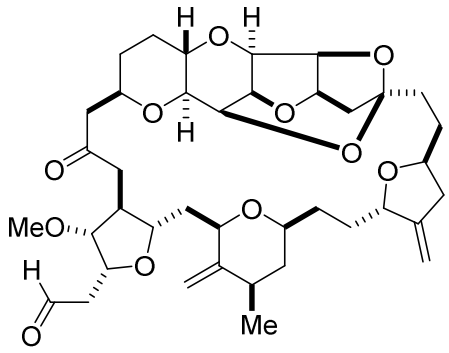
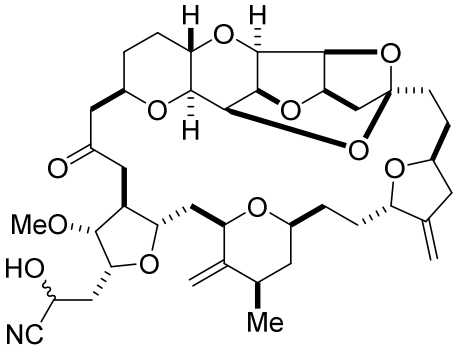


(**II**)

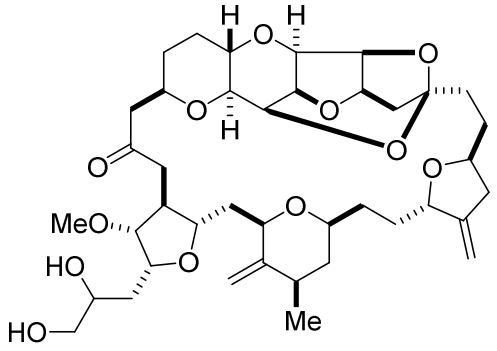
with a cyanide salt, e.g., potassium cyanide, under conditions to form a cyanohydrin according to formula (**IV**):



(**IV**)

and reducing the cyanohydrin according to formula (**IV**) with a reducing agent to form the compound according to formula (**I**). In some examples, the reducing agent is a silane, such as triethylsilane, used, for example, in combination with a Lewis acid, such as tris(perfluorophenyl)borane. In some examples, the cyanide salt contains carbon-11 (e.g., $K^{11}CN$).

In some examples, the aldehyde is synthesized by reacting a diol according to formula (**V**):



(**V**)

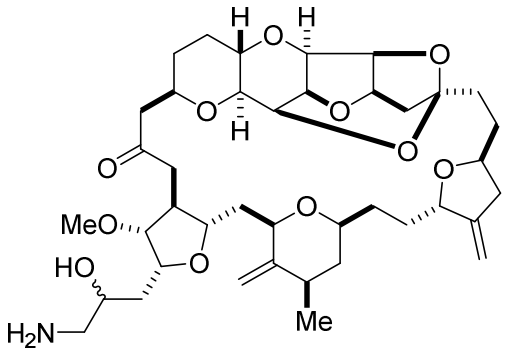
with an oxidizing agent, e.g., sodium periodate.

In some examples, any of the methods may further include salifying the compound of formula (**I**) to produce a pharmaceutically acceptable salt thereof, e.g., the mesylate salt. The methods may also include separating the diastereomers of the compound of formula (**I**) to isolate eribulin, or a pharmaceutically acceptable salt thereof, e.g., the mesylate salt.

In another example, the disclosure features a compound according to formula (**II**):

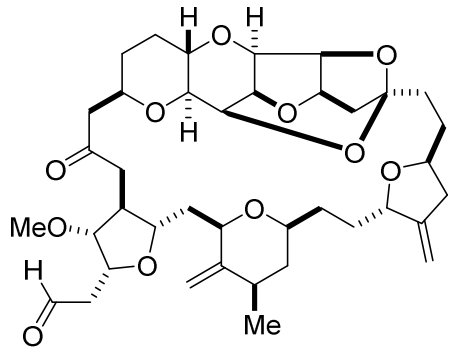
CLAIMS

1. A method of synthesizing a compound according to formula (**I**):



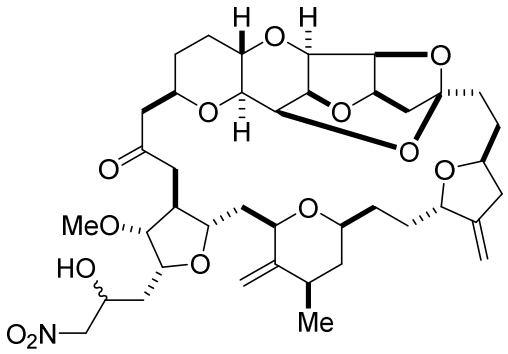
(**I**),

or a pharmaceutically acceptable salt thereof, the method comprising reacting an aldehyde according to formula (**II**):



(**II**)

with nitromethane under Henry reaction conditions to form a compound according to formula (**III**):



(**III**);

and reducing the compound according to formula (**III**) with a reducing agent to form the compound according to formula (**I**).

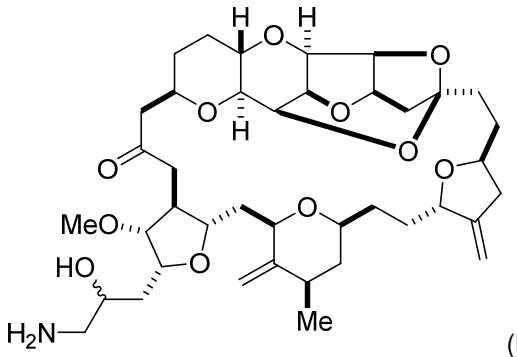
2. The method of claim 1, further comprising adding a base to a mixture comprising the aldehyde and the nitromethane.

3. The method of claim 2, wherein the base is sodium hydroxide.

4. The method of any one of claims 1-3, wherein the reducing agent is a lanthanide salt.

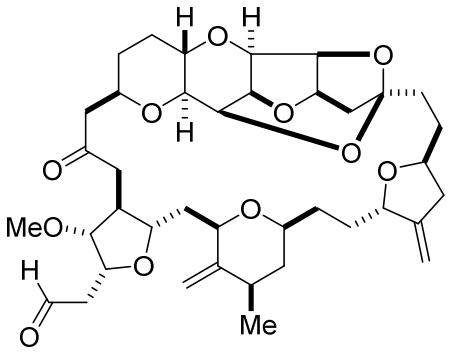
5. The method of claim 4, wherein the lanthanide salt is samarium (II) iodide.

6. A method of synthesizing a compound according to formula (**I**):



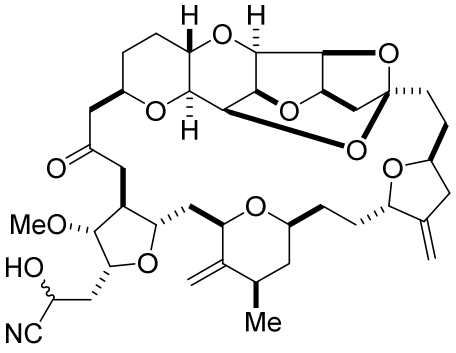
(**I**),

or a pharmaceutically acceptable salt thereof, the method comprising reacting an aldehyde according to formula (**II**):



(**II**)

with a cyanide salt under conditions to form a cyanohydrin according to formula (**IV**):



(**IV**);

and reducing the cyanohydrin according to formula (**IV**) with a reducing agent to form the compound according to formula (**I**).

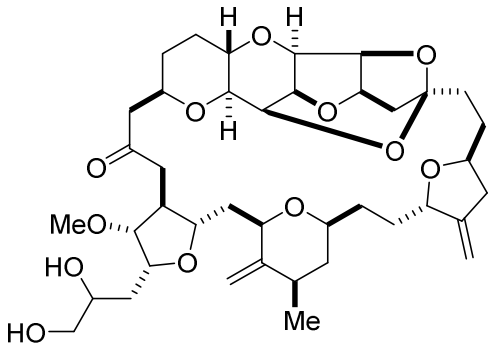
7. The method of claim 6, wherein the cyanide salt is potassium cyanide.

8. The method of claim 6 or 7, wherein the reducing agent is diethylsilane or triethylsilane.

9. The method of any one of claims 6-8, further comprising adding a Lewis acid to a mixture of the cyanohydrin and the reducing agent.

10. The method of claim 9, wherein the Lewis acid is tris(perfluorophenyl)borane.

11. The method of any one of claims 1-10, further comprising synthesizing the aldehyde according to formula (**II**) by reacting a diol according to formula (**V**):



(**V**)

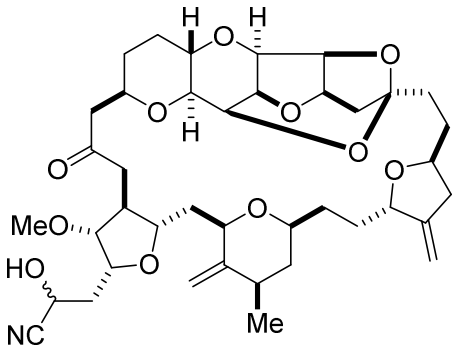
with an oxidizing agent to form the aldehyde.

12. The method of claim 11, wherein the oxidizing agent is sodium periodate.

13. The method of any one of claims 1-12, further comprising salifying the compound of formula (**I**) to produce a pharmaceutically acceptable salt thereof.

14. The method of claim 13, wherein the pharmaceutically acceptable salt is a mesylate salt.

15. A compound according to formula (**IV**):



(**IV**).