Healthcare industry BW

Cancer cells do not like rocket salad

Vegetables serve as the base of the food guide pyramid – but why? Research carried out by environmental scientist Dr. Evelyn Lamy and her team at the Institute of Environmental Medicine and Hospital Hygiene (IUK) at the Freiburg University Hospital shows that cruciferous plants (Brassicaceae) are not only low in calories but also contain healthy substances.

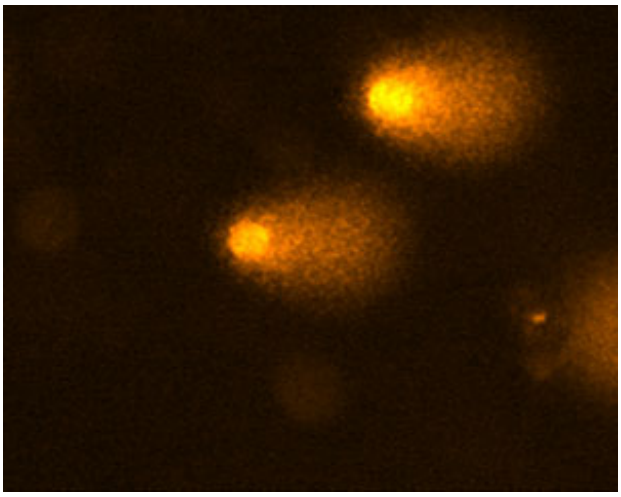
While healthy cells undergo apoptosis (programmed cell death) after a few cell divisions in order to protect the organism against accumulated DNA damage, malignant cancer cells continue to divide ad infinitum. This leads to tumours. It has been a long-standing public belief that a balanced diet based on certain vegetables might help combat tumours. "There is experimental evidence that certain cruciferous plant substances have a chemopreventive potential, i.e. are able to protect us against cancer," said Dr. Evelyn Lamy, head of Molecular Cell Biology at the IUK.

Isothiocyanate heat fights cancer

Isothiocyanates, which are substances found in vegetables such as rocket, kohlrabi or mustard, don't just burn the tongue but also promote good health. In order to provide further evidence supporting the anti-cancer effect of cruciferous plants, Lamy and her team have carried out a human intervention study in which they compared the blood of control patients with patients who had taken a defined quantity of isothiocyanates for several days. The researchers exposed all blood samples to carcinogenic substances and found that isothiocyanate consumption leads to considerably fewer DNA strand breaks in the blood cells. "But this is not the end of the story," said Lamy. "Isothiocyanates are not only able to protect normal cells from DNA damage; they can also induce malignant cancer cells to undergo apoptosis." In their experiments, the cell biologists exposed human liver cancer cells to rocket juice extracts and later to a specific rocket isothiocyanate and found that a large proportion of cancer cells switched on the cellular suicide programme.

Isothiocyanates from rocket and other cruciferous plants induce apoptosis in cancer cells. The question is, how do they do this? "In order to find out more details on the apoptotic mechanism, we carried out further molecular biological experiments," said Lamy. "For example, we investigated the genes that were switched on in the cancer cells upon exposure to isothiocyanates," said Lamy explaining that they came across old acquaintances, for example the tumour suppressor gene p53, which was discovered as far back as 80 years ago. p53 halts the cell division cycle when cell damage occurs in order to kick-start repair mechanisms; in the case of irreparable cell damage, p53 induces apoptosis. Genes that prevented apoptosis were suppressed

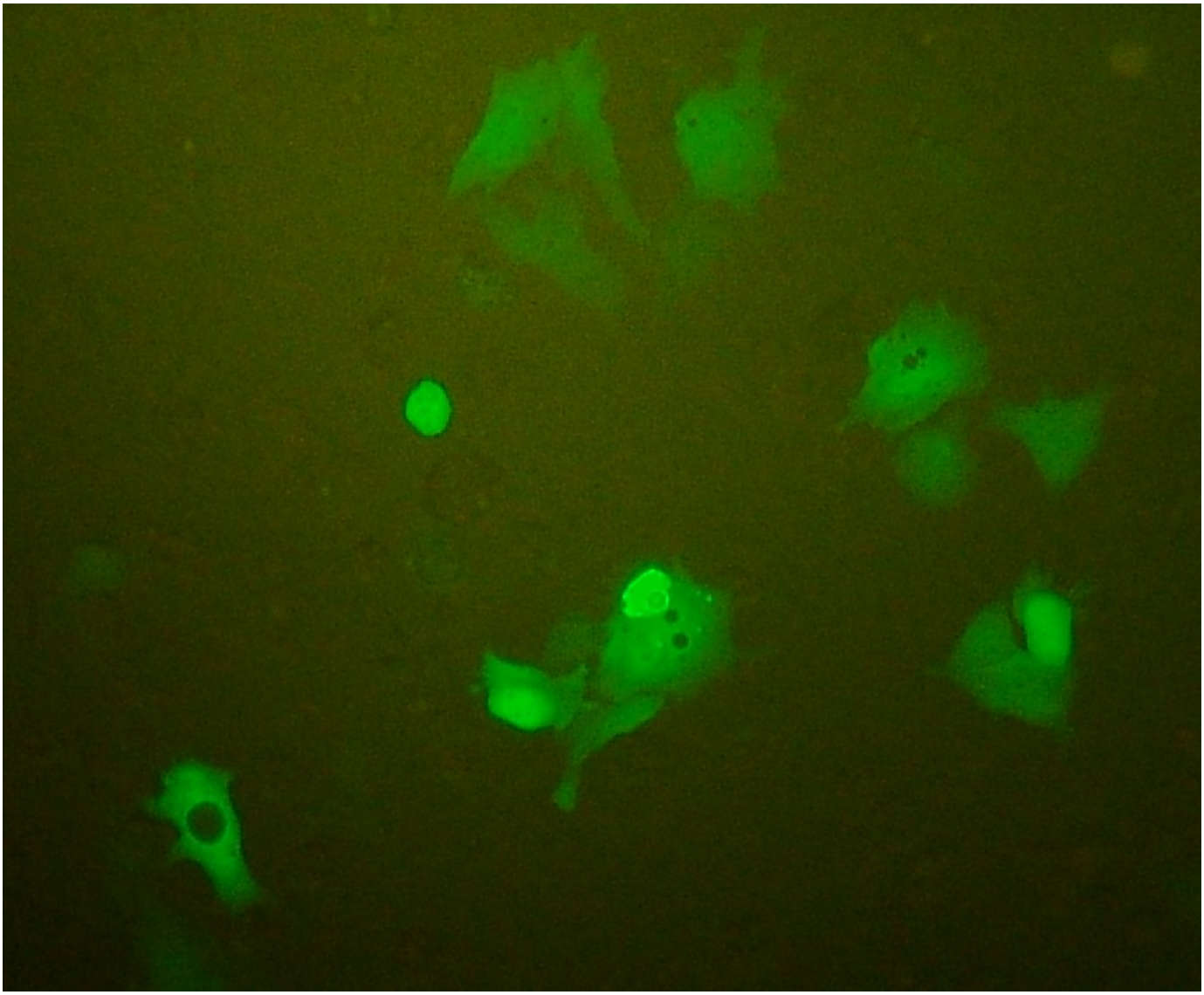
in the cells exposed to isothiocyanate. The Freiburg researchers thus found that the plant substances also released the breaks that protected the cancer cells from the onset of apoptosis.



The so-called comet assay reveals DNA stained with fluorescent ethidium bromide. The nuclear membrane of the cells was made permeable and the cells were exposed to an electrical field. As a result, DNA, which was damaged due to the cells' exposure to carcinogenic substances, migrates out of the nucleus. The picture shows a microscopic image of a cell nucleus with migrated DNA fragments (comet tail; the brighter and longer the tail, the higher the level of damage). (Photo: Dr. Evelyn Lamy)

Targeted application?

Lamy and her colleagues made another interesting discovery. They found that isothiocyanates also limited the concentration of the telomerase enzyme, which catalyses a reaction in which specific DNA repeats are added to the ends of eukaryotic chromosomes. This prevents the cells from ageing and dying. Telomerase activity is suppressed in the majority of human cells; however, 85 to 90 per cent of all tumour cells express telomerase and are able to divide continuously. "We still do not know whether isothiocyanates directly inhibit the enzyme or whether this is only a side effect of apoptosis induction," said Lamy. "But if we find that there is a direct correlation, then this might enable us to develop selective cancer therapies." Since telomerase only occurs in cancer cells, it might be possible to selectively inhibit the enzyme with plant substances in tumour tissue without inducing apoptosis in the rest of the tissue and thus to prevent healthy cells from being killed.



Liver cancer cells stained with green fluorescent protein (GFP), which express a so-called interfering RNA against the hTERT telomerase subunit, which is able to suppress hTERT activity. Such cells are of major importance for future experiments, in which Dr. Evelyn Lamy and her team will investigate the interaction between telomerase and isothiocyanates. (Photo: Dr. Evelyn Lamy)

In an ongoing project, Lamy and her colleagues are investigating whether healthy cells are also affected by isothiocyanates. In addition, they are also planning to suppress telomerase activity in order to find out details about the role of this enzyme on the induction of apoptosis through isothiocyanates. In future, the researchers might be able to discover the signalling pathways affected by healthy plant substances. But, in the meantime, it may be wise to follow the advice to eat as much rocket, kohlrabi and mustard as possible.

Article

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Further information

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