The main objective of project is to obtain materials with improved mechanical properties, improved hydrophobicity and thermal stability, which properties are preferred for use in the production of biodegradable packaging, based on potato starch esterified with unsaturated fatty acids in an enzyme catalysed reaction in the presence of an ionic liquid.

Global industry strives to reduce the pollution associated with processing of raw materials and production of new material. Are turning more and more attention to the use of pure and environmental friendly technologies. Is looking for a cheap, natural and biodegradable materials. One of them is starch - biodegradable and renewable polysaccharide. The packaging industry needs especially modified starches with more favorable processing properties than native starch. Strongly hydrophilic nature of the starch is a factor which severely limits the possibilities to use of this polysaccharide in the production of new material. Materials based on starch are generally very sensitive to external factors, primarily water and their properties largely depend on the ambient humidity. Starch has long been aroused interest as a raw material, which can replace a synthetic polymer or a potential component of the polymeric materials used in the production of biodegradable packaging. The addition of plasticizers or mixing with synthetic polymers do not produce the desired results because the starch showed very poor adhesion and miscibility with the hydrophobic synthetic polymers. Native starch usually does not form a continuous phase with these polymers, and the material has a limited tensile strength and breaking. This problem can be solved by chemical or biochemical modification, which is the main theme of the project. One of the most common modification is esterification with anhydrides or fatty acids. The esterification of the polysaccharide chain is an important procedure, which leads to increased hydrophobicity of native starch and to obtain products which have the improved or completely altered thermal properties and mechanical properties. The ester group introduced into the starch exhibit characteristics typical for the operation of internal plasticizers, and their efficiency increases with the length of the alkyl chain. In the reaction organic solvents are typically used to bring about a complete dissolution of the starch and increase the contact of the esterifying agents and polysaccharide. However, solvents used for decades in the processing of starch, like DMSO, DMF or pyridine, have a negative impact on the environment, thus reducing further the commercialization process of esterification of starch towards to obtain biodegradable materials for the packaging industry. The use of such organic solvents on an industrial scale is also expensive because it requires the use of high temperatures and long times of reaction.

The presented concept relates to the use of unsaturated fatty acids in the starch esterification or rich in these acids the waste vegetable oils like canola or high oleic sunflower oil, which may allow to conduct further modification and functionalization of esters - eg. by the addition to the double bond in the carbon chain (acyl residue) of acid. In addition the use waste vegetable oils as esterifying factors, could contribute to conduct proecological and consistent with the principles of sustainable development methods of synthesis. The present way for the synthesis of starch will not only allow to obtain a material with improved processing properties, but also allows to develop a method for disposal of a technologically used oils as waste products of the food industry. Another positive aspect is the use of an ionic liquid, which will eliminate more harmful classic solvents like DMSO, pyridine or DMF, typically used for the esterification of starch. The biocatalysts used in the esterification (fungal lipase) may increase the efficiency and effectiveness of ester synthesis. The planned in the process of heating in the microwave field can significantly reduce the time the esterification, whereby also compensate for the relatively high cost of the enzymes. The realization of presented project will also optimize the conditions for chemical esterification of potato starch, which is widely available in our climate.

The project provides the esterification of starch and identification of the obtained ester – determination of the degree of substitution of ester (DS), structural studies, the chemical and physical analyzes, including infrared spectroscopy (FTIR), and nuclear magnetic resonance (^{1}H NMR, ^{13}C NMR) spectroscopy, powder X-ray analysis (XRD), thermal analysis using a differential scanning calorimeter (TG/DTG/DSC) and observation using a scanning electron microscope. In order to determine the use of polymer materials on the basis of the esterified starch in the packaging industry it is planned to plasticization of the modified starch with mixer, film extrusion on a laboratory extruder and studies of extruded film in terms of mechanical strength, moisture absorptivity, impact resistance, biodegradability and hydrophobicity.