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Detection of Non-Milk Fat Adulteration of Labaneh Products in Jordanian Markets on the Basis of Fatty Acids Profiles Content by GC.

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Abstract
Dairy products containing milk fat as a major component play an important role in economic, functional and chemical properties of dairy products in addition to retaining nutrients and essential fatty acids (FAs). With the increased demand for dairy products, dairy fat has become a frequent target of economic fraud, often being substituted for vegetable oils or animal fats with less value In this review, we analyzed 16 samples and used gas chromatography method to differentiate milk fat by FAs profile . Gas chromatography was used to evaluate the concentration of FAs and fatty acids in all samples, including the control sample. The findings revealed a remarkable correlation between oleic acid (C18:1n9c), linoleic acid (C18:2n6c), palmitic acid (C16:0), stearic acid (C18:0), and cholesterol, and as the level of adulteration between In the purified control sample In contrast to the low levels of oleic acid (C18:1n9c), linoleic acid (C18:2n6c), and stearic acid (C18:0) expressed when compared with composite samples, pure control sample showed higher levels cholesterol and palmitic acid (C16:0) than some composite samples. Consequently, we propose that oleic acid (C18:1n9c), linoleic acid (C18:2n6c), palmitic acid (C16:0), stearic acid (C18:0), and fatty acids are relevant and identifying markers in milk fat Rapidly digested by gas chromatography that can act as biomarkers.
Keywords: adulteration, milk fat, Labaneh, gas chromatography, foreign fat

1. Introduction

It is widely recognized as a balanced and healthy choice of milk and dairy products, which are often recommended as essential components of a healthy diet (Pereira, 2014). Notably, milk fat contains a variety of fat-soluble vitamins, lipids, and essential fatty acids (FAs). Because of these traits, he became a target for adultery. Dairy fats are predominantly saturated FAs, which are considered to have lower nutritional value compared to free FAs. Thus, efforts to increase utilization of insoluble FA in milk fat through improved dietary intake are of particular importance (Sutton 1989; Grummer 1991). The fatty acid composition of dairy fats has been used as an indicator of adulteration, mainly because dairy fats are short-chain fatty acids, while vegetable oils contain short- and long-chain fatty acids (Molkentin and Precht, 1998 Ntakatsane). and others, 2013). Dairy fats have been vulnerable to fraudulent practices involving the substitution of low-cost non-dairy fats of plant and animal origin (Ntakatsane et al., 2013). Substituting a portion of expensive dairy fats with other cost-effective alternatives such as vegetable oils, animal fats, or margarine can also provide economic benefits, especially when the product is labeled indirectly (Lipp, 1996; Marekov et al., 2011). The main components of milk fat breakdown are various vegetable oils (such as soybean, sunflower, peanut, coconut, palm, and groundnut oil) and animal fats (such as goose and pork fat) (Trbović, Đorđević, 2017) so this purpose inspection is a routine in dairy factories in Jordan

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To ensure the availability of low-fat milk LABANEH was . Studies revolve around assessing visceral fat.

Typical Adulterants and their health hazards on humans:
Powdered Milk In some cases, powdered milk is introduced as an attractive fresh milk product. This practice is often adopted for economic benefits, especially when a country has a surplus of milk or offers subsidies for dry milk powder (Guan et al., 2005) Non-dairy milk containing protein fat, skimmed milk, . and other dairy products such as soy, pea, soluble wheat protein containing non-dairy proteins are often the culprits of adulteration by addition There are cases where cow rennet ground powder is mixed with milk powder (Haasnoot et al., 2006). Furthermore, it is not uncommon to replace dairy fats with fats from other sources, which can pose health risks. Due to the high price of dairy fat, some producers of milk fat and dairy products choose to eliminate dairy fat to increase their economies of scale, replacing it with non-dairy fats (e.g. sunflower or soybean oil) such as vegetable oil substitutes (Jha and Matsuoka 2004) .

2. Materials and Methods

2.1 Samples collection

Milk consumers and traders, especially LABANEH, collected 15 samples from grocery supermarkets, a local market, corner shops and dairy shops. Collect two samples of the same size as a consumer or labneh product package Each sample must weigh 250 grams, one sample is sent to the Jordan Food and Drug Administration laboratory for analysis and the other sample is sent to a private laboratory, and keep at 4°C

2.2 Sample preparation

Control sample preparation: Fresh cow milk with acidity 0.16-0.17 and fatty acid content 3.5 was obtained from the farm. The milk was batch-heated at 90 C° for 20 minutes, cooled to 45 C° and then added to the milk containing yogurt starter culture (CHR-Hansen), distributed in glass jars, and used was heated to 40 C° until the pH freezes and then The obtained precipitates were mixed and placed in cheese cloth bags, which ordered not to separate the soil from fresh labne stored at 6±1 C° 16 h, in 24 days. Fat extraction followed the modified Folch method (Challinor, 1996). In this reaction, 2.5 g of each sample was dissolved in 25 mL of chloroform and. methanol (2:1, v/v). The mixture was then homogenized at 2,500 rpm for 30 minutes, followed by a 20-minute ultrasonication step. Then, 10 mL of concentrated NaCl solution was added to the mixture. This suspension was centrifuged at 4,000 rpm for 20 minutes at -4 °C. The resulting chloroform fraction was carefully concentrated and transferred to a 25 mL round bottom flask. A rotary evaporator at 45°C under vacuum was used to further process the lipid extracts (Kim et al., 2013). This evaporation step yielded approximately 0.5 g of oil per sample. The oil was then treated with 8 mL of methanolic solution of 0.5 N NaOH and heated at 85°C for 10 min in a water bath. Then, 9 mL of 14% boron trifluoride (BF_3) solution was added for 2 min. A full NaCl solution was added to the saponification flask and left for 3 minutes. 1 gram of anhydrouss

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Chromatographic analysis

For the separation and determination of fatty acids (FA), we used a model 7890 gas chromatograph (Agilent, USA) equipped with a Supelco 24056 SPTM 2560 capillary GC column (100 m × 0.25 mm id df = 0.20 µm; Sigma Aldrich Co.). .) inserted used. , U.S.A.). and the flame ionization detector (FID). Each sample had a runtime of 67 minutes. The GC FID assay was performed under the following conditions; with an injection volume of 1 µL, a nitrogen carrier gas flow rate of 1.0 mL/min, a split ratio of 50;1, and constant flow control. The injector and detector were kept at a temperature of 250 °C. The oven operation started at 180°C. Stand at this temperature for 40 minutes followed by increasing at 3°C/min up to 230°C for the next 10 minutes. An aliquot of the supernatant was transferred to an autosampler vial in preparation, for GC FID analysis.

3. Results and Discussion

Fatty acid analysis by GC

In the context of vegetable oil blends, the concentration of linoleic acid (C18:2n6c) was found to increase as the rate of adulteration increased (Kim, H. J., Park, 2016) (Kim, J. M. 2015). The initial concentration of linoleic acid (C18:2n6c) in the control sample was 0.30%. The presence of linoleic acid (C18:2n6c) was significantly higher in the dried samples compared to the control samples. Consequently the linoleic acid content (C18:2n6c) is a reliable marker for the identification of vegetable oils such as soybean and corn oil blends in pure milk fat In the case of animal fat blends, oleic acid (C18:1n9c) levels increased with increased rates of adulteration (Kim, H. J., Park, 2016). In the control sample, the initial concentration of oleic acid (C18:1n9c) was measured as 19.437%. The oleic acid (C18:1n9c) content of hybridized samples was consistently higher than that of the control sample, making pure milk fat a reliable marker for the identification of substances e.g pork fat or adulterated ground beef (Table 1). of the control sample was lower than expected, while the ratio of the amount of stearic fatty acid (C18:0) in the samples mixed with vegetable oil to the control sample (Park, J. M., Jeong, 2013).

Cholesterol analysis by GC

GC analysis of the cholesterol profile in control sample and others samples showed that the concentration of cholesterol in the adulterated samples is significantly different. (Kim, H. J., Park, 2016. In case of adulteration with corn oil, the concentration of cholesterol decreased proportion (Table 1).

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Table 1.

Sample	cholestrol	palmatic acid	stearic acid	linolic acid	oleic acid c1	notes	Adulteration
control	2.35	2.01	1.64	0.3	19.44		
GG		10.37	1.11	0.36	21	palmatic acid not lowest than control Stearic acid not higher than control Linoleic acid not higher than control oleic acid higher than control	animal fat
CC		0.27	1.27	0.54	38.014	palmatic acid lowest than control Linoleic acid higher than control oleic acid higher than control	vegetabil oils adultration
AA		0.48	1.34	0	24.43	palmatic acid lowest than control oleic acid higher than control	vegetabil oils+ animal adultration
II	3.71	2.41	1.59	0.44	18.33	Linolic acid Highet than control oleic acid lowest than control	vegetabil oils adultration
MM	4.04	8.78	1.62	0.66	0.3	Linolic acid Highet than control oleic acid lowest than control	vegetabil oils adultration
EE	1.37	0.22	0.3	0.04	7.64	palmatic acid lowest than control Cholestrol lowest than control	vegetabil oils(Corn oil)

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LL	*4.74*	*0.46*	*2.18*	*1.12*	*15.11*	*Linolic acid Highet than control Stearic acid higher than control palmatic acid lowest than control*	*vegetabil oils adultration*
JJ	*3.15*	*11.09*	*2.05*	*0.22*	*22.282*	*palmatic acid not lowest than control Stearic acid not higher than control Linoleic acid not higher than control oleic acid higher than control*	*animal fat*
DD	*5.82*	*10.48*	*1.29*	*0.35*	*24.27*	*oleic acid Higher than control*	*animal fat*
BB	*4.65*	*5.96*	*1.17*	*0.47*	*51.99*	*Linolic acid Highet than control oleic acid Higher than control*	*vegetabil oils+ animal fat*
OO	*5.3*	*8.08*	*1.69*	*0.39*	*22.15*	*Linolic acid Highet than control oleic acid Higher than control*	*vegetabil oils+ animal fat*
NN	*4.14*	*0.35*	*1.38*	*0.24*	*24.14*	*palmatic acid lowest than control oleic acid higher than control*	*vegetabil oils+ animal fat*
FF	*4.9*	*0.58*	*1.95*	*0.33*	*20.13*	*palmatic acid lowest than control Stearic acid higher than control Linoleic acid higher than control oleic acid higher than control*	*vegetabil oils+ animal adultration*

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HH	*5.37*	*10.74*	*1.4*	*0.18*	*26.97*	*palmatic acid not lowest than control Stearic acid not higher than control Linoleic acid not higher than control oleic acid higher than control*	*animal fat*
KK	*5.39*	*11.12*	*2.06*	*0.42*	*23.65*	*Linolic acid Highet than control Stearic acid higher than control oleic acid lowest than control*	*vegetabil oils+ animal adultration*

Conclusion:

The primary objective of this study is to establish key issues related to adultery and physical use. Additionally, industry and accredited research organizations are adopting this approach to view multiple samples simultaneously. This information is particularly valuable for breast lipid analysis, and we anticipate that it can serve as a comprehensive database for further surveillance of the potential for breast adulteration.

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