The prevalence of obesity, along with the accompanying co-morbidities collectively referred as the metabolic syndrome, increased to epidemic proportions. Thus, new nutritional strategies to reduce the syndrome are necessary. Preclinical and some human epidemiological studies report that omega-7 monounsaturated palmitoleic acid (POA, also known as 9-hexadecenoic acid, 16:1n–7) improves metabolic parameters that are impaired in type 2 diabetes mellitus (T2DM) and obesity. POA exists in two geometrical forms known as *cis*- and *trans*-palmitoleic acid. Dietary *cis*-POA is present in modest amounts in some plant and marine based foods, but it is particularly concentrated in sea buckthorn (*Hippophae sp.)* pulp oil where it accounts for up to 40% of fatty acids. *Trans*-POA is commonly found in dairy products derived from ruminant animals. In contrast to detrimental *trans*-fatty acids produced industrially through partial hydrogenation at high pressure and temperature, milk derived *trans*-POA has beneficial influence on human metabolism and is a biomarker of lower diabetes risk. However, so far, there is no direct comparison of biological activities evoked by *cis*- and *trans* isomers of POA.

On the other hand, a large number of human correlation studies suggests that increased concentration of blood POA is associated with T2DM, elevated markers of inflammation, cardiovascular disease, or hepatic steatosis. The controversial reports about the function of palmitoleate might depend on the levels of *cis*- and *trans*-POA isomers and as well the levels of food-derived and endogenously formed POA. One can hypothesize that excess of POA in cells may have negative impact and some molecular mechanisms are necessary for neutralization of this effect. Very recently *cis*-POA was shown to be unusually tightly bound to human plasma proteins, in contrast to other free fatty acids. The surprising biochemical behavior of plasma POA may be one of mechanisms of its neutralization. Moreover, there are several intracellular enzymes (desaturase, elongases and oxidative enzymes) which can catalyze mutual conversions of three fatty acids: palmitic, palmitoleic and vaccenic, and in this way regulate their final concentrations in cells and tissues. Activities of the enzymes are regulated by nuclear receptors (LXR, RXR, and PPARα) and other not well known factors.

Taking into account rising intake of functional food products and supplements based on sea buckthorn (SB) oil products one can hypothesize that it may become a part of dietary strategy to combat metabolic syndrome. However, biological effects of sea-buckthorn pulp oil observed under *in vivo* human and rodent studies are, so far, inconsistent. SB pulp oil contains many lipophilic and hydrophilic bioactive compounds other than POA (palmitic acid, linoleic acid, carotenoids, phytosterols and flavonoids) which can activate some nuclear receptors (LXR, RXR, PPARα) and, in this way, modulate biological activity of POA. One can suppose that POA and SB pulp oil significantly differ in activation of cellular signaling pathways and nuclear receptors responsible for level and activity of proteins regulating lipid and glucose metabolism.

Since dietary POA is primarily found in triacylglycerols (TAGs), in the present project we would like to recognize the biological activity of SB pulp oil preparations made of TAGs and their digested form as well as fatty acids-free preparations containing only unsaponifiable components. We will also utilize the technology developed by us to separate oleosomes (self-emulsifying lipid fraction) and various pulp oil preparations from sea buckthorn berries.

To sum up, the major goal of this project is to unravel the role of the dietary POA in ameliorating lipid and glucose homeostasis. The studies are designed to define different biological activities of *cis*- and *trans* POA isomers and decipher their safety (cytotoxicity) in intestinal, liver, pancreatic, and adipose cells. Moreover, we are planning to elucidate complex mechanisms whereby POA may manifest its health benefits, in particular activation of specific membrane and nuclear receptor pathways and identify factors which regulate POA levels in plasma and cells. The proposed experiments will also test the hypothesis that non-fatty acid bioactive components present in sea buckthorn pulp oil interfere with biological activity of POA. We hope that these data will allow to define the future recommendations how to improve human diet with POA-rich food.