



**Supplementary Figure S9. Proposed catalytic mechanism of BOS.** Asp166 increases the negative charge of His162 through deprotonation. His162 then acts as a general base that obstructs a proton from the  $\beta$ -amine group of L-DAPA (blue). The resulting nucleophile attacks the carbonyl carbon of the thioester moiety of oxalyl-CoA (red), forming  $\beta$ -ODAP and releasing CoA. Wavy lines depict the links of the two amino acids to the protein backbone chain. The figure was generated using ChemDraw version 16.0.1.4