Processing impacts biochemical composition of plant-based products challenging current food processing classifications

TURKU, FINLAND, April 10, 2025 /EINPresswire.com/ -- A study conducted at the Food Sciences unit of the University of Turku in Finland showed that different processing methods significantly affect the biochemical composition of plant-based foods. Current food classification systems do not sufficiently acknowledge the biochemical composition of the product.

Many plant-based protein-rich foods are soy-based. Processing has a big impact on how much of the soybean's original components including potentially beneficial compounds end up in the final product and how healthy the product is. Photo: Ville Koistinen / CC BY 4.0

A plant-based diet is beneficial for health, and with population growth and environmental pressures, the proportion of plant products in the diet should be emphasised over animal products. However, not all plant products are the same when it comes to healthiness.

Plant-based products are often processed in different ways to improve their nutritional or organoleptic quality. Commercially available plant-based protein-rich products range from whole beans to more processed products, which may contain only the protein part isolated from the plant.

“Plants and plant-based products are known to contain phytochemicals, which are bioactive compounds that can have health benefits. Phytochemicals are a very large group of different compounds found only in plants, of which there are thousands of different types. On average, we consume 0.5–1 g of phytochemicals per day, depending on our diet. However, until now there has not been enough research on how different processing methods affect these compounds," says Professor of Food Development Kati Hanhineva.

In a recently published study, researchers analysed commercially available plant-based products such as foods made from soy, peas, wheat, and fava beans. Using a non-targeted metabolomics analysis, the researchers showed that different processing methods have significant effects on the biochemical composition of the products.

The study focused in particular on soy-based products and their isoflavonoids. Products prepared using protein concentrates or isolates, such as plant-based burger steaks, contained very little isoflavonoids. In contrast, products made using lighter processing techniques, such as tofu and soy chunks, still contained a high level of isoflavonoids from the original soybean.

“Fermentation was highlighted as an important processing method in the results. We found that in tempeh, for example, these isoflavonoids were in a form that is more readily absorbed due to the activity of the microbes used in fermentation," says Doctoral Researcher Jasmin Raita. Tempeh is a protein-rich food from Indonesia, usually made by fermenting soy using specific starter cultures.

Processing classification does not indicate food composition

When the researchers used existing processing classification systems for the studied plant-based products, some of the fermented tempeh products fell into the ultra-processed category typically considered harmful, as did products made with extrusion, even though they still contained high levels of isoflavonoids. According to the researchers, this highlights how current classification systems are limited in this respect when applied to plant-based products.

“Processing food is common, and even unprocessed food is often eventually processed at home, for example by cooking. Classification systems primarily take into account the processing technique used for the product and the type and number of added ingredients, rather than the biochemical composition of the product. It cannot be assumed that all processing makes a product unhealthy, because ultimately it is only the nutritional components of the edible product that matter, and how they are absorbed by our bodies. These determine the nutritional value and healthiness of food products," says University Research Fellow Ville Koistinen.

Ultra-processed food products are classified as unhealthy and to be avoided. Some plant-based products fall into this category, even though they still contain many compounds found in the unprocessed plant that are potentially beneficial for human health, as the study showed.

“The phytochemical compounds identified in the study may have health benefits, although they are currently not included in the nutrition labelling of food products. Phytochemicals could also indicate how well the original composition of the plant-based raw material has been preserved. If there are no phytochemicals left in the product, it indicates that the product has undergone heavy industrial processing, after which the biochemical composition is completely different to that of the original plant used as a raw material. This perspective is not fully supported by current food processing classification systems,” says Hanhineva.

“It is also important to note that food processing should not be seen as exclusively harmful, as fermentation, for example, can even improve the nutritional value of a product,” sums Raita.

The researchers suggest that future food classification systems should be developed to take into account the effects of processing on the biochemical composition of products. Classification should recognise the loss of useful compounds in the process and the formation of new ones, as well as the value of the added ingredients to the product, not just the addition of harmful ingredients such as salt. For example, many spices are rich in compounds with health benefits.

“Highly processed plant-based protein-rich foods have been on the market for such a short time that it is too early to say anything for certain about the healthiness of all processed plant-based products as a whole, but research on this topic is active. What is known, however, is that in population-based epidemiological studies, all food groups rich in phytochemicals are healthy, while unhealthy food categories typically do not contain them. Therefore, it is justified that the range of phytochemicals should be better recognised in the categorisation of foods," says Hanhineva.

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