Pharmaceutical oils (bio-oils) are plant oils obtained using conservative methods of extraction and refining (e.g. cold pressing, supercritical CO_2 extraction, physical refining). They are obtained from plant materials characterized by a unique composition of both bioactive components and fatty acids. Fatty acids, in particular unsaturated ones, play an important role in ensuring the proper functioning of the human body by, i.a., taking part in tissue hormone synthesis, constituting cell membranes and participating in both transport and oxidation of cholesterol. In addition, they have a beneficial effect on the circulatory system, prevent obesity and diabetes, and display a strong anticarcinogenic effect consisting in the inhibition of cancer tissue proliferation and spreading. Unfortunately, despite beneficial effects on the human body, their relatively high share in bio-oils is a direct cause of low durability of these products.

Products of these processes (aldehydes, ketones, polymers, peroxides, etc.) are hazardous to human health – they cause damage to intracellular structures, inhibit the activity of many enzymes, have pro-carcinogenic and cytotoxic effects. Finally, they affect the consumer quality of food products, causing defects in their sensory traits and physicochemical properties. The rate of the adverse oxidative processes may be slowed down by the right choice of package and storage conditions (low temperature, no access of light, small volumes of the package) and by the addition of substances with antioxidative properties. Some researchers suggest that polar antioxidants better protect hydrophobic matrices than typical non-polar counterparts (like tocopherols) - the "polar paradox" theory. According to this theory the right place for antioxidant-unsaturated fatty acid oil is the interface between oil and water (each oil contains small amounts of water).

Recently, special attention has been paid to phenolic compounds as antioxidants. Current literature suggests that not only phenolic acids, but also their derivatives may be strong antioxidants used in the food industry, in particular in the oil industry. It seems that the use of vinyl derivatives of phenolic acids is more beneficial than their parent compounds, this is mainly due to their higher solubility in oil matrices. In complex multi-phase matrices, the ability of phenolic compounds to inhibit lipid oxidation depends not only on their chemical structure, but also on the constituents of the emulsion and their interaction with other chemical compounds. In fact, the phenolic compounds interact, for example, with emulsifiers that may be present in food emulsions in the aqueous phase or may be absorbed at the oil-water interface. The research carried out on emulsions showed that emulgators (i.e. lecithin) act mainly as synergists in increasing the antioxidant activity of phenolic compounds due to their metal chelating properties.

The research planned in the project is based on the latest knowledge on the antioxidant activity of phenolic compounds and the theory of "polar paradox". The first goal of the research is to acquire new knowledge on the interaction between water content in oils and the concentration of various phenolic acids derivatives (with different polarity) during the oxidation of lipids of model flaxseed oil. The second goal is about the effect of the addition of an emulsifier on the protective effect of phenolic acids derivatives on the oxidation of oils with different water content. The third objective of the proposed basic research is about the possibilities of selecting phenolic acids derivatives for oxidative stabilization of pharmaceutical oils (bio-oils) based on the oil composition, especially the water content.

In the I task of this project, the analysis of water content in various bio-oils is planned depending on the type of raw material and oxidation state, task II is based on the analysis of the effect of water content on the oxidation rate of model flaxseed oil, task III includes analysis of the effect of phenol compounds addition (4- vinylsyringol, 4-VS and 4-vinylguaiacol, 4-VQ) on the rate of oxidation of flaxseed oil with variuos water content, task IV provides for the addition of emulsifier (lecithin) to mixtures of flaxseed oil with different water content with addition of 4-VS and 4-VQ, task V is analysis of the influence of derivatives of phenolic acids with different polarity on the rate of oxidation of flaxseed oil with different water content, and task VI is a validation of the results obtained with the participation of various bio-oils.

The project is based on the use of storage test under natural (sunny and darkened place) and forced conditions (thermostat test). The water content will be determined using the set for water content analysis by Karl Fischer method (Metrohm, Herisau, Switzerland). The research material will be subjected to laboratory analysis, which will be include the basic quality characteristics: sensory assessment (color, consistency, clarity, taste, aroma), oxidative stability (induction time), acid value, peroxide value, and anisidine value, and contents of conjugated fatty acids (dienes and trienes). Detailed analysis of the research material composition will be include determination of the contents and composition of fatty acids and sterols (gas chromatography technique) as well as tocols, carotenoids, squalene and phenolic compounds (with high-performance liquid chromatography technique).