps avoid fluctuations during the production process and reduces the amount of rejected product.

Palsgaard® PGPR 4175 is neutral in both taste and smell and is thus a unique non-flavour component.

Stabilising the fat phase

The oil absorber **Palsgaard® 6118** is based on non-hydrogenated vegetable fats and is especially suited for applications where we don't want to use hydrogenated products. The oil absorbing effect of **Palsgaard® 6118** is effective in products which contain a high amount of liquid oil, such as the oil phase in low fat spreads. The oil absorbing behaviour reduces the risk of oiling out.

The effect of sodium alginate in 10% low fat spreads

In the water phase we add sodium alginate (E401), which reacts as a thickener of the water phase. It stabilizes the water phase in the 10% low fat spread and reduces the risk of squeezing out the water.

Sodium alginate also improves the mouth-feel of very low fat spreads. The optimal effect is achieved when using 0.55% sodium alginate. At 0.75% sodium alginate the water droplets become too viscous and the spread starts to become less stable with a higher risk of free water.

How to set up the right processing conditions

The process of manufacturing these low fat spreads is the opposite of what is traditionally used when making a 40% spread. Therefore, the practical experience from producing 40% low fat spreads cannot be used in the production of very low fat spread emulsions. Figure 3 shows the process flow needed to successfully manufacture a 10% low fat spread.

The water phase needs to be added slowly, but the emulsion itself will have a tendency to build up a lot of viscosity in very low fat spreads if the mechanical treatment is too intensive. The stirrers that are functioning fine when making 30 - 40% low fat spread emulsions, need to be designed for more viscous emulsions otherwise "dead" areas will arise in the emulsion tank. Anker stirrers function very

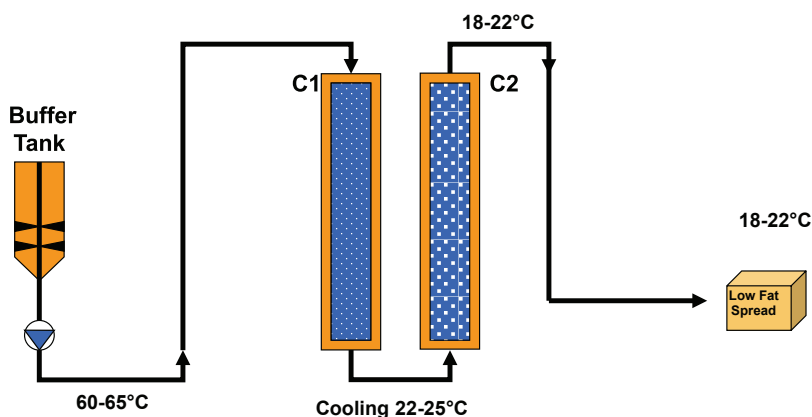


Figure 3 : Process flow chart of a low fat spread emulsion

well in emulsion tanks for the relative high viscous emulsions. Slow agitation is important to avoid the build-up of too viscous emulsions. Figure 4 shows that double up of agitation in a pre-emulsifying unit can increase the viscosity up to 5 times.

Keeping the temperature between 55 – 65°C in the emulsion- and buffer tanks is important for reducing the risk of high viscous emulsions. If this is not heeded the viscous emulsion may become so thick that it is impossible to pump from the tanks. This is also why pin machines are not necessary in the production flow. The production capacity can be high and the packing temperatures do not need to be very low because of the cooling capacity in the water phase.

The crystallisation part of the process is important, but in another way compared to high fat margarine products. In low fat spreads the fat crystals do not dominate the structure in the same way as in margarine and butter. The concentrated packing of water droplets produce a W/O emulsion with a more mayonnaise-like structure. In high fat margarines the mouth-feel is affected by the melting crystals and the subsequent phase inversion of the emulsion. Low fat products and its very strong emulsifier systems reduce the instability effect just because the fat crystals melt down unlike the high fat products.

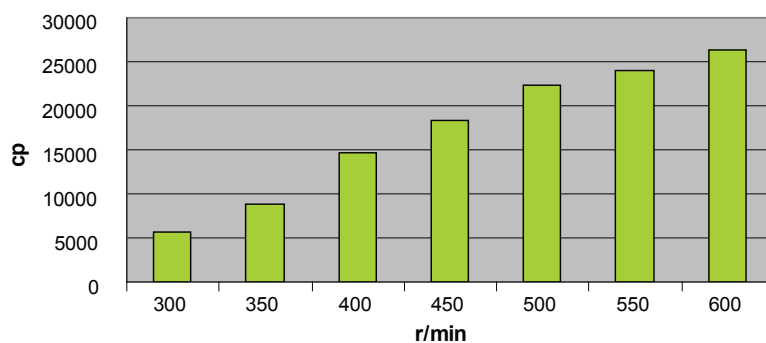


Figure 4 : Viscosity in low fat spread emulsions

Storage - the last step of production

In the first days after production the crystallisation and formation of crystal network will continue, thereby affecting the low fat spread. It is our experience that high storage temperatures help transform the spread to a softer product also after cooling to low temperatures. Contrary, fast cooling directly from production will increase the tendency to brittle and more unstable low fat spreads. Therefore, the best way to store low fat spreads is at 15°C for 3-5 days before cooling it down to 5°C.

Conclusion

As described above, it is possible to create a low fat margarine spread with only 10% fat and overcome the usual challenges of oil separation and poor mouth-feel, but it must be done with a clear focus on the recipe and on the production parameters. Choosing the right combination of emulsifiers will get you most of the way, and getting your processing parameters right will get you the rest of the way.

CONTACT US

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

