

COMPARISON OF KNOWLEDGE IN THE FIELD OF NUTRITIONAL FATS AMONG STUDENTS

S. ONACIK-GŪR ^a, A. ŹBIKOWSKA ^a and M. KOWALSKA ^{b*}

^a Faculty of Food Science, Warsaw University of Life Sciences (SGGW), Poland

^b Faculty of Materials Science, Technology and Design,
Kazimierz Pulaski University of Technology and Humanities in Radom, Poland,

*Corresponding author: Tel./Fax: 48 48 3617547,
email: mkowalska7@vp.pl

ABSTRACT

The aim of this work was to analyze the knowledge in the field of *trans* fatty acids (TFAs) and nutritional recommendations related to fats among students at the University of Life Sciences in Warsaw (SGGW) and Wageningen (WUR). The research was done using a questionnaire composed of 16 questions among 194 students from SGGW and WUR in 2012.

In Poland 96% and in Holland 89% of students had heard the name "*trans* fat". More than half of the questionnaire respondents knew industrial sources of TFAs. After comparing the results of the research, in which students succeeded, it was concluded that differences in the level of knowledge were statistically not significant ($p < 0.05$). Eating habits for fatty pastry products representing a potential source of TFAs were similar. WUR students' purchase of pastry products was dependent on price, whereas that of Polish students depended on information and ingredients listed on the package.

- Keywords: *trans* fatty acids, consumer awareness, Polish students, Dutch students, eating habits -

INTRODUCTION

Fats are one of the fundamental food ingredients, which play a significant role in the human body. Their nutritional value depends on the composition of fatty acids (FAs) and content of diluted vitamins. The most important for the organism are FAs, from the group of EFAs (essential fatty acids) (GURR, 2000; BAYIR *et al.*, 2011), and they are easily oxidized.

Fats used for technological purposes should be resistant to high temperatures and storage conditions. For pastry products and frying fats, mainly fats rich in saturated fatty acids (SFAs) and sometimes *trans* fatty acids (TFAs) are used. In the manufacture of many food products it is necessary to use fats with solid consistency. It could be a natural solid fat or a modified fat (McDONALD and MOSSOBA, 1996; MATTHÄUS, 2007). It is possible to alter the characteristics of fats by using hydrogenation, transesterification, mixing and fractionation. Hydrogenation is one of the oldest methods, where double bonds in triacylglycerols (TAG) are saturated. As a result of this treatment unsaturated fatty acids (UFAs) become SFAs. Moreover, *trans* isomerization of FAs occurs within the process of hydrogenation, which results in TFAs. The modified fat has a higher melting point and increased resistance to oxidation (FLACZYK and KORCZAK, 2002; MATTHÄUS, 2007; DOWNES *et al.*, 2013).

TFAs may occur in natural products originating from ruminants. As a result of enzyme activity in ruminants' bodies there occurs *trans* isomerization from *cis* bonds to *trans* (GOODMAN *et al.*, 2001; EFSA, 2004; GEBAUER *et al.*, 2007). The content of TFAs originating from natural sources (from meat and milk) may range from 2 to 8 g/100 g fat depending on kind, breed, way of feeding and season. In Europeans' diet on average 30% of consumed TFA comes from milk and 10% from meat. Fats developed with industrial hydrogenation way may include even 70% of TFA in the whole FAs (MATTHÄUS, 2007; JASTI and KOVACS, 2010; KRASNOWSKA and SALEJDA, 2011). *Cis-trans* isomerization may also happen during high temperature treatment, for example during deodorization of oils or frying (KRASNOWSKA and SALEJDA, 2011).

According to most researchers, *trans* fatty acid isomers have a negative impact on human health. Because of the hazards related to excessive consumption of TFAs, international organizations such as EFSA and WHO have stated that daily intake for adults and children should be reduced as much as possible (EFSA, 2004; DOWNES *et al.*, 2013).

Fats rich in TFAs and SFAs have a negative impact on the cardiovascular system. They contribute to the cholesterol rise in the blood and the higher risk of cardiovascular diseases. There are also reports indicating negative influences of TFA on other human body organs. Consump-

tion of 5 g of SFAs a day may increase the risk of heart diseases by about 2% and of TFAs by even 25% (MARTIN, 2007).

Due to the unfavorable effect of TFAs on the human body, legal restrictions of their content in food products have been implemented (Denmark and Canada). A different solution to reduce the consumption of TFAs is to require labeling of food products with information about the content of TFAs (Canada, USA) (ŻBIKOWSKA, 2010; DOWNES *et al.*, 2013). Denmark is the first country in the world to introduce a tax on food products containing SFAs. The aim of this tax is to reduce the consumption of products rich in saturated FAs and increase the consumption of fruits and vegetables (SIMOPOULOS, 1996).

Due to the negative impact of TFA on the body and any actions concerning with reduction of their consumption, it is important to follow the level of consumer's education in this area. It can be assumed that people with higher education related to food and nutrition sciences, interested in the subject of nutrition, should avoid consumption of products that may adversely affect their health, eg: products with *trans* fatty acids.

The aim of this study was to verify how the education of students at both universities influenced the knowledge in the field of TFAs, purchases of food products and eating habits. Therefore students' scores from the test were compared among students from studies related to food and health sciences with different studies (economic, marketing, agriculture, etc.). In addition, it was hypothesized that students of a master's degree course, especially from majors related to food and nutrition, are characterized by a high level of knowledge in the field of TFAs and fats.

MATERIALS AND METHODS

The analysis was based on the results of a survey carried out in 2012 among students from the University of Life Sciences in Warsaw (SGGW) (in Poland) and the University of Life Sciences in Wageningen (WUR) (in the Netherlands).

Before the questionnaire was distributed to respondents, a pilot test had been done. 215 people participated in the survey, but 194 of these questionnaires were qualified. 90 questionnaires were completed by students with different nationalities from Wageningen University (Table 1), while the rest of the respondents were Polish students from SGGW. The survey was addressed to students finishing their education at universities, from fields of studies related to food and nutrition, and also from other majors, but declaring an interest in the issues of food and nutrition. At first the study was conducted in The Netherlands. Participants of courses related to food sciences, which are in the master's degree program, were invited to take part in the sur-

Table 1 - Nationality of WUR students.

Country	Contribution (%)
Netherlands	38
Spain	18
Czech Republic	10
Finland	4
Germany	4
Hungary	4
USA	4
Canada	4
China	4
France	2
Greece	2
Turkey	2
Denmark	2
Sweden	2

vey. Students taking the bachelor's degree were allowed to participate in these classes (Table 1) only if they had finished specialized courses. Participants of these elective classes were students representing different majors. Therefore people who took part in the study were divided into two groups: respondents studying subjects related (fs) and not related to food and nutrition sciences (nfs). Students from WUR came from different countries, mainly of the European Union (Table 1). Master's degree studies at this university are open, which means that students are recruited from all over the world and classes are taught in English. Then, the study was conducted on respondents from SGGW in Poland. They were mainly students taking a master's degree, from majors related and not related to food and nutrition science. Students not attending any food faculties declared that they were interested in food related topics. In this connection, although there was a small population size it is assumed that the obtained results will answer the question whether it is necessary to intensify the education of students (including those that theoretically should have a high nutritional knowl-

Table 2 - Characteristics of the studied population. Legends: *fs – students from studies related to food science or human nutrition; **nfs – students from studies not related to food science.

Specification		Structure of population (%)	
		WUR	SGGW
sex	women	78	81
	men	22	19
age	average	24.6	24
	SD	5.60	0.99
field of studies	Fs*	38	81
	Nfs**	62	19
degree of studies	beachelor's	16	8
	master's	84	92

edge) in the subject of food fats especially those that contain *trans* isomers.

The survey was held in the classrooms and the questionnaire was distributed in a paper version to respondents. The interviewer was present with the students. Surveys that were distributed to students in The Netherlands were written in English, while in Poland they were in Polish.

Questions in terms of content were divided into those which were a test of the respondents' knowledge (10 questions) and observations of the students' eating habits. In the questionnaire there were also basic questions – legal information (Tables 1 and 2). Most of the respondents were women (Table 2). Most of the respondents were aged 24. In the case of WUR they constituted 24.4% of the whole population, while in SGGW 55.8%. The average respondents' age in Holland was around 25 and in Poland 23. In the Netherlands the age range was much wider than in Poland. The oldest respondent of the survey was 58 years old.

In the discussion results of students from studies related to food and human nutrition and students from studies not related to these fields were analyzed separately. With regard to questions concerning the knowledge test a scoring system was used in which each respondent received one point per correct answer. The maximum score was 13 points. Such presentation of responses helped to interpret the results and assess the level of knowledge of the students.

Survey results were analyzed in Excel 2011 and the statistical program Statistica v10.0. One-way analysis of variance and χ^2 test were applied, with the significance level $p < 0.05$. In order to conduct statistical analysis the responses were expressed as a percentage of answers.

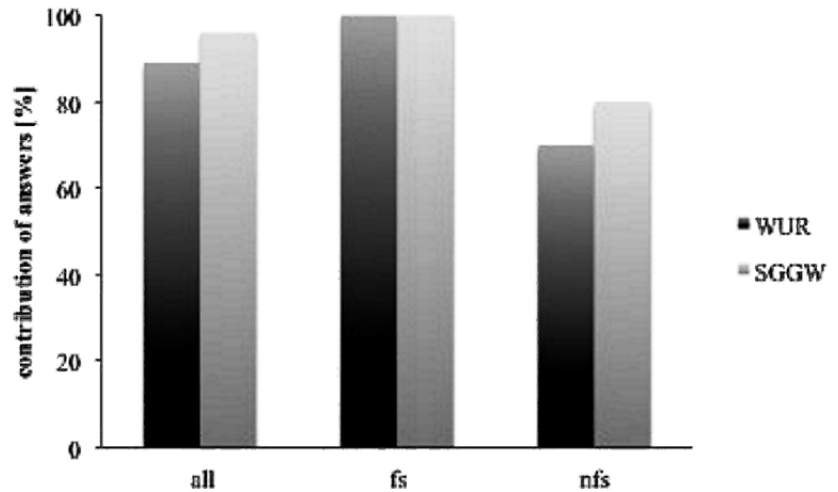
RESULTS AND DISCUSSION

Analysis of the answers given by respondents concerning knowledge of *trans* fatty acids

Over 90% of the examined populations were students from studies related to food or health and respondents interested in this topic.

All students studying in the field related to food and nutrition had heard earlier the name "*trans* fat". However, 65% of WUR and 80% of SGGW students from other studies had heard this term (Fig. 1). Similar studies were conducted in Canada, where since 2005 it has been obligatory to provide information on the content of TFAs. On this basis, it was found that food selection based on TFAs increased significantly (SMED, 2012). A study conducted in 2007 among students of different fields of study (related to food and not related) in the U.S. (where since 2006 it has been obligatory to label food products containing TFAs) showed that 92% of respondents were aware of the term "*trans* fat"

Fig. 1 - Students who had heard the term "trans fat".
 SGGW - University of Life Sciences in Warsaw; WUR - Wageningen University; all - all of the respondents; fs - students from studies related to food science or human nutrition; nfs - students from studies not related to food science.



(STAMPFER *et al.*, 1991). Based on this, it can be assumed that the subject of TFAs is more widespread in the U.S. (also among students of subjects not related to food or nutrition).

Most of the respondents correctly indicate as the main source of TFAs 3 groups of products: shortening, hard margarines and pastry products (Fig. 2). The other correct answers related to natural sources of *trans* fatty acids (milk fat and

dairy products) were selected much more often (30% more) by the students from WUR (Fig. 2a) than from SGGW (Fig. 2b). The aim of the following question was to verify whether respondents knew that food products might be a natural source of TFA developing naturally in bodies of ruminants. In research done by Stampfer (1991) 59% of students considered confectionery products as a source of TFAs in their diet.

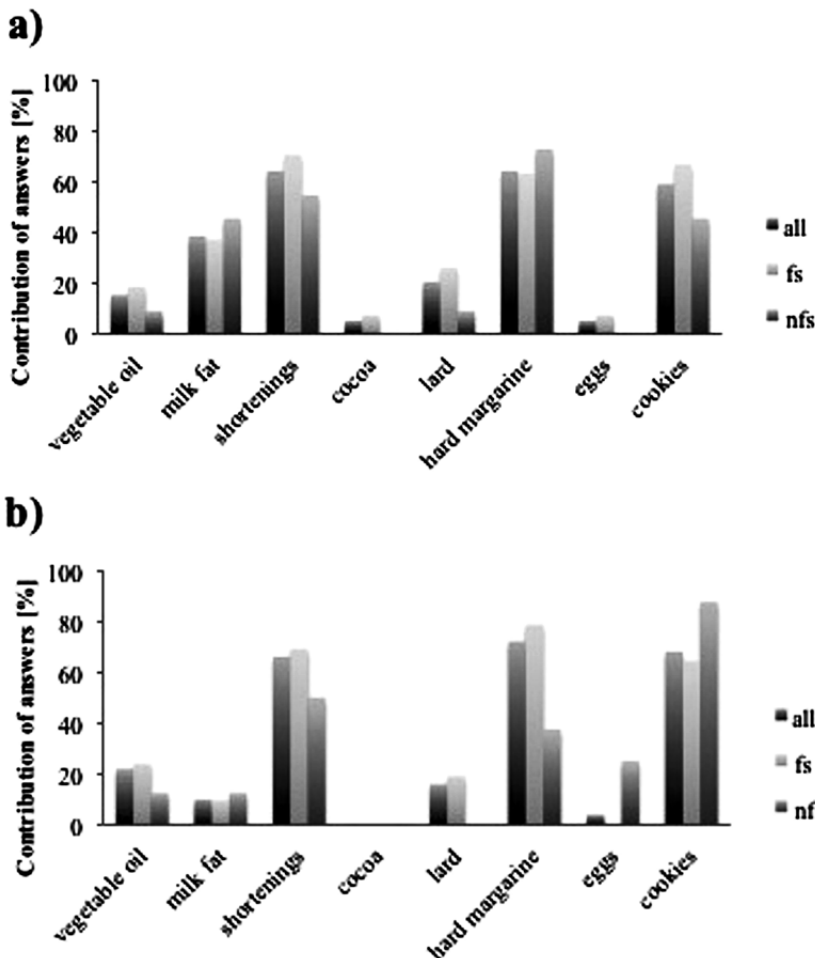


Fig. 2 - Sources of TFAs indicated by students of (a) WUR and (b) SGGW.
 *all - all of the respondents; * fs, nfs - explanation under the Table 2.

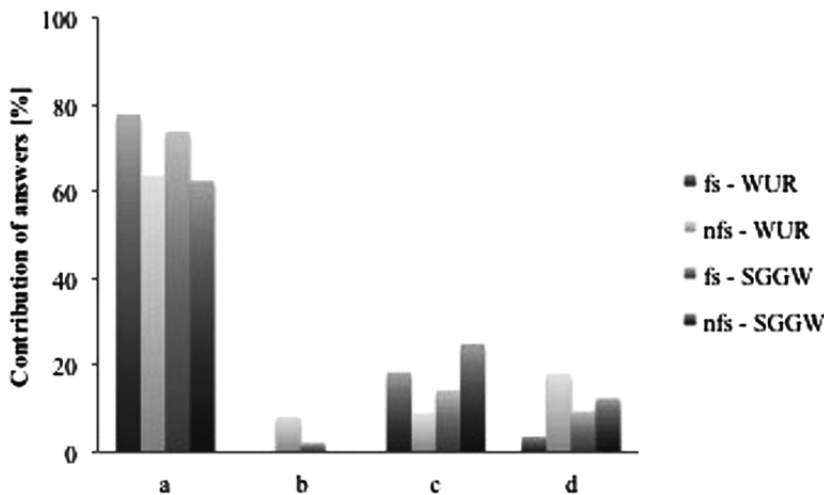


Fig. 3 - Structure of responses to the question "Are TFAs good for one's health?".
 a - no, b - yes, c - it depends on their origin, d - I do not know;
 explanation under the Fig.1.

Analysis of answers given by respondents concerning knowledge of the nutritional role of TFAs and fat

Most TFAs, mainly coming from industrial fats, have a negative influence on the human body. They contribute to increase of cardiovascular diseases. Only in the case of conjugated linoleic acid (CLA), which is present in the fat of ruminants, is it believed that the effect is positive (GEBAUER *et al.*, 2007). Therefore, the next question was to check the students' knowledge about the impact of TFAs on human health. At both universities more than two thirds of the students answered that TFAs have an adverse effect on human health (Fig. 3). Similarly, in another survey (STAMPFER *et al.*, 1991) 73% of American students

considered TFAs as negative food components for health.

Another question, testing knowledge in the field of fats with particular emphasis on TFAs, considered nutritionally valuable elements which are supplied to the body from fat. As nutritionally beneficial elements, respondents chose the following answers: essential fatty acids (EFAs), vitamins and, unfortunately incorrectly, saturated fatty acids (SFAs). All of the students who study food and nutrition and related fields at SGGW selected EFAs and half of them vitamins (Fig. 4a). Among those students who study food science and nutrition at WUR, 89% of them selected the answer for EFAs and 32% for vitamins. Several people (12%) from the Dutch university thought that TFAs are nutritionally important (Fig. 4b).

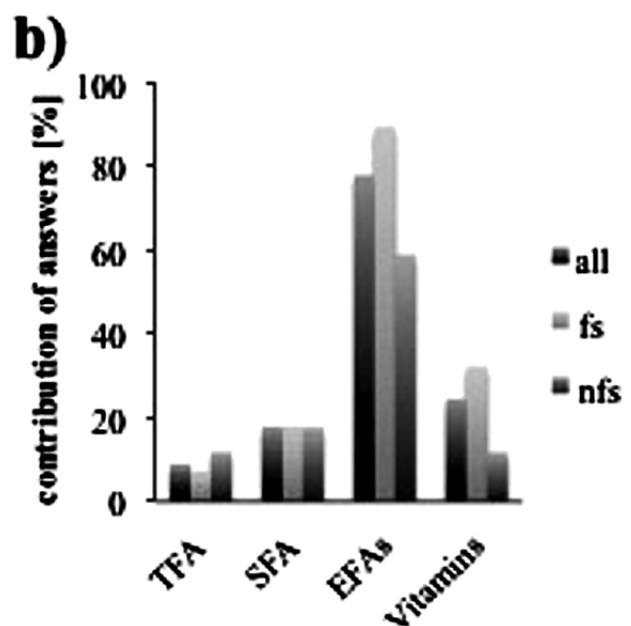
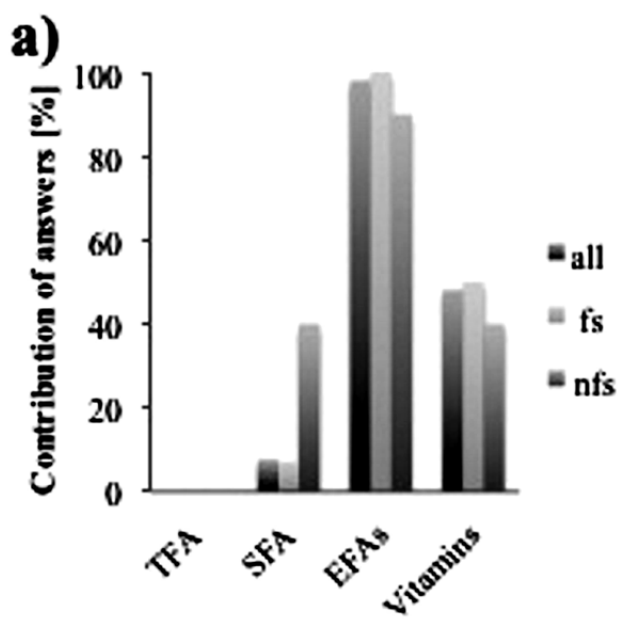


Fig 4 - Nutritionally valuable elements indicated by students of (a) SGGW and (b) WUR. Explanation under the Fig. 1.

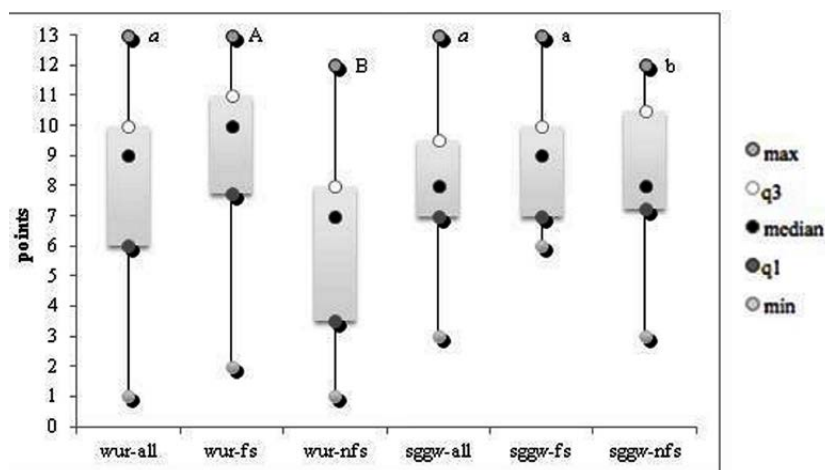


Fig. 5 - Averages of achieved points from students' test results. a, a - statistically not significant; A, B - statistically significant ($p = 0,00291$). *explanation under the Fig. 1.

Results of the knowledge test

From the test of knowledge in the field of fats, students from SGGW in Warsaw scored around 9 points and students from WUR 8 points, from the 13 possible (Fig. 5). Polish students from studies related to food and nutrition sciences did not show any statistically significant differences ($p < 0.05$) in higher knowledge in the field of TFAs and fats than the respondents from unrelated studies (Fig. 5). However, differences were significant in the case of students from the Dutch university.

Eating habits of respondents

Students of both universities were eating pastry and confectionary products at a similar frequency (Table 3). It could be due to similar availability of these types of products in shops and vending machines at universities. Women were consuming much more of these types of products than men. In The Netherlands 80% and in Poland 62% of female students declared that they consume sweet snacks at least several times a week. Men had better eating habits, because two thirds of SGGW male students and

nearly all male students from Wageningen University stated that they eat such products very rarely. Men from the Polish university were eating confectionary and pastry products more often than men studying in Holland. Researchers (URBAŃSKA and CZARNIECKA-SKUBINA, 2007) previously reported that 21% of high-school students were eating sweet snacks every day, while 31% consumed them several times a week. Thus, it can be concluded that university students eat fewer sweets than high-school students.

TFAs develop during frying. The most sensitive to *trans* isomerization in heat treatment are oils rich in unsaturated FAs. MORENO *et al.* (1999) reported that the TFA content substantially increases at 150°C and at 200°C reaches 357% compared to the initial content of *trans* isomers, while at 300°C it reaches the level of 3026%. That is why, for frying, it is advisable to use fats with a high thermal resistance. Almost all of the students declared that they use vegetable oil for this reason (94% of WUR respondents and 90% SGGW). FLACZYK and KORCZAK (2002) obtained a slightly different structure of answers of the question related to the fat used for frying. They found that, for frying meat, the most popular fat was lard (32% of answers) and vegetable oil (25%), for fish vegetable oil (91%),

Table 3 - Frequency of pastry product consumption among SGGW and WUR students.

Frequency of consumption	Contribution of answers (%)					
	WUR			SGGW		
	women	men	all	women	men	all
Once a month / not at all	11	10	11	19	10	17
2-4 times a month	9	90	27	19	60	27
2-4 times a week	43	0	33	31	0	25
almost everyday	37	0	29	31	30	31

and for eggs table margarine (63%). To fry flour-based products 40% of the respondents favored the use of vegetable oils.

Students' decisions related to purchase of pastry and confectionery were influenced by different factors (Table 4). In The Netherlands the most popular factors of purchase taken into consideration were price (29% of answers) and information on the package (24%). However, Polish students indicated first of all the ingredients and the information on the packages (38%) and then the brands (27%). Therefore the Polish students appreciated above all quality of these products and were guided as well by the trust of previously eaten products of the brands. Regardless of universities, one fifth of students claimed that they always chose the same products. In the following question the obtained answers among the students from both universities were different and statistically significant ($p = 0.04654$).

In turn, the studies of Krasnowska and Salejda [2011] showed that 37% of respondents were influenced by the price of products and then by the expiration date and brand (each 26%). The results of this research are very different from the answers obtained by the students from the Polish university.

CONCLUSIONS

Differences in the level of students' knowledge, independently of university, were statistically not significant ($p < 0.05$). Taking into account the fact, the all of the examined population's interest in nutrition aspects, it can be concluded that knowledge in the topic of *trans* FAs was not satisfactory. Most of the examined populations had heard the term '*trans* fats' before and were aware of their negative influence on human health. Some of the students, independently of the university, could not indicate all of the products constituting a potential source of TFAs (around 30%). Polish students were not aware of natural sources of TFAs (less than 10%) compared to students from the Dutch university (around 40%). Polish students from studies not related to food and nutrition sciences had less knowledge in the topic of TFA than respondents in the USA and Canada. Based on this, it can be concluded that Polish society should be further educated and food producers should be encouraged to label packages about nutritional characteristics of fat.

Eating habits related to consumption of pastry and confectionery products, which constitute a potential source of TFAs, of both populations were similar. Worrying is the fact that women (independently of population) were consuming these kinds of products definitely too often.

Taking into account the level of knowledge of Polish students (SGGW) and from different re-

Table 4 - Factors influencing students' decisions of the purchase of confectionery and pastry products ($p = 0.04654$).

Product features influencing the choice	Contribution of answers (%)	
	WUR	SGGW
ingredients and information on the package	24	38
price	29	10
brand	5	27
attractive package	20	4
always the same products	22	21

gions of the EU (studying in the Netherlands – WUR) finishing master's degree studies (fs and nfs) it should be considered that there is still a need for education about the negative effect of TFAs on health and to inform consumers which products can be a source of them in the diet. Based on the obtained results it can be assumed that people coming from different EU regions who were not educated may have even less knowledge in this subject. Moreover, eating habits of women should change as they consume sweet snacks far more often than men, which could be a potential source of undesired fatty acids in the diet.

REFERENCES

- Bayir A. Sirkecioglu A.N. Aksakal E. Bayir M. Haliloğlu H.I. Güneş M. and Aras N.M. 2011. Changes in the fatty acids of neutral and polar lipids of silurus glanis and barbus capito during an annual cycle. *IJFS*. 2: 173.
- Downes S.M. Thow A.M. and Leeder S.R. 2013. The effectiveness of policies for reducing dietary *trans* fat: a systematic review of the evidence. *Bull. World Health Organ*. 91: 262.
- EFSA. 2004. Opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to the presence of *trans* fatty acids in foods and the effect on human health of the consumption of *trans* fatty acids (Request N° EFSA-Q-2003-022). *The EFSA Journal*. 81: 1.
- Flaczyk E. and Korczak J. 2002. Influence of selected factors on consumer behavior on edible fats market. *Acta Sci. Pol., Technol. Aliment*. 1: 113.
- Gebauer S.K. Posta T.L. and Kris-Etherton P.M. 2007. The diversity of health effects of individual *trans* fatty acids isomers. *Lipids*. 9: 787.
- Goodman S. Hammond D. Pillo-Blocka F. Glanville T. and Jenkins R. 2001. Use of nutritional information in Canada: national trends between 2004 and 2008. *JNEB*. 43: 356.
- Gurr M. 2000. The role of Lipids in Human Nutrition. Ch. 13. In „Handbook of olive oil”. ed. J. Harwood and R. Aparicio. p. 521-563. Publisher Springer US.
- Jasti S. and Kovacs S. 2010. Use of *trans* fat information of food labels and its determinants in a multiethnic college student population. *JNEB*. 42: 307.
- Krasnowska G. and Salejda A. 2011. Consumer knowledge about food product labeling. *Żywność. Technologia. Nauka. Jakość*. 74: 173.
- Martin C. Milinsk M. Visentainer J. Matsushita, M. and De-Souza N. 2007. *Trans* fatty acid-forming processes in foods- a review. *Anais da Academia Brasileira de Ciências*. 79: 343.

- Matthäus B. 2007. Use of palm oil for frying in comparison with other high-stability oils. *Eur. J. Lipid Sci. Technol.* 109: 400.
- McDonald R. and Mossoba M. 1996. *Trans fatty acids: label, nutrition, and analysis*, Food Lipids and Health. Chicago, Min D. Marcel Dekker.
- Moreno M. Olivares D. Lopez F. Adelantado J. and Reig F. 1999. Determination of unsaturation grade and *trans* isomers generated during thermal oxidation of edible oils and fats by FTIR. *J. Molec. Struct.* 482: 551.
- Richter E.K. Albash Shawish K. Sheeder M.R.L. and Colombani P.C. 2009. *Trans fatty acids content of selected Swiss foods: The Trans Swiss Pilot study*. *J. Food Comp. Anal.* 22: 479.
- Simopoulos A. 1996. *Trans fatty acids*, Handbook of lipids in Human nutrition. ed. Spiller G. Boca Raton, USA: CRC Press Inc., 91.
- Smed S. 2012. Financial penalties on foods: the fat tax in Denmark. *Nutrition Bulletin.* 37: 142.
- Stampfer M.L. Sacks F.M. Savini S. Willett W.C. and Hennekens C.H. 1991. A prospective study of cholesterol, apolipoproteins, and the risk of myocardial infarction. *N. Engl. J. Med.* 325: 373.
- Urbańska I. and Czarniecka-Skubina E. 2007. Food products consumption frequency of youth offered by school shops. *Żywność. Technologia. Nauka. Jakość.* 52: 193.
- Żbikowska A. 2010. Formation and properties of trans fatty Acids – a review. *Pol. J. Food Nutr. Sci.* 60: 107.

Paper Received October 22, 2013 Accepted April 13, 2014