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## Factors influencing the consumption of aged cheeses among people associated with medical community – survey study

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### Abstract

**Introduction:** Long-maturing cheeses are gaining more followers lately. Their sustainable inclusion in the daily diet, in view of their nutritional values and the best source of bioavailable calcium, brings them the recommendations of doctors, dieticians.

**The aim of the study** is evaluation of factors influencing the consumption of aged cheeses among people associated with medical community.

**Material and methods:** Material used in the epidemiological analysis is the results of survey conducted on group of 204 young adults aged 18-24 rating factors influencing the consumption of long-maturing cheeses among the students of medical universities.

**Results:** The survey carried out indicates that 35% of people surveyed do not distinguish long-maturing cheeses from regular cheeses. Of the people surveyed, 47.1% have answered that their cheese purchasing is influenced by the product's appearance and that irregular holes and natural colour present in cheese are signs of high quality. Simultaneously, 35.3% of the respondents believe that the higher price of long-maturing cheese dissuades them from purchasing such products.

**Conclusion:** The conducted survey suggests that the main factors influencing the consumption of long-maturing cheeses in the medical community are: level of knowledge of health benefits, pricing, outer appearance of the product, and the degree of popularization of healthy nutrition. Yet still a significant percentage of respondents seem not to see the benefits of its consumption, suggesting a need for further education of people in terms of principles of nutrition, and advertising campaigns showing the importance of consumption of dairy products.

**Keywords:** long-maturing cheeses; benefits of cheeses' consumption; medical community

## **Introduction**

Cheeses are a basic component of the diet among the inhabitants of the world. Their history goes back to ancient Anatolia, where milk was transported in flasks made of lamb stomachs. With the use of shaking and high temperature, it was susceptible to the fermentation process, leading to the formation of cheese mass, which was collected and stored in characteristic baskets [1]. Cheese, due to the method of coagulation, can be divided into rennet, acid and acid - rennet [2]. Considering the period of aging and maturing, they are divided into short-term and longer-ripening ones. Long-maturing cheese differs in water content, which affects their variable consistency and hardness [2]. The milk used to produce this type of products must have a normalized fat content [3] and go through the standardization of quantitative and qualitative parameters. After the pasteurization process, it is fermented by adding sourdough. Subsequently, after adding the rennet, a curd is obtained, the maturity of which is determined

by the so-called "Scrap test". A properly formed curd is cut and subjected to subsequent processing that leads to the formation of grain [4], which ultimately undergoes forming, pressing and salting. Depending on the length of aging, long-maturing cheese varies in terms of the taste, the smell and the consistency itself.

In recent years, a gradual increase in the production and consumption of long-maturing cheeses has been observed [1]. This also applies to Poland, where consumption fluctuates between 12-13kg per person annually. This phenomenon can be associated with the growing dairy market, as well as the growing popularity of health and taste values of aged cheeses. They are one of the few wholesome food products available for sale. They have the greatest amount of available calcium, and 50g of cheese can cover 40% of its daily consumption [5]. In addition, they are valued for the rich resources of lipophilic antioxidants, including: CLA,  $\alpha$ -tocopherol, vitamin A, D3,  $\beta$ -carotene, coenzyme Q10, which despite their small presence play a synergistic role in silencing inflammation [6]. They are involved in the inhibition of lipid oxidation, which shows antiatherosclerotic effects and slows down the process of atherosclerotic plaque formation [7].

On the other hand, many concerns are raised regarding the high cholesterol content of high-quality cheeses and the associated increased cardiovascular risk. However, these conditions are not only due to the presence of cholesterol, but are associated with inflammatory changes in the blood vessels caused by excess starch, sugars and trans isomers [8]. Cholesterol itself is necessary to satisfy the basic functions of the cell – the construction of the cell membrane, it is also part of the myelin involved in neurotransmission. It also participates in modulating the function of G-protein-coupled receptors that transmit signals through the plasma membrane [9] and is involved in the synthesis of bile acids and certain hormones.

Long-maturing cheeses are a source of easily absorbable folates, including 5-methyl-TH4-folates, used to repair damaged proteins and DNA, as well as in the processes of myelination of nerve fibers [10]. They are expected to play a significant role as supplements that inhibit the development of neurological diseases. Matured cheeses may contain up to 100 $\mu$ g of bioavailable folates in 100g [11]. Folate compounds may reduce the severity of migraine attacks, chronic headaches, usually in combination with pyridoxine [12]. The health benefits

of maturing cheeses, regulating the nervous system, are similar to other products of the dairy industry, including milk, which is considered one of the richest sources of folates [11].

**The aim of the study** is evaluation of factors influencing the consumption of aged cheeses among people associated with medical community.

### **Material and methods**

The study was conducted in 2019 using a proprietary online questionnaire. The participation of the respondents was voluntary and anonymous. The questionnaire was addressed to the medical community, with particular emphasis on medical students (70% from Medical University in Lublin, 17% from Medical University of Warsaw, 13% from University of Warmia and Mazury in Olsztyn), because they are likely to have comprehensive knowledge of the principles of healthy and rational nutrition. The diagnostic survey contains 24 questions, both single and multiple-choice, regarding factors affecting the consumption of long-maturing cheeses in a group of people associated with medical fields. 204 people responded to the questions asked in the questionnaire, consisting of 51% women and 49% men, in the age group 19-24 with an average age of 22 years ( $\pm 1,16$ ) and a median of 22.

### **Results**

In the first part of the survey, the respondents were asked about the criteria they follow when buying cheese. As many as 47.1% of respondents indicated that their choice is correlated with the appearance of the product, and irregular holes and a natural colour are a determinant of high quality for them. A significant percentage of pollsters — 23.5% are willing to pay more per kilogram of cheese, declaring that the higher price of the product results, according to respondents, from the fulfillment of quality standards by the manufacturer. On the other hand, 9.8% of people answered that they do not want to overpay for "regular" cheese and quality class concerns are not significant for them. The last group of respondents — 19.6% pays attention to the composition of the cheese, analyzing its label and the content value of individual nutrients (Graph 1).

The next step was to determine the frequency of consumption of yellow cheeses among the group subjected to the survey. The results showed that the highest percentage of respondents consumes cheese twice a week (29.4%), while the smallest — five times a week. There were

no persons who did not eat cheese at least once a week, as well as people consuming cheeses six days a week (Chart 2).

The next issue that was raised during the survey was the knowledge of the differences between short-maturing cheeses and long-maturing cheeses and the awareness of technological differences in their production process. As many as 64.7% of the respondents indicated that they know what are the various stages of cheese making, both short and long-maturing. On the other side, 17.6% of the respondents were not aware of these differences. For the next 17.6%, long maturing cheeses were associated with blue cheese.

An important aspect of the study on factors affecting the consumption of long-ripening cheeses was the query of respondents for the best bioavailable source of calcium. The largest number of respondents (33.3%) considered that to be long-maturing cheese, 21.6% indicated milk, 17.6% thought it was cottage cheese, while 11.8% were convinced of the value of kefir, buttermilk and yoghurt. The rarest response in the questionnaire was fish and leafy green vegetables – 2% each (Chart 3).

The respondents were also asked about spermidine – one of the polyamines found in few food products – and about their knowledge of its widespread use. From among the group of medical students surveyed, only 9.8% heard about its pro-health qualities, while 90.2% did not.

Another question that was addressed to the respondents concerned the knowledge of the influence of long-ripening cheeses on the risk of osteoporosis. Over half of the respondents – 51% responded that long-maturing cheeses inhibited the development of osteoporosis and reduced the probability of its occurrence. As many as 45% did not have an opinion on this subject. The remaining part of the surveyed believed that long-ripening cheeses increase the risk of osteoporosis or have no scientifically proven influence – 2% each (Chart 4).

Another important aspect of the study was to learn the health concerns of respondents that prevent them from eating long-ripening cheeses. Among them, 58.8% do not indicate any

factors discouraging them from purchasing long-maturing cheeses, 9.8% are afraid of complications in the form of acceleration of atherosclerotic processes, another 9.8% have doubts whether the cheeses, which are a rich source of fats, do not contribute to the development of obesity, and the remaining 9.8%, due to the drugs taken, must limit the consumption of products rich in cholesterol and fat. Among the respondents there were also people who, due to their traditionalism and them being used to traditional short-ripening cheeses, were sceptical about shopping for long-ripening cheeses — 23.5% of all respondents (Chart 5).

An important issue that divides respondents into groups is the price they are able to pay for the kilogram of cheese. Among them, 35.3% believe that the higher price of long-ripening cheeses, as compared to cheeses with short period of maturity, discourages them from purchasing such products. In the group of 204 people surveyed, 39.2% declared that they are able to spend 16-25 PLN per 1kg of cheese, 33.3% of respondents — 26-35 PLN, 19.6% of respondents — 36-50 PLN, 5.9% — over 50 PLN, and the remaining 2% may spend a maximum of 15 PLN (Chart 6).

The next question, which was asked to the respondents, concerned the availability of long-ripening cheeses in stores near their place of residence. As many as 92.2% of the respondents indicated that this type of product is available for purchase in their immediate vicinity, while 7.8% of them replied in the negative.

In the penultimate question, respondents were informed about positive effects of long-ripening cheeses and had to indicate the most surprising one. The most common response, chosen by 42% of respondents, was that consumption of long-maturing cheeses improves mood, reduces tension and anger. As many as 34% were most surprised by the reduction of inflammatory processes, including inflammatory bowel states. Less surprising effects of cheeses consumption according to the surveyed were: inhibition of bloating and influence on maintaining the proper pH of the vagina — 12% of all responses; reduction of the allergy occurrence, due to the presence of probiotics and vitamin D — 8%; prevention of liver fibrosis — 4%.

Long-maturing cheeses contain the highest amount of total cholesterol of all types of cheese. The last important aspect that was raised in the survey was the respondents' indication of the product with the highest content of cholesterol. The most common response was cheese-like products – 56.9%, followed by short-ripening cheeses – 21.6%, longer-ripening cheeses – 13.7%, and curd cheese – 7.8%.

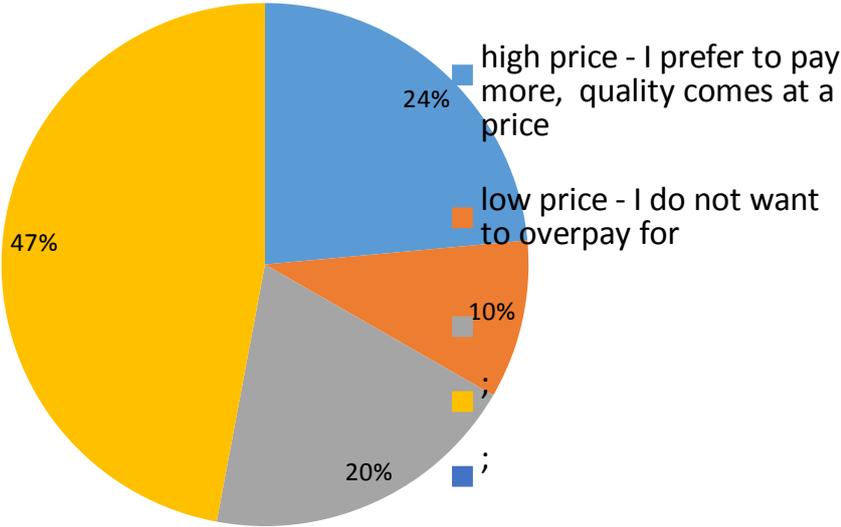
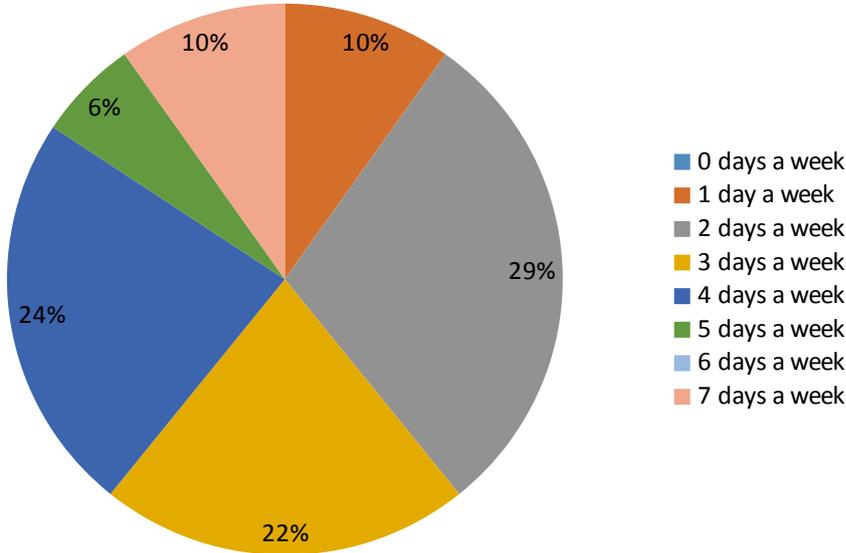


Chart 1. Criteria that the respondents follow when buying cheese



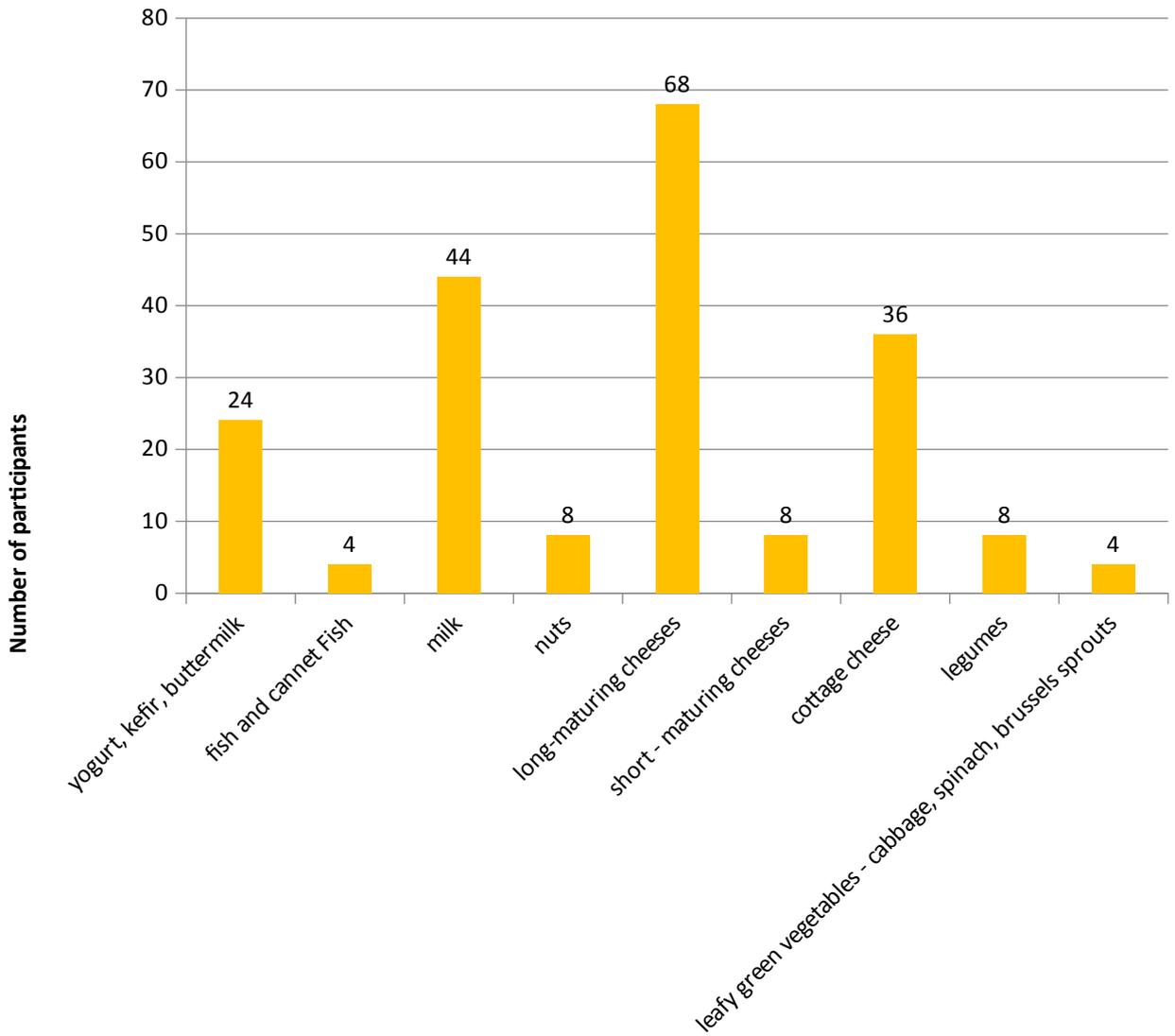


Chart 2. The frequency of consumption of yellow cheese by respondents during the week

Chart 3. The best available source of calcium in food products according to subjects

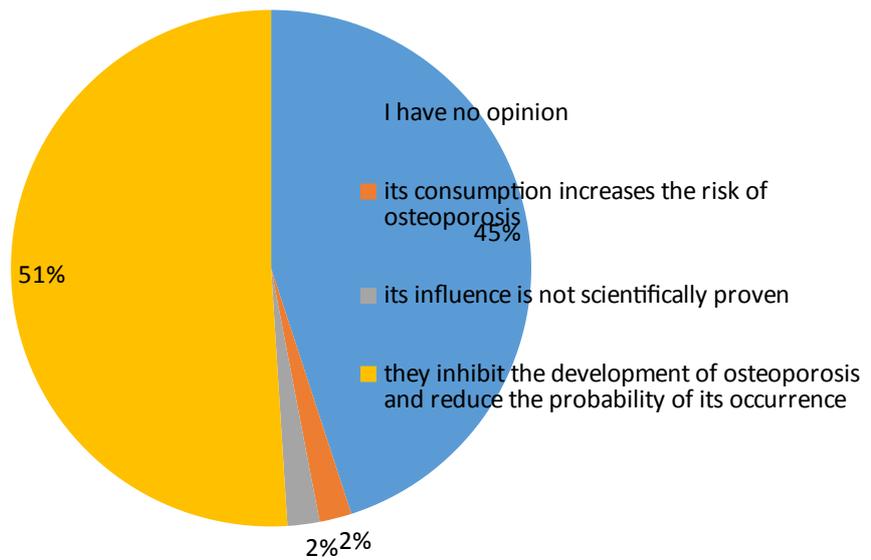


Chart 4. Respondents' knowledge of the role of long-ripening cheeses in preventing osteoporosis

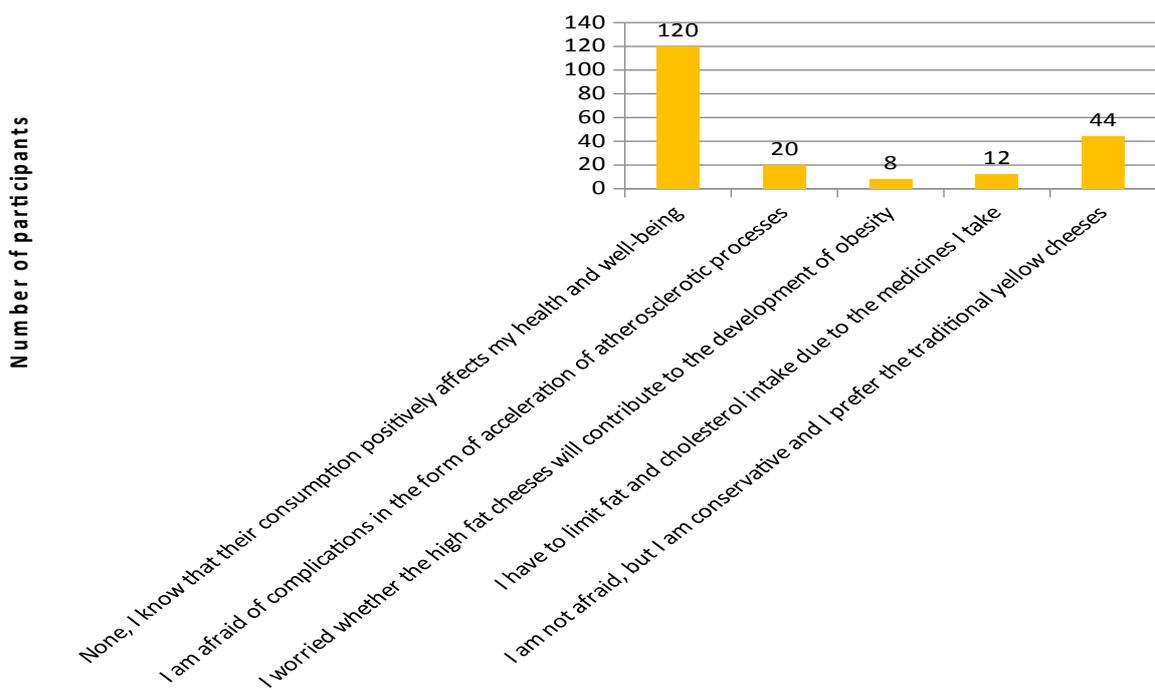


Chart 5. Health concerns that prevent respondents from consuming long-maturing cheeses

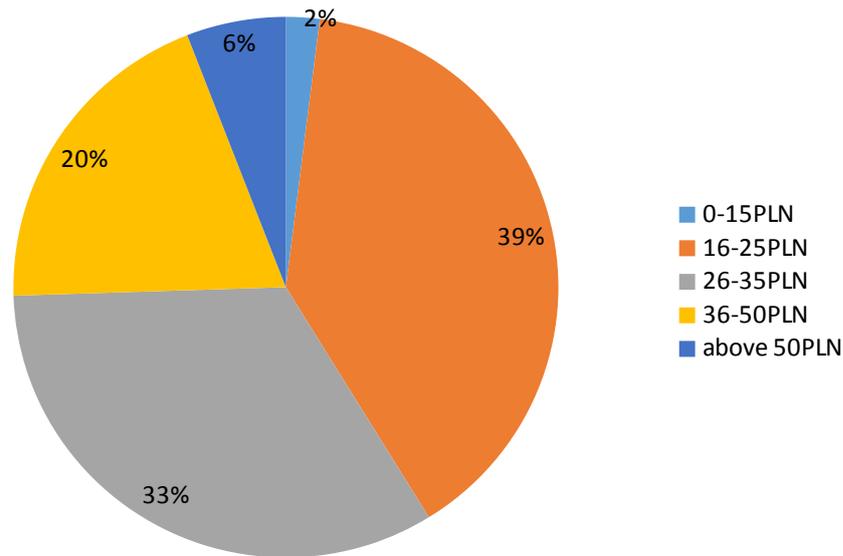


Chart 6. The price that respondents are willing to pay for 1 kg of long-ripening cheese

## Discussion

The study showed that the main factors influencing the consumption of high-ripening cheeses in the medical environment is the respondents' knowledge about the health benefits they generate, the product price proposed by the producers, the external appearance of the cheese, and the degree of popularization of healthy nutrition. A significant part of the surveyed group, as many as 35%, is not aware of the differences between short and long-maturing cheeses. Respondents showed only superficial knowledge about the health benefits of incorporating into the diet products rich in antioxidants, calcium, unsaturated fatty acids – such as in long-maturing cheeses. According to recent studies, long-ripening cheeses are the most expensive source of calcium among dairy products [5].

One of the objections against the consumption of long-ripening cheeses concerns their high lipid content as well as total cholesterol. This aspect was explored by Rita Nilsen, who conducted research on a group of 153 people, analyzing the effect of Gamalost cheese and Gouda type cheese with 27% fat content on cholesterol level [13]. In people with metabolic syndrome who consumed Gouda-type cheese for a long time, a decrease in total cholesterol was observed, compared to the control group, as well as a significant decrease in triglycerides. In the Gamalost-consuming group, with high baseline total cholesterol, a decrease of total cholesterol was observed with respect to the control group. Other researchers have noted that cheese intake is associated with a reduction in the prevalence and incidence of metabolic

syndrome [14, 15]. On the other hand, some dietary guidelines recommend the complete elimination of fat-rich dairy products [16] from the diet, while others require them to be kept to a minimum [17].

Long-maturing cheeses contain a significant amount of tyramine, which may interact with sympathomimetic drugs, increasing the risk of hypertensive crisis. A similar effect may occur when using MAO-B inhibitors in combination with levodopa. However, some MAO-B inhibitors, including Deprenyl, can be used safely in a dose not exceeding 10mg / day in combination with products containing tyramine [26].

Studies published in recent years place a lot of hope in spermidine – the same polyamine as the one found in human seed – which can also be found in long-ripening cheese. In addition to spermidine, long-maturing cheese also contains spermine and putrescine [18, 19] (Chart 7). The higher content of putrescine in long-ripening cheeses [20], compared to cheeses with a short aging period, is the result of fermentation processes. These polyamines play a significant role in the regulation of cell growth and proliferation, and control cellular apoptosis [21]. In addition, they participate in the prevention of neurodegeneration and stimulate neuroprotective effects, protecting against locomotion disorders and memory loss. They inhibit the neurotoxic effect of  $\alpha$ -synuclein [22] and stimulate axonal regeneration [23]. Other properties of polyamines include cardioprotective activities. Spermidine contained in cheese may increase the bioavailability of arginine, due to the lack of necessity of endogenous conversion of arginine to spermidine, which in turn may increase the production of vasodilating nitric oxide. This leads, inter alia, to the reduction of hypertension and to the reduction of the risk of cardiovascular events occurring [24]. Spermidine potentially plays a role also in the case of inhibiting the formation of certain types of cancer, including HCC. It reduces the extent of liver fibrosis and reduces the incidence of hepatocellular carcinoma [25].

Many diseases of civilization can be prevented through a proper lifestyle, the component of which is an appropriate and conscious diet, rich in products of the dairy industry. An essential initiative is the introduction of basic activities that will promote healthy behaviours not only among the representatives of medical fields, but also on a larger scale, covering the entire Polish society. These include trainings and educational campaigns within schools, colleges and other education units, building and propagating pro-health views from an early age.

Considering the pathophysiology of many diseases and the combination of certain drugs with food products, efforts aimed at implementing elements of a rational and valuable diet into the programs of studies at medical universities should be intensified, without excluding or rejecting the achievements of natural medicine that place great emphasis on correct nutrition. On the other hand, planning and rationalizing nutrition often requires more financial and time expenditure, which may explain some resistance to full dissemination of the principles of healthy nutrition among medical students. The incorporation of long-maturing cheeses into the daily diet brings many benefits, however their consumption in excessive amounts may have a negative impact on the overall health condition, which is why further scientific research is recommended.

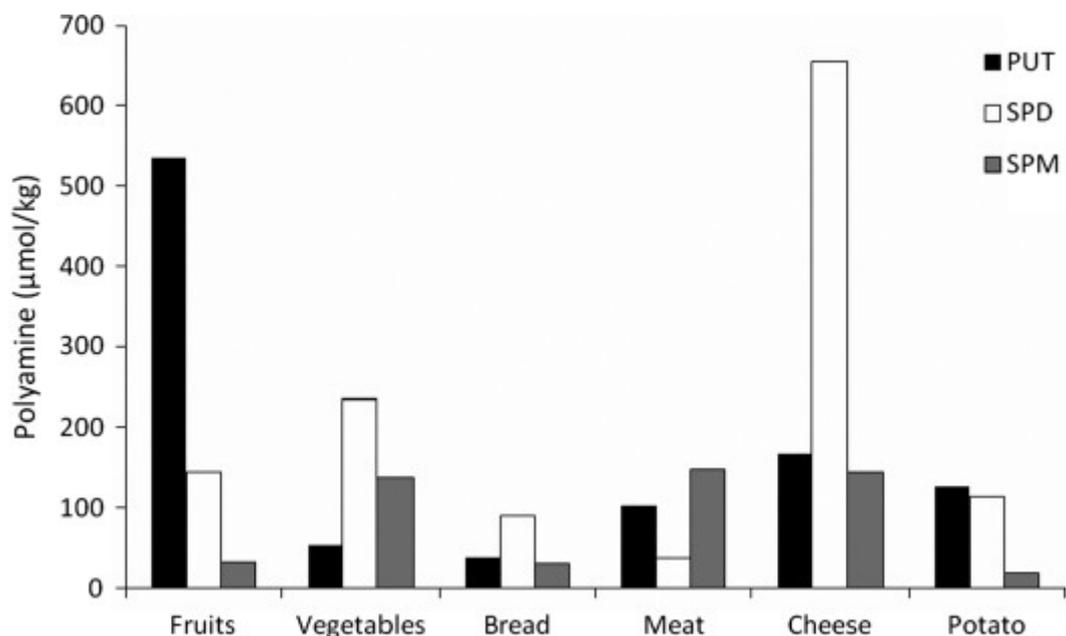


Chart 7. Mean polyamine (putrescine, spermidine, and spermine) content in each food group according to the developed database. Number of foods included in each group: fruits (29), vegetables (46), bread (14), meat (55), cheese (19), and potato (6).

Source: Atiya Ali, M., Poortvliet, E., Strömberg, R., & Yngve, A. (2011). Polyamines in foods: development of a food database. *Food & Nutrition Research*, 55.

<https://doi.org/10.3402/fnr.v55i0.5572>

## Conclusions

The main factor affecting the consumption of long-ripening cheeses is their price, which is set by the producer taking the production costs into account, which are higher in the case of long-ripening cheeses. However, still a significant percentage of respondents do not see the benefits of their consumption, which requires educating the population in terms of nutrition and conducting advertising campaigns, which promote consumption of dairy products. Lack of knowledge and awareness about long-maturing cheeses prevents the popularization of these products in the medical environment and is a factor inhibiting their consumption.

## References

1. Dane Głównego Urzędu Statystycznego; Departament Produkcji: [https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5866/33/1/1/25\\_maja\\_23052016.pdf](https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5866/33/1/1/25_maja_23052016.pdf) [02-07-2019]
2. Czerwińska D, Sery podpuszczkowe twarde od kuchni, „Przegląd Gastronomiczny”, czerwiec 2012, s. 7-9
3. McSweeney PLH, Ottogalli G, Fox PF, Diversity of Cheese Varieties: An Overview W: Cheese Chemistry, Physics and Microbiology, pod redakcją Fox F, McSweeney PLH, Cogan TM and Guinee TP, Third Edition, Volume 2 Major Cheese Groups, 2004, s. 1-22.
4. Żelazowski P, Sery podpuszczkowe dojrzewające typu holenderskiego (Gouda, Edam), Badania młodych naukowców tom IV, Wydawnictwo Diecezji Siedleckiej UNITAS, Editors: Szczepańczyk P, Rajewska M, pp.5-26
5. Cichosz G, Czeczot H: „Wapń niezbędny dla każdego” Polski Merkuriusz Lekarski 2014, XXXVI (216): 407-411
6. Cichosz G, Czeczot H: „Tłuszcz mlekowy - źródło antyoksydantów w diecie człowieka”. Bromat. Chem. Toksykol. XLIV, 2011,1, 8-16
7. Cichosz G, Czeczot H: „Tłuszcz mlekowy w profilaktyce chorób dieto zależnych” Bromat. Chem. Toksykol. XLVII,2014, (1):1 – 8

8. Cichosz G, Czeczot H: „Kontrowersje wokół cholesterolu pokarmowego” *Polski Mercuriusz Lekarski*, 2012, XXXIII, nr 193: 38-42
9. Luchetti G et al., “Cholesterol activates the G-protein coupled receptor Smoothed to promote Hedgehog signaling,” *Elife*, vol. 5, 2016.
10. Öhrvik V, Lemming EW, Nälsén C, Becker W, Ridefelt P, Lindroos AK, Dietary intake and biomarker status of folate in Swedish adults, *Eur J Nutr*. 2018 Mar;57(2):451-462
11. Forssén KM1, Jägerstad MI, Wigertz K, Witthöft CM, Foliates and dairy products: a critical update, *J Am Coll Nutr*. 2000 Apr;19(2 Suppl):100S-110S
12. Askari G, Nasiri M, Mozaffari-Khosravi H, Rezaie M, Bagheri-Bidakhavidi M, Sadeghi O, The effects of folic acid and pyridoxine supplementation on characteristics of migraine attacks in migraine patients with aura: A double-blind, randomized placebo-controlled, clinical trial, *Nutrition*. 2017 Jun;38:74-79.
13. Nilsen R, Høstmark AT, Haug A, and Skeie S, Effect of a high intake of cheese on cholesterol and metabolic syndrome: results of a randomized trial, *Food Nutr Res*. 2015; 59
14. Høstmark AT, Tomten SE. The Oslo health study: cheese intake was negatively associated with the metabolic syndrome. *J Am Coll Nutr*. 2011;30:182–90
15. Fumeron F, Lamri A, Khalil AC, Jaziri R, Porchay-Balderelli I, Lantieri O, et al. Dairy consumption and the incidence of hyperglycemia and the metabolic syndrome: results from a French prospective study, Data from the Epidemiological Study on the Insulin Resistance Syndrome (DESIR) *Diabetes Care*. 2011;34:813–17
16. Benatar JR, Chapter 20—Does dairy food have effects on cardiovascular disease and cardiometabolic risk? A2—Watson, Ross R.. In: Collier RJ, Preedy VR, editors. *Dairy in Human Health and Disease Across the Lifespan*. Academic Press; Cambridge, MA, USA: 2017. pp. 263–271
17. Harvard School of Public Health Healthy Eating Plate and Healthy Eating Pyramid. [(accessed on 21 January 2018)]; Available online: <https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate> [02-07-2019]
18. Okamoto A, Sugi E, Koizumi Y, Yanagida F, Udaka S. Polyamine content of ordinary foodstuffs and various fermented foods. *Biosci Biotechnol Biochem*. 1997;61:1582–4

19. Atiya AM, Poortvliet E, Strömberg R, Yngve A. (2011). Polyamines in foods: development of a food database. *Food & Nutrition Research*, 55. <https://doi.org/10.3402/fnr.v55i0.5572> [02.07.2019]
20. Eliassen KA, Reistad R, Risoen U, Ronning HF. Dietary polyamines. *Food Chem.* 2002;78:273–80
21. Pegg AE, Functions of polyamines in mammals. *J. Biol. Chem.* 2016, 291, 14904–14912
22. Büttner S, Broeskamp F, Sommer C, Markaki M, Habernig L, Alavian-Ghavanini A, Carmona-Gutierrez D, Eisenberg T, Michael E, Kroemer G, Tavernarakis N, Sigrist SJ, Made F, Spermidine protects against  $\alpha$ -synuclein neurotoxicity. *Cell Cycle* 13, 3903–3908 (2014)
23. Deng K, He H, Qiu J, Lorber B, Bryson JB, Filbin MT, Increased synthesis of spermidine as a result of upregulation of arginase I promotes axonal regeneration in culture and in vivo. *J. Neurosci.* 29, 9545–9552 (2009).
24. Eisenberg T, Abdellatif M von Frieling-Salewsky, Pieske B, Scorrano L, Pieber T, Pechlaner R, Willeit J, Sigrist SJ, Linke WA, Mühlfeld C, Sadoshima J, Dengjel J, Kiechl S, Kroemer G, Sedej S, Made F, Cardioprotection and lifespan extension by the natural polyamine spermidine. *Nat. Med.* 22, 1428–1438 (2016).
25. Yue F, Li W, Zou J, Jiang X, Xu G, Huang H, Liu L, Spermidine prolongs lifespan and prevents liver fibrosis and hepatocellular carcinoma by activating MAP1S-mediated autophagy. *Cancer Res.* 77, 2938–2951 (2017)
26. Sathyanarayana TSR and Yeragani1 VK, Hypertensive crisis and cheese, *Indian J Psychiatry.* 2009 Jan-Mar; 51(1): 65–66.