Possible opportunities of palm fat replacement

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ABSTRACT

From year to year the food industry has to follow the new food trends, the consumers' new demands, the possible changes of the ingredients and the supply system. Likewise, in recent years in many products' marketing, palm oil free mark is a positive sign for the costumers. This is due to the assumed negative impact of the palm oil cultivation on the rain forests, animal species, environment and human health. To this new trend the food industry has to adapt. All palm fat using companies have two choices. One is to only buy this ingredient from sustainable sources, and to join the Roundtable on Sustainable Palm Oil (RSPO). The other option is to use other fats instead of palm fat. However, due to the unique fatty acid composition and the several possible usages of palm fat, the substitution will be difficult, and the opportunities have to be investigated by product categories. In confectionary applications, one opportunity could be the mixing of fully hydrogenated fat with oil or with lauric fat. However, the suitability of the replacement needs to be examined from many perspectives, like rheological, textural, thermal behaviour and from sensory points of view.

Therefore, the goal of our research was to investigate the thermal and texture behaviour of palm fat and two different fat mixtures, as possible palm fat replacers.

MATERIALS & METHODS

For substitution, we used fully hydrogenated rapeseed oil mixed in one case with sunflower oil and in the other case with coconut fat. The mixing ratios were determined based on previous experiences.

Table 1: Investigated samples

	Samples
1	Palm fat - control
2	65% sunflower oil 35% fully hydrogenated rapeseed oil
3	95% coconut fat 5% fully hydrogenated rapeseed oil

We followed the thermal behaviour with differential scanning calorimetry (NETZSCH 3500) and the texture behaviour with penetrometry using conical pressure head at 25 °C (Stable Micro System TA-XT 2i).

Figure 1:NETZSCH DSC 3500

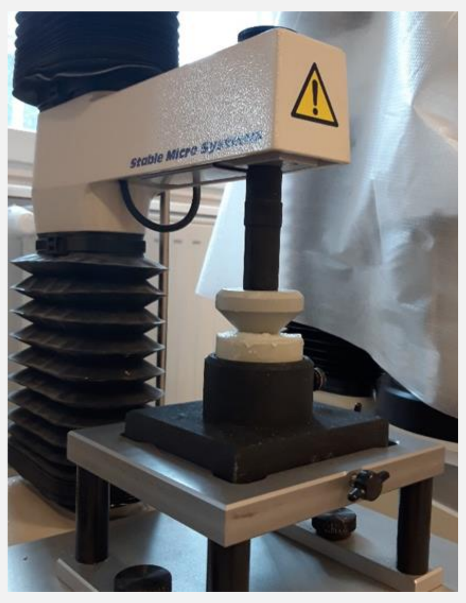

Figure 2: Stable Micro System TA-XT 2i texture analyser

CONCLUSIONS

In conclusion, the coconut fat sample showed very promising values in case of the texture parameters. Also in the case of the thermal behaviour this samples crystallization peak temperature were closer to the palm fat. Further analyses are needed to decide the coconut fat mixture sample suitability as palm oil replacement, especially looking at its shelf life.

RESULTS

According to our results (Figure 3.), the three fats' DSC curves showed different heating and cooling behaviours due to the different fat acid and triacyl glycerol compositions of the samples. However, for the crystallization behaviour all samples showed two peaks, and the coconut sample peak temperatures were close to the palm fat's.

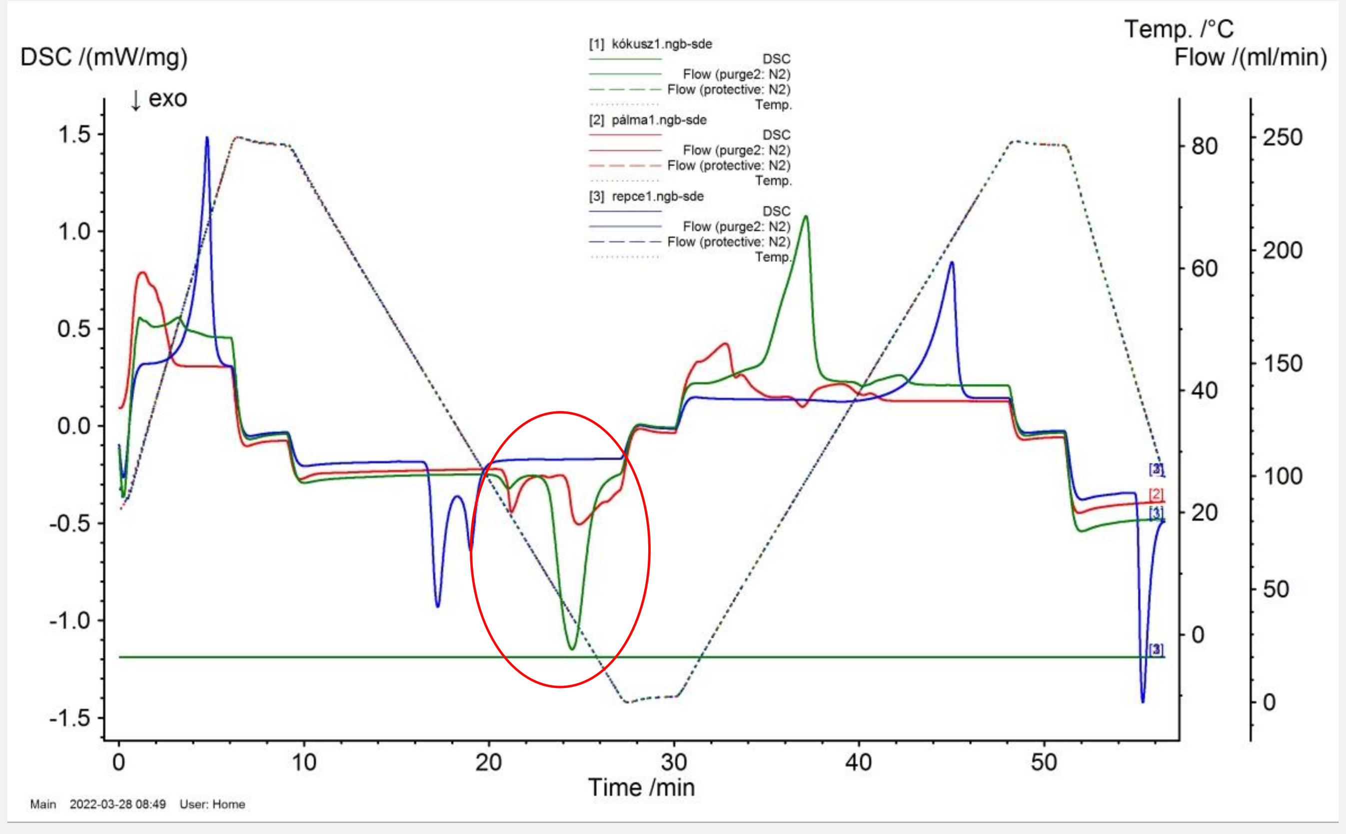

Figure 3: Average DSC curves of the samples (n=3)

Figure 4: Average Hardness values of the samples (n=5)

Figure 5: Average Work of penetration values of the samples (n=5)

Figure 6: Average Adhesiveness values of the samples (n=5)

In case of texture measurement, we recorded the hardness (Figure 4.), work of penetration (Figure 5.) and adhesiveness values (Figure 6.). The results showed that the coconut sample values were very similar to the palm fat values in every parameter. There were no significant differences between these two samples. In case of the investigated texture parameters the coconut fat samples could be a substitution the control sample.
However, the sunflower sample showed higher values in all cases than the palm fat, as it shown in the Figures.

ACKNOWLEDGEMENTS

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KEYWORDS

substitution, palm fat, DSC, texture analyses

Effect of heating rate on different confectionary fats' thermal behaviour

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ABSTRACT

Plant and animal fats are commonly used ingredients is many food technologies, for example in confectionary, bakery, dairy and meat productions. They influence the viscosity and texture properties of the foods due to their different chemical and physical characteristic. One of the most important physical attributes is the melting and crystallization behaviour of the fats. The achieved crystal structure is depending on the type of the fat and the fatty acids, their distribution in the lipid molecule and the crystallization circumstances like the temperature and heating rate. If the circumstances are changing the crystal habits, size and number are changing, too. This has an influence on the final product. Therefore, studying the thermal behaviour of fats are essential in the food industry.

The goal of our research was to investigate the effect of different heating rates on the crystallization and melting behaviour of 3 different kinds of fat.

MATERIALS & METHODS

Pure palm fat, coconut fat and milk fat were studied with a differential scanning calorimeter (NETZSCH DSC3500).

	Samples
1	Palm fat - control
2	Coconut fat
3	Milk fat

Table 1: Investigated samples

Figure 1:NETZSCH DSC 3500

The same temperature program was used and only the heating/cooling rate during the measurements were changed. For each sample 1-5-10 K/min heating and cooling rates were applied, and we compared the achieved results.

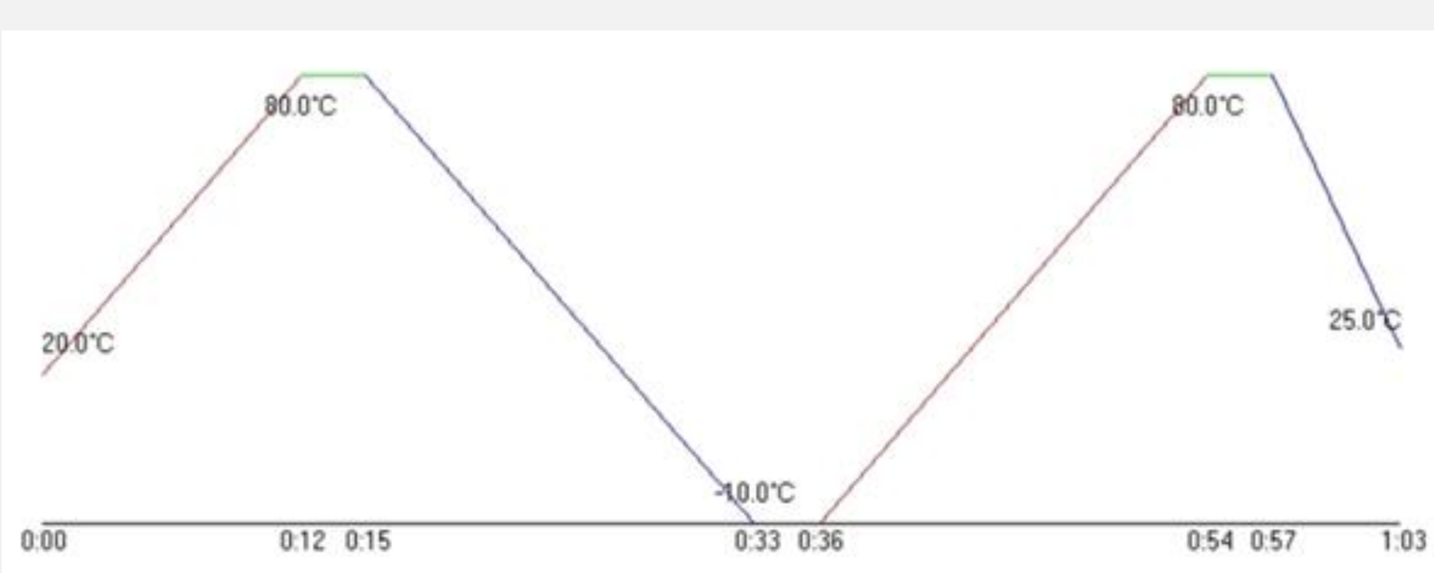

Figure 2:Temperature program

RESULTS

In correlation with the literature, our results also showed that the applied temperature profile (1/5/10 K/min) determined melting and crystallization, the size of the peaks and the enthalpy changes.

Analysing the melting curves, we could see that the faster we change the temperature, the steeper and sharper the peaks are for every sample.

The crystallization curves showed that fast cooling rate was not beneficial, as due to the fast temperature change there is not enough time for the transition of the different crystal forms, which led to data loss. However, the very slow cooling rate is also not the best option, because the slow temperature change results low peak and enthalpy change values.

According to the above mentioned, in our research the 5 K/min curves proved to be the best, independently of the type or source (animal or plant) of the fat.

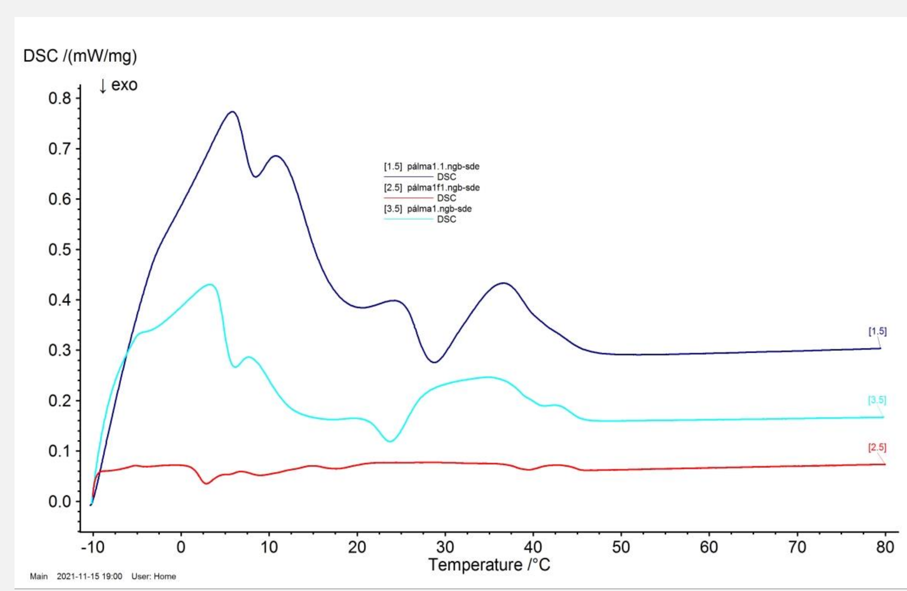

Figure 3: Average DSC curves of palm fat melting (n=3)

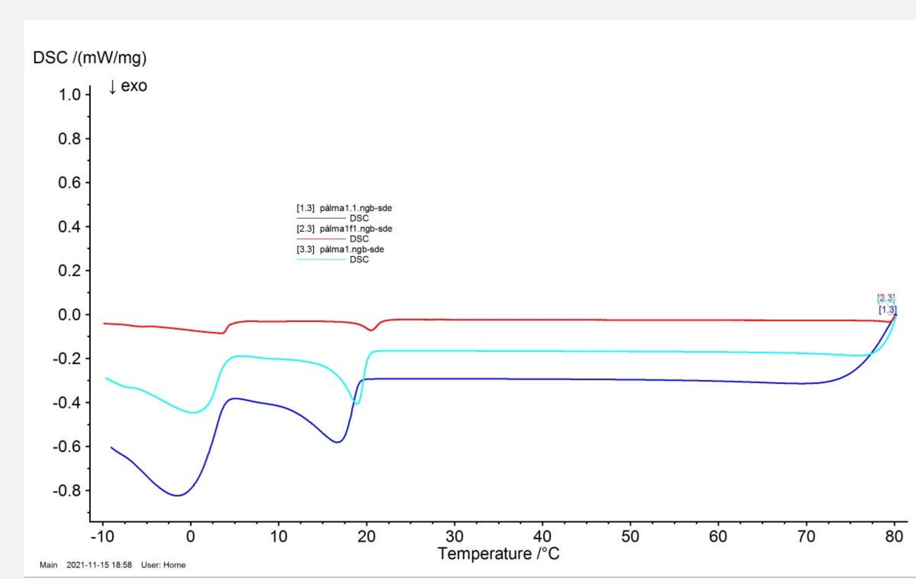

Figure 4: Average DSC curves of palm fat cooling (n=3)

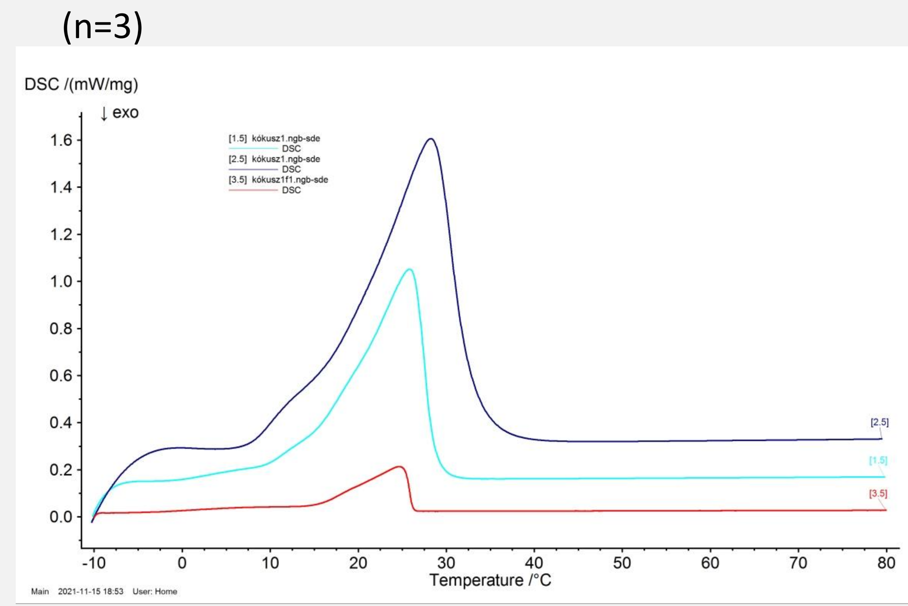

Figure 5: Average DSC curves of coconut fat melting (n=3)

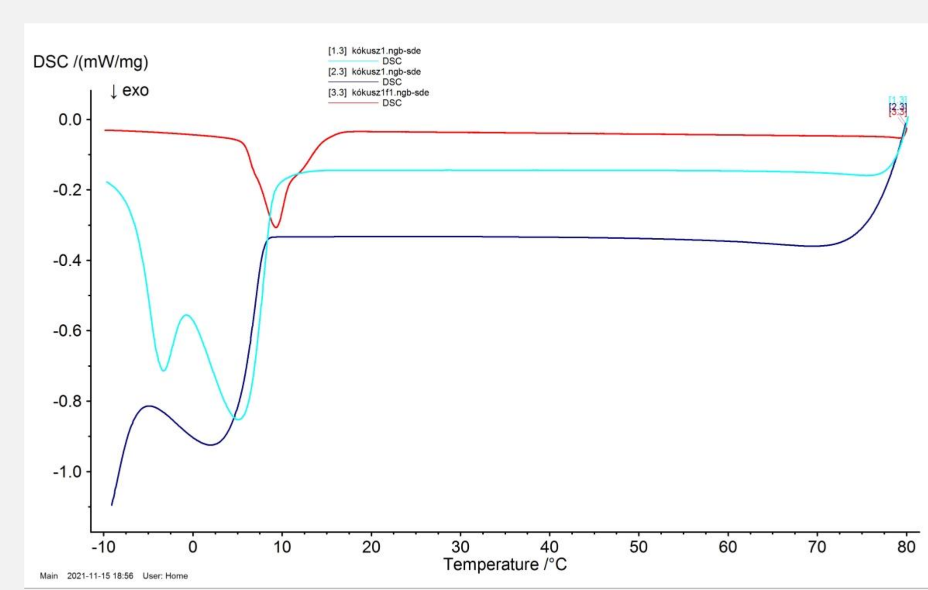

Figure 6: Average DSC curves of coconut fat cooling (n=3)

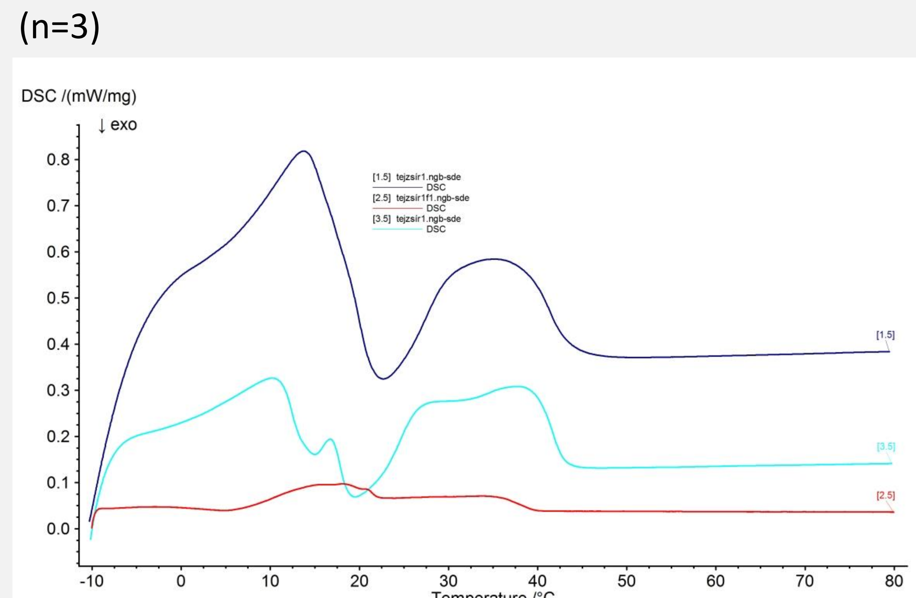

Figure 7: Average DSC curves of milk fat melting (n=3)

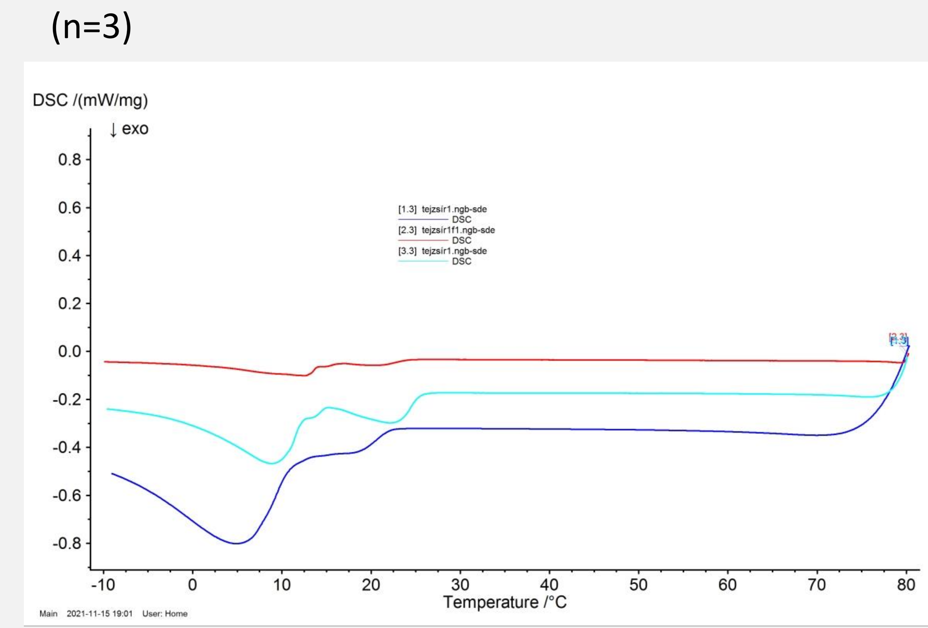

Figure 8: Average DSC curves of milk fat cooling (n=3)

CONCLUSIONS

In conclusion, our results are consistent with the literature data, both too slow and too fast cooling (heating rates) had disadvantages. Therefore, the selection of the optimal rate is very important for the analysis of fat crystal forming and melting behaviour. Also, in the industry the temperature should be carefully controlled to achieve the appropriate crystal forms for the product.

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KEYWORDS

fat crystallization, fat melting, DSC, thermal behaviour, palm fat, milk fat, coconut oil