Puttindg equation (1) & equation (3) in the equation

$$\lim_{x \to 0} \left(\frac{a^x - 1}{x} \right) = \lim_{x \to 0} \left(\frac{y}{\log_a(1+y)} \right) = \lim_{x \to 0} \left(\frac{\left(\frac{1}{y}\right)(y)}{\left(\frac{1}{y}\right)\log_a(1+y)} \right)$$
$$= \lim_{x \to 0} \left(\frac{1}{\log_a(1+y)^{\frac{1}{y}}} \right)$$