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Do Consumers' Attitudes Towards Food Technologies and Motives of Food Choice Influence Willingness to Eat Cereal Products Fortified with Fibre?

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Key words: bread, food technology neophobia scale, consumer, fibre, cereal products

The aim was to assess the relationships between willingness to eat cereal products fortified with fibre, attitudes towards food technologies and some food choice motives.

The questionnaire survey was carried out in 2013 within 1000 Polish consumers. Selection criteria of the sample took into account representativeness of the population due to province, then the choice had quota character by gender, education and size of residence place. The questionnaire consisted of questions on Food Technology Neophobia Scale (FTNS), motives of food choice (health, quality, and hedonic value) and intention to eat bread, pasta and biscuits fortified with fibre. The frequency analysis, cross tables and cluster analysis were used to analyse data. Relationships between parameters were assessed by calculating Pearson correlation coefficients using SPPS, version 21.0.

The neophilic attitudes towards new food technologies (12.6% of participants) were represented by more women and people in the 26–35 age group. More neophobic (16.1%) were male, worse educated and older respondents. Only 18.4% of participants were in cluster "wanting to eat". More of them were people with neophilic attitudes. Among "not wanting to eat" (24.5%) there were more men, worse educated respondents, and representing neophobic attitudes. There were statistically significant correlations between perceived motives of food choice and declared intentions to eat cereal products fortified with fibre, except perceived pleasure from eating pasta. The willingness to eat cereal products fortified with fibre was significantly determined by attitudes towards new food technologies, health, quality and pleasure as motives of food choice, but also by socio-demographic profile.

INTRODUCTION

Nowadays consumers are becoming more demanding and conscious of their food selection [Lindeman & Vaananen, 2000], especially with regard to novel foods. They are expressing more stringent requirements and greater concern for quality of the products and health benefits associated with them [Barrena & Sánchez, 2013].

It appears that now consumers understand that nutrition may affect their health and well-being, primarily in relation to prevention of chronic diseases [Pounis *et al.,* 2011]. Therefore today foods should not be intended only to satisfy hunger and to provide necessary nutrients for humans but also to prevent nutrition-related diseases and improve physical and mental well-being of the consumers [Siro *et al.,* 2008].

As a result of these changes in consumer preferences and the constant saturation of the market, food producers are forced to develop new products, nutrient-enriched, or produced by using new technologies in order to meet consumer needs and demands, and to position themselves competitively on the market [Siro *et al*., 2008; Barrena & Sánchez, 2013].

Numerous consumer studies have pointed out that the most meaningful factor that directs consumers food choices in general is the taste of food [Urala & Lahteenmaki, 2004]. This also applies to the specific case of functional and unfamiliar foods [Verbeke, 2006; Siegrist *et al*., 2013]. The second very important factor is the perceived impact of consumed food products on health and well-being. Also the factors, such as food attributes, and the perceived relevance of the health claim to the consumer, have an influence on perception, willingness to buy and consumption of novel foods [Jeżewska-Zychowicz, 2009; Pounis *et al*., 2011].

According to latest literature, consumers' awareness of health issues shows growing trend which results in their willingness to change the eating habits in order to secure healthy life [Niva, 2007; Siro *et al.,* 2008]. Providing people with proper information on the effect of various diets on their health and therefore persuading them to make these changes would influence general public health by decreasing mortality and increasing quality of life, which is in a common economic and public interest [Van Kleef *et al.*, 2005; Siro *et al*., 2008].

The acceptance of specific functional ingredients is linked to the consumer's knowledge of their effects on health. Therefore, functional ingredients, which have been in the consumers' mind for a relatively long period (*e.g.* vitamins, fibre, minerals) achieve considerably higher rates of the acceptance than

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ingredients, which have been used since a short period of time (*e.g.* flavonoids, carotenoids, omega-3 fatty acids, selenium, xylitol) [Urala & Lähteenmäki, 2004; Siro *et al.,* 2008].

The dietary fibre deficiency among consumers encourages more and more research on fibre fortification in different products. The dietary fibre can be described in general terms as the edible parts of plants, or similar carbohydrates, that are resistant to human digestive enzyme. There are many beneficial effects of increased dietary fibre consumption on human health and body functions. Plant fibre spools and binds the excess of acid in the stomach, increases the bulk of intestinal digesta and stimulates the peristalsis, while also creating a favourable ground for the development of the desired bacterial flora in the large intestine. In the gastrointestinal tract, plant fibre components bind a number of substances, among them cholesterol and gastric acid. Because of these properties the plant fibre is of great importance in the prevention of lifestyle diseases, which include obesity, atherosclerosis, heart disease, colon cancer and diabetes [Schulze *et al.,* 2007; Kristensen & Jensen, 2011].

Some research have shown that information about higher fibre content enhanced white bread liking. The provision of information on the fibre content had a strong effect on consumer perceptions of healthiness and nutritional value (positive for high fibre products; negative for low fibre ones) [Mialon *et al.,* 2002]. Consumers seem to be ready to pay more for the bread rolls labelled as 'source of fibre'. However, they still underline the importance of sensory aspects in addition to the nutritional information in the evaluation of a food product. The implication for public health would be that bread containing more fibre could be accepted not only by health-concerned consumers, at least as far as the sensory characteristics were to be elevated to the satisfactory level [Ginon *et al.,* 2009]. However, the potential barriers for novel, functional food consumption still exist. In recent years studies revealed that some people reject unfamiliar food products. Consumers' unwillingness or refuse to eat new foods or simply avoidance of these products is defined as food neophobia [Pliner & Hobden, 1992].

Evaluation of food neophobia as a personality trait may be performed with measuring scales known as Food Neophobia Scale – FNS [Pliner & Hobden, 1992]. Neophobia can also be treated as a state and as such can be measured with the use of task-based experiments that involve various tests evaluating, *inter alia*, willingness to try unfamiliar food products or food preferences [Pliner & Loewen, 2002].

Numerous studies have shown that the Food Neophobia Scale (FNS) developed by Pliner & Hobden [1992] which measures willingness to taste novel foods accurately predicts responses to novel or unknown food, including ethnic food [Tuorila *et al*., 2001; Ritchey *et al*., 2003; Urala & Lähteenmäki, 2004].

Food neophobia influences not only the acceptance of novel food products, but also the acceptance of new technologies used in food production and processing [Ronteltap *et al.,* 2007; Siegrist *et al.,* 2007]. Nevertheless, the research showed that Food Neophobia Scale is less suitable for assessing receptivity to foods produced by new technologies [Bäckström *et al.,* 2004; Cox & Evans, 2008; Siegrist, 2008]. Thus, the Food Technology Neophobia Scale (FTNS) was developed [Cox & Evans, 2008]. This validated scale could be applied to identify segments of consumers that have greater or lesser neophobia, that determine the acceptance of foods produced by using novel technologies [Evans *et al.,* 2010].

Not only product characteristics have an impact on individual phobia levels, but also socio-demographic variables, with the age showing the greatest influence [Tuorila *et al*., 2001; Pliner & Loewen 2002]. Both the gender and the place of residence also have a significant impact on neophobic attitudes [Tuorila *et al.,* 2001; Flight *et al.* 2003].

Consumers can be willing to try new foods independently from their neophobia for various reasons, *e.g*. hedonism (for pleasure or enjoyment), ease of preparation of the product, its nutritional value, the positive influence it can have on the quality of their life and because it enables them to maintain healthy diet [Barrena & Sánchez, 2013]. Numerous studies show that the unwillingness for novel food consumption is linked to neophobia and report lower reluctance towards new foods among consumers that are less neophobic [Pliner & Hobden, 1992; Tuorila *et al.*, 2001; Pliner & Loewen, 2002; Barrena & Sánchez, 2013].

The aim of this study was to test the relationship between the attitudes towards food technologies, intention to eat cereal products enriched with fibre, and perceived motives of food choice including three values, namely health, quality and hedonic value.

MATERIAL AND METHODS

Respondents

One thousand of Poles completed the questionnaire. The participants were over 18 years old and were solely or jointly responsible for the family's grocery shopping. The data were collected in October and November 2013 by a marketing agency.

Selection criteria of the sample took into account the representativeness of the population due to the province, then the choice had quota character by gender, education and size of residence place.

The sample consisted of 1000 participants (54.5% women and 45.5% men), with age ranging between 18 and 83 years (mean 45.18; standard deviation 14.01). The detailed profile of respondents was presented in Table 1.

Materials and questionnaire

The questionnaire consisted of measures for attitudes towards new technologies used in food industry – Food Technology Neophobia Scale (FTNS). The questionnaire consists of the 13 items (see Table 2) scored on a 7-point scale anchored "strongly disagree" (1) to "strongly agree" (7) [Cox & Evans, 2008].

The participants' motives of food choice were measured with 3 items on a 7-point scales anchored "strongly disagree" (1) to "strongly agree" (7). The following statements were used: "I pay great attention to healthiness of foods that I eat" (this statement was used to describe consumers in regard to their health orientation to food); "I eat what I like and I don't care about my health" (hedonic value-orientation), "I eat food products that are characterised by the highest quality because they guarantee my health" (quality-orientation).

TABLE 1. Profile of participants according to demographics and attitudes towards food technologies (%).

Groups of respondents	Total		Attitude towards food technologies					
			neophilic (A)		neutral (B)		neophobic (C)	
	N	(%)	N	(%)	N	(%)	N	(%)
Total	1000	100.0	126	12.6	713	71.3	161	16.1
Gender (A, C)*								
Female	545	54.5	79	14.5	394	72.3	72	13.2
Male	455	45.5	47	10.3	319	70.1	89	19.6
Place of residence								
Rural area	378	37.8	52	13.8	255	67.5	71	18.8
Town with less than 20 000 citizens	88	8.8	9	10.2	68	77.3	11	12.5
Town with 20 000 – 99 000 citizens	247	24.7	26	10.5	188	76.1	33	13.4
Town with more than 100 000 citizens	287	28.7	39	13.6	202	70.4	46	16.0
Education (C)								
Primary	88	8.8	7	8.0	59	67.0	22	25.0
Vocational	310	31.0	37	11.9	216	69.7	57	18.4
Secondary	370	37.0	45	12.2	278	75.1	47	12.7
Higher	232	23.2	37	15.9	160	69.0	35	15.1
Age (A, C)								
25 years old and less	123	12.3	14	11.5	97	78.9	12	9.8
26–35 years old	175	17.5	35	20.0	117	66.9	23	13.1
36–45 years old	166	16.6	25	15.1	120	72.3	21	12.6
46–55 years old	283	28.3	40	14.1	205	72.5	38	13.4
56–65 years old	197	19.7	7	3.6	142	72.1	48	24.3
More than 65 years old	56	5.6	5	8.9	32	57.2	19	33.9
Opinion on income (A, B)								
It is totally insufficient	80	8.0	18	22.4	49	61.3	13	16.3
It lets fulfil only basic needs	246	24.6	25	10.2	176	71.5	45	18.3
We can afford some needs, but not all	472	47.2	57	12.1	333	70.5	82	17.4
We can afford all needs	166	16.6	16	9.6	135	81.3	15	9.1
We can afford all needs and save something	36	3.6	10	27.8	20	55.5	6	16.7

* statistically significant differences at $p<0.05$ (Chi^2 test) after considering (A) neophilic attitude; (B) neutral attitude; (C) neophobic attitude.

The participants' intentions to eat next month three cereal products (white bread, pasta, biscuits) fortified with fibre were measured separately for each product on a 7-point scale anchored "I would not eat at all" (1) to "I would like to eat very much" (7).

The questionnaire also included a set of demographic questions.

Statistical analysis

Data obtained from 1000 questionnaires were entered into SPSS, version 21.

The range of possible score for the FTNS is 13–91 points, with higher scores indicating that individuals were relatively more neophobic [Cox & Evans, 2008]. The measure of FTNS for the sample had a mean of 58.25 (SD=13.05; range – 19–91).

Principal Factor Analysis (PCA) of the matrix of 13 items from FTNS was performed to determine the primary factors that are associated with food technology neophobia in the population (Table 2). The results of the PCA showed the usefulness of all items from FTNS in further analyses (loadings greater than 0.700). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.922 and the Bartlett's Test of Sphericity was 8053.91 (df=78; $p<0.0001$).

Firstly the sum of scores of all items of FTNS for each participants, and next the mean score of sum ($\bar{X}$) and standard deviation (SD) for the sample were calculated. They were used to determine the ranges for three attitudes towards new food technologies. The first attitude (minimum sum – $\bar{X}$-SD) was called neophilic attitude towards new technologies (range 19.00–45.20), the second one ($\bar{X}$-SD – $\bar{X}$+SD) – neutral attitude (range 45.21–71.30) and the third one ($\bar{X}$+SD – max sum) – neophobic attitude towards new food technologies (range 71.31–91.0). The neophilic attitude was represented by 12.6% of respondents, the neutral one by 71.3% and neophobic attitude characterised 16.1% of the sample.

TABLE 2. Food Technology Neophobia Scale: factor descriptions and loadings distinguished on the basis of Principal Component Analysis (PCA), means and standard deviation.

Factor	Description	Items	Loading	Mean*	SD
1	Perception of risks and necessity of new food technologies	There are plenty of tasty foods around so we don't need to use new food technologies to produce more	0.754	4.54	1.58
		The benefits of new food technologies are often grossly overstated	0.758	4.71	1.53
		New food technologies decreases the natural quality of food	0.795	4.66	1.56
		There is no sense trying out high-tech food products because the ones I eat are already good enough	0.769	4.32	1.60
		New foods are not healthier than traditional ones	0.764	4.57	1.56
		New food technologies are something I am uncertain about	0.857	4.60	1.52
		Society should not depend heavily on technologies to solve its food problems	0.813	4.72	1.52
		New food technologies may have long term negative environmental effects	0.826	4.64	1.51
		It can be risky to switch to new food technologies too quickly	0.839	4.76	1.53
		New food technologies are unlikely to have long term negative health effects (R)**	0.834	4.71	1.51
2	Healthy choice and role of information from media	New products manufactured using new food technologies can help people have a balanced diet (R)	0.858	3.96	1.43
		New food technologies gives people more control over their food choices (R)	0.875	4.05	1.43
		The media usually provide a balanced and unbiased view of new food technologies (R)	0.708	4.02	1.62

*the scale from 1 – I strongly disagree to 7 – I strongly agree; **(R) the scores from the scale were recoded.

The mean score and standard deviation was used to determine the ranges for participants' self-perception on motives of food choice. Health-orientation towards food was described as negative (range 1.00–3.11); neutral (range 3.12––5.93); positive (range 5.94–7.00). Hedonic value-orientation was described as negative (range 1.00–2.94); neutral (range 2.95–5.68); and positive (5.69–7.00). Quality-orientation was described as negative (range 1.00–2.49); neutral (range 2.50–5.37); and positive (5.38–7.00).

The cluster analysis was used to determine the type of consumer according to declared intention to eat three cereal products fortified with fibre. Three clusters were separated using the scores from the three 7-point scales expressing participants' intention to eat white bread, pasta and biscuits fortified with fibre. ANOVA and Tukey's post hoc test ($p<0.05$) was used to confirm statistically significant differences between declared intentions to eat each of the products and the cluster groupings.

Chi-square analysis was used to determine significant differences between categorical variables. Relationships between different parameters were assessed by calculating Pearson correlation coefficients. A p-value of <0.05 was taken as significant.

RESULTS

Attitudes towards new technologies in food production

Respondents' opinions about the statements forming the Food Technology Neophobia Scale (FTNS) showed a slightly negative attitude towards innovative technologies used in food production. In the case of statements expressing the risks associated with consumption of such foods and the lack of the need to use modern technology the mean value was in the range of 4.32–4.76. In contrast, the mean value for opinions on the possible use of food produced using modern technologies to better balance the diet and the control over the selection of food was approximately 4.00, and therefore characterised by "neither agree nor disagree" statement (Table 2).

Results of the Principal Component Analysis with Varimax rotation are presented in Table 2. Two principal factors were separated that explained 65.32% of the variances, the first factor explained 49.82% of variance, and the second one – 15.50% of the variance of variables. The initial value of factors were respectively 6.48 and 2.02. The first factor was the most strongly represented by the opinions on the risks arising from the use of new technologies and the perceived necessity for their use in food production, while the other by the opinions about the health aspects and the role of media in the dissemination of new technologies (correlation coefficient, $p>0.700$) (Table 2).

Attitudes towards new food technologies statistically differed according to gender, education, age, and respondents' opinion on income. The neophilic attitudes towards new technologies used in food production were represented by more women, better educated people, in the 26–35 age group, but also in the 36–55 age group. More of the respondents with neophilic attitude assessed their income as totally insufficient or as very satisfied "We can afford all needs and save something". More neophobic were male, worse educated and older respondents (Table 1).

Intentions to eat cereals fortified with fibre

The mean values for all products fortified with fibre were very similar and expressed by "neither agree nor disagree" statement. For all products, women were more willing to eat

TABLE 3. Declared intentions to eat selected cereal products fortified with fibre (mean*, standard deviation).

Items	Cereal products fortified with fibre		
	White bread	Pasta	Biscuits
Total	4.18; 1.54	4.05; 1.54	4.01; 1.54
Gender			
Female	4.32[a]; 1.49*	4.17[a]; 1.51	4.12[a]; 1.51
Male	4.01[b]; 1.58	3.92[b]; 1.56	3.88[b]; 1.54
Education			
Primary	4.07[ab]; 1.84	3.83[ab]; 1.81	3.91[ab]; 1.62
Vocational	3.89[b]; 1.52	3.81[b]; 1.54	3.74[b]; 1.54
Secondary	4.28[a]; 1.49	4.15[a]; 1.46	4.11[a]; 1.47
Higher	4,45[a]; 1.45	4,30[a]; 1.50	4,27[a]; 1.57
Place of residence			
Rural area	4.31[a]; 1.59	4.12[ab]; 1.59	4.10[a]; 1.56
Town with less than 20 000	4.56[a]; 1.17	4.40[a]; 1.23	4.26[a]; 1.33
Town with 20 000 – 99 000	3.93[b]; 1.49	3.83[b]; 1.49	3.85[a]; 1.52
Town with more than 100 000	4.10[ab]; 1.57	4.06[ab]; 1.58	3.98[a]; 1.58

*the scale from 1 – I wouldn't rather like to eat to 7 – I would like to eat very much. For each variable means with different superscripts within each category of characteristics and product are significantly different (ANOVA, Tukey test, $p<0.05$).

TABLE 4. Clusters based on the declared intentions to eat selected cereal products fortified with fibre (mean*, standard deviation).

Intention to eat	Cluster 1 "Wanting to eat" N = 184	Cluster 2 "Not wanting to eat" N = 245	Cluster 3 "Undecided" N = 571
White bread fortified with fibre	6.26[a]; 0.71	2.24[b]; 0.91	4.34[c]; 0.77
Pasta fortified with fibre	6.18[a]; 0.66	2.10[b]; 0.83	4.20[c]; 0.78
Biscuits fortified with fibre	6.10[a]; 0.79	2.12[b]; 0.85	4.16[c]; 0.83

*the scale from 1 – I wouldn't rather like to eat to 7 – I would like to eat very much. Means with different superscripts are significantly different (ANOVA, Tukey test, $p<0.05$).

the products than men. Respondents with vocational education expressed significantly less intention of eating white bread, pasta and biscuits enriched with fibre than those with secondary and higher education, while there were no statistically significant differences between the opinions of those with secondary and higher education. Furthermore, the place of residence differentiated significantly the declared intention of consuming products enriched with fibre. Residents of medium-sized cities have expressed lower intentions of eating white bread enriched with fibre than residents of small towns and villages. There were no statistically significant differences in declared intentions to eat white bread with fibre between residents of small towns and villages. In the case of pasta enriched in fibre statistically significant differences in opinions have been observed only for those respondents from small and medium-sized cities (Table 3).

On the basis of the declared intentions to eat particular products enriched with fibre, three homogeneous groups of respondents were isolated. The mean values of opinions among identified clusters differed significantly, which confirmed the proper classification of respondents to each cluster (Table 4).

The largest group of respondents consisted of representatives of cluster 3, described as "undecided" (Table 5). The cluster affiliation presented significant statistical differences according to: gender, level of education, place of residence and attitude towards new food technologies (FTNS). Cluster 3 was represented by the highest number of people with secondary and higher education, residents of small towns, and those with neutral attitudes towards food technologies. Cluster 1 was represented by more individuals with neophilic attitude toward new food technologies. One fourth of the sample did not declare the intentions of eating cereal products (cluster 2). Among these there were significantly more men, people with primary and vocational education, from medium-sized cities, with the neophobic attitudes towards new food technologies (Table 5).

Consumers' perceived motives of food choice

According to mean values, the food choice was generally influenced by health reasons (mean value 4.52, where 1 – strongly disagree, and 7 – strongly agree; SD=1.41), to a lesser degree by hedonic values (4.31; 1.37) and to the least extent by quality (3.93; 1.44).

Among those representing positive opinions about health there were significantly more women, people with higher education, people with the neophilic attitudes towards new technologies used in the food industry, and respondents declaring the intentions of eating cereal products enriched with fibre. The group negatively oriented in terms of health was in turn represented by a greater proportion of men, people with primary and vocational education, and those not intending to consume cereal products enriched with fibre (Table 6).

Among those representing the hedonistic orientation with respect to food there were significantly more respondents perceiving their income as totally insufficient, and declaring the intention to eat cereal products enriched with fibre. People

TABLE 5. Socio-demographic profile of clusters based on the declared intentions to eat selected cereal products fortified with fibre (%).

Items	Cluster 1 "Wanting to eat" (W)		Cluster 2 "Not wanting to eat" (N)		Cluster 3 "Undecided" (U)	
	N	(%)	N	(%)	N	(%)
Total population	184	18.4	245	24.5	571	57.1
Gender (N)*						
Female	110	20.2	118	21.7	317	58.1
Male	74	16.3	127	27.9	254	55.8
Education (N, U)						
Primary school	22	25.0	26	29.5	40	45.5
Vocational	46	14.9	95	30.6	169	54.5
Secondary school	67	18.1	80	21.6	223	60.3
Higher	49	21.1	44	19.0	139	59.9
Place of residence (N, U)						
Rural area	82	21.7	86	22.8	210	55.5
Town with less than 20 000	13	14.8	12	13.6	63	71.6
Town with 20 000 – 99 000	38	15.4	75	30.4	134	54.2
Town with more than 100 000	51	17.8	72	25.1	164	57.1
Attitude towards food technologies (W, N, U)						
Neophilic	33	26.2	25	19.8	68	54.0
Neutral	134	18.8	151	21.2	428	60.0
Neophobic	17	10.6	69	42.8	75	46.6

* statistically significant differences at $p<0.05$ (Chi^2 test) after considering (W) "wanting to eat"; (N) "not wanting to eat"; (U) "undecided".

TABLE 6. Structure of population according to opinions on health as perceived motive of food choice and socio-demographic profile (%).

Items	Health orientation towards food					
	Negative (U)		Neutral (N)		Positive (P)	
	N	(%)	N	(%)	N	(%)
Total population	211	21.1	552	55.2	237	23.7
Gender (U, P)*						
Female	92	16.9	308	56.5	145	26.6
Male	119	26.2	244	53.6	92	20.2
Education (U, P)						
Primary school	23	26.1	46	52.3	19	21.6
Vocational	85	27.4	174	56.1	51	16.5
Secondary school	70	18.9	211	57.0	89	24.1
Higher	33	14.2	121	52.2	78	33.6
Place of residence (N)*						
Rural area	88	23.3	207	54.7	83	22.0
Town with less than 20 000	9	10.2	62	70.5	17	19.3
Town with 20 000 – 99 000	50	20.2	138	55.9	59	23.9
Town with more than 100 000	64	22.3	145	50.5	78	27.2
Attitude towards food technologies (P)						
Neophilic	24	19.0	61	48.4	41	32.6
Neutral	143	20.1	409	57.3	161	22.6
Neophobic	44	27.4	82	50.8	35	21.8
Intention to eat (U, N, P)						
"Wanting to eat"	25	13.6	77	41.8	82	44.6
"Not wanting to eat"	89	36.3	112	45.7	44	18.0
"Undecided"	97	17.0	363	63.6	111	19.4

* statistically significant differences at $p<0.05$ (Chi^2 test) after considering (U) Negative; (N) Neutral; (P) Positive.

negatively oriented towards pleasure derived from food consumption were in turn represented by a greater share of women, people with higher education, residents of medium and large cities, with neophilic attitude, and both intending and not intending to eat cereal products enriched with fibre (Table 7).

Among the quality-oriented respondents there were significantly more women, people with higher education, with the neophilic attitudes towards food technologies and declaring the intentions of eating cereal products enriched with fibre. People who are not focused on the quality of food as a guarantee of health were represented mostly by those with lower than secondary school education, with negative opinions on income, and also by those "not wanting to eat" fibre-enriched cereal products (Table 8).

TABLE 7. Structure of population according to opinions on hedonic value as perceived motives of food choice and socio-demographic profile (%).

Items	Hedonic value-orientation towards food					
	Negative (U)		Neutral (N)		Positive (P)	
	N	(%)	N	(%)	N	(%)
Total population	101	10.1	714	71.4	185	18.5
Gender (U)*						
Female	68	12.5	387	71.0	90	16.5
Male	33	7.3	327	71.8	95	20.9
Education (U, N)						
Primary school	9	10.2	58	65.9	21	23.9
Vocational	21	6.8	228	73.5	61	19.7
Secondary school	37	10.0	277	74.9	56	15.1
Higher	34	14.6	151	65.1	47	20.3
Place of residence (U)						
Rural area	26	6.9	277	73.3	75	19.8
Town with less than 20 000	5	5.7	68	77.3	15	17.0
Town with 20 000 – 99 000	34	13.8	174	70.4	39	15.8
Town with more than 100 000	36	12.5	195	67.9	56	19.6
Opinion on income (N, P)						
It is totally insufficient	8	10.0	46	57.5	26	32.5
It lets fulfil only basic needs	22	8.9	175	71.2	49	19.9
We can afford some needs, but not all	50	10.6	346	73.3	76	16.1
We can afford all needs	13	7.8	126	75.9	27	16.3
We can afford all needs and save something	8	22.2	21	58.4	7	19.4
Attitude towards food technologies (U)						
Neophilic	21	16.7	80	63.5	25	19.8
Neutral	65	9.1	523	73.4	125	17.5
Neophobic	15	9.3	111	68.9	35	21.8
Intention to eat (U, N, P)						
"Wanting to eat"	26	14.1	114	62.0	44	23.9
"Not wanting to eat"	32	13.1	178	72.6	35	14.3
"Undecided"	43	7.5	422	73.9	106	18.6

* statistically significant differences at $p<0.05$ (Chi^2 test) after considering (U) Negative; (N) Neutral; (P) Positive.

TABLE 8. Structure of population according to opinions on quality as perceived motive of food choice and socio-demographic profile (%).

Items	Quality-orientation towards food					
	Negative (U)		Neutral (N)		Positive (P)	
	N	(%)	N	(%)	N	(%)
Total population	168	16.8	700	70.0	132	13.2
Gender (P)*						
Female	83	15.2	378	69.4	84	15.4
Male	85	18.7	322	70.8	48	10.5
Education (U, P)						
Primary school	20	22.7	60	68.2	8	9.1
Vocational	63	20.3	214	69.1	33	10.6
Secondary school	53	14.3	268	72.4	49	13.3
Higher	32	13.8	158	68.1	42	18.1
Opinion on income (U, N)						
It is totally insufficient	21	26.3	48	60.0	11	13.7
It lets fulfil only basic needs	35	14.2	181	73.6	30	12.2
We can afford some needs, but not all	94	19.9	312	66.1	66	14.0
We can afford all needs	14	8.4	133	80.2	19	11.4
We can afford all needs and save something	4	11.1	26	72.2	6	16.7
Attitude towards food technologies (N, P)						
Neophilic	26	20.6	76	60.4	24	19.0
Neutral	107	15.0	511	71.7	95	13.3
Neophobic	35	21.7	113	70.2	13	8.1
Intention to eat (U, N, P)						
"Wanting to eat"	25	13.6	111	60.3	48	26.1
"Not wanting to eat"	56	22.8	169	69.0	20	8.2
"Undecided"	87	15.2	420	73.6	64	11.2

* statistically significant differences at $p<0.05$ (Chi^2 test) after considering (U) Negative; (N) Neutral; (P) Positive.

TABLE 9. Bivariate correlations between variables (Pearson correlation coefficient).

Items	Intention to eat:		
	white bread fortified with fibre	pasta fortified with fibre	biscuits fortified with fibre
Attitude towards food technologies (sum of scores)	-0.203**	-0.194**	-0.184**
Health-orientation towards food	0.237**	0.244**	0.237**
Hedonic value-orientation towards food	0.074*	0.035	0.210**
Quality-orientation towards food	0.167**	0.210**	0.177**

*correlation is statistically significant at the level of 0.05; **correlation is statistically significant at the level of 0.01.

Bivariate correlations between variables showed significant relationships between the intentions to consume selected cereal products and the attitudes towards the new technologies used in food production as well as perception of food choice motives such as health, pleasure and quality. These relationships were weak, but statistically significant except for the correlation between the perceived pleasure from eating food and the declared intention of eating pasta enriched with fibre. The more positive attitudes towards new food technologies were represented by the participants in the study, the more likely they were to consume foods enriched with fibre. Greater willingness to consume fibre-enriched cereal products was shown by the respondents positively oriented towards health and quality. In terms of the hedonic motives and the declared intentions to eat the strongest relationship was found for biscuits enriched with fibre (Table 9).

DISCUSSION

The differences in consumers' responses to food products placed on the market prompted researchers to look for their causes. The outcome of their research creates a broad spectrum of potential applications at all stages of a product's life, from the development of the product concept to its appearance on the market, including go-to market strategies and the way to inform the consumers about the product and its qualities.

It is well known that white bread enriched with fibre has inferior composition in terms of providing health benefits compared to traditional whole grain, nutrient-dense bread, which is rich in many components, such as vitamins (vitamin E, thiamine, niacin, riboflavin, and pantothenic acid), minerals (calcium, magnesium, potassium, phosphorus, iron, and sodium), essential fatty acids and other bioactive compounds like: resistant starch; lipids; oligosaccharides; antioxidants such as phenolic acids, flavonoids and avenanthramides; hormonally-active compounds including phytosterols and lignans; and antinutrients like phytic acid and tannins [Slavin, 2004]. Each of these compounds may have a positive influence on health; however, there are evidences suggesting that the whole-grains may be greater than the sum of its parts. It is likely there is a synergy among its bioactive components [Edge *et al*., 2005]. Consumption of whole grains, unlike consumption of refined grains, has been associated with a lower risk of cardiovascular disease and stroke as well as type 2 diabetes mellitus, hypertension, insulin sensitivity, obesity, metabolic syndrome, and some types of cancer [O'Neil *et al.,* 2010]. However in many populations, the consumption of whole grains is estimated to be too low [Thane *et al.,* 2005], which is one of the reasons of insufficient fibre intake.

Consumer perception of foods naturally rich in fibre, such as made from wholemeal flour, as distasteful [Yue & Waring, 1998] has become an incentive for the food industry to design and manufacture new products fortified with fibre. White bread fortified with fibre, like other products made from plain flour, is dedicated to people who are health conscious, applying different diets because of their perceived health problems and who do not want to or cannot consume wholegrain bread. The analysis of previous research suggests that the knowledge about the acceptance of cereal products enriched with fibre is small, as research in this area up to date has been limited [Mialon *et al.,* 2002; Dean *et al.,* 2007]. It is known, however, that products enriched in fibre are more accepted than cholesterol-lowering products [Dean *et al.,* 2007]. In addition, their acceptance depends on the product, to which fibre is added [Balasubramanium & Cole, 2002; Van Kleef *et al.,* 2005].

After extracting the homogeneous groups of respondents with regards to their declared intentions of eating three cereal products enriched with fibre, it has been found that only about 20% of them expressed a desire to eat cereal food enriched with fibre and about two thirds of the sample presented neutral opinions. In relation to specific products, such as white bread, pasta and biscuits, there were no significant differences in the declared intentions of eating, however the intentions were slightly higher in case of bread comparing to biscuits. Other studies also suggest that people preferred staple foods, bread and pasta as the base products for modification than hedonistic foods as biscuits [Balasubramanium & Cole, 2002; Dean *et al*., 2007].

A small proportion of people declaring intentions to consume cereal products fortified with fibre can be explained by referring to the research that indicated too low consumption of cereal wholegrain products, and stated that one of the most significant barriers for growth in the consumption of these products is the lack of public understanding of the health benefits or insufficient knowledge about fibre [Seal *et al.,* 2006]. On the other hand, many studies have shown that consumers can fairly well recognize the sources of fibre and they were able to correctly associate fibre with several diseases [Cashel *et al.,* 2001; Lyly *et al.,* 2004]. Another reason for the low interest in products from plain flour enriched with fibre may be the perception of fibre as a component deteriorating sensory properties of the products in which it occurs. Consumers often perceive the fibre as an ingredient giving the strong,

unpleasant taste and masking other flavours [Yue & Waring, 1998]. Research has shown that the fibre-supplemented bread still shows a pronounced decrease in quality parameters compared to white bread [Gomez *et al.,* 2003].

The results of some research have shown that certain socio-demographic characteristics are potential determinants of consumer acceptance and intention to eat functional foods [Bech-Larsen & Grunert, 2003; Cox *et al*., 2004; Verbeke, 2005]. In the case of the tested cereal products enriched with fibre, women were more willing to eat them than men, which is supported by some studies [Childs, 1997; Bäckström *et al.,* 2004]. Lack of correlation between gender and acceptance of functional foods has also been shown by researchers [Bech-Larsen & Grunert, 2003], proving that the differences in acceptance may result from the specifics of the tested products. For example study by Dean *et al.* [2007] has shown that women evaluated pasta fortified with fibre more positively than men, while in the case of bread such differences were not found. Other studies have shown that men with lower education, living in rural areas were more suspicious of new products [Bäckström *et al*., 2004].

People with relatively better education expressed significantly greater intentions of eating white bread, pasta and biscuits enriched with fibre than other respondents, which is reflected in the results obtained by Childs [1997]. The characteristics of the homogeneous groups separated by the intentions of eating all the products has shown that the greater intentions were declared by women, people with primary and higher education, rural residents and people with positive attitudes toward the new technologies. Lack of the willingness to consume these foods was expressed by more men, people with relatively lower education, residents of large cities and people having negative attitudes towards new technologies used in food production. The present study did not show statistically significant differences in the declared intentions of eating cereal products enriched with fibre between different age groups, whereas in other studies such differences were reported. It was found that older consumers who paid attention to the content of fibre in the diet showed higher acceptance towards the product labelled as containing fibre and greater willingness for purchase as well [Ginon *et al*., 2009]. This confirmed the research of Tuorila *et al*. [1998], which showed that older people declared greater willingness to buy the product labelled as a source of fibre, while young consumers have shown no intention of buying it.

The relationship between the attitudes of consumers to novel foods and their purchasing behaviours has been shown in literature [Verbeke, 2005]. What is lacking is research on the relationship between attitudes towards the new technologies used in food production and purchasing behaviors, despite the fact that they can significantly condition the consumers' behaviours in the food market [Siegrist *et al.,* 2007; Bieberstein *et al.,* 2013]. At the same time there is an indication that these attitudes are varied in the studied populations, with a predominance of negative attitudes [Ronteltap *et al.,* 2007; Cox & Evans, 2008]. Our study confirms the existence of differences in the perception of new technologies used in food production, and at the same time in attitudes disclosed towards them. Consumers' fears of novel food technologies and the risks related with them are well documented in other studies [Evans & Cox, 2006; Cardello *et al.,* 2007; Ronteltap *et al.,* 2007] and confirmed also by the results of our research.

The results of the use of the Food Technology Neophobia Scale (FTNS) have shown rather negative attitudes towards new technologies used in food production. Only slightly more positive opinions were expressed about the possibilities to use food produced by them to better balance the diet and to control the selection of food, rather than the safety associated with the consumption of such foods and the need to use modern technologies.

As in the other studies [Bruhn, 2007; Fell *et al.,* 2009], statistically significant differences have been demonstrated in the attitudes towards new technologies, taking into account socio-demographic characteristics. It has been shown that men, worse educated and older respondents were more neophobic. The neophilic attitudes towards new technologies used in food production were represented by more women, people in the 26–35 age group, but also by those of 36–55 years of age. Research carried out by Fell *et al.* [2009] has shown, however, that women are more concerned, less positive, and more likely to perceive fewer benefits of novel food technologies than men, which indicates their higher degree of neophobia.

The negative attitudes towards the new food technologies, resulting probably from a lack of confidence in them, explains the relatively low interest in innovative cereal products enriched with fibre. The more positive attitudes towards new food technologies were presented by participants in our study, the more likely they were to consume foods enriched with fibre.

Research done by Vassallo *et al.* [2009] has shown that health benefits and pleasure of consumption were the main determinants of the choice of functional breads. However, the study participants did not perceive functional bread as a mean of preventing coronary heart disease and enteric diseases. Similarly Shepherd *et al*. [2012] demonstrated that the willingness to consume functional bread was not due to the probability of occurrence or the severity of particular diseases, but the main factors were the health benefits of food, health motivation and sensory acceptance. Our study has shown that the declared intentions to eat cereal products fortified with fibre were to a greater degree connected with health and quality motives of food choice, and to a lesser extent with hedonic motive, for which a statistically significant correlation was found in the case of biscuits enriched with fibre. The importance of these factors should be taken into account in the design of health and sensory characteristics of the new products, both in terms of the perception of quality and pleasure of eating, which was confirmed by the results of previous studies. It was revealed that consumers were not willing to compromise when choosing food. They expect food that will benefit their health, without losing the desirable sensory properties [Augustin, 2001; Cox *et al.,* 2004].

The socio-demographic characteristics also differentiated the respondents' beliefs on health, pleasure and quality as determinants of food choice. Among the respondents considering health as one of the important motives of food choices, there were significantly more women, and better educated

people. Among those representing the hedonic attitude with respect to food there were significantly more people assessing their income as entirely inadequate. The quality of food was more important for women, well educated people, and residents of large cities and rural areas.

One limitation of this study should be mentioned. By focusing on a couple of products, we are unable to generalize the findings to other novel foods or the food market in general. It would be therefore useful to continue research by extending its scope to other geographical areas and other food innovations.

CONCLUSIONS

The intentions of eating cereal products enriched with fibre were determined by attitudes towards new technologies used in food production and motives of food choice such as health, quality and pleasure, but also by socio-demographic characteristics.

A more positive attitudes towards food technologies were associated with the declared intentions of eating such foods.

Health and quality as motives of food choice determined the willingness to eat cereal products enriched with fibre to a greater extent than the pleasure of eating, which significantly affected the intention of eating biscuits with fibre.

It can be concluded that the success of the new cereal product enriched with fibre requires actions aimed at increasing consumer confidence in the technologies used in food production but also providing information on health benefits and quality of such foods. Different responses to particular products as a source of pleasure during their consumption require great attention in the design of food, especially comfort food.

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