PROCESS FOR THE PRODUCTION OF SUGAR ESTERS

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ABSTRACT OF THE DISCLOSURE

Transesterification of sugar with a fatty acid ester in the presence of a basic transesterification catalyst at temperature and pressure conditions designed to distill off alcohol by-product and thereby eliminate the need of an inert solvent reaction medium and its inherent disad- 15 vantages.

BACKGROUND OF THE INVENTION

This invention relates to an improvement in the produc- 20 tion of sugar esters via transesterification of sugars with fatty acid esters. The conventional prior art trans- 25 esterification process is carried out in the presence of an inert solvent reaction medium such as dimethyl form- 30 amide or dimethyl sulfoxide in the presence of any one of the well known basic transesterification catalysts. This prior art process suffers from the disadvantage of requiring the use of specialized solvents which are slightly toxic, as well as the necessity of solvent removal after comple- 35 tion of the reaction. Moreover, such a process requires the use of a three fold excess of sugar reactant in order to obtain sugar monoesters of commercial significance.

The present invention is based on the unexpected dis- 40 covery that it is possible to eliminate the prior art re- quired inert reaction medium under conditions which do not require the use of a three fold excess of sugar re- 45 actant and yet obtain a high yield of commercially sig- nificant sugar monoesters.

SUMMARY OF THE INVENTION

The process of the present invention for producing sugar esters by transesterification of a sugar with a fatty acid ester comprises heating said reactants in the pre- 50 sence of a catalytic amount of a basic transesterification catalyst under pressure and temperature conditions which eliminate alcohol by-product and produce readily recover- able sugar ester. In general, from about 0.5 to about 3 mos of sugar reactant are employed per mol of fatty acid ester and the temperature involves ranges from 100 to 170° C. at a pressure of from about 0.1 to about 500 mm. Hg.

DETAILED DESCRIPTION OF THE INVENTION

In accordance with the transesterification process of the present invention, it is carried out in the presence of the usual or known basic transesterification catalyst at a temperature of from 100 to 170° C. and at a pressure within the range of from about 0.1 to about 500 mm. Hg, the choice of the temperature employed dictating a pressure within said range which distills off resultant al- cohol by-product. The preferred transesterification temperature is from 130 to 160° C. and the preferred pressure is from 1 to 15 mm. Hg. The reaction time is not a critical aspect of the pres- ent invention other than it is determinative of percentage yields obtained. In general, it ranges from 3 to 24 hours, most reaction conditions having run their course in from about 5 to 10 hours.

Although all sugars are susceptible to the transesterifi- ization process of the instant invention, disaccharides and trisaccharides are generally preferred since they yield the more commercially significant products. Sucrose and tre- 55 halose typify the disaccharides and raffinose is a typical trisaccharide.

The preferred fatty acid esters for the process of the present invention include the lower alkyl esters of satu- rated or unsaturated fatty acids or hydroxy fatty acids having 12–18 carbon atoms. Examples of particularly 60 important fatty acid esters include the methyl, ethyl, propyl, hydroxypropyl, and glycerol esters of lauric, my- ristic, palmitic, stearic, hydroxy stearic, oleic, ricinene, linoleic and ricinoleic. Additionally, the fatty acid esters present in tallow, coconut oil and soybean oil are of major interest from the standpoint of product utility.

Any of the conventional basic transesterification cata- 65 lysts used in the prior art process may also be employed in the present process. In general, catalytic amounts there- of range from about 0.5 to by weight based on the amount of fatty acid ester reactant. Typical preferred catalysts include the alkali metal salts of water, alkali metal hydroxides and alkali metal alcohohes of lower alkanols. The preferred basic catalyst is potassium carbonate.

The molar ratio of sugar to fatty acid ester employed in the present invention ranges between about 0.5 and 3 mos of sugar to 1 mol of fatty acid ester. The preferred ratio is from about 0.8 to about 1.2 mos of sugar per mol of fatty acid ester employed.

Recovery of the product of the instant invention is in accordance with conventional techniques of the prior art. It is helpful to boil the crude reaction product in methyl- 70 ethyl ketone, chloroform or acetone in the presence of a small amount of acid for the purpose of converting the fatty acid salt by-products to fatty acids. Thereafter, un- reacted sugar may be removed from the hot solution by suction filtration. Upon further cooling, the desired sugar ester product separates out as a solid from the filtrate.

The sugar ester product of the present invention com- 75 prises a mixture of esters. Depending upon the choice of re- actant ratio, fatty acid ester identity and the catalyst employed, these mixtures comprise mono- and diesters in varying proportions, the monoesters being the predom- inant product present. Depending upon the choice of re- 80 actants, ratios thereof and other reaction conditions, the yields obtained, based on the monoester, range from about 60 to 90% of theory.

As is known by those in the art, sugar esters of the type produced by the present invention are useful as biologically decomposable emulsifiers in food processing, the pharmaceutical industry and in cosmetics.

The following examples are for the purpose of illus- trating the present invention but are not limiting to the scope thereof. The percentages referred to therein are by weight and the temperatures are in degrees centigrade.

EXAMPLE 1

34.2 g. (0.1 mol) sucrose, 29.9 g. (0.1 mol) methyl stearate and 4.5 g. potassium carbonate are heated with stirring at 140 to 145°/15 mm. Hg, with about 3 g. methanol distilling off during the course of 8 hours.

The resultant reaction mixture which contains, apart from sugar stearate, unreacted sugar, methyl stearate, potassium carbonate and potassium stearate, is boiled with 200 cc. methyl ethyl ketone after the addition of 4 cc. glacial acetic acid (in order to convert potassium stearate into stearic acid), and while hot, undissolved sugar and potassium acetate are filtered off with suction. When cooling down, sugar stearate in the form of a light brown powder precipitates from the filtrate. Yield: 42 g. ( =69% of the theoretical referred to sucrose monostearate).
EXAMPLE 4
34.2 g. (0.1 mol) sucrose, 34.3 g. (0.1 mol) 1,2-propanediol monostearate and 4.5 g. potassium carbonate are heated with stirring at 140–145°/1 mm. Hg. About 7.5 cc. 1,2-propanediol distills off in the course of 8 hours. After working up as described in Example 1, 45.4 g. sugar stearate (74.5% of the theoretical referred to sucrose mono-stearate) having a saponification value of 103 are obtained.

If the 1,2-propanediol monostearate of this example is replaced with 0.1 mol 1,2-propanediol monooleate (43.1 g.), a sucrose olate having similar properties is obtained.

What is claimed is:

1. A process for producing sugar esters by transesterification of a sugar with a fatty acid ester which comprises heating a mixture consisting of a catalytic amount of a basic transesterification catalyst, from about 0.5 to about 3 mols of a sugar selected from the group consisting of sucrose, trehalose and raffinose and 1 mol of a fatty acid ester which is a lower alkyl ester of a saturated or unsaturated fatty acid or hydroxy fatty acid having 12 to 18 carbon atoms at a temperature of from 100 to 170° C. and at a pressure within the range of from about 0.1 to about 500 mm. Hg to distill off resulting alcohol byproduct and recovering resulting sugar ester.

2. The process of claim 1 wherein from about 0.8 to about 1.2 mols of sugar to 1 mol of fatty acid ester are employed.

3. The process of claim 2 wherein said heating is conducted for from about 3 to about 24 hours.

4. The process of claim 1 wherein said sugar is sucrose, said fatty acid ester is methyl stearate, methyl laurate or 1,2-propanediol monostearate and said catalyst is potassium carbonate.

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