



ANTI-NEOPLASTIC PROPERTIES OF PLANTS – CAN NATURE HELP TO CURE CANCER?

KATARZYNA SCHAB, PAULINA MULAWKA, DOMINIKA MULAWKA, MAGDALENA AMAROWICZ,
MARCIN URBAŃCZUK, KAMILA BAŁ, JUSTYNA MARKOWICZ, LIDIA KOTUŁA, JANUSZ KOCKI

Abstract. Nowadays cancers are predominant cause of morbidity and mortality all over the world. Therefore, the greatest challenge for clinical oncology is to reduce the prevalence of these diseases. What gains rising interest are natural substances derived from plants, which have both chemopreventive and chemotherapeutic properties. The task is demanding since the mechanisms underlying antitumor activity of plants-derived natural substances are complex and diverse. Several natural substances are already the components of international protocols of multi-drug chemotherapy. Nevertheless, cooperation between botanists, pharmacologists and clinical oncologists is essential to achieve further improvement in this field.

Key words: natural substances, plants, antineoplastic properties, cancer, oncology

Department of Clinical Genetics, Medical University of Lublin, ul. Radziwiłłowska 11, 20-080 Lublin, Poland; zgkumlub@wp.pl

Introduction

Nowadays cancers are predominant cause of morbidity and mortality all over the world. Therefore, the greatest challenge for clinical oncology is to reduce the prevalence of these diseases. Noticeable development of genetics and molecular biochemistry allows for better understanding of cancer cell biology, which is essential in inhibiting the mitosis and inducing apoptosis by precise interaction with particular molecular pathway. What gains rising interest is not only the modern target-specific drugs (tyrosine kinases inhibitors, specific antibodies blocking growth factors receptors), but also natural substances derived from plants. Antineoplastic properties of plants have been already known in ancient times. In Middle Ages there were only six plants with supposed potential usage in tumor treatment. Since that time many substances have been extracted from plants and successfully used in oncologic therapy.

Antineoplastic mechanisms of plant-derived natural substances

The mechanisms underlying antineoplastic activity of plants-derived natural substances are complex and diverse. Many of them can be used in chemoprevention whereas there is a number of

plants which has therapeutic properties. Among the chemopreventive mechanisms there is the ability to improve the metabolism of xenobiotics in order to preserve from their detrimental effects on human cells. The other is an antioxidative effect resulting in elimination of free radicals, which play a crucial role in carcinogenesis (SIELUK 2010). Therapeutic remedies work through cell cycle arrest, microtubule polymerization inhibition, rising apoptosis of cancer cells and immunomodulation or busting immunosurveillance (RÓŻAŃSKI 2014).

Particular examples of plants of potential utility in future therapy

Allium sativum L. is one of the most popular plant widely known from its antineoplastic properties. When it comes to the mechanism of it, the elimination of free radicals has been emphasized (DĘBSKI & MILNER 2007). The underlying cause of carcinogenesis is gene mutations due to reactive oxygen forms. Therefore the garlic properties should be further investigated.

Green tea, soy, celery, parsley, grapefruit, turmeric (curry), broccoli and onion contain dietary polyphenols that have been studied for their chemopreventive and chemotherapeutic activity.

Cardioprotective properties of polyphenols contained in red wine are well established whereas

their role in oncology still requires diligent evaluation (SIELUK 2010; RÓŻAŃSKI 2014).

Brassica oleracea L. var. *capitata* L. which is a traditional element of European diet is another example of plant with chemopreventive activity supported by significant negative correlation between the consumption of this plant and the prevalence of colon, breast and lung cancer (KUSZNIEREWICZ *et al.* 2007).

Solidago virgaurea L. (goldenrod) has been known with its anti-inflammatory activity was evaluated for the possible role in the treatment of cancers. It presents cytotoxic activity and turned to be effective on various tumor cell lines, including human prostate (PC3), breast (MDA435), melanoma (C8161), and small cell lung carcinoma (HS20) (GROSS *et al.* 2002).

Stems of *Ficus hispida* L. have been used as one of the ingredients of some Thai traditional remedies for cancer treatment. Cell cycle analysis revealed a rising of apoptotic cell population in breast cancer cells (PRATUMVINIT *et al.* 2009). Recent study confirmed the ability of sesquiterpene lactone compound obtained from *Magnolia* L. extract and parthenolide to induce apoptosis of follicular NHL cells in vitro (Marin *et al.* 2013)

Chelidonium majus L. containing chelidonine and protopine has been used in traditional medicine because of its antineoplastic properties. In many studies it has been proved effective in pancreatic, melanoma and lymphoma cell lines (RÓŻAŃSKI 2014).

The research conducted on cell lines proved also the effectiveness of natural substances on leukemic cells. *Trigonella foenum-graecum* L. (Fenugreek) seed extract turned out to inhibit proliferation of acute lymphoblastic leukemia and acute myeloblastic leukemia cells as well as to increase the level of apoptosis (ALIZADEH *et al.* 2013).

Natural substances of established role in antitumor therapy

Several plants-derived substances have already been commonly used in standard chemotherapy and no one can dispute their important role in modern-day oncology. Podophyllotoxin, colchicine, paclitaxel, *Vinca rosea* L. alkaloids, camptotecin are components of international protocols of multi-drug chemotherapy (WIECZOREK *et al.* 2006).

Conclusions

In the light of the high incidence of cancers, significant attention has to be focused on plants-derived drugs with chemopreventive and chemotherapeutic properties, since of their low toxicity and effectiveness proved in many studies give hope for cancer patients. Therefore cooperation between botanists, pharmacologists and clinical oncologists is essential to achieve the improvement in this field.

References

- ALIZADEH S., DARGAHI H., KASHANI KHATIB Z., MOSSAHEBI M. 2013. Investigation of antineoplastic effects of *Trigonella foenum-graecum* seeds extract on some acute leukemic cell lines. *Int. J. Res. Med. Health Sci.* 6 (2): 1–9.
- DĘBSKI B., MILNER J.A. 2007. Molekularne mechanizmy przeciwnowotworowego działania czosnku; rola reaktywnych form tlenu. *Bromatol. Chem. Toksykol.* 40 (3): 223–228 (in Polish)
- GROSS S.C., GOODARZI G., WATABE M., BANDYOPADHYAY S., PAI S.K., WATABE K. 2002. Antineoplastic activity of *Solidago virgaurea* on prostatic tumor cells in an SCID mouse model. *Nutr. Cancer* 43 (1): 76–81
- KUSZNIEREWICZ B., PIASEK A., LEWANDOWSKA J., ŚMIECHOWSKA A., BARTOSZEK A. 2007. Właściwości przeciwnowotworowe kapusty białej. *Żywność. Nauka. Technologia. Jakość* 6 (55): 20–34 (in Polish)
- MARIN G.H., MANSILLA E., CIOCCHINI S., QUIROGA N., CARDOZO N., WEISS M., MARIN G.H., TREBUCQ H. 2013. Sesquiterpene lactone extract from native American herbs demonstrated antineoplastic activity against Non Hodgkin Lymphoma cells. *Annalen der Chemischen Forschung* 1 (2): 50–55.
- PRATUMVINIT P., SRISAPOOMI T., WORAWATTANANON P., OPARTKIATTIKUL N., JIRATCHARIYAKUL W., KUMMALUE T. 2009. *In vitro* antineoplastic effect of *Ficus hispida* L.: plant against breast cancer cell lines. *J. Med. Plants Res.* 3 (4): 255–261.
- RÓŻAŃSKI H. 2014. Wybrane rośliny przeciwnowotworowe uprawiane i dziko rosnące w Polsce. *Świat bez raka – naturalne metody zapobiegania i leczenia* (25 października 2014, Toruń). http://luskiewnik.strefa.pl/rosliny_onkostatyczne_rozanski.pdf. (in Polish)
- SIELUK J. 2010. Naturalne substancje przeciwnowotworowe. *Gazeta Farmaceutyczna* 2: 30–31. (in Polish)
- WIECZOREK M., SOBIĄK S., MEISSNER R.K. 2006. Rozwój badań nad wykorzystaniem substancji pochodzenia roślinnego w terapii nowotworów. *Nowiny Lekarskie* 75 (4): 407–413. (in Polish)