

## **Quality improvement of snack products through the addition of protein obtained from unconventional sources**

### **Summary**

The identification of new trends in product development and quality improvement is possible by combining elements of the market research, consumer attitudes and the nature of products and raw materials. Among the ways of quality improvement, we can distinguish not only activities to seek nonconformities using quality management tools, but also the application of new production technologies and additives. One example of technology that can be applied in quality improvement of food products is the extrusion process, which makes it possible to produce products of significant interest to consumers - extruded snack products.

According to the FAO, the world's population could reach up to 11 billion. Therefore, today, in order to ensure food security for the growing population, additional sources of protein - unconventional raw materials are being sought. The scientific research in this area makes it possible to determine nutritional value, impact on the environment and safety of these raw materials. An example of proteins obtained from unconventional sources are hemp protein and cricket powder, characterized by high nutritional value and numerous environmental benefits.

One of the main barriers of use of unconventional protein sources is negative consumer attitudes toward unfamiliar foods. As a result therefore, it is crucial to find a conventional product to incorporate proteins from unconventional sources into consumer-acceptable food products. Extruded products are an example of such a product.

The aim of this study was to identify the impact of the addition of protein from unconventional sources on the quality improvement of the snack product.

The study was conducted in two stages. In stage I, an attempt was made to assess consumer attitudes and behavior toward snack products fortified with protein from unconventional sources. The research considered consumer behavior in the snack and fortified products market, as well as the intention to purchase products fortified with protein from unconventional sources. The research was conducted using direct (PAPI) and indirect online (CAWI) survey measurement methods among 684 respondents, of which 489 met the established selection criterion. The results were analyzed in terms of three factors: the level of food neophobia and innovativeness of respondents, and consumer attitudes toward proteins from unconventional sources.

Phase II of the study involved the quality evaluation of extrusion-produced products fortified with hemp protein and house cricket powder.

In order to achieve the stated goal of the study, two, positively verified research hypotheses were adopted:

- H 1. Consumer attitudes toward various fortified products depend on the type of unconventional protein source used.
- H2. The quality of fortified snack products depends on the type of unconventional protein source used.

The research conducted in stage I allowed us to determine the influence of the level of neophobia, consumer innovativeness and attitudes toward proteins from unconventional sources on the degree of liking, frequency of consumption, consumption situations and determinants of consumer choice of snack products, as well as the type of fortified products consumed and the intention to purchase extrudates with added proteins from unconventional sources. Based on the results, it was found that the selected three factors influenced most of the issues studied in Stage I. Analyzing consumer behavior in the snack products market, it was found that the majority of respondents consumed snack products from one to several times a month, and the most important determinant of the consumer choice of snack products was taste. Evaluation of purchase intentions for fortified products showed that among fortified snack products - the highest percentage of respondents were interested in purchasing products with added vegetable-derived proteins.

On the basis of the research conducted in the second stage of the work, the relationships between the type and amount of added protein from unconventional sources and the values of quality characteristics of extruded products were determined. An important part of the work was the creation of two regression models that characterized the relationship of selected texture parameters and quality attributes, as well as the impact of sensory attributes on the overall desirability of manufactured snack products. Thus, the conducted research confirmed the possibility of using proteins from unconventional sources in quality improvement of snack products. Based on the study, it was found that products with the addition of hemp protein, compared to the base product, had higher nutritional value, lower water content and activity, and lower hardness and chewiness. The use of the addition of house cricket powder was associated with an increase in the nutritional value of the extrudates, a decrease in water content and activity, an improvement in texture characteristics,

an increase in shape evaluation results and an increase in storage life compared to the base extrudate and hemp protein-fortified products.