POPULAR SCIENCE SUMMARY - AIM OF THE PROJECT, HYPOTHESIS, METHODOLOGY AND EFFECT ON SCIENCE

The aim of the project is to determine the possibility of conducting biofortification (enrichment) of lettuce (*Lactuca sativa* L.) with iodine with the use of its mineral (KIO_3) and organic forms, that is iodosalicylates (5-iodosalicylic /5-ISA/ and 3,5-diiodosalicylic /3,5-diISA/ acid), with determining the action of pure salicylic acid (SA) on the process. Additionally, an objective of the research is to trace the effect of vanadium on iodine uptake by plants. The project will examine the effects of the applied compounds (iodine and vanadium) on the growth, yield and chemical composition of plants. Another research objective is the analysis of the expression of genes related to root uptake, conversion and degradation of the tested compounds in plants. A further goal of the research work is to determine the health-promoting properties of biofortified lettuce as a functional foods and its influence on human gastric and colon carcinoma cell lines.

The plan encompasses scientific research related to introducing into plants new compounds, hitherto not applied in cultivation, which is a novel solution achieved by scientists of the University of Agriculture in Kraków. This relates to iodosalicylates, mineral and organic iodine compounds together with vanadium, as well as pure SA combined with mineral form of iodine. The research will allow to examine how the conversion of compounds introduced into plants affects the nutritional and health-promoting qualities of lettuce. The object of the research will be lettuce (*Lactuca sativa* L.), of the 'Melodion' variety, cultivated for two years in a hydroponic system **with a closed nutrient solution circulation** (an NFT system – Nutrient Film Technique), **and in a pot experiment**.

The research will be directed towards discovering the molecular aspects related to the mechanism of transformation of iodosalicylates and SA in plants as affected by vanadium application. As a result of the application of iodosalicylates there can be observed an increase of iodine stability in plants due to reduction of the methylation process (CH_3I volatilization), conditioned by the gene for S-adenosylmethionine-dependent halide/thiol methyltransferase. Additionally, the expression level of the gene encoding vHPO (vanadium-dependent haloperoxidases) responsible for the iodine transport mechanism will be investigated. The simultaneous application of SA to plants can increase or silence the activity of genes related to the conversion, degradation or *de novo* synthesis of SA, which will translate into increasing the resistance of plants to various abiotic and biotic stress eg. various pathogens. This applies, among others, to genes encoding salicylic acid 3-hydroxylase (S3H), responsible for SA catabolism. There will also be investigated the expression level of genes related to SA metabolism in plants as well as mitochondrial genes encoding alternative oxydase and glutathione peroxidase. The scope of research work conducted human carcinoma cell lines (Caco-2, SNU-1) covers issues relating to assessment of the functional quality of food and ensuring food safety. There exist indications that extracts from biofortified lettuce reduce the growth of cancer cells of the human digestive system. During the completing of the project, the influence of extracts from lettuce fortified with iodine (mineral and organic) on three different cell lines: human epithelial colon cancer cells (Caco-2), human epithelial gastric cancer cells (SNU-1) and human epithelial colon normal cells (FHC) will be analyzed including the determination of cell viability, proliferation and apoptotic activity. With the use of the Real-Time PCR technique, changes of the expression of genes related to cell cycle, cell proliferation and apoptosis will be determined. In order to study the activity mechanism of lettuce extracts, proteins participating in cell cycle and cellular stress, and of apoptotic proteins will be analyzed..

Justification for undertaking the research. The issue of iodine deficiency currently affects 30% of global human population. Supplementation of deficient mineral nutrients in food can be achieved through plant biofortification (enrichment) with the respective nutrients. Plant biofortification with mineral elements fulfils the requirements for functional food production. It has been proved to be highly cost-effective and efficient approach to counteract or alleviate the consequences of mineral nutrient deficiencies in people and animals. Iodine is an element which plays a vital role in a great number of physiological and biochemical processes in human and animal organisms. In many countries round the world, for many years iodine prophylaxis has been based on table salt iodization. Despite that, in many countries a permanent iodine deficiency in food is observed as the loss of this element from salt (from production to consumption) reaches up to 90%. Plants fortified with iodine can be an alternative source of this element in the human diet. Until now, in-depth scientific research has not been conducted on the effects of iodine compounds on plants, including iodosalicylates, nor was investigated the influence of vanadium on iodine uptake by higher plant. Conducting research on plant biofortification with iodine applied in mineral and organic forms is therefore susbtantiated. In previous studies it has been shown that extracts of lettuce plants enriched in mineral iodine (KI) may limit the growth of cancer cells Caco-2.