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Original article

Knowledge about food additives among adults – pilot study

Calin Avram[1], Laura Avram[2], Peter Olah[1], Victoria Rus[1], Ion Mihai Georgescu[3], Oana Maria Bucur[4], Ruta Florina[5]

[1]"George Emil Palade" University of Medicine and Pharmacy, Science and Technology of Targu-Mures, Faculty of General Medicine, Department Medical informatics and biostatistics, Romania; [2] "Dimitrie Cantemir" University of Tirgu-Mures, Faculty of Economical Science, Tirgu-Mures, Romania; [3] Braila County Emergency Hospital, Obstetrics Gynecology 1st Section, Braila, Romania; [4]"George Emil Palade" University of Medicine and Pharmacy, Science and Technology of Targu-Mures, Faculty of Pharmacy, Department of Cellular and molecular biology, Tirgu-Mures, Romania; [5] "George Emil Palade" University of Medicine and Pharmacy, Science and Technology of Targu-Mures, Faculty of General Medicine, Department Community Nutrition and Food Safety, Tirgu-Mures, Romania.

Abstract. *Introduction:* To gain as more benefits as possible from food labels, the level of knowledge of consumers in Romania about the information on the food labels needs to be assessed. *Aim:* The study aims to provide practical results and orientations based on consumers' perspectives, not only for food processors, retailers, but also for designing efficient labels so that for the purchase of food and semi-prepared products they allow the choice of discerning products that meet the requirements preferences or needs such as: low caloric content, low sugar content, without allergens, without additives. *Methods:* To complete this pilot, cross-sectional study, an on-line evaluation questionnaire was developed and disseminated between December 2016 and February 2017. *Results:* Of the total of 476 people surveyed, from which 380 women (namely 79.84%) and the rest 96 of them are men (namely 20.16%) and the rest are women (namely 79.84%). Of those surveyed 214 (namely 45%) of them go shopping at least 3 times a week. Most 348 people (73%) shop in the supermarket or hypermarket. Residency plays an important role in the knowledge of food additives, people in the rural environment have less knowledge than those from the urban environment with regard to the meaning of "E" on the packaging (OR = 3.13, 95% CI: 1.86-5.26), do not know that food additives are not harmful (OR = 0.58, 95% CI: 0.36-0.94), as well as about adequate knowledge of food additives(OR=3.46, 95 % CI: 2.01-5.95). *Conclusions:* An information on the effects of food additives would be beneficial to both the population and the country. This would allow the choice of foods that correspond to the health of the buyer. Awareness and information of the population of the potential elimination or addition of food additives and their function in the final product.

Key words: additives, label, food safety, knowledge

Introduction

The food and agricultural sectors in developing countries have significantly changed in the production, processing, marketing and consumption of food in the last 20 years (1,2,3,4). Globalization, the development of food industry and consumption have led to an increase in nutrition-related health problems, all of which have a significant impact on developed and developing societies (5,6,7,8), the increase of incomes leading to a new lifestyle, the desire for comfort leading to an increase of the consumption of semi-prepared products and processed foods (9).

Today's food products contains a wide range of natural or artificial food additives, which not only serve to increase the preservation of food products, but also to change the colour, taste, smell or texture (10).

Food labelling become an important tool in pre-packaged food commerce and not only. Pre-packaged food producers use label information to market their products, while consumers use information to make informed food choices.

For this reason, a number of European regulations on the provision of food information have been introduced for the correct information of buyers. This has resulted in the obligation to provide information regarding nutrition from 2011 onwards under EU Regulation (EU) No. 1169/2011 (11) on: the minimum size of mandatory information, the clear and harmonious presentation of allergens, and the list of nanomaterials from ingredients (12).

The six Member States of the European Economic Community (EEC) (Belgium, Germany, France, Italy, Luxembourg and The Netherlands) adopted the first Regulation on the Food Additives Directive 62/2645/EEC in 1962, the "E-classification system", a robust food safety system designed to protect consumers from possible food-related risks. Lists food additives approved by the EU (or predecessor organizations) in the form of "E-numbers" that allow a clear identification of a single compound.

Subsequently, according to Regulation no. 1169/2011: "It is important to provide information on the presence of food additives, processing aids and other substances or products with a scientifically proven allergenic or intolerable effect in order to allow consumers, in particular those of them who suffer from food allergies or intolerances, to make informed choices about products that are safe for them" (11).

The buyer perceives the information on the label differently depending on several variables: education level, socio-economic status, age, gender, individual nutrition knowledge, and awareness of the importance of one's own health. In many cases, products are chosen according to the price or brand and less importance is given to the information on the label (13). Traffic light food labelling provides easy understanding of nutritional values by consumers in a context where the lack of correct understanding of labelling was proven to be a big obstacle in its actual reading and the buying of healthier options (14).

To gain as more benefits as possible from the food product's labels, the level of knowledge of consumers in Romania about the information on these labels needs to be assessed.

The present survey proposes to analyze the knowledge and understanding of the labels containing food additives and how this knowledge is reflected in food purchasing decisions in a group of adult people from Mures County, Romania.

The study aims to provide practical implications and orientations based on consumers perspectives, not only for food processors, retailers, but also for designing efficient labels so that for the purchase of food and semi-prepared products they are able to discern allowing the choice of products that meet the requirements of consumers such as: caloric content, saturated fats (CnH_2nO_2), sugar ($C_{12}H_{22}O_{11}$), allergens, additives, etc.

Materials and Methods

Design, sampling and data collection

To complete this pilot, cross-sectional study, an on-line evaluation questionnaire was developed and disseminated between December 2016 and February 2017 using Google Forms, free source survey software from Google Inc. In order to invite as many individuals as possible to participate to this survey, the link to completing the questionnaire has been shared on the Facebook social network. The age of the surveyed persons was requested to be over 18-years-old, and if it was not fulfilled this was a criterion for exclusion from the survey.

The questionnaire included 27 articles, comprising 3 sections. In the first section, questions regarding demographic information included the level of education (primary education, high school, college, higher education), employment status (unemployed, employed, student, self-employed, retired, other/not declared); monthly income (less than 200 Euro, 201 Euro up to 350 Euro, 351 Euro to 550 Euro and more than 551 Euro). The second section referred to the participant's information about the data found on the food labels he or she purchased. The third section dealt

with the subjects' knowledge regarding the food additives found in foods.

The volunteers who completed the questionnaire were informed regarding the objective of the study and were provided with the anonymity of their answers. The study was conducted in accordance with the principles outlined in the Helsinki Declaration.

The statistical analysis was performed using SPSS V20 (IBM, Chicago, IL). The categorical variables are expressed as frequency and percentages. Multivariate logistical regression has been applied to determine the potential correlations between socio-demographic factors (depending on the gender of the participant and place of residence) that determine the consumer's profile with regard to food additive information (those who have chosen the "do not know" answer were taken into account for regression calculation). The threshold for statistical significance was set at $p<0.05$, and all statistical tests were two-dimensional. The participants who answered "do not know" about the food additives questions were not taken into account in the logistic regression calculation.

Results

The present study surveyed a total number of 476 people of which the majority were women (79.84%). The socio-demographic and grocery buyer profile of the study population are described in Table 1. Results highlight that 19% of the study respondents had lower education level, almost a third of them (29%) were unemployed, and almost a half of them (49%) had incomes below 350 Euros per month. Regarding the grocery buyer profile, we have identified that 45% of the respondents do grocery shopping at least 3 times a week, and 73% of them are used to frequent the super or hypermarkets for grocery shopping.

Table 2 presents the level of knowledge about food additives, focusing on the definition, the role of E-number, and the effects of additives. Regarding the level of knowledge about food additives, results highlight that a third of the study population (30%) don't know the meaning of E-number, 38% of the respondents declared that they don't have adequate knowledge of food additives, and 61% of them declared that they do not know that food additives are not harmful.

Table 1. Socio-demographic and grocery buyer profile of the study sample

	Total	**Gender**		**Residence**	
	(n=476)	**Male (n=96)**	**Female (n=380)**	**Rural (n=90)**	**Urban (n=386)**
People with low education level	92 (19%)	18 (19%)	74 (19%)	21 (23%)	71 (18%)
Unemployed	138 (29%)	31 (32%)	107 (28%)	30 (33%)	108 (28%)
People aged over 35	202 (42%)	37 (39%)	165 (43%)	39 (43%)	163 (42%)
People with incomes below 350 Euro	234 (49%)	43 (45%)	191 (50%)	54 (60%)	180 (47%)
Do grocery shoping at least 3 times a week	214 (45%)	43 (45%)	171 (45%)	32 (36%)	182 (47%)
Grocery Shoping is made from supermarket / hypermarket	348 (73%)	73 (76%)	275 (72%)	62 (69%)	286 (74%)

Table 3 shows factors associated with lack of knowledge about food additives. The logistic regression results highlight that gender and residency environment could be factors associated with lack of knowledge about food additives. Results shows that in our study population, men go shopping less than 3 times a week unlike women (OR=1.78, 95% CI: 1.06-3.00, p<0.05) and do not know the meaning of "E" on the packaging (OR=0.52, 95% CI: 0.29-0.93, p<0.05). Men in comparison to women do not know that preservatives are food additives (OR=1.88, 95% CI: 1.11-3.17, p<0.05) and do not know that food additives can cause allergies (OR=0.59, 95% CI: 0.34-0.99, p<0.05).

Also, residence environment plays an important role in the knowledge of food additives, people from the rural environment have less knowledge than those from the urban environment with regard to the meaning of "E" on the packaging (OR=3.13, 95% CI: 1.86-5.26, p<0.001), do not know that food additives are not harmful (OR=0.58, 95% CI: 0.36-0.94, p<0.05), as well as about adequate knowledge of food additives (OR=3.46, 95 % CI: 2.01-5.95, p<0.001).

Discussions

Due to the globalization, development and industrialization that has taken place in the last 50 years, the way and type of food of the world's population has undergone major changes. Romania is a developing country, and Romanian menus are caught between modern (processed, packaged food) and traditional (natural, unprocessed), depending on the time available for cooking, economic possibilities, self awareness

Table 2. Level of knowledge about food additives

	Total	**Gender**		**Residence**	
	(n=476)	**Male (n=96)**	**Female (n=380)**	**Rural (n=90)**	**Urban (n=386)**
Do not know the meaning of the „E" on the packaging	142 (30%)	19 (20%)	123 (32%)	44 (49%)	98 (25%)
The role of „E-numbers" is not to identify additives as easily as possible and to reduce the space on the packaging	108 (23%)	20 (21%)	88 (23%)	18 (20%)	90 (23%)
Additives are not consumed as food, they are added to food for their technological role	72 (15%)	19 (20%)	53 (14%)	4 (4%)	68 (18%)
Preservatives are not food additives	80 (17%)	25 (26%)	55 (14%)	4 (4%)	76 (20%)
It cannot be assigned an „E-number" to all additives	56 (12%)	10 (10%)	46 (12%)	12 (13%)	44 (11%)
I do not have adequate knowledge of food additives	180 (38%)	27 (28%)	153 (40%)	51 (57%)	129 (33%)
I do not know that food additives are not harmful.	290 (61%)	58 (60%)	232 (61%)	46 (51%)	244 (63%)
I do not know food additives that can cause allergies	202 (42%)	29 (30%)	173 (46%)	38 (42%)	164 (42%)

Table 3. Factors associated with lack of knowledge about food additives

Variables/ OR and IC	Women (n=380) vs. Men(n=96)	95% CI	People who live in the Urban area (n=386) vs. Rural area (n=90)	95% CI
Low education	1.13	0.61 - 2.09	0.83	0.43 - 1.60
Unemployed	1.73	0.93 - 3.21	0.94	0.49- 1.80
Age over 35 years	1.07	0.61 - 1.86	0.98	0.53- 1.80
Income below 350 Euro	0.68	0.40 - 1.16-	1.56	0.88- 2.76
Go shoping at least 3 times a week	1.78*	1.06- 3.00	0.55*	0.32- 0.92
The grocery shopping is made from supermarket / hypermarket	1.07	0.620- 1.87	0.82	0.47- 1.45
Do not know the meaning of the „E" on the packaging	0.52*	0.29- 0.93	3.13***	1.86- 5.26
The role of „E-numbers" is to identify additives as easily as possible and reduce space on the packaging	0.68	0.40- 1.16	1.51	0.89- 2.58
Additives are not consumed as food, they are added to food for their technological role	1.54	0.85 - 2.80	0.41*	0.19 - 0.88
Preservatives are food additives	1.88*	1.11- 3.17	0.82	0.45- 1.49
Each additive can be assigned an „E-number"	0.95	0.52- 1.71	0.97	0.52- 1.81
I do not have adequate knowledge of food additives	0.72	0.42-1.24	3.46***	2.01-5.95
I do not know that food additives are not harmful.	0.96	0.61-1.53	0.58*	0.36-0.94
I do not know food additives that can cause allergies	0.59*	0.34-0.99	0.54*	0.31-0.95

**p<.05, **p<.01, ***p<.001*

and residence environment (in the country side, food tends to be more natural/unprocessed because in Romania, the rural population still works in agriculture for their own consumption).

As a result of rising living standards in Romania, this has led to an increase in food trade. This growth, which has an upward trend in recent years is due to the income increases registered (15). Unfortunately, this increase in food consumption is not supported by information on long-term health-related products such as informing the public of the dangers of foods containing high amounts of food additives. In a survey on food safety conducted in 2019 (16) in the EU (included 12 countries), 82% of Romanians said that television is one of the most important sources of information, but at the moment there are no informative messages on TV stations regarding the meaning and role of food additives, on the contrary, TV stations are promotion and advertising channels for processed foods with a high content of food additives. Our study shows that a share of 38% of respondents do not have enough information about food additives, similar to the results of the study conducted in the EU (16), where a share of 26% of Romanians were of the opinion that information on food safety is often very complex and difficult to understand.

A study conducted by Szucs et al. in 2012 (17), on a population sample from Hungary showed that more than half of the study population (61.8%) knew that each additive could be assigned an E-number, this

aspect being similar to the results obtained by the present study, in which only 12% of respondents agreed with the statement "It cannot be assigned an "E-number" to all additives".

Also in the same survey conducted in 2019 (16), in the EU, was concluded that Europeans from Sweden (90%), Netherlands (81%) and Denmark (77%) had a high level of awareness of food safety topics (16 topics, including: additives like colours, preservatives or flavourings used in food or drinks; allergic reactions to food or drinks; genetically modified ingredients in food or drinks), but at the other end of the spectrum, respondents from Romania (30%), Hungary (33%) and Italy (25%), were the least likely to have a very high level of awareness. Countries like Italy (17%) and Romania (16%) had the highest proportions of respondents with a very low level of awareness (i.e. they have heard about one or no topics) (16).

In our study people from the rural environment have less knowledge about additives than those from the urban environment, this is probably due to lower access to information, or lower level of interest from rural respondents, due to the fact that people in the country side consume more food grown by themselves, or they don't pay attention to substances like food additives, because they are thinking that anyway they do not consume, but either way 69% of the rural population surveyed in this study declared that they are doing grocery shopping from supermarket/hypermarket.

A wide range of food additives, which may be natural or artificial, are used in the production of current foods in order to increase the conservation of foods and prevention against the change of color, taste, smell or even texture.

In recent years, there has been a growing interest in replacing synthetic food additives with their natural counterparts. This is due to the fact that many synthetic food additives proved to have side effects on human health. Scientists have pointed out for years that synthetic dyes may be involved in the development of attention deficit hyperactivity disorder (ADHD) (18).

Since 2008, the EU has made the warning label "It can negatively affect children's activity and their capacity of attention" compulsory for all producers using controversial substances. The new regulation applies to tartrazine dyes (E102), quinoline yellow (E104), orange yellow S (E110), azorubine (E122), red cochineum (E124) and allusion (E129) Also, the negative health effects of artificial sweeteners are currently being discussed. Cyclamic acid is banned in the US and the UK because of its potential links to cancer but is still approved as a food additive in the EU like E952. Also, the role of artificial sweeteners in the prevention of obesity is discussed and it is controversial (19).

Unfortunately, this information on food additives is not considered essential for the population purchasing food because in a study conducted in 2018 on a sample of 838 people, only 9.3% of consumers said they were reading label information when shopping, also in the same study it was reported that while consumers check the labels, they do not necessarily understand what they are reading (20). Such studies are multiple and identify the lack of information for the population about food additives, the lack of interest in knowing the side effects on health or the habit of buying a product to which the label serves only for design.

It should be noted that, theoretically, the use of food labels as the only strategy to improve nutritional health is insufficient due to their limited distribution (meaning that they only appear on pre-packaged food but not on fresh fruit or vegetables) (21). In addition, limited nutritional knowledge may reduce the consumer's ability to understand the nutritional information provided in the first place. However, in practice, nutrition information is often the only source of objective information about food available to the consumer (22), which highlights why it is so important to understand how the consumer uses this information.

According to the data obtained in this study, 30% of the population surveyed do not know the meaning of the food additive symbol "E". This should be an alarm signal for decision-makers in Romania, and an information and awareness campaign for the population would have beneficial effects on the health of the population, in order to prevent chronic diseases and to protect population groups with special needs, children, pregnant women, the elderly (23). An informed and conscious person about the information on the food label and in particular, about food additives may choose food that fits his or her health level. An understanding of products that contain food additives would

allow re-orienting customers to healthy products, thus stimulating bio-economy.

A formalization (24,25,26) of the whole labelling process would allow an understanding of the phenomenon, and so more and more people could choose products that fit their own nutritional requirements.

Conclusions

The results of this pilot study indicate that the study's population has an average level of knowledge about food additives, emphasizing that the residence environment and gender could be factors associated with lack of knowledge.

A correct and pertinent information regarding the use of food additives would allow better choice-making decisions about healthier products. By providing information on the effects of food additives and the products, containing high quantities of additives a transition to bio-ecological products can be made.

References

1. Pinstrup-Andersen P. Food policy research for developing countries: emerging issues and unfinished business. Food Policy. 2000;25,p.125–141.
2. Reardon T, Codron JM, Busch L, Bingen J, Harris C. Global change in agri-food grades and standards: agribusiness strategic responses in developing countries. International Food and Agribusiness Management Review. 2001;2,p.421–435.
3. Busch L, Bain C. New! Improved? The transformation of the global agri-food system. Rural Sociology. 2004;69,p.321–346.
4. Deshingkar P, Kulkarni U, Rao L, Rao S. Changing food systems in India: response-sharing and marketing arrangements for vegetable production in Andhra Pradesh. Development Policy Review. 2003;21,p.627–639.
5. WHO. World Health Organization. Global status report on noncommunicable diseases. Geneva. WHO;2014.298 p.
6. WHO. World Health Organization. Global report on diabetes. Geneva: WHO. 2016
7. WHO. World Health Organization (WHO). WHO European Ministerial Conference on Counteracting Obesity: Conference Report. 2009. http://www.euro.who.int/__data/assets/pdf_file/0006/96459/E90143.pdf. [Accessed 14 December 2018].
8. Popkin BM, Adair LS, Ng SW. NOW AND THEN: Global nutrition transition: the pandemic of obesity in developing countries. Nutr Rev. 2012;70,p.3–21.
9. Avram C, Avram L, Ruta F, Georgescu IM, Rus V. Consumer profile in terms of food label reading in Mures country, Romania– a pilot study: Consumer profile in terms of food label reading. Progr Nutr [Internet]. 2020Sep.4 [cited 2020Nov.3];22(4). Available from: https://www.mattioli-1885journals.com/index.php/progressinnutrition/article/view/9225
10. Kallscheuer N. Engineered Microorganisms for the Production of Food Additives Aproved by the European Union-A Systematic Analysis. Frontiers in Microbiology. 2018,9.
11. REG UE. Regulamentul (UE) Nr. 1169/2011 al Parlamentului European si al Consiliului. 2011. https://eur-lex.europa.eu/legal-content/ro/TXT/?uri=CELEX%3A32011R1169. [Accessed 14 December 2018]
12. REG UE. Regulamentul (CE) Nr. 1333/2008 al Parlamentului European si al Consiliului din 16 decembrie 2008 privind aditivii alimentari. 2008. https://eurex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:354:0016:0033:RO:PDF. [Accessed 14 December 2018]
13. Grunert KG, Wills JM. A review of European research on consumer response to nutrition information on food labels. J Public Health. 2007;15,p.385–99.
14. Petrescu DC, Petrescu-Mag RM, Bran F, Rădulescu CV. Consumer Food Security and Labeling Intervention on Food Products through Public Policies in Romania. Amfiteatru Economic. 2018;20(47), p.99–115
15. INS. Institutul National de Statistică. Cifra de afaceri din comerţul cu amănuntul în luna decembrie 2018, http://www.insse.ro/cms/sites/default/files/com_presa/com_pdf/com_amanunt_12r18.pdf. [Accessed 14 December 2018]
16. Food safety in the EU. 2019. https://www.efsa.europa.eu/sites/default/files/corporate_publications/files/Eurobarometer2019_Food-safety-in-the-EU_Full-report.pdf. [Accessed 27 October 2020]
17. Szűcs V, Fülöp Á, Juhász R. Analysis of age differences in the risk perception of food additives: Results of focus group interviews. Acta Universitatis Sapientiae, Alimentaria. 2014; 7,p.96–108.
18. Stevens LJ, Kuczek T, Burgess JR, Stochelski MA, Arnold LE, Galland L. Mechanisms of behavioral, atopic, and other reactions to artificial food colors in children. Nutr. Rev. 2013;71,p.268–281.
19. Suez J, Korem T, Zeevi D, Zilberman-Schapira G, Thaiss CA, Maza O, et al. Artificial sweeteners induce glucose intolerance by altering the gutmicrobiota. Nature. 2014;514,p.181–186
20. Goyal B, Goyal P. Manufacturing of Potato Chips and its Quality Improvement. J Food Process Technol. 2018;9:12, 1000765.
21. Mulders MDGH, Corneille O, Klein O. Label reading, numeracy and food & nutrition involvement. Apetite. 2018;128,p.214–222
22. Cowburn G, Stockley L. Consumer understanding and use of nutrition labelling: A systematic review. Public Health Nutrition. 2005;8(1),p.21–28.

23. Iacob OM, Bacarea A, Ruta FD, Bacarea VC, Gliga FI, Buicu F, et al. Anthropometric indices of the newborns related with some lifestyle parameters of women during pregnancy in Tirgu Mures region-a pilot study. PROGRESS IN NUTRITION 2018; 20(4), 585–591. doi: 10.23751/pn.v20i4.7080
24. Calin A, , Adrian G, Laura A. A Formal Model Based Automated Decision Making. 2020;46, 573–579. doi: 10.1016/j.promfg.2020.03.083
25. Avram C, Gligor A, Avram EL. (2012). New approach on optimal decision making based on formal automata models. Procedia Economics and Finance 2012; 3, 852–857. doi: 10.1016/S2212-5671(12)00240-7
26. Calin A, Laura AE, Adrian G. (2014). Formal Models for Describing Mathematical Programming Problem. Procedia Economics and Finance 2014; 15, 1501–1506. doi: 10.1016/S2212-5671(14)00617-0

Correspondence:
Laura Avram,
Associate Professor, PhD, "Dimitrie Cantemir" University of Tirgu-Mures, Faculty of Economical Science, Bodoni Sandor Street 3-5, code 540545, Tirgu-Mures, Romania,
Phone: +40722405615
E-mail: eleonora_avram@yahoo.com