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A Survey on Consumers with Lactose Intolerance in Italy: Their Perception, Habits and Needs When Shopping for Groceries

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Abstract

This study aimed to investigate perceptions, habits and needs of a new growing consumers' category: individuals with lactose intolerance (LI). This digestive disorder affects about 70% of the world population who need to follow a lactose-free (LF) diet to respite symptoms, so that the purchase of suitable LF foods becomes essential. An ad hoc questionnaire was administered to 384 subjects with LI and the collected data were imported into a SAS dataset for statistical analyses.

Consumers with LI need to do grocery shopping quickly and safely (79.2%), avoiding spending time reading unclear labels. The dominant factors determining food choices resulted in taste (26.6%) and price (21.3%) while relevant is the need to taste new products (55.7%). A growing demand for LF references, especially sweet (24.9%) and savoury (12.6%) bakery goods and ice cream (18.4%) was reported.

The first in-depth study about consumers with LI has been carried out. The results can be exploited as new and widespread cultural model of consumption of LF products by food companies to sell the most desired products to this consumer category. An improvement of LF labelling through a recognizable certification trademark, such as Lfree®, could represent a good strategy for quick and safe purchases. Consumers would be protected and assisted during their grocery shopping making it quicker, also complying with the new safety measures for Covid-19 pandemic. These findings shed light on a poorly-known topic that is increasing its relevance.

Keywords: *Lactose Intolerance; Lactose-Free Products; Lactose-Free Labelling; Lactose-Free Food Purchases; Consumer Preference; Purchase Choices*

Abbreviations

AILI: Associazione Italiana Latto-Intolleranti; LI: Lactose Intolerance; LF: Lactose-Free; LNP: Lactase Non-Persistence; QoL = Quality of Life

Introduction

Lactose intolerance condition

In recent years, following the globalization of markets, agri-food consumption patterns have changed. The first reason is linked to the diffusion of innovative products following cultural exchanges and migratory flows. The second reason is linked to the introduction of products designed to meet specific needs including the numerous increases in forms of intolerance. However, the new cultural models are not affirmed only in specific categories of the population but extend to all those who go beyond the specific dietary characteristics [1,2]. To highlight the specificity of the purchasing models of LF products, we wanted to investigate not only how they are consumed by the Italian population but what are the new demands of the lactose intolerant consumer. Lactose is a disaccharide well-known as the main source of carbohydrates that can be found in mammal's milk. Digestion and absorption of lactose require an enzyme called lactase-phlorizin-hydrolase for hydrolysis into its component, glucose and galactose [3]. Approximately 70% of the adult worldwide population has a limited expression of this enzyme, with a large variation between different regions and countries [4]. This condition occurs for one of two reasons: genetically determined lactase non-persistence (LNP) or the presence of other gastrointestinal disorders [5]. Specifically, LNP is found on average in 56% of the Italian population and it is estimated to reach peaks of up to 70% in the southern regions of the country [6].

Lactose maldigestion and lactose malabsorption can ultimately lead to the onset of a clinical condition characterized by the presence of gastrointestinal symptoms mainly defined as lactose intolerance (LI) [6].

LI is defined as the symptomatic condition present in individuals not able to digest and absorb lactose, leading to its fermentation by the intestinal microbiota [3].

The main treatment for LI consists in reducing, or even eliminating, lactose from the diet until the symptoms disappear. Additional treatments include the administration of delactosed products, defined as lactose-free (LF) products and the oral intake of lactase enzyme supplements or the use of some specific probiotic strains producing β-galactosidase [7].

Nowadays, lactose is commonly present in dairy products, but it can be found in foods not directly derived from milk, so-called "hidden lactose". Lactose is also used for its technological and sensory characteristics such as texture and adhesive qualities, as well as its influence on viscosity and softness [8,9].

Nonetheless, LF product labelling is still controversial. There is still not a regulation specifying a labelling policy that identifies a cut-off value for LF products nor laws that instruct a specific production system for delactosed products. The lack of any specific requirements results in a continuous check of the labels of all foods and drinks among lactose-intolerant consumers.

Given the widespread use of lactose in dairy and non-dairy products together with the misleading and controversial labelling concerning LF them, lead the consumers with LI to spend considerable time deciphering the ingredients list. This inevitably prolongs the average time spent in the supermarkets touching and turning several products so that a major exposure to possible contaminations with Covid-19 can be considered.

In this context, Lfree®, the international certification trademark for LF products, is growing its popularity among health-related goods. Indeed Lfree® certification can be used as a useful tool to clearly identify suitable LF products, so that quick and safe purchases can be made [7].

Developments of the lactose-free market: New culture model of consumption

The growing attention to food products with a high health content is currently a global trend. Thus, a great interest is devoted to an emerging food segment known as "healthy food", which concerns foods with health benefits deriving from the addition or elimination of specific substances or specific foods addressed to intolerant or allergic people. This macro-category of the market includes a wide range of products: from functional foods rich in one or more nutrients ("rich-in") to foods characterized by the absence or lower presence of a component ("free-from"), organic, 100% vegetable, and supplements and products for intolerant people.

In 2021, the Italian free-from market reached a turnover of 7 billion euros, growing by +0.6% compared to the previous year, as reported in the analysis by the Osservatorio Immagino GS1 Italy, carried out in collaboration with Nielsen [10]. Indeed, the free-from trend has recorded the most significant supermarket turnover. This is confirmed by Savarese., *et al*. in 2021 that reports the sudden rise of gluten-free and LF products on the market, also among tolerant people [11].

According to Rizzo., *et al*. in 2020, if one member of the family has been diagnosed with LI, the entire household consumes LF products, especially LF milk [12].

In the last few years, a considerable interest in LF diets has contributed to the increase in the number of LF products. Globally, the LF claim is no longer only used for niche products; LF products have had the highest growth rate among all other free-from foods.

Particularly in 2021, the percentage of sales in the LF segment rose to 0.9%, while the gluten-free segment rose to 2.9% (with gluten-free claim) and 0.0% (with crossed grain symbol) as reported by Osservatorio Immagino GS1 Italy (2021). Also, the claim "milk-free" was considered in its report and registered a substantial growth (+4.4%) in sales variation from 2020 to 2021.

The use of many claims in food packaging, the increased number of specialized food industries and the growing variety of new LF products have a positive impact on the global market, giving consumers with LI a larger range of choices.

The present study aimed to investigate lactose-intolerant consumers and their attitude towards LF products and claims linked to them.

In this regard, considering the lack of data available on the topic, a specific questionnaire was administered, which included different themes aimed at:

- Profiling lactose-intolerant consumers' sociodemographic characteristics and the diffusion of new modern/model culture of consumption,
- Understanding their perception of various food labelling present on front-of-pack (FOP) of LF products,
- Researching lactose-intolerant consumers' grocery shopping habits,
- Investigating their needs and preferences about LF products in the context of large-scale distribution. Moreover, these results could have a positive appeal on the product policies of food manufacturing companies that are currently increasing the production of LF foods. On the other hand, the consumers would have their purchasing experience improved because of the more accurate choices made by the companies, selling the most desired products. This is even more important when seen in relation to the attributes of food products classified in the literature as search [13], experience [14] and credence [15]. The search attributes are visible to the consumers prior to purchase; hence, they can become aware of them before choosing and consuming the product. The experience attributes are visible only after the purchase of the product - duration and taste, for example - and therefore require some kind of

"proof" by the consumer. Finally, the credence characteristics are never accessible to the consumer, and they are what we actually refer to in relation to LF products. As reported by previous studies in the food sector [16-19], in the absolute absence of tools on the part of the buyer for identifying elements within the chosen product, a correct communication to be reported in the labelling becomes of fundamental importance.

Materials and Methods

Study design and target

The questionnaire was designed *ad hoc* by our research team, administered through the Google Form platform and was open from October 2020 to January 2021. Because of the inability of collecting data in person, due to Covid-19 pandemic restrictions, the questionnaire was sent via email to members of Italian lactose-intolerant patients' association, AILI (Associazione Italiana Latto-Intolleranti) and to students of the Master's Degree in Food Quality Management and Communication of the University of Pisa.

Checks were made to eliminate any multiple answers to the questionnaire (questionnaires sent several times by the same user): the few cases identified were solved, keeping the latest completed questionnaire sent from the same email.

The questionnaire was filled out by 384 lactose-intolerant subjects (340 women, 44 men; median age: 35 years ± 16 SD) as reported in table 1. The prevalence of the women who reply to the questionnaire is probably due to their shopping habits because gender does not affect LI condition [20]. Currently, women tend to do grocery shopping more frequently and to pay more attention to their health-related needs than men. They usually are the "main shopper" of the household with more control on the food stocks and inventory [21]. Furthermore, the restrictions due to the Covid-19 pandemic encourages this situation so that only one person per household has to do grocery shopping. The "main shopper" must be able to choose suitable products, including LF ones, for the whole family. This should be done preferably without reading all the labels, so that less time would be spent in the supermarket putting health at risk.

Age	N
Less than 24 years	59
From 25 to 34 years	146
From 35 to 44 years	108
More than 45 years	71

Table 1: *Composition of respondents by age.*

Questionnaire

A 25-item survey was designed ad hoc to collect information on different topics about LI, organized in sections as follows:

- Section 1: The questionnaire contained a specific question on the presence of the condition of LI and only one respondent who had declared not to have this condition was eliminated. None were lactose tolerant.
- Section 2: This section, containing 6 questions, was developed to investigate the LI condition among respondents such as diagnosis time, quality of life (QoL), and coexistence of additional allergies or other food intolerance.

- Section 3: This section was created to research habits and preferences of respondents when doing their grocery shopping. It contains 9 questions.
- Section 4: This section, containing 5 questions, aimed to understand LF food labelling perception by consumers with LI.
- Section 5: This section, containing 4 questions, aimed to profile the sample's socio-demographic characteristics.

Statistical analysis

The data collected through the Google platform were exported in .txt format, checked as indicated above, and imported into a SAS dataset for subsequent statistical analyses.

The answers provided were checked for consistency in SAS environment.

Contingency tables were obtained through SAS software, calculating significance through the chi-square test or through Fisher's exact test in the case of 2x2 tables with observed values lower than 5.

After an initial descriptive analysis, it was decided to merge some of the response methods when the number of choices of the last method was too low, and without the merging changing the meaning of the response.

As for variables of section 1, we transformed multiple answers obtained for "acquisto", "attenzione" and "fattori" in dummy variables, generating other 22 variables for each of the choices made by the respondent. A cluster analysis [22] was applied on these dummy variables to obtain a global description of consumers.

Results and Discussion

Subject characteristics

In total, 384 participants were collected among the members of AILI, and among the students of the master's degree in food quality management and communication of the university of Pisa. All participants were lactose- intolerant people, parents or legal guardians of lactose-intolerant minors.

Of these, 88.5% (n = 340) were women and 11.5% (n = 44) men, mainly employees (54.7%). The mean age (± SD) of subjects was 35 ± 16 years.

The prevalence of the female reply to the questionnaire is probably due to their shopping habits because gender does not affect LI condition [5,20]. Currently, women tend to do grocery shopping more frequently and to pay more attention to their health-related needs than men [23]. They are usually the "main shopper" of the household with more control on the food stocks and inventory.

Respondents were distributed in all the Italian regions, 56.5% (n = 217) came from central-southern regions and 43.5% (n = 167) from northern regions.

More than half the subjects (59.9%, n = 230) have been diagnosed with LI for more than 3 years and, in most cases, have no other allergies or intolerance (66.9%, n = 257).

According to Casellas., *et al*. (2016) LI has a negative impact on the respondents' QoL [24]; indeed, most participants reported a severe or moderate effect of LI on their QoL, 29.2% (n = 112) and 50.1% (n = 192), respectively.

Lactose-intolerant consumers' habits and needs

The majority of participants (75%, n = 288) declared to consume delactosed products. Among them, 60.8% reported consuming 'delactosed' LF products only with less than 0.01% of lactose residue.

In this context, the statistical analysis highlights a strong correlation between the consumption of LF products and the LF tolerated threshold.

Meanwhile, 20% (n = 77) of the total number of participants stated that they did not tolerate LF products. Among them, 41.5% declared to consume only naturally LF products and the majority preferred percentages of lactose less than 0.01% (32.7%) compared to 5.8% who chose 0.1%.

Soft, semi-hard and hard cheeses are good examples of natural FL products with lactose levels of less than 0.01% [25].

It can be hypothesize that the remaining 61.5% of those who do not consume delactosed LF products consume plant-based products [26].

It follows that most consumers prefer residual percentages of lactose as evidence of the fact that this type of intolerance is sensitized with very low quantities. Hence an alignment of regulations at European level would be desirable, given that currently the situation is very diverse, with different applicable thresholds (the use of a single trademark is also desirable) [7]. This can mislead the consumer or suggest inappropriate eating patterns, as it is necessary to remember that the diet does not refer exclusively to a single meal that may contain a lactose- based product - albeit in minimal quantities - but must be weighted in a daily consumption that, summed together with different products, even if delactosed, can lead to exceeding the tolerance thresholds. It is understood that the diet in reference can be the one modeled in the individual countries, given that the use of dairy products is internationally envisaged at least 2-3 times a week [27].

Almost all consumers (91.9%, n = 353) reported that they buy their LF products in large-scale distribution. Online grocery shopping was not extremely popular among consumers with LI (1.8%, n = 7). Interestingly, online shopping of products specifically addressed to intolerant or allergic people, such as LF foods, goes against the growing trend of the current e-commerce market.

During this period of Covid-19 pandemic, the possibility to do online grocery shopping is a great advantage for the consumers, as it would further reduce the risk of infection. Indeed, e-commerce of large-scale distribution represents the most relevant segment among online shopping, with a turnover of 854 millions in 2020, +85% compared to 2019, in Italy [28]. This opposite trend could be a consequence of the lack of detailed product information available on most online grocery websites, necessary for safe purchases and to avoid food waste and economic expenditure due to the purchase of unsuitable foods. Food labelling items as list of ingredients or allergy information are often absent or poorly legible on the product images available on the online websites. Therefore, it is assumed that this issue discourages consumers with special health-related needs from making online food purchases. If not well read, the label images on online shopping websites could lead to the purchase of unsuitable products. These products could have a lactose residue which is not tolerable or could not be proper LF foods. In this way the purchased products are useless for a LF diet because they cannot be safely consumed by people with LI. This behaviour does not meet the goals descripted in the 2030 Agenda for Sustainable Development aiming at reducing food waste for protecting the environment and humanity's well- being [29].

It is possible to suppose that improving FOP and product images available on the online shopping websites could be a winning strategy to guide consumers with LI to make informed choices and to buy more both online and also in person.

More than two-thirds of participants (79.2%, n = 304) prefer to find LF products on a dedicated shelf rather than on the same shelf with conventional or vegan foods, avoiding putting health-related needs on an equal footing with ethical choices. In this regard, the identification of LF products in well-recognized department stores could make grocery shopping easy, safe, and quick for consumers with LI or in charge of doing the grocery shopping.

In 65% (n = 252) of respondents, the time spent in supermarkets is on average between 30 minutes and one hour.

About half of the respondents declared that the LF products' price is not suitable and defined it inadequate (45.4%, n = 175), since it is higher than the price of conventional products. This is confirmed by Taeger., *et al*. (2021) that, after literature review, indicates LF substitutes as more expensive than lactose-containing traditional products [30].

According to Rizzo., *et al*. (2020) this study shows that lactose-intolerant people are not aware of lactose removal methods, preferring products with the lowest final price regardless of their manufacturing process [12]. Special offers have no impact on consumers with LI acceptance and buying decisions: 56.4% (n = 217) of respondents indicated it as not very or not at all important.

Lactose-intolerant consumer drivers for LF new culture

The main drivers for consumers' LF purchases decision-making were, primarily, taste (26.6%, n = 288), subsequently, price (21.3%, n = 231), distribution (19.3%, n = 209), and certification (17%, n = 184).

The attention to taste as the primary driver is confirmed by the preference of 54.3% (n = 208) of subjects to vary and try new LF products. Not renouncing a conventional taste could be due to LI diagnosis usually occurring in adulthood, given that enzyme activity diminishes with increasing age [31]. Therefore, lactose- intolerant people expect to find the same taste in LF products that they were used to before the diagnosis of LI. Interestingly, Rizzo., *et al*. (2020) reported that lactose-intolerant consumers purchase LF milk according to price instead of paying attention to the name or brands [12]. The price, from this study, has turned out to be one of the main drivers of consumer choice, recently confirmed also by Dana., *et al*. (2021) [32].

The facility of getting suitable food is gaining relevance among dominant LF food choice factors, as well as the "certification", receiving respectively 19.3% and 17% of the responses. Despite this, a common mistake is the attribution of the meaning of "certification" to a wide variety of symbols highlighting the absence of lactose in the products. For example, a barred milk bottle or barred milk drop are the most frequently used symbols to indicate LF products, although they are not recognized as certification marks. To date, the only certification trademark available for LF or naturally LF or milk-free products is Lfree®. This mark guarantees the product, confers safety to lactose-intolerant consumers, and enables faster identification of suitable products for the LF diet.

Lactose-intolerant consumers need to improve their knowledge about LF food labelling in order to distinguish a truly guaranteed, certified and safe product through a self-declaration by the manufacturer with unambiguous symbols. As reported in Facioni., *et al*. (2020) today, consumers with LI need a nutritional education to easily understand LF food labels in order to make healthy choices and ensure adequate nutritional requirements [7]. In order to assure the most suitable LF products, consumers with LI declared to pay attention to selected items: list of ingredients (33.8%, n = 258), certification trademark (28.5%, n = 218) and product lines specifically addressed to consumers with LI (15%, n = 115). As we have already highlighted, LF represents a credence attribute, not observable by the consumer nor verifiable before or after the purchase. The only way to gain certainty is to read the product labelling, which is not always adequate or complete.

Reading each list of ingredients of every food product seems to be the best solution for a safe purchase by lactose-intolerant consumers. It is clear how this purchasing behaviour extends the time spent for grocery shopping, also considering the scattered position of LF products on supermarket shelves. Spending prolonged time in a closed environment, such as grocery stores, is in opposition to the safety measures in place during the Covid-19 pandemic to minimize the risk of contagion.

To overcome these problems, a certification trademark (such as Lfree® for LF products or crossed grain for gluten-free foods) could represent a good strategy to easily identify suitable products for specific health-related needs [7]. The importance of an intuitive identification of the absence of lactose or its residual content is confirmed by the above-mentioned study by Rizzo., *et al*. reporting participants' preference to easily find this information on the label [12].

Moreover, considering the growing number of self-declarations by food companies to highlight the absence of lactose, this research aimed to investigate the main ones that drive consumers' LF products purchases. Among these, claims as naturally lactose-free (28.1%, n = 300), dairy-free (25.2%, n = 269), and indication about lactose residue of delactosed products (< 0.1% or < 0.01%; 20.7%, n = 221) are the most representative answers.

As highlighted by the fragmented responses, the use of multiple claims to indicate lactose content causes confusion in lactose-intolerant consumers. Indeed, many respondents declared that LF labels are not very adequate and clear yet (37.8%, n = 145). This could be due to the lack of common cut-off levels for LF products misleading consumers' answers and, probably, leading to wrong purchases. As established for gluten-free labelling (Reg. EU n. 828/2014) [33], a univocal claim also for LF products, better if supported by a well- recognized symbol, is needed to improve consumers' awareness of safe purchases.

Lactose-intolerant consumers' preferences

With the aim of detecting the purchasing preferences among the various LF products, respondents were asked to indicate which products they purchase most frequently. Furthermore, they were asked for which product categories they would like an expansion of the line, since they consider that those existing at the present time are not satisfactory, as reported in table 2.

Product	Positioning in the purchase ranking	Positioning in the expansion ranking
Dairy products (milk excluded)	1	4
Sweet baked goods	2	1
Cheese	3	6
Milk	4	8
Cured meats	5	9
Ice cream	6	2
Vegetable drinks	7	10
Savoury baked goods	8	3
Chocolate	9	7
Pre-cooked foods	10	5

Table 2: *Preference ranking for purchasing and product range expansion.*

As reported in figure 1, the consumers indicated that the most chosen LF products were dairy products (17.5%, n = 243), sweet baked goods (15.8%, n = 219), and cheese (13.4%, n = 186). Despite the growing availability of LF sweet baked products, surveyed consumers with LI expressed the preference of increasing the supply of these kind of products even more (24.9%, n = 187), together with ice cream (18.4%, n = 138), and then savoury baked goods (12.6%, n = 95). This trend is confirmed by 55.7% (n = 182) of the subjects who expressed the preference of varying and tasting new LF products.

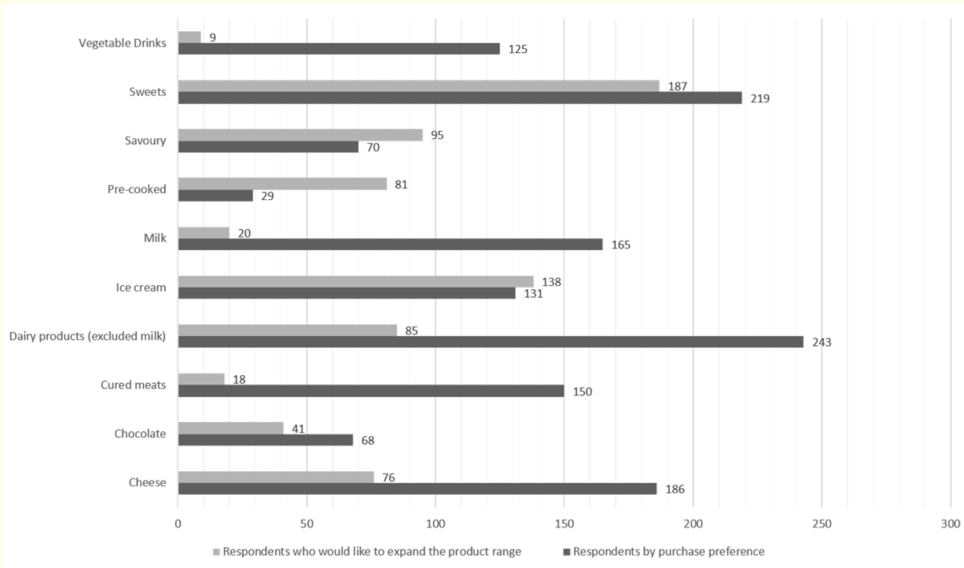

Figure 1: *Respondents (N) by purchase preference and range expansion.*

Milk and dairy products

Consumers who buy milk most frequently (n = 165) consider that the supply of the product on the market is satisfactory. The same trend is observed for vegetable drinks (n = 125). The low demand for new products is linked to the fact that LF milk is the first focus of attention following the increase in cases of lactose intolerance. The number of products on the market is large enough, even if a small percentage of those who frequently buy milk ask for greater differentiation. As regards dairy products, the question on the questionnaire was formulated specifying the references referred to as dairy products, including butter, cream, yogurt, mascarpone cheese, ricotta cheese, etc. Those who buy LF dairy products more frequently (n = 243), would like to expand the range of products. Indeed, by aggregating the data on the creation of new product references (n = 85) it is positioned in 4th place in the ranking of expansion requests. It follows that there is good room for growth in the creation of suitably produced references that meet LF requirements. Second only to milk, dairy products were among the first products formulated for consumers with this nutritional need. It is the type of product to which the consumer, once diagnosed, pays more attention in the quest for alternatives to the conventional dairy product containing, by nature, a large amount of lactose. Furthermore, once the LF version of the traditional product has been formulated, companies also tend to focus their advertising campaigns on these LF products in order to increase awareness in the population. As far as cheeses, also derived from milk, both in the case in which they are bought with high frequency and low frequency (n = 186), consumers do not consider it necessary to expand the offer on the market (n = 76).

Chocolate

Chocolate is a product purchased in a residual manner compared to the other product references (n = 68) and for which the sample states that an expansion of the offer on the market is not necessary (n = 41).

In the case of chocolate, the request for new references is very small, especially by those who do not frequently consume the product. The low demand can be justified by the fact that it remains a product for which, from a health food point of view, a low consumption is recommended.

Furthermore, consumers were not asked if they wanted an expansion of the dark or milk chocolate references and this may have affected the outcome, as the LF milk chocolate offerings are almost absent on the market.

Ice cream

Out of the total sample analysed, 131 respondents stated that they very frequently purchase this product category. However, as many as 138 respondents requested an expansion of the offer on the market (2nd product for expansion request). This presupposes that there is good room for growth in the creation of new suitably produced references that meet LF requirements.

Although today the ice cream offer - mostly plant-based - has increased, there are still few LF references, and it follows that the consumer encounters difficulties in finding products on the market.

Sweet baked goods

The sample of consumers (n = 219) who claim to buy sweets more frequently considers an expansion of the offer on the market useful in most cases (n = 116).

The aggregate data (purchase with more or less frequency) of the expansion of the product on the market places sweets in 1st place in the ranking of LF products for which consumers positively evaluate an expansion (n = 187). Sweets are one of the main references that contain dairy products and/or lactose, so in most cases, they are foods that a lactose-intolerant renounces. Despite the growth in variety and product offer in recent years, demand is still high. Furthermore, faced with the difficulty of finding LF baked goods, the lactose-intolerant consumer adapts to consuming plant-based references - not always 100% derived from plants therefore not suitable for a LF diet - as lactose could be added as an ingredient or additive.

Savoury baked goods

As regards savoury baked goods, 70 respondents declared that they buy this product reference very frequently, while 95 consumers requested an expansion of the range.

However, although savoury goods are among the products purchased less frequently by consumers (8th position in the purchase ranking), they are among those for which consumers consider an expansion of the market offer to be useful (3rd position in the expansion ranking).

Savoury products are often not considered risky foods by lactose-intolerant consumers. As highlighted by the results, consumers who are more informed about the uses of lactose have noticed this deficiency and wish to expand the savoury LF references.

Pre-cooked foods

As far as pre-cooked products are concerned, 29 respondents declared that they buy this product reference with high frequency, while 81 consumers requested an expansion of the range.

However, although savoury products are among the products purchased less frequently by consumers (10th position in the purchase ranking), they are among those for which consumers consider an expansion of the market offer to be useful (5th position in the expansion ranking).

The offer of LF pre-cooked foods is very small, probably because the presence of lactose and dairy products in these types of products is consistent and could generate difficulties in the development of LF alternatives; therefore, further production tests by the manufacturing companies are necessary.

Cured meats

The sample that buys cured meats with high frequency (n = 150) does not consider it useful to expand the offer on the market. By aggregating the data, the number of those who consider this operation useful turns out to be small (n = 18).

In these types of products, lactose is added by the manufacturing company as it has a low cost for industries and increases the product's shelf life. Furthermore, its compacting characteristics make it a useful product for the meat industry, which often uses it to obtain a compact and easy-to-cut product.

With the increase in the number of lactose-intolerant people, companies have decided to eliminate or replace this sugar in their processing, so to date, most cured meats do not contain lactose. In addition, there has been an improvement in labelling, highlighting the absence of milk and dairy products in these products.

Respondents are described through a cluster analysis of the dummy variables of section1 (Sas procedure FASTCLUS). The consumers groups are the following:

- Cluster 1 (n = 104) is composed of people who buy sweets, chocolate, and dairy products. They pay attention to certification and intolerance warnings. Factors influencing their choice are certification, taste and then organic. They are probably health-conscious people willing to pay higher prices for quality. Certification is a useful tool to identify products where it is more difficult to detect lactose (long ingredient list).
- Cluster 2 (n = 118) is characterized by people who buy dairy products, milk, cheese but also sweets and ice cream. They pay attention to the certification and the list of ingredients. They decide based on price and taste, but also on distribution. They probably buy lactose-free products, so the certification or ingredients list is necessary to know the percentage of residual lactose in the product.
- Cluster 3 (n = 94) is composed of buyers of dairy products, milk, and cheese. They mainly pay attention to the list of ingredients and the factors that influence their LF purchases are taste and certification, then price. They have a similar attitude to the members of Cluster 2 when they do grocery shopping.
- Cluster 4 (n = 71) consists of people who buy cold cuts, sweet and savoury baked goods, and vegetable drinks. They pay attention to the ingredient list and label, but also to the nutrition table. The factors that guide them during LF products choice are price and taste, and then distribution. They tend towards naturally free products. According to their purchasing preferences, it can be hypothesized that this cluster mainly buys naturally LF products.

Lactose intolerant consumer for more than 3 years vs lactose intolerant consumer for less than 3 years

In this section, we wanted to investigate whether there is a correlation between the time since the consumer with LI was diagnosed and their behaviour. As found in related trade literature and introduced in the previous paragraphs, the condition of lactose intolerance affects individuals' QoL [24]. Our results suggest that a LI condition diagnosed for more or less than 3 years can affect - albeit moderately - in different ways multiple aspects such as socio-economic factors (price, social factors, health factors), consumption models (consumption of delactosed products, taste) and purchasing behaviours (propensity to buy new products, preference for a shelf dedicated to LF products at the point of sale, packaging).

With regard to socio-economic factors, the "price" variable in most cases (60%, n = 230) is a factor that determines the purchase of the product both in people with LI who have discovered that they have been so for more than 3 years as well as in those who have discovered their condition for less than 3 years. Social factors (e.g. that the LF product is suitable for the whole family) are not factors that determine the purchase of products for 86% of respondents (n = 330). Similar results with regard to health factors (e.g. organic), where 74% of respondents state that these are not factors that determine the purchase (n = 284), to a greater extent in intolerant people for more than 3 years (n = 169), and, to a lesser extent, in intolerant people for less than 3 years (n = 115).

With reference to purchasing and consumption behaviour, the consumption variables of LF products, the importance of taste, the propensity to purchase new products, the preference of a shelf dedicated to LF products in the store, and the packaging were identified as determining factors for the purchase. About 75% of respondents state that they consume delactosed products (n = 287), to a greater extent in intolerant people for more than 3 years (n = 170), and to a lesser extent in intolerant people for less than 3 years (n = 117). The remaining 25% of the sample stated that they did not consume delactosed products (n = 44), or that they only consume naturally lactose-free products (n = 52).

About 75% of the sample considered "taste" to be a determining factor for the purchase (n = 288), with a higher percentage among those intolerant for more than 3 years (n = 180). As for the propensity of lactose-intolerant individuals to buy and try new products, in 54% (n = 208) of cases the respondents - without particular distinction between the lactose-intolerant people diagnosed for more or less than 3 years - declared to be willing to positively evaluate new product references.

Among lactose-intolerant consumers there appears to be a preference in finding shelves inside the points of sale dedicated to LF products. Consumers with LI for more than 3 years declare that they prefer a dedicated shelf in 73.9% of cases, a growing percentage for those who have been intolerant for less than 3 years, which stands at 86.9%. Packaging is not a factor that determines the purchase, as stated by 95.3% of respondents (n = 365).

Conclusion

The attention on the LI condition has recently grown thanks to the increase in scientifically reliable diagnoses, as well as the dissemination of health information.

This has led food-manufacturing companies to focus on developing new products suitable for lactose-intolerant people's diet. The consumer's attention to LF products constitutes a real factor in the focus of innovation in the food industry [34].

It can be said that in the new cultural models that are spreading in Italy, a growing number of consumers tend to prefer foods free of certain substances in the belief that "absence" constitutes a healthy element. This regardless of whether or not they belong to the category of intolerant people with different degrees of tolerance. If we add to this cultural trend the response of companies to the creation of an increasing number of LF products, it is likely to witness a considerable change in the references on the market and dedicated exhibitions in the points of sale. Not only that, but this differentiation will constitute an important marketing lever for attributing a price mark up to new references with a negative effect on the cost-effectiveness of consumer spending.

For the first time, this research work attempted to outline the socio-demographic profile of people with LI and their habits, needs and perceptions when they do grocery shopping at the supermarket. Interestingly, through a questionnaire designed ad hoc and administered during the Covid-19 pandemic to consumers with LI, it emerged that the LI condition impacts the QoL of lactose-intolerant people, regardless of when LI occurred. Regarding the purchasing habits of this consumer category, this study showed lactose-intolerant consumers' demand to do grocery shopping quickly and safely, avoiding spending time reading each food label. In this context, the apposition of the Lfree® certification trademark could guide consumers' shopping to immediately recognize suitable products for their LF diet. Indeed, the list of ingredients and the presence of a certification mark are items that capture more consumers' attention during their purchases. Moreover, this work identified taste and price as the dominant factors determining food choices of consumers with LI, and the urgent need to improve LF food labelling.

The results obtained from this study showed a growing demand for a large variety of safe, guaranteed, and tasty LF references, especially sweet and savoury bakery goods, ice cream, and dairy products. These outcomes were specifically contextualized and collected during the Covid-19 pandemic so it has to be considered if they could represent the "new normal". In conclusion, these findings can be also useful for food-manufacturing companies that want to develop or improve a specific product line addressed to lactose-intolerant people, meeting their needs.

Conflict of Interest

Maria Sole Facioni is a partner of ELLEFREE S.r.l. and president of AILI (Associazione Italiana Latto-Intolleranti). Simona Dominici is partner of ELLEFREE S.r.l.

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