we are experts in emulsifiers and stabilizers for bakery, confectionery, dairy, ice cream, margarine and fine foods - and we are happy to share our expertise. our company values can be defined in just three words: loyalty, responsibility and commitment. we aim to be the preferred partner and supplier of quality products, application service and know-how to regional and multi-national food companies. to Palsgaard loyalty means that we act as a reliable and honourable business partner for our customers. we treat information confidentially and know how to keep a business secret. to Palsgaard responsibility means caring about the environment and being aware of our corporate social responsibility; we have a goal to be CO_2 neutral by 2020 and are members of SEDEX and RSPO. to Palsgaard commitment means we are dedicated to getting the best results for our customers' products - to the benefit of their customers. we care about our employees and have a declared aim that Palsgaard must be a pleasant place to work. Palsgaard we know that our most important resource is the know-how and dedication found in our employees. Heart we are committed to getting the best results with our products in our pilot plants and in your facilities. Working at Palsgaard we don't sell standard solutions - we start with your needs. Palsgaard - Heart Working People heart work is the best way to achieve success - let us help you get it. our products are produced according to the strictest quality criteria. we are experts in emulsifiers and stabilizers and we are happy to share our expertise with you. let our pilot plants help you shorten the step between idea and your new product. heart work is the best way to succeed - let us help you do so.

Puff pastry margarine
- Focusing on functionality and fat reductions

Palsgaard Technical Paper, October 2011

Palsgaard®
Heart working people

Puff pastry margarines have always been a challenge for the margarine industry to produce due to the many demands of the margarine such as a *non-greasy surface* so that the margarine is easy to work with both by hand and by extrusion process, *very plastic*, so that it can be folded without breaking, because breaks will lead to insufficient lift and flaky structure in the puff pastries, *high functionality* so that the best expansion can be obtained. In recent years new challenges such as no trans fatty acids in the margarines, no hydrogenated fats in the margarine and no lecithin in the margarine have been added. Furthermore, the fat content in puff pastry is significant because the amount of margarine rolled into the dough is approx. 35%. Consequently, there is, both because of declarations and also because of the costs of raw materials, now a wish to reduce the fat content of the margarine. This article discusses the possibilities for fulfilling the above demands and also by trials and evaluations demonstrate some important parameters.

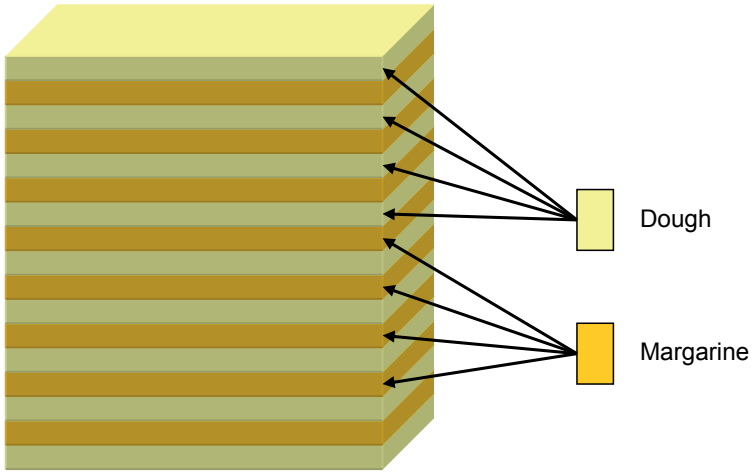
Puff pastry and puff pastry margarines

Puff pastry is characterised by its laminated structure of baked layers of dough separated by thin layers of margarine or fat. The ratio between the dough and the margarine is typically 2:1, as illustrated in table 1.

During the lamination process each layer of dough will be separated by one layer of margarine. In puff pastry the numbers of layers are typically 144 or 288. However, puff pastries with up to 1458 layers are also produced.

After preparation of the dough the layers can be illustrated as in figure 1 (across).

Figure 1:
Puff pastry dough with layers of dough and margarine.



After baking this lamination of the dough will result in a puff pastry with a nice lamination and volume (expressed as height and expansion).

Table 1:
Typical recipe for puff pastries

Ingredient	weight	%
Flour	1000 g	39.1 %
Salt	10 g	0.4 %
Water	550 g	21.4 %
Puff pastry margarine	100 g	3.9 %
Roll in with puff pastry margarine.	900 g	35.2 %

Figure 2:
Puff pastry dough during baking process

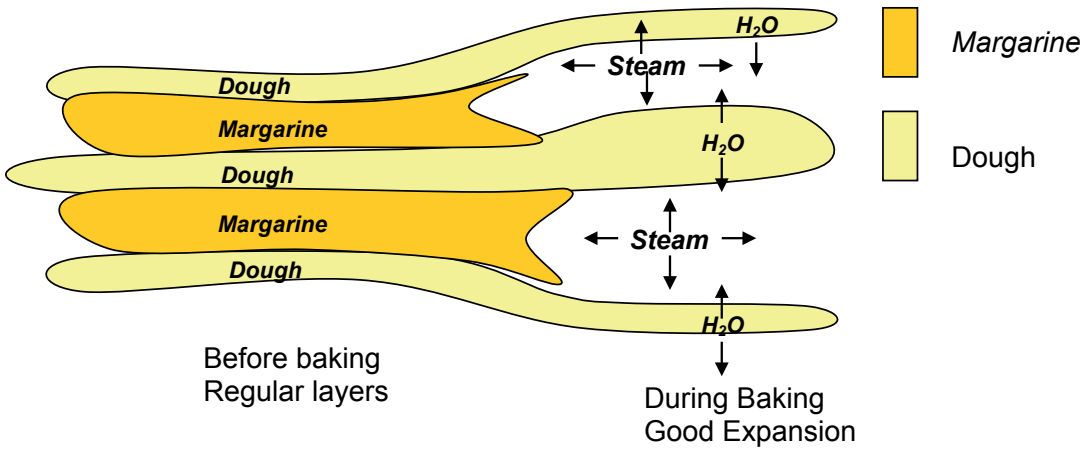


Figure 2 shows what is happening during the baking process.

A puff pastry dough typically contains flour, salt, water and puff pastry margarine, and in this article we will focus upon the puff pastry margarine; both the traditionally type with minimum 80% fat content, but also reduced fat types.

Puff pastry margarine

Puff pastry margarines are characterized by the plasticity, which allows the margarines to be worked with and folded and extruded without breaking and becoming greasy. In order to obtain this margarine both the composition of the margarine, the processing and the tempering of the margarine are extremely important parameters.

Fat blends for puff pastry margarines

Typically used fat blends for puff pastry margarine contain palm fats and liquid oils as different combinations of these will form a good basis for creating margarines with very good plasticity.

Palm fats are slow crystallizing fats and polymorph fats, which poses specific demands to the process of the puff pastry margarine: The margarine must be completely crystallized and most of the primary bondings removed and exchanged to secondary bondings in order to keep the plasticity of the margarine after production. Puff pastry margarine is subsequently tempered in typically 3 days to 1 week before distribution in order to obtain the best plasticity.
If the puff pastry margarine is prepared for the dough by extruders, the final kneading of the margarine will take place during this process. If the margarine is used in a traditionally manufactured puff pastry dough, the plasticity of the margarine after production and tempering is very important.

Emulsifiers typically used in puff pastry margarines

In order to get the right performance of the pastry margarines combinations of different emulsifiers are normally used:

Distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids (E-471) will reduce the interfacial tension in the margarine emulsion, so that the final margarine, which is a water-in-oil emulsion will contain a stable homogenous distribution of small water droplets which cannot agglomerate and create free water on the margarine. During the process of producing the puff pastry dough it is necessary to work with the margarine by hand or by extrusion and unstable water-in-oil emulsions will create free water which will decrease the plasticity of the margarine and give breaks in the margarine and thereby make it difficult to produce the right quality of puff pastries afterwards.

Lecithin, (E-322) is used in order to improve the plasticity of the puff pastry margarine because it also is an emulsifier and will additionally improve the solubility of the distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids (E-471) in the fat blend for the puff pasty margarine.

Polyglycerol esters of fatty acids, (E-475) are used in combination with distilled mono- and diglycerides of fatty acids/mono- and diglycerides of fatty acids (E-471) in order to improve the crystal structure of the margarine. A high number of smaller crystals will have a larger surface area than a few large crystals in the margarine, and thereby the margarine with a high number of small crystals will absorb the liquid oil created during working with the margarine. Thus a non-greasy margarine is created.

As illustrated in figure 3 the addition of polyglycerol esters of fatty acids (E-475) will also promote the crystallization of the margarine in the tube chiller, meaning that if polyglycerol esters of fatty acids (E-475) are added to the recipe the process must be adjusted in order for the margarine not to be overworked, resulting in the margarine becoming more greasy and thereby less suitable for use in puff pastry production.

Test system

In order to illustrate these parameters the following trials with puff pastry margarines with 80% fat content were performed:

- Puff pastry margarine with distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids, fully saturated type, (E-471)[1] and lecithin, (E-322)[3]
- Puff pastry margarine with distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids, (E-471)[1] partially unsaturated and lecithin, (E-322)[3]
- Puff pastry margarine with a combination[4] of distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids (E-471)[2] and polyglycerol esters of fatty acids, (E-475)[4] and lecithins, (E-322)[3]

The puff pastry margarines were produced on a scrape surface heat exchanger and the margarines were tempered 1 week before evaluation. The evaluations of the margarines are shown in table 2 (below).

It can be observed from the above, that the type of emulsifier has a significant impact on the consistency and the surface of the puff pastry margarines and thereby makes the margarines more or less suitable for producing the puff pastry dough and the baked puff pastry, as shown on figure 4.

Notes

1. *Palsgaard® DMG 0093 Pellets; distilled mono- and diglycerides of fatty acids with minimum 90 % monoglyceride; IV < 2 (E-471)*
2. *Palsgaard® DMG 0291 Pellets; distilled mono- and diglycerides of fatty acids with minimum 90 % monoglyceride, IV 60 – 70 (E-471)*
3. *Standard soya lecithin (E-322)*
4. *Palsgaard® 1304, which is a special combination of distilled mono- and diglycerides of fatty acids/ mono- and diglycerides of fatty acids (E-471) and polyglycerol esters of fatty acids (E-475) for puff pastry margarine*
5. *Palsgaard® 1325 is a combination of non-hydrogenated mono- and diglycerides of fatty acids (E-471), citric acid esters of mono- and diglycerides of fattys acids (E-472c) and polyglycerol esters of fatty acids (E-475).*

Figure 3:
Effects of polyglycerol esters in puff pastry margarine.

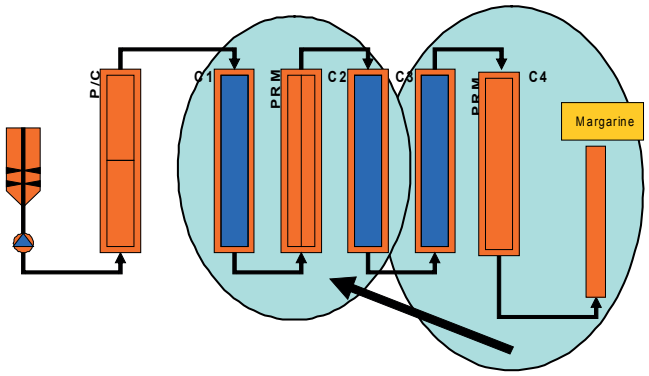


Table 2:
Evaluation of margarines

Emulsifier Type added	Consistency	Surface
Palsgaard® 1304	Plastic	Very dry
Palsgaard® DMG 0093	Stiff	Dry
Palsgaard® DMG 0291	Soft	Greasy

The trials show the differences in expansions if different types of emulsifiers are used and it is partly caused by the different qualities of the margarines and partly by the functionalities of the different emulsifiers during baking.

Because of the lamination process the emulsion in the margarine will be stressed and a strong emulsion is necessary, so that no free water from the margarine will occur. Typically, a higher amount of emulsifier make the emulsion stronger, and the next trials were made in order to find an optimal dosage of emulsifier in this water-in-oil system, as shown in figure 5. In this trial the dosage of lecithin[3] was 0.50 % and pH 3.8.

The result of this trial confirms, that a higher dosage of emulsifier will improve the baking result.

Other dimensions are the effects of dosage of lecithin[3] and the pH of the water phase of the margarines.

In the test was used 1.00% of Palsgaard 1304[4] and a lecithin[3] content from 0.00 to 1.00 %.

As shown in figure 6 both the pH and the dosage of lecithin will have an important impact on the expansion of the baked puff pastries. These trials showed, that a content of 0.50% lecithin[3] and pH 3.8 is the best combination. By lowering the pH the oxidation of the fats and oils need to be monitored carefully.

Figure 4:
Test of different emulsifiers in puff pastry margarine.

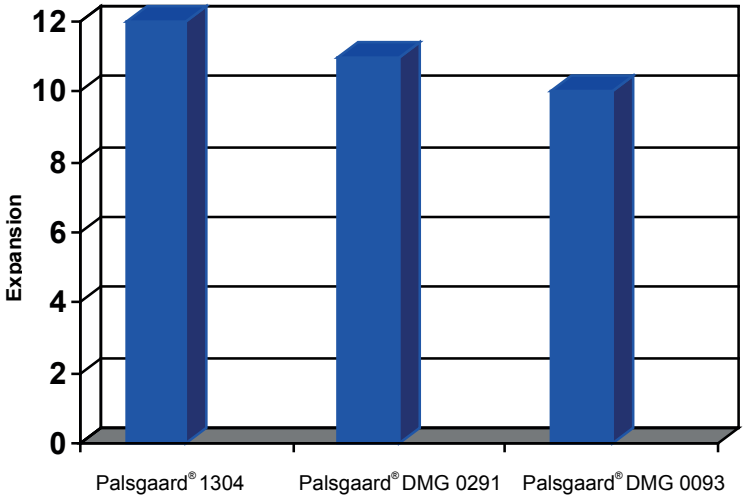


Figure 5:
Test of different dosages of an emulsifier in puff pastry margarine.

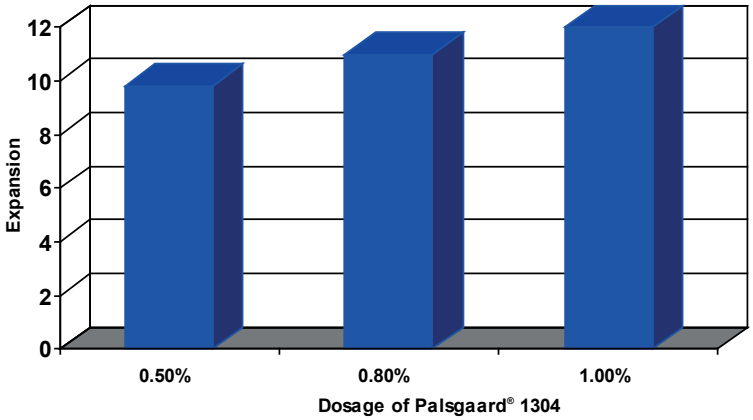
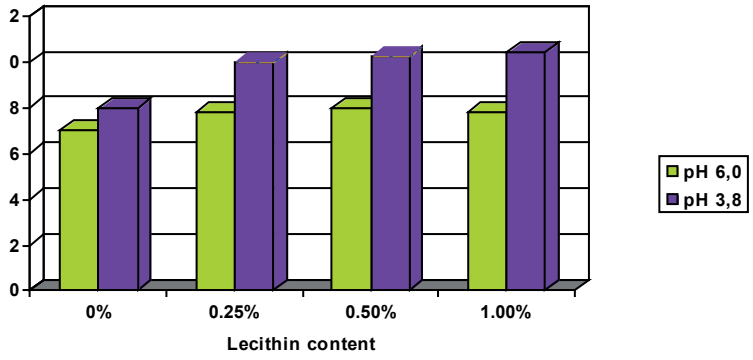


Figure 6:
Influence of lecithin and pH value.



From the above mentioned trials, made with puff pastry margarine with 80 % fat content, it can be concluded that:

- The use of combinations[4] of emulsifiers make the margarine more suitable for use in pastry production.
- A dosage of emulsifiers of 0.80 - 1.00 %, lecithin dosage 0.50 % and pH 3.8 will provide the best baking results in puff pastries.

Reduced fat content

As described above the content of puff pastry margarine is approx. 33 % of the total puff pastry dough.

Both in connection with declaration and costs there might be a wish to reduce the fat content of the margarine and thereby the baked puff pastry.

The demands to the quality and performance of the puff pastry margarine are high, and these must of course be fulfilled in reduced fat puff pastry margarine, if possible. Another demand might be that the process must be similar to the process with puff pastry margarine with 80% fat content. Last but not least the quality of the baked puff pastries must be in line with the puff pastries baked with margarine with higher fat content.

For this article trials with puff pastry margarines with 60% fat content and 80% fat content were performed. With 33% puff pastry margarine in the dough (weight) this will reduce the fat content in the dough with approx. 6 - 7%.

During recent years more consumer demands have appeared such as: no content of trans fatty acids and hydrogenated fats and lecithin and if those can be included in the new products it provides new possibilities for the manufacturer of puff pastry margarine and puff pastry products, respectively.

For the trials below the fat blend shown in table 3 (across) for the pastry margarine was used.
This fat blend will be suitable for producing puff pastry margarine with a non-greasy surface and high plasticity.

Table 3:
Recipe for the non-hydrogenated and non-trans fatty acid containing fat blend used in the trials.

Ingredient	%
Palm stearin	46 %
RBD palm oil	46 %
Liquid oil	8 %

Table 4:
Trials.

	60 % puff pastry margarine	80 % puff pastry margarine
water phase		
glucose	1.00 %	1.00 %
salt	1.00 %	1.00 %
water	38.00 %	18.00 %
colour, flavourings, sorbate and/or benzoate might be added		
pH	3.8	3.8
fat phase		
Palsgaard® 1325[5]	2.00 %	0 %
Palsgaard® DMG 0093[1]	0 %	0.80 %
lecithins[3]	0 %	0.50 %
fat blend	58.00 %	78.70 %

After production both types of margarine were evaluated and they both showed a good and similar plasticity and with a non-greasy surface.

The puff pastries were produced with 288 layers and after baking the height and expansion were measured. The results are shown in table 5 (below).

From the results of the trials it can be observed, that the height of the baked puff pastries and the expansion are almost identical when using puff pastry margarines with high and low fat contents.

The puff pastries produced with both types of margarines had a very good distribution of the layers and a crispy surface.

Table 5:
Comparison of height and expansion.

	60 % puff pastry margarine	80 % puff pastry margarine
Height (average)	510	505
Expansion (average)	11.3	11.2

Summary

From the above trials it has been shown, that a range of factors have an influence on the quality of margarines for puff pastry but also on the baked puff pastries.

Furthermore, it has been shown, that it is possible to reduce the fat content from 80% to 60% in the puff pastry margarine and still obtain very satisfactory results both with regards to the margarine but also in the baked goods.

It is very important to choose the right type of emulsifier in order to obtain the best puff pastry margarine and the best baked goods. As shown the dosage of the emulsifier also has a big impact on the baked goods.

It is always important to consult the legislation and patent rights and test the performance in your own margarines and baked goods before introducing the solutions in the market

Palsgaard

In addition to the above mentioned emulsifiers for puff pastry margarines, Palsgaard also manufactures a wide range of emulsifiers and stabilizer blends for fine foods, lipid, bakery, confectionery, dairy and ice cream.

For further information on the abilities of Palsgaard's emulsifiers for puff pastry please contact Business Unit Manager Cai Christensen at ccc@palsgaard.dk or +45 7682 7682 or visit www.palsgaard.com.

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