Editorial

Health Implications of Thermally Processed Foods – COST Action 927

The main objective of the present COST Action 927, chaired by Professor Vincenzo Fogliano from the University of Naples Federico II, Italy, is to improve the nutritional quality and safety of heat-processed foods, also taking into consideration consumer's needs and preferences.

Although research activities are not directly funded by the European COST program, it can endorse research projects by stating their scientific excellence and international relevance. COST Action supports coordination activities (management committee meetings, expert meetings, travel, *etc.*) and short-term scientific missions among laboratories which are intended for young researchers to exchange technology and spread knowledge.

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So far, twenty eight European countries have joined the Action as COST Actions are also open to those states which are not full members of the European Community. The initiatives of the Action are regularly reported on the website at http://www.if.csic.es/proyectos/cost927.

One of the key tasks for COST 927 is to gain basic knowledge about the formation of those compounds which are beneficial and harmful to health and are formed during the heat-treatment of various foods. Analytical protocols for the chemical characterisation and quantitation of novel markers of thermal treatment are being developed. The health effects of compounds formed during the heat treatment of foods are being investigated in *in vitro* studies, animal feeding experiments as well as in controlled human trials and epidemiological studies on large populations.

After the health effects of the chemically characterised markers of heat treatment have been proven, the processing conditions of the respective food items are optimised in order to lower the contents of harmful compounds and increase the amounts of ingredients beneficial to health.

Finally, suggestions are to be made to the EC food regulatory authorities to improve the safety and the traceability of thermally treated foods.

The scientific activities carried out in the frame of this COST action are divided into the following five working groups (WG), each of which is chaired by a European expert in the respective field:

WG 1: Analytical methods, formation pathways and EU regulation (WG leader: Dr. F. J. Morales, Instituto del Frío, Madrid / Spain)

WG 2: Biological methods, risk assessment, consumer perception (WG leader: Dr. S. Salvini, CSPO – Scientific Institute of Tuscany / Italy)

WG 3: Process optimisation and new developments (WG leader: Dr. E. Shimoni, Technion – Israel Institute of Technology / Israel)

WG 4: Absorption and physiological effects (WG leader: Prof. Dr. K. H. Wagner, University of Vienna / Austria)

WG 5: *In vitro* transformations and maintaining health (WG leader: Dr. K. Sebeková, Slovak Medical University Institute of Preventive and Clinical Medicine / Slovakia)

From these activities, a much clearer understanding of the chemical nature and the health risks and benefits of heat-induced compounds in various foods is expected.

The main topics addressed in the present Issue of *Molecular Nutrition and Nutrition Research* are: (i) the development of fast and simple analytical screening methods to evaluate the formation of Maillard reaction products as indicators of heat treatment in potato chips and breakfast cereals; (ii) analyses of chemical changes in heat-treated foods, namely extra virgin olive oil and buckweat groats, and (iii) the investigation of metabolic transit pathways of various Maillard reaction products, such as fructoselysine, *N*-epsilon-carboxymethyllysine and 5-hydroxymethylfurfural, and their interaction with the intestinal mircoflora. Moreover, the question was addressed whether a mixed Western diet poses a higher risk for developing multi-factorial metabolic disorders as compared with a vegetarian diet.

Among the screening methods presented, the fluorescence of advanced Maillard reaction products and soluble tryptophan measured in a so-called "FAST" assay was correlated with different heat treatments applied to microwave-pasteurised milk samples and was demonstrated to be suitable for the discrimination of the different heat treatments.

Another contribution supports the idea that measuring fluorescence might be an indicator for the degree of heat treatment. Here, fluorescence of breakfast cereals correlated well with the heat-induced formation of various Maillard reaction products, such as furfural, 5-hydroxyfurfural, glucosylisomaltol and furosine.

In a rapid computer vision-based assay, the formation of acrylamide in potato chips was studied. Pixels of fried potato chips were demonstrated to correlate well with acrylamide concentrations analysed by LC-MS using ^{13}C-labeled acrylamide as the internal reference compound.

Another screening for high acrylamide contents was performed in potato crisps fried at different temperatures for various time periods by near-infrared spectroscopy. The data obtained also correlated well with the acrylamide concentrations analysed by LC-HRMS.

The chemical changes induced by heat treatment of foods were studied in extra virgin olive oil. The interesting result of this study was that the addition of rosemary extract to the native olive oil prior to heat treatment prevented the formation of nutritionally harmful sterol oxides. The heat-dependent consumption of antioxidants was also shown in another study in which buckwheat groats were processed at different temperatures.

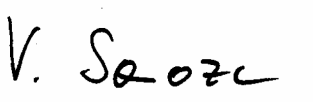
The work now presented in the field of "physiological implications" of Maillard reaction products formed in heat-treated foods comprises metabolic transit studies in rats, to which protein-linked fructoselysine or *N*-epsilon-carboxymethyllysine were administered, and in humans, in whom the urinary excretion of 5-hydroxymethylfurfural from plum jam was investigated.

An interesting review then focuses on the metabolism of Maillard reaction products by the intestinal microflora and possible health implications. This review also presents various analytical techniques suitable for the investigation of bacterial population changes in the human intestines.

Finally, results from a human trial are reported in which risk factors for the development of the so-called metabolic syndrome were analysed in omnivores consuming a mixed Western diet and in vegetarians. In general, omnivores are assumed to consume larger amounts of Maillard reaction products from severely heat-treated foods than vegetarians who, in most cases, prefer raw or boiled vegetables.

The metabolic syndrome is a multi-factorial metabolic disease which is characterised by elevated biochemical markers of inflammation, a rise in blood lipids and blood pressure, and is often associated with the onset or the progression of Diabetes mellitus. In the human trial presented here, the intake of protein, fat, and cholesterol was higher in omnivores than in vegetarians, whereas the omnivores' intake of antioxidants such as vitamin C or beta-carotene did not reach the level of intake reported by the vegetarians. Although the intake of Maillard reaction products was not recorded, it is interesting to note that omnivores were demonstrated to be at a higher risk of developing clinical symptoms of the metabolic syndrome than vegetarians. Whether dietary Maillard reaction products actually pose a higher risk for the onset of certain diseases, such as Diabetes mellitus or the metabolic syndrome, has to be clarified in controlled human intervention trails in which chemically-defined compounds are administered.

In summary, all of these contributions only cover a very small part of the research which still needs to be done. But with the interdisciplinary European approach of COST Action 927, an excellent scientific basis is provided to improve the quality and safety of thermally treated foods.



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