NAJA ERŽEN[2], MILICA KAČ[2], IGOR PRAVST[1]*
*Corresponding author
1. Nutrition Institute, Tržaška cesta 40, Ljubljana, Slovenia
2. University of Ljubljana, Biotechnical Faculty, Jamnikarjeva 101, Ljubljana, Slovenia


Naja Erzen

Perceived healthfulness of dairy products and their imitations:
nutrition experts' perspective

KEYWORDS: dairy products, dairy imitations, perceived healthfulness, nutrition experts, Slovenia

Abstract Due to their nutritional quality, milk and dairy products are an important element of the human diet in many countries, while there is also an emerging market for their plant-based imitations. These are marketed as a healthier alternative to dairy products, employing the negative health image of saturated animal fats, the animal origin of dairy products, the prevalence of milk allergies and lactose intolerance. The objective of this study was to evaluate the healthfulness of dairy products and their imitations as perceived by experts working in the area of nutrition and food technology. The perceived healthfulness of 112 representative food products was measured using a modified Delphi method. We observed that the nutrition experts generally perceived dairy products to be healthier than their plant-based imitations. The most important negative factors influencing the experts' perception of the healthfulness of the tested products were fat, sugar and sodium content.

INTRODUCTION

In many parts of the world, milk and dairy products have been an important element of the human diet for thousands of years (1). The wide diversity of dairy products and their nutritional quality are clearly important factors boosting their popularity (1, 2). This has also led to the emergence of a market for plant-based dairy imitations which offer a similar texture and taste to traditional dairy products, but have different properties, e.g. dairy-free, lactose-free and a low fat content. Dairy imitations have become important due to the negative health image of saturated animal fats and increasing demand for products of a non-animal origin. Moreover, milk allergies and/or lactose intolerance are common and dairy imitations enable the consumption of dairy-like foods without these health concerns (1). Plant-based dairy imitations are being marketed aggressively as a healthier alternative to dairy products and are growing in popularity (1, 3, 4).

Milk and dairy products are recognised as an important dietary component in Europe, being a useful source of highly valuable protein, calcium, vitamins (B2, B12 and D, if added) and essential fats. However, there are significant differences between countries in both the quantity and type of dairy products consumed (2, 5-8). In Slovenia a trend of greater consumption of dairy products was observed in the last decade; similar trends are also reported for other European countries and Australia (8, 9). Szakaly and colleagues (10) investigated consumer knowledge about the origin of some dairy products and their plant-based imitations in Hungary; they observed that a significant proportion of consumers did not know about the origin of butter (26.7 percent) and margarine (14.0 percent), and many confused certain food categories. Bus and Worsley (3) studied Australian consumers' perceptions of whole milk, reduced fat milk and soy milk. They determined that consumers held positive perceptions about milk, mainly due to its good sensory properties, as providing a good source of nutrients and being a convenient and safe product. However, misperceptions and unawareness about the nutritional composition of milk were also prevalent. The most negative perceptions were found for whole milk, largely related to consumers' beliefs that whole milk is high in fat, cholesterol and energy. On the other hand, soy drinks received lower ratings for sensory quality than milk. In another study, Bus and Worsley (4) showed that whole milk was generally perceived more negatively than soy or reduced fat milk. While these findings highlight consumers' perceptions of dairy products and some of their plant-based imitations, the opinions of nutrition experts and food technologists have not yet been investigated.

The objective of this study was to evaluate the healthfulness of dairy products and their imitations as perceived by experts working in the area of nutrition and food technology, and to assess the reasons for their opinion. We asked 19 of such nutrition experts to score the healthfulness of 112 representative food products from the market and to support their decisions with argument.

MATERIALS AND METHODS

Sampling of foods

The sampling was done in grocery stores of the three retailers with a share of sales exceeding 60 percent of the market in Slovenia (one megamarket, one supermarket and one discounter). The retailers provided us with a list of food products available in the market. The starting sample included all foods in selected food categories that were available in selected grocery stores at the time of sampling. Using simple randomisation, we selected a final sample composed of 112 food products in the following categories: 9 milks (8 percent), 35 yoghurts (31 percent), 40 cheeses (36 percent), 5 butters (5 percent), 8 imitation milks (7 percent), 7 imitation yoghurts (6 percent), 2 imitation cheeses (2 percent) and 6 margarines (5 percent). We used the FoodEx II food classification system (11) to decide whether a particular food product is an imitation dairy product. In FoodEx II, imitation dairy products are described as food preparations created as imitations of dairy products using alternative ingredients, e.g. of plant origin instead of animal origin. Soya, almond and rice drink are examples of such imitation milk. Soya desserts were included among imitation yoghurts. In the absence of other imitation cheeses, soya tofu was included in this category. The number of products per food category correlates with the prevalence of the selected food categories in the market. The selected food products were photographed for further evaluation. The following information was collected from the product labelling: name of the product, nutrition declaration, ingredients and nutrition and/or health claims.

Assessment of the foods by nutrition experts

The foods included in the study were assessed by 19 nutrition experts and food technologists (5 experts from academia, 9 experts from public and research institutions and 5 experts from the food industry), which we chose by way of purposive sampling. The Delphi method is typically used to develop a consensus on an issue in question (12), but can also be modified to provide qualitative information about the various opinions, without reaching a consensus among the experts involved in the study (13). We used such a modified method (13) to obtain the nutrition experts' subjective opinions on the perceived healthfulness of dairy products and their imitations. The method included a multistage process involving the initial measurement of opinions (first round – questionnaire), followed by data analysis, and a second measurement of opinions (second round – personal interview). In the first round, a survey questionnaire was used to measure the perceived healthfulness of test products and to collect the reasons for their opinion. The following information from the food label was available to the experts at the time of scoring: name of the product, nutrition declaration and ingredients. The commercial name (brand) of the product was not disclosed. The experts were asked to complete the survey questionnaire in which they scored the healthfulness of the selected 112 food products using a Likert scale from 1 (˝less healthy˝) to 6 (˝healthier˝), and to support their decisions with arguments. The experts' arguments for scoring the healthfulness of a particular product were collected as independent recalls, classified in groups (e.g. good nutritional composition, low in fat, high in sodium,...) and counted across the tested food categories. The results of the scoring are presented in Table 1, while the results of such counting are shown in Figure 1. After this first round, we analysed the results and identified outliers using an interquartile range. The second round was carried out in the form of personal interviews with the nutrition experts. In the interviews the experts were made familiar with the average scores of the test products and asked to explain the reasons for their outlying scores, if any. Results of the second round were evaluated and are presented descriptively.

Statistical analysis

A statistical comparison of the nutrition experts' assessments was performed using a Welch *t*-test for the following comparable categories of foods: milk vs. imitation milk, yoghurts vs. imitation yoghurts, butter vs. margarine). P-values < 0.05 were considered to be statistically significant. Analyses were performed using the R software v.2.13.0: R Console and R Commander (The R Foundation for Statistical Computing, Vienna, Austria) and Microsoft Excel 2007 (Microsoft Corporation, Redmond, USA).

Food category	Foods in set	Perceived healthfulness scores (±SD)			
		All experts (N=19)	Experts from academia (N=5)	Experts from institutions (N=9)	Experts from food industry (N=5)
Milk	9	4.9±0.3*	4.9±0.3	4.8±0.4	5.1±0.2
Imitation milk	8	4.6±0.2*	4.8±0.2	4.4±0.3	4.9±0.4
Yoghurts	35	4.0±0.8	4.3±0.7	3.9±1.0	3.7±0.9
Imitation yoghurts	7	3.9±0.3	4.3±0.2	3.6±0.3	4.0±0.5
Cheeses	40	3.6±0.7	3.4±0.8	3.8±0.7	3.3±0.8
Imitation cheeses	2	4.7±0.4	4.6±0.3	4.6±0.5	5.0±0.3
Butter	5	2.9±0.1*	2.6±0.1	3.5±0.1	2.3±0.2
Margarine	6	2.6±0.3*	2.9±0.5	2.7±0.2	2.3±0.4

Table 1. Healthfulness scores given by experts in nutrition and food technology using a Likert scale from 1 (˝less healthy˝) to 6 (˝healthier˝).
Notes: *statistical significant difference ($p<0.05$); calculated for scoring by all experts (N=19) for the pairs: milk vs. imitation milk, yoghurt vs. imitation yoghurt, butter vs. margarine.

RESULTS AND DISCUSSION

The results of the nutrition experts' scoring of the selected foods' healthfulness are shown in Table 1. A Likert scale from 1 (˝less healthy˝) to 6 (˝healthier˝) was used to measure the perceived healthfulness. The statistical significance of the difference in scoring was calculated using the scores of all experts for the following pairs: milk vs. imitation milk; yoghurt vs. imitation yoghurt; and butter vs. margarine. The statistical significance of the scoring differences was not calculated between cheeses and imitation cheeses due to the difference in the number of samples within those categories. This difference occurred because a randomisation of available foods was used in the sampling. Since considerably more cheeses are available in the market compared to their plant-based imitations, this difference was reflected in the final sample. Using the survey questionnaire, we also assessed which parameters had the biggest impact on the nutrition experts' healthfulness scores. Parameters were collected

using independent recalls in the evaluation of all 112 food products. The parameters that influenced the nutrition experts' assessments of comparable categories of the foods in question are summarised in Figure 1 where the number beside a particular parameter means how many times that parameter was mentioned by the nutrition experts within the observed category of products.

Mean scores for milk and imitation milk were 4.9±0.3 and 4.6±0.2, respectively; the difference was statistically significant (p=0.02) (Table 1). For both milk and milk substitutes, the highest scores were given by industry experts (5.1±0.2 and 4.9±0.4, respectively) (Table 1). Analysis of all the experts' responses showed that fat content and processing techniques were two key factors with a negative impact on the scoring of milk products (Figure 1: A, B). With imitation milk, a negative impact was observed in relation to sugar content and overall composition/ ingredients. In contrast, factors with the most positive impact were nutritional composition in the case of milk, and energy value/calories and fat content in the case of imitation milk. These findings are in agreement with the results of a study investigating consumers' perceptions of milk and soy-based imitation milk, where positive perceptions of milk were related to nutritional composition and good sensory properties (3).

The difference in the mean scores between the yoghurts (4.0±0.8) and imitation yoghurts (3.9±0.3) was not statistically significant (p=0.77) (Table 1). In the case of the yoghurts and their plant-based imitations, the highest scores were given by experts from academia (4.3±0.7 and 4.3±0.2, respectively) (Table 1). Interestingly, sugar content was the most commonly mentioned factor with a negative scoring impact for both yoghurts and imitation yoghurts (Figure 1: C, D). The parameters with the most positive impact for yoghurts were fat and sodium/salt. In the case of imitation yoghurts, the values of parameters with a positive impact on the assessment were very similar and so it is difficult to point to any particular one.

Mean scores for cheeses and imitation cheeses were 3.6±0.7 and 4.7±0.4, respectively (Table 1). For cheese products, the highest scores were given by experts from institutions (3.8±0.7), while for imitation cheeses the highest scores came from industry experts (5.0±0.3). Regarding cheese products, the nutrition experts mentioned that the most negative impact on scoring arose from the fat and sodium content, while a positive impact came from the calcium and protein content (Figure 1: E, F). In relation to imitation cheeses, parameters with a negative impact (fat, ingredients and dietary fibre) were mentioned only a few times, while the most prevalent factor with a positive impact was the protein content, followed by a lower sodium/salt content.

The difference between the mean scores for butter (2.9±0.1) and margarine (2.6±0.3) was relatively low, but statistically significant (p=0.03) (Table 1). In the case of butter, the highest scores were given by experts from institutions (3.5±0.1) and for margarine by experts from academia (2.9±0.5) (Table 1). As expected, fat content was the factor with the most negative impact on the scores for both butter and margarine, followed by the presence of food additives in the case of margarine (Figure 1: G, H). In both categories the negative impact of saturated fatty acids was also observed. Factors with a positive effect on the scoring of the products were mentioned much less frequently.

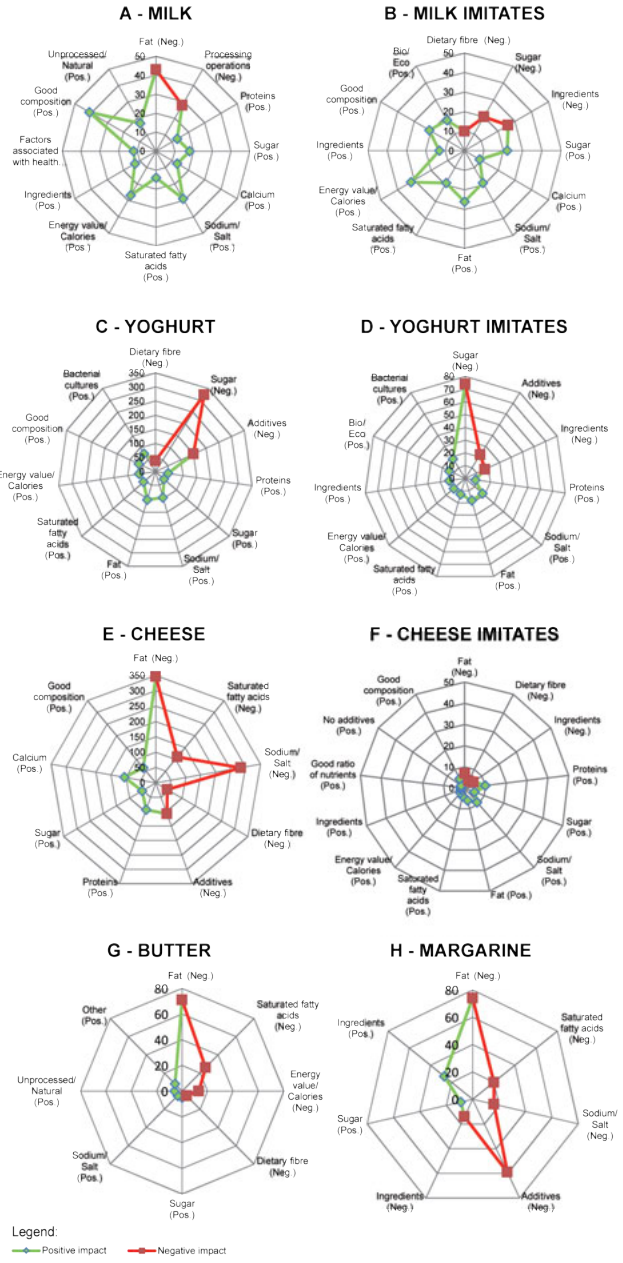

Figure 1. Parameters mentioned by the experts as important in the scoring of healthfulness.

After the scoring survey, personal interviews were carried out (the second round) with all experts to obtain a more in-depth understanding of their (non)acceptance of dairy products and their imitations. The experts were made familiar with the average scoring of the test products and asked to explain the reasons for their outlying scores, if any. We noted a wide variety of reasons for the experts' decisions, making it difficult to point out any particular ones. Soy was one of the main ingredients in imitations of cheese, yoghurt and milk, and some experts saw this as a negative factor due to the risk of soy allergy and as a possible source of genetically modified organisms (GMOs). Interestingly, the presence of milk constituents, which also

pose a risk in the case of milk allergy, was noted much less frequently. Further, for margarines composed of vegetable fats (without soy as an ingredient), ingredients were mentioned as a factor with a positive influence on the overall scoring.

CONCLUSIONS

Based on the results of the nutrition experts' healthfulness scores for the tested dairy products and their imitations, we may conclude that milk and dairy products are generally perceived to be healthier than their plant-based imitations. These results are in line with previously reported observations performed on consumers where milk and dairy products were also perceived to be healthier than their plant-based imitations. The most important general negative factors influencing the experts' perception of the tested products' healthfulness were fat, sugar and sodium content, and soy as an ingredient in the case of imitations of cheese, yoghurt and milk.

ACKNOWLEDGEMENTS

We acknowledge Katarina Košmelj (University of Ljubljana, Slovenia) for help in interpreting the results and statistics, and Murray Bales for providing assistance with the language. The work was financially supported by the Ministry of Agriculture, Forestry and Food of the Republic of Slovenia, the Slovenian Research Agency (Contract 1000-11-282007, Research project V7-1107), the Ministry of Higher Education, Science and Technology of the Republic of Slovenia, and the European Social Fund (PhD co-financing contract 26-96).

REFERENCES AND NOTES

1. Euston S.R., *Dairy Substitutes,* in *Kirk-Othmer Encyclopedia of Chemical Technology*, John Wiley & Sons, Inc., Hoboken (2007), 1-23.
2. Ozen A.E., Pons A., et al., *Nutr Rev*, **70(8)**, 472-481 (2012).
3. Bus A. and Worsley A., *Public Health Nutrition*, **6(2)**, 201-208 (2003).
4. Bus A.E. and Worsley A., *Appetite*, **40(2)**, 93-100 (2003).
5. Buttriss J., *Dairy Products: Nutritional contribution,* in *Encyclopedia of Food Sciences and Nutrition*, Edited by Caballero B., Trugo L.C., et al., Eds. Academic Press, Amsterdam (2003).
6. EFSA, *The EFSA Journal*, **644**, 1-44 (2008).
7. Fox P.F., *Milk: Introduction,* in *Encyclopedia of Dairy Sciences*, Edited by Fox P.F. and McSweeney P.L.H., Eds. Academic Press, Amsterdam (2011), 458-466.
8. Koch V. and Kostanjevec S., *Pogostost uživanja živil,* in *Prehrambene navade odraslih prebivalcev Slovenije z vidika varovanja zdravja*, Edited by Gabrijelčič Blenkuš M., Ed. Pedagoška fakulteta, Univerza v Ljubljani, Ljubljana (2009).
9. Walker K.Z., Woods J., et al., *Public Health Nutrition*, **13(7)**, 1036-1041 (2010).
10. Szakaly Z., Szente V., et al., *Milchwissenschaft - Milk Science International*, **67(2)**, 181-184 (2012).
11. EFSA, The food classification and description system FoodEx 2. Supporting Publications 2011:215, 438 pp. URL: http://www.efsa.europa.eu/it/search/doc/215e.pdf (last assessed on 14 May 2014).
12. Rayens M.K. and Hahn E.J., *Policy, Politics, & Nursing Practice*, **1(4)**, 308-315 (2000).
13. Medved Djurasinovic P., Kuhar A., et al., *Bulgarian Journal of Agricultural Science*, **18(6)**, 834-845 (2012).