Enhancing plant protein functionality through glycation using by-product carbohydrates (ProtbyProd) – CORNET –

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Aim of the project

Plant proteins, especially proteins from legumes, are an important factor in ensuring an adequate and sustainable protein supply for a steadily growing world population. Soybeans are currently the most important source of vegetable proteins. However, due to the high allergenic potential of soy proteins, there is an increasing demand for alternative vegetable protein sources In recent years, pea proteins gained considerably in importance, resulting in a global market volume of approximately 555 million US dollars for pea proteins in 2028. However, pea proteins have a lower technological functionality compared with soy proteins, which can be particularly attributed to their low solubility and less pronounced thermal stability.This also directly affects properties such as emulsifying ability and foam formation, which limits the use of pea proteins in various foods and beverages. In particular, the incorporation of high levels of pea proteins into liquid-based foods such as high-protein ready-to-drink beverages proves difficult.

Nevertheless, in order to use pea proteins for such products, methods to improve the solubility and thermal stability of pea proteins have to be developed. With this aim, various physical, chemical and enzymatic approaches to modify the protein structure have already been investigated. On a commercial scale, only the

enzymatic modification of pea proteins has been successfully implemented so far. However, enzymatic modification can negatively affect sensory properties, which can be manifested by, among other things, a bitter taste as well as an astringent mouthfeel. Therefore, there is a definite need for alternative processes to generate pea proteins with improved solubility and without negative impact on sensory properties, so that they can be incorporated into liquid foods at higher concentrations.

A promising approach has been the glycation of (pea) proteins, in which the proteins are glycated under controlled conditions with an excess of reducing carbohydrate. For this purpose, carrageenan, gum arabic, corn dextrane and corn starch have been frequently used; a correlation between the molecular weight of the carbohydrate components and the functional properties of the glycated proteins has been suspected or, in some cases, already demonstrated. In terms of sustainability, however, it is essential to ensure that plants are used in their entirety in the process of food production. Therefore, the use of commercial by-products from the pea protein and starch production as feedstocks for the generation of carbohydrate components suitable for glycation is aimed. These by-products include pea inner fiber and pea outer fiber, which are rich in pectins and xylans, respectively, and cellulose. In the proposed project, results from a recent IGF project (IGF 21616 N) can be used, which demonstrated that it is in principle possible to generate oligosaccharides and polysaccharides with a low degree of polymerization (OS/LMWPS) and a molecular weight < 20 kDa from pea fibers. Since carbohydrates with molecular weights of this magnitude showed the best results in glycation of pea proteins with dextrans, it seems realistic to use pea processing side streams for glycation. In addition to the technofunctional modification of the proteins, the dietary fiber components can also positively influence the nutritional properties.

The aim of the project is to optimize the glycation of pea proteins with OS/LMWPS concerning the technofunctional properties (solubility, emulsifiability) of the glycated proteins. In particular, the composition, structure, and molecular weight distribution of the generated OS/LMWPS are the main focus.

Economic impact

Both in Germany and the USA, there is a very innovative start-up scene in the sector of plant-based foods. Likewise, a rethinking among established food and beverage manufacturers towards a more sustainable production and a plant-based diet is evident. Accordingly, the pressure of innovation on the supplying industry is growing; the production of ingredients has to be adapted to the corresponding requirements. The described industries all have in common that they are largely made up of small and medium-sized enterprises (SMEs). For example, about 90 % of companies in the German food industry are SMEs. In addition, about 10 % of the approximately 70,000 start-ups in the German start-up scene belong to the food sector.

This project will lead to economic improvements in the entire value chain of protein-rich plants. It is expected that, among other things, the cultivation of protein-rich plants and their marketing in form of processed products as well as plant proteins with functional properties will increase. Accordingly, both the agricultural sector and the manufacturers of ingredients and food products will benefit from the higher added value of the entire protein-rich plant. Improving the functionality of plant proteins will also enable food-producing companies to replace animal proteins, which was previously not feasible due to the limited functional properties of plant protein concentrates and isolates. In addition, the functionalization of plant proteins provides the possibility of their use in innovative products and the access to new markets. The project therefore strengthens the national and international market position esp. of SMEs which are acting in the dynamic and growing market for plant-based foods.

Further information

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