Forskolin is a promising medicinal compound belonging to the plethora of specialized plant metabolites that constitutes a rich source of bioactive high-value compounds. A major obstacle for exploitation of plant metabolites is that they often are produced in low amounts and in plants difficult to cultivate. This may result in insufficient and unreliable supply leading to fluctuating and high sales prices. Hence, substantial efforts and resources have been invested in developing sustainable and reliable supply routes based on microbial cell factories. Here, we report microbial synthesis of (13R)-manoyl oxide, a proposed intermediate in the biosynthesis of forskolin and other medically important labdane-type terpenoids. Process optimization enabled synthesis of enantiomerically pure (13R)-manoyl oxide as the sole metabolite providing a pure compound in just two steps with a yield of 10 mg/l. The work presented here demonstrates the value of a standardized bioengineering pipeline and the large potential of microbial cell factories as sources for sustainable synthesis of complex biochemicals.