Quantification of Starch and Flour Adulterants in the Yogurt by Using Raman and FTIR Spectroscopy

N. Cebi1\*, S. Kayacan Cakmakoglu1, S. Karasu1, O. Sagdic1, M. Arici1

1 Yıldız Technical University Food Engineering Department, İstanbul, nurcebi@yildiz.edu.tr

1 Yıldız Technical University Food Engineering Department, İstanbul, [skayacan@yildiz.edu.tr](mailto:skayacan@yildiz.edu.tr)

1 Yıldız Technical University Food Engineering Department, İstanbul, skarasu@yildiz.edu.tr

1 Yıldız Technical University Food Engineering Department, İstanbul, osagdic@yildiz.edu.tr

1 Yıldız Technical University Food Engineering Department, İstanbul, muarici@yildiz.edu.tr

\*Nur Cebi

Yogurt is one of the most nutritious and healthy fermented milk products widely consumed in Turkey. In our country, the addition of flour and starch is not allowed, according to the Turkish Food Codex Legislation. However, it is known that flour and starch may be added to the yogurt to obtain desirable texture and stability properties. This research study is built for the detection and quantification of flour and starch in yogurt samples by using Raman and FTIR spectroscopy combined with chemometrics.

The adulterated yogurt samples (Y1 and Y2) were prepared separately by addition and starch (S1 and S2) and flour (F1 and F2) at the concentrations of 0%, 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16%, and 18% (w/w). Portable Raman spectrometer (Rigaku Raman Technologies, Wilmington, MA, ABD) and ATR-FTIR system ( Bruker Tensor 27, Bremen, Germany) were used in the studies. The chemometrics software (OPUS, version 7.2) of the FTIR equipment was used for the quantification of adulterants. Hierarchical cluster analysis was applied to observe the classification pattern of adulterated samples.

Results showed that flour and starch could be successfully quantified on the basis of their FTIR and Raman spectral data. Higher correlation coefficient (R2) value between 0.99 and 1 was obtained in the FTIR regression models when compared to Raman regression models (R2= 0.80-0.92). HCA results clearly illustrated the classification pattern of adulterated and control yogurt samples. The findings from this study presented the high capability of FTIR and Raman non-destructive techniques for the quantification of adulterants such as flour and starch in yogurt.

**Keywords:** Yogurt, starch, flour, adulteration, FTIR, Raman, chemometrics.

**Acknowledgments:** This study was funded by Yildiz Technical University Scientific Research Project Unit (YTU-BAP) under Project No: FBA-2021-4301.