

Evolution of heterotrophy: Genes needed for regulation of the acidity of pancreatic juice appeared recently in man evolution.

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The pancreas works as two glands with endocrine and exocrine functions. The exocrine function of the pancreas consists of the acinar cells that are responsible for synthesize and secrete digestive enzymes comprising the pancreatic juice. The digestive enzymes - namely amylases, proteases and lipases - are stored Zymogen granules. The stimulation of acinar cells by acetylcholine and cholecystokinin by the Parasympathetic nerve and the intestinal I-cells, respectively, triggers the generation of an intracellular Ca^{2+} signal cascade. This signalization culminates on the secretion of the enzymes in the zymogen granule. In general, the proteins related with the pancreas enzymatic secretion are associated with the zymogen granule migration and fusion on the acinar apical membrane, releasing the enzymes on the lumen, or adjusting the pH and ion equilibrium in the cell. We determined the Lowest Common Ancestor (LCA) for the genes on this system to investigate their origin along the evolution. The pancreas main secretive function is found in the acinar cells. In these cells there are proteins responsible for receiving the external stimulation from the secretagogues - M3, CCKAR - and for the pH regulation and the Ca^{2+} equilibrium - PLC, CD38/157, SOC - that have their origin in Bilateria. These proteins are involved on key processes such as the zymogen granule migration. Other proteins, remarkably some transmembrane transporters, are a recent acquisition of these cells emerging in more recent clade such as Euteleostomi, although some of them have ancient functions, such as SOC, ATP, NHE1 and AE2. Similarly, although the function for the secreted enzymes is rather ancient some of their sequences show a remarkably recent origin such as CEL in Euteleostomi and PLA2 in Amniota. Thus it is reasonable to suggest that the central components of the pancreatic secretion system emerged in Bilateria. The other type of cells found in the pancreas are the duct cells, whose main function is the secretion of bicarbonate, which neutralize the acidity of gastric contents. Several of the proteins found in these cells have more recent origins, in clades such as Gnathostomata, Euteleostomi and Dipnotetrapodomorpha. Although the function of the duct cells are not critic for the digestive process, they are essential for the occurrence of this process, otherwise the pancreatic juice would digest the intestine itself. Thus, we conclude that this important gland, deeply associated with the heterotrophy needs recent biological functions for its systemic functioning, originated between the clades Bilateria and Euarchontoglires.