FATTY ACID COMPOSITION INCLUDING *TRANS* FATTY ACIDS CONTENT OF SELECTED VIETNAMESE INSTANT NOODLES

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ABSTRACT

This study provides information on the fatty acid composition and *trans* fatty acid content analyzed by gas chromatography of selected Vietnamese instant noodle products and accompanying additive oil bag.. Five most abundant fatty acids were C14:0, C16:0, C18:0, C18:1 (9c) and C18:2 (9c, 12c). The concentration of saturated fatty acids ranged from 34% to 45% and from 51% to 60%, and of polyunsaturated fatty acids ranged from 12% to 20% and from 6.7% to 11% in additive oil bags and noodles, respectively. *Trans* fatty acids were detected in all samples but at low concentration and the content ranged from 0.16% to 0.83% of total methyl ester fatty acid in noodles and from 0.23% to 0.7% of total methyl ester fatty acid in small additive oil bags. *Trans* 18:2 isomers were the major group of *trans* fatty acids which were found in all the analyzed brands, representing about 80% of total *trans* isomers.

Keywords: Instant noodles, *trans* fatty acids, fatty acid compositions.

Thành phần axít béo bao gồm axít béo dạng *trans* trong một số sản phẩm mì tôm Việt Nam

TÓM TẮT

Kết quả của nghiên cứu này cung cấp thông tin về thành phần axít béo bao gồm axít béo dạng *trans* trong một số loại sản phẩm Mì tôm Việt Nam, bao gồm cả trong gói dầu gia vị. Có năm loại axít béo chủ yếu được phát hiện trong các mẫu phân tích đó là C14:0, C16:0, C18:0, C18:1 (9c) and C18:2 (9c, 12c). Nồng độ axít béo bão hòa từ 34% đến 45% và từ 51% đến 60%, nồng độ axít béo đa bão hòa từ 12% đến 20% và từ 6,7% đến 11% trong gói dầu gia vị và sợi mì tôm, theo tuần tự. Axít béo dạng *trans* được phát hiện trong tất cả các mẫu phân tích nhưng nồng độ thấp và chiếm từ 0,16% đến 0,83% tổng axít béo ở trong sợi mì và từ 0,23% đến 0,7% tổng axít béo trong gói dầu gia vị. Đồng phân *trans* 18:2 là nhóm chủ yếu của axít béo dạng *trans* được phát hiện trong tất cả các mẫu phân tích, và chiếm khoảng 80% trên tổng số đồng phân dạng *trans*.

Từ khóa: Axít béo dạng *trans*, mì tôm, thành phần axít béo.

1. INTRODUCTION

Dietary intake evaluation of a given nutrient depends on various approaches including the traditional one that consists in crossing consumption data with consumption data (FAO/WHO, 1985). Instant noodles have been used many years ago world-wide,, Vietnam is not an exception because of their convenience of use. Therefore, these products have often been the focus of attention in nutritional studies, especially the quality of fat and fatty acids. As requirement of food law in healthy and nutritional claim aspect, the data on the fatty acid (FA) composition of food are requested for food composition tables and labeling purposes (U.S. Department of Health and Human Services, 2009; UNION., 2006). Therefore, labeling must be able to detail as many individual FA as possible. Nearly all most Vietnamese instant noodle brands, however, did not have information about composition fatty acid, at least amount of polyunsaturated and saturated fatty acids but products were just

labeled with total fat (gram/ total weight). The small additive oil bag is used, which contains oils and food additive ingredients, for improving taste and flavor. Therefore, fatty acids do not only come from the noodles but also from this small oil bag when instant noodle was consumed. However, up to now, the information on label about the qualities, fatty acids composition and nutritional values in this small additive oil bag was not indicated. Obviously, this might lead to misunderstanding and/or misinformation about the true qualities and nutritional values of products.

Other important aspect related to consumer's health of instant noodle products is *trans* fatty acid (TFA) content. Basically, instant noodles are produced through several main steps, these include (1) dough mixing, (2) dough piece forming, (3) rolling, (4) cutting, (5) drying and (6) frying (Hong-Zhuo Tan, 2009). Main ingredients of instant noodles are wheat flour, shortening, and food additives (Fu, 2008). *Trans* fats are not formed during frying process even under drastic heating conditions i.e. heating the unhydrogenated oils at high temperatures or reusing the unhydrogenated oils many times (Tsuzuki, 2010; Liu, 2007; Wakako Tsuzuki 2010). Therefore, TFA in instant noodles may be come from in the ingredient such as shortening, and oils which are used as additive ingredient. Up to date, however, there is very limited data available on the quality of fat in Vietnamese instant noodles.

Thus, the aims of this study was to determine the fatty acids composition including *trans* fatty acid content of selected instant noodles, a type of instant noodle commonly consumed in Vietnam, in order to get the first overview of the Vietnamese instant noodles fatty acids and *trans* fatty acids situation.

2. MATERIALS AND METHODS

2.1. Sampling

Sixteen industrial Instant noodles of different kinds and within a wide price range were chosen for FA analysis. Three package units of each brand of Instant noodles were purchased from local supermarkets and general stores between May and August 2011 with manufacture date from April to July 2011. Each brand was coded with letter from IN1 to IN16. The small oil bag taken from thirteen brands was coded with letter from SB1 to SB13. Lot numbers were checked to ensure that each unit belonged to a different lot. Samples were selected to include the major manufacturers and private company of the Instant noodles in Vietnam. The analyses were carried out in triplicate.

2.2. Methods

Lipid Extraction

For extracting oil in instant noodles, all samples were ground to fine powder with a pestle and fat was extracted with petroleum ether solvent according to goldfish method (Milan, 1998). In brief, twenty grams of sample was weighed in extraction thimbles and 80 ml of petroleum ether were added to each extraction beaker glass. The thimbles were immersed in boiling solvent at 110°C for 90 minutes and then washed for 60 minutes with reflux. The solvent was then evaporated by rotavapor equipment and the fat was collected for preparing transmethylation.

For extracting oil in small additive oil bags, all bag samples were melted at 60°C in an oven to obtain the fat phase and this phase was removed by centrifugation and dried with anhydrous sodium sulfate.

Transmethylation and analysis of fatty acid

Ten milligram of oil sample was converted to fatty acid methyl ester (FAME) by dissolving in hexane and 2M methanolic KOH in a tube (2 ml for each solvent). Then, the tube was shaken vigorously for 2 minutes at room temperature in the vortex. The supernatant was transferred to other test tube and added with sodium sulfate, after that upper layer organic solvent was collected for gas chromatography (GC) analysis.

The fatty acid composition was determined in triplicate by separating the FAME on a GC-MS equipment with BPX-70 column (30m x 0.25mm). The temperature program was 1 min at 170oC

and then it was increased to 225oC with 2oC/min and maintained at this temperature for 7 min. The injection temperature was 250oC, split flow (ml/m) was 100 and split ratio was 100 (Kramer; Zhou, 2002).

Ag+thin layer chromatography fractionation

Total fatty acid methyl esters were fractionated by silver-ion thin layer chromatography. In brief, precoated silica gel 60 high performances TLC was impregnated by dipping in 10% (wt/vol) $AgNO_3$ solution in acetonitrile for 20 min. The plate was then left for 5 min to dry at 110°C in an oven. Total fatty acid methyl esters were applied onto the plate in the narrow band, and developed in hexane/diethyl ether (90:10, vol/vol) solvent. After the developing finished, the plate was then air-dried and sprayed with a 0.2% (wt/vol) 95% ethanolic solution of 2',7'-dichlorofluorescein, examined under UV light and marked. The bands were scraped off, then poured into a short column of anhydrous sodium sulfate (prepared in a Pasteur pipette, plugged with a small piece cotton wool) and extracted with diethyl ether/hexane (50:50 vol/vol), and then analyzed by GC-MS (Pierre Juanéda, Jean-Louis Sébédio, 2007).

Fatty acid methyl ester identification

Chromatographic peaks were identified by comparison with chromatographic of fatty acid methyl ester standards, and with chromatograms reported in literature (Duchateau, 1996; Kramer, 2002; Ledoux, 2009; Martial Ledoux, 2005; Pierre Juanéda, 2007; Vetter, 2005).

3. RESULTS AND DISCUSSION

3.1. Fatty acid compositions of instant noodles

Table 1 shows fatty acid composition of instant noodles analyzed. Palmitic acid was the most abundant fatty acid in all samples; its concentration varied from 43% to 55%. The presence of high amounts of palmitic acid indicated the presence of palm oil. Oleic acid was the next main fatty acid, that accounts for from 32% to 36%, followed by linoleic acid with concentration from 6% to 11% and stearic acid from 3,8% to 6,3%. Various studies (Aro, 1997; Hu, 1999) have suggested that saturated fatty acids with chain length of C12:0-C16:0 are atherogenic, stearic acid is neutral, and oleic and polyunsaturated fatty acids have a lipid lowering effect.

Total saturated fatty acids (SFA) were significantly higher in brand IN16 (60.1%), followed by brand from IN12 to IN15. The lowest concentration of SFA was identified with brand IN5 (51.8%). The content of polyunsaturated fatty acid ranged from 6.3% to 10.6%, which are significantly higher in brand IN1, IN3, IN4 and IN5. The low PUFA content indicated the use of solid fats, often obtained by hydrogenation of refined vegetable oils. Polyunsaturated fatty acids have beneficial effects on both normal heath and chronic diseases, such as regulation of cardiovascular lipid level (Mori, 2000) (Kris-Etherton, 2002) and immune functions (Hwang, 2000)

Monounsaturated fatty acid content ranged from 32 % to 37%. Among the cis-monounsaturated fatty acids, oleic acid was the most represented. Oleic acid is considered to be responsible for lowering the LDL cholesterol levels. For concluding the quality and safety of fat in instant noodles, however, other studies should be carried out for determining some parameters such as peroxides values and p-anisidine values. Rivellese *et al.*(2003) reported that high SFA diets negatively influence the cholesterol and triacylglycerol content of LDL lipoproteins while, on the contrary, high MUFA diets have beneficial effects on LDL cholesterol and triacylglycerols. As the recommendation of Department of Health (UK) (HMSO, 1994), the minimal ratio value of PUFA/SFA should be 0.45. In this study the cis-PUFA/SFA ratio ranged from 0.11 to 0.22 which is much lower than the recommended value.

In this study, all peaks appearing between the C18:0 and C18:1 (9c) major peaks were quantified as the *trans* 18:1 group, even if they did not contain all the trans-C18:1 isomers as the results which were shown in study by Vingering et al. (Ledoux, 2009)

Table1. Fatty acids composition of selected Vietnamese Instant noodles

Fatty acid	Brands							
	IN1	IN2	IN3	IN4	IN5	IN6	IN7	IN8
C14:0	1.48 ± 0.01	1.63 ± 0.08	1.00 ± 0.07	1.12 ± 0.03	1.09 ± 0.09	1.20 ± 0.13	1.19 ± 0.05	1.34 ± 0.10
C15:0	0.06 ± 0.02	0.07 ± 0.01	0.03 ± 0.01	0.03 ± 0.01	0.03 ± 0.01	0.04 ± 0.02	0.03 ± 0.00	0.04 ± 0.01
C16:0	44.11 ± 1.81	46.47 ± 0.34	45.89 ± 1.76	45.13 ± 0.20	45.09 ± 0.46	46.59 ± 0.36	48.24 ± 0.47	49.83 ± 0.31
C16:1 9c	0.12 ± 0.01	0.11 ± 0.02	0.16 ± 0.02	0.10 ± 0.03	0.08 ± 0.01	0.08 ± 0.00	0.10 ± 0.01	0.12 ± 0.02
C17:0	0.08 ± 0.01	0.10 ± 0.02	0.22 ± 0.21	0.12 ± 0.09	0.07 ± 0.01	0.07 ± 0.02	0.07 ± 0.01	0.08 ± 0.01
C18:0	6.12 ± 0.32	6.25 ± 0.19	5.18 ± 0.94	5.51 ± 0.06	5.27 ± 0.21	5.17 ± 0.19	5.08 ± 0.07	4.88 ± 0.30
C18:1(t)	0.13 ± 0.03	0.08 ± 0.02	0.04 ± 0.01	0.08 ± 0.01	0.12 ± 0.04	0.09 ± 0.01	0.04 ± 0.01	0.04 ± 0.01
C18:1(9c)	36.33 ± 1.14	35.70 ± 0.49	35.95 ± 1.34	35.98 ± 0.33	36.02 ± 0.60	34.27 ± 0.43	34.36 ± 0.31	33.34 ± 0.61
C18:1 (11c)	0.64 ± 0.10	0.51 ± 0.02	0.53 ± 0.06	0.58 ± 0.09	0.57 ± 0.04	0.68 ± 0.02	0.60 ± 0.04	0.60 ± 0.03
C18:2(t,c and c,t)	0.57 ± 0.02	0.19 ± 0.01	0.22 ± 0.02	0.45 ± 0.04	0.70 ± 0.05	0.49 ± 0.05	0.19 ± 0.02	0.19 ± 0.02
C18:2 9c,12c	10.07 ± 0.39	8.65 ± 0.17	10.55 ± 0.91	10.59 ± 0.20	10.67 ± 0.11	10.05 ± 0.25	9.81 ± 0.15	9.29 ± 0.35
C20:0	0.25 ± 0.04	0.23 ± 0.02	0.20 ± 0.01	0.24 ± 0.01	0.23 ± 0.02	0.24 ± 0.01	0.23 ± 0.01	0.21 ± 0.03
C20:1	0.05 ± 0.02	0.04 ± 0.01	0.04 ± 0.01	0.05 ± 0.01	0.05 ± 0.01	0.04 ± 0.01	0.04 ± 0.01	0.04 ± 0.01
SFA	52.10 ± 1.47	54.76 ± 0.34	52.52 ± 1.46	52.16 ± 0.17	51.79 ± 0.66	53.30 ± 0.21	54.85 ± 0.45	56.38 ± 0.25
cis-MUFA	37.27 ± 1.27	36.43 ± 0.48	36.73 ± 1.32	36.79 ± 0.30	36.84 ± 0.61	35.15 ± 0.40	35.15 ± 0.31	34.14 ± 0.56
cis-PUFA	10.07 ± 0.39	8.65 ± 0.17	10.55 ± 0.91	10.59 ± 0.20	10.67 ± 0.11	10.05 ± 0.25	9.81 ± 0.15	9.29 ± 0.35
TFA	0.70 ± 0.04	0.27 ± 0.03	0.27 ± 0.03	0.53 ± 0.05	0.83 ± 0.08	0.57 ± 0.05	0.23 ± 0.03	0.23 ± 0.03
cis-PUFA/SFA	0.20 ± 0.01	0.16 ± 0.00	0.21 ± 0.02	0.21 ± 0.00	0.22 ± 0.00	0.22 ± 0.01	0.18 ± 0.00	0.17 ± 0.01

*. Results expressed as percentage of total fatty acid methyl ester. Values are means ± SD for three samples of triplicates.

*. Fatty acids less than 0.1%: C15:0, C17:0, C21:1

*. SFA: saturated fatty acids

*. PUFA: polyunsaturated fatty acids

*. TFA: trans fatty acids

* .MUFA: monounsaturated fatty acids

The amount of total TFA in the samples ranged from 0.16% to 0.83% of total fatty acid with the mean of 0.38%. Total *trans* content was significant higher in brands IN1 and IN5, 0.7% and 0.83%, respectively. The significant lower value was identified with brands IN14, IN12, and IN16, with 0.16%, 0.17% and 0.19%, respectively. The *trans* fatty acids comprise isomers of 18:1 and 18:2, and t*rans* 18:2 isomers were the major group of TFA present in all the analyzed brands, representing 80% of total trans isomers. Total mono-*trans* 18:2 isomer (c,t and t,c) content ranged from 0.15% to 0.80% of total fatty acids, this being the most prevalent group of *trans* polyunsaturated acid. The *trans* 18:1 isomer were found at very low levels (0.01–0.16% of total fatty acids). *Trans* 18:3 isomer content was not found in all samples.

These results show that the amount of *trans* monounsaturated and polyunsaturated in selected Vietnamese instant noodles is quite variable among the analyzed samples. It could be explained by manufacturing process: use of different ingredients , such as shortening and the differences in frying condition, such as temperature, type and quality of oils, and the reuse of oils. All of these factors affect the resulting TFA content of the fat in instant noodles. However, the results also indicate that selected Vietnamese Instant Noodles contain

Table 1 (cont). Fatty acids composition of selected Vietnamese Instant noodles

Fatty acid	Brands							
	IN9	IN10	IN11	IN12	IN13	IN14	IN15	IN16
C14:0	1.17 ± 0.03	1.17 ± 0.17	1.05 ± 0.03	1.14 ± 0.11	1.00 ± 0.02	1.07 ± 0.13	0.94 ± 0.03	0.91 ± 0.02
C15:0	0.03 ± 0.01	0.04 ± 0.01	0.03 ± 0.01	0.04 ± 0.01	0.03 ± 0.00	0.04 ± 0.01	0.04 ± 0.02	0.03 ± 0.01
C16:0	48.68 ± 0.20	50.86 ± 0.86	51.12 ± 0.39	52.68 ± 0.09	51.84 ± 0.47	54.39 ± 0.06	53.24 ± 0.82	55.62 ± 0.40
C16:1 9c	0.10 ± 0.01	0.12 ± 0.03	0.10 ± 0.01	0.10 ± 0.01	0.08 ± 0.01	0.09 ± 0.01	0.08 ± 0.00	0.07 ± 0.01
C17:0	0.07 ± 0.01	0.07 ± 0.01	0.06 ± 0.01	0.07 ± 0.01	0.06 ± 0.00	0.07 ± 0.00	0.06 ± 0.01	0.05 ± 0.01
C18:0	4.75 ± 0.09	4.70 ± 0.33	4.73 ± 0.10	4.30 ± 0.11	4.71 ± 0.15	3.87 ± 0.10	4.19 ± 0.19	4.07 ± 0.11
C18:1(t)	0.09 ± 0.00	0.04 ± 0.02	0.05 ± 0.01	0.03 ± 0.01	0.05 ± 0.01	0.02 ± 0.01	0.03 ± 0.00	tc
C18:1 9c	33.25 ± 0.22	32.97 ± 0.39	32.80 ± 0.13	33.51 ± 0.19	32.84 ± 0.08	32.59 ± 0.33	32.86 ± 0.41	32.30 ± 0.03
C18:1 11c	0.68 ± 0.03	0.55 ± 0.05	0.56 ± 0.04	0.45 ± 0.01	0.39 ± 0.03	0.29 ± 0.01	0.32 ± 0.02	0.28 ± 0.05
C18:2 t,c and c,t	0.51 ± 0.03	0.21 ± 0.05	0.27 ± 0.02	0.16 ± 0.02	0.34 ± 0.02	0.14 ± 0.01	0.30 ± 0.02	0.15 ± 0.02
C18:2 9c,12c	10.39 ± 0.10	9.04 ± 0.47	9.01 ± 0.11	7.28 ± 0.05	8.40 ± 0.21	7.26 ± 0.31	7.73 ± 0.22	6.32 ± 0.36
C20:0	0.21 ± 0.01	0.21 ± 0.03	0.18 ± 0.02	0.19 ± 0.01	0.21 ± 0.01	0.16 ± 0.02	0.17 ± 0.02	0.15 ± 0.01
C20:1	0.06 ± 0.03	0.04 ± 0.01	0.03 ± 0.01	0.05 ± 0.01	0.04 ± 0.01	0.04 ± 0.01	0.04 ± 0.01	0.03 ± 0.01
SFA	54.91 ± 0.14	57.05 ± 0.58	57.17 ± 0.28	58.42 ± 0.17	57.85 ± 0.30	59.59 ± 0.05	58.64 ± 0.63	60.83 ± 0.46
cis-MUFA	34.19 ± 0.19	33.71 ± 0.42	33.54 ± 0.17	34.14 ± 0.18	34.41 ± 0.08	33.01 ± 0.32	33.32 ± 0.41	32.69 ± 0.07
cis-PUFA	10.39 ± 0.10	9.04 ± 0.47	9.01 ± 0.11	7.28 ± 0.05	8.40 ± 0.21	7.26 ± 0.31	7.73 ± 0.22	6.32 ± 0.36
TFA	0.60 ± 0.03	0.25 ± 0.06	0.32 ± 0.03	0.19 ± 0.03	0.40 ± 0.02	0.16 ± 0.00	0.33 ± 0.02	0.17 ± 0.03
cis-PUFA/SFA	0.20 ± 0.00	0.16 ± 0.01	0.16 ± 0.00	0.13 ± 0.00	0.15 ± 0.00	0.12 ± 0.01	0.14 ± 0.01	0.11 ± 0.01

*. Results expressed as percentage of total fatty acid methyl ester. Values are means ± SD for three samples of triplicates.

*. Fatty acids less than 0.1%: C15:0, C17:0, C21:1

*. SFA: saturated fatty acids

*. PUFA: polyunsaturated fatty acids

. TFA: trans fatty acid .MUFA: monounsaturated fatty acids

negligible proportions of *trans* fatty acids, bothwith monounsaturated and poly-unsaturated fatty acids. These results also indicated that cis 18:1, with oleic acid 18:1 (9c) being the main isomer , was significantly higher in all brands, ranged from 32% to 36%. The linoleic acid, 18:2 (9c, 12c), the next cis-isomer was found in samples with content ranging from 6% to 11%. The highest and lowest concentration was determined in brand IN6, and IN16, respectively. Both fatty acids have good nutritional values, especially linolic acid is essential for normal growth, healthy promotion, and disease resistance in man (Carvalho 2011).

Following the requirement of FDA that *trans* fatty acids must be listed in nutrition labeling if a serving contains more than 0.5 gram. It means that the instant noodles studied, could be expressed “0 g”

Fatty acid composition of small additive oil bags

Table 2 show the analysis results of fatty acid compositions of small oil bag which was commonly put in instant noodle bag of Vietnamese products. Oleic acid was the most abundant fatty acid in all samples; its concentration was from 39% to 42% (total fatty

Table 2. Fatty acid composition of small additive oil bag in selected Vietnamese instant noodle products

Fatty acid	Brands					
	SB1	SB2	SB3	SB4	SB5	SB6
C14:0	1.09 ± 0.14	1.00 ± 0.03	1.16 ± 0.05	1.07 ± 0.13	1.13 ± 0.26	4.45 ± 0.08
C15:0	0.03 ± 0.01	0.02 ± 0.00	0.03 ± 0.00	0.02 ± 0.00	0.03 ± 0.00	0.03 ± 0.01
C16:0	34.68 ± 0.54	34.39 ± 0.42	26.04 ± 0.06	29.24 ± 0.37	35.70 ± 0.21	33.76 ± 0.18
C16:1 (9c)	0.19 ± 0.01	0.19 ± 0.01	1.46 ± 0.06	0.79 ± 0.09	0.19 ± 0.04	0.18 ± 0.00
C17:0	0.05 ± 0.01	0.05 ± 0.01	0.09 ± 0.01	0.08 ± 0.01	0.05 ± 0.01	0.05 ± 0.00
C18:0	4.14 ± 0.01	4.43 ± 0.10	6.66 ± 0.20	6.17 ± 0.32	4.13 ± 0.24	4.18 ± 0.06
C18:1(t)	0.07 ± 0.01	0.04 ± 0.00	0.07 ± 0.00	0.06 ± 0.01	0.06 ± 0.01	0.07 ± 0.01
C18:1 (9c)	41.92 ± 0.34	42.25 ± 0.41	40.58 ± 0.25	39.84 ± 0.64	41.22 ± 0.57	40.59 ± 0.18
C18:1 (11c)	0.09 ± 0.02	0.87 ± 0.05	2.31 ± 0.03	1.60 ± 0.06	0.90 ± 0.04	0.81 ± 0.03
C18:1 (12c)	tc	tc	0.06 ± 0.01	0.03 ± 0.01	tc	tc
C18:2 (t,c and c,t)	0.46 ± 0.02	0.24 ± 0.02	0.17 ± 0.01	0.25 ± 0.03	0.47 ± 0.05	0.59 ± 0.02
C18:2 (9c,12c)	16.00 ± .0.36	16.04 ± 0.14	20.13 ± 0.25	19.87 ± 0.32	15.62 ± 0.19	14.92 ± 0.14
C18:3 (t)	0.04 ± 0.01	tc	0.32 ± 0.01	0.03 ± 0.00	0.04 ± 0.01	0.03 ± 0.00
C18:3 (9c,12c,15c)	0.14 ± 0.02	0.13 ± 0.01	tc	0.34 ± 0.03	0.14 ± 0.02	0.08 ± 0.01
C20:0	0.24 ± 0.01	0.25 ± 0.01	0.20 ± 0.02	0.22 ± 0.02	0.25 ± 0.01	0.22 ± 0.02
C20:1	0.07 ± 0.02	0.07 ± 0.01	0.50 ± 0.02	0.27 ± 0.02	0.07 ± 0.01	0.06 ± 0.01
C20:2	tc	tc	0.23 ± 0.01	0.10 ± 0.00	tc	tc
SFA	40.23 ± 0.68	40.14 ± 0.51	34.18 ± 0.32	36.81 ± 0.74	41.29 ± 0.34	42.67 ± 0.27
cis-MUFA	43.13 ± 0.34	43.42 ± 0.38	44.97 ± 0.16	42.60 ± 0.49	42.44 ± 0.51	41.71 ± 0.17
cis-PUFA	16.15 ± 0.38	16.16 ± 0.14	20.48 ± 0.24	20.59 ± 0.26	16.68 ± 0.23	15.62 ± 0.12
TFA	0.56 ± 0.02	0.31 ± 0.01	0.56 ± 0.01	0.34 ± 0.05	0.58 ± 0.07	0.69 ± 0.03
cis-PUFA/SFA	0.41 ± 0.02	0.41 ± 0.01	0.61 ± 0.01	0.56 ± 0.02	0.39 ± 0.00	0.37 ± 0.01

*. Results expressed as percentage of total fatty acid methyl esters. Values are means ± SD for three samples of triplicates.

*. Fatty acids less than 0.1%: C15:0, C17:0, C21:1

*. SFA: saturated fatty acids

*. PUFA: polyunsaturated fatty acids

*.MUFA: monounsaturated fatty acids

*. TFA: trans fatty acids

*. tc: traces

acid methyl esters, FAME), with the highest concentration indentified in brands SB2, SB 9, and SB11, and lowest concentration was found in brand SB4. Palmitic acid was the next most main fatty acid, accounting for from 26% to 39% (total FAME).

The high amounts of oleic acid and palmitic acid indicated the presence of peanut oil, a common oil in Vietnam, and palm oil in these products. Linoleic acid was the next highest with concentration from 12% to 19% (total FAME), followed by stearic acid (3%-7%, total FAME). Cis-isomers 18:1(9c) and 18:2 (9c, 12c) are the main isomers of polyunsaturated fatty acids in all samples. Significant differences between samples were found regarding total SFA (saturated fatty acids), and PUFA (polyunsaturated fatty acids). SFA were around 34% to 45% of total fatty acid methyl esters; cis-PUFA, around 13% to 20% of total methyl esters.

Within the SFA the predominant fatty acid was oleic acid. Among cis-PUFA, oleic acid and linoleic acid were predominant with the concentrations as mentioned above. High content of PUFA has more potential change in quality of fats and oils via oxidized process to form toxic compounds (Andrews, 1960; Crampton, 1951; Frankel, Smith, Hamblin, Creveling, Clifford, 1984; Lamboni, 1998). The oils in these bags may be oxidized during preservation under strict condition such as high temperature and light. This reaction causes deterioration in taste, flavor, and especially a decrease in the nutritional value of oils (Frankel, 1998; Kamal-Eldin, 2003).

Table 2 (cont). Fatty acid composition of small additive oil bag in selected Vietnamese instant noodle products

Fatty acid	Brands						
	SB7	SB8	SB9	SB10	SB11	SB12	SB13
C14:0	1.04 ± 0.18	0.88 ± 0.05	1.06 ± 0.09	0.96 ± 0.02	1.31 ± 0.16	1.41 ± 0.27	0.75 ± 0.12
C15:0	0.04 ± 0.01	tc	tc	0.02 ± 0.00	0.03 ± 0.00	0.012 ± 0.02	tc
C16:0	36.13 ± 0.92	38.40 ± 0.22	37.87 ± 0.50	39.39 ± 0.67	29.74 ± 0.81	36.44 ± 0.11	37.89 ± 1.65
C16:1 (9c)	0.22 ± 0.02	0.19 ± 0.02	0.22 ± 0.02	0.17 ± 0.01	1.33 ± 0.06	0.38 ± 0.04	0.12 ± 0.02
C17:0	0.06 ± 0.01	0.05 ± 0.014	0.07 ± 0.01	0.04 ± 0.01	0.10 ± 0.01	0.19 ± 0.01	tc
C18:0	4.10 ± 0.41	3.78 ± 0.18	3.75 ± 0.24	3.30 ± 0.14	6.66 ± 0.50	6.92 ± 0.17	3.05 ± 0.22
C18:1(t)	tc	0.08 ± 0.01	0.06 ± 0.01	0.05 ± 0.01	0.09 ± 0.01	0.25 ± 0.02	tc
C18:1 (9c)	41.34 ± 0.19	41.33 ± 0.28	42.11 ± 0.82	41.54 ± 0.24	42.06 ± 0.21	40.57 ± 0.42	41.43 ± 0.91
C18:1 (11c)	0.75 ± 0.04	0.76 ± 0.02	0.78 ± 0.05	0.63 ± 0.08	1.45 ± 0.09	0.45 ± 0.02	0.43 ± 0.01
C18:1 (12c)	tc	tc	tc	tc	0.06 ± 0.00	tc	tc
C18:2 (t,c and c,t)	0.35 ± 0.02	0.28 ± 0.03	0.42 ± 0.03	0.38 ± 0.02	0.21 ± 0.02	0.24 ± 0.02	0.23 ± 0.01
C18:2 (9c,12c)	15.55 ± 0.18	13.84 ± 0.08	12.93 ± 0.76	13.19 ± 0.16	15.96 ± 0.22	12.49 ± 0.49	15.45 ± 0.67
C18:3 (t)	0.03 ± 0.00	tc	0.03 ± 0.01	tc	tc	0.03 ± 0.01	tc
C18:3 (9c,12c,15c)	0.11 ± 0.01	0.13 ± 0.02	0.27 ± 0.30	0.09 ± 0.01	0.27 ± 0.02	0.18 ± 0.02	0.34 ± 0.04
C20:0	0.21 ± 0.02	0.20 ± 0.02	0.23 ± 0.04	0.18 ± 0.02	0.15 ± 0.02	0.19 ± 0.01	0.18 ± 0.04
C20:1	0.06 ± 0.01	0.05 ± 0.01	0.09 ± 0.02	0.05 ± 0.02	0.39 ± 0.06	0.06 ± 0.01	tc
C20:2	tc	tc	tc	tc	0.17 ± 0.03	tc	tc
SFA	41.57 ± 0.25	43.31 ± 0.15	43.08 ± 2.02	43.89 ± 0.52	37.99 ± 0.48	45.27 ± 0.52	41.87 ± 1.58
cis-MUFA	42.37 ± 0.20	42.41 ± 0.26	43.26 ± 0.99	42.45 ± 0.36	45.38 ± 0.24	41.71 ± 0.39	41.98 ± 0.91
cis-PUFA	16.04 ± 0.17	14.25 ± 0.12	13.65 ± 1.04	13.65 ± 0.17	16.63 ± 0.28	12.93 ± 0.52	16.03 ± 0.71
TFA	0.38 ± 0.02	0.36 ± 0.04	0.51 ± 0.05	0.45 ± 0.04	0.32 ± 0.02	0.51 ± 0.03	0.23 ± 0.01
cis-PUFA/SFA	0.39 ± 0.01	0.33 ± 0.00	0.32 ± 0.04	0.31 ± 0.01	0.44 ± 0.01	0.29 ± 0.01	0.38 ± 0.03

*. Results expressed as percentage of total fatty acid methyl esters. Values are means ± SD for three samples of triplicates.

*. Fatty acids less than 0.1%: C15:0, C17:0, C21:1

*. SFA: saturated fatty acids

*. PUFA: polyunsaturated fatty acids

*. MUFA: monounsaturated fatty acids

*. TFA: trans fatty acids

*. tc: traceal

Trans fatty acids were also indentified in all samples. The amount of total TFA ranged from 0.25% to 0.80% of total fatty acid methyl esters, less than 1%. Total *trans* fatty acid content was significantly higher in samples SB3 and SB6, 0.80% and 0.72%, respectively. The significant lower content was identified with samples SB3 and SB13, 0.33%, and 0.25%, respectively. The *trans* fatty acids comprise isomers of 18:1, 18:2 and 18:3, and *trans* 18:2 isomers being the major group of TFA present in all the analyzed brands, representing 80% of total *trans* isomers. The mono-*trans* 18:2 isomer (c,t and t,c) content ranged from 0.16% to 0.66% of total fatty acids methyl esters, this being the most prevalent group of *trans* polyunsaturated acid. The *trans* 18:1 isomer was found at very low levels (0.04–0.07% of total fatty acid methyl esters). *Trans* 18:3 isomer content was found in all samples, except sample SB2 but at low concentration. The amount of *trans* 18:1 isomers for brand SB12 was significantly higher which might be due to the use of not quite good hydrogenated oil as one of the fat sources.

4. CONCLUSION

The data obtained in this study, had shown the fatty acids composition of selected Vietnamese instant noodles. The results show that the amount of *trans* monounsaturated and polyunsaturated fatty acids in all the brands studied were very low or even undetectable. The results, however, also shown that selected Vietnamese instant noodles contain large amounts of saturated fatty acids and low amounts of polyunsaturated fatty acids, which mainly palmitic acid, oleic acid and linoleic acids. Therefore, it would be necessary to keep monitoring and inspecting content of atherogenic fatty acids in Instant noodles.

Acknowledgements

The authors would like to thank Dr. Matthias Schreiner for supporting the conduct of a part of this study at his laboratory (Division of Food Chemistry, Department of Food Sciences and Technology, University of Natural Resources and Life Sciences, Vienna), and for his helpful comments and advice. The TRIG2 project provided funding for this work.

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