

## CAN OUR DIET PROTECT US AGAINST CANCER?

The Preventive Effect of Plant Substances Contained in Foods in the Processes of Neoplasm Formation

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According to one of the theories, neoplastic diseases are the revenge of evolution<sup>1</sup>. Civilizational development gave us enormous possibilities, but if we want to take advantage of them, we risk our health. As demonstrated by studies, the population of highly developed areas is at a higher risk of many newly formed diseases<sup>2</sup>. The literature describes traditional Chinese medicine, which, in a miraculous, incomprehensible way treats various ailments<sup>3</sup>. Many of us had surely undergone therapies applying traditional recipes. What is the connection between traditionally applied recipes and the practices applied by Tibetan monks? Ethnopharmacology, commonly referred to as folk wisdom! The only question is: are we really able to use it these days? Elements, which have been becoming more and more popular recently, include living in peace with nature, slow food and the return to the roots.

However, people of the 21<sup>st</sup> century find it difficult to believe in ancient messages. What counts today is reliably verified information. Fortunately, thanks to today's science, advanced laboratory technologies allow for analyzing the properties of a range of substances in various research models. An enormous number of various plants found on Earth are a rich source of chemical compounds of unique structure. Today, thanks to the works of scientists, we are able to draw information on the structure and mechanisms of action of foodstuffs which have been commonly considered healthy for centuries. Thanks to modern science, we discover in what ways our diet can influence our organism. We find answers to questions concerning the ways the substances from vegetables which we were told to eat in childhood, for example white cabbage, may penetrate into single cells, thus preventing the formation of neoplasms. Chemoprevention, i.e. preventing neoplastic diseases through the action of substances, most frequently of natural origin, is being studied intensely. Some foods contain valuable anti-cancer compounds. The action of plants such as cabbage, broccoli, soy, tomatoes, ginger, green tea or chili peppers has been described well – they contain chemical compounds such as capsaicin, which regulate the function of the cells of the organism<sup>4</sup>. There are also descriptions of

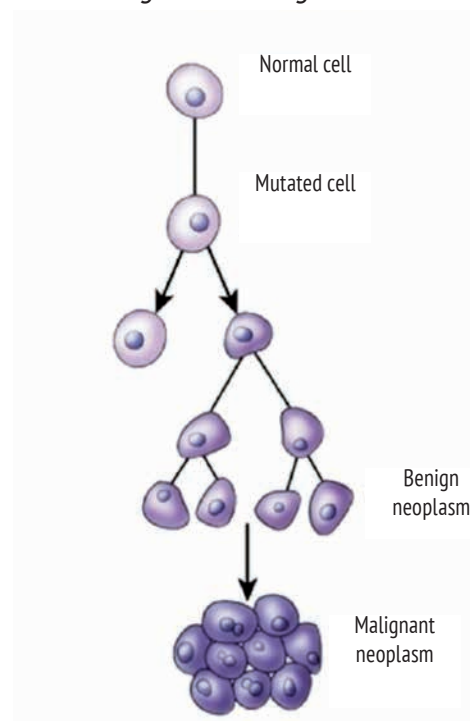
components of everyday diet, for example sugar or sweeteners, which, when used regularly, increase the occurrence risk of neoplasms<sup>5</sup>. It is known that food products which are eaten at least three times a day, strongly influence the human organism. It is worth remembering that when deciding on the composition of the next meal.

## The Silent Path from a Single Cell to a Malignant Tumor

Neoplastic diseases are a serious social problem and a challenge for medicine these days. From year to year the number of diagnosed cases is increasing and the advances in medicine barely catch up to the number of new cases. A neoplasm is not one disease, but many different ones which have one common feature – the pathological multiplication of mutated cells. Due to various reasons, such as exposure to harmful factors (UV<sup>6</sup>, chemicals<sup>7</sup>), smoking cigarettes<sup>8</sup> or genetic load<sup>9</sup>, cells acquire new features and, at a certain moment, they become no longer controlled by the organism's control systems. The human organism is equipped with many mechanisms which can repair mutated cells; however, frequently, due to various factors, a neoplastic cell survives. Disease lesions are never caused by a single mutated cell, but by an accumulation of many damaged cells.

The process of neoplasm formation is not as fast as an infection with the influenza virus. Frequently, the time elapsing from the emergence of the first durable mutation in a single cell to the manifestation of the disease symptoms is several dozen years. The reason for that is that along with time, particular mutations of single cells accumulate, forming tumors which can acquire invasive properties and transfer to distant organs of the body, forming the metastasis. Out of 10,000 neoplastic cells which multiplied in the original location, acquired invasive properties and are only starting their way in order to settle in new locations of the organism, only two will reach the target destination. The cells which survived the way through the organism, omitting the defense mechanisms, settle in other, healthy organs, in which they can freely multiply, forming a secondary tumor. Neoplastic diseases most frequently occur in elderly persons in whom the mutations which have been gathered for years, start to cause health-threatening tumors. It is a paradox that the progress of civilization and advances in medicine allow us to live a longer life, but also reveal many diseases. It is sure that along with the increasing life age of the population, the number of diagnoses of neoplastic diseases is going to increase.

*Stages of carcinogenesis*



## The Devil is in the Detail

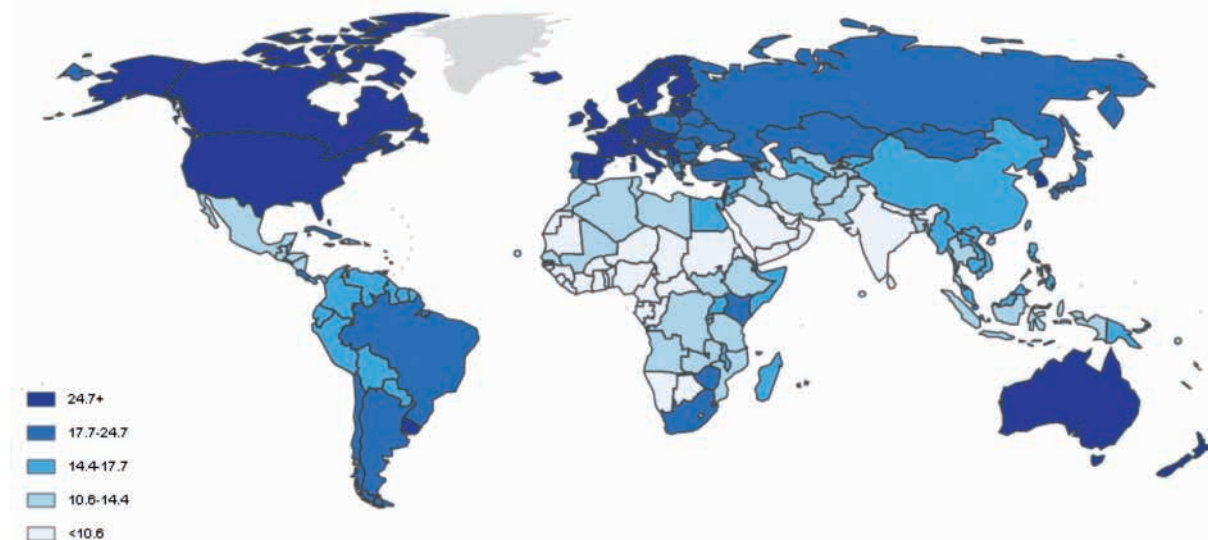
Besides any genetic dependences, very frequently our fate is in our own hands. Numerous reports of organizations dealing with neoplasm-related statistics in the world, such as the World Health Organization<sup>10</sup> or the US National Institutes of Health<sup>11</sup> demonstrate the influence of exposure to environmental factors and of the diet on the incidence of neoplastic diseases. Seemingly ordinary activities which are regularly repeated for a long period, may lead to irreversible lesions and diseases. The human organism is enormously influenced by the food eaten every day. It should be remembered that the food ingredients which we deliver to our organisms during meals, such as meat, starch additives and vegetables, are not only the building substance of our bodies and a delivery of the energy necessary to live, but also the components for the molecular machinery which is part of all proteins and enzymes that are the condition of the proper functioning of the organism and preventing diseases. Therefore, the phrase “you are what you

eat”, which is being repeated like mantra by the supporters of healthy nutrition, has also its grounds in biochemistry. It turns out that nutrients may, to a significant degree, influence the particular stages of formation of neoplasms – in a both inhibitory and protective way. According to some epidemiologists, about 30% of neoplasms diagnosed in developed countries are related to nutrition<sup>12</sup>, which is not yet sufficiently strongly rooted in social awareness. Some of the factors which increase the risk of the occurrence of a neoplastic disease are quite obvious. It is undoubtable that smoking cigarettes favors mutations of cells<sup>8</sup>. Gradual delivering of toxic substances, in a systematic way, for many years, very frequently causes neoplastic lesions in the lungs. According to the data of the WHO (Globocan 2012 data base), lung cancer is the main reason of death among neoplastic diseases in men<sup>2</sup>. Also, long-term exposure to the sun, without applying appropriate protective agents, results in disastrous damages of the DNA of skin cells, causing the emergence of melanoma<sup>13</sup>. The substances which we intake in food may act in the same way, though more generally, because they are distributed throughout the whole organism.

## Contemporary Scientists Prove what Tibetan Monks have Known for Years

Many available analyses allow for becoming familiar with the “geography of cancer.” Statistics show that inhabitants of Europe and of the United States are at a higher risk of falling ill, while the Asian populations, known for a completely different lifestyle and a diet rich in substances of plant origin, demonstrate lower susceptibility to this disease (Figure 1: GLOBOCAN 2012 Internet base). Areas of a lowered risk of people’s susceptibility to neoplastic diseases are known for their deeply rooted culture and using treatment methods of traditional folk medicine. For thousands of years natural methods of fighting diseases have been used by Tibetan monks with good results, however, for a long time their action was shrouded in mystery.

Fig. 1. Neoplasm prevalence in the world in both sexes in general per 100,000 people

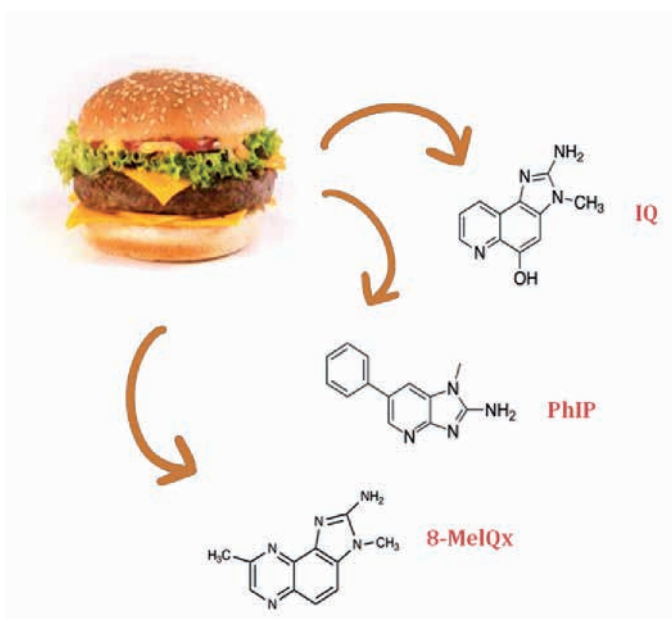
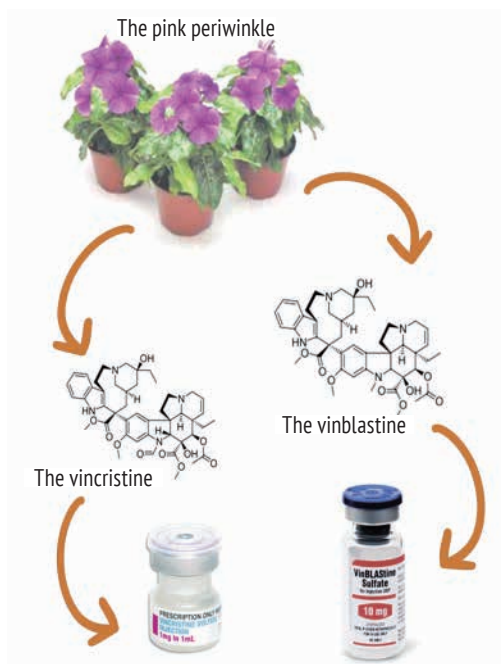


Thanks to the methods of contemporary molecular biology, scientists are able to experimentally verify the rightness of applying substances of plant origin in the therapies of various diseases. One of the good examples is the *Catharanthus roseus*, which grows naturally in tropical conditions. In high amounts this plant is poisonous, yet its beneficial properties have been appreciated not only in traditional Chinese medicine. The native inhabitants of Madagascar applied it as a medicine for treating malaria and the inhabitants of Jamaica and India treated diabetes with its help. *Catharanthus roseus* contains over 100 different alkaloids, two of which – vincristine and vinblastine – have been analyzed better and are now commonly applied in the therapy of neoplasms<sup>14</sup>. The mechanism of their neoplasm-combating action consists in inhibiting cell division. The isolation of the substances at an industrial scale required a very high amount of the plant material, which – in the long term – could disrupt the ecosystem, therefore their synthesis and industrial production started being held using more efficient and safer biotechnological methods<sup>15</sup>.

One of the leading plants which prevent the formation of neoplasms is green tea. Both in studies applying cell models, animal ones as well as clinical ones, it has been proven that the substances included in green tea have an inhibiting effect on the formation of mutated cells and tumors<sup>16</sup>. Above all, green tea neutralizes free radicals which are harmful for cells, acting stronger than vitamin C - and it is possible to replace preventive swallowing of pills by drinking a cup of this valuable drink<sup>17</sup>. It has been demonstrated that drinking green tea reduces the tendency for the occurrence of neoplasms of the digestive system in people and of lung neoplasm in mice. The substances present in green tea are also applied as therapy supporting the treatment of brain neoplasms and of multiple myeloma<sup>18</sup>.

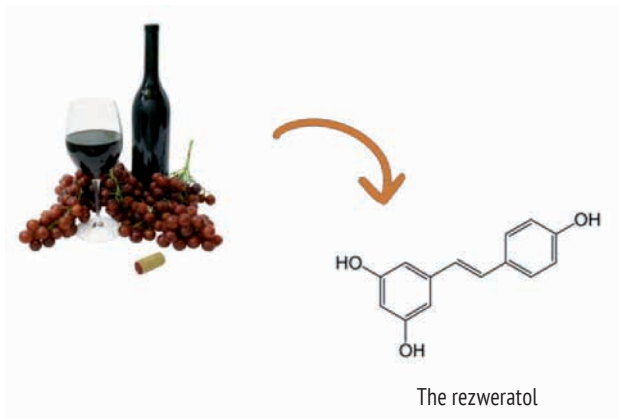
Despite the enormous amount of active substances included in tea, the drink which is considered the most complex one in human diet is red wine. Its properties were appreciated already by Hippocrates. Studies have demonstrated a reduction of the proliferation of neoplastic cells under the influence of resveratrol present in wine<sup>19</sup>. Studies also demonstrate that resveratrol works best in a mixture of natural compounds present in wine and grapes<sup>20</sup>. What is also important is the region of origin of the grapes, the highest amount of resveratrol is present in Swiss wines<sup>21</sup>. We can, therefore, pay attention to the drinks used during various occasions.

It is worth to be aware that cell mutations may be also caused by improper preparation of meals. Thermal treatment of meals in very high temperature, i.e. very popular grilled meat, may result in the formation of numerous carcinogenic substances such as heterocyclic amines (HCA). These substances are formed as a result of long thermal processing of meat products and fish in high temperatures. Although the amounts of HCA produced there are negligible, their mutagenicity, i.e. the ability to damage DNA, is high.



The heterocyclic amines produced in processed food, such as IQ, 8-MeIQx and PhIP, enter our organism, for example, while eating hamburgers and grilled meat. After the metabolic activation of HCA in the organism, their reactive forms may bind to DNA and form adducts which may lead to the formation of neoplasms<sup>22</sup>. Fortunately, these substances may be neutralized in a way. It has been demonstrated that marinating meat with the addition of rosemary before thermal treatment may reduce the formation of HCA even by 40%<sup>23</sup>. Also other spices from the Lamiaceae family, besides rosemary, such as oregano, sage or thyme, contain polyphenols which have an antioxidant effect. By removing free radicals, antioxidants reduce the risk of damaging normal cells and of the formation of DNA mutations which can increase the risk of the occurrence of neoplastic processes. Many people are familiar with

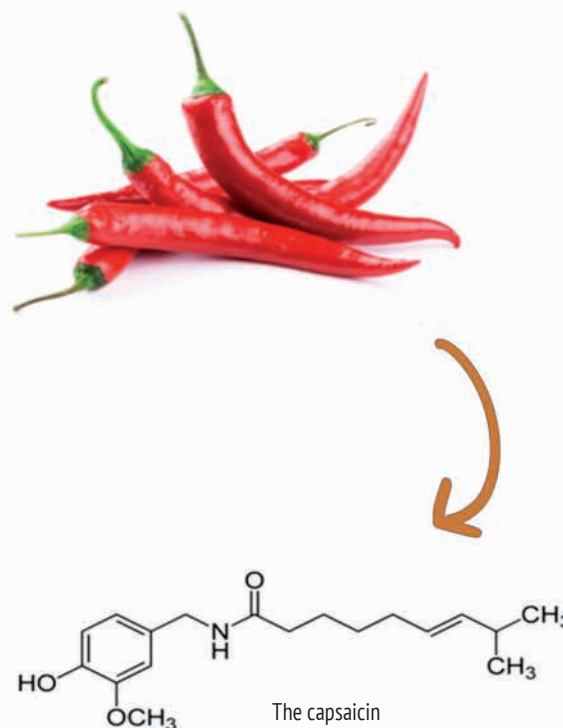




the properties of many other spices, such as sweet chili peppers which contain capsaicin – a substance that changes the metabolism of toxic and carcinogenic substances to the benefit of human<sup>24</sup>. Spices containing polyphenols (especially flavonoids) which enrich the pro-health properties of everyday meals through eliminating harmful substances and reducing the risk of the formation of single mutations may be easily introduced to everyday diet.

## The Grass is Always Greener on the Other Side of the Fence...

Not only the inhabitants of the Far East and of the Mediterranean Basin, who have access to green tea, soy and grow salutary herbs in their gardens, have the possibility to protect themselves from neoplasms thanks to their native diet. The Polish cuisine includes numerous dishes which can be considered as ones which reduce the risk of neoplasm formation. Cruciferous vegetables, with, above all, broccoli and white cabbage, demonstrate strong antioxidant effect, protect against chemically induced DNA damages and inhibit the proliferation of neoplasms. This is thanks to the glucosinolates included in cabbage, which modulate the activity of enzymes responsible for anti-neoplastic processes, mainly through the modulation of the activity of enzymes of phase I and II detoxification. Also the breakdown products of glucosinolates in the organism may influence the metabolism of neoplastic cells<sup>25</sup>.



There is a reason why in traditional Polish cuisine meat prepared in high temperature is associated with white cabbage. Studies carried out on a group of Polish female migrants within the scope of the Polish Women's Health Study at Harvard demonstrated that women who used to eat raw, cooked or sour cabbage 3-4 times a week when they were teenagers, were by 70% less susceptible to breast cancer<sup>26</sup>. In the United States the possibility to use glucosinolates isolated from cruciferous plants as chemopreventive agents, has been patented<sup>27</sup>.

The conducted studies and literature descriptions indicate that a given population is influenced the best way by native vegetation which has been used for generations in the traditional cuisine of the people inhabiting particular areas. It is, therefore, worth considering which diet is natural for the area where we are and what was obvious for our ancestors.

Carlo Petrini, the founder and boss of the international organization Slow Food, already in the 1980s, protested against opening the first McDonald's restaurant in Rome. Petrini, who is a gastronomic traditionalist, believes that today's food has no taste or the properties it had in the past, and which it should have, and he is convincing people not to buy what our grandmother would not touch. It is not surprising, therefore, that the American magazine "The Guardian"

considered him one of the 50 people who can change the world. The change of the lifestyle of highly developed civilizations would surely be beneficial in numerous dimensions, because the costs of treatment of oncologic patients constitute a serious economic problem. Reducing the number of cases of cancer which require long-term, expensive therapy, would be beneficial for the budget of countries which are particularly at risk of the occurrence of neoplastic diseases. According to data from Oxford scientists, the amount spent on treating neoplasms in the European Union in 2009 was 126 billion euro, 40% of which was covered by public health care. It has been also estimated that the cost of the reduction of productivity, due to premature death, was 42 billion euro, and the days off work used for sick leaves of employees generated losses of 9 billion euro<sup>28</sup>. Therefore, preventive action in the scope of the occurrence of neoplastic diseases is in the interest of the whole society. The USA – the country whose inhabitants are at the highest risk of the occurrence of neoplastic diseases – has for many years been holding actions aimed at popularizing a healthier lifestyle and introducing plant substances to the everyday diet of citizens. Other countries, which have only adopted the unhealthy American lifestyle, ready-prepared, processed meals and consumerism focused on gaining energy for life, also seem ready for pro-health initiatives.

Every person has a different metabolism, various genetic predispositions and living environment. Irrespectively of the exposure to carcinogenic factors, using the blessings of nature may bring many advantages. Plants carry enormous potential which cannot be ignored. Technological development should not stand in opposition to the values we are familiar with, but it should supplement them. It is important to maintain wisdom in diversity with maintaining respect for tradition. Seemingly simple activities, such as preparing meals, may have a big influence on our health.

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