

Hybrid products from animal and plant sources (MeatHybrid)

(CORNET)

Coordination:	Forschungskreis der Ernährungsindustrie e. V. (FEI), Bonn (Research Association of the German Food Industry)
National Agencies:	<ul style="list-style-type: none"> • AiF - German Federation of Industrial Research Associations, Germany • VLAIO Flanders Innovation & Entrepreneurship, Agentschap Innoveren & Ondernemen, Brussels/Belgium
Research Association:	<ul style="list-style-type: none"> • Flanders' Food, Brussels/Belgium
Research Institutes:	<ul style="list-style-type: none"> • DIL - German Institute of Food Technologies, Quakenbrück • University of Hohenheim, Institute of Food Science and Biotechnology, Department of Food Physics and Meat Science • Institute for Agricultural and Fisheries Research (ILVO) Unit Technology and Food Science, Melle, Flanders/ Belgium
Industrial Branch:	<ul style="list-style-type: none"> • Meat Processing Industry
Duration:	2017 - 2019
Volume:	€ 772.149,-- (total)

Initial situation:

The use of plant proteins in meat products has been permitted by an EU directive in 1988, but only a few corresponding products are available on the market today. Especially small and medium-sized companies invest little in research and development of such hybrid products, as it is not clear how consumers react to this new product class. Currently, there is not enough information available on the possible acceptance rates and product preferences of consumers. Also, many smaller producers lack knowledge about the ideal concentration and correct processing of plant proteins into "hybrid sausage meat" to produce sliceable or spreadable products. As a result, previous attempts to simply add plant-based proteins to meat products have failed. This is due to the fact that (a) incompatible plant proteins were used, (b) proteins were added unstructured (as powder) and (c) the products were not acceptable from a sensory point of view.

The aim of the research project was to combine food technology approaches with consumer research in an interdisciplinary concept in order to develop knowledge that will enable the production of hybrid products that are successful on the market and meet the needs and wishes of con-

sumers in terms of taste, nutritional physiology and sustainability.

Research results:

The aim of the research project was to characterize the effects of plant proteins in hybrid cooked and dried-stabilized sausages, as well as in convenience products. In a functionality screening, different functional plant proteins from potato, pea, and pumpkin seeds were selected. Furthermore, pea, pumpkin, and sunflower seed proteins were shown to be suitable for texturization by extrusion.

This selection was then evaluated in the project to determine the following aspects of hybrid meat products: 1) consumer-specific limits; 2) technological-functional limits; 3) technological limits; 4) nutritional-physiological limits. For this purpose, the acceptance and sensory influences were investigated with different panels. Second, the functional influence of plant-based raw materials on the characteristic attributes, individual process steps, and hybrid end products was assessed. At the end of the project, the findings obtained were evaluated holistically to describe possible windows for the development of novel hybrid meat products.

Regarding consumer behavior, it was found that in the meat sector, consumer acceptance is largely determined by sensory quality. Along with this, a low sensory quality can represent a barrier to market entry for meat substitutes. It should be noted that the latter, including hybrid products, still have a high catching up to do in comparison to the meat reference.

From the qualitative as well as quantitative study, it was unanimously concluded that consumers are already expecting a poorer taste of meat substitutes or hybrid products compared to meat. Meat replacement products are perceived by at least sub-segments of consumers as healthier and environmentally friendlier than the meat reference. Nevertheless, there is a need in terms of marketing communication to highlight and place the advantages of meat substitutes in combination with information about the production process even more in the market. In addition, it can be stated that the majority of consumers are currently not willing to pay higher prices for hybrid products.

Flexitarians who have already partially changed their diet to vegetable products are not part of the target group of hybrid sausage products, but were shown to be meat eaters who want to reduce their meat consumption, but do not to completely refrain on meat.

On the basis of laboratory and product development tests, it has been shown that the formulation of attractive hybrid products is only possible up to a certain concentration of plant proteins or a certain meat reduction - both from a technological and a technological point of view. This concentration is individual for each plant protein source and product group tested. This was due to complex, partly antagonistic interactions of plant and meat proteins, as well as to the sensory attributes of the plant raw materials, i.e. off-flavors due to fat oxidation in pea proteins. In general, soluble, powdered proteins proved to be not suitable in hybrid matrices. In contrast, extruded plant proteins turned out to be compatible mixing partners with meat proteins, since they act as inert particles and did not interfere with the functionality of the animal-based ingredients. Furthermore, they had a supporting effect on the texture. In addition, sensory studies of hybrid sausage products with oil pomace proteins revealed positive, new, nutty flavour components. In convenience products, the development of acceptable products was easiest and meat could be reduced by up to 50 %. In raw sausage matrices, an adaptation of the characteristic acidification step was developed by a model system to ensure microbial safety and sufficient structure formation. Furthermore, it was shown that the drying behaviour of the products changes from a

specific plant protein content. By combining different plant protein sources, it was also possible to produce hybrid cooked-stabilized sausages with an optimised nutritional profile.

Finally GC-MS-O analysis showed, that dry and wet texturization of plant proteins can reduce the "off-flavour" of the plant proteins and thus improve the applicability compared to the powdered starting materials.

Life-Cycle Assessment of the raw materials and hybrid meat balls revealed that the negative environmental impact of protein isolates was higher than of concentrates or flours, as expected. Taking extrusion data into account it was found, that the application of high moisture extrudates can significantly reduce the negative environmental impact of pork-based meat balls.

Economic impact:

In 2017, the European food industry consisted of 310,000 companies and employed 4.2 million people. In Germany alone, more than 600,000 people were employed, of which about 85,000 were in the meat processing industry.

In terms of turnover, the food industry is the second largest industrial sector in Europe (turnover of € 917 billion). Most producers are small and medium-sized enterprises (SMEs), only a few of which are able to compete on the world market. The turnover in Germany in 2017 was 179.6 billion € (of which 53.6 billion € were exported).

The results of the project will give small and medium-sized enterprises in particular the opportunity to develop national and international markets with new hybrid products and to occupy new product niches, especially in the export business.

Publications (selection):

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4. Ebert, S., Kaplan, S., Gibis, M., Terjung, N., & Weiss, J.: Establishing the mixing and solubilization behavior of pork meat and

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<https://doi.org/10.1021/acsfoodscitech.0c00032> (2021).
5. Ebert, S., Kaplan, S., Brettschneider, K., Terjung, N., Gibis, M. & Weiss, J.: Aggregation behavior of solubilized meat potato protein mixtures. *Food Hydrocoll.* 113. <https://doi.org/10.1016/j.foodhyd.2020.106388> (2021).
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 9. Terjung, N.: MeatHybrid – Substitution von tierischen durch pflanzliche Proteine. *DIL-Jahresber.* 2020/21, 116-117 (2020).
 10. Terjung, N.: MeatHybrid – Substitution von tierischen durch pflanzliche Proteine. *DIL-Jahresber.* 2019/2020, 88-89 (2019).
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