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Original Article

Lactose-free products: A study of young Polish consumers' knowledge and purchase behaviour

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Abstract

Lactose-free products are an example of an emergent, innovative product on the milk market, with particular properties targeted at a specific group of consumers. Trends indicate that the value of the global lactose-free market will increase. The aim of the study, one of the first studies in Poland, was to examine young consumers' knowledge of lactose-free products and in so doing to inform sector recommendations. Using a three-part questionnaire, knowledge of these products was determined from respondents (n=240) in a university setting in Poland. Few young people in the study correctly understood the definition of a lactose-free product. Those who reported themselves as being lactose intolerant have greater awareness of the presence of these products on the market, are more likely to buy the products, use nutritional information, use composition and ingredient information, are more likely to read labels, and know the definition of a lactose-free product. The findings have sector implications in that awareness campaigns need to be developed at government and market level to increase knowledge and awareness of these products, their value to specific groups and their availability in the dairy market.

Keywords: food industry, dairy product, innovative product, lactose-free product, knowledge

1. Introduction

Lactose is a specific sugar, naturally occurring at a level of approximately 4.7% in milk. This sugar is synthesized in the mammary gland, and largely determines the volume of milk produced and provides a relevant portion of slow-release energy (Costa *et al*., 2019; Romero-Velarde *et al*., 2019). Lactose intolerance is a condition primarily associated with the lack or deficiency of lactase (an enzyme that breaks down milk sugar into glucose and galactose) in the small intestine in humans. Its main causes can be 'hypolactasia', a lactase enzyme deficiency, and 'alactasia', congenital lactase deficiency. Lactose intolerance most often manifests as diarrhoea, but also in a short interval after eating dairy products, symptoms such as flatulence, nausea and abdominal pain can occur. As a result of illness, injury or surgery, which leads to small intestinal damage (e.g. acute enteritis), secondary lactase deficiency may occur. Indeed, celiac disease, bacterial overgrowth and Crohn's disease are commonly associated with secondary lactose intolerance (Bielawska, Tomczyk, & Łabuz-Roszak, 2019; Micic, Rao, & Rubin, 2019; Oak & Jha, 2019).

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Children are usually born able to produce enough lactase to digest the sugar in breast milk. However, by age 3, about two-thirds of the world's population stops making high levels of lactase, leading to varying degrees of poor lactose absorption. Adolescents and adults with hypolactasia may have lactase activity of only 5 to 10% compared with their lactase activity during infancy (Fidler-Witoń, Mądry, Krasińska, & Walkowiak, 2011). Consuming lactose-free dairy products is one of the recommendations for improving milk tolerance as it is not then necessary to completely exclude dairy products from the diet (Fidler & Walkowiak, 2009; Suchy *et al*., 2010; Suri *et al*., 2019). Dairy exclusion and the early adoption of a lactose-free diet may reduce calcium absorption and bone mineralisation and, may also a lower intake of other important nutrients, such as vitamin B_{12}, as well as an increased intake of less beneficial carbohydrates (Bielawska *et al*., 2019; Romero-Velarde *et al*., 2019; Silberman & Jin, 2019).

Over 60 percent of the human population has a reduced ability to digest lactose due to low levels of lactase enzyme activity, and between 50% to 90% in African, Asian, and South American countries (Oak & Jha, 2019). In Poland, the country of interest in this research, 37% of all adult inhabitants have lactose intolerance, and in Europe it varies from a few to over 50% (EDA, 2017). The degree of lactose tolerance varies in people with diagnosed lactose intolerant, and in some cases dairy products can be consumed. Most clinicians and researchers report that 12 to 15 g of lactose (about the amount in 1 to 2 cups of milk) is generally well tolerated by people identified as having a lactose intolerance (Romero-Velarde *et al*., 2019; Silanikove, Leitner, & Merin, 2015; Silberman & Jin, 2019). Thus, a range of products with varying degrees of lactose content will allow those who are lactose intolerant to adapt their gut microbiome to the presence of lactose, and decrease the signs and symptoms of the intolerance. It is also important that these products are on offer to people who show extreme intolerance (Wieczorkiewicz, 2018). There is some evidence to suggest there is clinical potential for the probiotic bacteria used in fermented and unfermented milk products (i.e. *Bifidobacterium* and *Lactobacillus*) to address the clinical symptoms of lactose intolerance (Oak & Jha, 2019; Yilmaz-Ersan, Ozcan, & Akpinar-Bayizit, 2020).

The market for lactose-free products is the fastest growing segment in the dairy industry as demonstrated by the increasing number of new product launches. The global value of the lactose-free food market in 2015 amounted to USD 6.7 billion; 80% of which is attributable to dairy products. It is predicted that by 2022 the global market for lactose-free dairy food will be worth USD 11 billion. Latin America and Western Europe are the biggest and fastest growing lactose-free markets (Dekker, Koenders, & Bruins, 2019; Gordon & Baroke, 2016). Not only a factor of health, which is very important, but individual countries' socioeconomic environment and consumer psychographics such as rising purchasing power, education levels but even tightening of sugar tax as in Thailand, are driving momentum in the lactose-free food market (Wong & Wong, 2020). People with lactose intolerance are therefore prospective consumers also for the Polish dairy sector if appropriate products are provided for them and marketed appropriately. The main aim of the study was to examine young Polish consumers' awareness and knowledge about lactose-free products and in so doing to inform dairy sector recommendations that concern lactose-free products in the country for this age group.

The rules on labelling and composition, defining the absence or reduced lactose content in food are not uniform throughout the European Union (EU), or even precise at the national scale in Poland. According to the Regulation (EU) No 1308/2013 (EU, 2013), a reduction of lactose content in milk by conversion to glucose and galactose is allowed. This regulation enables the production of milk with reduced lactose content (by at least 70%) or lactose-free milk (containing only small amounts of lactose, usually not exceeding 1%). It is worth noting that this process changes the organoleptic characteristics of final products. Milk with reduced lactose content or lactose-free has a higher sweetness than 'normal' milk because lactose hydrolysis products (glucose and galactose) are three times sweeter than lactose alone. However, the inclusion of information on a lack of lactose should be in line with the general regulatory requirements for food labelling.

According to EU Regulation (EU, 2011) food information must not be misleading, in particular as to the properties and composition of the food. Therefore, underlining the information on the absence of lactose in a food by using messages such as 'lactose free' is only justified if the final product does not contain lactose, and only where the consumer would reasonably expect lactose to be present in the product (e.g. in milk and dairy products). The Polish national official body, the *Chief Sanitary Inspectorate* (GIS) states that due to the lack of regulation regarding the maximum lactose content in products labelled as 'lactose free', the lowest value should be used and be closest to zero, which is the safest for consumers i.e. equal to the limit of quantification of the enzymatic method considered as the reference method, i.e. 0.01% (10 mg lactose per 100 g of product). Therefore, there is no legal basis that supports the adoption of a specific level of lactose content that reflects the use of "free from" messages.

Since Poland's accession to the EU, milk production in the country has grown steadily. In 2019, Poland was one of the leading milk producers in the EU (fifth place) with 156 dairies and the share of the dairy sector in terms of the national sales value of the food industry is over 15%. The value of sold dairy products in 2019 amounted to over USD 9 billion, 44% more than in 2010, of which 17% supported food exports. Despite the dynamic increase in exports, especially since Poland's accession to the EU (more than doubling to 4.6 million tonnes in 2018 in raw material equivalent), the domestic market remains the main focus of dairy industry production. The domestic consumption of milk products is increasing (Zuba-Ciszewska, 2019).

In Poland, despite the fact that the technology for developing lactose-free products has been in place for 30 years, these products have only appeared on a larger scale in the market, in the last five years (Świąder, 2018). There is no officially accepted definition of "a lactose-free product", however, a dairy product with lactose removal is considered as such a product. Currently, a range of lactose-free dairy products is offered by several dairies and includes not only the basic products like milk, butter, young/fresh cheeses or cream, but also products which require more processing, like yoghurt or ice cream. They are most often the equivalents of

traditional, classic products. Research on the innovativeness of Polish consumers in the food market shows that younger consumers have a greater interest in new products (Sajdakowska *et al*., 2018).

The aim of the study was to examine young Polish consumers' awareness and knowledge about lactose free products and in doing so to inform dairy sector recommendations that concern lactose-free products in the country for this age group. The sample consists of full time students. The choice of the sample population results from the fact that students belong to the group of modern dairy consumers who search for innovative products with new or modified characteristics and select products that best meets their needs (Garbowski, Radzymińska, & Garbowska, 2010). On the other hand students are supposed to be vulnerable to developing unhealthy behaviours that could lead a higher risk of chronic diseases (Baghianimoghadam *et al*., 2016). It is important to note that there is the lack of studies on young Polish consumers' attitudes to lactose free products.

This study tries to answer the following research questions:

1. Do young people recognised the benefits of consuming dairy based products?

2. Are innovative (lactose-free) dairy products regularly included in the diet of young consumers with lactose intolerance?

2. Methodology

Quantitative data was gathered in May 2018 using a three part survey provided to 350 full-time students at public universities in Lublin and completed by each student individually in a classroom setting. Respondents were selected by means of a non -probability sampling method, using purposive sampling. It allows the sampling of cases that are "information rich". The completed research questionnaires were obtained from 240 respondents (68.6% response rate), who then formed the research sample. The first part of the survey collected demographic data i.e. age and gender. The second part concerned purchasing behaviour and dairy consumption.

The third part of the questions sought to capture the state of knowledge about lactose-free products.

The question regarding the selection criteria for dairy products was close-ended, with a Likert scale. The question about the frequency of consumption of selected dairy products was close-ended and the question about the perception of dairy products in the context of health was open-ended. The questions concerning the issue of lactose digestion and purchase of lactose-free food were also close-ended. The remaining questions were open-ended to enable the cross-checking of the respondents' knowledge of lactose-free products. The questionnaire was developed with academics who were specialists in the topic area and its readability was tested via a pilot survey with a group of 20 people.

Data was analysed both descriptively and inferentially. The former includes frequency distribution analysis. The latter involves correlation analysis. To find the relationship between buyers' characteristics and the knowledge on the lactose-free dairy products and the intention to buy these products, we calculated the tetrachoric correlation coefficients among the selected binary variables. The tetrachoric correlations assume a latent bivariate normal distribution (X_1, X_2) for each pair of variables (v1, v2), with a threshold model for the manifest variables, $v_i = 1$ if and only if $X_i > 0$. The means and variances of the latent variables are not identified, but the correlation, r, of X_1 and X_2 can be estimated from the joint distribution of v_1 and v_2 and is called the tetrachoric correlation coefficient. The set of analysed variables includes:

- X_1 - buyer' sex (1-male, 0-female),
- X_2 - buyers' employment status (1-employed, 0- not employed),
- X_3 - buyers' reported health problems due to lactose intolerance, (1-the existence of health problems, 0-the lack of health problems),
- X_4 - buyers' knowledge on the market offers of the lactose-free dairy products (1-be aware of the market offers of the lactose-free dairy products, 0-not be aware of the market offers of the lactose-free dairy products),
- X_5 - buyers' propensity to buy the lactose-free dairy products (1-buying the lactose-free dairy products, 0-not buying the lactose-free dairy products).
- X_6 – buyers' attitude to dairy products (1 – positive, 0 – negative),
- X_7- buyers' purchase frequency of dairy products (1 –often, 0 - seldom or not at all),
- X_8- buyers' use of nutritional information in the purchasing process of dairy products (1- use, 0 - not use),
- X_9 - buyers' use of composition and ingredient information in purchase process of dairy products (1- use, 0 - no use),
- X_{10} - buyers' propensity to read the label of dairy products (1- read, 0 - no read),
- X_{11}- buyers' knowledge on the lactose-free dairy products definition (1- full knowledge, 0 – no knowledge).

3. Results

Women accounted for 74% of the entire sample (n=240), while the average age in the sample was 22 years and the age range was 19 to 25 years. When shopping for dairy products, the respondents reported that they pay the most attention to the expiry date of the product - for 88% of all respondents, this criterion proved to be significant or very significant (Figure 1), taste (87.9%), habits (75.4%), nutritional values (60.4%), price (53.8%) and composition of the product (50%). Therefore, it seems that the composition of the product and nutritional values are stated by this group as the significant criteria when choosing dairy products.

Between 40% to 50% of young people in this study consume at least once a week skimmed milk, butter, natural yogurt, flavoured yogurt, sour cream, quark, cheese spread, or ripening cheese. Less often it was pointed out that full-fat milk, milk-fat spread, kephir, buttermilk, soured milk, cream cheese, cottage cheese and milk dessert was consumed (Figure 2).

The majority of respondents (91.7%) felt that dairy product consumption from the milk of cows, sheep or goats has a beneficial effect on the human body. The majority of responses suggested three health-promoting benefit of dairy consumption were important to them (Figure 3): bone

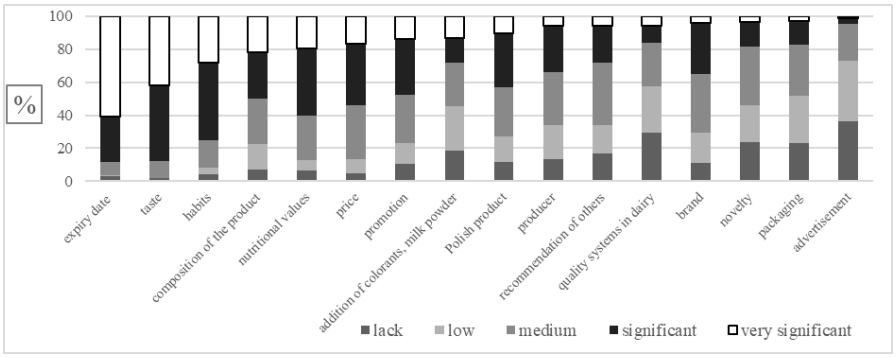

Figure 1. Degree of inclusion of different criteria when choosing dairy products

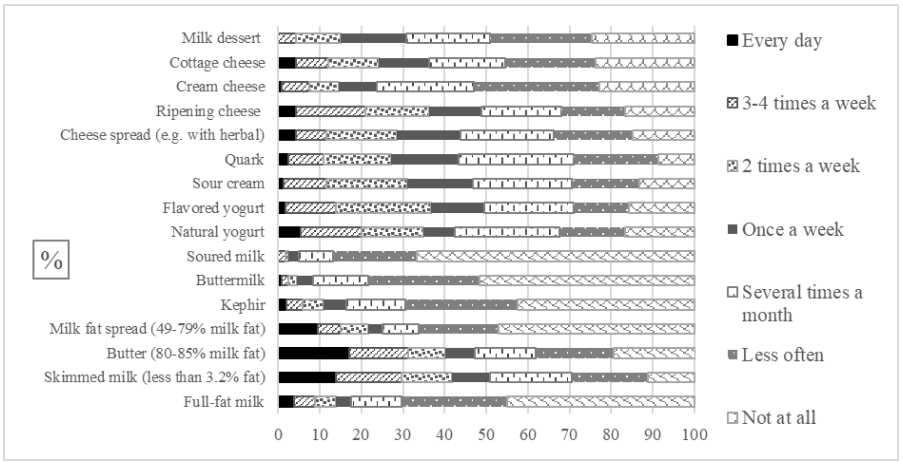

Figure 2. Frequency of consumption of dairy products

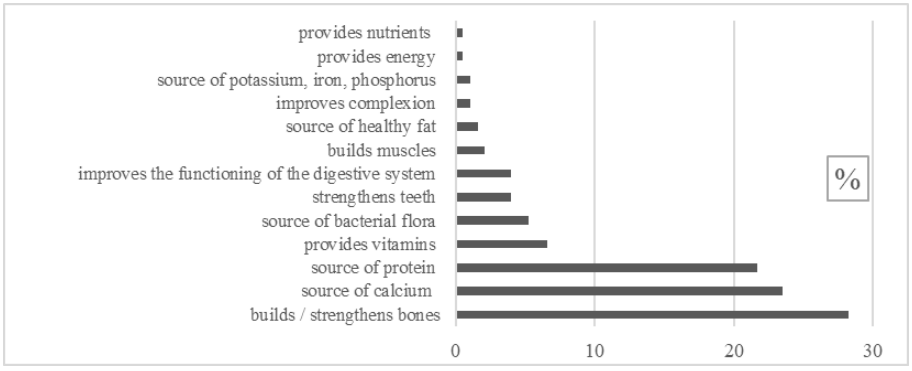

Figure 3. The main health-promoting properties of dairy products

building/strengthening (28.2%), source of calcium (23.5%), and source of protein (21.6%).

The remaining responses include that dairy products provides vitamins, a source of bacterial flora, strengthens teeth, improves the functioning of the digestive system, builds muscles, a source of healthy fat, improves complexion, a source of potassium, iron, phosphorus, provides energy and nutrients. Thus, young consumers recognise the many benefits of consuming dairy products. For this sample group proposition one can be confirmed.

60% of all respondents buying dairy products stated they fail to read their product labels carefully. Almost half the respondents (47%) did not know the meaning of the term 'lactose-free'. Among those who answered positively to this question (Figure 4), the first group of people indicated no sugar/disaccharide (32.8%), no milk sugar (20.8%) or no lactose sugar (3.2%). A subsequent group replied that these products are consumed by people who are allergic (4.8%) to lactose (11.2%), that it did not contain an allergen (13.6%) and more specifically an allergising sugar (4%).

Almost 71% of all respondents knew of at least one lactose-free product (and two on average), even when 36% of this group failed to provide its definition (Figure 5). Almost ¾ of all responses (73.8%) were milk (34.5%), cheese (20.6%) and yoghurt (18.7%). Other mentioned items were cottage cheese (7.7%), butter (6.7%), sour cream (4.8%), quark (3.4%), kephir (2.9%) and buttermilk (0.7%). Hence, these products are recognised by consumers, although every third individual does not know identify their meaning.

Over 13% of the respondents (n=32) reported they have problems digesting lactose, but only 18 of these individuals buy lactose-free dairy products. Everyone within this group drank lactose-free milk (100%), but fewer people consume lactose-free cottage cheese (27.8%), yogurt (27.8%), cheese (27.8%), quark (16.7%), butter (16.7%), sour cream (11.1%), and milk dessert (11.1%). Additionally, four people stated they purchased a lactose-free product, even though they have no problems digesting lactose.

Some respondents, both those with self-reported lactose intolerance (n=18) and those who also buy products despite being able to digest lactose (n=4) were able to provide the name of the manufacturer of the lactose-free dairy products they bought. The respondents listed a total eight manufacturers of these products, even though three of the manufacturers named do not have such products in their range. Instead of names of producers, the answers also included the names of three product brands, including discount stores. The majority of people who reported in the survey as being lactose intolerant and buying lactose-free products (11 respondents from 18) indicated that after their consumption, they felt they experienced an improvement in their health. Of note, few respondents who consumed lactose-free products (n=5) proposed extending the range of products and indicated items that are already available on the market (flavoured yoghurts, ice cream, cheese, quark).

The correlation matrix shows that there is the correlation between the buyers' gender and buyers' self-reported health problems due to lactose intolerance (X_3) and knowledge (X_{11}). In other words, women reported more frequently personal health problems with lactose intolerance than men whilst men knew the definition of lactose-free more explicitly than women. Those who reported themselves as being lactose intolerant (X_3) have greater awareness of the presence of these products on the market (X_4), are more likely to buy the products (X_5), use nutritional information (X_8), use composition and ingredient information (X_9), are more likely to read labels (X_{10}), and know the definition of a lactose-free product (X_{11}). Those who know about the presence of lactose-free products on the market (X_4), buy these more often (X_5), and have a more negative attitude towards standard dairy products (X_6). Those who buy lactose-free products more often (X_5), use information about the composition and ingredient information (X_9), when they purchase. Those who are positive about dairy products (X_6) buy them more often (X_7). Buyers who state they use nutritional information when purchasing dairy products (X_8) also use composition and ingredient information (X_9), and are more likely to read labels (X_{10}). Buyers who state they use composition and ingredient information (X_9) are also more likely to read labels (X_{10}).

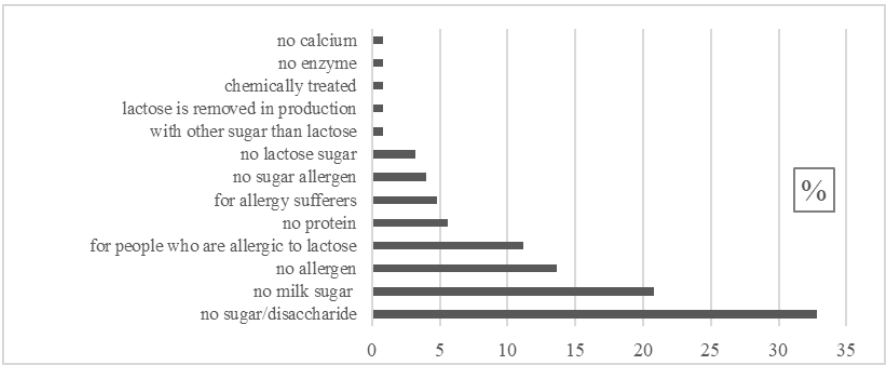

Figure 4. The meaning of the expression "lactose-free" on a dairy product

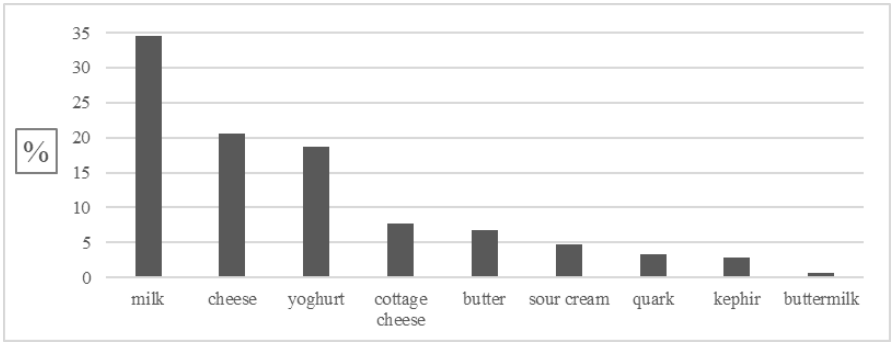

Figure 5. Knowledge of the types of "lactose-free" dairy product

Table 1. Correlation matrix between buyers' characteristics and the knowledge about the lactose-free dairy products and the intention to buy these products

Variable	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}
X_1	1										
X_2	-0.002	1									
X_3	-0.304*	0.019	1								
X_4	-0.002	0.223	0.379*	1							
X_5	0.078	0.247	1.000*	0.946*	1						
X_6	0.117	-0.169	0.212	-0.494*	-0.303	1					
X_7	-0.017	0.001	0.158	-0.035	0.183	0.307*	1				
X_8	-0.049	0.004	0.329*	0.138	0.206	0.066	0.028	1			
X_9	0.056	0.085	0.322*	0.153	0.338*	-0.218	-0.031	0.690*	1		
X_{10}	0.031	0.169	0.305*	0.177	0.227	0.179	0.050	0.628*	0.750*	1	
X_{11}	0.241*	0.059	0.528*	-0.090	-0.095	0.047	-0.047	0.139	0.128	0.182	1

X1 - sex, X2 - employment status, X3 - reported health problems due to lactose intolerance, X4 - knowledge about the market offers of the lactose-free dairy products, X5 - propensity to buy the lactose-free dairy products, X6 –attitude to dairy products, X7- purchase frequency of dairy products, X8- use of nutritional information in the purchasing process of dairy products, X9 - use of composition and ingredient information in purchase process of dairy products, X10 - propensity to read the label of dairy products, X11- knowledge on the lactose-free dairy products definition, *$p<0.05$

4. Discussion

The present study indicates that, among the young people surveyed, the composition of the product and nutritional values are among the most important criteria for the selection of a dairy product. European research (EC, 2012) highlights that food quality is a very important factor for young Poles when buying dairy products with 55% of young people (15-24 years) and 52% of university students stating this to be the case. An important finding in this study is that 60% of respondents buying dairy products declare that they fail to read their product labels carefully. In response to consumer preferences, Polish dairies have more diversified products, in line with the global trend. However, the Polish food sector still needs to catch up with the developed economies of the world, which probably provides an opportunity for significant growth in the development of innovations (Firlej & Żmija, 2014) like lactose-free products.

In new market development, it is important to provide information to consumers because knowledge is one of the success factors that supports uptake of food related innovation (Busse & Siebert, 2017; Oak & Jha, 2019). Much fewer young people in the study correctly understood the wording of the "lactose-free" product designation (7.9%). The results among those self-reporting as being buyers of such dairy products are not much different (13.6%). Other research suggests half of young Poles (51%) or students (45%) sometimes or always checks whether the packaging has a quality mark, indicating that the food has specific characteristics (EC, 2012). Thus the findings here are comparable.

New experiences around food product innovation have a considerable effect on purchasing decisions (Bangsa & Schlegelmilch, 2020; Grunert & van Trijp, 2014; Kapsokefalou *et al*., 2019) especially where new products significantly differ in their characteristics or intended use, from products that were previously marketed. There are many categories of food innovation (Guiné *et al*., 2016; Petrus, do Amaral Sobral, Tadini, & Gonçalves, 2021; Purba *et al*., 2018), especially traditional food products (Guerrero, Claret, Verbeke, Sulmont-Rossé, & Hersleth, 2016; Martínez Rodríguez, Samaniego-Vaesken, & Alonso-Aperte, 2021; Vanhonacker *et al*., 2013), and in the dairy sector (Gere, Radvanyi, & Moskovitz, 2019). A key food product innovation trends (FPITs) in Poland is for medical food products, i.e., the presence of ingredients that benefit health or are deemed natural (Figiel & Kufel-Gajda, 2017; Glover & Poole, 2019). These health benefits can be associated with dairy products (Granato, Branco, Cruz, Faria, & Shah, 2010; Khurana & Kanawjia 2007; Yilmaz-Ersan, Ozcan, & Akpinar-Bayizit, 2020). Dairy products are a good source of calcium, protein, potassium and phosphorus. Moreover, they are readily available in a relatively low price (Rozenberg *et al*., 2016).

This study also showed that those who reported themselves as being lactose intolerant have greater awareness of the products on the market, are more likely to buy the products and use nutritional, composition and ingredient information via the labels and know the definition of a lactose-free product. Greater awareness of and purchase of lactose free products is linked to use of information about the composition and ingredient information. Over 13% of the respondents in this study have reported problems digesting lactose, but only 56.3% of these individuals buy lactose-free dairy products. In another study 3.4% of respondents stated they recognise and consume lactose-free products because they suffer from lactose intolerance rising to almost 17% of respondents consumed lactose-free products because of the health-promoting properties (Bielawska *et al*., 2019). Individuals suffering from lactose intolerance may instead limit or stop the consumption of dairy products (Carroccio, Montalto, Cavera, & Notarbatolo, 1998; Szilagyi & Ishayek, 2018). Interestingly, Silva *et al*. (2019) reported that intolerance was more frequent in: female individuals (75%), age range 18 to 25 years (62.5%), being non-white (50%), and in their 5th semester of studies (37.5%). Research was carried out among 117 Brazilian students of which 6.8% were diagnosed with lactose intolerance and 1.7% with bacterial overgrowth. The actual rate of lactose intolerance was not measured in this study, but the self-reported rate is similar to the above studies (female individuals 78% and average age 23).

5. Conclusions

As the present research demonstrated, young people are often not clear about the meaning of "lactose-free" product. The findings have dairy sector implications in that awareness campaigns need to be developed at the government and market level to increase knowledge and awareness of these products and their availability. Information on lactose free dairy products, their properties and purpose on dairies websites in Poland may be helpful to promote awareness. A good example of how to educate customers by explaining the issue of lactose intolerance on product packaging or on website, is the Finnish dairy Valio. The market could offer dairy products with varying lactose content. Lactose-free products are an example of an emergent, innovative product on the milk market, with particular properties targeted at a specific group of consumers. Trends indicate that the value of the global lactose-free market will increase.

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