Catalytic Asymmetric Synthesis of the \textit{endo}-6-Aryl-8-oxabicyclo[3.2.1]oct-3-en-2-one Natural Product from \textit{Ligusticum chuanxing} via 1,3-Dipolar Cycloaddition of a Formyl-Derived Carbonyl Ylide Using Rh\textsubscript{2}(S-TCPTTL)\textsubscript{4}

\textbf{Synthesis of endo-6-Aryl-8-oxabicyclo[3.2.1]oct-3-en-2-one}

\begin{equation}
\text{A} \xrightarrow{\text{3 steps}} \text{B} \xrightarrow{\text{C (1 mol\%)}} \text{D}
\end{equation}

\begin{equation}
\text{E} \xrightarrow{\text{H\textsubscript{2}, Pd/C, MeOH}} 73\%, \text{er} = 97.5:2.5
\end{equation}

\begin{equation}
\text{F} \xrightarrow{\text{1. LiAlH\textsubscript{4}, THF}} \xrightarrow{\text{2. TBDPSCl, imidazole, DMF}} 85\%
\end{equation}

\begin{equation}
\text{G} \xrightarrow{\text{1. \text{LIAH}, THF}} \xrightarrow{\text{2. TBDPSCI, imidazole, DMF}} 74\%
\end{equation}

\begin{equation}
\text{H} \xrightarrow{\text{1. MnO\textsubscript{2}, CH\textsubscript{2}Cl\textsubscript{2}}} \xrightarrow{\text{2. TBAF, THF}} 61\%
\end{equation}

\begin{equation}
\text{I} \xrightarrow{\text{1. MnO\textsubscript{2}, CH\textsubscript{2}Cl\textsubscript{2}}} \xrightarrow{\text{2. TBAF, THF}} 99%
\end{equation}

\textbf{Significance:} This is the first example of an enantioselective 1,3-dipolar cycloaddition of a cyclic formyl carbonyl ylide. This methodology was successfully applied to the synthesis of \textit{endo}-6-aryl-8-oxabicyclo[3.2.1]oct-3-en-2-one, which was isolated from \textit{Ligusticum chuanxing} Hort., a traditional Chinese medicine used to promote blood circulation.

\textbf{Comment:} The enantioselective 1,3-dipolar cycloaddition proceeds with impressive er (97.5:2.5) to form E. The reduced product F could then be recrystallized and the er upgraded to 99.5:0.5. The circular dichroism of the natural product differed from the synthetic sample, leading the authors to speculate that the natural product may be biosynthesized in racemic form.