GENETICS OF SOYBEAN SEED LIPOXYGENASES AND LINOLENIC ACID CONTENT IN SEEDS OF THE SOYBEAN WILD ANCESTOR

Julián Mario Lenis

Dr. Kristin D. Bilyeu and Dr. J. Grover Shannon, Dissertation Supervisors

ABSTRACT

Soybean seeds, valuable feed and food resources, have high protein and oil contents, with a fairly balanced amino acid profile and abundant essential fatty acids (FA). Linolenic acid (18:3), an essential ω-3 type of FA, makes up to 8% of typical soybean seed oil. In humans, ω-3 FAs play a crucial role in brain function as well as normal growth and development. *Glycine soja* typically has twice as much 18:3 as soybean. However, very little is known about the genetic regulation of high 18:3 in *G. soja*. The role of microsomal *FAD2* and *FAD3* as well as *DGAT*, *PDAT* and *PDCT* genes in 18:3 accumulation in *G. soja* seeds was investigated. Structural and functional analyses of the genes were carried out. The relative greater contribution of PDAT in the final acylation step of triacylglycerol synthesis might be partially responsible for the higher 18:3 content in *G. soja* seeds. Also, the continuous distribution of phenotypes and large environmental influence indicate 18:3 is multigenic. Breeding for increased 18:3 seed content with *G. soja* as the donor has an impact on other traits of importance. In addition, 18:3 in seeds is usually oxidized by lipoxygenases, resulting in the development of undesirable flavor and aroma. Soybean seeds contain three lipoxygenases encoded by *Lox1*, *Lox2* and *Lox3*. Null alleles have been identified. Previous studies determined that a missense mutation rendered Lox2 inactive. The basis of either *lox1* or *lox3* mutation was not known. The genetic basis of *lox1* and *lox3* mutant alleles was determined, and molecular markers that allow efficient selection for *lox1, lox2* and *lox3* mutant alleles were developed.