

Theses of doctoral (PhD) dissertation

**STATISTICAL ANALYSIS OF THE PRODUCTION
AND CONSUMPTION OF MANGALICA PORK**

Orsolya Bernadett Nagy

Supervisor:

Prof. Dr. Péter Balogh

professor



UNIVERSITY OF DEBRECEN

Károly Ihrig Doctoral School of Management and Business

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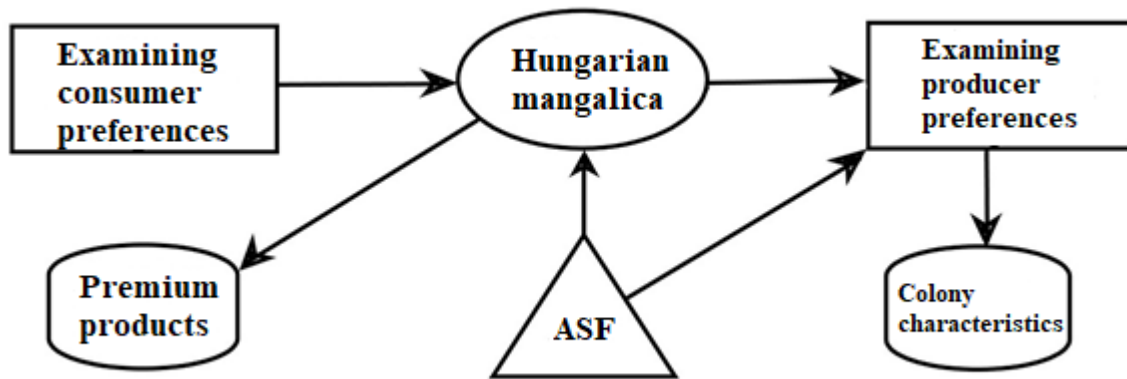
1. RESEARCH BACKGROUND AND OBJECTIVES, PRESENTATION OF THE RESEARCH HYPOTHESES

There has always been a high degree of heterogeneity in consumer attitudes towards traditional things, and this is no different today. The degree of importance attached by certain consumer groups to a product associated with a particular geographical area depends on many factors, the importance of which is still a key issue in the literature today. The study of preferences is an essential aspect in understanding the underlying processes of consumer behaviour. The analysis of consumer preferences for traditional products has been the subject of a number of studies, among which the focus on certain traditional animal species is very common (*MONJARDINO - RAQUEL 2001; PLATANIA - PRIVITERA 2006; EKELUND et al., 2007; SZAKÁLY et al. 2008; SZENTE et al. 2011; ADANACIOGLU - ALBAYRAM 2012; SZIGETI et al. 2015; PLATANIA et al. 2015; BALOGH et al. 2016; CZINE et al. 2020*). In addition, there is an increasing emphasis on surveying young people still in education, as they represent the consumers of the future. Examining their attitudes towards traditional products could be a key question to find out whether there is a future for the values associated with these geographical areas (*HERTZBERG - MALORGIO 2008; ADANACIOGLU - ALBAYRAM 2012; BERNUÉS et al. 2012; KISS et al. 2016; EUGENIO et al. 2018; SILVESTRI et al. 2020*).

One of Hungary's most famous traditional animal breeds is the Mangalica pig. Mangalica meat and its products are available as a premium product (*SZENTE et al., 2011; TÖRÖK, 2011*). However, it is important to note that the herd is under serious threat from the emergence and rapid spread of African swine fever across Europe. In order to protect the herd, it is essential that producers are properly informed about the control of the virus and are able to operate their pig farms at the highest level of safety (*AKI, 2009*).

As mentioned above, it is clear that my PhD thesis research aims to investigate a highly complex process, starting with a preference analysis of future consumers. My aim in doing so is to assess whether there is a real demand for local livestock and their products among future consumers. I then want to analyse producer preferences for the control of African swine fever, which is a threat to herd safety. To this end, I will examine the perception of different farm characteristics by producers in relation to the control of the virus. The complexity of my research process is illustrated in *Figure 1*.

Figure 1: **Presentation of the research process**



Source: *Own construction, 2021*

Based on the above, the objectives of my research are:

1. To investigate the preferences of future consumers for traditional mangalica.
2. To investigate whether there are differences in the characteristics and functioning of Hungarian mangalica farms with small and large populations.
3. To assess the preferences of Hungarian mangalica farmers for their farms in the light of the ASF threat.

I have defined my hypotheses as follows:

- H1: The consumer group under study has a positive perception of mangalica meat and processed products made from it.
- H2: There are statistically verifiable differences in the characteristics and operations of farms with small (up to 30 mangalica) and large (more than 30 mangalica) herds.
- H3: The preferences of mangalica farmers for ASF control are determined by the characteristics associated with the enclosure of the colony.

The novelty of my research:

The novelty of my thesis research is that the situation of Hungarian mangalica has not been investigated so far by focusing on the threat of African swine fever (ASF). In terms of data collection, there has been no similar, comprehensive, national survey in the recent past. In addition, from a methodological point of view, the use of a discrete choice experiment to investigate the producer side is a novelty, and no African swine fever (ASF) risk aversion calculations have been carried out before my research.

2. DATABASE AND DESCRIPTION OF THE METHODS USED

During my research I collected secondary and primary data. In my secondary research, I collected and reviewed 168 national and international literature sources and analysed data from closely related databases.

The secondary research process

During the secondary data collection, my aim was to present the most important information and trends on meat consumption at international and national level, the status and importance of industrial pig farming at international and national level, the status and importance of Mangalica pig farming in Hungary, consumer preference surveys at international and national level, agricultural risk, African swine fever (ASF) and pig farm characteristics at international and national level. Furthermore, I performed a bibliometric analysis using VOSviewer 1.6.17 software. I examined the keywords of the articles dealing with African swine fever (ASF), explored the correlations between them, and the bibliographic linkages between countries. To do this, I used the Web of Science Core Collection-Clarivate Analytics database. Using the software, I formed 3 clusters of the keywords identified and analysed the relationships between them.

To present the international situation of the sector, I used data from the OECD and FAO databases, and to present the domestic information, I used the database of the Hungarian Central Statistical Office (KSH).

Primary research process and sample presentation

During my research, I conducted primary data collection in addition to secondary data collection. I conducted a questionnaire survey among university students to analyse the consumer side. On the producer side, I conducted a nationwide data collection among mangalica farmers in cooperation with the National Association of Mangalica Breeders.

Description of the consumer research process

I conducted my research in October 2019 among students of the Faculty of Economics at the University of Debrecen. The data collection was conducted online in a self-completion format. The completion was voluntary and anonymous. A total of 349 respondents filled in the questionnaire, of which 324 were interpretable and could be used for analysis.

My questionnaire consisted of three parts. In the first part, respondents reported on their purchasing and consumption habits for industrial pigs and mangalica pigs (e.g., Where do you typically buy pork? Which parts of the pig do you consume? Which processed products do you consume? I also asked in the first part how much more the buyers were willing to pay for Hungarian products and for healthier products (*BARCS - JENES, 2017*). In the second part of the questionnaire, I asked the respondents to evaluate the aspects they considered when buying industrial pigs and mangalica pigs. Finally, in the third part I measured the sociodemographic characteristics of the respondents.

It is also important to mention that data were collected through a convenience sampling procedure, so my conclusions are not generalisable. Furthermore, it is also necessary to mention that I have surveyed university students in order to assess the consumer side, because they have a higher education and therefore have considerable information on the subject and will play a decisive role in the future decision-making process on purchasing. The characteristics of my consumer survey sample are shown in *Table 1*.

Table 1: Demographic data of respondents

Variablen	Stichprobe (N=324)		Kodierung
Gender (%) Male Female	30.9 69.1		categorical variable (0 - Male, 1 - Female)
Age (years)	average 21.1	standard deviation 3.5	continuous variable
Education level (%) FOSZ/BSC MSC	83.0 17.0		categorical variable (0 - FOSZ, BSC, 1 - MSC)
Place of residence (%) municipality small town big city county seat	18.5 40.4 11.1 30.0		categorical variable (0 - municipality, 1 - small town, 2 - big city, 3 - county seat)
Number of persons living in the household (persons)	average 3.7	standard deviation 1.0	continuous variable
Net monthly household income (per 1 person) (%) do not wish to answer less than 100 thHUF 100-200 thHUF 200-300 thHUF more than 300 thHUF	19.8 10.8 32.7 22.2 14.5		categorical variable (0 -I do not wish to answer, 1 - less than 100 thHUF, 2 - 100-200 thHUF, 3 - 200-300 thHUF, 4 - more than 300 thHUF)

Source: *Own construction* based on NAGY, 2020

Table 1 shows that more than twice as many women completed the questionnaire as men. This is not surprising, given that more women than men are enrolled in higher education (KSH, 2021). The average age of respondents was 21.1 years, which is due to the fact that the survey was conducted among university students. In terms of educational level, the vast majority of respondents had studied at FOSZ or BSC level. In terms of place of residence, almost 40% of respondents live in a small town. As for the number of persons living in a household, it can be concluded that on average 4 persons live in a household, and for the majority the monthly net income per person was between 100 and 200 thousand HUF.

Description of the process of the survey on the producer side

This part of my research is based on a nationwide, comprehensive survey conducted in autumn 2020 in cooperation with the National Association of Mangalica Breeders. The data collection was carried out among mangalica breeders, with the personal presence of National Association of Mangalica Breeders's registry staff (interviewers) via an online interface. The

research was conducted in the framework of a cooperation between the University of Debrecen and the National Association of Mangalica Breeders. The questionnaire asked about general farm characteristics (e.g.: What kind of fence borders your farm? What is the fencing material? What is the fence? What is the height of the fence? etc.); questions on the transport and origin of animals, feed and bedding material, the reception of visitors, the processing and marketing of products; and finally, questions related to specific decision situations. The main objective of the survey was to assess the farm characteristics relevant for the prevention and control of African swine fever (ASF). 172 questionnaires were completed, of which 128 were evaluated and used for the studies. *Table 2* shows the distribution of respondents by county.

Table 2: Distribution of respondents by county

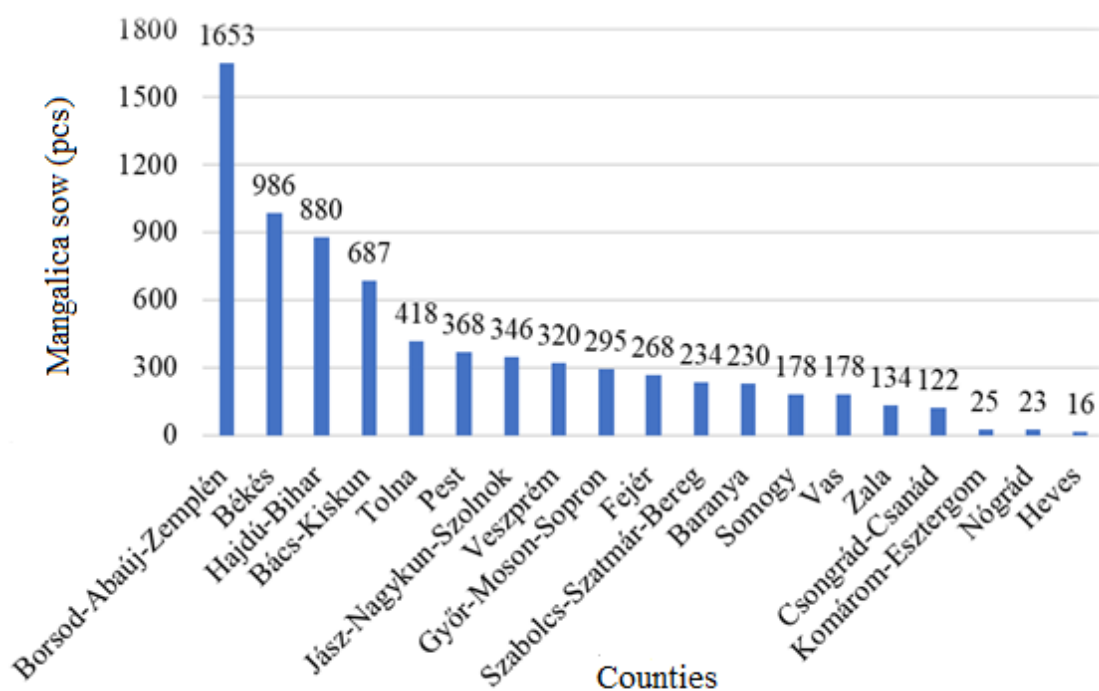
Counties (N=128)	Frequency (%)
Borsod-Abaúj-Zemplén	11.72
Hajdú-Bihar	11.72
Bács-Kiskun	9.38
Szabolcs-Szatmár-Bereg	8.59
Pest	7.81
Veszprém	7.81
Jász-Nagykun-Szolnok	7.03
Somogy	7.03
Békés	5.47
Győr-Moson-Sopron	4.69
Baranya	3.91
Fejér	3.91
Csongrád-Csanád	3.13
Zala	2.34
Komárom-Esztergom	1.56
Vas	1.56
Heves	0.78
Nógrád	0.78
Tolna	0.78

Source: *Own construction, 2021*

Table 2 shows that the highest percentage of mangalica farmers who filled in the questionnaire came from Borsod-Abaúj-Zemplén (11.72%) and Hajdú-Bihar counties (11.72%), while the lowest percentage of respondents came from Heves (0.78%), Nógrád (0.78%) and Tolna (0.78%) counties.

Figure 2 shows the prevalence of Mangalica sows by county.

Figure 2: Frequency of mangalica sows by county



Source: Own construction, 2021

Figure 2 shows that the number of Mangalica sows is particularly high in Borsod-Abaúj-Zemplén (1653), followed by Békés (986), Hajdú-Bihar (880) and Bács-Kiskun (687) counties. The lowest numbers are in Komárom-Esztergom (25), Nógrád (23) and Heves (16) counties.

Figure 3 shows the distribution of Mangalica sows by breed.

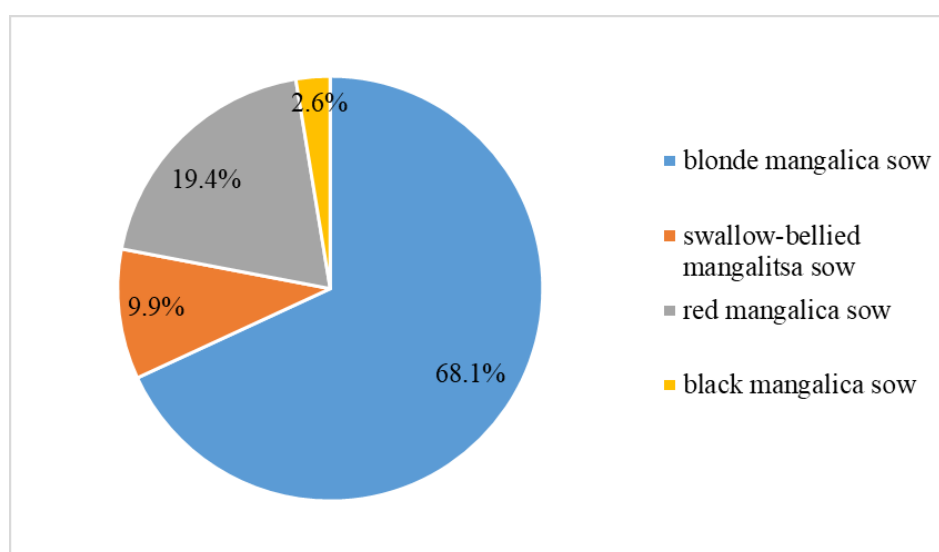


Figure 3: Distribution of Mangalica sows by species

Source: Own construction, 2021

Figure 3 shows that of the current four independent breeds, the most common is the blonde mangalica sow (68.1%), with the lowest proportion of black mangalicas (2.6%).

Methodology

In this subsection, I describe the methods used to process my data. My analyses were performed using IBM SPSS Statistics 25 (*IBM SPSS, 2017*), Microsoft Office Excel 2016 and the Apollo 0.2.1 package of the R software (*HESS-PALMA, 2019; R CORE TEAM, 2020; HESS-PALMA, 2021*).

I performed descriptive statistical analyses on the data collected in the consumer survey, first on sociodemographic characteristics and then on information on purchasing and consumption patterns. I then conducted non-parametric tests, Spearman rank correlation calculations, Khi-square tests and Kruskal-Wallis tests. Finally, I applied dimensionality reduction and segmentation methods, i.e. principal component analyses and two-stage cluster analyses.

On the producer side, I conducted Khi-square tests and discrete choice modelling. Further analysing the results of the latter, I made risk aversion calculations.

Descriptive statistical methods

Within the descriptive statistical methods, distribution ratios, means and coefficients of variation were calculated. I used distribution ratios to characterise the frequency of pork consumption, the place of meat purchase, the importance of the aspects considered when purchasing, and the extent to which consumers would be willing to pay more for Hungarian products and healthier products. The distribution ratios show the proportion of each part of the population in relation to the total statistical population. Consequently, they provide information on the composition and internal structure of the population (*HUZSVAI, 2012*).

In order to assess the importance of the factors taken into account for the purchase, I calculated an arithmetic mean. Within the means, a distinction is made between calculated (arithmetic, root mean square, geometric and harmonic means) and positional (mode, median) means. The calculated means are the result of a mathematical calculation and have some relation to the elements of the manifold. The positional means are determined without

mathematical calculation and characterise the population under study by their positioning between the covariates (*HUNYADI - VITA, 2008*).

In order to determine the importance of the criteria taken into account for the purchase, a standard deviation was calculated. The elements of a given population vary from one another, and the magnitude of this variability can be characterised by indicators. Dispersion indicators describe the variance of data with the same characteristics but different magnitudes from each other or from the mean (*HUZSVAI, 2012*).

Spearman rank correlation

In order to examine the co-movement of the criteria considered in the purchase of both industrial and mangalica pigs, I performed a Spearman rank correlation test.

Spearman's rank correlation tests whether there is a correlation between two variables at at least ordinal measurement level. By applying this method, we can find out to what extent the magnitude of one variable determines the magnitude of the other variable. It is not, however, suitable for determining causality (*SPSSABC, 2020*). Pearson correlation is a non-parametric counterpart. Consequently, its application is much more flexible. It can also be applied in the absence of normality violations or scale-type variables (*ARTUSI et al., 2002; CROUX - DEHON, 2010*). Its main measure is the Spearman correlation coefficient, which can take a value between -1 and +1. The closer the correlation coefficient is to these values, the stronger the correlation between the variables. A correlation coefficient with a positive sign expresses a correlation in the same direction, while a correlation coefficient with a negative sign expresses a correlation in the opposite direction. A value close to zero indicates a lack of correlation (*HUZSVAI - VINCZE, 2012*).

Khi-square test

Chi-square tests were conducted to investigate the relationship between demographic data and the purchase and consumption of industrial pigs and parts of Mangalica pigs and their products.

The Khi-square test is a non-parametric test, i.e. it can be used for nominal and ordinal measurement level variables, and also when the data do not fit a normal distribution (*GRAY et al., 2017; POLIT - BECK, 2018*). The Khi-square test examines the existence of a

relationship between two variables. It tests whether the empirical frequency table is significantly different from the theoretical frequency table. If it does, then there is a correlation between the two variables (*FIELD, 2017*).

Kruskal-Wallis test

I used the Kruskal-Wallis test to examine whether there is a significant difference in the importance of the aspects of the shopping experience between groups of people separated by certain sociodemographic factors.

The Kruskal-Wallis test examines whether there is a difference between two or more independent groups. It is often referred to as the non-parametric counterpart of analysis of variance, due to the fact that its applicability criteria (normality, level of measurement of the outcome variable) are more permissive. The method can also be applied when normality is violated and when ordinal measurement level variables are available (*MCKIGHT - NAJAB, 2010*).

When a difference between the groups under study is found, a post hoc test can be used to perform pairwise comparisons in order to determine the exact location of the difference (*FIELD, 2017*).

Principal Component Analysis (PCA)

Factor analysis is a multivariate statistical method that models correlational relationships between variables. In factor analysis, the independent variables are known. On a dataset, the method can only be performed if they are well correlated (*TÓTHNÉ, 2011*). Factor analysis helps to find common factors that characterise preferences and are related to several variables under study. These factors are the factors. The aim of the analysis is to reduce the number of variables, so the number of factors obtained in the analysis should be less than the number of initial variables (*VARGA - SZILÁGYI, 2011*). For factor analysis, I used principal component analysis (PCA) with varimax rotation (*MALHOTRA, 1999*). Factors with eigenvalues less than 1 and variables with loading weights less than 0.6 were excluded from further analysis as they were not considered statistically significant for my interpretation. In order to verify the reliability of the principal component analysis, I calculated Cronbach's alphas for the variables included in the analysis on an aggregate basis

and then on a component-specific basis (*NUNNALLY - BERNSTEIN, 1994*). I then determined the Kaiser-Meyer-Olkin (KMO) test values and examined whether they exceeded the threshold of 0.6 (*KAISER, 1974*). Next, I performed Bartlett tests, where I examined whether the test results were significant (*BARTLETT, 1954*). Finally, I looked at what percentage of the total variance was explained by the components.

Two-step cluster analysis

Following the principal component analysis, I used cluster analysis to classify consumer profiles into clusters. Cluster analysis is a summary name for the methodology of clustering (*WIND, 1978*), a multivariate method that aims to explore structures and create a relatively homogeneous subset by simultaneously considering the characteristics of a relatively heterogeneous set (*SIMON, 2006*). Cluster analysis does not distinguish between dependent and independent variables, but examines the interrelationships within a set of variables. The elements of a given cluster are similar to each other but different from elements of other clusters. The analysis first involves formulating the problem, i.e. defining the variables on which the clustering is based. Then, the appropriate distance measure, which shows how similar or different the observation units are from each other, must be defined. The appropriate clustering procedure is then selected and the number of clusters determined. The resulting clusters are then interpreted and characterized. Finally, the validity of the analysis is checked (*MALHOTRA - SIMON, 2009*).

Two-step cluster analysis is used to analyse databases with a large number of elements when hierarchical and K-means clustering are less efficient. The method can be applied to both categorical and continuous variables. The determination of the number of clusters is usually based on some information criterion (e.g. Bayesian information criterion (BIC)) (*MCINTYRE - BLASHFIELD; 1980, HADI et al., 1992*).

Discrete choice experiment (DCE) theory

Two groups of preference assessment procedures are distinguished in the literature. The first group includes methods based on so-called revealed preference (RP) data, which examine an individual's choices in a real market situation. The second group includes revealed

preference (SP) methods, which analyse the revealed preference in a hypothetical situation (LOUVIERE *et al.*, 2010).

The latter group includes the discrete choice experiment (DCE), which analyses the preferences of respondents in the survey context by providing multiple observations at the same observation point (TRAIN, 2009). The method is based on the theory of random utility, i.e. it assumes consumer utility maximisation. It decomposes total utility into a systematic (observable by the researcher) and a random (unobservable by the researcher) component according to *Equation 1*.

$$U_{n,i,t} = V_{n,i,t} + \varepsilon_{n,i,t}, \quad (1)$$

where n denotes the individual, i the alternative, t the decision situation U the total utility, V the systematic part of the utility and ε the random component of the utility (BEN-AKIVA - LERMAN, 1985).

In most cases, the modelling of experimental data is based on a conditional logit (CL) specification, which has the advantage of a relatively simple estimation process and easy interpretability of the results (MCFADDEN, 1974). To carry out my CL model estimation, I defined the utility function in *equation 2* for my analysis.

$$\begin{aligned} V_i = & ASC_i + \\ & \beta_{More\ than\ 3\ months\ litter\ storage\ time} Litter\ storage\ time_{More\ than\ 3\ months}_i + \\ & \beta_{Visitor\ occasional} Visitor_{Occasional}_i + \beta_{Visitor\ never} Visitor_{Never}_i + \\ & \beta_{Double\ fence} Fence_{Double}_i + \\ & \beta_{Double\ fence\ and\ one\ solid} Fence_{Two\ fences\ and\ at\ least\ one\ solid}_i + \\ & \beta_{Fence\ more\ than\ 175\ cm\ high} Fence\ height_{More\ than\ 175\ cm}_i + \beta_{ASP\ risk} ASP\ risk_i \end{aligned} \quad (2)$$

Calculation of willingness to risk (WTR)

Further analysis of the utility coefficients obtained from discrete choice modelling (DCM), using an unlabelled format, primarily involves marginal rate of substitution (MRS) calculations (HOLE, 2007). In my analysis, I have made calculations of ASP willingness to risk (WTR) using the relationship in *Equation 3*.

$$ASP\ WTR_k = -1\left(\frac{\beta_k}{\beta_{ASP\ risk}}\right), \quad (3)$$

where $ASP\ WTR_k$ is the ASP risk-taking propensity for the k th attribute under consideration, β_k is the utility coefficient for the k th attribute, and $\beta_{ASP\ risk}$ is the estimated utility coefficient for the ASP risk attribute.

Practical design of a discrete choice experiment

To set up the decision situations for my discrete choice experiment, I performed a two-round process. First, I used a D-efficient experimental design to investigate respondents' perceptions of seven mangalica properties (selected through expert interviews) in a pilot study (*ROSE - BLIEMER, 2009*). The experimental design was implemented using the Ngene 1. 2 software, which resulted in 32 decision situations (*CHOICEMETRICS, 2018*). Due to the excessive number, blocking was applied, so that the respondents were confronted with only a subset of the choice situations, 8 decision situations. Each of these contained 3 hypothetical mangalica alternatives. The farm characteristics considered are presented in *Table 3*.

Table 3: Colony characteristics tested in the experiment, their levels and descriptions

Property	Property level	Property description
Feeding	Own	The animals are fed entirely on home-produced feed
	Purchased from	At least part of the animals' feed is provided by purchased feed
<i>Litter storage time</i>	Maximum 3 months	The risk of ASF infection in litter used within 3 months can be very significant
	More than 3 months	Risk of ASF contamination is minimised if litter is stored for more than 3 months before use
<i>Visitor (civilian)</i>	Regular	External persons visit the site at least once a week
	Occasional	External persons visit the site at least once a month
	Never	The site is not visited by external persons
<i>Form of fence</i>	Single	The site is enclosed by a single fence
	Double	The site is bounded by a double fence with a minimum distance of 50 cm between them
	Double and at least one solid	The site is bounded by a double fence with a minimum distance of 50 cm between them, one of which is made of solid material
<i>Fence height</i>	Maximum 175 cm	A fence lower than 175 cm is not a reliable protection against wild animals
	More than 175 cm	Fence heights above 175 cm significantly reduce the number of wild animals that may enter the premises
Applied	Permanent	Personnel working on the premises are not replaced
	Frequently changing	Some of the people working on the site have been working on the site for less than half a year
<i>Risk of ASP occurrence (%)</i>	20	For the minimum risk of ASP, the value recommended by experts
	40	Value recommended by experts for ASP medium risk
	60	Value recommended by experts for ASP with significant risk

Note: The bold and italics highlighted site properties were included in the final experiment.

Source: Own construction, 2021

I conducted a pilot study (with 90 participants) in September 2020, which concluded that two farm characteristics (type of feeding, employee turnover) are not significant factors in farmers' decision making.

Prior to the final data collection, I performed a redesign of my experimental setup using the results of the pilot study. I used a Bayesian efficient layout type, in which the a priori values of the trait coefficients were given by the results of the conditional logit model estimation of the pilot study (BLIEMER *et al.*, 2008). My decision situations and the number of alternatives offered were the same as in the pilot study (32 decision situations arranged in 4 blocks; 8 choice situations per respondent, each containing 3 plant alternatives). I introduced my choice situations with the following decision task: *"In the next 8 choice situations, you will see mangalica colonies with different characteristics (three per choice situation). In each case, please choose the colony (just one) that you consider safest, taking into account the ASP threat"*. An example of a decision situation is shown in Table 4.

Table 4: **Example of a decision situation**

	Supposed colony 1	Supposed colony 2	Supposed colony 3
Litter storage time	More than 3 months	More than 3 months	Maximum 3 months
Visitor (civilian)	Occasional	Regular	Never
Form of fence	Double	Double and at least one solid	Single
Fence height	Maximum 175 cm	Maximum 175 cm	More than 175 cm
Risk of ASP occurrence (%)	40	40	60

Source: *Own construction, 2021*

3. MAIN FINDINGS OF THE DISSERTATION

The main findings of my research are in line with my objectives.

1. To investigate the preferences of future consumers for traditional mangalica.

The consumer side was investigated among university students. From the results of my survey, it can be said that all the respondents consume pork and 37.3% of the respondents consume mangalica pork. This proportion is much higher than the age-specific distribution of meat consumption shown in the literature for this age group, and contradicts trends found in the international literature that higher educated people eat less meat than lower educated people. The results of the questionnaire suggest that there may indeed be a link between education and meat consumption, but the direction of this is likely to vary by region. In Hungary, my research shows that meat consumption is positive, i.e. higher educated people eat more meat than lower educated people. Of course, it cannot be excluded that the answers are biased and that only those who eat meat filled in the questionnaire in the first place.

In view of this, I accept hypothesis H1 (The consumer group surveyed has a positive perception of mangalica meat and processed products made from it).

For both industrial pigs and mangalica pigs, the most preferred place of purchase is the butcher. For processed products, the most popular products are sausages and hams for industrial pigs and sausages and bacon for mangalica pigs. Freshness and the ingredients of the product were the most important factors for both types of pigs when buying meat, while the least important factors were presentation/packaging and price. For the factors considered in the purchase, the industrial pig tended to show a weak to medium correlation, while for the Mangalica pig, all factors were significant at the 1% level and the relationship between the factors was strong or very strong.

In the case of industrial pigs, significant correlations were found for gender, residence and highest education level with the purchase and consumption patterns of industrial pigs, while in the case of mangalica pigs, significant correlations were found for gender, residence, highest education level and net monthly per capita income with the purchase and consumption patterns of mangalica pigs. The importance of the factors taken into account for the purchase of industrial pigs was found to be significant by gender, highest education level and net monthly per capita income, while for mangalica pigs it was only significant along the income axis. In the case of industrial pigs, three components were identified,

namely the "Hungarian-brand-fresh product" aspect, health-related factors and marketing-related aspects. In the case of the Mangalica pig, all factors were grouped into one component.

In the two-step cluster analysis, I identified three subgroups for the industrially reared pig, the component "domestic-brand-fresh product" takes the highest value for the first cluster and the lowest value for the third cluster, i.e. the former members are the most important and the latter members are the least important aspects that the component includes. For the health-related factors component, the third cluster shows the strongest effect, while the first cluster shows the weakest effect. The impact of the marketing aspects component is strongest in the first cluster and weakest in the third. Men and women with tertiary education were placed in the first cluster, women with secondary education in the second, and men with secondary education in the third sub-cluster.

For the Mangalica pig, the two-stage cluster analysis identified three subgroups, with the component on Mangalica aspects taking the highest value for the second cluster and the lowest for the first cluster, i.e. the aspects that are most important for the members of the former and least important for the latter, are the aspects that the component includes. The first cluster was composed of men with secondary education, the second of men and women with tertiary education, and the third of women with secondary education.

2. To investigate whether there are differences in the characteristics and functioning of Hungarian mangalica farms with small and large populations.

On the production side, I found that there was no significant correlation at the 5% level between different farm characteristics related to fencing and farm size; between the contact of outsiders with the farm and farm size; between characteristics related to the slaughter of pigs, the preparation of meat products and the sale of products and farm size.

Based on the results, I reject hypothesis H2 (There are statistically verifiable differences in the characteristics and operations of small and large mangalica farms).

3. To assess the preferences of Hungarian mangalica producers for plantations in the light of the ASF threat.

In the analysis of the producer side, I found that longer litter storage time, reduced frequency of visits by outsiders, increased complexity and height of fencing, and reduced risk of ASF increase the producers' perception of the utility of their sites.

The frequency of external visits is less of an important attribute in the preferences of managers of large farms, and they show lower ASF risk tolerance for all attributes studied.

Colonies with up to 30 mangalica would take the highest ASF risk if the frequency of external visits was minimised, whereas decision-makers in colonies with more than 30 mangalica would take the highest ASF risk if there were double and at least one solid fence.

Based on this, I was able to partially confirm hypothesis H3 (The importance of the attributes related to the fence of the colony in the preferences of mangalica producers for ASF control), because the data above show that the hypothesis was not confirmed for small colonies, but was confirmed for large colonies.

4. NEW AND NOVEL RESULTS OF THE DISSERTATION

My research has led me to the following new and novel findings:

1. I analysed consumer preferences and found that pork consumption is more common in the age group studied than in the literature. I also found that for young people, mangalica meat is predominantly purchased from butchers, and the most popular processed product was sausage.
2. Comparing the consumer preference of mangalica as an indigenous Hungarian pig breed and a hungarian product with that of industrially reared pigs, I found that consumer preference for mangalica differs from that of traditional pigs, which supports the difference between products made from traditional mangalica and industrially reared pigs from a consumer perspective. I could not find product personality characteristics for mangalica meat consumers in the literature, and thus, I interpret my finding that mangalica meat consumers were from the middle to upper secondary education strata living in metropolitan and county areas with a preference for health-conscious eating as a new finding.
3. I consider it a novel finding that I have explored and shown that there are no statistically verifiable differences in the characteristics and operation of small (up to 30 mangalica) and large (more than 30 mangalica) herds in Hungary, but that small and large mangalica producers have different preferences for their herds in terms of the threat of African swine fever (ASF).
4. I appreciate that, in terms of data collection, a similar, comprehensive, national survey has not been conducted recently. In addition, the use of a discrete choice experiment to investigate the producer side is methodologically novel, and ASF risk aversion calculations have not been carried out before my research.

5. PRACTICAL APPLICABILITY OF THE RESULTS

I see the practical applications of my research as follows.

Although not supported by my research, the literature has shown that young people consume less pork than the older generation, and therefore they need stronger marketing activities to raise awareness of the benefits of meat consumption.

In the case of industrial pork products, if the producer or processor wishes to market its pork products to a market with a high proportion of higher education graduates, the product should be presented in a way that highlights its domestic origin, freshness and brand on the packaging, and in a market that typically attracts middle-aged consumers, the healthy lifestyle parameters of the product, such as its fat content or ingredients. The research also suggests that marketing campaigns should be targeted at people with a higher education level, as they are the most likely to be influenced by these aspects.

When selling mangalica products in markets where the majority of consumers are university graduates, it is also worth highlighting the product's origin, freshness and brand, as well as information on healthy lifestyle on the packaging. Overall, since among the factors considered for the purchase of mangalica pork, a significant result was obtained for all factors at the 1% level and the relationship between the aspects was strong or very strong, it is worth emphasising more strongly the mangalica raw material and its healthiness in products made from mangalica.

Marketers could try to position mangalica meat and products as a category in its own right to help reach the right target audience more effectively. This target group is likely to come from the middle or higher educated classes living in large cities or counties, who prefer a health-conscious diet.

For the decision-makers in a colony with more than 30 mangalica, the presence of double and at least one solid fence reduces the risk of ASF and increases the sense of utility. And managers of colonies with up to 30 mangalica have identified visitors as a health risk factor, so investments to facilitate disinfection in such colonies (construction and purchase of mobile black and white changing rooms) should be encouraged, as well as the launching of tenders at government level to support this and the construction and modernisation of fencing.

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6. PUBLICATIONS ON THE TOPIC OF THE DISSERTATION



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MTMT ID: 10063405

List of publications related to the dissertation

Articles, studies (5)

1. **Nagy, O. B.:** Comparison of consumption and purchase habits for University students for industrially kept pigs and mangalica pigs.
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