Natural is not always innocuous

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Two Introductory Questions[1, 2]

Over recents years, interest in plant-derived products has increased proportionally to the withdrawal of raw materials, functional or not, made from substances of animal origin.

This is due to the growing popularity of various movements, including those fighting for an end to animal testing, which has led to the addition to the 6th Modification of the EEC Directive of an article which provides for raw materials tested on animals to be banned as of 01.01.98, technical achievements permitting.

We have in the past already had the possibility to comment upon, and often even to challenge, the use of the adjective "natural" as a synonym for "vegetable" and consequently for "harmless" to influence the unaware consumer, the "victim" of advertising statements which have little to do with the reality of the finished cosmetic product.

According to recent legal interpretations, which in any case highlight a certain legislative fuzziness surrounding the use of this adjective, the term "natural" can be freely attributed to products derived from vegetable, animal and mineral sources, provided that the process of extraction, refinement, purification, concentration, conservation, ethoxylation etc. has not transformed the original material into something completely different.

Why should we take a closer look at the statement that natural plant substances are harmless and respect the environment?

First of all, the exploitation of certain species of the world's flora leads to the exhaustion of sources which are difficult to replace (as has already occured with certain precious woods), and consequently, in certain cases, the purely "ecological" nature of this operations is, at the very least, questionable.

Many examples can be cited to reverse the established principle "vegetable is harmless". To follow the suggestion that we consume hemlock or Amanita would surely have a lethal effect, but eating products deriving from "biological culture" increases the risk of introducing into the body carcinogenic vegetable toxins, spontaneously present as a form of natural pesticide.

Nor should we forget the risk of toxicity linked to the use of botanical drugs, as the hepatotoxicity of plant-derived substances containing pyrrolizidine alkaloids or safrole or pulegon; ginseng abuse syndrome; the carcinogenicity of aristolochic acid; etc...

And finally another possible negative aspect of plant-derived substances: contamination by arsenic, mercury, tin, lead, radionuclides, pesticides, etc... This can also be a danger if vegetable substances or their non-purified extracts are applied to the skin.

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[1] Translation of the article published in Lexicon Vevy Europe 1993, 7:100-101.

[2] See abstract published in Lexicon Vevy Europe 1992, 1:7-15(12-13) "Test alternativi alla sperimentazione animale". English translation in Lexicon Vevy Europe 1992, 3: 65-67.

But should the slaughter of animals in order to use the properties of some of their by-products not in any case be considered as an even more negative factor for our ecology?

The crude and irrefutable images we are shown of animals sacrificed for the sake of humanity must, for the most part, be attributed to sectors other than the cosmetic industry (primarily the food industry); on the contrary, the cosmetics industry has eliminated substances of animal origin, substituting them with synthetic equivalents, for example, spermaceti and beeswax.

With the exception of vegetarians, who abhor the initial sacrifice of the animal and the consumption of products of animal origin (e.g. butter, cheese, eggs), it is quite astonishing to consider the total lack of sensitivity (on the part of producers, consumers and marketing operators) towards fish - they too animals - which can be used to obtain alternative products such as collagen, without seeming to come up against any objection whatsoever.

Remaining within the area of protein derivatives (collagen, fibronectin, elastin, etc.), it should be pointed out that, by analogy with all the active principles concerning the use of animals in the cosmetic industry, these are *by-products* of the food industry, which sacrifices different animals in order to fulfil its own objectives. None are killed with the aim of producing cosmetics; on the contrary, the beauty industry, by using the left-overs of others, is helping to reduce the problem of their disposal, thus rendering animal derivatives substantially more ecological or *green*, in as much as the cosmetic industry is in agreement with this easy way of recycling large amounts of waste produced by the food industry.

Finally, attention should be drawn to the fact that through biotechnological processes it has always been possible to obtain certain animal derivatives, by means of bacterial or other cellular cultures, without having to use the animal itself as a primary source.

There are no preconceptions to indicate *a priori* those raw materials which are “better”or “more ecologically sound” uniquely due to their origin. Only careful, scrupulous and safe reseach, be it analytical, chemical, pharmacotoxicological or concerning its applications, can determine the worth of an ingredient for local, topical use.

Generic promotional information, incomplete and eye-opening, is useless for the consumer or the industry.

Carcinogenic Plant Life[3]

If a representative cross-section of the population were to be questioned on the various possible causes of cancer, the majority of people interviewed and able to give an answer other than "I don't know" would, almost without fail, cite - apart from cigarette smoke - exposure to man-made chemical compounds. Indeed, ecologists have herewith managed to convince most people that nuclear power stations, industrial pollution, car fumes, chromium, pesticides and other products of "civilisation" are the main causes of disease in general and of cancer in particular, and that the human race can only be saved by "going back to nature".

One of the possible reasons for this psychological eco-terrorism no doubt resides in the fact that, during the second half of this century, toxicology specialists have concentrated on studying the harmful effects of synthetic compounds, while paying little or no attention to those caused by natural substances. This is particularly true in the case of carcinogenesis, and it is easy to affirm this by skimming through the list of compounds examined by the WHO International Agency for Research on Cancer in its 49

[3] "Cancerogeni vegetali". Lexicon Vevy Europe 1991, 9:193-197.

"Monographs on the Carcinogenic Risk of Chemicals to Humans" published from 1972 to the present day.[4]

It is Bruce Ames, the father of mutagenesis testing on bacteria, who has been attributed the distinction of having been the first person to categorically declare that the food we eat, and a lot of vegetable matter in particular, contains a great amount of toxic substances, mutagenic and carcinogenic elements[5,6] which, together with smoke, are probably the major cause of cancer development, and are perhaps, to some extent at least, responsible for other pathologies such as atherosclerosis and aging.

The fact that plants contain toxic chemical substances, and sometimes in significant quantities, and that some of them may constitute a carcinogenic risk to man is not in the least surprising. These substances are often synthesised as a means of defence against insects or other predators. Many of the most well known and powerful poisons in the world today are of botanical origin. For the most part, they have been known of for quite some time, seeing that their acute effects are easily recognisable, and pharmacologists today show a very strong interest in these poisons given that, in small doses, they have therapeutic effects. Morphine, atropine, scopolamine, eserine, ergometrine and digoxin are just a few examples from a long list. Contrary to their carcinogenic activity, which, in order to be highlighted requires periods of testing which are long (months or years) and extremely expensive, the functional effects of these active ingredients can be identified, summarily at least, in just a few days. More recently, the use of short-term tests for carcinogenesis, the first developed by Ames, which allow the rapid evaluation of whether or not a substance is mutagenic for bacteria, has enabled the identification of a number of potentially carcinogenic compounds present in the vegetable matter our diet contains. For certain of them, their ability to cause cancer has been successively documented by long-term tests carried out on rodents.

Some Examples

Certain mushrooms contain mutagenic and carcinogenic hydrazines.[7] Ergotine,[8] present to the extent of 0.4g/kg of fresh weight in *Agaricus bisporus* and also in a number of other species, is not carcinogenic by itself, but one of the products of its hydrolysis causes pulmonary and blood vessels cancer to develop in the mouse. *Gyromitra esculenta* contains various hydrazones, the most well known of which is giromatrine (acetaldehyde-N-methyl-N-formylhydrazine), present in dried mushrooms in concentrations varying from 0.5 to 3g/kg. In the mouse, this provokes an increase in the occurrence of lung and stomach tumors, as well as those of the foreskin in males and of the clitoris in females. One of its metabolites, N-methyl-N-formylhydrazine causes tumors of the liver, the gall bladder, the bile duct and the lung to appear, again in the mouse. Another metabolite, N-methylhydrazine, has proved to be carcinogenic in the hamster, in which the occurrence of cancer of the caecum and of histiocytomes in particular increases.[9]

Vegetables ad Drinks

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[4] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. 1972-1990, Vol. 1-49. IARC, Lyon, France.

[5] Ames,B.N. Dietary carcinogens and anticarcinogens. Oxygen radicals and degenerative diseases. Science, 1983, 221: 1256-1264.

[6] Ames,B.N. and Gold,L.S. Pesticides, risk, and applesauce. Science, 1989, 244:755-757.

[7] Toth,B. Synthetic and naturally occurring hydrazines as possible cancer causative agents. Cancer Res., 1975, 35:3693-3697.

[8] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 3l, Some Food Additives, Feed Additives and Naturally Occurring Substances. IARC, Lyon, France, 1983, pp. 63-69.

[9] Ibidem, pp. 163-170.

A great number of edible plants - including, to name but the most common, onion (*Allium cepa*), asparagus (*Asparagus officinalis*), chicory (*Cichorium endivia*), lettuce (*Lactuca sativa*), apple (*Pyrus Malus*), potato (*Solanum tuberosum*) and spinach (*Spinacia oleracea*) - contain quercetin, the most extensively studied of the flavonoids.

The interest in the carcinogenicity of these compounds has been generated by their presence, in the form of glucosides, in a number of beverages (tea, coffee, cocoa, fruit juice, red wine, vinegar and beer) and, more particularly, by the fact that they are present in the fern *Pteridium aquilinum* which, it has been shown, has a tumor-inducing ability in various animals. On the other hand, some flavonoids have shown an anti-carcinogenic activity which can be attributed either to their being inducers of detoxifying enzymatic systems, or to the inhibition of the carcinogenic nitrosation of precursors containing amine groups.

Other Edible Vegetables

However, at least 27 aglycons of different flavonoids are mutagenic for *Salmonella typhimurium*, and for one of these, quercetin, the results of tests carried out in the rat provide certain evidence of tumorigenic activity.[10] Another flavonoid present in a large number of plants, many of which are edible, is campherol (kaempferol) or lutine. This, too, is mutagenic, not only in *Salmonella*, but also in the cells of mammals, and it induces micronuclei in the polychromatic erythrocytes of the bone marrow of mice; unfortunately, the data available is insufficient for it to be established whether or not it is also carcinogenic in laboratory animals.[11]

Many essential oils contain saphrol; in particular, that of sassafras (up to 93%), but also, to a lesser extent, (1-10%) those of nutmeg, ginger, cinnamon, black pepper and anise. In the same oils, very small amounts of isosafrole and methyleugenol can also be found. Both safrole (3,4-methylenedioxy-1-allyl benzene) and isosafrole (1,2 methylene-dioxy-4-propenyl benzene) generate the appearance of liver tumors in the mouse and rat models.[12]

Cicasine, a methylazoxymethanol glucoside, has proved to be carcinogenic in various animals;[13] it is present in the seeds, leaves and roots of the *Cycadaceae*, which grows in tropical and subtropical regions. The diet of certain populations uses a flour ground from the nut produced by these plants, and in certain areas, they are also the source of well known local drugs. Various tests have shown that both cicasine and its aglycon are genotoxic, and even relatively small doses produce cancer, particularly in the liver. In the diet of the rat, for example, the presence of a mere 1-3% of flour from the nut of the Cycadaceae is enough to cause hepatocarcinoma and/or kidney cancer to appear in all animals treated.

The Risks Associated with Herbalism

A particularly numerous and widespread category of vegetable matter with carcinogenic effect are pyrrolizidine alkaloids.[14] They are present in hundreds of plants, especially in the different varieties of *Senecio*, but also in those of crotalaria, *Heliotropium*, *Lappul*, *Symphytum*, *Petasites* and *Tussilago farfara*. A large number of these plants can be found in herbalist stores since they have a therapeutic use; they may contaminate cereals used for human consumption, and honey; and they are used in the preparation of certain beverages or even as foodstuffs. Extracts of *Tussilago farfara* are even ingredients in certain shampoos and skin cleansers. Among the different pyrrolizidinic alkaloids which have been identified, the most well known are senkirkine, hydroxysenkirkine, senephicilline, isatidine,

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[10] Ibidem, pp. 33-35, 213-229.

[11] Ibidem, pp. 171-178.

[12] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 10. Some Naturally Occurring Substances. IARC, Lyon, France, 1976, pp. 231-244.

[13] Ibidem, pp. 121-138.

[14] Kingsbury,J.M. Poisonous Plants of the United States and Canada. Prentice-Hall, Englewood Cliffs, N.J., 1964.

jacobine, lasiocarpine, monocrotaline, retrorsine, riddelline, petasitenine and symphitine.[15,16] In general, they are mutagenic, teratogenic and hepatotoxic, with the latter having also been highlighted in man. In the rat, apart from certain pure alkaloids, only the products of plants which contain them have proved to be carcinogenic, especially for the liver where they are transformed into pyrrole reactive metabolites.

The case of *Umbrelliferae*

Plants belonging to the *Umbelliferae* family - such as celery and parsley - and also bergamot oil contain linear furocoumarins, such as derivatives of psoralen which, activated by UV rays lead to an acceleration in the tanning process, but also, either directly or indirectly, by producing free radicals which harm DNA, to an increased occurrence in the appearance of skin cancer. A documented criticism of the regulations which discipline the use of bergamot oil in tanning products was published in 1981 by Ashwood-Smith and Polton.[17] This specified that the clastogenic effect of bergapten (5-methoxypsoralen), which constitutes the melanogenic active ingredient, is proportional to the product of its concentration in different preparations, varying from between 12 and 50 µg per ml per dose of UV rays; consequently, it is sheer nonsense to impose limits in the concentration of furocoumarin, since a small dose of this in combination with a high dose of UV can do similar damage to higher concentrations combined with a small amount of radiation.

Some Very Powerful Poisons

For centuries it has been known that foodstuffs in storage can be damaged by moulds which sometimes make necessary their destruction. A toxic syndrome, ergotism, caused by the fungus *Claviceps purpurea*, which grows on rye (*Secale cereale*) and other graminaceae has been known, sadly, since the Middle Ages. But it is only recently that certain mycotoxins have been found to have a very powerful carcinogenic effect. Among them, the most important - since their cencerogenic action in man has now been established - are the aflatoxins, produced by strains of fungi which are fairly common. In recent years, epidemiological investigations[18] have shown a distinct relationship between the consumption of foodstuffs contaminated by aflatoxin and the increase in the incidence of hepatocellular carcinoma.

These investigations concern not only certain developing countries, such as Uganda, Kenya, Swaziland, Mozambique or China, but also a number of Western nations, including the south-eastern region of the United States of America; they indicate that a daily absorption of some tens of nanogrammes of these mycotoxins is enough to determine a significant increase in the risk of hepatocancerogenesis.

Another mycotoxin, ocratoxin A,[19] produced by fungi of the *Aspergillus* and *Penicillum* types, has been found particularly in cereals and has been identified in the blood of animals which have consumed contaminated food. This provokes a chronic tubulo-interstitial nephropathy, and in the Balkans, where

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[15] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 10, Some Naturally Occurring Substances. IARC, Lyon, France, 1976, pp. 263-342.

[16] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 31, Some Food Additives, Feed additives and Naturally Occurring Substances. IARC, Lyon, France, 1983, pp. 207-212, 231-246.

[17] Ashwood-Smith,M.J., Poulton,G.A. Inappropriate regulations governing the use of oil of bergamot in preparations. Mutat.Res., 1981, 85:389-390.

[18] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Supplement 7, Overall Evaluation of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42. IARC, Lyon, France, 1987, pp. 83-87.

[19] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 10, Some Naturally Occurring Substances. IARC, Lyon, France, 1976, pp. 191-197.

it is most commonly found, a definite increase in the frequency of cancer of the urinary tract has been noted.[20]

Among the different fungi which grow on rice, the staple diet in many parts of Asia, the most well researched is *Penicillum islandicum*. Two of the mycotoxins produced by this fungus, cyclochlorotine and luteoskirine[21] are the cause of benign and malignant tumors in mice; even though epidemiological studies are not available, it is suspected that these may contribute to the high rate of primary liver carcinoma which is characteristic in the Asiatic people.

Unfortunately, and apart from the lack of epidemiological studies, it is often the inadequacy of carcinogenesis testing in rodents which currently prevents scientists from estimating the potential risk to man of other mycotoxins such as patriline, penicillic acid, sterigmatocysteine and T2-tricotecene.

Genotoxics

With a vegetable diet, numerous quinones, or the phenols which are their precursors, are introduced into the organism. The genotoxic effect of quinones[22,23,24] can either be direct, or else due to their transformation into semi-quinonic radicals able to react with DNA and to give rise to the formation of free radicals of oxygen by means of a redox cycle. These in turn activate the peroxydation of the fatty acids present in the lipids of biomembranes, a process which, in its final stage generates a number of aldehydes - alkanales, alkenales and hydroxyalkenales - capable of interfering with various enzymatic systems and of provoking mutations.[25] Methylglyoxal,[26] present in various different foods and in coffee in particular, is another genotoxic aldehyde; it is also normally produced be the enzymatic mechanisms of the human organism.

The Case of Gossypol

A carcinogenic toxin called gossypol[27] is found in the proportion of about 1% in cotton seed and of about 0.1% in the unrefined oil which is extracted from it. This oil is used for cooking in certain countries (e.g. Egypt) even though it has been known for quite some time that gossypol initiates and promotes the growth of skin cancer in mice, and induces genetic damage in the rat. Moreover, this has not prevented gossypol from being put forward and tested as an economical spermicide. With the aim of reducing the risk, a new variety of cotton has been developed, the seed of which contains only a small amount of gossypol, but in this particular case, the cure would appear to be worse than the disease in so far as the new seed is even more liable to be attacked by *Aspergillus flavus*, a producer of aflatoxins. Furthermore, cotton seed oil, like the meat and livestock fed on this seed, contains

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[20] Dirheimer,G., Creppy,E.E. Mechanisme d'action de l'ochratoxine A, une mycotoxine nephrotoxique et cancérìgéne. Atti del Joint Meeting della Società Francese e Italiana di Tossicologia, Venezia, Novembre 1990, p. 31.

[21] International Agency for Research on Cancer. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Vol. 10, Some Naturally Occurring Substances. IARC, Lyon, France, pp. 139-144, 163-169.

[22] Brown,J.P., Dietrich,P.S. Mutagenicity of anthraquinone and benzanthrone derivatives in the Salmonella/microsome test: activation of anthraquinone glycosides by enzymic extracts of rat cecal bacteria. Mutat.Res, 1979, 66:9-24.

[23] Stich,H.F., Rosin,M.P., Wu,C.H., Powrie,W.D. A comparative genotoxicity study of chlorogenic acid (3-o-caffeoylquinic acid). Mutat.Res., 1981, 90:201-212.

[24] Bosch,R., Friederich,U., Lutz,W.K., Brocker,E., Bachmann,M., Schlatter,Ch. Investigation on DNA binding in rat liver and in Salmonella and on: mutagenicity in the Ames test by emodin, a natural anthraquinone. Mutat.Res., 1987, 188:161-168.

[25] Brambilla,G., Martelli,A., Cajelli,E., Canonero,R., Marinari,U.M. Lipid peroxidation products and carcinogenesis: preliminary evidence of n-alkanal genotoxicity. In "Eicosanoids, Lipid Peroxidation and Cancer", Nigam et al. (eds.), Springer-Verlag,Berlin, 1988, pp. 243-251.

[26] Cajelli,E., Canonero,R., Martelli,A., Brambilla,G. Methylglyoxal-induced mutation to 6-thioguanine resistance in V79 cells. Mutat.Res., 1987, 190:47-50.

[27] Ames,B.N. Dietary carcinogens and anticarcinogens. Oxygen radicals and degenerative diseases. Science, 1983, 221: 1256-1264.

cyclopropenoid fatty acids, sterculic acid and malvalic acid, which are easily oxydised into peroxydes;[28] it is perhaps to this mechanism to which we owe the great variety of toxic effects that these acids perform, like, for example the carcinogenic effect which has been noted in trout.

Vegetables and Nitrosamines

In certain cases, the relationship between the ingestion of vegetable matter and the increase in the carcinogenic risk has remained less direct, but probably no less dangerous; for example, the high level of nitrates provided by certain vegetables (celery, lettuce, spinach, etc.). Within the organism, nitrate is partly reduced to nitrite which, in the acid environment of the stomach, nitrosates the molecules containing amine and amide groups transforming them into nitrosamines and nitrosamides respectively.[29] These nitroso compounds are generally genotoxic and carcinogenic, and a growing number of epidemiological studies now show that cancer of the oesophagus and the stomach is higher in populations whose diet is rich in nitrates.[30] In this case, a valid remedy exists in the form of the simultaneous absorption of ascorbic acid, which blocks nitrosation.

Apples

The list of vegetable carcinogenic substances listed here is far from complete, including only those for which experimental and/or epidemiological evidence capable of allowing us to make, if not an estimate, then at least an appreciation of the probable risks involved, is indispensable; however, it is more than long enough to demonstrate that the picture of cancer that we have today, as being a by-product of the industrial civilisation, should be profoundly reconsidered. Ames and Gold have recently tackled this problem in a lecture published in "Science",[31] by intervening in a violent debate on the need or not to outlaw the use of Alar, a growth regulator which retards the ripening of apples and thus prevents them from falling from the tree prematurely, or from ripening too quickly during storage. Alar, in fact, decomposes, and one of the products it generates, UDMH, is carcinogenic, but the danger of it leading to the appearance of cancer is less than that which derives from the consumption of mushrooms containing carcinogenic hydrazine; to be precise, it is 59 times more likely that the absorption of one mushroom per day will lead to the development of cancer than that of one glass of apple juice per day, made from apples treated with Alar.

Pesticides

To consider the problem from a more general angle, Ames and Gold affirm that 99.99% of the"pesticides" we consume every day are of natural origin. Only 0.01%, that is to say 10,000 times less than this, are made up of man-made, synthesised compounds.The list of foodstuffs containing natural pesticides which have proved carcinogenic in rodents is very long: apples, bananas, basil, Brussels sprouts, broccoli, cabbage, cauliflower, carrots, mushrooms, mustard, orange juice, peaches, pepper, pineapple, etc. Unfortunately, our knowledge on this subject is still rather limited; it is enough to consider that the juice of the apple contains some 137 natural volatile compounds; only 5 have been tested for possible carcinogenic effects, 3 of which have proved to be cancerogenic. The situation is quite likely to worsen in the future, considering the effort that agricultural economists are putting into the development of plants which are resistant to attack from insects, a situation which often leads to the creation of varieties which contain even greater numbers of natural pesticides. Here are two cases in

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[28] Ames,B.N. Dietary carcinogens and anticarcinogens. Oxygen radicals and degenerative diseases. Science, 1983, 221: 1256-1264.

[29] Mirvish,S.S. Formation of N-nitroso compounds: chemi stry, kinetics and in vivo occurrence. Toxicol.Appl.Pharmacol., 1975, 31:325-351.

[30] Bartsch,H., Montesano,R. Relevance of nitrosamines to human cancer. Carcinogenesis, 1984, 5:1381-1393.

[31] Ames,B.N., Gold,L.S. Pesticides, risk, and applesauce. Science, 1989, 244:755-757.

point: the first concerns a new potato which is resistant to insects, and which has been taken off the market because it has proved to be toxic owing to its high concentration of two teratogens, solanine and caconine, normally only present in minute amounts; the second relates to a new strain of celery, also resistant to insects, but which causes dermatitis in farmers because of the level of carcinogenic 8-methoxypsoralen it contains. With this in mind, it is only natural for us to query the degree of rationality behind the position of different Agencies which continue to issue ever more restrictive norms regarding the use of synthetic pesticides, while paying no attention whatsoever to the dangers posed by natural pesticides. In addition, it is our duty to question the fact that the major part of available ressources continues to be devoted to study the toxicity of synthetic compounds, while the study of natural substances is neglected.

Conclusion

To conclude, we would be wiser to consider that nature is not necessarily benign and that the carcinogenic elements present in our diet - not only those of vegetable origin which have been considered in this text, but also those which derive from the pyrolysis of proteins, which occurs during cooking, for example - are the cause of a quantity of human neoplasia which is difficult to estimate but which is no doubt significant. And to speak only of cancer is most certainly too restrictive, since the degenerative illnesses associated with aging are at least partly due to damaged DNA. However, nature also provides us with a remedy made up of a number of tiny molecules which are present in our diet and which have an antioxydant and anticarcinogenic effect: vitamin E, which is the main protection the lipids of biomembranes have against free radicals; beta-carotene, another molecule which protects fats from oxydation; selenium, which is present where gluthatione peroxydase is active, and is an indispensible element in the destruction of hydrogen peroxydes and lipidic hydroperoxydes; gluthatione, one of the most efficient antimutagens; and ascorbic acid, which has an antioxydant effect and which blocks reactions of nitrosation. It is quite probable that the several neoplasias which occur in various geographical locations can be put down not only to levels of industrialisation, to lifestyle and to the amount of carcinogenic elements absorbed from dietary sources, but also to a varying intake of substances which are capable of inhibiting one or several phases of the carcinogenetic process.