Interesterification of Camelina and Castor Oil: Analysis and Optimization of the Reaction

*J. Garcia *, J.-Y. Bergeron, J. Labrecque, G. Hersant, A. Tremblay*
*OLEOTEK Inc., Thetford Mines, Quebec, Canada, * e-mail : jgarcia@oleotek.org*

LINNAEUS Plant Sciences

Industrial Oil Seed Network

Introduction

Camelina sativa oil contains high levels of polyunsaturated fatty acids, up to 40-60% of total fatty acids.
Castor oil is very rich (about 90%) in ricinoleate and it is the only commercial source.

Table 1: Fatty acid composition of oils analyzed by GC

Fatty Acid	Camelina (%)	Castor (%)
C16:0	5,6	1,3
C18:0	2,4	1,4
C18:1	16,7	3,3
C18:1-OH	0	88,7
C18:2	19,7	4,8
C18:3	32,6	0,5
C20:0	1,5	0
C20:1	14,3	0
C20:2	1,9	0
C20:4	1,2	0
C22:0	0,3	0
C22:1	3,2	0
C22:6	0,6	0

Aim of this study

Interesterification is one of the most important processes for modifying both composition and physical properties of oils. The aim of the present study is the synthesis and production of strutured TAG enriched with ricinoleic acid (C18:1-OH) in order to improve the properties of target oils. Chemical interesterification occured between Camelina sativa oil and Castor oil. The operating conditions (duration, temperature, vacuum, concentrations of the reactants, etc.) of the interesterification reaction were optimized in order to maximize yield, properties and quality of the resulting structured oil.

Experimental section

Materials

Synthesis

Crude Castor oil (Solution Chemco)
Cold-pressed Camelina oil (Canpressco Products)
Potassium methoxide 95% (Sigma-Aldrich)
Citric acid (Sigma-Aldrich)

Analysis[1]

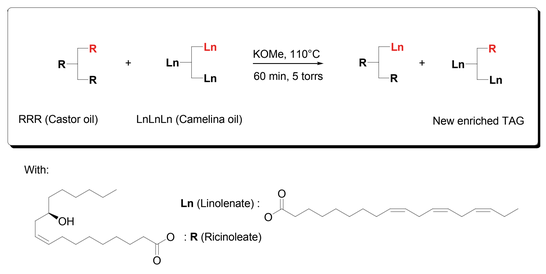
RP-HPLC system consisting of two C18 columns (250 x 4.6 mm x 5 µm)
UV detector
A binary solvent (acetonitrile and 2-propanol)
Isocratic method is used to analyze TAG

Camelina sativa

Optimization of reaction[2]:

- Castor oil 20% (w/w), Camelina oil 80% (w/w)
- Time : 1 hour
- Temperature : 110°C
- Vaccum : 5 torrs
- Quantity of base : 0,6 % (w/w)

Figure 1: Optimization of interesterification



HPLC results

- Qualitative analysis
- Identification of major TAGs predicted by Equivalent Carbon Number (ECN) and standards (castor oil[3] and unsaturated TAGs)
- Areas comparison of target TAGs (RRR and LnLnLn)
- TAG distribution: RRR disparition, LnLnLn decreases by half, formation of new TAGs (RRX, RXX')

Figure 2: Evolution of TAG: 60 min reaction time with 0,6% KOMe (w/w)

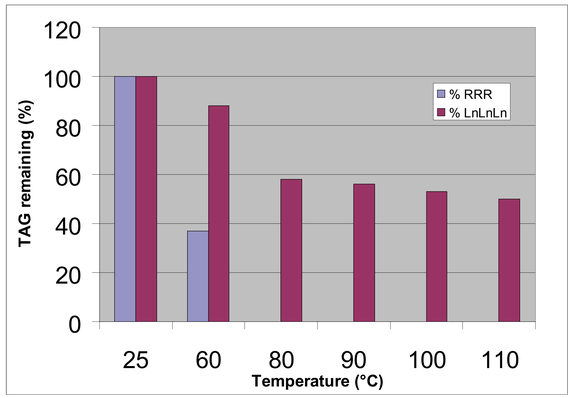
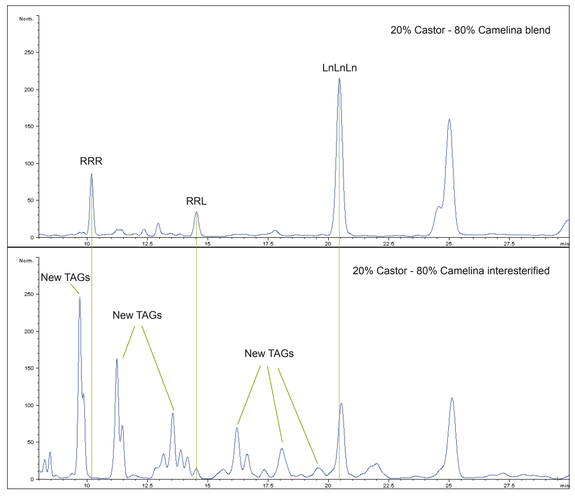


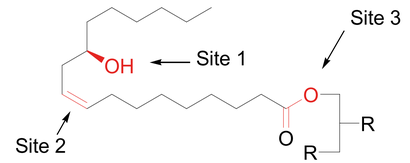
Figure 3: Chromatograms of blended and interesterified oils



Upcoming work

- Fonctionnalisation of TAG :

Figure 4: Active sites



- Measurements of properties (kinetic viscosity, pour point, oxidation stability, four ball wear tests etc.)

Castor plant and fruit
(photo: Joaquim Alves Gaspar)

References

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[2] S. Azadmard-Damirchi, P. C. Dutta, *J Am. Oil Chem. Soc.* **2008**, *85*, 13
[3] G. Stübiger, E. Pittenauer, G. Allmaier, *Phyto. Anal.* **2003**, *14*, 337

Acknowledgements

The authors would like to thank the Agricultural Bioproducts Innovation Program (ABIP) for financing this project as well as the following organization for its financial support :

Agriculture et Agroalimentaire Canada
Agriculture and Agri-Food Canada
Éducation, Loisir et Sport Québec