Atypical fatty acids appearing during technological treatments. General survey concerning their presence in food, their absorption and metabolism *in vivo*. A Grandgirard *(INRA, Station de Recherches sur la Qualité des Aliments de l'Homme, Unité de Nutrition Lipidique, 17 rue Sully, BV 1540, 21034 Dijon)*

Fatty acids may be submitted to some changes during technological treatments. A correlation of the fragility of these fatty acids with the number of ethylenic bonds in their molecule has been established. In fact, polyunsaturated fatty acids are also the most interesting type as far as nutrition is concerned: therefore technological treatments often induce a decrease in food nutritional value. They also lead to the formation of new compounds (or new chemical species) to be included in food and which could thus be ingested.

The catalytic hydrogenation of fat products causes geometric and positional isomerizations. A complex blend is obtained which mainly includes *cis* and *trans* monoenes and some dienes. The *trans* fatty acids thus obtained have already been much studied. The conclusions put forward are that these *trans* fatty acids behave more as saturated fatty acids than as monoenes and that these compounds present no particular problem if the linoleic acid level in the diet is sufficient. A recent study carried out by Mensink and Katan (1990) provides contrary results. Their results seem to demonstrate that the *trans* fatty acids induce more hypercholesterolemics in man than the saturated fatty acids. These *trans* fatty acids indeed increase LDL cholesterol as do the saturated fatty acids, but they also significantly reduce HDL cholesterol. This study requires further confirmation, but provides new impetus to the study of such compounds.

Heat treatment induces some changes in the fatty substances, the main reactions being polymerization, oxidation, cyclization and isomerization. A large number of compounds (≈ 500) may be thus obtained. The absorption of these compounds has been studied in particular by Combe *et al* (1981). This absorption varies greatly according to the type of compounds, the thermic polymers being virtually not absorbed; the cyclized fatty acids and the geometric isomers of polyunsaturated fatty acids are very well absorbed. The absorption of oxide compounds differs widely.

The cyclized fatty acids (or cyclic monomers) are considered as the most toxic compounds to appear in heated fatty substances, and in particular those from linolenic acid. These cyclic monomers can only be observed in trace form in frying oils. Their rate increases with temperature and heating duration. The linolenic acid content acts only on the cyclic monomer content when heating conditions are very extreme. The incorporation of these compounds into animal tissues depends on their structure. For instance, the cyclopentanic cyclic monomers are incorporated in a greater amount than the cyclohexanic compounds. A detoxifying system for these compounds seems to exist and leads to their excretion in the urine.

Trans isomers of polyunsaturated fatty acids should not be confused with the *trans* fatty acids appearing during hydrogenation of fatty substances; the isomers of linolenic and linoleic acids produced by heat treatment are mainly geometric isomers and very rarely position isomers. These compounds have only been recently detected in heated fatty substances due to the improvement of analytical techniques. They can be found in non negligible amounts in food. Some of these isomers can be submitted *in vivo* to desaturation and elongation (Grandgirard *et al* (1989) to yield *trans* isomers of eicosapentaenoic (20:5 n–3) and docosahexaenoic (22:6 n–3) acids. Such compounds have been detected in all lipid categories and in organs such as the liver, kidney, heart, testicles, adrenals, brain and retina. The physiological effects induced by the incorporation of such compounds in the tissues is still under study.

References

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