

Consumer perception and acceptance of plant-based meat substitutes

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Abstract

Nowadays, the meat market is affected by the changes in consumer lifestyles related to the health, sustainability, and environment as well as population growth and the increasing meat demand. In the following years, meat production can be replaced partially by production of meat substitutes. The aim of the paper is to point out the consumer perception and acceptance of plant-based meat substitutes, as well as to identify key motives and barriers for their consumption. For fulfilment the aim a consumer survey was carried out in Slovakia on a sample of 733 respondents. Using statistical methods, differences in consumer attitudes towards plant-based meat substitutes were examined in three identified segments, namely meat consumers, meat and also meat substitutes consumers, meat substitutes consumers. The first segment includes consumers who think that it is not possible to replace meat with plant-based meat substitutes. However, consumers expect that consumption of plant-based meat substitutes to be moral, ecological, sustainable, safe and healthy. These consumers consider similarity to meat in taste, smell and appearance as key motives for consumption and they state that the main reasons for consumption are the health aspect, taste and environmental protection, and the main barriers are the habit of meat and the fear of lack of appetite. Consumers from the second segment perceive plant-based meat substitutes as an acceptable alternative for the future, and they expect consumption to be moral, ecological, safe and healthy. Currently, most consumers already consume plant-based meat substitutes or assume their consumption in the future, and the key reasons are health, environment and taste. The key motive for higher consumption is consumer awareness related to health, the impact on the environment and the production process. The last segment includes consumer who consume plant-based meat substitutes due to environmental protection, their lifestyle and health aspects and perceive them as a suitable alternative. Consumers consider their consumption to be moral and nutritious and higher consumption will be achieved by increased consumer awareness. Based on the results of the study and the situation on the meat market, it is desirable that Slovak consumers gradually should become informed about alternative diet and accept the possibility of consuming plant-based meat substitutes. The research paper provides a new perspective on the consumer acceptance and consumption of plant-based meat substitutes, divided into three segments regarding current eating habits of consumers, which can fill the scientific research gap because this issue has not yet been examined in Slovakia. The results of the study provide valuable information to food companies in the creation of marketing strategies and policy makers in improving food policy and supporting the public health.

Keywords: plant-based meat substitutes, consumer, acceptability, perception, attitudes, consumption, motives, reasons

1. Introduction

The consumption of meat has an important role in human diet (Ahmad et al. 2018; Pereira & Vicente 2013). Meat has a high nutritional value and provides the human body a variety of nutrients such as proteins, vitamins and minerals (Geiker et al. 2021; Sui et al. 2017; Boler & Woerner 2017; Ostaszewski 2018). Meat consumption brings many positive health effects to human body. On the other hand, excessive consumption of meat is associated with negative health aspects on consumers health and also on the environment (Godfray et al. 2018; Leroy et al. 2022; van den Berg et al. 2022).

Moreover, the meat market faces many challenges related to sustainability, environmental protection and also health (Kumar 2022; Stubbs 2018). Based on OECD/FAO (2022) is expected that the global meat consumption is projected to increase by 14% by 2030. The main drivers of increasing meat consumption are income and population growth. However, it is desirable to reduce the meat consumption due to its impacts on the human health and sustainability issues (Font-i-Furnols 2023; Modlinska et al. 2020). Moreover, the meat market is influenced by changing consumers perception to healthy and sustainable food (Lee et al. 2020). For consumers, the most important reasons for reducing meat consumption are health, environment, animal welfare and also saving money. The main barriers for reduce the amount of consumed meat are their habits, taste and higher prices of meat substitutes.

In the context of the mentioned, one of the ways to reduce meat consumption and consume more healthy and sustainable food is to consume a meat alternative - plant-based meat substitutes (van den Berg et al. 2022; Willett et al. 2019; Apostolidis & McLeay 2016; Szenderák et al. 2022; Bryant & Sanctorem 2021). The most known plant-based meat substitutes are tofu, tempeh, fungi, nuts, seeds, legumes. Plant-based meat substitutes are good source of protein and has similar nutritional profiles as food of animal origin (Ahmad et al. 2022). The development of healthy products with a high protein content, low saturated fat content and other health benefits brings a great potential for replacing meat with products based on plant proteins (Sun et al. 2021).

Plant-based food may help to face the challenges regarding sustainability issues of food sector, as consumers consider plant-based meat substitutes as healthy, environmentally friendly and ethical (Aschemann-Witzel et al. 2021). Consumption of plant-based meat substitutes (plant-based diet) has become more popular among consumers and demand for plant-based meat substitutes is growing. Furthermore, the meat alternatives help to moderate the negative impacts on the environment and also

improve consumers health (Alcorta et al. 2021; Poore and Nemecek 2018; Curtain and Grafenauer 2019; Ahmad et al. 2022). On the other hand, consumer preferences for meat substitutes are currently low. It is important to focus on increase the awareness of consumers about meat alternatives, educate them and focus on food labelling regulations oriented to health and environmental benefits, also animal welfare advantages of meat substitutes (Apostolidis & McLeay 2016). Consumption of these products can be increased thought greater emphasis on health and environmental aspects (Szenderák et al. 2022). According to van den Berg et al. (2022) it is possible to support meat substitutes consumption by applying strategies aimed at increasing the attractiveness of plant-based meat substitutes and also reducing the prices of plant-based meat alternatives. In addition, Bryant (2022) stated, that plant-based animal product alternatives have a potential for improvement related to taste, price, nutritional profile and other characteristics.

The study explores consumer perception and acceptance towards plant-based meat substitutes with emphasis on expectations, motives and reasons for consumption. The results of the paper may enrich the literature in the field of consumer behaviour with a new perspective related to plant-based meat substitutes consumption. We consider the results of the study as beneficial for food companies in the development of new plant-based meat substitutes and also for increasing the consumers awareness of these products. In the context of the mentioned, the following research questions were formulated:

1. Are there different segments depending on the consumption of meat and meat substitutes?
2. What are the differences in the perception and acceptance of the consumption of plant-based meat substitutes between segments?
3. Are plant-based meat substitutes acceptable future food for Slovak consumers?

2. Methodology

The study was based on a consumer survey exploring consumer perception and attitudes towards plant-based meat substitutes. The aim of the study was to examine the perception and acceptance of plant-based meat substitutes and to identify the key motives, expectations, reasons for consumption, as well as future perspectives. The questionnaire survey was carried out in 2021 on a sample of 733 respondents in Slovakia. Respondents were divided into eight categories, which are specified in the following Table 1.

Table 1 Demographic profile of research sample (source: own research)

		n	%
Gender	male	260	35.5%
	female	473	64.5%
Age	≤ 25 years	353	48.2%
	26 – 45 years	230	31.4%
	≥ 45 years	150	20.5%
Education	elementary	28	3.8%
	secondary	317	43.2%
	university	388	52.9%
Members in household	1 member	25	3.4%
	2 members	154	21.0%
	3 members	205	28.0%
	4 members	257	35.1%
	≥ 5 members	92	12.6%
Place of residence	rural	348	47.5%
	urban	385	52.5%
Monthly income of respondent	≤ 500 €	313	42.7%
	501-1,000 €	242	33.0%
	1,001-1,500 €	133	18.1%
	1,501-2,000 €	30	4.1%
	≥ 2,001€	15	2.0%
Monthly income of household	≤ 1,000 €	83	11.3%
	1,001-2,000 €	366	49.9%
	2,001-3,000 €	194	26.5%
	3,001-4,000 €	58	7.9%
	≥ 4,001€	32	4.4%
Economic activity	Employed	312	42.6%
	Student	303	41.3%
	Self-employed	47	6.4%
	Unemployed	14	1.9%
	Retired	23	3.1%
	Maternity leave	23	3.1%
	Other	11	1.5%

Data were obtained by the questionnaire survey and evaluated by statistical software XLSTAT 2022.4.1. For the purposes of statistical testing, a significance level was set to 0.05.

According to eating habits, consumers were divided into three segments: meat consumers, meat and plant-based meat substitutes consumers, plant-based meat substitutes consumers. Each segment expressed their opinion related to plant-based meat substitutes as a future food. They determined one of these options: plant-based meat substitutes is a long term solution, plant-based meat substitutes is an efficient substitute, plant-based meat substitutes is a suitable alternative, plant-based meat substitutes is an acceptable substitute or consumption of plant-based meat substitutes is impossible.

In the next part of the survey, respondents divided into three segments expressed the degree of agreement with expectations related to plant-based meat substitutes

consumption on 5-point scale, where 5 representing strong agreement and 1 representing strong disagreement. They evaluated 8 claims related to plant-based meat substitutes consumption, namely consumption is moral, consumption is ecological, consumption is safe, consumption is nutritive, consumption is sustainable, consumption is reasonably priced, consumption is tasty. We found statistically significant differences in the evaluation of mentioned expectations using the Friedman test and its post hoc test Nemenyi's procedure. These differences were graphically shown by Demsar plots for each segment.

We also focused on reasons of plant-based meat substitutes consumption for each segment. Consumers from each segment evaluated 7 reasons for consumption, namely environmental protection, lifestyle, health aspects, taste, sustainability, moral aspect and safety on 5-point scale, where 5 representing the least important reason and 1 representing the most important reason for consumption. By applying Friedman test and its post hoc test Nemenyi's procedure, we examine statistically significant differences in the evaluation of these reasons.

To fulfill the aim of the paper, we examine consumers motives for plant-based meat substitutes consumption. Each segment of consumers evaluated the following motives: appearance as meat, color as meat, texture as meat, aroma as meat, taste as meat, price as meat, information about health aspects of plant-based meat substitutes, information about production of plant-based meat substitutes, information about sustainability and environmental protection related to this consumption, on a 5-point scale, where 5 representing the least important motive and 1 representing the most important motive for consumption. We found differences in the evaluation of motives using the Friedman test and its post hoc test Nemenyi's procedure for meat consumers, meat and plant-based meat substitutes consumers, plant-based meat substitutes consumers, which were showed by Demsar plots.

Furthermore, we were also interested in future consumption of plant-based meat substitutes. We determined statistically significant differences between the future consumption of plant-based meat substitutes and each segment.

3. Results

Based on the data obtained by the survey, consumers were divided into 3 segments according to their eating habits. The first segment represents consumers who consume only meat and meat products, therefore was named as "meat consumers" and consists of 47.5 % respondents. The second segment includes consumers who consume meat and also plant-based food. This segment was named as "meat and plant-based meat substitutes consumers" and represents 46 % of the respondents. The last segment involves consumers who only consume plant-based food and therefore the name of

this segment is “plant-based meat substitutes consumers”. The mentioned segment includes almost 7% of respondents.

The consumer survey was focused on the consumer acceptability of plant-based meat substitutes as potential meat substitute. The results stated in the Table 2 showed that for more than one third of Slovak consumers are plant-based meat substitutes acceptable. Moreover, 16.8% of respondents perceive plant-based meat substitutes as a solution in the long-term with regard on health and sustainability aspects. A further 14.2% of consumers consider plant-based meat substitutes as a suitable alternative and for 14.2% plant-based meat substitutes are an efficient solution. For 18.4% of respondents, plant-based meat substitutes are unrealistic and impossible alternative for meat and meat products. In our research, we also identified differences between segments in the consumer perception of plant-based meat substitutes as future food (p-value <0.0001).

Table 2 Consumer acceptability of plant-based meat substitutes (source: own research)

	Meat consumers		Meat and plant-based meat substitutes consumers		Plant-based meat substitutes consumers	
	n	%	n	%	n	%
efficient	36	10.3	60	17.8	8	16.7
long-term solution	72	20.7	44	13.1	7	14.6
impossible	112	32.2	23	6.8	0	0.0
acceptable	102	29.3	151	44.8	14	29.2
suitable	26	7.5	59	17.5	19	39.6

In the context of plant-based meat substitutes as future food, we were interested in the consumers' expectations. Consumers evaluated eight different expectations and the results showed that Slovak consumers have relatively high positive expectations related to moral consumption (mean = 3.88), ecological aspect (mean = 3.70), safety (mean = 3.63) and also health aspect (mean = 3.62). On the other hand, Slovak consumers do not have positive expectations regarding price (mean = 2.91) and taste (mean = 2.76). We also identified differences in evaluation of these expectations for all segments using Friedman test (p-value <0.0001) and these differences are shown by Demsar plot for each segment (Figure 1 - Figure 3).

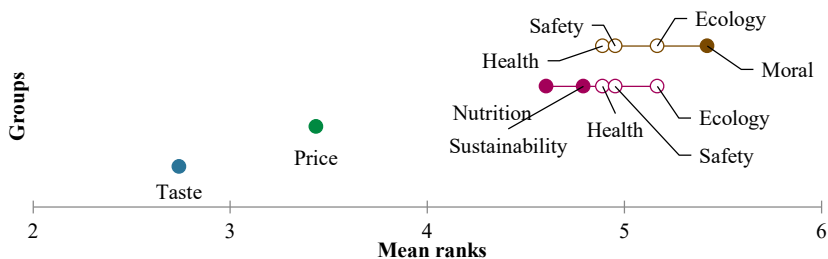


Figure 1 Expectations for plant-based meat substitutes consumption - segment "Meat consumers" Source: own research

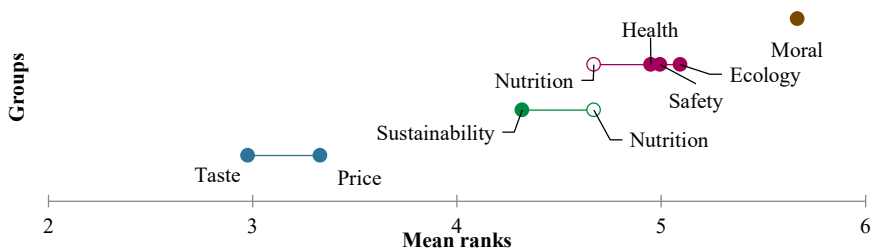


Figure 2 Expectations for plant-based meat substitutes consumption - segment "Meat and plant-based meat substitutes consumers" Source: own research



Figure 3 Expectations for plant-based meat substitutes consumption - segment "Plant-based meat substitutes consumers" Source: own research

The next part of research survey was aimed to identify the key reasons for plant-based meat substitutes consumption for each segment. The results showed that “meat consumers” segment consumes plant-based meat substitutes mainly due to health aspects, taste and environmental protection. For comparison, “plant-based meat substitutes consumers” segment stated, that they consume plant-based meat substitutes mainly due to the reasons related to environmental protection, lifestyle, sustainability, health aspects and taste. Applying Friedman test and its post hoc test

Nemenyi's procedure, we identified statistically significant differences in evaluated expectations among mentioned segments (p -value <0.0001) (Table 3 – Table 5).

Table 3 Reasons for plant-based meat substitutes consumption - segment "Meat consumers" (source: own research)

Sample	Mean of ranks	Groups
Health aspects	3,041	A
Taste	3,342	A
Environmental protection	3,725	A B
Sustainability	4,158	B C
Moral aspect	4,383	B C
Lifestyle	4,582	C
Safety	4,769	C

Table 4 Reasons for plant-based meat substitutes consumption - segment "Meat and plant-based meat substitutes consumers" (source: own research)

Sample	Mean of ranks	Groups
Health aspects	3,248	A
Environmental protection	3,533	A B
Taste	3,806	B C
Sustainability	4,147	C D
Lifestyle	4,214	C D
Moral aspect	4,341	D E
Safety	4,712	E

Table 5 Reasons for plant-based meat substitutes consumption - segment "Plant-based meat substitutes consumers" (source: own research)

Sample	Mean of ranks	Groups
Environmental protection	3,406	A
Lifestyle	3,573	A
Health aspects	3,604	A
Taste	3,938	A
Sustainability	3,948	A
Moral aspect	4,146	A B
Safety	5,385	B

For increase consumer awareness, it is necessary to motivate consumers to consume plant-based meat substitutes or at least to taste it. Slovak consumers evaluated nine possible motives for plant-based meat substitutes consumption. The results showed that Slovak consumers consider taste and information related to health aspects (mean = 2.29), sustainability (mean = 2.36) and production (mean = 2.36) as key motives for consumption. On the other hand, texture (mean = 2,84), appearance (mean = 2.76) and colour (mean = 2.88) are the least important motives for Slovak consumers. Furthermore, based on the results of Friedman test (p -value<0.0001) we identified statistically significant differences in the evaluation of motives for plant-based meat substitutes consumption in the future in individual segment. The specification of differences was explored by Nemenyii post-hoc test and the results are graphically shown by the Demsar plot for individual segments (Figure 4 – Figure 6).

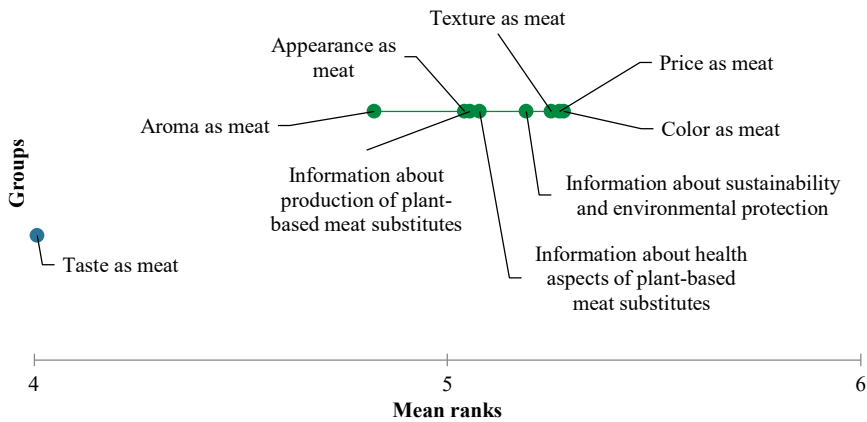


Figure 4 Motives for plant-based meat substitutes consumption - segment "Meat consumers"
Source: own research

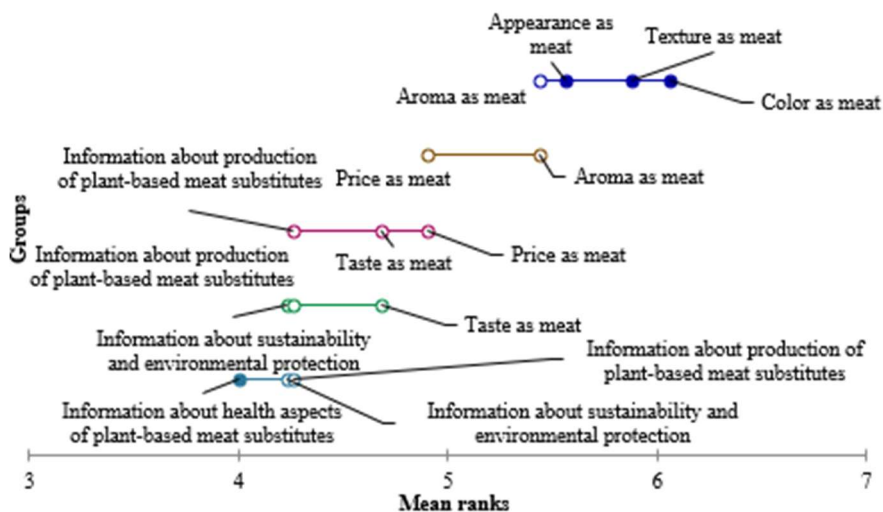


Figure 5 Motives for plant-based meat substitutes consumption - segment "Meat and plant-based meat substitutes consumers"
Source: own research

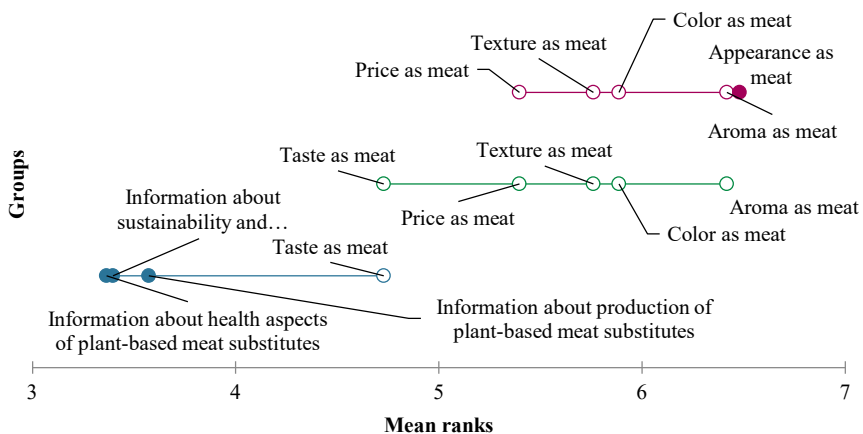


Figure 6 Motives for plant-based meat substitutes consumption - segment "Plant-based meat substitutes consumers"
Source: own research

Consumer survey was also focused on possible consumption of plant-based meat substitutes in the future. Based on the results of Chi-square test of independence (p -value < 0.05) we identified statistically significant differences between examined segments and future consumption of plant-based meat substitutes. According to the data stated in the Table 6, we can state, that more than 50% consumers from segment "meat consumers" will not consume plant-based meat substitutes in the future and more than 45 % of these consumers would like to taste it. Therefore, it is important to

raise consumer awareness of the benefits associated with the health and environmental aspects of consuming plant-based meat substitutes. Moreover, it is desirable to reduce meat consumption and partially replace meat and meat products with various alternatives, including products based on plant proteins. The results also showed that consumers from segment “plant-based meat consumers” will not plan to reduce the consumption of plant-based meat substitutes in the future.

Table 6 Future perspectives of the plant-based meat substitutes consumption (source: own research)

	Meat consumers		Meat and plant-based meat substitutes consumers		Plant-based meat substitutes consumers	
	n	%	n	%	n	%
current consumption	0	0.00	164	48.7	46	95.8
taste in the future	158	45.4	173	51.3	2	4.2
non-consumption in the future	190	54.6	0	0.0	0	0.0

4. Discussion

Plant-based meat substitutes belong to meat alternatives, which can represent one of the most suitable solutions for consumers with the aim of reducing the consumption of meat and meat products due to the negative impact of globally high meat consumption on sustainability, but also on the health of consumers. Based on the results of the survey conducted on a sample of 733 respondents, we divided consumers into three segments: meat consumers, meat and plant-based meat substitutes consumers and plant-based meat substitutes. Consumers of the first segment expect that consumption of plant-based meat substitutes should be moral, ecological, sustainable, safe and healthy. Key reasons for consumption are mainly health aspect and environmental protection and important motive is the similarity to meat. Consumers of the second segment expect that consumption of plant-based meat substitutes should be moral, ecological, safe and healthy. Consumers consider health aspect, taste and environment as the most important reasons for consumption and the consumption of this alternative should be supported by consumer awareness about health, environmental impact and production process. Consumers from the last segment have already consumed plant-based food and these alternatives prefer due to the health aspect, environment and taste. Moreover, an increase in consumption will be possible if consumer awareness is higher. There are more studies that deal with the issue of examination of consumer acceptance of plant-based meat substitutes, as interest in plant-based diets and the consumption of plant-based meat substitutes is growing rapidly, especially for health reasons and environmental protection (Estell et al. 2021). The results of the study conducted by Estell et al. (2021) showed that

consumers perceive the consumption of plant-based meat substitutes as healthy, environmentally friendly and sustainable. Begho et al. (2022) add that consumers perceive plant-based meat substitutes as being better for the environment and Vural et al. (2023) found that plant-based meat alternatives have an advantage of a higher perceived healthiness. On the other hand, the key barrier for the consumption of plant-based meat substitutes is mainly poorer taste pleasantness and reduced satiety compared to meat (Vural et al. 2023). According to Graça et al. (2019) it is possible to consider lack of information about plant-based meat substitutes and lack of cooking skills as other barriers. In the context of the mentioned, Michel et al. (2021) found that especially for meat consumers are more attractive meat alternatives which are similar as meat. Another motive for plant-based meat substitutes consumption is positive taste expectations for plant-based meals (Graça et al. 2019). Moreover, Michel et al. (2021) emphasize that the production of products that are very similar in taste and texture to meat products and offer a good price-quality ratio is a prerequisite for increasing the consumption of plant-based meat substitutes. However, Knaapila et al. (2022) point to the important fact that the most potential group of consumers of plant substitutes for dishes are millennials with a future perspective.

5. Conclusion

Meat market has been developing and affecting by changing consumer behaviour and trends toward health aspects and sustainability. In recent years, the assortment of meat substitutes has been raising. These products, which have similar nutritional composition as meat, are becoming more popular and consumer interest in healthy diet and sustainable eating is also growing. In the context of the negative impacts of meat consumption related to health and sustainability, it is very important to increase consumer awareness about consumption of plant-based meat alternatives, which can help to reduce the negative impact on the environment and have many positive benefits on the health of consumers.

The results of the study are beneficial for the scientific purposes, food companies, policy makers, consumers. The results of the study are applicable in food companies and are helpful in the creation of marketing strategies and launching new products on the food market. Production of plant based-meat substitutes also represents an opportunity for new food companies. The study also provides information to consumers with the aim to increase consumer awareness related to plant-based meat substitutes consumption.

However, the paper has some limitations. The first limitation is the territoriality of conducted research. The second limitation relates to application of self-reported measures related to consumer perception and acceptance of plant-based meat substitutes. Future research should monitor the developing situation on the market of plant-based meat substitutes in Slovakia and in other countries. Moreover, it is

desirable to deal with the consumption of PBMS in the future and conduct a comparative study aimed at exploring consumer attitudes towards the consumption of plant-based meat substitutes between different countries.

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References

Ahmad, M. et al. (2022) 'Plant-based meat alternatives: Compositional analysis, current development and challenges', *Applied Food Research*, 2(2), p. 100154. doi:10.1016/j.afres.2022.100154.

Ahmad, R.S., Imran, A. and Hussain, M.B. (2018) 'Nutritional composition of meat', *Meat Science and Nutrition*. doi:10.5772/intechopen.77045.

Alcorta, A. et al. (2021) 'Foods for plant-based diets: Challenges and innovations', *Foods*, 10(2), p. 293. doi:10.3390/foods10020293.

Apostolidis, C. and McLeay, F. (2016) 'Should we stop meating like this? reducing meat consumption through substitution', *Food Policy*, 65, pp. 74–89. doi:10.1016/j.foodpol.2016.11.002.

Aschemann-Witzel, J. et al. (2021) 'Plant-based food and protein trend from a business perspective: Markets, consumers, and the challenges and opportunities in the future', *Critical Reviews in Food Science and Nutrition*, 61(18), pp. 3119–3128. doi:10.1080/10408398.2020.1793730.

Begho, T., Odeniyi, K. and Fadare, O. (2022) 'Toward acceptance of Future Foods: The role of trust and perception in consumption intentions of plant-based meat alternatives', *British Food Journal*, 125(7), pp. 2392–2406. doi:10.1108/bfj-07-2022-0583.

Boler, D.D. and Woerner, D.R. (2017) 'What is meat? A perspective from the American Meat Science Association', *Animal Frontiers*, 7(4), pp. 8–11. doi:10.2527/af.2017.0436.

Bryant, C. and Sanctorum, H. (2021) 'Alternative proteins, evolving attitudes: Comparing consumer attitudes to plant-based and cultured meat in Belgium in two consecutive years', *Appetite*, 161, p. 105161. doi:10.1016/j.appet.2021.105161.

Bryant, C.J. (2022) 'Plant-based animal product alternatives are healthier and more environmentally sustainable than animal products', *Future Foods*, 6, p. 100174. doi:10.1016/j.fufo.2022.100174.

Curtain, F. and Grafenauer, S. (2019) 'Plant-based meat substitutes in the Flexitarian age: An audit of products on supermarket shelves', *Nutrients*, 11(11), p. 2603. doi:10.3390/nu11112603.

Estell, M., Hughes, J. and Grafenauer, S. (2021) 'Plant protein and plant-based meat alternatives: Consumer and nutrition professional attitudes and perceptions', *Sustainability*, 13(3), p. 1478. doi:10.3390/su13031478.

Font-i-Furnols, M. (2023) 'Meat Consumption, sustainability and alternatives: An overview of motives and barriers', *Foods*, 12(11), p. 2144. doi:10.3390/foods12112144.

Geiker, N.R. et al. (2021) 'Meat and human health—current knowledge and research gaps', *Foods*, 10(7), p. 1556. doi:10.3390/foods10071556.

Godfray, H.C. et al. (2018) 'Meat Consumption, health, and the environment', *Science*, 361(6399). doi:10.1126/science.aam5324.

Graça, J., Godinho, C.A. and Truninger, M. (2019) 'Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions', *Trends in Food Science & Technology*, 91, pp. 380–390. doi:10.1016/j.tifs.2019.07.046.

Knaapila, A. et al. (2022) 'Millennials' consumption of and attitudes toward meat and plant-based meat alternatives by consumer segment in Finland', *Foods*, 11(3), p. 456. doi:10.3390/foods11030456.

Kumar, P. et al. (2022) 'New insights in improving sustainability in meat production: Opportunities and challenges', *Critical Reviews in Food Science and Nutrition*, pp. 1–29. doi:10.1080/10408398.2022.2096562.

Lee, H.J. et al. (2020) 'Status of meat alternatives and their potential role in the future meat market — a review', *Asian-Australasian Journal of Animal Sciences*, 33(10), pp. 1533–1543. doi:10.5713/ajas.20.0419.

Leroy, F. et al. (2022) 'Animal Board invited review: Animal Source Foods in healthy, sustainable, and ethical diets – an argument against drastic limitation of livestock in the food system', *Animal*, 16(3), p. 100457. doi:10.1016/j.animal.2022.100457.

Michel, F., Hartmann, C. and Siegrist, M. (2021) 'Consumers' associations, perceptions and acceptance of meat and plant-based meat alternatives', *Food Quality and Preference*, 87, p. 104063. doi:10.1016/j.foodqual.2020.104063.

Modlinska, K. et al. (2020) 'Gender differences in attitudes to vegans/vegetarians and their food preferences, and their implications for promoting sustainable dietary patterns—a systematic review', *Sustainability*, 12(16), p. 6292. doi:10.3390/su12166292.

OECD/FAO. (2022). OECD-FAO Agricultural Outlook, OECD Agriculture statistics (database). https://www.oecd-ilibrary.org/agriculture-and-food/data/oecd-agriculture-statistics_agr-data-en

Ostaszewski, M. (2018). 'Meat and meat products as functional food', *World Scientific News*, (110), pp.147-158.

Pereira, P.M. and Vicente, A.F. (2013) 'Meat nutritional composition and nutritive role in the human diet', *Meat Science*, 93(3), pp. 586–592. doi:10.1016/j.meatsci.2012.09.018.

Poore, J. and Nemecek, T. (2018) 'Reducing Food's environmental impacts through producers and consumers', *Science*, 360(6392), pp. 987–992. doi:10.1126/science.aaq0216.

Stubbs, R.J., Scott, S.E. and Duarte, C. (2018) 'Responding to food, environment and health challenges by changing meat consumption behaviours in consumers', *Nutrition Bulletin*, 43(2), pp. 125–134. doi:10.1111/nbu.12318.

Sui, Z., Raubenheimer, D. and Rangan, A. (2017) 'Consumption patterns of meat, poultry, and fish after disaggregation of mixed dishes: Secondary analysis of the Australian National Nutrition and Physical Activity Survey 2011–12', *BMC Nutrition*, 3(1). doi:10.1186/s40795-017-0171-1.

Sun, C. et al. (2021) 'Processing, quality, safety, and acceptance of meat analogue products', *Engineering*, 7(5), pp. 674–678. doi:10.1016/j.eng.2020.10.011.

Szenderák, J., Fróna, D. and Rákos, M. (2022) 'Consumer acceptance of plant-based meat substitutes: A narrative review', *Foods*, 11(9), p. 1274. doi:10.3390/foods11091274.

van den Berg, S.W. et al. (2022) 'Reducing meat consumption: The influence of life course transitions, barriers and enablers, and effective strategies according to young Dutch adults', *Food Quality and Preference*, 100, p. 104623. doi:10.1016/j.foodqual.2022.104623.

Vural, Y., Ferriday, D. and Rogers, P.J. (2023) 'Consumers' attitudes towards alternatives to conventional meat products: Expectations about taste and satisfaction, and the role of disgust', *Appetite*, 181, p. 106394. doi:10.1016/j.appet.2022.106394.

Willett, W. et al. (2019) 'Food in the anthropocene: The eat–lancet commission on healthy diets from sustainable food systems', *The Lancet*, 393(10170), pp. 447–492. doi:10.1016/s0140-6736(18)31788-4.