



[< Back to results](#) | 1 of 1
[Export](#)
[Download](#)
[Print](#)
[E-mail](#)
[Save to PDF](#)
[Add to List](#)
[More... >](#)
[Full Text](#)
[View at Publisher](#)

International Journal of Food Properties
Volume 20, Issue 9, 2 September 2017, Pages 2147-2156


Authentication of butter from lard adulteration using high-resolution of nuclear magnetic resonance spectroscopy and high-performance liquid chromatography (Article)

Fadzillah, N.A.^{ab} , Rohman, A.^c, Salleh, R.A.^b, Amin, I.^d, Shuhaimi, M.^e, Farahwahida, M.Y.^b, Rashidi, O.^a, Aizat, J.M.^a, Khatib, A.^f 

^aInternational Institute for Halal Research and Training, International Islamic University Malaysia, Kuala Lumpur, Malaysia

^bCenter of Research for Fiqh Science and Technology, Universiti Teknologi Malaysia, Skudai, Johor Bahru, Malaysia

^cResearch Center of Halal Products and Faculty of Pharmacy, Gadjah Mada University, Yogyakarta, Indonesia

[View additional affiliations](#) 

Abstract

[View references \(39\)](#)

Food authentication is an interesting issue for all parties in the food industry, including the fats and oils industry. Some unethical players try to blend high -quality foods, such as butter, with lower ones like lard, therefore, the analytical methods capable of analyzing the adulteration practices must be developed. This study used proton nuclear magnetic resonance spectroscopy in combination with high-performance liquid chromatography for the authentication of butter from lard adulteration. The identification of triacylglycerol composition of lard as a chemical marker for halal authentication is analyzed using high-performance liquid chromatography and high resolution nuclear magnetic resonance spectroscopy. The suitability of proton nuclear magnetic resonance provides a high-performance approach for determination butter adulterated with lard in their entirety of all proton bearing components. Peaks in the region of 2.60–2.84 ppm show special characteristics only present in lard. Only lard has its own unique characteristics which only polyunsaturated fatty acids would give signals at δ 2.63, that corresponded to the chemical shift of the double-allylic methylene protons. In the same way, the intensity of signal at 2.63 ppm, due to methylenic protons in a position α to two double bonds, that is to say, due to the linoleic group. Furthermore, we also correlate some signals between ^1H and ^{13}C -NMR spectra for the confirmation of signals. © 2017 Taylor & Francis Group, LLC.

Author keywords

Butter Halal authentication Lard NMR spectroscopy Triacylglycerol composition

Indexed keywords

Engineering controlled terms:

Authentication Blending Chemical analysis Chemical bonds Chemical shift
Chromatography Complexation Fatty acids Food technology Glycerol
High performance liquid chromatography Liquid chromatography Liquids
Magnetic resonance spectrometers Magnetic resonance spectroscopy Magnetism
Nuclear magnetic resonance Oils and fats Polyunsaturated fatty acids Resonance

Metrics

0 Citations in Scopus
0 Field-Weighted Citation Impact



PlumX Metrics

Usage, Captures, Mentions, Social Media and Citations beyond Scopus.

Cited by 0 documents

Inform me when this document is cited in Scopus:

[Set citation alert >](#)

[Set citation feed >](#)

Related documents

Detection of butter adulteration with lard by employing ^1H -NMR spectroscopy and multivariate data analysis

Fadzillah, N.A. , Man, Y.B.C. , Rohman, A. (2015) *Journal of Oleo Science*

Detection of lard in vegetable oils

Che Man, Y.B. , Rohman, A. (2011) *Lipid Technology*

Determination of types of fat ingredient in some commercial biscuit formulations

Yanty, N.A.M. , Marikkar, J.M.N. , Abdulkarim, S.M. (2014) *International Food Research Journal*

[View all related documents based on references](#)

[Find more related documents in Scopus based on:](#)

Compendex keywords Butter Food authentications Halal authentications Lard Performance approach
Proton nuclear magnetic resonance Proton nuclear magnetic resonance spectroscopy
Triacylglycerol compositions



Engineering main heading: Nuclear magnetic resonance spectroscopy

ISSN: 10942912
CODEN: IJFPF
Source Type: Journal
Original language: English

DOI: 10.1080/10942912.2016.1233428
Document Type: Article
Publisher: Taylor and Francis Inc.

References (39)

[View in search results format >](#)

All [Export](#)  [Print](#)  [E-mail](#) [Save to PDF](#) [Create bibliography](#)

- 1 (2011) *Center for Nutrition Policy and Promotion. ChooseMyPlate.gov* accessed
-
- 2 Timms, R.E.
Determination of Oxidative Deterioration of Milk Powder and Reconstituted Milk by Measurement of Chemiluminescence
(1982) *Journal of Dairy Research*, 47, pp. 295-303. Cited 24 times.
-
- 3 Precht, D.
Detection of Foreign Fat in Milk Fat
(1992) *Qualitative Detection by Triacylglycerol Formulae. European Journal of Food Research and Technology*, 194, pp. 1-8.
-
- 4 Precht, D.
Detection of Adulterated Milk Fat by Fatty Acid and Triglyceride Analysis
(1991) *Fett Wissens Technology*, 93, pp. 538-544. Cited 30 times.
-
- 5 Precht, D., Mukherjee, K.D., Weber, N., Sherma, J.
(1993) *CRC Handbook of Chromatography, Analysis of Lipids; CRC Press: Boca Raton, FL*, p. 123.
-
- 6 *Commission of the European Communities: Detection of Foreign Fats in Milk Fat by Means of Gas Chromatographic Triglyceride Analysis*
Doc. No VI/5202/90-EN, VI/2645/91
-
- 7 Jensen, R.G.
The composition of bovine milk lipids: January 1995 to December 2000
(2002) *Journal of Dairy Science*, 85 (2), pp. 295-350. Cited 543 times.
http://www.elsevier.com/wps/find/journaldescription.cws_home/721317/description#description
doi: 10.3168/jds.S0022-0302(02)74079-4

[View at Publisher](#)

- 8 Marikkar, J.M.N., Ghazali, H.M., Che Man, Y.B., Peiris, T.S.G., Lai, O.M.
Distinguishing lard from other animal fats in admixtures of some vegetable oils using liquid chromatographic data coupled with multivariate data analysis
(2005) *Food Chemistry*, 91 (1), pp. 5-14. Cited 41 times.
doi: 10.1016/j.foodchem.2004.01.080
[View at Publisher](#)
-
- 9 Che Man, Y.B., Rohman, A., Mansor, T.S.T.
Differentiation of lard from other edible fats and oils by means of Fourier transform infrared spectroscopy and chemometrics
(2011) *JAOCS, Journal of the American Oil Chemists' Society*, 88 (2), pp. 187-192. Cited 37 times.
doi: 10.1007/s11746-010-1659-x
[View at Publisher](#)
-
- 10 Regenstein, J.M., Chaudry, M.M., Regenstein, C.E.
Kosher and Halal in the Biotechnology Era
(2003) *Applied Biotechnology Food Science and Policy*, 1, pp. 95-108. Cited 7 times.
-
- 11 Indrasti, D., Che Man, Y.B., Mustafa, S., Hashim, D.M.
Lard detection based on fatty acids profile using comprehensive gas chromatography hyphenated with time-of-flight mass spectrometry
(2010) *Food Chemistry*, 122 (4), pp. 1273-1277. Cited 20 times.
doi: 10.1016/j.foodchem.2010.03.082
[View at Publisher](#)
-
- 12 Marikkar, J.M.N., Lai, O.M., Ghazali, H.M., Che Man, Y.B.
Compositional and thermal analysis of RBD palm oil adulterated with lipase-catalyzed interesterified lard
(2002) *Food Chemistry*, 76 (2), pp. 249-258. Cited 31 times.
doi: 10.1016/S0308-8146(01)00257-6
[View at Publisher](#)
-
- 13 Lipp, M.
Review of methods for the analysis of triglycerides in milk fat: application for studies of milk quality and adulteration
(1995) *Food Chemistry*, 54 (2), pp. 213-221. Cited 27 times.
doi: 10.1016/0308-8146(95)00611-L
[View at Publisher](#)
-
- 14 Contarini, G., Povalo, M., Bonfitto, E.
The Present and Future for Controlling the Authenticity of Butter
(1999) *Latte*, 24, pp. 60-69. Cited 5 times.
-
- 15 de la Fuente, M.A., Juarez, M.
Review: Application of chromatographic techniques to the study of triglycerides and sterols of milk fat
(1999) *Food Science and Technology International*, 5 (2), pp. 103-119. Cited 8 times.
doi: 10.1177/108201329900500201
[View at Publisher](#)
-

16 Ulberth, F., Buchgraber, M.
Authenticity of fats and oils
(2000) *European Journal of Lipid Science and Technology*, 102 (11), pp. 687-694. Cited 59 times.
[View at Publisher](#)

17 Kamm, W., Dionisi, F., Hischenhuber, C., Engel, K.-H.
Authenticity assessment of fats and oils
(2001) *Food Reviews International*, 17 (3), pp. 249-290. Cited 65 times.
doi: 10.1081/FRI-100104702
[View at Publisher](#)

18 Jee, M.
Milk Fat and Other Animal Fats
(2002) *Oils and Fat Authentication*, pp. 115-142. Cited 5 times.
Jee M., (ed), Blackwell Publishing CRC Press: Reading, UK:

19 Duce, S.L., Amin, M.H.G., Horsefield, M.A., Tyszka, M., Hall, L.D.
NMR Imaging of Dairy Products in Two Or Three Dimensions
(1999) *International Dairy Journal*, 5, pp. 311-319.

20 Guillén, M.D., Ruiz, A.
High resolution ¹H nuclear magnetic resonance in the study of edible oils and fats
(2001) *Trends in Food Science and Technology*, 12 (9), pp. 328-338. Cited 121 times.
doi: 10.1016/S0924-2244(01)00101-7
[View at Publisher](#)

21 Lavine, B.K.
Chemometrics
(1998) *Analytical Chemistry*, 70 (12), pp. 209R-228R. Cited 106 times.

22 Nicholson, J.K., Lindon, J.C., Holmes, E.
'Metabonomics': Understanding the metabolic responses of living systems to pathophysiological stimuli via multivariate statistical analysis of biological NMR spectroscopic data
(1999) *Xenobiotica*, 29 (11), pp. 1181-1189. Cited 2320 times.
[View at Publisher](#)

23 Vogels, J.T.W.E., Terwel, L., Tas, A.C., Van Den Berg, F., Dukel, F., Van Der Greef, J.
Detection of Adulteration in Orange Juices by a New Screening Method Using Proton NMR Spectroscopy in Combination with Pattern Recognition Techniques
(1996) *Journal of Agricultural and Food Chemistry*, 44 (1), pp. 175-180. Cited 84 times.
[View at Publisher](#)

24 Belton, P.S., Colquhoun, I.J., Kemsley, E.K., Delgadillo, I., Roma, P., Dennis, M.J., Sharman, M., (...), Spraul, M.
Application of chemometrics to the ¹H NMR spectra of apple juices: Discrimination between apple varieties
(1998) *Food Chemistry*, 61 (1-2), pp. 207-213. Cited 126 times.
doi: 10.1016/S0308-8146(97)00103-9
[View at Publisher](#)

- 25 Bailey, N.J.C., Sampson, J., Hylands, P.J., Nicholson, J.K., Holmes, E.
Multi-component metabolic classification of commercial feverfew preparations via high-field ¹H-NMR spectroscopy and chemometrics
(2002) *Planta Medica*, 68 (8), pp. 734-738. Cited 59 times.
doi: 10.1055/s-2002-33793
[View at Publisher](#)
-
- 26 De Pedro, E., Casillas, M., Miranda, C.M.
Microwave oven application in the extraction of fat from the subcutaneous tissue of Iberian pig ham
(1997) *Meat Science*, 45 (1), pp. 45-51. Cited 58 times.
[View at Publisher](#)
-
- 27 Marikkar, J.M.N., Ghazali, H.M., Long, K., Lai, O.M.
Lard uptake and its detection in selected food products deep-fried in lard
(2003) *Food Research International*, 36 (9-10), pp. 1047-1060. Cited 24 times.
www.elsevier.com/inca/publications/store/4/2/2/9/7/0
doi: 10.1016/j.foodres.2003.08.003
[View at Publisher](#)
-
- 28 Miyake, T., Watanabe, K., Watanabe, T., Oyaizu, H.
Phylogenetic analysis of the genus *Bifidobacterium* and related genera based on 16S rDNA sequences
(1998) *Microbiology and Immunology*, 42 (10), pp. 661-667. Cited 86 times.
[View at Publisher](#)
-
- 29 Sacchi, R., Addeo, F., Paolillo, L.
¹H and ¹³C NMR of virgin olive oil. An overview
(1997) *Magnetic Resonance in Chemistry*, 35, pp. S133-S145. Cited 169 times.
[View at Publisher](#)
-
- 30 Al-Rashood, K.A., Abdel-Moety, E.M., Abou-Shaabab, R.R., Al-Khamis, K.I., Abdul, R.
Triacylglycerols-profiling by high performance liquid chromatography: A tool for detection of pork fat (lard) in processed foods
(1995) *Journal of Liquid Chromatography*, 18 (13), pp. 2661-2673. Cited 14 times.
doi: 10.1080/10826079508009316
[View at Publisher](#)
-
- 31 Yanty, N.A.M., Marikkar, J.M.N., Che Man, Y.B., Long, K.
Composition and thermal analysis of lard stearin and lard olein
(2011) *Journal of Oleo Science*, 60 (7), pp. 333-338. Cited 21 times.
http://www.jstage.jst.go.jp/article/jos/60/7/333/_pdf
doi: 10.5650/jos.60.333
[View at Publisher](#)
-
- 32 Kallio, H., Yli-Jokipii, K., Kurvinen, J.-P., Sjövall, O., Tahvonen, R.
Regioisomerism of triacylglycerols in lard, tallow, yolk, chicken skin, palm oil, palm olein, palm stearin, and a transesterified blend of palm stearin and coconut oil analyzed by tandem mass spectrometry
(2001) *Journal of Agricultural and Food Chemistry*, 49 (7), pp. 3363-3369. Cited 39 times.
doi: 10.1021/jf010015w
[View at Publisher](#)

- 33 Aursand, M., Standal, I.B., Axelson, D.E.
High-resolution ^{13}C nuclear magnetic resonance spectroscopy pattern recognition of fish oil capsules
(2007) *Journal of Agricultural and Food Chemistry*, 55 (1), pp. 38-47. Cited 46 times.
doi: 10.1021/jf061754l
[View at Publisher](#)
-
- 34 Gunstone, F.D., Seth, S.
A study of the distribution of eicosapentaenoic acid and docosahexaenoic acid between the α and β glycerol chains in fish oils by ^{13}C -NMR spectroscopy
(1994) *Chemistry and Physics of Lipids*, 72 (2), pp. 119-126. Cited 36 times.
doi: 10.1016/0009-3084(94)90095-7
[View at Publisher](#)
-
- 35 Ando, Y., Satake, M., Takahashi, Y.
Reinvestigation of positional distribution of fatty acids in docosahexaenoic acid-rich fish oil triacyl-sn-glycerols
(2000) *Lipids*, 35 (5), pp. 579-582. Cited 38 times.
[View at Publisher](#)
-
- 36 Mannina, L., Luchinat, C., Emanuele, M.C., Segre, A.
Acyl positional distribution of glycerol tri-esters in vegetable oils: A ^{13}C NMR study
(1999) *Chemistry and Physics of Lipids*, 103 (1-2), pp. 47-55. Cited 65 times.
doi: 10.1016/S0009-3084(99)00092-4
[View at Publisher](#)
-
- 37 Aursand, M., Grasdalen, H.
Interpretation of the ^{13}C -NMR spectra of omega-3 fatty acids and lipid extracted from the white muscle of Atlantic salmon (*Salmo salar*)
(1992) *Chemistry and Physics of Lipids*, 62 (3), pp. 239-251. Cited 63 times.
doi: 10.1016/0009-3084(92)90061-5
[View at Publisher](#)
-
- 38 Christie, W.W., Moore, J.H.
A comparison of the structures of triglycerides from various pig tissues
(1970) *Biochimica et Biophysica Acta (BBA)/Lipids and Lipid Metabolism*, 210 (1), pp. 46-56. Cited 66 times.
doi: 10.1016/0005-2760(70)90060-3
[View at Publisher](#)
-
- 39 Kagawa, M., Matsubara, K., Kimura, K., Shiono, H., Fukui, Y.
Species identification by the positional analysis of fatty acid composition in triacylglyceride of adipose and bone tissues
(1996) *Forensic Science International*, 79 (3), pp. 215-226. Cited 19 times.
www.elsevier.com/locate/forsciint
doi: 10.1016/0379-0738(96)01915-9
[View at Publisher](#)

About Scopus

[What is Scopus](#)
[Content coverage](#)
[Scopus blog](#)
[Scopus API](#)
[Privacy matters](#)

Language

[日本語に切り替える](#)
[切换到简体中文](#)
[切换到繁體中文](#)
[Русский язык](#)

Customer Service

[Help](#)
[Contact us](#)

ELSEVIER

[Terms and conditions](#) [Privacy policy](#)

Copyright © 2017 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

Cookies are set by this site. To decline them or learn more, visit our [Cookies page](#).

 RELX Group™