# Studies on the synthesis of biodiesel catalyzed by $Nb_2O_5.nH_2O$ in transesterification reactions of cotton, coconut and flaxseed oils


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## INTRODUCTION

Transesterification is the predominant process for converting vegetable oils into biodiesel.[1]

$Nb_2O_5.nH_2O$ is known to have strong surface acidity and it reportedly[2] increases Lewis acid sites at temperatures higher than 500 ºC, whereas Bronsted acid sites are more abundant at temperatures between 100 and 300 ºC.

This study, which is a continuation of other investigations of this research group[3], aims to implement a methodology for preparing methylic biodiesel through transesterification process of cotton, coconut and flaxseed oils, monitoring heat treatment of $Nb_2O_5.nH_2O$ catalyst ratios and different proportions of catalyst mass/oil mass.

## RESULTS AND DISCUSSION

The reactions were made with the addition of methanol (1.0 ml), cotton seed, coconut and linseed oils (0.5 g), DMSO (2.5 ml) as solvent to increase the boiling point of the mixture, and the catalyst in the proportions and treatment conditions shown in Table 1. For each vegetable oil, a reaction was made without the use of catalysts.

All reactions were made under heating conditions of 170 °C in a reflux system, and 0.5 mL of methanol was added every 8 hours. Reaction time was 48h. After the end of the reaction time, the products were extracted through multiple extractions.

Through the use of $^1H$ NMR spectroscopy, the products obtained were analyzed and quantified by the following expression:

$$\text{Conversion rates (\%)} = \frac{3\,Ab}{3\,Ab + 2\,Ao} \times 100\%$$

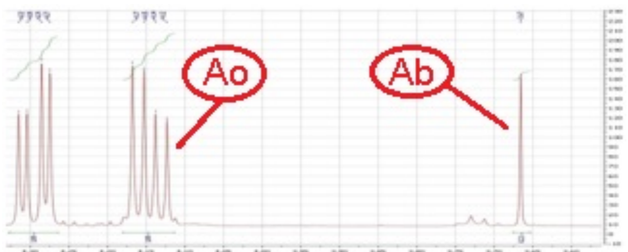


**Figure 1.** Methylene hydrogen's of the triglyceride (Ao) and methoxy hydrogen's ester (Ab) of biodiesel.

This expression relates the area of integration of the signal referring to the methoxy hydrogen's ester (Ab) and the area of methylene hydrogen's of the glyceridic of triglyceride (Ao).

**Table 1.** Proportions of catalyst/oil, calcinations temperature and conversion rates.

| Oils | Catalyst/oil (m/m) % | Calcination TºC | Conversion rates (%) |
|---|---|---|---|
| Cotton seed | 20 | 115 °C | 6.2 |
| | | 300 °C | 9.5 |
| | 100 | 115 °C | 12 |
| | | 300°C | 17.4 |
| | 0 | -- | 0 |
| Coconut | 20 | 115 °C | 8.3 |
| | | 300 °C | 13.1 |
| | 100 | 115 °C | 5.7 |
| | | 300 °C | 24.0 |
| | 0 | -- | 0 |
| Linseed | 20 | 115 °C | 5.7 |
| | | 300 °C | 18.4 |
| | 100 | 115° C | 5.7 |
| | | 300 °C | 21.0 |
| | 0 | -- | 0 |

We observed an increase in conversion rates with the increase of the mass ratio of $Nb_2O_5.nH_2O$. This behavior was already expected, because with the increased amount of catalyst, there is increased availability in the reaction.

## CONCLUSION

We found that the use of $Nb_2O_5.nH_2O$ as a catalyst promotes conversions in the transesterification of vegetable oils studied, but not in very satisfactory yields.


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## REFERENCES


[1]Soldi, R.; Oliveira, A.; Ramons, L. e César-Oliveira M. A. *Appl Catal. A*: Gen. **2009**, *361*, 42-48.

[2]Nowak, I.; Ziolek, M.; *Chem. Rev*. **1999**, 3606-3624.

[3]Arpini, H. B.; Lacerda Jr., V.; dos Santos, D. A.; dos Santos, R. B.; Greco, S. J; Neto, Á. C.; 35ª *RASBQ*, **Resumos**, TEC 008, **2013**