TECHNICAL ARTICLE

How to make high-quality non-dairy creamers

BRINGING GOOD THINGS TOGETHER

Palsgaard®

The demands of a good non-dairy creamer are many: Not only is it required to offer the same mouthfeel and whitening effect as its milk-based alternatives, it is also required to disperse very quickly without causing oil separation in the beverage. Demands that can all be met by using the right combination of emulsifiers.

What is a non-dairy creamer?

"Non-dairy creamers", "creamers", "coffee creamers", "coffee whiteners", "tea whiteners", "beverage whiteners", "dairy creamers", "non-dairy coffee creamers", "ND Creamer" or "non-dairy whitener"...

All these product names are synonymous with the same lactose-free liquid or granular substances, carefully manufactured with the intent to substitute for milk or cream as an additive to coffee or other beverages.

Hence the NDC is to provide the same whitening effect and mouthfeel, but is also required to disperse or dissolve very quickly without causing oil separation in the beverage.

In order to achieve this, the manufacturer needs to pay special attention to the choice of raw materials for the NDC, the individual steps in the production process, and just as importantly the choice of emulsifiers as they will influence the quality of the NDC greatly.

Emulsifiers & know-how put to work

As the inventor of the modern food emulsifier, Palsgaard has unsurpassed insights into the functionality of these versatile ingredients and gladly shares its know-how with food manufactures around the world.

With application centres and R&D facilities on three continents we are in a unique position to not only develop new emulsifiers but also to test the effect of them in their finished products and advise our customers on their use.

This also applies to non-dairy creamers as our R&D centre, Nexus, in Denmark has the facilities to manufacture non-dairy creamers from scratch and thereby allow us to test the effect of not only our emulsifiers, but also of the different ingredients and production processes. Findings which we are happy to share in this article

Table 1: *Overview of the most commonly used ingredients in non-dairy creamers and their functionalities. Readers will note that despite being called "non-dairy", due to their lactose-free ingredient list, the creamers may still contain milk proteins (sodium caseinate).*

INGREDIENT	SOURCE	FUNCTIONALITY
Glucose/Malto-dextrin	From corn, potatoes, wheat, barley, rice or cassava/tapioca	Bulking agent or principal diluent, Carrier to retard coalescence of fat. Sweetness, Improve body.
Vegetable fat	From hydrogenated palm oil or hydrogen-ated coconut oil	Whitening power. Give body and viscosity.
Sodium caseinate	Milk	Provide a mild dairy flavour. Help with emulsification.
Emulsifiers	Vegetable origin	Combine immiscible fat and water. Improve emulsion stability. Increase stability against feathering in coffee/tea. Create the proper amount of fat agglomeration to achieve whitening effect. Improve creaminess and mouth-feel.
Anti caking agent	Silicon dioxide (SiO_2	Prevents lumping of the NDC.
Colour (Annatto, beta carotene) % varies according to concentration	Plants	Ensures a yellowish colour of the NDC.
Buffer salt	Sodium bicarbonate, dipotassium phosphate	Keeps a balanced pH (between 6.8 - 7.3) in the NDC system. Stabilizes the protein.
Flavour	Natural, natural identi-cal or artificial	Controls taste, mouth-feel.

Palsgaard's R&D centre in Denmark, which comprises emulsion tanks, homogenisation units, buffer tanks, spray tower and external fluid bed for agglomeration, in addition to numerous analysis equipment makes it possible for the company's technologists to produce NDC batches from scratch and subsequently test the results of different production processes, emulsifier combinations and raw materials.

Choosing the right key ingredients

As shown in Table 1, glucose syrup is a key ingredient in non-dairy creamers (NDC). During our trials we have noticed that it is important to keep the total solid content of the glucose syrup between 69-72% as more energy is required to pump it during manufacturing with a higher content of total solids. Equally, the dextrose equivalent used should be as low as possible as the higher the dextrose equivalent, the lower the heat resistance of the glucose syrup and subsequent higher risk of burning or browning during production. This may in turn effect the colour and taste of the finished NDC.

Most non-dairy creamers contain vegetable fats which substitute for dairy fats and add texture, flavour and opacity. The most commonly used fats in the South-East Asian region are hydrogenated palm kernel oil, hydrogenated coconut oil or combinations of the two. The fats are chosen based on the desired creaminess, taste and mouthfeel influenced by the melting point, solid fat index and colour, health considerations, oxidative stability and economic considerations.

Emulsifiers for non-dairy creamers

The emulsifiers used in non-dairy creamers are typically mono- and diglycerides (E471) produced by the reaction of edible vegetable fats or oils when combined with glycerol. The resulting molecule is composed of a hydrophilic and a lipophilic part, positioned at the interface between fat and protein on the one hand, and water on the other. These molecules are formed during homogenisation and ageing of the product.

The mono and diglycerides (MDG/DMG) form a complex with the proteins, making the fat globule membrane more resistant to coalescence, and reducing fat separation in the product at the same time. But that's not all – these emulsifiers lower the net charge of the membrane, creating a three-dimensional network that acts to increase the creaminess of the NDC. Importantly, and perhaps somewhat counter-intuitively, the emulsifiers also guard against creaming in the finished product.

Another common emulsifier used in NDC is Sodium stearoyl-2-lactylate (SSL) (E481) to ensure good dispersion and whitening power. SSL is manufactured by the esterification of stearic acid with lactic acid and partially neutralized with either food-grade soda ash (sodium carbonate) or caustic soda (concentrated sodium hydroxide). SSL is slightly hygroscopic, soluble in ethanol and in hot oil or fat, and dispersible in warm water. These properties are the reason that SSL is an excellent emulsifier for fat-in-water emulsions.

MDG/DMG and SSL have different qualities and thus affect the end result of the NDC differently. MDG/DMGs are more lipophilic, so they attach more to the fat phase, whereas SSL is more hydrophilic and attaches to the water phase.

In practice, this means that by combining the qualities of both emulsifiers you will create a better emulsion, where the protein and emulsifier will form a physical barrier between the oil droplet and the surroundings which reduces the incidence of emulsion destabilization.

Combining the right type of MDG/DMG with the right type of SSL and defining the right dosage is another matter as they will offer different results regarding dispersibility, whitening effect, mouthfeel and emulsion stability.

How to achieve good dispersibility

Creating non-dairy creamer powders with good dispersibility and wettability can be a challenge and is highly dependent on the choice of emulsifier as well as the production process and the quality of the agglomeration.

The dispersibility of a non-dairy creamer is affected by several parameters during the production process:

The stability of the emulsion created during wet mixing, as a stable emulsion will result in a constant particle size. An unstable emulsion will break down, creating phase separation. The stability of the emulsion will depend on the emulsifier type, the amount of emulsifier and the homogenisation process.

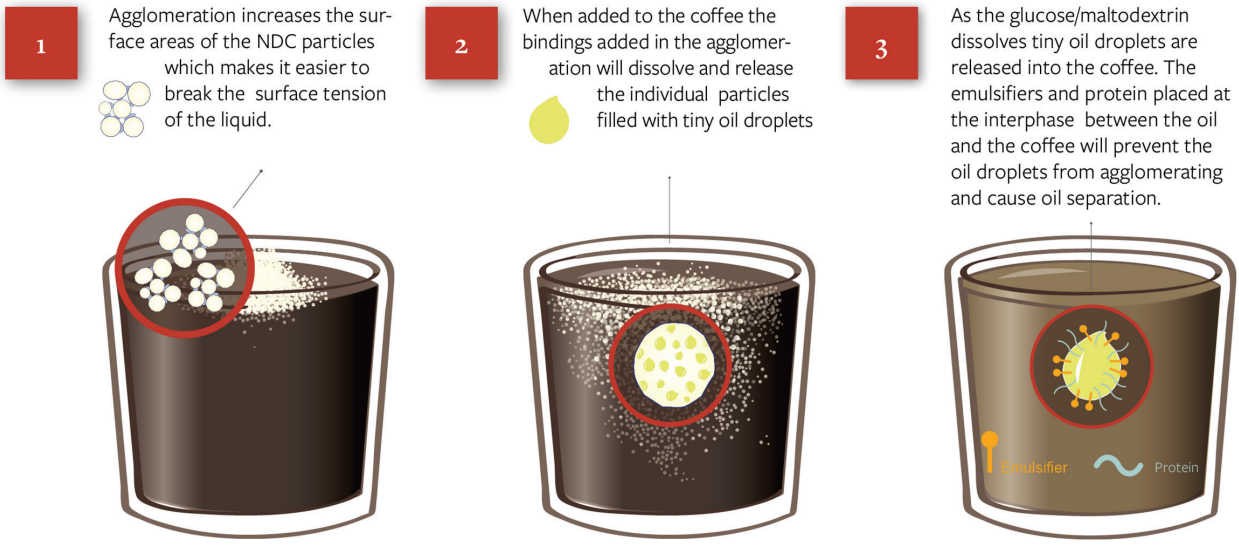
The spraying temperature and subsequently the moisture content of the spray dried product – if the moisture content is too high, there is greater risk of lumping which will again affect the dispersibility. Emulsifiers help ensure that more water is evaporated, thereby preventing lumping.

The effect of the agglomeration – as a stable agglome-rated product will have less breakage as a result of a good capillary system and will therefore be dispersed more easily. Emulsifiers affect agglomeration as they help ensure that more water is evaporated during spray drying, thereby making it possible to create a harder agglomeration and a less sticky product.

The effect of emulsifiers on dispersibility

Using our R&D centre in Denmark, comprising emulsion tanks, homogenisation units, buffer tanks, spray tower and external fluid bed for agglomeration, Palsgaard has produced a number of NDC test- batches to test the effect of our emulsifiers.

All batches were produced from the same basic recipe and processing parameters with the only different being the type of emulsifiers and amounts of these. We subsequently tested the dispersibility of the NDC powders in 100 ml of 85°C hot coffee and compared it to a control test with a market leading product. Results show that a combination of MDG and SSL prove to be the most effective – and much faster than the control test as shown in this video, which you access via the QR code.



Figures 1 - 3: Dispersion of NDC in coffee illustrated.

The wish for whitening

That the non-dairy creamer has a good whitening effect is a must for all manufacturer as it is a consumer demand to get the same visual effect when adding NDC to the coffee as they would when adding milk or cream.

Achieving that desired whitening effect is, however, not easy and requires skill and know-how of the effect of the individual ingredients and processing steps in the production.

The whitening effect is primarily effected by the fat types used and the effect and temperature of the homogenisation process.

Once the NDC enters the coffee, the glucose or maltodextrin surrounding the oil droplets will dissolve in the coffee. This causes the viscosity of the coffee to increase. Upon dissolving the glucose/ maltodextrin and the coffee will form the continuous phase surrounding the oil droplets, which will form the disperse phase. It is important to stabilize the oil droplets to prevent them from rising to the surface and forming larger droplets.

The small oil droplets will add a whitish colour to the coffee due to light scattering in the individual droplets. Hence, the smaller the oil droplets, the whiter the coffee will seem.

Control test with market leading product

Combination of **Palsgaard® MDG 0054** and **Palsgaard® SSL 3429**

Emulsifier effect on whitening

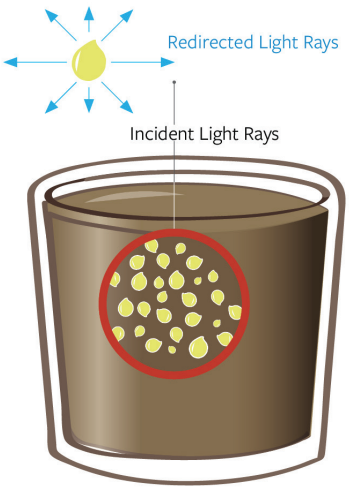
Emulsifiers play a key role in creating a good whitening effect in the NDC as it all comes down to creating many small oil droplets to reflect light in the coffee.

The emulsifiers are fundamental in stabilizing the formed small oil droplets during the spray drying process.

Once the NDC is dissolved in the coffee and the oil droplets have been released, emulsifiers also have a key role to play as the environment is completely different from that of the emulsion before spraying with regards to temperatures and acidity.

It is therefore highly important that the emulsifiers used can ensure functionality and stability in both environments. Emulsifiers such as SSL work well in acidic environments and help keep the fat globules small and stable. Sodium caseinate also has a stabilising effect.

Figures 4: *Emulsifiers play a key role in creating a good whitening effect in the NDC as it all comes down to creating many small oil droplets to reflect light in the coffee*



Overcoming oiling

Imagine adding a non-dairy creamer to your coffee only to find it causing big, unpalatable oil droplets to form on the surface of your coffee. This is not a situation many consumers would like to experience, which is why creating an NDC that doesn't cause oil separation is high on the wish list of most manufacturers.

There is, however, a solution to this problem, which is caused by an unstable emulsion between the fats used and the water in the NDC. By using high quality emulsifiers of the right dosage and type it is possible to create a strong, stable emulsion that will work all the way from emulsion tank to spray drying and agglomeration to being dispersed into the coffee.

It is also important to homogenise the NDC emulsion sufficiently before spray drying.

Ensuring emulsion stability

Creating a good, stable emulsion is key to producing a good non-dairy creamer. If the emulsion formed during the wet mixing phase isn't up to scratch, there is great risk that you will end up with a poorly functioning final NDC.

The quality of the emulsion affects the NDC in several ways:

- During homogenisation it ensures that the oil droplets will be of a similar size.
- During spray drying it ensures uniformity in the powder particles
- During agglomeration, it ensures that the powder is easily mixed and agglomerated
- During dispersion, it ensures stability so that there is not much feathering, oiling and instability in the coffee.

In order to form a good, stable emulsion for NDC you need to control two important parameters: The ingredients and the production process – as they each have an influence on the quality of the emulsion

PICKING THE RIGHT INGREDIENTS

For the ingredients it is important to consider the types and amounts of fats to be used, the amount of sodium caseinate and most importantly the amount and type of emulsifiers to be used. The emulsifiers will place themselves at the interface of the fat globules in order to keep the fat globules small and stable and prevent them from agglomerating and cause oiling on the surface of the coffee.

AND THE RIGHT COMBINATION OF EMULSIFIERS

A recipe based on MDG/DMG tend to disperse faster whereas one based on combination of DMG and SSL will be more stable. As a general rule of thumb, the reduction of interfacial tension is more effective with small molecule emulsifiers and the stabilisation of emulsion is more effective with high molecular weight emulsifiers.

CONTROLLING THE PRODUCTION PARAMETERS

During production it is important to control the melting of the fat and emulsifiers during the wet mixing step and ensure that the emulsifiers are properly distributed in the fats, just as you must control the pressure during homogenisation.

Achieving the right mouthfeel

The mouthfeel of the non-dairy creamer when dispersed in coffee is another quality parameter consumers use to judge the quality of an NDC. Some prefer a NDC with a cleaner mouthfeel so that the taste or the aroma is not suppressed while others prefer it to be creamy in order to reduce the bitterness of the coffee.

In order to meet consumer requests for NDCs with either a clean or creamy mouthfeel there are several parameters the manufacturer must get right:

For one, the mouthfeel of the NDC is affected by the type of fats used in the recipe and the Solid Fat Index and melting points of these. If the melting point is too high and a significant portion of the fat remains solid at the temperature consumed, it will give a greasy or waxy after-taste which is not desirable.

Mouthfeel is also affected by the efficiency of the homogenisation and spray drying as the size of the particles will affect the flavour release.

The above is in turn affected greatly by the quality, type and amount of emulsifiers used in the NDC. Mono- and diglycerides and Sodium stearoyl-2-lactylate are as mentioned the most commonly used emulsifiers in NDCs, but they have different qualities and affect mouthfeel of the NDC differently.

Sustainability as a key ingredient

When choosing the right ingredients for their NDCs there is another ingredient that manufacturers are increasingly required to add to their shopping list: Sustainability. By choosing Palsgaard, manufacturers will get a partner fully dedicated to CSR. The company has a strategic focus on responsible sourcing and resource consumption and and is able to offer its full product range based on RSPO certified segregated palm oil.

Let's help you make the right choice

From the above, it is easy to conclude that a good emulsifier combination of MDG/DMG and SSL will help manufacturers create a good non-dairy creamer. The tricky bit lies in choosing which MDG/DMG to combine with what SSL and what dosage to use as they each have different abilities within emulsion stability, dispersibility, mouthfeel and whitening effect. Palsgaard will be happy to advise NDC manufacturers on the choice of emulsifiers just as we'll make a series of NDC recipes based on our emulsifiers available for testing.

Contact us to order samples of **Palsgaard® MDG 0054** and **Palsgaard® SSL 3429** to try out in our vast library of NDC recipes, or visit **www.palsgaard.com** for more information.

CONTACT US