Relative contribution of phospholipid:diacylglycerol acyltransferases (PDAT) and acyl-CoA:diacylglycerol acyltransferases (DGAT) in seed oil accumulation of selected plants

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The last step of plant triacylglycerols biosynthesis is catalysed by enzymes of DGAT type (acyl-CoA:diacylglycerol acyltransferases) and PDAT type (phospholipid:diacylglycerol acyltransferases). It has been recently demonstrated that these two enzymes together are responsible for the majority of the triacylglycerols formation in Arabidopsis seeds (1). However, the relative contribution of these classes of enzymes in the synthesis of TAG has not been established yet. In the presented work we measured the activity of both these enzymes in microsomal preparations of developing seeds of sunflower, safflower, crambe and high erucic acid rape; we also checked oil accumulation in these seeds.

Seeds at different stages of development were used for preparation of microsomal fractions and for lipid extraction. The microsomes were store at -80^{o}C prior to the enzymatic assays. Lipid extracts were either analysed immediately or stored for a few days at –20^{o}C. The rate of the acylation of sn-1-18:1-sn-2-[^{14}C]18:1-DAG into [^{14}C]TAG was regarded as a measure of PDAT activity. No DAG/DAG acyltransferases activity has been detected in any of the microsomal preparations. The rate of incorporation of the added [^{14}C]DAG into TAG in presence of added acyl-CoA was regarded as a measure of the combined activity of DGAT + PDAT.

The ratio of PDAT/DGAT activity differed considerably between the tested oil crops. The highest ratios were observed in microsomal preparations from safflower seeds. In the early stage of their development, PDAT activity was lower than DGAT's with 18:1-CoA as a substrate (ratio around 0,6) and higher than DGAT's with 18:2-CoA (ratio around 1,3). In the middle and later stages, PDAT activity was always higher than DGAT’s (with both tested substrates: 18:1-CoA and 18:2-CoA). In the sunflower seeds, DGAT activity dominated over PDAT activity. At the early stage of development PDAT/DGAT activity ratio was around 0,1 and in the late stage achieved a ratio of around 0,2 in case of 18:1-CoA as DGAT substrate. With 18:2-CoA the ratios were even lower. DGAT activity in microsomal preparations of rape and crambe seeds was strongly influenced by fatty acids in the acyl-CoA, however, in seeds of both plants the activity of DGAT dominated over the activity of PDAT.

1. Zhang M., Fan J., Taylor DC., Ohlrogge JB. (2009) Plant Cell. 21(12): 3885-901.