以脂解酵素合成甲基葡萄糖酯之研究

朱、謝淳仁,張德明

E-mail: 9018626@mail.dyu.edu.tw

摘 要

糖酯可應用於清潔劑、化妝品、醫藥及食品工業等。目前為止，糖酯以化學法合成為主，但以化學法合成需高溫長時間下進行，容易造成油脂的劣變、產生不必要的副產物以及導致還原糖焦糖化；若將還原糖的C-1烷化，成為非還原性且反應性低的糖類後進行反應，則可避免上述的情形發生；此外，再配合酵素法去進行反應，其反應條件溫和、不會產生不要的副產物且易於純化而得到糖酯。 因此本研究將0.1 M甲基葡萄糖在有機溶劑環境下與月桂酸進行反應，探討不同酵素 (LIPASE AY、G、PS 及 IM77)與反應參數 (反應時間6-24 H、合成溫度30-50 oC及甲基葡萄糖與月桂酸莫耳比1：2 - 1：6) 以一對一的實驗方式 (固定其中兩個反應參數，對另一個反應參數做變動) 對於甲基葡萄糖酯中酸之合併率之影響。結果發現基質莫耳比對於甲基葡萄糖酯中酸之合併率影響最大，固定化脂解酵素IM77在本實驗之反應條件下最具活性和安定性。 最後利用反應曲面法 (RESPONSE SURFSCE METHODOLOGY, RSM) 及五階層四變數之中心混成實驗設計 (CENTRAL COMPOSITE ROTATABLE DESIGN, CCRD) 評估反應參數，分別為反應時間 (4-20 H)、合成溫度 (25-65 oC)、甲基葡萄糖與月桂酸莫耳比 (1：2-1：6) 及酵素用量 (10-50%)，藉由SIGMA PLOT之等高線圖 (CONTOUR PLOTS) 繪出脂解酵素IM77之最佳酸合併率為：合成溫度44.5 oC、反應時間8 H、基質莫耳比1：3.1及酵素用量15%，酸合併率達到2.48 ± 0.56。

關鍵詞 : 脂解酵素、甲基葡萄糖酯、最優化、反應曲面法、中心混成實驗設計

目錄

參考文獻

1.江文德。1999。脂肪胺在油脂加工的應用。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.