We prove the transcendence results for the infinite product $\prod_{k=0}^{\infty} \frac{E_k(\alpha^{r^k})}{F_k(\alpha^{r^k})}$, where $r \geq 2$ is an integer, $E_k(x)$ and $F_k(x)$ are polynomials for every $k \geq 0$, and α is an algebraic number. As applications, we give necessary and sufficient conditions for transcendence of $\prod_{k=0}^{\infty}(1 + \frac{a_k}{F_{r^k}})$ and $\prod_{k=0}^{\infty}(1 + \frac{a_k}{L_{r^k}})$, where F_n and L_n are the $n-$th Fibonacci number and the $n-$th Lucas number respectively, and $\{a_k\}_{k\geq 0}$ is a sequence of algebraic numbers with $\log ||a_k|| = o(r^k)$.