

Distinguishing Triglyceride and Diglyceride Content with Magnetic Resonance Spectroscopy at 3 T

E. Saive¹, L. Fairgrieve-Park¹ and A. Yahya^{1,2}

1. Department of Oncology, University of Alberta, Edmonton, AB, Canada

2. Department of Medical Physics, Cross Cancer Institute, Edmonton, AB, Canada

INTRODUCTION

- Fat in the body is primarily found as triglycerides; however, in certain diseases, increased levels of diglycerides have been reported^{1,2}
- Magnetic resonance spectroscopy (MRS) is a non-invasive way of assessing fat composition.
- Figure 1 shows molecular structures of a triglyceride (TG), a 1,3-diglyceride (1,3-DG) and a 1,2-diglyceride (1,2-DG) along with a spectrum showing the glycerol protons of relevance.
- The glycerol resonances (3.7 – 5.3 ppm)³ of all three strongly overlap at 3 T rendering their quantification challenging.

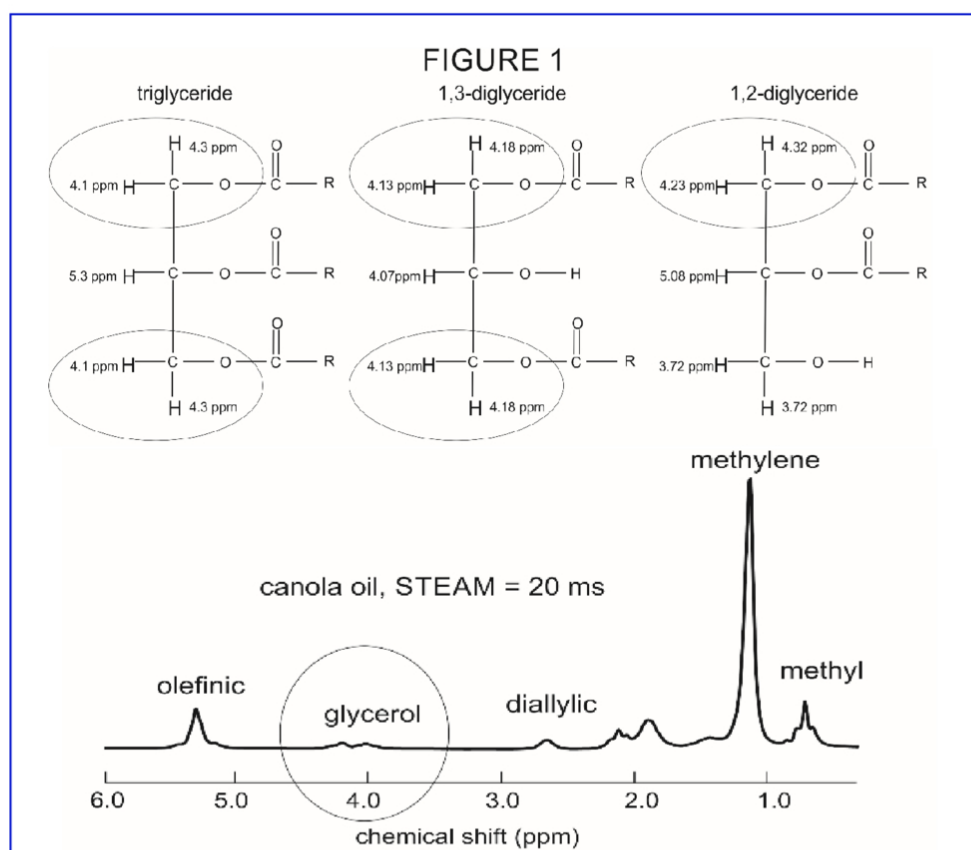
AIM

The objective of the work is to determine if changes in relative concentrations of diglycerides and triglycerides can be measured with magnetic resonance spectroscopy techniques such as PRESS (Point RESolved Spectroscopy) and STEAM (STimulated Echo Acquisition Mode) at 3 T.

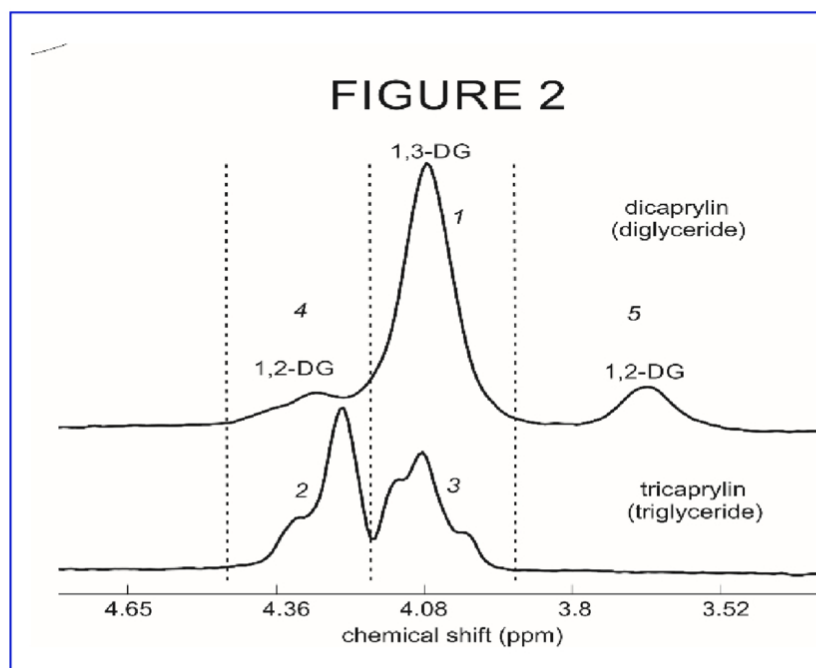
METHODS

- Scalar coupling evolution of the glycerol protons of dicaprylin (100% diglyceride) and tricaprylin (100% triglyceride) as a function of PRESS and STEAM TE (echo time) was investigated.
- TE was varied in steps of 10 ms from 40 ms to 300 ms for PRESS and from 20 ms to 300 ms for STEAM.

RESULTS



- STEAM with a TE of 20 ms was found to resolve resonances adequately.
- As described in Figure 2, the amounts of 1,2-DG and 1,3-DG relative to the amount of triglycerides can be estimated from the three resonances at ≈ 3.72 , 4.24 and 4.29 ppm with knowledge obtained from pure triglyceride and diglyceride samples.
- The 1,3-DG peak overlaps directly with the TG signal at about 4.14 ppm (the amount of which can be estimated from the ≈ 4.29 ppm TG resonance).
- A resonance at about 3.72 ppm indicates the presence of 1,2-DG and can be used to adjust the 4.29 ppm signal area to account for 1,2-DG contamination.



- Spectra acquired with STEAM TE = 20 ms from dicaprylin (primarily 1,3-DG with a small amount of 1,2-DG) and tricaprylin (a triglyceride).
- The 1,3-DG peak **1** overlaps directly with the TG peak **3**.
- The amount of peak **3** contaminating peak **1** can be determined from the TG peak **2** (area ratio of peak **3** to **2** determined from a pure triglyceride).
- The presence of 1,2-DG can be detected by peak **5** from which the triglyceride peak **2** can be adjusted (based on ratio of peak **4** to peak **5** area determined from a pure diglyceride) to account for 1,2-DG signal contamination.

CONCLUSIONS

It was determined that STEAM with a TE of 20 ms is suitable for determining relative concentrations of diglycerides and triglycerides at 3 T.

ACKNOWLEDGEMENTS

Grant funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) is gratefully acknowledged.

REFERENCES

- Puri *et al.*, Hepatology, v. 46, p. 1081, 2007
- Erion *et al.*, Nat. Med., v. 16, p. 400, 2010
- Hatzakis *et al.*, J. Am. Oil. Chem. Soc., v. 88, p. 1695, 2011

CONTACT INFORMATION

ayahya@ualberta.ca (A. Yahya)