

## **The summary of the doctoral thesis**

### **“The influence of extrusion parameters on the quality of products”**

Products based on wheat and vegetables are one of the main sources of minerals necessary in the human diet. Pellets are extruded semi-finished products made from blends of various starchy raw materials, mainly from wheat flour, corn flour and potatoes. A variety of starchy raw materials, mainly wheat and potato products, are used for the production of pellets. A very important feature of pellets, from a dietetic and health point of view, is their susceptibility to fat absorption while frying. Products with the lowest fat content are currently on demand. The need to conduct research in the field of pellet food extrusion is also visible in market and sales surveys, which show that products of this type are gaining popularity year by year. According to Nielsen's data, presented during the congress “Sweets and Snacks 2017”, the snack market is growing, just like the confectionery market, and faster than the entire range of grocery products. It is worth noting that from October 2016 to September 2017 it increased by 5.8 percent and is currently worth PLN 17.3 billion.

The purpose of the work was to select parameters for the production of new types of multigrain and potato pellets and the assessment of the properties of extrudates and the snacks obtained from them.

During the tests, the extrusion of pellets was observed in different processing conditions, including temperatures, the level of moisture in the raw mixes, the shapes of the shaping dies and the rotation of the extruder screw.

Pellets, the semi-finished product obtained during the manufacturing process and ready-to-eat snacks after pellet frying were subjected to selected physicochemical and practical tests to determine the influence of used raw materials and production parameters on the quality characteristics of products and their suitability for possible implementation in mass production of high quality extruded snacks. From the point of view of producer practice and market requirements, the following qualitative characteristics should be considered as important: high efficiency with low energy consumption, limited hygroscopicity during storage, high index of expansion, low fat absorption, low bulk density of snacks, their low hardness and consumer acceptability.

The scope of research included the production of multigrain and potato pellets depending on the conditions of the extrusion process, stability and efficiency and energy consumption were determined. Wetness and bulk density of extrudates were determined as the characteristics of extrudates (pellets). The extrudates were subjected to a frying process at 190°C. During the tests of fried snacks, the index of expansion, bulk density, WAI and WSI, hardness in the Kramer chamber, and sensory evaluation of the products were determined. On the basis of the conducted tests, a few ready-made products were selected. They met the producer and market requirements on the EU market. Their mechanical and acoustic features as well as microstructure were examined. A statistical analysis was carried out, on the basis of which the impact of manufacturing conditions on the quality characteristics of pellets and fried snacks was determined. As a result of statistical analysis of the obtained results, two types of products with the most desirable characteristics were selected, for which the polyphenol content and antioxidant activity were additionally examined.

Research work on the scientific problems involved in the extrusion of snack pellets made it possible to obtain, using the proposed raw material mixes and selected process parameters, high process efficiency with relatively low energy consumption, which is both, an important and a positive feature, considering the industrial use of this research. The extrusion process proceeded without major disturbances. The variables used during the process influenced its course and the quality of the obtained product to varying degrees. Snacks made using the single-screw extruder type S45-12 ICHMAD PROFARB have been positively evaluated by consumers. It was shown that the type of applied mixture (multigrain) had a significant influence on the choice of consumers, which is related to the reduced gluten content and fat absorption of the obtained snack.

The obtained results of the research can be the basis for the development of pellet production technology and its transfer from laboratory scale to industrial scale (development works). Thanks to laboratory tests, it will be possible to minimize the costs of introducing new, innovative products to the market.