

## THE CURRENT STATE OF VEGETARIANISM IN HUNGARY, ITS POSSIBLE EFFECTS ON THE AGRICULTURAL STRUCTURE AND THE FOOD SYSTEM

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**ABSTRACT.** *In Hungary, very little data is available on vegetarianism, even though the phenomenon affects many sectors of the economy. Initially, we intended to examine the impact of vegetarianism on the agricultural sector when we realized that there was no adequate data available. Therefore, to collect adequate data on this issue, we compiled a questionnaire on September 9, 2021. We weighted our data based on the distribution of gender/age and gender/education level of the country. In our experiment, involving 1642 Hungarian participants over age 7, 86% of the respondents were regular meat consumers, 9 % flexitarians, 2 % pescatarians, 2 % vegetarians, and 1% vegans. The proportion of people consuming reduced amounts of meat was the highest between ages 46-60. The proportion of the most radical vegetarian forms is the highest in the 19–25 age group. The proportion of vegetarians in the Hungarian population increases with the education level, as it is the highest among Ph.D. graduates. In the case of the older generation, health motivation, while in the case of the younger generation, environmental and animal welfare motivation is crucial in choosing the form of nutrition. The love of meat's taste and the idea that it is impossible to live a healthy life without it are the two most important reasons Hungarians consume meat. Current costs do not influence the choice of meat versus plant nutrition, but Hungarian society would be sensitive to significant increases in meat prices. Omnivores would largely give up eating meat due to health problems, but they are open to laboratory-produced meat. If artificial meat were offered in supermarkets at affordable prices with the right taste and texture, 43% of respondents would stop eating meat.*

**KEY WORDS:** *sustainable agriculture, plant-based diet, vegetarianism, motivations,*

## INTRODUCTION

Crop production in agriculture is growing dynamically worldwide (FAO 2020a, Ray et al. 2013b). Between 2000 and 2019, total primary crop production increased by 53%. Cereals were the most widely planted crop in 2019, followed by sugar crops (24%), vegetables, and oil crops (12 percent each). Fruit, roots, and tubers combined accounted for 9% of total production. (FAO 2020b). The world's agricultural systems face meeting the rising demands from population growth, changing dietary preferences, and expanding biofuel use (Groom et al. 2008, Pretty 2012, Ray & Foley 2013a). The change in eating habits also means a growing demand for meat (Delgado 2003, Steinfeld et al. 2006a). In the last 50 years, meat production has increased 3.5 times (FAO 2021). Meat demand is expected to rise by 72 percent by 2030 (Steinfeld et al. 2006b). Animal products need to be expanded to 465 million tons by 2050 to ensure food security for 9.1 billion people (Bruinsma 2009). Global meat production was 325 million tons in 2019 (Schmidhuber et al. 2020, Kumar et al. 2021). By 2050, global agricultural production may need to be increased by 60%–110% to meet these increasing demands. We cannot compensate for this increased consumption only with an increased yield (Tilman et al. 2011, Ray & Foley 2013a).

Land use is also extremely unequally distributed between livestock and crops for human consumption. Meat, eggs, and dairy use about 83% of the world's farmland and contribute 56–58% of food's different emissions, despite providing only 37% of our protein and 18% of our calories (Hillel & Rosenzweig 2011, Poore & Nemecek 2018). Sustainably, we can no longer produce the amount of feed needed to produce meat. Further growth could easily lead to a collapse in feed supply (Fukase & Martin 2016). The impact of this disruption on industrial animal farming will be profound. By 2030, the number of cows in the US will have fallen by 50%, and the cattle farming industry will be bankrupt (Tubb & Seba 2021).

Global agriculture, including Hungary's, is facing many challenges. Now, at the beginning of the 21st century, the damaging effects of agriculture can be clearly stated. The causes of unsustainable production include the inclusion of natural areas in production, the destructive impact of fertilizers on soil quality, and the environmental aspects of plant protection products. Animal husbandry is criticized not only for its land use but also for its animal welfare aspects. Its high water uses and methane

production questions its sustainability in its current form (Steinfeld et al. 2006a, Piazza et al. 2015).

Trends in the world are forcing agriculture to change. The extra tax burden on CO<sub>2</sub> emissions will enhance local agricultural production (Augère-Granier 2016). Environmental laws and regulations will limit the use of fertilizers and pesticides (Aneja et al. 2009, Mardones & Flores 2018). Humanity will be forced to utilize its land as efficiently as possible as the world's population grows. And while this will be a difficult undertaking, it is not impossible, as various methods exist to support the Earth's considerably bigger population in the same agricultural area as before (FAO 2020a, Erem et al. 2021).

According to EAT-Lancet Commission (2019), a radical transformation of the global food system is urgently needed. There are scientific reports that link diets with human health and environmental/ agricultural sustainability. The transformation to healthy diets by 2050 will be substantial. Global consumption of plant-based food will have to double, and consumption of red meat will have to be reduced by more than 50% (Friel et al. 2009).

Plant-based nutrition offers several solutions to the problems listed above (Pengue et al. 2018). The spread of vegetarianism or plant-based diets could have a strong health, social, economic, and environmental impact (Hargreaves et al. 2021, Lusk & Norwood 2009, Leitzmann 2003, Leitzmann 2014). If the phenomenon becomes widespread, its impact on tourism (Dilek & Fennell 2018), the agricultural economy, and the food industry will be decisive (Gomez et al. 2018, Raphaely & Marinova 2014).

The plant-based diet has several levels and forms. Six different forms are defined in the literature (Boyle 2011, Meister 1997). At one end of the spectrum is type I. They consume reduced amounts of meat and do not consume red meat. They are called flexitarians or semi-vegetarians. Type II vegetarians avoid eating meat and poultry, but they eat fish, also known as pesco-vegetarians or pescatarians. Type III vegetarians do not consume any meat, but they consume eggs and milk. Type IV vegetarians do not consume eggs (lacto-vegetarians). Type V vegetarians do not consume dairy products (ovo-vegetarians). At the opposite end of the spectrum are Type VI dietary vegans, who consume only vegetable-derived foods, avoiding all animal-derived food products. A strict vegan does not consume meat, dairy products, eggs, honey, or any product derived from an animal. Several extreme variants of vegetarianism are

known. A raw vegan diet combines veganism and raw foodism. Fruitarianism is a fad diet related to veganism that primarily consumes fruits and possibly nuts and seeds, but without any animal products (Beardsworth & Keil 1992, Ruby 2012).

Researchers estimate that 6% to 10% of the worldwide population follow a vegetarian diet, and 2% to 6% follow a vegan diet (Leahy et al. 2010, Wu 2014). India is the leading country in the share of vegetarians amongst its population. About 40% of Indian respondents stated in a 2021 survey that they typically follow a vegan, vegetarian, or pescetarian diet and thus do not eat meat (Wunsch 2021). In European countries, the estimated proportion of those who follow different vegetarian diets, including so-called flexitarians, is between 13% and 39,5% (Table 1). Statistical measurements of the spread of vegetarianism are being conducted in many countries worldwide, but other countries are still unexplored areas where none or partial data are available. In Hungary, there is also a scarcity of data (Rosenfeld & Tomiyama 2020, Motrøen 2020, IPSOS 2018, Reisinger 2003, Újvári et al. 2020). The purpose of this study was to partially fill this void in the literature.

Numerous studies have shown that a vegetarian diet is gender-related like most other diets. Across Western societies, women are twice as likely as men to be vegan or vegetarian (Modlinska et al. 2020, Browarnik 2012, Rudy 2012). In general, women are more prone to diets that contain less meat (Rosenfeld & Tomiyama 2021, Gossard & York 2003). Previous experiments have suggested that men's desire to eat meat increases when their sexual motivation system is activated. Eating meat tends to be a kind of expression of the status of men (Bogueva et al. 2020, Chan & Zlatevska 2019, Timeo & Suitner 2018). In contrast, when their sexual motivation system is activated, women prefer meatless meals, possibly since they pursue other strategies such as beauty and health to make themselves desirable to men (Chan & Zlatevska 2019, Modlinska et al. 2020).

International statistics show that the number of vegetarians is the highest among the 18–30-year-old generation. It is very high till the age of 50, and then suddenly the rate drops. Vegetarian and vegan diets are more popular among young people in the United States, with 7% of those aged 18–29 claiming to be vegetarian and 3% claiming to be vegan (Beardsworth & Bryman 2004, McCarthy 2018).

Table 1. Prevalence of plant-based diets in different European countries.

	Flexitarian	Pescatarian	Vegetarian	Vegan	Total	
Norway	12%	1%	4%	4%	21%	Motrøen (2020)
Sweden	12%	2%	6%	4%	29%	Motrøen (2020)
Denmark	9%	2%	4%	4%	19%	Motrøen (2020)
Finland	7%	2%	7%	2%	18%	Motrøen (2020)
Estonia	10%	1%	4%	1%	16%	Motrøen (2020)
Latvia	11%	1%	3%	1%	16%	Motrøen (2020)
Lithuania	7%	2%	3%	1%	13%	Motrøen (2020)
Germany	30,5%	5,1%	4,6%	1,9%	42,1%	Bryant (2020)
France	20%	2,1%	4%	1,2%	25,2%	Magrini (2021)
Spain	23%	no data	1%	1,8%	25,8%	Magrini (2021)
Portugal	28,5%	1,9%	2%	1,2%	33,6%	Veganz (2020)
Switzerland	20,5%	2,4%	5,8%	2,6%	31,3%	Veganz (2020)
Austria	31,8%	2,4%	3,7%	1,6%	39,5%	Veganz (2020)
Belgium	16,1%	3,4%	1,7%	1,6%	22,8%	Veganz (2020)

Vegetarians were more prevalent among younger respondents in Germany than in other age groups. 11 percent of those aged 20 to 29 said they follow vegetarian eating rules. The proportion of those who do not consume meat or fish was substantially lower among those aged 40 and over (Wunsch 2022). The proportion of vegetarians and vegans is highest in Finland, especially among women aged 15–24 and males aged 25–34. (Niva & Jallinoja 2018). Vomad, an Australian-based civil organization, conducted the most complete investigation on the subject in 2019. The study included 12,814 vegans from 97 countries around the world. According to the report, the proportion of vegans is highest among those aged 25–34 and lowest among those aged 18–24 (McCarthy 2018).

Not only are gender and age aspects of vegetarianism well known, but it can also be associated with basic personality traits. Australian researchers have examined the relationship between vegetarianism and different personality traits. It has been found that openness, intellect, and a willingness to agree can be a hallmark of vegetarians (Tan et al. 2021). Research conducted within Central European countries also indicates that vegetarians are usually educated and affluent people (Pfeiler & Eglof 2018, Gilsing et al. 2013, Allès et al. 2017, Paslakis et al. 2020).

Most international studies reveal that people who adopt a plant-based lifestyle do so for health or ethical reasons (Mathieu & Dorard 2016, Ruby 2012, Dilek & Fennell 2018). Exceptions to this are countries where vegetarianism is based on religious reasons (Shani & DiPietro 2007, Rivera & Shani 2013). Lack of interest and awareness, taste, and inadequate cooking skills, on the other hand, are all key reasons for not being a vegetarian. Encouragingly, health and discovering new flavors were seen as the most important motives for considering eating a more vegetarian-based diet (Mullee et al. 2017).

People's opinions are quite ambivalent about the cost of a vegetarian lifestyle. In the Western world, the general assumption is that a vegetarian diet is expensive, while we also know that some parts of the population eat little meat because they are poor (Antony 2019). According to Leahy et al. (2010), only 75 million people worldwide are vegetarians of choice, a number that will gradually grow with increasing affluence and education. The other 1,450 million people are vegetarians of necessity (Leahy et al. 2010).

In the modeling study of Springmann et al. (2021), regionally comparable food prices were used in the International Comparison Program for 150 countries. It found that in high-income countries, vegan diets reduce food costs by up to one-third. Vegetarian diets were a close second. Flexitarian diets reduced costs by 14%. By contrast, pescatarian diets increased costs by up to 2% (Springmann et al. 2021).

According to a study by BCG, by 2035, the size of the alternative protein market could reach \$290 billion (Morach et al. 2021). Four main groups of the most important alternative proteins are described in the literature. The first is legumes (soybeans, beans, peas, lentils) (Pihlanto et al. 2017, Erem et al. 2021), the second is protein from microorganisms (algae, fungi, yeast) (Kuhad et al. 1997, Koyande et al. 2019), the third is insect protein, and the fourth is artificial meat from tissue culture (Kumar et al. 2021). The first three are available. A jump in product scale and quality is expected over the next few years. By 2035, it is estimated that meat from tissue culture will also be available in stores at affordable prices (Morach et al. 2021, Bladby & Wersäll 2017, Matassa et al. 2016, Enzing et al. 2014, Harun et al. 2010, Becker 2007). The only question is which societies are open to consuming alternative proteins. What are the protein supplements that people are willing to reduce their meat intake for (Onwezen et al. 2021)?

Developing cultured beef from bovine skeletal muscle stem cells through tissue-engineering techniques is potentially a resource-efficient way to grow meat (Post 2014). In-vitro meat is typically well received, and most omnivores would like to try it, but frequent use is frowned upon due to genetic, economic, and unnatural concerns (Verbeke et al. 2015, Wilks & Phillips 2017, Kumar et al. 2021).

The perception of food products by consumers is a complex process influenced by various factors. Sensual characteristics, cost/price balance, and consumer health (sufficient/balanced nutrition) could be the driving forces behind food choice and nutrition (Kaya 2016). When examining the appearance and importance of values in nutrition, economic considerations can be the most determining limiting factor in Hungary, resulting from Hungarians' income situation and the level of prices. In 2000, Switzerland's income-to-food ratio was 10%, whereas the European Union average was 17.5 percent (Horváth et al. 2005). Hungarians spend, on average, 24% of their income on food. However, because food is a product group that is easy and relatively inexpensive to obtain, the financial situation of the population also contributes to the fact that a significant portion of Hungarians experiences consumer satisfaction in their meals (Horváth et al. 2005). According to sociological studies, Hungarians are defined by their adherence to traditional values (Hankiss et al. 1982), which is reflected in their culinary preferences Horváth et al. (2005).

The main motivations for a vegetarian lifestyle are health and environmental or ethical considerations. Some researchers cited health as the primary reason for adopting a vegan diet (Coelho 2019, Corrin & Papadopoulos 2017, Dyett et al. 2013). In many countries, such as India, vegetarianism is a widespread diet and even a religion-based lifestyle (Jayanthi 2001, Natrajan & Jacob 2018, Wunsch 2021).

And why do omnivores prefer eating meat? It was discovered that loving the taste of meat is the main motivation for both men and women (78%) (Lea & Worsley 2003, Corliss et al. 2002).

## **MATERIALS AND METHODS**

Data were collected by surveying a questionnaire format. In evaluating the data, we looked for relationships between quantitative data, samples, and variables

(Bryman 2011). The questionnaire was prepared on September 9, 2021 and was designed via Google Forms. It was anonymous. The questionnaire was completed in equal proportions online and on paper. Participants in the experiment were randomly selected. Besides demographic data (independent variable), the questionnaire contained research questions (dependent variable). Except for demographic questions, we usually offered the option of “other” answers everywhere (Lipták & Hajdú 2018). The center of our research is Nyíregyháza/Hungary.

The questionnaire covered 18 questions, of which eight are analyzed in this publication. These questions are:

RQ1: What diet do you follow?

RQ2: What is your gender?

RQ3: How old are you?

RQ4: What is the level of your education?

RQ5: What is your type of residence?

RQ6: If you are a vegetarian or consume reduced amounts of meat, what are the reasons for your decision? (Multiple answers are possible.)

RQ7: What are the reasons for consuming meat? (Multiple answers are possible.)

RQ8: What are the factors that would make you think about consuming less meat? (Multiple answers are possible)

We distributed the questionnaire in internet groups independent of eating habits (dissertation writers, gardeners, retirees, etc.). The printed questionnaire was sent to different groups in society, in terms of different ages, places of residence, occupations, qualifications, and various clubs, schools, and workplaces. The full range of the Hungarian population participated in the research in terms of age, gender, place of residence, and education (except under seven years).

In the questionnaire, we examined five forms of eating habits. To prevent the results from falling below 1%, we did not divide the main group into further subgroups. The vegetarian forms we examined were:

1. omnivore
2. flexitarians or semi-vegetarians
3. pesco-vegetarians or pescatarians.
4. vegetarians, lacto-vegetarians, and/or ovo-vegetarians.
5. dietary vegans and strictly vegan

Statistical methods applied in the experiment were:

1. Weighting: We weighted our data based on the distribution of gender/age and gender/education level, which is typical for the country (KSH 2011a). The population of Hungary is 9,730,772, of which 8,983,667 are over seven years old

(KSH 2021). We evaluated 1642 questionnaires (N= 1642). Weighting was performed using SPSS 28.0.1.0. (Reinhart 2018, Analytics 2018, Szelényi 2021).

2. *Margin error*: The margin of error allowed in any estimate depends mainly on the number of interviews on which it is based. The margin of error indicates the likely range within which estimates are 95% likely to fall, expressed as the number of percentage points above or below the actual estimate (Roy Morgan 2019). When calculating the margin of error, considering the number of Hungarians over the age of 7, the following formula was used:

$$MOE = z * \sqrt{p * (1 - p) / n}$$

where:  $z = 1.96$  for a confidence level ( $\alpha$ ) of 95%,  $p$  = proportion (expressed as a decimal),  $n$  = sample size. The formula gives our statistics the margin of error values (MOE or ME) (Kosar et al. 2018).

The purpose of this study is to provide a quantitative overview of the plant-based diet. We made our hypotheses based on international research (Table 2).

Table 2. The hypotheses of our research.

Main hypothesis	Sub-hypothesis
H1: Vegetarians represent more than 1% of the population in Hungary.	
H2: There is a significant difference in the number of plant-based diet followers at different ages.	H2a: The proportion of vegetarians increases with age and then decreases. H2b: The proportion of vegetarians between the ages of 7 and 14 is low. H2c: The proportion of vegetarians is highest among young adults. H2d: The proportion of vegetarians over 61 is very low.
H3: The distribution of Hungarian plant-based diet followers depends on their gender and education.	H3a: The proportion of vegetarians is higher among women than men. H3b: The proportion of vegetarians is higher among intellectuals.
H4: The vegetarian lifestyle is mainly chosen for health reasons by the Hungarians.	H4a: Older people have a significantly higher number of vegetarian people for health reasons. H4b: In the younger generations, the number of vegetarians for animal welfare reasons is significantly higher.
H5: The most important reason for consuming meat is the love of the taste of meat.	
H6: The price of meat products is extremely important to Hungarian society. A higher price could influence people's eating habits.	
H7: Hungarian society has controversial feelings again artificial meat consumption.	

Form of the table: Kőkény & Kiss (2021)

## RESULTS

In our experiment, involving 1642 participants, after weighting the data, 86% of the respondents are regular meat consumers, 9% eat plant-based foods with occasional meat-eating, 2% are pescatarians, who do not eat meat but eat fish, 2% are vegetarians who do not consume any meat but eat eggs and/or dairy products, and 1% are vegans, who do not consume any meat, dairy, or eggs. Taken together, 14% of the respondents follow a meat-avoiding diet. If pescatarians are also considered vegetarians, the rate in our experiment is 4%; without pescatarians, it is 3 % (Table 3). In the Hungarian population, 10% of women and 4% of men are vegetarians; 44% of men and 42% of women eat an omnivorous diet.

We can state that the proportion of flexitarians among the Hungarian population over the age of 7 is 9%. The proportion of pescatarians and real vegetarians (ovo-lacto and ovo/lacto) can range from 1.4 to 2.6% and the proportion of vegans from 0.6 to 1.4%. The rate of vegetarians, except flexitarians, is between 4% and 6% (Table 3). Even if the lowest value is considered authoritative, this rate of 4% is significantly higher than the previously estimated 1% (Reisinger 2003, Újvári et al. 2020).

Table 3. Statistical values of a plant-based diet with a margin of error.

Parameter examined	Percentage	Margin error
Omnivore	86%	±1.5
Plant-based diet followers	14%	±1.7
Flexitarian	9 %	±1.2
Pescatarian	2 %	±0.6
Vegetarian	2 %	±0.6
Vegan	1 %	±0.4
Pescatarian & Vegetarian & Vegan	5%	±1
Vegetarian & Pescatarian	4 %	±0.9
Vegetarian & Vegan	3 %	±0.8
Female vegetarians/population (including flexitarians)	10%	±1.5
Male vegetarians/population (including flexitarians)	4%	±1
Omnivorous men in the total population	44%	±2.4
Omnivorous women in the total population	42%	±2.4

In our experiment, 71% of the plant-based diet followers were female, while 29% were male. Among women, 80% are omnivorous, while the rate is 91% among men. 12% of women are flexitarian, while the probability that a man is a flexitarian is 7%. Among women, 2% are pescatarians, while 1% of men are pescatarians. 4% of women are vegetarian (ovo-lacto and ovo/lacto). This rate, in the case of men, is 1%. The rate of vegans among women is 2% and 1% among men. Hungarian men are less likely to follow a meat-free diet (Table 4). This reflects international trends. However, among men, the proportion of vegans is higher than the proportion of vegetarians, although this does not necessarily make a real difference due to the margins of error (Table 3).

Table 4. Statistical values of a plant-based diet with a margin of error.

Parameter examined	Percentage	Margin error
Female vegetarian /vegetarians	71 %	±3
Male vegetarian / vegetarians	29 %	±3.2
Omnivores among women	80 %	±2.7
Omnivores among men	91 %	±2
Plant-based diet among women	20%	±2.7
Plant-based diet among men	9%	±1.9
Flexitarians among women	12 %	±2.2
Flexitarians among men	7 %	±1.79
Pescatarians among women	2 %	±0.9
Pescatarians among men	1 %	±0.7
Vegetarians among women	4 %	±1.3
Vegetarians among men	1 %	±0.7
Vegans among women	2 %	±0.9
Vegans among men	1%	±0.7

The highest plant-based diet followership ratio was observed in the 46–60 age group. This age group has the highest proportion of flexitarians. In the 19–25 age group, more people choose a more radical meat-free diet. While the proportion of flexitarians is 6%, the proportion of those on other vegetarian diets is 7%. At the age of 7–14, the vegan lifestyle does not appear, but the number of vegetarians (ovo-lacto and ovo/lacto) is 3%. The proportion of vegetarians in the 15–18 age group is the lowest in

terms of both milder and more extreme forms. The proportion of flexitarians in the 26–35 age generation is significant (12%), but the proportion of real vegetarians (ovo-lacto and ovo/lacto) is highest here (4%). Among 35–45-year-olds, the proportion of flexitarians is 11%, while the other types of diet are followed by 7%. We found no real vegetarians (ovo-lacto and ovo/lacto) or vegans over the age of 61; however, 2% were pescovegetarians, and 10% were flexitarians (Table 5).

Table 5. The proportion of plant-based diet followers in different generations and the margin of error (ME).

	Omnivore	ME	Flexitarian	ME	Pescatarian	ME	Vegetarian	ME	Vegan	ME
7-14 y	88%	±5.1	8%	±4.2	1%	±1.5	3%	±2.7	0%	-
15-18y	91%	±3.1	5%	±2.4	1%	±1.1	2%	±1.5	1%	±1.1
19-25 y	87%	±4.7	6%	±3.3	2%	±1.9	3%	±2.4	2%	±1.9
26-35 y	82%	±5.8	12%	±4.9	1%	±1.5	4%	±3	1%	±1.5
36-45 y	82%	±5.1	11%	±4.1	2%	±1.9	3%	±2.3	2%	±1.9
46-60 y	78%	±2.7	16%	±2.7	1%	±1.3	2%	±1.3	3%	±1.3
61- y	86%	±4.1	10%	±3.6	2%	±1.7	0%	-	0%	-

Ph.D. students and Ph.D. graduates from university graduates were treated separately in our study. As Figure 4 shows, this was a good decision because the proportion of vegetarians in this group is even higher than those with "only" a university degree.

Regarding the education level, the proportion of vegetarians is highest among Ph.D. students and those with a doctorate. The proportion of plant-based diet followers among Ph.D. students is 17%, and 16% among those with a university degree, 13% among high school students or those with a primary school certificate, and 10% among primary school students or those with a primary school certificate.

Vegetarians and vegans have the highest proportion of PhDs, so more radical diets are the most common here. Undergraduates and high school students prefer milder vegetarian diets. Veganism is not common among those with only primary school education. Pesco-vegetarians occur in 1% of all groups. When determining the margin of error, we took the Ph.D. and the university group as a set because Hungarian statistics do not treat the group of PhDs separately (Table 6).

Table 6. The proportion of plant-based diet followers at different education levels and the margin of error (ME).

	Omni-vore	ME	Flexi-tarian	ME	Pescata-rian	ME	Vegeta-rian	ME	Vegan	ME
elementary	90%	±3.7	8%	±3.3	1%	±1.2	1%	±1.2	0%	-
highschool	87%	±2.6	10%	±2.3	1%	±0.8	1%	±0.8	1%	±0.8
university & Ph.D./Dr.	85%	±2.6	11%	±2.3	1%	±0.7	2%	±1	1%	±0.7

In Hungary, the top three motives are health, environmental, and animal welfare (Figure 1). Also, a significant reason is when the participant does not like or desire the taste of the meat. Many are afraid of the effects of drugs used in animal husbandry. Even religious reasons are a significant motivator. However, although present, fashion, financial reasons, and family traditions are not significant (Figure 1).

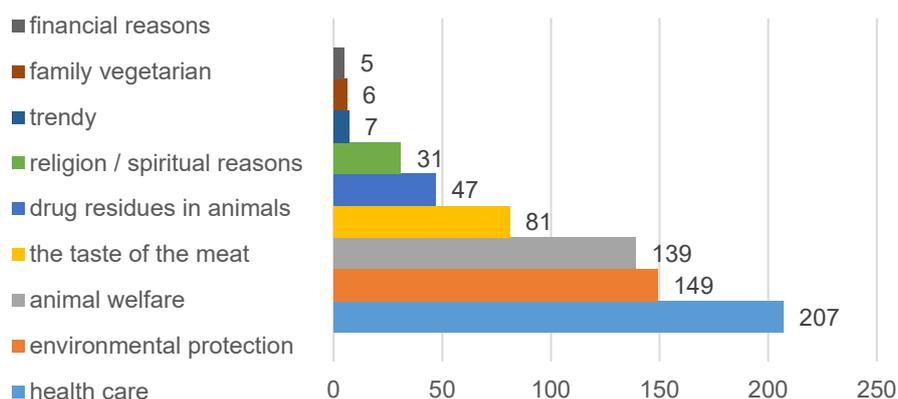


Figure 1. The main motivations of those who choose a plant-based diet in Hungary (Number of answers of participants)

If we examine the three main motivations (health, environment, and animal welfare) in the different age groups, we can see that health reasons are more significant in the older age group, while environmental and animal welfare reasons are more significant in the younger generation (Figure 6). Among those over 61 years old, 23% responded that the reason for their low meat intake was health, while for those aged 35–60,

the three leading causes occur in a similar proportion in the responses. The 26–35 age group is less likely to avoid meat for health reasons, but they are more concerned with animal welfare and the environment. For the generation between 19 and 25 years old, the environmental cause is the absolute leader. The strongest motivation for the 7–14 age group is animal welfare. There is no significant difference between the motivations of the youngest and the oldest.

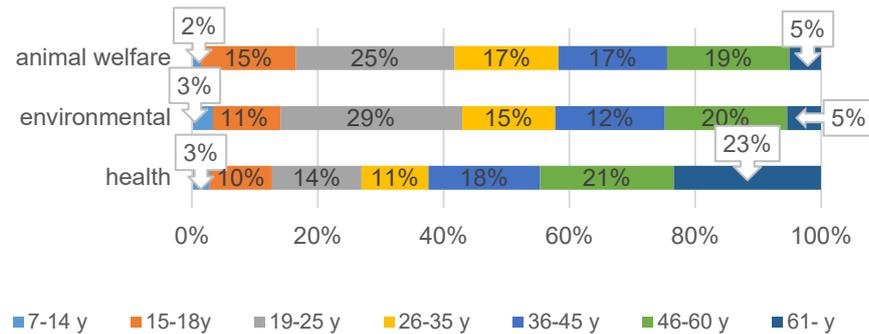


Figure 2. The emergence of health, environmental and animal welfare motivations in different age groups.

Contrary to the previous question, omnivorous participants are also questioned about the main reasons for consuming meat. As Figure 3 shows, the most important motivation for eating meat is to like the taste of meat. Most respondents think and believe that meat is essential for humans because it contains nutrients that cannot be replaced in any other way. Many people consume meat because of customs or family traditions. It is not the most significant reason, but some respondents still feel they don't know enough about plant-based recipes to pursue a plant-based diet. Several tried to give up eating meat but could not change their diet. The fewest participants consume meat simply because they don't have enough time or money for plant-based foods (Figure 3).

To determine if the number of vegetarians will rise in the near future, we must first understand the variables that might induce people to change their diet. Most respondents would probably do anything for their health. As a result, people today would refrain from eating meat if they had health

problems (e.g., arthritis, high cholesterol). Based on the results, Hungarian society seems to accept the meat produced by artificial tissue production under laboratory conditions. Many respondents (43%) claimed they would consider eating other animal products if artificial meat were accessible in supermarkets at reasonable rates. According to our findings, the price of meat has a moderate impact on Hungarian society.

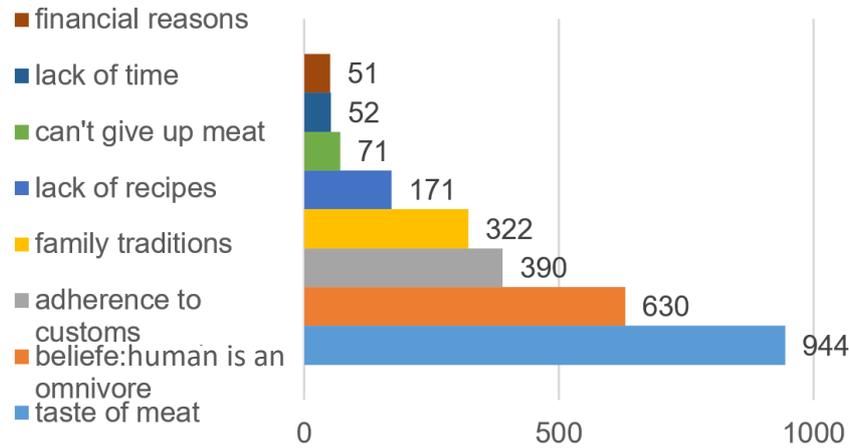


Figure 3. The primary reasons why people in Hungary prefer an omnivorous diet (Number of answers of participants)

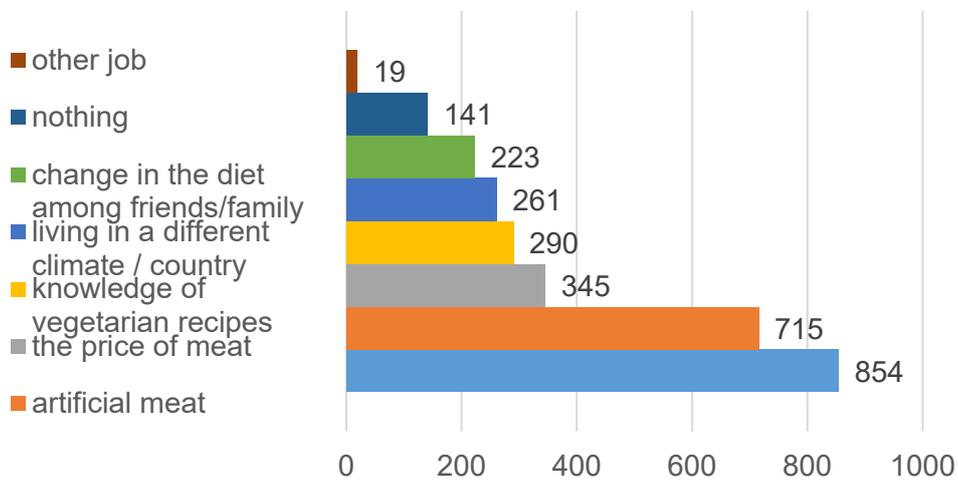


Figure 4. What factors might lead participants to abstain from meat consumption? (Number of answers of participants)

A fifth of respondents said that a large increase in pricing would make them stop eating beef. Many people would switch to a plant-based diet if they knew vegetarian recipes, if they lived in a different country or climate, or if their family and/or friends changed their eating habits. Few people believe that their job has any impact on their diet. About 10% of respondents were completely reluctant to switch to a plant-based diet. However, it is important to note that the response only offers us an impression of the respondents' attitudes, not how they would act in an actual circumstance.

It is almost inevitable that health problems will occur with aging. As shown in Figure 5, people would be more likely to continue a vegetarian lifestyle as they get older for health reasons. We also found a correlation between age and the acceptance of artificial meat. The 36-45 age group has the most positive attitudes towards artificial meat, while the youngest and oldest are the most negative. In a major increase in meat prices, the same two generations would be most affected and would opt to consume plant-based diets. Interestingly, the younger generation thinks that no factor can force them to give up meat. As you age, you become less and less likely to cling to meaty foods (Figure 5).

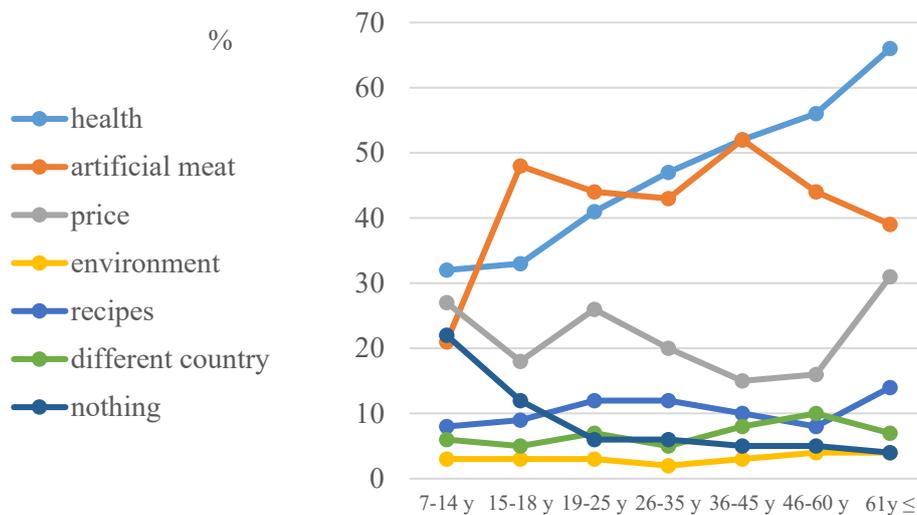


Figure 5. Possible motivators for giving up meat by age. (Percentage within the age group)

## **DISCUSSION**

In our experiment, involving 1642 participants, after weighting the data, we can conclude that 14% of the respondents follow a plant-based diet in Hungary. Hungary falls behind the European averages with this figure, narrowly exceeding Lithuania (Motrøen 2020). The most committed countries to plant-based nutrition in Europe are Austria, Germany, Switzerland, and Portugal, where the proportion is over 30% (Vegan2020, Bryant et al. 2020).

When we break down plant-based nutrition into categories, the situation becomes even more complicated. Vegans range from 1% to 4% of the population in European countries. In Hungary, this percentage is 2%, in line with the European average. Vegetarians make up a wide range of percentages in European countries, ranging from 1% to 7%. Hungary's 2% rate is extremely low; only Belgium (1,7%) and Spain (1%) have lower rates. The number of pescatarians in the rest of Europe is between 1 and 4.6%. Hungary is average with a value of 2%. The ratio of so-called flexitarians, on the other hand, has the highest standard deviation. Austria (31.8%) has the greatest percentage, while Finland and Lithuania have the lowest (7%). In Hungary, the rate is 9%, which is low by European standards (1 Table) (Magrini 2021, Motrøen 2020, Bryant et al. 2020, Vegan2020).

Regarding the gender aspects of vegetarianism, confirming our hypotheses (Table 7), we have obtained similar results to the research mentioned previously, which predicted a double probability of women being vegetarian or vegan, compared to men (Modlinska et al. 2020, Browarnik 2012, Rudy 2012). According to the findings, in Hungary, 71% of vegetarians are women, and 29% are men. Similar results were achieved in 2022 in Germany. Here, 80% of vegetarians were women, and 20% were men (Koptuyug 2021). In Hungary, the proportion of male vegetarians in the entire population is 4% (including flexitarians), whereas the number of female vegetarians is 2.5 times that, or 10%.

The picture is much more nuanced than international research has revealed in terms of age. In Hungary, most of those who eat plant-based diets are between the ages of 46 and 60 because the number of flexitarians in this age group is quite high, at 16%. Hungary has the highest number of people aged 19–25 who eat more extreme vegetarian diets (pescatarian, vegetarian, and vegan), similar to the Finnish sample

(Niva & Jallinoja 2018). Comparing our results to Vomad's international veganism research shows a substantial deviation from global trends. Unlike the rest of the globe, where the proportion of vegans is highest among those aged 25–34 (McCormick 2019), in Hungary, the proportion of vegans in this age range is just 1%, with the biggest proportion being among those aged 46–60. With these results, our age-related hypotheses are partially fulfilled (Table 7).

Our experiment seems to confirm our hypotheses based on international trends that higher education and, presumably, the associated higher intelligence may be a feature of plant-based nutrition. This is true for the full range of forms of vegetarianism, including the more extreme vegan diet (Pfeiler & Egloff 2018, Gilsing et al. 2013, Allès et al. 2017, Paslakis et al. 2020).

Most international studies reveal that people adopt a plant-based lifestyle for health or ethical reasons (Mathieu & Dorard 2016, Ruby 2012). Our research also confirmed this, although motivations vary significantly across age groups, as previously hypothesized (Table 7). Our hypothesis that Hungarian consumers are price sensitive (Horváth et al. 2005) has not been substantiated, as their eating decisions do not appear to be influenced by costs at current food prices (Table 7).

The prime motivation for meat eating in Hungary, similar to worldwide studies (Lea & Worsley 2003), is to enjoy the taste of the meat. The price is not the decisive factor when choosing food (plant-based or meat), at least not at today's meat prices. However, roughly a quarter of respondents feel that if the price of meat increased, they would consider switching to a plant-based diet (Figure 4). The question, of course, is what will be the price difference between meat and plant-based products that will already influence consumer decisions?

According to our theory for question 8 (Figure 4, Table 7), Hungarian society has controversial feelings again artificial meat consumption as its food preferences are driven by traditional values (Horváth et al. 2005). The answers were unexpected. When tissue-cultured beef is available in supermarkets at a reasonable price, many individuals would decide to take advantage of the opportunity and eat it instead of meat.

We can see that current global trends, such as rising meat consumption and, with it, rising livestock production, will no longer be satisfied by technological advancements, efficient feeding, or breeding (Delgado 2003, Steinfeld et al. 2006a, Groom et al. 2008, Tilman et al. 2011, Pretty

2012, Ray & Foley 2013a, FAO 2021, Erem et al. 2021). Growing areas will need to be converted to pasture or fodder production. Other environmental implications of livestock farming, such as water consumption, methane emissions, and production energy and fuel requirements, indicate that this industry will be difficult to sustain as the world's population grows.

Table 7. Summary table of the fulfillment of our hypotheses.

Main hypothesis	Sub-hypothesis	Accepted/Rejected
H <sup>1</sup> : Vegetarians represent more than 1% of the population in Hungary.		Accepted
H <sup>2</sup> : There is a significant difference in the number of plant-based diet followers at different ages.	H <sup>2a</sup> : The proportion of vegetarians increases with age and then decreases.	Accepted
	H <sup>2b</sup> : The proportion of vegetarians between the ages of 7 and 14 is low	Accepted
	H <sup>2c</sup> : The proportion of vegetarians is highest among young adults	Rejected
	H <sup>2d</sup> : The proportion of vegetarians over 61 is very low.	Rejected
H <sup>3</sup> : The distribution of Hungarian plant-based diet followers depends on their gender and education.	H <sup>3a</sup> : The proportion of vegetarians is higher among women.	Accepted
	H <sup>3b</sup> : The proportion of vegetarians is higher among intellectuals.	Accepted
H <sup>4</sup> : The vegetarian lifestyle is mainly chosen for health reasons by the Hungarians.	H <sup>4a</sup> : Older people have a significantly higher number of vegetarian people for health reasons.	Accepted
	H <sup>4b</sup> : In the younger generations, the number of vegetarians for animal welfare reasons is significantly higher.	Accepted
H <sup>5</sup> : The most important reason for consuming meat is to like the taste of meat.		Accepted
H <sup>6</sup> : The pricing of meat products is extremely important to Hungarian society. A higher price could influence people's eating habits.		Partly accepted
H <sup>7</sup> : Hungarian society has controversy feelings against artificial meat consumption.		Rejected

However, we must analyze the situation in Europe, and specifically in Hungary, in greater depth. According to population projections, the country's population will drop. Hungary's population will fall to 7.75 million in the most likely scenario by 2070 or to 6 million in the worst-case, and 9 million in the very best-case scenario (Obádovics 2019). Animal husbandry's share of Hungary's agricultural economy is steadily decreasing. Between 2010 and 2020, it fell from 46 percent to 25 percent. Animal husbandry is not only less profitable than crop production, but it also requires more investment, effort, and knowledge (Benkő et al. 2018). The membership of Hungary in the European Union has resulted in a significant increase in foreign commerce. As a result, the importance of international trade in the meat business is growing. The two-way trade in animal-based goods was typical. Meat exports and imports show similar values (Poór 2013). We can't talk about the growth in meat consumption in Hungary either. While meat consumption in the EU is 81 kg per person per year and rising, it has fluctuated between 63-73 kg per person per year in Hungary since 2000 (Vetőné Móznér 2012, KSH 2020a). In conclusion, Hungary is not threatened by population growth, a considerable extension of animal agriculture, or significant increases in meat consumption. As a result, for the time being, supply issues in the livestock sector do not need to be considered; Hungary can also increase its feed exports. However, even though Hungary is not now involved in the issue, we live in a global economy, and everything that happens on the globe impacts individual countries, whether positively or negatively (Abdulkadyrova et al. 2016).

Current trends, such as education level increases (KSH 2011b), the spread of environmentally conscious thinking (Schneider & Medgyesi 2020), and nature conservation laws and regulations (Szöllősi et al. 2007, Kutasi & Perger 2014), suggest that vegetarianism could spread in Hungary. Even if the prevalence of vegetarianism persists and the figures approach those of some European countries, it is unlikely that the structure of agriculture, including livestock/crop production, will change significantly. What may change, however, is the increase in legume production. This change may even be desirable considering the effect of legumes on soil fertility. In the case of Hungary, this would be particularly favorable, as the production of legumes has been significantly reduced with the closure of canneries. Half of the bean production area, one-tenth

of the peas, and lentil cultivation have practically ceased in Hungary (KSH 2020b).

## REFERENCES

- Abdulkadyrova, M.A., Dikinov, A.H., Tajmashanov, H.Ė., Shidaev, L.A., Shidaeva, E.A. (2016): Global food security problems in the modern world economy. *International Journal of Environmental and Science Education* 11(12): 5320-5330.
- Allès, B., Baudry, J., Méjean, C., Touvier, M., Péneau, S., Hercberg, S., Kesse-Guyot, E. (2017): Comparison of sociodemographic and nutritional characteristics between self-reported vegetarians, vegans, and meat-eaters from the NutriNet-Santé study. *Nutrients* 9(9): 1023.
- Analytics, G. (2018): How does the Gallup Poll Social Series Work? <https://www.gallup.com/175307/gallup-poll-social-series-methodology.aspx>
- Aneja, V.P., Schlesinger, W.H., Erisman, J.W. (2009): Effects of agriculture upon the air quality and climate: research, policy, and regulations. *Environmental Science and Technology* 43(12): 4234–4240.
- Antony, A.C. (2019): Chapter 13 – Vegetarianism and other restricted ideas. pp. 153-174. In: Means, R.T.Jr. (Ed.), *Nutritional Anemia: Scientific Principles, Clinical Practice, and Public Health*. Cambridge University Press.
- Augère-Granier, M.L. (2016): Short food supply chains and local food systems in the EU. *European Parliamentary Research Service, Briefing*, pp. 1-10.
- Beardsworth, A., Keil, T. (1992): The vegetarian option: varieties, conversions, motives and careers. *The Sociological Review* 40(2): 253–293.
- Beardsworth, A., Bryman, A. (2004): Meat consumption and meat avoidance among young people: An 11-year longitudinal study. *British Food Journal* 106(4): 313-327.
- Becker, E.W. (2007): Micro-algae as a source of protein. *Biotechnology Advances* 25 (2): 207-210.
- Benkő, B., Kolozsváriné Csontos, M., Nagy, D.B., Stummer, I., Szántai, J., Szili, V., Szlovák, S., Varga, É., Zubor-Nemes, A. (2018): A főbb mezőgazdasági ágazatok költség- és jövedelemhelyzete 2016. *Agrárgazdasági Információk*. Agrárgazdasági Kutató Intézet. file:///C:/Users/Dell/Downloads/2018\_AI\_03\_Agazatok%20kiadvany%20KO%CC%88LTSE%CC%81GE%CC%81S%20JO%CC%88VEDELEMHELYZETE\_web\_pass%20(1).pdf
- Bladby, H., Wersäll, J. (2017): A meat free society: The different substitutes for meat, their future and their environmental and health impact compared to meat. KTH Royal Institute of Technology School of Architecture and the Built Environment, Degree Projects in Technology, Stockholm, Sweeden.
- Bogueva, D., Marinova, D., Gordon, R. (2020): Who needs to solve the vegetarian men dilemma? *Journal of Human Behavior in the Social Environment* 30(1): 28-53.
- Boyle, J. (2011): Vegetarianism and fruitarianism as deviance. pp. 266-271. In: Bryant, C.D. (Ed.), *The Routledge Handbook of Deviant Behavior*. Taylor & Francis Group, London.

- Browarnik, B. (2012): Attitudes toward male vegetarians: challenging gender norms through food choices. Psychology Honours Papers, Connecticut College, New London, CT, USA.
- Bruinsma, J. (2009): The resource outlook to 2050: by how much do land, water and crop yields need to increase by 2050? pp. 1-33. In: How to feed the World in 2050. Proceedings of a technical meeting of experts, Rome, Italy, 24-26 June 2009. Food and Agriculture Organization of the United Nations (FAO).
- Bryant, C., van Nek, L., Rolland, N. (2020): European markets for cultured meat: A comparison of Germany and France. *Foods* 9(9): 1152.
- Bryman, A. (2011): *Social Research Methods*. Oxford University Press, Oxford.
- Chan, E.Y., Zlatevska, N. (2019): Is meat sexy? Meat preference as a function of the sexual motivation system. *Food Quality and Preference* 74: 78-87.
- Coelho, R. (2019): *Veganism motivation and obstacles*. Master thesis. Linnaeus University. <https://www.diva-portal.org/smash/get/diva2:1346878/FULLTEXT01.pdf>.
- Corliss, R., August, M., Cooper, M., Bjerklie, D., McLaughlin, L. (2002): Should we all be vegetarians? Would we be healthier? Would the planet? The risks and benefits of meat-free life. *Time* 160(3): 48-56.
- Corrin, T., Papadopoulos, A. (2017): Understanding the attitudes and perceptions of vegetarian and plant-based diets to shape future health promotion programs. *Appetite* 109: 40-47.
- Delgado, C.L. (2003): Rising consumption of meat and milk in developing countries has created a new food revolution. *Journal of Nutrition* 133(11, Suppl. 2): 3907S-3910S.
- Dilek, S.E., Fennell, D.A. (2018): Discovering the hotel selection factors of vegetarians: the case of Turkey. *Tourism Review* 73 (4): 492-506.
- Dyett, P.A., Sabaté, J., Haddad, E., Rajaram, S., Shavlik, D. (2013): Vegan lifestyle behaviors. An exploration of congruence with health-related beliefs and assessed health indices. *Appetite* 67: 119-124.
- Eat-Lancet Commission. (2019): Food planet health. Healthy Diets From sustainable food system. <https://www.thelancet.com/commissions/EAT>, accessed in January 2022.
- Enzing, C., Ploeg, M., Barbosa, M., Sijtsma, L. (2014): Microalgae-based products for the food and feed sector: an outlook for Europe. JRC scientific and policy reports, no. JRC 85709, Joint Research Centre, Luxembourg. [https://ec.europa.eu/jrc/sites/default/files/final\\_version\\_online\\_ipts\\_jrc\\_85709.pdf](https://ec.europa.eu/jrc/sites/default/files/final_version_online_ipts_jrc_85709.pdf)
- Erem, E., Icyer, N.C., Tatlisu, N.B., Kilicli, M., Kaderoglu, G.H., Toker, Ö.S. (2021): A new trend among plant-based food ingredients in food processing technology: Aquafaba. *Critical Reviews in Food Science and Nutrition*, DOI: 10.1080/10408398.2021.2002259.
- FAO (2020a): *Statistical yearbook. World Food and Agriculture*. Roma. <https://www.fao.org/3/cb1329en/online/cb1329en.html>, accessed in April 2022.
- FAO (2020b): *The state of food and agriculture 2020. Overcoming water challenges in agriculture*. Rome. <https://www.fao.org/documents/card/en/c/cb1447en/>, accessed in January 2022.
- FAO (2021): *Food and agriculture data – FAOSTAT*, <https://www.fao.org/faostat/en/#data> accessed in January 2022.
- Friel, S., Dangour, A.D., Garnett, T., Lock, K., Chalabi, Z., Roberts, I., Butler, A., Butler, C.D., Waage, J., McMichael, A.J. (2009): Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. *Lancet* 374 (9706): 2016-2025.

- Fukase, E., Martin, W. (2016): Who will feed China in the 21st century? Income growth and food demand and supply in China. *Journal of Agricultural Economics* 67(1): 3-23.
- Gilting, A.M., Weijenberg, M.P., Goldbohm, R.A., Dagnelie, P.C., van den Brandt, P.A., Schouten, L.J. (2013): The Netherlands Cohort Study–Meat Investigation Cohort; a population-based cohort over-represented with vegetarians, pescetarians and low meat consumers. *Nutrition Journal* 12(1): 156.
- Gomez, J.M., Ruiz, M.R., Meleb, P.M. (2018): Vegetarian restaurants as a determining factor of the vegetarian tourist's destination choice. *European Journal of Family Business* 8(1): 69-79.
- Gossard, M.H., York, R. (2003): Social structural influences on meat consumption. *Human Ecology Review* 10(1): 1–9.
- Groom, M.J., Gray, E.M., Townsend, P.A. (2008): Biofuels and biodiversity: principles for creating better policies for biofuel production. *Conservation Biology* 22(3): 602-609.
- Hankiss, E., Füstös, L., Manchin, R., Szokolczai, Á. (1982): Kényszerpályán? A magyar társadalom értékrendszerének alakulása 1930 és 1980 között. MTA Szociológiai Intézet, Budapest.
- Hargreaves, S.M., Raposo, A., Saraiva, A., Zandonadi, R.P. (2021): Vegetarian diet: An overview through the perspective of quality of life domains. *International Journal of Environmental Research and Public Health* 18(8): 4067.
- Harun, R., Singh, M., Forde, G.M., Danquah, M.K. (2010): Bioprocess engineering of microalgae to produce a variety of consumer products. *Renewable and Sustainable Energy Reviews* 14 (3): 1037– 1047.
- Hillel, D., Rosenzweig, C. (2011): *Handbook of climate change and agroecosystems: impacts, adaptation, and mitigation*. Imperial College Press. London.
- Horváth, Á., Kovács, A.F., Fodor, M. (2005). Az értékrend hatása a táplálkozásra. The effect of value judgements on nutrition. *Élelmiszer, Táplálkozás és Marketing*. The Hungarian Journal of Food, Nutrition and Marketing 2(1-2): 69-76.
- IPSOS (2018): What does it mean to consumers? An exploration into diets around the world. [https://www.ipsos.com/sites/default/files/ct/news/documents/2018-04/natural\\_food.pdf](https://www.ipsos.com/sites/default/files/ct/news/documents/2018-04/natural_food.pdf), accessed in January 2022.
- Jayanthi, V. (2001): Vegetarianism in India. *Peritoneal Dialysis International* 21(Suppl. 3): S322-S325.
- Kaya, I.H. (2016): Motivation factors of consumers' food choice. *Food and Nutrition Sciences* 7: 149-154.
- Kökény, L., Kiss K. (2021): There is a time and a place for everything (and for everyone): Examining main socio-demographic and territorial differences in use of leisure time. *Regional Statistics* 11(2): 136–164.
- KSH (2011a): 2011 census data. 1.1.2.1 A népesség korcsoport és nemek szerint. 1.1.4.1 A népesség iskolai végzettség és korcsoport szerint. [https://www.ksh.hu/nepszamlalas/tablak\\_teruleti\\_00](https://www.ksh.hu/nepszamlalas/tablak_teruleti_00)
- KSH (2011b): 2011 census data. 14. A népesség iskolázottsága. [https://www.ksh.hu/docs/hun/xftp/idoszaki/nepsz2011/nepsz\\_14\\_2011.pdf](https://www.ksh.hu/docs/hun/xftp/idoszaki/nepsz2011/nepsz_14_2011.pdf), accessed in May 2022.
- KSH (2020a): 1934-2018 census data. 5.5.1. A rendelkezésre álló húsfélék egy főre jutó mennyisége (1934–). [https://www.ksh.hu/stadat\\_files/mez/hu/mez0062.html](https://www.ksh.hu/stadat_files/mez/hu/mez0062.html).

- KSH (2020b): 1921-2018 census data. 4.2.4. Fontosabb száraz hüvelyes növények termésmennyisége (1921-). [https://www.ksh.hu/docs/hun/agraar/html/tabl1\\_4\\_2\\_4.html](https://www.ksh.hu/docs/hun/agraar/html/tabl1_4_2_4.html).
- KSH (2021): Magyarország népességének száma nemek és életkor szerint, január 1. <https://www.ksh.hu/interaktiv/korfak/orszag.html>, accessed in January 2022.
- Koptyug, E. (2021): Vegetarians and flexitarians Germany 2020, by gender. <https://www.statista.com/statistics/1271587/vegetarians-flexitarians-by-gender-germany/>, accessed in May 2022.
- Kosar, T., Bohra, S., Mernik, M. (2018): A systematic mapping study driven by the margin of error. *Journal of Systems and Software* 144: 439-449.
- Koyande, A.K., Chew, K.W., Rambabu, K., Tao, Y., Chu, D.T., Show, P.L. (2019): Microalgae: A potential alternative to health supplementation for humans. *Food Science and Human Wellness* 8(1): 16-24.
- Kuhad, R.C., Singh, A., Tripathi, K.K., Saxena, R.K., Eriksson, K.E.L. (1997): Microorganisms as an alternative source of protein. *Nutrition Reviews* 55(3): 65-75.
- Kumar, P., Sharma, N., Sharma, S., Mehta, N., Verma, A.K., Chemmalar, S., Sazili, A.Q. (2021): In-vitro meat: a promising solution for sustainability of meat sector. *Journal of Animal Science and Technology* 63(4): 693-724.
- Kutasi, G., Perger, J. (2014): Adóösztönzőkkel az externáliák ellen: a népegészségügyi termékadó és a széndioxidadó nemzetközi példái. *Köz-gazdaság-Review of Economic Theory and Policy* 9(4): 109-126.
- Lea, E., Worsley, A. (2003): Benefits and barriers to the consumption of a vegetarian diet in Australia. *Public Health Nutrition* 6(5): 505-511.
- Leahy, E., Lyons, S., Tol, R.S.J. (2010): An estimate of the number of vegetarians in the World. ESRI Working Paper, 340, The Economic and Social Research Institute (ESRI), Dublin.
- Leitzmann, C. (2003): Nutrition ecology: the contribution of vegetarian diets. *The American Journal of Clinical Nutrition* 78 (3): 657S-659S.
- Leitzmann, C. (2014): Vegetarian nutrition: Past, present, future. *American Journal of Clinical Nutrition* 100(1): 496S-502S.
- Lipták, K., Hajdú, N. (2018): Jarred baby food purchasing habits among mothers of infants in Hungary, and the features of baby food labels. *Regional Statistics* 8(1): 202-221.
- Lusk, J.L., Norwood, F.B. (2009): Some economic benefits and costs of vegetarianism. *Agricultural and Resource Economics Review* 38(2): 109-124.
- Magrini, M.B. (2021): Transition agroécologique et alimentaire vers plus de protéines végétales diversifiées: comment l'analyser et l'accompagner? Journées d'échanges autour de l'amélioration des protéines végétales pour la santé des consommateurs et des systèmes de production, Alliance Plant2Pro et QUALIMENT d'INRAE, April 2021, Webinaire, France.
- Mardones, C., Flores, B. (2018): Effectiveness of a CO<sub>2</sub> tax on industrial emissions. *Energy Economics* 71: 370-382.
- Matassa, S., Boon N., Pikaar I., Verstraete, W. (2016): Microbial protein: future sustainable food supply route with low environmental footprint. *Microbial Biotechnology* 9 (5): 568-575.
- Mathieu, S., Dorard, G. (2016): Vegetarianism and veganism lifestyle: Motivation and psychological dimensions associated with selective diet. *Presse Medicale* 45(9): 726-733.

- McCarthy, N. (2018): Who Are America's Vegans and Vegetarians? <https://www.statista.com/chart/14989/who-are-americas-vegans-and-vegetarians/> accessed in January 2022.
- McCormick, B. (2019). Why People Go Vegan: 2019 Global Survey Results. vomadlife.com. <https://vomadlife.com/blogs/news/why-people-go-vegan-2019-global-survey-results>.
- Meister, K. (1997): Vegetarianism. American Council on Science on Health. New York.
- Modlinska, K., Adamczyk, D., Maison, D., Pisula, W. (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): 6292.
- Morach, B., Witte, B., Walker, D., von Koeller, E., Grosse-Holz, F., Rogg, J., Schulze, U. (2021): Food for Thought: The Protein Transformation. *Industrial Biotechnology* 17(3): 125-1.
- Motrøen, M. (2020): The Orkla Sustainable Life Barometer. <https://www.orkla.fi/app/uploads/sites/12/2020/11/Orkla-Sustainable-Life-Barometer-2020-Main-Report.pdf>, accessed in January 2022.
- Mullee, A., Vermeire, L., Vanaelst, B., Mullie, P., Deriemaeker, P., Leenaert, T., Huybrechts, I. (2017): Vegetarianism and meat consumption: A comparison of attitudes and beliefs between vegetarian, semi-vegetarian, and omnivorous subjects in Belgium. *Appetite* 114: 299-305.
- Natrajan, B., Jacob, S. (2018): 'Provincialising' vegetarianism putting Indian food habits in their place. *Economic and Political Weekly* 53(9): 54-64.
- Niva, M., Jallinoja, P. (2018): Taking a stand through food choices? Characteristics of political food consumption and consumers in Finland. *Ecological Economics* 154: 349-336.
- Obádovics, Cs. (2019): The structure and future of Hungary's population. pp. 273–296. In: Monostori, J., Őri, P., Spéder, Zs. (Eds.), *Demographic Portrait of Hungary, 2018. Report on the conditions of the Hungarian population*. Hungarian Demographic Research Institute, Budapest.
- Onwezen, M.C., Bouwman, E.P., Reinders, M.J., Dagevos, H. (2021): A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite* 159: 105058.
- Pengue, W., Gemmill-Herren, B., Balázs, B., Ortega, E., Viglizzo, E., Acevedo, F., Diaz, D.N., Díaz de Astarloa, D., Fernandez, R., Garibaldi, L.A., Giampetro, M., Goldberg, A., Khosla, A., Wishek, H. (2018): 'Eco-agri-food systems': today's realities and tomorrow's challenges. pp. 57-109. In: *TEEB for Agriculture & Food: Scientific and Economic Foundations*. Geneva: UN Environment.
- Paslakis, G., Richardson, C., Nöhre, M., Brähler, E., Holzappel, C., Hilbert, A., de Zwaan, M. (2020): Prevalence and psychopathology of vegetarians and vegans—Results from a representative survey in Germany. *Scientific Reports* 10(1): 1-10.
- Pfeiler, T.M., Egloff, B. (2018): Examining the "Veggie" personality: Results from a representative German sample. *Appetite* 120: 246–255.
- Piazza, J., Ruby, M.B., Loughnan, S., Luong, M., Kulik, J., Watkins, H.M., Seigerman, M. (2015): Rationalizing meat consumption. *The 4Ns. Appetite* 91: 114-128.

- Pihlanto, A., Mattila, P., Mäkinen, S., Pajari, A. M. (2017): Bioactivities of alternative protein sources and their potential health benefits. *Food & Function* 8(10): 3443-3458.
- Poore, J., Nemecek, T. (2018): Reducing food's environmental impacts through producers and consumers. *Science* 360(6392): 987-992.
- Poór, J. (2013): A magyarországi hústermékek világgpiaci pozíciójának alakulása. *GAZDÁLKODÁS: Scientific Journal on Agricultural Economics* 57(80-2016-943): 460-471.
- Post, M.J. (2014): An alternative animal protein source: Cultured beef. *Annals of the New York Academy of Sciences* 1328(1): 29-33.
- Pretty, J. (2012): Agriculture and food systems our current challenge. pp. 37-52. In: Rosin, C., Stock, P., Campbell, H. (Eds.), *Food Systems Failure: The Global Food Crisis and the Future of Agriculture*. Earthscan Food of Agriculture. Routledge, Taylor & Francis Group, London.
- Ray, D.K., Foley, J.A. (2013a): Increasing global crop harvest frequency: recent trends and future directions. *Environmental Research Letters* 8: 044041
- Ray, D.K., Mueller, N.D., West, P.C., Foley, J.A. (2013b): Yield trends are insufficient to double global crop production by 2050. *PLOS ONE* 8(6): e66428.
- Raphaely, T., Marinova, D. (2014): Flexitarianism: Decarbonising through flexible vegetarianism. *Renewable Energy* 67: 90-96.
- Reinhart, R.J. (2018): Snapshot: few Americans vegetarian or vegan <https://news.gallup.com/poll/238328/snapshot-few-americans-vegetarian-vegan.aspx>, accessed in May 2022.
- Reisinger, O. (2003): *Mérlegen a vegetarizmus*. Oltalom Alapítvány Kiadó, Budapest.
- Rivera, M., Shani, A. (2013): Attitudes and orientation toward vegetarian food in the restaurant industry: an operator's perspective. *International Journal of Contemporary Hospitality Management* 25(7):1049-1065.
- Rosenfeld, D.L., Tomiyama, A.J. (2020): Taste and health concerns trump anticipated stigma as barriers to vegetarianism. *Appetite* 144: 104469.
- Rosenfeld, D.L., Tomiyama, A.J. (2021): Gender differences in meat consumption and openness to vegetarianism. *Appetite* 166: 105475.
- Roy Morgan Ltd. (2019): Rise in vegetarianism not halting the march of obesity. <http://www.roymorgan.com>, accessed in January 2022.
- Ruby, M.B. (2012): Vegetarianism. A blossoming field of study. *Appetite* 58(1):141-150.
- Rudy, K. (2012): Locavores, feminism, and the question of meat. *Journal of American Culture* 35: 26-36.
- Schmidhuber, J., Pound, J., Qiao, B. (2020): COVID-19: Channels of transmission to food and agriculture. Food and Agriculture Organization of the United Nations, Rome.
- Schneider, M., Medgyesi, M. (2020): Környezettel és környezetvédelemmel kapcsolatos lakossági attitűdök változása Magyarországon. pp. 500-521. In: Kolosi, T., Szelényi, I., Tóth, I. (Eds.), *Társadalmi Riport*, Budapest.
- Shani, A., DiPietro, R.B. (2007): Vegetarians: a typology for foodservice menu development. *Hospitality Review* 25(2): 66-73.
- Springmann, M., Clark, M.A., Rayner, M., Scarborough, P., Webb, P. (2021): The global and regional costs of healthy and sustainable dietary patterns: a modelling study. *Lancet Planet Health* 5(11): E797-E807.

- Steinfeld, H., Wassenaar, T., Jutzi, S. (2006a): Livestock production systems in developing countries: status, drivers, trends. *Revue Scientifique et Technique* 25(2): 505-516.
- Steinfeld, H., Gerber, P., Wassenaar, T.D., Castel, V., Rosales, M., Rosales, M., de Haan, C. (2006b): Livestock's long shadow: environmental issues and options. Food and Agriculture Organization of the United Nations, Rome.
- Szelényi, B. (2021): Az adatbázis súlyozása. <http://demografia.hu/hu/letoltes/adatbazisok/eletunk-fordulopontjai/sulyozas.pdf>, accessed in January 2022.
- Szőllősi, N., Juhász, C., Tamás, J. (2007): CO2 Emission trade in the European Union and Hungary. *Acta Agraria Debreceniensis* 27: 198-203.
- Tan, N.P., Conner, T.S., Sun, H., Loughnan, S., Smillie, L.D. (2021): Who gives a veg? Relations between personality and Vegetarianism/Veganism. *Appetite* 163: 105195.
- Tilman, D., Balzer, C., Hill, J., Befort, B.L. (2011): Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences of the USA* 108: 20260–20264.
- Timeo, S., Suitner, C. (2018): Eating meat makes you sexy: Conformity to dietary gender norms and attractiveness. *Psychology of Men & Masculinity* 19(3): 418–429.
- Tubb, C., Seba, T. (2021): Rethinking food and agriculture 2020-2030: The second domestication of plants and animals, the disruption of the cow, and the collapse of industrial livestock farming. *Industrial Biotechnology* 17: (2) 57-72.
- Újvári, G., Bencsik, D., Zsótér, B. (2020): Sport habits and food purchasing and consuming patterns of vegetarians and vegans in Hungary *Quaestus Multidisciplinary Research Journal* 18 (2): 112-122.
- Verbeke, W., Sans, P., Van Loo, E.J. (2015): Challenges and prospects for consumer acceptance of cultured meat. *Journal of Integrative Agriculture* 14(2): 285–294.
- Veganz (2020): Veganz nutrition study 2020. <https://vegan.com/blog/results-of-the-current-vegan-nutrition-study/> accessed in January 2022.
- Vetőné Mózner, Z. (2012). Az élelmiszer-fogyasztás környezeti hatásai és szerkezeti változásai. pp. 29-43. In: Fenntartható fejlődés, élhető régió, élhető települési táj 2. Budapesti Corvinus Egyetem, Budapest.
- Wilks, M., Phillips, C.J. (2017): Attitudes to in vitro meat: A survey of potential consumers in the United States. *PIOS one* 12(2): e0171904.
- Wu, J.Y. (2014): Everyone vegetarian, world enriching. *Open Journal of Philosophy* 4(2): 160-165.
- Wunsch, G.N. (2021): Share of consumers who follow a meat-free diet worldwide in 2021, by select country. <https://www.statista.com/statistics/1280098/global-non-meat-eaters-by-select-country/>, accessed in May 2022.
- Wunsch, G.N. (2022): Share of vegetarians in Germany in 2021, by age group. <https://www.statista.com/forecasts/1261028/adults-following-vegetarian-diet-in-germany-by-age>, accessed in January 2022.
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