The modern world, especially highly developed and rapidly developing countries, including Poland, are struggling with increasing civilization diseases which generate the inevitable need to increase efforts of science to respond to that problem.

Betalains, including betacyanins, are a group of natural dyes that are increasingly attracting attention due to their valuable antioxidant, anti-cancer and anti-inflammatory properties. In addition, due to their physicochemical properties and mostly the lack of toxicity or allergy to humans, they can be an alternative to synthetic dyes. The chemical synthesis of betalains is difficult. That is why their common source is natural raw material. These factors contribute to the widespread use of coloring substances obtained from beetroot (*B. vulgaris*) which is the only approved source of betalain colorant as a food additive in the United States and the European Union.

B. vulgaris is not the only source of betalains. They are present in raw materials such as Malabar spinach, *Bougainvillea glabra* flowers or red pitaya fruits - *Hylocereus polyrhizus*. The potential of these plants is appreciated, among others by their use in the production of functional food or nutraceuticals. It should be noted that the aforementioned raw materials have different betalain profiles. So far, the bioactive properties of beetroot extracts and its selected betalains have been best studied. It is also necessary to thoroughly test betalains isolated from alternative sources, including *H. polyrhizus* fruits which are characterized by violet flesh and pink skin due to the high content of betacyanins.

The general objective of this project is to expand the current state of knowledge about the bioactive, antioxidant and physicochemical properties of isolated unique acylated betacyanins and their decarboxylated/dehydrogenated derivatives as well as purified extracts from fruits of *Hylocereus polyrhizus* selected clones. Said pigments have mostly never been tested in pure form at all. Betacyanin derivatives will be generated by the pigment thermal degradation and chemical oxidation.

The main part of the planned work will be studying of the effect of the pigments on the metabolic activity of *hepatocellular carcinoma* three standard cell lines and their normal analogues in *in vitro* tests. The cytotoxic effect of said substances will be also tested. The investigation of the influence of acylated betacyanins on metabolic activity as well as determination of the molecular effects of isolated pigments on selected enzymes' expression and on transcription factors will be performed taking advantage of the main characteristic differences between cancer and normal cells in metabolic regulation processes.

Betalains undergo significant degradation in the digestive system which results in a lower chance of their effective absorption into the bloodstream from the intestines. That is why another aim of this project will be to verify and increase the stability of the purified extracts and isolated acylated compounds by preparation of microencapsulated systems with controlled kinetics of the active substance release in simulated body fluids.

Summarizing, planned research will enable to obtain a multidimensional picture of the influence of the described compounds and their derivatives on the metabolism of cancer cells. The results of this project will help to develop knowledge about these compounds, providing a good introduction to further *in vivo* research and contributing to a better use of the health potential of natural betalain pigments which have a very high protective, therapeutic and chemopreventive potential.

Acylated betacyanins from *H. polyrhizus* were almost not tested, especially in terms of health applications and the influence of the acylation of the pigments on their bioactivities. We can also expect to obtain new, unknown betacyanins and derivatives which will open up research perspectives in the future. These facts are the main reason for choosing *H. polyrhizus* as an alternative source of betacyanins for this study. Thanks to the development of knowledge in this project, it will be possible to define the influence of the compound structural factors and their differences on the metabolic activity and cell viability. There are rare reports on microencapsulation of pure betalains and not many more reports on purified extracts. The proposed experiments will expand the state of knowledge about the microencapsulation process itself, especially in terms of its optimization, to achieve systems with the desired properties. Research focused on encapsulation will allow checking the potential of using coating substances to increase the stability of these betacyanins in simulated body fluids, and thus may constitute an introduction to *in vivo* research on increase the bioavailability of mentioned compounds.