The pancreatic beta cell (β cell) is solely responsible for insulin production and secretion and is crucial to the maintenance of glucose homeostasis. β cell health and function is compromised in diabetes mellitus (DM). Type 2 diabetes mellitus (T2DM), the most prevalent form of DM, is a worldwide epidemic; T2DM is correlated with obesity, insulin resistance, and dyslipidemia. Several studies suggest that diets rich in "omega-3" (n-3) polyunsaturated fatty acids (PUFA) can reduce insulin resistance and may protect against T2DM development by improving β cell function. Unfortunately, the most prevalent source of these PUFA are fish that are neither a sustainable resource nor readily available to most of the world’s people. Certain plant-based oils are rich in both n-3 and/or n-6 PUFA and may have similar health benefits to those of fish oil. These oils, however, have not yet been comprehensively tested with respect to reducing diabetes risk and affecting β cell physiology. The goals of this study entail comparing the effects of a fish oil-enriched diabetogenic diet with two distinct plant seed oil-enriched (echium and starflower oil) diets in both diabetes-prone and wild type mice with respect to (1) improving glucose homeostasis, (2) increasing β cell function, and (3) enhancing β cell mass. Since the bioactive PUFA composition varies between fish oil and each of the seed oil diets, it is anticipated that each treatment group may have distinct effects on β cell physiology, growth, and survival. It is hypothesized that echium and starflower seed oil may have beneficial effects comparable to or greater than those of fish oil (in the form of increased glucose uptake and greater insulin responses to elevated glucose levels, as well as through enhanced β cell function) while all three of these PUFA sources are expected to improve energy metabolism compared to the control.