究STUDY ON ENZYMATIC SYNTHESIS OF METHYL GLUCOSIDE ESTERS BY LIPASE

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ABSTRACT

SUGAR ESTER USED IN PHARMACEUTICAL, DETERGENT, COSMETIC, FOOD INDUSTRIES. AT PRESENT, SUGAR ESTERS FOR CHEMICAL SYNTHESIS ARE COMMERCIALLY AVAILABLE. HOWEVER, THE PROCESS REQUIRE HIGH TEMPERATURE AND LONG TIME FOR CHEMICAL SYNTHESIS. IT MAY CAUSE LIPIDS DETERIORATION AND UNWANTED PRODUCTS. LIPASE SYNTHESIS SUGAR ESTERS UNDER MILD REACTION. IN THIS STUDY, 0.1 M METHYL GLUCOSIDE ESTERIFICATION IN ORGANIC SOLVENT WITH LAURIC ACID. EFFECT OF DIFFERENT REACTION TIME (6-24 H), TEMPERATURE (30-50 oC), AND METHYL GLUCOSE TO LAURIC ACID MOLAR RATIO (1:2-1:6) ON THE ACID INCORPORATION RATIO OF METHYL GLUCOSE ESTER, CATALYZED BY LIPASE AY, G, PS AND IM77. LIPASE CATALYZED IN ORGANIC SYSTEM, BUT ORGANIC SOLVENTS AND FATTY ACID ATTACK TO LIPASE WHICH EFFECTED TO INACTIVE. IF USED IMMOBILIZED LIPASE WOULD NOT BE EFFECTED. ACID INCORPORATION OF METHYL GLUCOSIDE ESTERS EFFECTED TO SUBSTRATES MOLAR RATIO IN THIS STUDY. IMMOBILIZED LIPASE IM77 MORE ACTIVITY AND STABLE THAN THE OTHER LIPASE. RESPONSE SURFACE METHODOLOGY (RSM) AND 5-LEVEL- 4-FACTOR CENTRAL COMPOSITE ROTATABLE DESIGN, CCRD WERE USED TO EVALUATE THE EFFECT OF SYNTHESIS PARAMETERS, REACTION TIME (4-20 H), TEMPERATURE (25-65 oC), METHYL GLUCOSE TO LAURIC ACID MOLAR RATIO (1：2-1：6), AND ENZYME AMOUNT (10-50%). BASED ON THE RIDGE MAX ANALYSIS, OPTIMUM CONDITION WERE：REACTION TIME 8 H, TEMPERATURE 44.5 oC, SUBSTRATE MOLAR RATIO 1：3.1, ENZYME AMOUNT 15%, AND ACID INCORPORATION RATIO 2.48 ± 0.56 BY LIPASE IM77.

Keywords : LIPASE, METHYL GLUCOSIDE ESTERS, OPTIMUM, RESPONSE SURFACE METHODOLOGY, CENTRAL COMPOSITE ROTATABLE DESIGN.

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REFERENCES

1.江文德。1999。脂肪脢在油脂加工的應用。食品工業月刊。第31卷第7期。10-19。 2.張為憲、張基郁。1995。第六章 酵素。食品化學。172-211。 3.楊宗熙。1998。蔗糖酯的特性與應用。食品工業月刊。第30卷第7期。11-18。 4.AKOH C. C. 1994. ENZYMATIC SYNTHESIS OF ACETYLATED GLUCOSE FATTY ACID ESTERS IN ORGANIC SOLVENT. J. AM. OIL CHEM. SOC. 71 : 319-323. 5.AKOH C. C. 1998. LIPID BIOTECHNOLOGY. IN " FOOD LIPIDS : CHEMISTRY, NUTRITION, AND BIOT -ECHNOLOGY. " EDITED BY C.C. AKOH AND D. B. MIN, MERCEL DEKKER, NEW YORK. 589-640. 6.AKOH C. C., AND MUTUA L. N. 1993. SYNTHESIS OF ALKYL GLYCOSIDE FATTY ACID ESTERS IN NON -AQUEOUS MEDIA BY CANDIDA SP. LIPASE. J. AM. OIL CHEM. SOC. 70 : 43-46. 7.AKOH C.C. AND SWANSON B. G., 1989.SYNTHESIS AND PROPERTIES OF ALKYL GLYCOSIDE AND STACH -YOSE FATTY ACID POLYESTERS. J. AM. OIL CHEM. SOC. 66 : 1295-1301. 8.BHATTACHARYYA D. K., AND CHATTERJEE T. 1998. SYNTHESIS OF TERPENE ESTERS BY AN IMMOBILI -ZED LIPASE IN A SOLVENT-FREE SYSTEM. BIOTECHNOL. LETT. 20 : 865-868. 9.BOX G. E. P., AND DRAPER N. R. 1987. IN EMPIRICAL MODEL-BUILDING AND RESPONSE SURFACES. WILEY : NEW YORK. 10.BOX G. E. P., AND WILSON K. B. 1951. ON THE EXPERIMENTAL ATTAINMENT OPTIMUM CONDITIONS. J. ROY. STATIST. SOC. B13 : 1-45. 11.DUCRET A., GIROUX A., TRANI M., AND LORTIE R. 1995.

CHARACTERIZATION OF ENZYMATICALLY PREPARED BIOSURFACTANTS. J. AM. OIL CHEM. SOC. 73 : 109-113. 12.FERRER M., CRUCES M. A., PLOU F. J., BERNABE M., AND BALLESTEROS A. 2000. A SIMPLE PROC -EDURE FOR THE REGIOSELECTIVE SYNTHESIS OF FATTY ACID ESTERS OF MALTOSE, LEUCROSE, MALT -OTRIOSE AND N-DODECYL MALTOSIDES. TETRAHEDRON. 56 : 4053-4061. 13.FREGAPANE G., SARNEY D. B., GREENBERG S. G., KNIGHT D. J., AND VULFSON E. N. 1994. ENZY -MATIC SYNTHESIS OF MONOSACCHARIDE FATTY ACID ESTERS AND THEIR COMPARISON WITH CONVENTI -ONAL PRODUCTS. J. AM. OIL CHEM. SOC. 71 : 87-91. 14.GHOUL M., ISMAIL A., AND SOULTANI S. 1998. OPTIMIZATION OF THE ENZYMATIC SYNTHESIS OF BUTYL GLUCOSIDE USING RESPONSE SURFACE METHODOLOGY. BIOTCHNOL. PROG. 14 : 874-878. 15.GOTO M., KAMIYA N., MIYATA M., AND NAKASHIO F. 1994. ENZYMATIC ESTERIFICATION BY SURFA -CTANT-COATED LIPASE IN ORGANIC MEDIA. BIOTCHNOL. PROG. 10 : 263-268. 16.GRIFFIN W. C. 1965. EMULSIONS. IN KIRK-OTHMER ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. VOL. 8, 2ND ED. JOHN WILEY & SONS, NEW YORK. 117-154. 17.HAYES D. G., AND ZHANG X. 1999. INCREASED RATE OF LIPASE-CATALYZED SACCHARIDE-FATTY ACI -D ESTERIFICATION BY CONTROL OF REACTION MEDIUM. J. AM. OIL CHEM. SOC. 76 : 1495-1500. 18.HIMMELBLAU D. M. 1970. PROCESS ANALYSIS BY STATISTICAL METHODS. JOHN WILEY AND SONS, NEW YORK. 230-292. 19.HUANG K. H., AND AKOH C. C. 1996. OPTIMIZATION AND SCALE-UP OF ENZYMATIC SYNTHESIS OF STRUCTURED LIPID USING RSM. J. FOOD SOC. 61 : 137-141. 20.JAEGER K. E., RANSAC S., DIJKSTRA B. W., COLSOR C., AND MISSET O. 1994. BACTERIAL LIPAS -ES. FEM MICROBIOL. REV. 15 : 29-63. 21.JANSSEN A. E. M., KLABBERS C., FRANSSEN M. C. R., AND RIET K. V. 1991. ENZYMATIC SYNTHE -SIS OF CARBOHYDRATE ESTERS IN 2-PYRROLIDONE. ENZYME MICROB. TECHNOL. 13 : 565-572. 22.KARRA-CHAABOUNI M., PULVIN S., TOURAUD D., AND THOMAS D. 1998. PARAMETERS AFFECTING THE SYNTHESIS OF GERANYL BUTYRATE BY ESTERASE 30,000 FROM MUCOR MIEHEI. J. AM. OIL CHEM. SOC. 75 : 1201-1206. 23.KRIS-ETHERTON P. M., AND NICOLOSI R. J. 1995. TRANS FATTY ACID AND CORONARY HEART DISEA -SE RISK, EDITED BY P.M. KRIS-ETHERTON AND R. NICOLOSI, ILSI PRESS, WASHINGTON DC, P.17. 24.NAKAMURA S. 1997. USING SUCROSE ESTERS AS FOOD ADDITIVES. INFORM. 8 : 866-874. 25.OGUNTIMEIN G. B., ERDMANN H., AND SCHMID R. D. 1993. LIPASE CATALYSED SYNTHESIS OF SUGA -R ESTER IN ORGANIC SOLVENTS. BIOTECHNOL. LETT. 15 : 175-180. 26.OOSTEROM M. W., RANTWIJK F., AND SHELDON R. A. 1996. REGIOSELECTIVE ACYLATION OF DISACC -HARIDES IN THE TERT-BUTYL ALCOHOL CATALYZED CANDIDA ANTARCTICA LIPASE. BIOTECHNOL. BIO -ENG. 49 : 328-333. 27.OTERO C., ARCOS J. A., AND BERNABE M. 1998. QUANTITATIVE ENZYMATIC PRODUCTION OF 6-O-AC -YLGLUCOSE ESTERS. BIOTECHNOL. BIOENG. 57 : 505-509. 28.OTTO R. T.,BORNSCHEUER U.T., SYLDATK C., AND SCHMID R. D. 1998. LIPASE-CATALYZED SYNTHE -SIS OF ARYLALIPHATIC ESTERS OF B -D(+)-GLUCOSE, N-ALKYL- AND ARYLGLUCOSIDES AND CHARAC -TERIZATION OF THEIR SURFACTANT PROPERTIES. J. BIOTECHNOL. 64 : 231-237. 29.SCHMID R. D., YAN Y., BORNSCHEUER U. T., AND CAO L. 1999. LIPASE-CATALYZED SOLID-PHASE SYNTHESIS OF SUGAR FATTY ACID ESTERS REMONAL OF BUPRODUCTS BY AZEOTROPIC DISTILLATION. MICROB. TECHNOL. 25 : 725-728. 30.SHIEH C. J., AKOH C. C., AND KOEHLER P. E. 1995. FOUR-FACTOR RESPONSE SURFACE OPTIMIZA -TION OF THE ENZYMATIC MODIFICATION OF TRIOLIN TO STRUCTURE LIPIDS. J. AM. OIL CHEM. SOC. 72 : 619-623. 31.TSUZUKI W., KITAMURA Y., SUZUKI T., AND KOBAYASHI S. 1998. SYNTHESIS OF SUGAR FATTY AC -ID ESTERS BY MODIFIED LIPASE. BIOTECHNOL. BIOENG. 64 : 267-271. 32.VILLENEUVE P., AND FOGLIA T. A. 1997. LIPASE SPECIFICITIES : POTENTIAL APPLICATION IN LIPID BIOCONVERSIONS. INFORM. 8 : 640-651. 33.VULFSON E. N. 1998. ENZYMATIC SYNTHESIS OF SURFACTANTS, IN NOVEL SURFACTANTS : PREPARA -TION, APPLICATIONS, AND BIODEGRADABILITY, SURFACTANT SCIENCE SERIES. EDITED BY K. HOLM -BERG, MARCEL DEKKER, NEW YORK. 74 : 279-300. 34.WILLIS W. M. AND MARANGONI A. G. 1998. ENZYMATIC INTERESTERIFICATION. IN" FOOD LIPIDS : CHEMISTRY, NUTRITION, AND BIOTECHNOLOGY. " ED. C. C. AKOH AND D. B. MIN, MARCEL DEKKER, NEW YORK. 665-698. 35.ZIMMERMANN W., DEGN P., PEDERSEN L. H., AND DUUS J. O. 1999. LIPASE-CATALYSED SYNTHESI -S OF GLUCOSE FATTY ACID ESTERS IN TERT-BUTANOL. BIOTECHNOL. LETT. 21 : 275-280.