OPTIMIZATION ON ACIDOLYSIS REACTION OF PALM STEARIN AND OLEIC ACID BY A DUAL LIPASE SYSTEM AND ITS PHYSICOCHEMICAL CHARACTERISTICS

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ABSTRACT

Acidolysis reaction makes the acyl group specificallyto be incorporated into the triacylglycerol of palm stearin. The acidolysis reaction was optimized to measure its optimum condition of reaction and the effect of dual lipase system used in this reaction through its interesterification degree (ID). The final product is expected to have healthier fatty acid composition and characteristics compare to palm stearin.In this study, acidolysis reaction was catalyzed by lipase Amano AK and immobilized lipase *Thermomyceslanuginoses*(TL IM). All four parameters affecting the reaction-enzyme ratio (w/w), enzyme load (%), reaction time (h) and substrate molar ratio (w/w), were optimizedvia Response Surface Methodology (RSM) using Central Composite Rotatable Design (CCRD). The responses measured were percentage of free fatty acid (FFA) and fatty acid compostion (FAC) of oleic acid. The target was to have the minimum FFA percentage and maximum FAC of oleic acid in the final product. The physicochemical analysis of triacylglycerol (TAG) composition, FACpercentage and its slip melting point (SMP) profile were conducted to the finished product to compare with the palm stearin.From the RSM, the optimum condition obtained were 3 hours of time reaction, 5:5 (w/w)of enzyme ratio, 1:3 (w/w)of substrate molar ratio and 10% (w/w) enzyme load. Among these four factors, the substrate molar ratio was found to have a significant effect ($p<0.0001$) towards the percentage of FFA while in contrast towards percentage of FAC of oleic acid, the enzyme ratio, enzyme load, and reaction time had a significant effect ($p<0.0001$).The synergistic effect between the two lipases with ratio 5:5 gives average interesterification degree (ID) of 0.73. Slip melting point for purified modified palm stearin (PMPS) was 46.13°C. TAG composition of oleic-oleic-oleic(OOO) and palmitic-oleic-oleic (POO)as well as percentage of FAC of oleic acid increased in their percentage after the reaction. These conclude that the model given by RSM can be implied to predict the responses as well as interactions between the parameters and the finished product, PMPShave a lower melting point and healthier fatty acid composition as compared to palm stearin.

Keywords: RSM, dual lipase, physicochemical, palm stearin, acidolysis

ABSTRAK

Tindak balas acidolisis boleh membuatkan asid lemak dimasukkan ke dalam triasilgliserol minyak stearin sawit secara spesifik. Tindak balas acidolisis telah dioptimumkan dan kesan sinergi dua lipase yang digunakan dalam tindak balas ini ditentukan melalui darjah interesterifikasi (ID). Hasil produkdijangka mempunyai struktur asid lemak dan ciri-ciri yang lebih sihat berbanding minyak stearin sawit. Dalam kajian ini, tindak balas acidolisis dimangkin oleh dua enzim iaitu lipase Amano AK dan lipozim *Thermomyceslanuginoses* (TL IM). Empat parameter yang mempengaruhi tindak balas-nisbah enzim (w/w), jumlah enzim (%), masa tindak balas (h) dan nisbah molar substrat (w/w), telah dioptimumkan melalui Kaedah Permukaan Tindak Balas (RSM) menggunakan Rekaan Komposit Berpusat (CCRD). Tindak balas yang diukur adalah peratusan asid lemak bebas (FFA) dan asid oleik di dalam komponen asid lemak (FAC). Sasarannya adalah untuk mempunyai peratusan FFA minimum dan maksimum FAC asid oleik dalam produk akhir. Analisis fizikokimia melalui komposisi triasilgliserol (TAG), peratus FAC dan titik takat lebur (SMP) Profil telah dijalankan untuk produk siap untuk membandingkan dengan stearin sawit. Dari RSM, keadaan optimum diperoleh adalah 3 jam masa tindak balas, 5:5 nisbah enzim, 1:3 dengan nisbah molar substrat dan 10% (w/w) jumlah enzim. Di antara empat faktor tersebut, nisbah molar substrat didapati mempunyai kesan yang signifikan ($p < 0.0001$) terhadap peratusan FFA manakala berbeza terhadap peratusan FAC asid oleik, nisbah enzim, jumlah enzim, dan masa tindak balas mempunyai kesanyang signifikan ($p < 0.0001$). Kesan sinergi antara kedua-dua enzim dengan nisbah 5:5 memberikan purata darjah interesterifikasi (ID) daripada 0.73. Titik takat lebur untuk minyak stearin sawit yang telah diubah suai (PMPS) adalah 46.13°C. Komposisi TAG, oleik-oleik-oleik(OOO) dan palmitik-oleik-oleik (POO) serta peratusan FAC asid oleik meningkat selepas tindak balas. Ini dapat menunjukkan bahawa model yang diberikan oleh RSM boleh meramalkan interaksi antara faktor, dan tindak balas yang diukur serta produk hasil acidolisis (PMPS) mempunyai takat lebur yang lebih rendah dan komposisi asid lemak yang lebih sihat berbanding stearin sawit.

Kata kunci: RSM, dual lipase, fizikokimia, stearin sawit, acidolysis

ملخص

تفاعل التحليل الحمضي يجعل تنظيم مجموعة أسيلية أكثر تحديدا لإندماج في أسيل الغليسرول الثلاثي في ستيارين النخيل. هذا التفاعل محفزعن طريق نظام ثناء اللیباز حيث يتكون من اللیباز أمانوAKواللیباز المثبت(TL IM)*Thermomyceslanuginoses*لمعرفة تأثير التآزُر بين الليبازَين. العوامل الأربعة التي تؤثر على التفاعل تُستخدم جميعهاعلى الاستجابة السطحية(RSM) (أر.إس.إيم). وهي نسبة الإنزيم، كمية الانزيم، وقت التفاعل، ونسبة المولار الركيزة. ومِن (أر.إس.إيم)، وكانت أفضل الظروف التي تم الحصول عليها هي 3 ساعات لوقت التفاعل، 5: 5 نسبة إنزيم الليباز أمانوAKنحو الليباز المثبت TL IM ، ثم 3 :1نسبة لستيرين النخيل نحو حمض الأوليك و% 10(وزن / وزن) كمية الانزيم . ومن بين العواممل الاربعة نسبة ركيزة المولار تُري ذا دلالة إحصائية عند مستوى (P<0.0001) نحو (إف.إف.إي) مما تجعل التصنيفات أن تميل إلى نسبة ركيزة المولارر من أجل تفعيل التفاعل الكيميائي.على الرغم من ذلك، نسبة الإنزيم، وكية الإنزيم ووقت التفاعل ذو دلالة إحصائية عند مستوى (P<0.0001) نحو (إف. إي. سي). وهذا يدل على أنّ أقل وقت التفاعل، يتسنى أن يكمل التفاعل، كمية الثابتة % 10، والنسبة المعدلة بين اللیباسين للوصول إلى أقصى نطاق الدرجات ل (إيف. إي.سي) وأدنى نطاق الدرجات ل (إيف.إيف.إي). ومن هنا، يلخص أن النموذج الذي يُعطى لأر إيس إيم يمكن أن يُستخدم لتوقَع إيف.إيف.إيف ووفاء إي.سي تحت جميع الكالات في القيمة التجربية. والآثار التآزرية بين اللیباسين بنسبة 5:5 يساهم إلى معدلة المستوى الانترستريفي ()ID 0.73. وهذا (ID) يتضح أنّ تفاعل اللیباس يرتفع كفاءة نشاط لیباس AK. معدل ستررين النخيل الخالص PMPSيحصل على 46.13°Cلنقطة الانصهار. وبجانب ذلك، بناءً على عناصر أسيل الغليسرول الثلاثي، نسبة OOO وPOOترتفع بعد عملية التفاعل، بينما قيمة PPPوPOO تنخفض. ولذلك، المنتاج المعدل PMPSله نقطة الانصهار الأدنى والعناصر الأصح من ستيارين النخيل.

كلمات مفتاحية:RSM ، ثناء الليباز ، فيزيائي كيميائي، ستارينن النخيل، التحليل بالحامض

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ABBREVIATION

ANOVA	Analysis of variance
ARA	Arachidonic acid
CCRD	Central composite rotatable design
DHA	docosahexanoic acid
DOE	Design of experts
ECN	Equivalent carbon number
ELSD	Evaporating light scattering detector
FAC	Fatty acid composition
FAME	Fatty acid methyl esters
FFA	Free fatty acid
FID	Flame ionization detector
GC	Gas chromatography
HDL	High density lipoprotein
HMFS	Human milk fat substitute
HPLC	High-performance liquid chromatography
ID	Interesterification degree
LDL	Low density lipoprotein
LO	Linseed oil
MCFA	Medium chain fatty acid
MPOB	Malaysian Palm Oil Board
MPOC	Malaysian Palm Oil Council
MUFA	Monounsaturated fatty acids
NaOH	Sodium hydroxide
OOO	Oleic-Oleic-Oleic
PMPS	Purified modified palm stearin
POO	Palmitic-Oleic-Oleic
PPO	Palmitic-Palmitic-Oleic
PPP	Palmitic-Palmitic-Palmitic
PS	Palm stearin
PUFA	Polyunsaturated fatty acids
RBD	Refined, bleached, deodorized
RSM	Response surface methodology
SL	Structured lipid
SMP	Slip melting point
TAG	triacylglicerols
TL IM	*Thermomyces lanuginoses*