



Final report

Bacon fat – from biofuel to food

Chemical composition of bacon fat and the use of bacon fat in liver pâté or sausages or as a frying agent

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Review

The background is a wish to upgrade bacon fat from biofuel to a food ingredient. The idea is that bacon fat can contribute with bacon flavour to various meat products either by directly adding rendered bacon fat to the recipes or by frying in bacon fat. In this project, bacon fat has been tested in lever pâté as well as sausages and as a frying agent for hamburger patties. To ensure that the bacon fat is safe to use it has been analysed for the content of N-nitrosamines and smoke mutagens (PAH). The fatty acid profile was analysed, and transfer of ingredients, such as lactate, acetate and nitrite, from the brine into the bacon production as well as oxidation during storage of the bacon fat with and without antioxidants has been investigated.

A design for collection of bacon fat in a closed system on factories as well as a business case has been made.

Sensory testing of bacon fat

Conclusion

The results showed that an overall variation in the rendered fat is to be expected. Both bacon types (cubes or slices) and the different cooking lines resulted in different sensory profiles.

In general, the level of bitter taste and off-flavour in the samples was low. Smoke and salt taste were not found to vary in the samples, whereas a difference was found between “fresh bacon odour”, “fried bacon odour”, “raw bacon flavour” and “fried bacon flavour” for the different cooking lines and bacon types. The intensity of the samples’ aftertaste was in general found to be high but with no difference between the samples.

The sensory testing was performed on bacon fat collected at a factory producing fried bacon slices and cubes.

Addition of bacon fat to liver pâté and sa- sages

Replacement of pure pig fat by bacon fat containing 0, 10, 25, and 50% fat, respectively, were tested in liver pâté and sausages. For liver pâté and sausages, it was possible to replace up to 50% of the fat in the recipe with rendered bacon fat without having excretion of fat during manufacturing or reheating.

Liver pâté sensory testing

The results show that when substituting 25% or 50% of the pure pig fat with bacon fat, the liver pâté had a higher bacon odour, flavour, and aftertaste compared to the reference. The bacon fat made the liver pâté less firm and gave a higher metallic flavour compared to the reference.

Sausages sensory testing

A 50% substitution of pure pig fat with bacon fat resulted in a higher bacon flavour and less salty taste, but it was not significantly different from the reference. The test indicated that adding bacon fat only gave marginal changes in bacon flavour compared to a sausage with pure pig fat.

Frying in rendered bacon fat

There was a difference between hamburger patties fried in bacon fat and pure pig fat, but the bacon fat did not add bacon flavour to the patties. The results indicated that the bacon fat made the patty greasier and gave a more coated mouthfeel.

For the test, both the rendered bacon fat and the bacon were produced at TI.

Unwanted chemical compounds

Chemical analyses

No unwanted chemical compounds, such as N-nitrosamines and smoke mutagens (PAHs), were detected in the rendered bacon fat.

PAH

The four PAHs Benzo(a)pyrene, benzo(a)anthracene, Chrysene, and Benzo(b)fluoranthene were all below the quantification limit (LOQ) of <0.5 µg/kg for all three types of bacon.

Nitrosamines

The eight nitrosamines N-Nitroso-di-n-butylamine, N-nitrosodiethylamine, N-Nitroso-di-n-propylamine, N-nitrosodimethylamine, N-Nitrosomethylethylamine, 4-Nitrosomorpholine, N-nitrosopiperidine, and N-nitrosopyrrolidine were all below the quantification limit.

Ingredients from the brine in bacon fat

Chemical analyses of the bacon fat showed that low levels of lactate and acetate were found in the rendered bacon fat. On the contrary, no nitrite nor salt were detected in the rendered bacon fat.

Fat content and fatty acid composition

The fat content in the rendered bacon fat was 99.2-99.9%. Saturated fat was 43.0-46.5%, monosaturated fat 9.5-12.8%, and polyunsaturated fat 9.5-12.8%. The values found are close to the content in commercial spreadable pork lard.

Oxidation during storage

No oxidation was found during storage at room temperature and daylight in an eight-week period in rendered bacon fat with or without antioxidants.

Bacon fat

All chemical analyses were performed on rendered bacon fat produced at DTI from bacon from industrial produced bacon from a project partner.

Design and business case for a closed collection system for rendered bacon fat

The business case was estimated based on the need of a company to invest in an automatic collection of rendered fat from individual cooking lines. The system considered will be executed in stainless steel, fully heated, and insulated with a pump selection that prevents blockage along with one central collection tank located outside the factory for liquid truck pickup.

The automated collection system is based on a fat collection of 25 ton/week distributed evenly between 10 cooking lines.

In 2021, it was possible to sell the bacon fat for biofuel production for **0.36 EUR/kg**, and it is expected that if the bacon fat is sold for human consumption in the future, it will be possible to achieve a sales price of approx. **0.60 EUR/kg**. The calculation below is obtained by absorbing the entire investment during year 1 along with the regular operational costs. The subsequent years are based on sales of 1,140 ton fat at two different prices.

| | Biofuel | Human consumption |
|----------------------|-------------|-------------------|
| Fat price EUR/kg | 0.36 EUR/kg | 0.60 EUR/kg |
| Return on investment | 0.66 year | 0.40 year |
| Business case: | | |
| Result | | |
| Year 1 (investment) | 138,000 EUR | 412,000 EUR |
| Year 2 | 359,000 EUR | 633,000 EUR |
| Year 3 | 359,000 EUR | 633,000 EUR |

The calculation shows a substantial business potential with a return on investment of less than one year for sales prices and a subsequent annual potential of between 359,000 and 633,000 EUR after subtraction of operations costs.

Detailed information can be found in the following reports:

Nersting L. Bacon fat – from biofuel to food. Chemical composition of bacon fat and unwanted chemical compounds and oxidation in rendered bacon fat. Project no. 2009653. 2.12.2022

Nersting L. Bacon fat – from biofuel to food. Bacon fat in liver pâté or sausages or used as a frying agent. Project no. 2009653. 16.12.2022

Selcuk Kilic & Laurits Beck Nielsen. Investment cost estimate for automatic collection of bacon frying fat. Project no. 2008811. 16.12.2022.