1,3-二辛酸-2-棕櫚酸甘油酯特化油脂之最優化研究

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摘 要

本研究擬採用sn-1,3的特定位脂解酵素IM77 (LypozymeR IM77)，以單一步驟之轉酯化酸解反應(transesterification acidolysis)來催化三棕櫚酸 (tripalmitin)與辛酸(caprylic acid)，以合成1,3-二辛酸-2-棕櫚酸甘油酯(1,3-dicapryloyl-2-palmitoyl-sn-glycerol)，此為適合早產兒吸收的人類母乳脂質替代品(human milk fat replacer; HMF replacer)，並利用三階層四變數(three-level-four-factor)之中心混層實驗設計 (central composite rotatable design; CCRD)與反應曲面法(response surface methodology; RSM)來探討反應之重要變數，分別為: 反應時間(1-3 hrs.)、反應溫度 (35-55 0C)、基質莫耳比(caprylic acid: tripalmitin =3:1-5:1) 及酵素用量 (0.2-1BAUN) 對產率之影響，並藉由等高線圖(contour plots)的繪製，找出建構脂質1,3-二辛酸-2-棕櫚酸甘油酯之最優化合成條件。研究結果發現，當反應時間為2小時、反應溫度52.20C、基質莫耳比(caprylic acid: tripalmitin)為4.5: 1及酵素用量0.75 BAUN時，為最優化合成條件，可得高達87%的產率。

關鍵詞 : 建構脂質、人類母乳脂質替代品、轉酯化酸解反應、脂解酵素、反應曲面法、中心混層實驗設計、最優化

目錄

參考文獻

1. 田蔚城, 2001「生物技術的發展與應用」九州圖書文物有限公司。 2. 張曉莉及黃世佑。1997。生物轉換法-有機溶劑中維持酵素活性之研究。化工。44:71-84。 3. Akoh, C.C. 1995. Structured lipids-enzymatic approach. INFORM. 6:1055-1061. 4. Bach, A. and Babayan, V.K. 1982. Medium-chain triglycerides: an update. Am. J. Clin. Nutr. 36:950-962. 5. Carnielli, V.P., Luijendijk, I.H.T., Van Goudoever, J.B., Sulkers, E.J., Boerlage, A.A., Degenhart, H.J. and Sauer, P.J.J. 1996. Structural position and amount of palmitic acid in infant formulas: effects on fat, fatty acid, and mineral balance.J. Pediatr. Gastroenterol. Nutr. 23:553-560. 6. Carnielli, V.P., Rossi, k., Badon, T., Gregori, B., Verlato, G., Orzali, A. and Zacchello, F.1996, Medium-chain triacylglycerols in formulas for preterm infants: effect on plasma lipids, circulating concentrations of medium-chain fatty acids, and essential fatty acids. Am. J. Clin. Nutr. 64:152-158. 7. Deffense, E. 1993. Milk fat fractionation today :a review. J. Am. Oil Chem. Soc. 70:1193-1201. 8. Dotson, K.D. Jerrell, J.P., Picciano,M.F. and Perkins, E.G. 1992. High-performance liquid chromatography of human milk triacylglycerols and gas chromatography of component fatty acids. Lipids. 27:933-939. 9. Dunham, E.C.1955. Premature infant: A manual for physicians. Paul B. Hoeber, INC., New York,USA., Chaper 7. 10. Fouw, N.J., Kivits, G.A.A., Qulinlan, P.T., Nielen, W.G.L.1994. Absorption of isomeric, palmitic acid containing triacylglycerols resembling human milk fat in the adult rat. Lipids. 29:765-770. 11. Giovanni, M.

1983. Response surface methodology and product optimization. Food Technol.41-45. 12. Ghazali, H.M., Hamidah, S. and Che Man , Y.B. 1995. Enzymatic tansesterification of palm olein with nonspecific and 1,3-specific lipase. J. Am. Oil Chem. Soc. 72:633-639. 13. Green, K.D. and Nakajima, M. 1998. Evaluation of immobilized modified lipase: aqueous preparation and reaction studied in n-hexane. J. Am. Oil Chem. Soc. 75:1193-15251519. 14. Hamosh, M., Bitman, .J., Liao, T.H., Mehta, N.R., Buczek, R.J., Wood, D.L., Grylack, L.J. and Hamosh, P. 1989. Gastric lipolysis and fat absorption in preterm infant: effect of medium-chain triglyceride or long-chain triglyceride -containing formulas. Pediatrics 83:86-92. 15. Heim, T. 1985. How to meet the lipid requirements of the premature infant. Pediatr. Clin. 32:289-317. 16. Heird, W.C., Grundy, S.M. and Hubbard, V.S. 1986.Structured lipids and their use in clinical nutrition. Am. J. Clin. Nutr. 43:320-324. 17. Innis, S.M., Dyer, R. and Nelson, C.M. 1994. Evidence that palmitic acid is absorbed as sn-2 monoacylglycerol from human milk by breast-fed infants. Lipides. 29:541-545. 18. Jandacek, R.J., Whiteside, J.A., Holcombe, B.N., Volpenhein, R.A. and Taulbee, J.D.1987. The rapid hydrolysis and efficient absorption of triglycerides with octanoic acid in the 1 and 3 positions and long-chain fatty acid in the 2 position. Am. J. Clin. Nutr. 45:940-945. 19. Jensen, G.L. and Jensen, R.G. 1992. Specialty lipids for infant nutrition. J. Pediatr.Gastro.Nutr.15:382-394 20. Jensen, R.G. 1996. The lipids in human milk. Prog. Lipid Res. 35:53-92. 21. Johnson, R.C., Young, S.K., Cotter, R., Lin, L. and Rowe, W.B. 1990. Medium-chain-triglyceride lipids emulsion: metabolism and tissue distribution. Am. J. Clin. Nutr. 52:502-508. 22. Kavanagh, A.R. 1997. A breakthrough in infant formula fats. Oleagineux, Corps Gras, Lipides. 4:165-8. 23. Kenndy, T.P. 1991. Structured lipids: fats of the future. Food Technol. 76-83. 24. Kubow, S. 1996. The influence of positional distribution of fatty acids in native, interesterified and structure-specific lipids on lipoprotein metabolism and atherogenesis. Nutr. Biochem. 7:530-541. 25. Ledochowska, E., Jewusiak, A. and Szymczak, M. 2001.Preparation of structured lipids with special functional properties. Food Lipids 8:239-250. 26. Lee, K.T. and Akoh, C.C. 1998. Structured lipids: synthesis and applications. Food Rev. Int., 14(1),17-34. 27. Megremis, C.J. 1991. Medium-chain triglycerides: a nonconventional fat. Food Technol. 2:113-114. 28. Mclaren, D.S., Burman, D., Belton, N.R. and Williams, A.F. 1991. Textbook of Paediatric Nutrition. Churchill Livingstone. New York. Chaper 5 29. Mrera Pons, S., Castellote Bargallo, A.I. and Lopez Sabater, M.C. 1998. Analysis of human milk triacylglycerols by high-performance liquid chromatography with light-scattering detection. J. Chromatogr. A. 823:475-482. 30. Mukherjee, K.D. and Kiewitt, I. 1998. Structured triacylglycerols resembling human milk fat by transesterification catalyzed by papaya (Carica papaya) latex. Biotech. Lett. 20:613-616. 31. Namal Senanayake, S.P.J. and Shahidi, F. 2002. Enzyme-catalyzed synthesis of structured lipids via acidolysis of seal (Phoca groenlandica)blubber oil with capric acid. Food Res. Int.35:745-752. 32. Peng, L., Xu, X., Mu, H., Hoy, C.E. and Adler-Nissen, J. 2002. Production of structured phospholipids by lipase-catalyzed acidolysis: optimization using response surface methodology. Enz.Micro.Technol.31:523-532. 33. Quinlan, P. and Moore, S. 1993. Modification of triglycerides by lipases:process technology and its application to the production of nutritionally improved fats. INFORM. 4:580-585. 34. Roig, M.J., Alegria, A., Barbera, R., Farre, R. and Lagarda, M.J. 1999. Calcium bioavailability in human milk, cow milk and infant formulas comparison between dialysis and solubility methods. Food Chemistry 65:353-357. 35. Sarda, P., Lepage, G., Roy, C.C.and Chessex, P.1987. Storage of medium chain triglycertides in adipose tissue of orally fed infants. Am. J. Clin. Nutr. 45:399-405. 36. Schmid, U., Bornscheueer, U.T., Soumanou, M.M., McNEIL, G.P. and Schmid, R.D.1998. Optimization of the reaction conditions in the lipase-catalyzed synthesis of structured triglycerides. J. Am. Oil Chem. Soc. 75:1527 -1531. 37. Shieh, C.J., Akoh, C.C. and Koehler, P.E. 1995. Four-factor response surface optimization of the enzymatic modification of triolein to structured lipids. J. Am. Oil Chem Soc. 72:619-623. 38. Shieh, C.J., and Chang, S.W. 2001. Optimized synthesis of lipase -catalyzed hexyl acetate in n-hexane by response surface methodology. J. Agric. Food Chem. 49:1203-1207. 39. Soumanou, M.M., Bornscheuer, U.T. and Schmid, R.D. 1998.Two-step enzymatic reaction for the synthesis of pure structured triacylglycerides. J. Am. Oil Chem. Soc.75:703-710. 40. Villeneuve, P. and Foglia, T.A. 1997. Lipase specificities: potential application in lipid bioconversions. INFORM. 8:640-651. 41. Williams, A.F. 1991.Textbook of paediatric nutrition. Churchill livingstone INC. New York, USA.Chaper 5 42. Winter, C.H., Hoving, E.B. and Muskiet, F.A.J. 1993. Fatty acid composition of human milk triglyceride species possible consequences for optimal structured of infant formula triglycerides. J. Chromatogr. 616:9-24.