



## Positioning of the high-quality food trademark in Hungary through consumer segmentation

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### ABSTRACT

Consumers' focus on food quality is a growing trend. Certification schemes can guide conscious purchasing decisions and help navigate overlapping or misleading messages. The High-Quality Food (HQF; Hungarian acronym: KMÉ) trademark as a government-established certification plays an important role in fostering public trust, promoting food safety, quality control, and sustainability in Hungary. Despite its introduction in 2019 as a renewed and more structured certification scheme, consumer recognition remains significantly lower than that of its predecessor, the Excellent Hungarian Food (EHF) trademark. Comparable national food certification schemes exist across EU and non-EU countries, yet their recognition and influence vary widely, and academic research on their consumer-oriented development is scarce. This study addresses that gap by assessing consumer awareness and identifying key consumer segments for targeted positioning of the HQF trademark. A nationally representative questionnaire survey (N = 1001) was conducted in 2024, followed by principal component and K-means cluster analyses using SPSS to segment consumers based on attitudes toward existing and non-existing certification schemes, health-conscious eating, and trust in brands and local food products. The results revealed six distinct consumer clusters, each exhibiting unique preferences in food choices attitudes and levels of recognition with HQF. Based on these findings, tailored communication strategies are proposed to address consumer scepticism, build trust, and strengthen HQF's market positioning. The study demonstrates how targeted branding and consumer education can facilitate the transition from a legacy certification scheme to an enhanced food quality certification, providing practical guidance for policymakers and industry stakeholders.

### 1. Introduction

The "EU best practice guidelines for voluntary certification schemes for agricultural products and foodstuffs - 2010/C 341/04" laid down recommended practices in establishing certification schemes for agricultural products and foodstuffs. According to these guidelines, a certification can be defined as "third-party attestation related to products, processes, systems or persons" [1]. In which case, the High-Quality Food (HQF) trademark in Hungary can be classified under this category since

it certifies products that meet certain quality standards, including production process criteria. Certifications, such as the HQF, are classified as indicators of origin or quality and are critical tools in economic competition, granting exclusivity through industrial property protection processes. These certifications primarily serve to identify and distinguish goods and services while informing and reassuring consumers. Their practical utility is particularly evident in marketing, where they play a significant role in brand development.

Beyond their marketing value, certification schemes – including

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national, community, and regional – fulfil broader objectives, such as competition regulation, public health policy, rural development, food security, environmental protection, and sustainability goals [2–5].

Certification schemes also play key roles in market regulation and consumer differentiation. They influence consumer choice and perceived product quality, often reflecting origin, trust, and ethnocentric preferences [6–11]. In Hungary, research on the HQF trademark highlights its instrumental role in supporting informed purchasing decisions and strengthening competitive advantage through quality assurance [12,13].

Moreover, certification schemes also support public policy goals by promoting environmental protection and rural development through sustainable production and short food supply chains [4,14–17]. They also help guide consumers toward healthier and more sustainable choices via labelling and functional food schemes [18–21]. As such, they align with EU objectives in public health, sustainability, and food security [19].

International research has extensively explored the economic relevance of certification schemes. These studies support the notion that certification schemes generate economic value [14,22–25], although relatively few analyses have specifically quantified their market advantages [23,26,27]. Consumer surveys significantly enhance our understanding of certification schemes, particularly in the food industry, where these schemes predominantly target end-users. Prior studies often examine the recognition and preference for national or regional certification scheme [28–33].

Positive product differentiation offers numerous benefits, as exemplified by certification schemes in EU Member States (e.g., Austria, France, Czech Republic). Certification schemes provide legitimate state marketing opportunities within the otherwise restrictive framework due to EU food legislation and the principle of free movement of goods [34]. National governments allocate their own resources to support producers by creating voluntary instruments and quality schemes for food chain operators. These include certification schemes, geographical indications, and public awareness campaigns [35–39]. Research highlights that such certification systems strengthen local economies by promoting traditional practices and enhancing product differentiation in competitive markets [39].

One of the most successful examples is Austria's AMA-Gütesiegel or AMA-Quality Seal, which is widely recognized and sought after by Austrian consumers who prioritise high-quality agricultural products and foodstuffs. This label guarantees compliance with strict quality standards, transparency in production processes, and the use of primarily Austrian-sourced raw materials [14]. Consumer awareness of AMA-Gütesiegel is remarkably high, with representative surveys indicating that nearly all Austrian citizens recognize the label and associate it with superior quality and food safety [40]. The certification scheme has played a pivotal role in building consumer trust, significantly influencing purchasing behaviour and preferences for domestically produced food products [35]. Since its establishment in 1994, the AMA has continuously expanded, reinforcing its position in the Austrian food sector [41]. Beyond consumer trust, AMA has also contributed to sustainability and rural development by supporting local producers and promoting environmentally responsible production practices. Its success serves as a model for efficient national-level certification systems within the European Union [36].

Similarly, France's Label Rouge certification highlights the superiority of specific agricultural products and has become a benchmark for excellence within the European Union. In the Czech Republic, the KLASA label exemplifies how governments leverage certification schemes to encourage voluntary adoption of quality systems by food producers, thereby enhancing consumer trust and market positioning [42,43].

As in other Member States, Hungarian literature has also examined consumer perceptions of certification schemes, particularly those that existed at the time, such as the Excellent Hungarian Food (EHF)

(abbreviated in Hungarian: KMÉ), Traditions-Tastes-Regions Trademark (TTR) (Hungarian abbreviation: HÍR), Hungarian Product Trademark, and other national or regional certification schemes [2,44–52]. Earlier Hungarian studies highlighted that the oversaturation of certification schemes in the market has created a confusing landscape for consumers, making it difficult for them to navigate between certification marks effectively [2,53].

Due to EU competition rules, the Excellent Hungarian Food (KMÉ) trademark could not receive state or community support for its continuation and could not become an EU-registered national quality system due to its national colour logo and the word “Hungarian” [34]. However, the abbreviation KMÉ was already widely recognized by consumers. This familiarity suggested that by retaining the KMÉ name, the new KMÉ trademark could benefit from pre-existing consumer recognition, despite graphic redesigns and its renaming as High-Quality Food (HQF) (in Hungarian: KMÉ).

The HQF trademark, established in 2018, is an entirely state-owned certification designed to combine food safety, quality control, tradition, and sustainability [13,54]. Compared to EHF the most significant change in the HQF trademark system is the implementation of sustainability criteria to support the transition to bioeconomy-related solutions [55–57], and the exposition of the responsible organization for maintaining the quality system. Under the management of the National Food Chain Safety Office (NFCO), intensive work continues to define category-specific parameters, involving industry experts, public authorities, and scientific organizations. The aim of this regulatory framework is to establish ambitious but attainable product-level standards, guiding the Hungarian food industry toward continuous improvement in quality, safety, and sustainability. The HQF trademark is intended to be widely accessible, ensuring that consumers can choose among multiple certified products in each category. The mere presence of this certification in the market serves as a promotional tool for the initiative.

These national certification schemes align with the concept of consumer ethnocentrism, whereby consumers demonstrate a stronger preference for domestic or locally sourced products [58]. Ethnocentrism significantly influences the formation of trust and the buying behavior in agri-food context, and it is an important factor in shaping consumers' preference for local food products [59].

There have been studies done to investigate the influence of national and sub-national (e.g., state or local) ethnocentrism on consumers' attitudes, perceptions, knowledge, and purchasing decisions for foods of different categories and origins. While some studies observed a positive relationship, others suggested that it did not significantly affect purchasing decisions [58,60,61]. In Slovakia, ethnocentric tendencies strongly affect consumers' choices within their own country, promoting domestic products. In contrast, at the broader EU level, ethnocentrism has a limited impact on food preferences [62]. These findings suggest that both national and sub-national ethnocentrism can partially explain why consumers favor local or domestic foods, although the strength of the effect varies by context.

Although the new HQF trademark incorporates additional consumer-focused attributes, awareness remains limited to a relatively small consumer segment. Based on the consumer segmentation results presented in this study, NFCO will be able to better leverage its communication channels (press contacts, website, social media) and paid advertising campaigns to raise consumer awareness. The study's objective is to identify individuals already interested in the HQF trademark, determine the most effective messaging strategies, and develop communication approaches that will cultivate consumer engagement, ensuring that HQF becomes a sought-after certification even in a market saturated with competing certification systems. These results may be equally important for the modernization and reformulation of other legacy certification schemes, as well as for the development of new quality certification schemes.

The study's novelty lies in the segmentation of consumers in the

context of the modernization and image transition involving a nearly three-decade-old quality certification scheme, as well as providing research-based insights to optimized communication activities to enhance awareness and fostering a positive perception of the new certification scheme.

## 2. Materials and methods

### 2.1. Background of the surveys

This study was conducted as part of the NFCSO's food chain surveillance research programme [63,64], which has been monitoring Hungarian consumers' knowledge, risk perception, trust, and expectations regarding food safety and surveillance institutions since 2012. The annual surveys incorporate issues of strategic importance for NFCSO, such as major food safety crises or legislative changes affecting consumers. The HQF trademark is also a strategic issue with significant social and economic dimensions, warranting further investigation within this research programme.

### 2.2. Sampling and data management

The research methodology was a questionnaire-based consumer survey conducted through face-to-face interviews. The total number of the respondents is 1001 consumers. The interviews, each lasting approximately 18–20 min, were conducted between 18 June and 29 July 2024 in the following nine Hungarian cities: Budapest, Szolnok, Kecskemét, Sárospatak, Füzesabony, Veszprém, Győr, Siófok, and Tatabánya. Extensive fieldwork was carried out during the data-collection period, with the research team making multiple visits to each location, particularly busy transport hubs, to ensure broad participation. Some of the analyses include research data spanning the past four years (since 2020). These previous datasets were collected using the same methodology as the 2024 survey, ensuring their comparability and scientific validity.

Participants were selected randomly; however, a quota-based sampling method was applied to ensure representativeness in terms of gender, age group, and geographical region (NUTS-2 regions), based on the latest available census data from the Hungarian Central Statistical Office (KSH) (Table 1).

The quantitative survey was carried out in consultation with the National Food Chain Safety Office's experts. Appropriate protocols for protecting the rights and privacy of all participants were utilized during the execution of the research. Before the interviews, the participants were informed about the study's purpose, topic, and the handling of their data, which was collected anonymously. All respondents provided informed consent before participating in the survey. Participation was

**Table 1**  
Socio-demographic characterization of participants for the 2024 survey data.

		Participants	Population <sup>a</sup>
		n (%)	n (%)
Gender	Woman	52.34	51.97
	Man	47.65	48.03
Age group (years old)	18–29	16.28	16.22
	30–39	14.18	15.51
	40–59	37.66	35.86
	60 or over	31.87	32.40
Region of residence	Central Hungary	30.56	31.42
	Central Transdanubia	10.98	11.00
	Western Transdanubia	10.19	10.23
	Southern Transdanubia	8.89	8.89
	Northern Hungary	11.28	11.33
	Northern Great Plain	14.79	14.63
	Southern Great Plain	13.28	12.50

<sup>a</sup> Ratio in the population according to the latest census at the time of the survey [63].

voluntary, and respondents were able to withdraw from the study at any time. Upon agreeing to participate, information on their age, gender, and geographic location was recorded to ensure compliance with the sampling quotas. While the questionnaire was designed to be self-administered, interviewers provided assistance when necessary.

The survey explored participants' awareness of certification schemes (both existing and non-existing), key preferences in food selection, eating habits, and other food safety and quality-related concerns. Responses were collected using both closed-ended and open-ended questions, as well as five-point Likert scale items (1 = not important at all, 5 = extremely important). The final section of the questionnaire included personal background questions, such as hobbies and additional demographic details, including income level, education level, and field of education. The socio-demographic distribution of the sample used in the analysis is summarized in Table 2.

### 2.3. Analysis

The data recording and error filtering processes were performed using Microsoft Excel, while statistical analyses were conducted in IBM SPSS Statistics (Version 27, SPSS Inc., Chicago, IL). Descriptive statistical methods, including mean and standard deviation calculations, were first employed to provide an initial understanding of the dataset's distribution. However, given the complexity of the research problem – specifically, identifying HQF trademark-aware consumers and potential trademark-preferred segments – multivariate statistical methods were required for a more in-depth analysis.

Given the dataset's size (242 variables), redundancy was anticipated. To enhance the efficiency of the segmentation process, Principal Component Analysis (PCA) with varimax rotation was applied as a dimensionality reduction technique before cluster analysis. Prior to PCA, Pearson correlation analysis was used to eliminate variables with no significant correlations, ensuring that only interrelated variables were retained [65]. Additionally, dummy variables were created for categorical variables (e.g., binary “Yes/No” responses) to facilitate statistical analysis [66].

Following the exclusion of non-correlated variables, a final set of 11 variables was identified as both thematically relevant and statistically suitable for deriving new latent structures through PCA. To validate the PCA results, the KMO measure of sampling adequacy and Bartlett's test of sphericity were conducted.

To confirm the suitability of the dataset for factor analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were conducted. The KMO value was considered acceptable above 0.60, good above 0.70, and excellent above 0.80 [67]. Bartlett's test was required to

**Table 2**  
Socio-demographic composition of the study sample by education level.

Socio-demographic categories	Participants	
	n (%)	
Type of residence	Village	16.12
	City	62.75
	Capital	21.12
Education	Primary education	9.07
	Secondary education	32.23
	Higher education	58.69
“Natural science” specialization among those with higher education	Yes	24.28
	No	75.71
Connection to work to food production and food trade	Yes	18.19
	No	81.81
Level of income	Very low	2.36
	Low	15.03
	Average	66.17
	Above average	14.29
	Outstanding	2.14

be statistically significant ( $p < 0.05$ ) to justify PCA [68]. Additionally, communalities had to exceed 0.40 to ensure adequate variable representation in the factor structure.

The internal consistency of the extracted components was evaluated using Cronbach's alpha [69]. According to conventional thresholds, values above 0.70 were considered acceptable, while those below 0.60 indicated weak reliability [70]. Given that Cronbach's alpha is sensitive to the number of scale items, the Spearman coefficient was also considered for factors composed of only two items [71].

Following PCA, hierarchical clustering (Ward's method) was applied to determine the optimal number of clusters. The final cluster solution was selected based on dendrogram inspection and ANOVA tests, with significance levels set at  $p < 0.01$ . Given the large sample size ( $N = 1001$ ), hierarchical clustering alone was not efficient for ensuring statistically robust clusters [72]. Therefore, K-means clustering was applied as a secondary step, using Euclidean distance, which is well-suited for continuous variables [73].

The "elbow method" is a widely used technique for determining the optimal number of clusters in K-Means clustering. It evaluates the total within-cluster sum of squares (SSE) as the number of clusters increases, identifying the point at which additional clusters no longer yield a substantial reduction in SSE [74]. The elbow in the plotted curve represents the optimal number of clusters, as adding further clusters beyond this point results in diminishing returns in variance reduction. The elbow method is particularly effective when dealing with continuous variables, as it provides an intuitive and visual approach to assessing the appropriate number of clusters. However, one of its limitations is its reliance on subjective interpretation – while the "elbow point" is often distinct, ambiguity can arise in some cases regarding the precise cut-off point [75]. Nevertheless, in this study, the method provided a robust confirmation of the six-cluster solution, reinforcing its suitability for segmentation.

To assess the distinctiveness of the resulting clusters, ANOVA was used to test for statistically significant differences between groups ( $p < 0.001$ ). Additionally, Pearson's Chi-Square tests were conducted to examine socio-demographic distributions across clusters, where  $p < 0.05$  was required for statistical significance. However, given that  $p$ -values close to 0.05 may still indicate meaningful trends in social science research, these variables were retained for further analysis [76].

Throughout all statistical analyses, a  $p$ -value of  $< 0.01$  was used as the primary threshold for determining significance. This higher standard was chosen to reduce the risk of Type I error given the large sample size ( $n = 1001$ ) and the multiple comparisons performed during the clustering procedure.

By integrating hierarchical clustering, the elbow method, and ANOVA validation, the analysis ensured a robust segmentation approach. The combined methodology allowed for the identification of distinct consumer clusters, providing valuable insights into HQF trademark awareness and consumer segmentation patterns.

### 3. Results

#### 3.1. Socio-demographic characterization of participants

A total of 1001 participants completed the face-to-face questionnaire survey. Tables 1 and 2 present the socio-demographic characteristics of the respondents. In terms of gender distribution, 52.34 % of respondents were women, while 47.65 % were men, closely reflecting the demographic composition of the general Hungarian population. The age distribution was similarly well-balanced: 16.28 % of respondents were aged 18–29 years, 14.18 % were 30–39 years old, 37.66 % were 40–59 years old, and 31.87 % were 60 years or older. Participants were drawn from all seven statistical regions of Hungary, with the highest representation from Central Hungary (30.56 %), followed by the Northern Great Plain (14.79 %) and the Southern Great Plain (13.28 %), while the remaining regions exhibited proportions similar to national

demographics. Regarding place of residence, the majority of respondents lived in urban areas (62.75 %), while 16.12 % resided in villages and 21.12 % in the capital. The socio-demographic composition of the sample deviates only marginally (within 1.2 percentage points) from national statistics, indicating a strong alignment with the general population [77] in terms of the above-described socio-demographic categories. Educational attainment varied considerably: 58.69 % of participants held a higher education degree, 32.23 % had completed secondary education, and 9.07 % had attained only primary education. Among those with higher education qualifications, 24.28 % specialised in the natural sciences. In terms of employment, 18.19 % of participants worked in food production or trade, whereas the majority (81.81 %) had no direct connection to the food industry. Finally, respondents were categorised according to income level: 66.17 % reported an average income, 15.03 % a low income, and 2.36 % classified their income as very low. Conversely, 14.29 % reported an above-average income, while 2.14 % described their income as outstanding.

#### 3.2. Time-series analysis of HQF and EHF trademark recognition

The analysis of the time-series data reveals a complex dynamic between the HQF trademark and its predecessor, the EHF trademark. While the HQF trademark was introduced as a modernized, consumer-oriented improvement of EHF, its recognition among consumers has not followed a clear or consistent upward trend. The findings indicate that, although HQF recognition has fluctuated over time, there has been a gradual increase in consumer awareness. In 2020, only 30.35 % of respondents recognized HQF, whereas by early 2024, this figure rose to 49.43 %. The anomaly observed in the control question – namely, that there is no consistent increase in whether consumers report having heard of the HQF mark – suggests that a clear understanding of this relatively new certification scheme has yet to be established in consumers' minds. However, despite these positive trends, the older EHF trademark remains dominant in consumer recognition, with over 90 % of respondents recognising it in 2020. Although its recognition rate has declined slightly over the years, falling to 87.46 % in early 2024, the trademark remains deeply embedded in consumer perception (Fig. 1). Research on brand equity and consumer habit formation suggests that long-established certification schemes create strong mental associations, making it difficult for newer brands or certifications to replace them, even when they offer superior attributes [78–80]. One particularly notable finding is that an increasing segment of consumers now recognises HQF alongside EHF rather than viewing it as a replacement for the older certification. This suggests that, while the transition is slow, HQF has the potential to establish itself more firmly in the future. Studies on brand transition strategies highlight the importance of consistent branding, targeted messaging, and strategic partnerships in ensuring that consumers associate the new certification scheme with credibility and added value [81–83]. Given this context, the main part of this study will apply cluster analysis to examine which consumer segments value HQF, who the potential future HQF adopters are, and what communication strategies are necessary to accelerate its acceptance. Research suggests that successful brand repositioning and consumer adoption depend on effectively identifying and targeting key consumer groups through personalised marketing and engagement strategies [84,85]. By understanding the characteristics and preferences of HQF-aware consumers, we can identify the most effective pathways for increasing trademark recognition and establishing HQF as Hungary's leading quality food certification.

#### 3.3. Principal component analysis of consumer attitudes towards food choices

The KMO value of 0.654 indicates that the data are suitable for factor analysis [67]. Bartlett's test ( $\chi^2 = 3176.852$ ,  $p < 0.001$ ) confirms that the correlations among variables are sufficiently strong to justify the

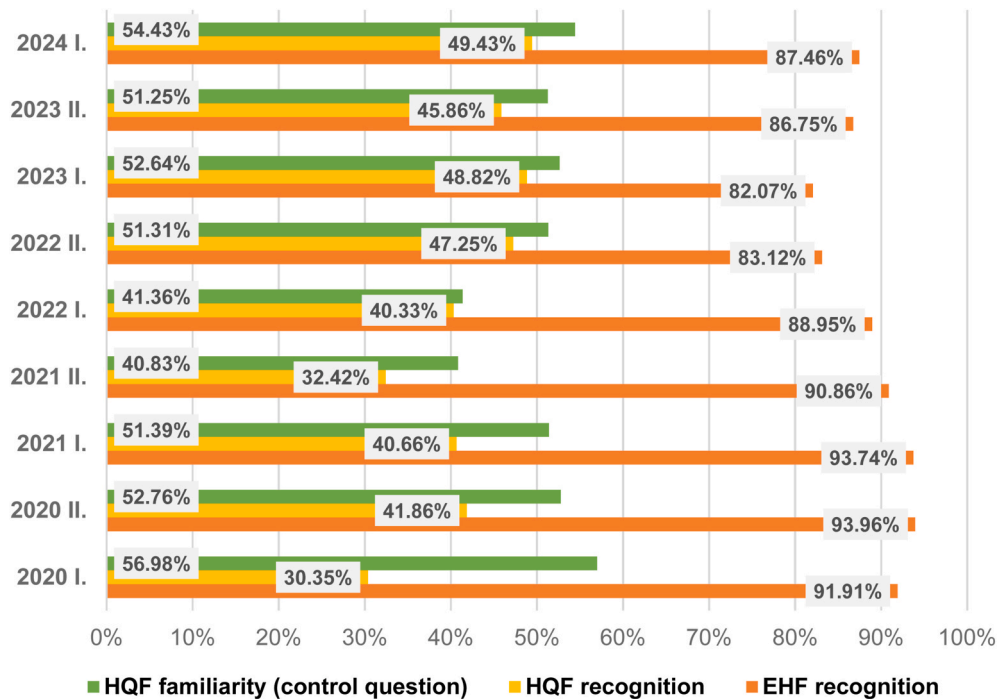


Fig. 1. Recognition and awareness of EHF and HQF trademarks over time.

application of PCA. Furthermore, all communalities exceeded the recommended threshold of 0.4, reinforcing the robustness and reliability of the factor structure [68]. The internal consistency of the various constructs was assessed using Cronbach’s alpha coefficients [69]. Due to the low internal consistency of Factor 5 (Cronbach’s  $\alpha < 0.6$ ), an additional validation test was conducted, as recommended in the literature, to further assess its reliability [71]. However, since the factor loadings were high (both above 0.80), the lower alpha value is likely attributed to the limited number of items rather than poor internal consistency. Given that Cronbach’s alpha is sensitive to scale length, alternative reliability measures, such as the Spearman coefficient, may be more appropriate in cases where only two items are present [71]. Future research could address this issue by incorporating additional items to enhance construct reliability.

Following the validation procedure, a five-factor solution was selected, as illustrated in Fig. 2, where the first five components accounted for 79.08 % of the total variance.

The final structure ensured that each retained factor had a clear theoretical interpretation, with factor loadings exceeding 0.50 and minimal cross-loadings [86]. The five extracted factors reflect distinct patterns in dietary preferences, consumer food choices, recognition of the existing HQF trademark, recognition and trust in the non-existent EHF trademark, as well as attitudes towards local products (Table 3).

The first factor, “Health-conscious eating”, reflects a consumer orientation towards personal health, diet, and nutrition-conscious food choices. Individuals scoring highly on this factor pay close attention to their diet, actively seek foods suitable for healthy diet, and prioritise well-being through their food consumption. Their food choices are

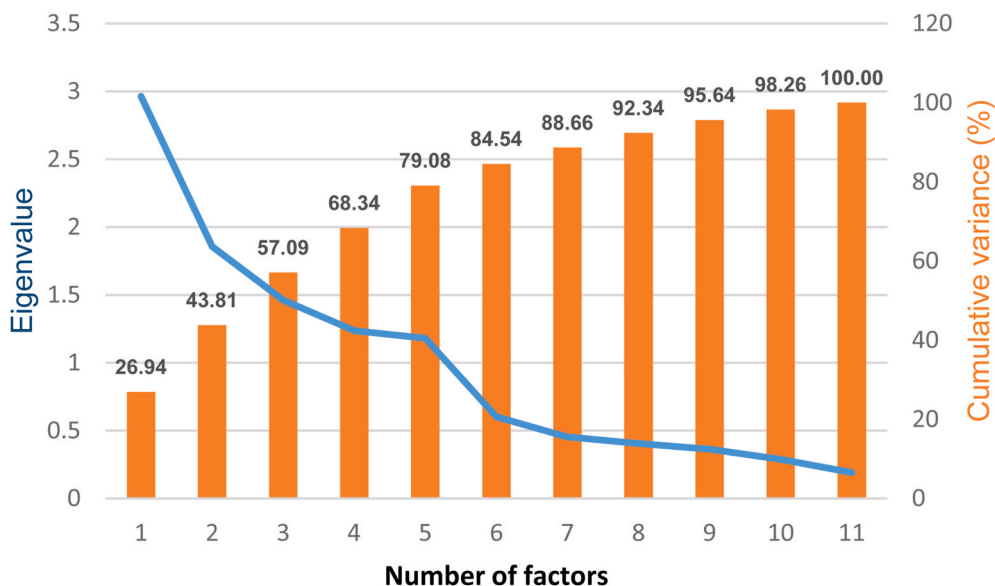


Fig. 2. Scree plot and cumulative variance explained (PCA).

**Table 3**  
Rotated component matrix with factor loadings (based on Varimax rotation).

Validation	Cronbach's $\alpha$	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
		0.855	0.888	0.726	0.723	0.508 <sup>b</sup>
Intuitively assigned factor names		Health-conscious eating	Preference for local food products	Conscious grocery and brand choice	HQF trademark awareness	Trust in the EHF trademark
Items		Factor loadings <sup>a</sup>				
HQF/recognize/yes (Dummy)		0.015	0.080	0.039	<b>0.878</b>	0.003
EHF/recognize/yes (Dummy)		0.032	-0.052	0.083	0.111	<b>0.840</b>
EHF/credible/yes (Dummy)		0.059	0.200	0.032	-0.033	<b>0.805</b>
HQF/have you heard/yes (Dummy)		0.014	0.029	0.029	<b>0.882</b>	0.077
I choose my shop consciously: there are reliable and unreliable shops		0.065	0.108	<b>0.881</b>	0.059	0.058
I choose brands and manufacturers consciously when it comes to food		0.165	0.134	<b>0.854</b>	0.012	0.065
Hungarian products are safer than imported products		0.066	<b>0.919</b>	0.185	0.064	0.071
Hungarian products are of better quality than imports		0.085	<b>0.935</b>	0.077	0.058	0.079
I pay attention to my health		<b>0.866</b>	0.121	0.085	0.002	0.007
I care about healthy eating		<b>0.866</b>	0.048	0.072	0.008	0.070
I take care of my diet		<b>0.893</b>	0.002	0.106	0.027	0.036

<sup>a</sup> Items associated with the same factor, as determined by their factor loadings, are highlighted with a grey background to indicate their conceptual grouping.

<sup>b</sup> Factor 5 has lower internal consistency; further validation was performed.

primarily influenced by nutritional benefits, and they are likely to be receptive to health-focused labels and certifications. The second extracted factor, "Preference for local food products", captures consumers' preference for domestic products over imported goods, with an emphasis on safety, quality, and trust in Hungarian food production. Consumers with high scores on this factor perceive local products as safer and of higher quality, often associating them with trust and reliability. Individuals for whom this factor is dominant are more inclined to choose domestic products over foreign alternatives and are likely to favor food certifications that emphasize local origin. The factor "Conscious grocery and brand choice" characterises consumers who deliberately select food brands and retailers based on trust and credibility. Individuals associated with this factor consider brand and store reliability when making purchases. They value transparency, reputation, and consistency in food quality, and their purchasing behaviour is strongly influenced by trust in established brands and retail locations. The key factor for this analysis captures consumer awareness and recognition of the HQF trademark. Those scoring highly on this factor are familiar with the HQF certification and can identify its logo. These consumers have already been exposed to the trademark and may be more receptive to marketing campaigns promoting its benefits. The final factor reflects consumer trust and recognition of the former EHF trademark, despite its official discontinuation in 2019. Consumers with high scores on this factor still associate EHF with quality and credibility, suggesting that its image remains strong in their perception. This factor highlights the potential challenge of shifting consumer trust from EHF to the newer HQF trademark. The identified factors provide valuable insight into distinct consumer profiles, each reflecting different attitudes towards food choices. These factors will be applied in the next stage of analysis – consumer segmentation – to classify individuals based on their dominant food-related preferences and behaviours.

### 3.4. Consumer segmentation process

#### 3.4.1. Validation of K-means clustering

To further validate the cluster structure, the "elbow method" was employed, which evaluates the within-cluster sum of squared errors (SSE) across different numbers of clusters. The elbow point represents the optimal number of clusters where additional clusters no longer result in a significant SSE reduction [74]. This method ensures that the chosen cluster solution balances variance reduction and interpretability while avoiding excessive fragmentation [87]. By implementing the elbow method, it was confirmed that the six-cluster solution was indeed the most suitable choice, aligning with the hierarchical clustering results. The SSE curve (Fig. 3) clearly demonstrates a sharp decline up to six clusters, followed by a noticeable flattening, indicating that additional clusters do not significantly improve intra-cluster homogeneity. However, an unusual sharp increase in SSE is observed after the eighth cluster, which contradicts the expected stabilisation of variance reduction. This phenomenon may be attributed to the over-partitioning effect in K-Means clustering, where an excessive number of clusters forces data points into smaller, less meaningful groups, disrupting the balance of variance minimisation [88]. Such abrupt increases can also arise due to poor cluster centroid initialisation or instability in cluster assignment, particularly when the dataset contains high-dimensional or overlapping data structures [89]. These issues are well-documented in clustering literature, as excessive segmentation can lead to increased noise sensitivity and distort the natural structure of the data [90]. This convergence between hierarchical clustering and K-Means clustering strengthens the validity of the segmentation process, reducing the likelihood of over-fitting or misclassification [87]. The identified six-cluster solution provides an optimal trade-off between data cohesion and model interpretability, minimising variance without over-segmenting the dataset.

To further assess the robustness of the identified clusters, an Analysis

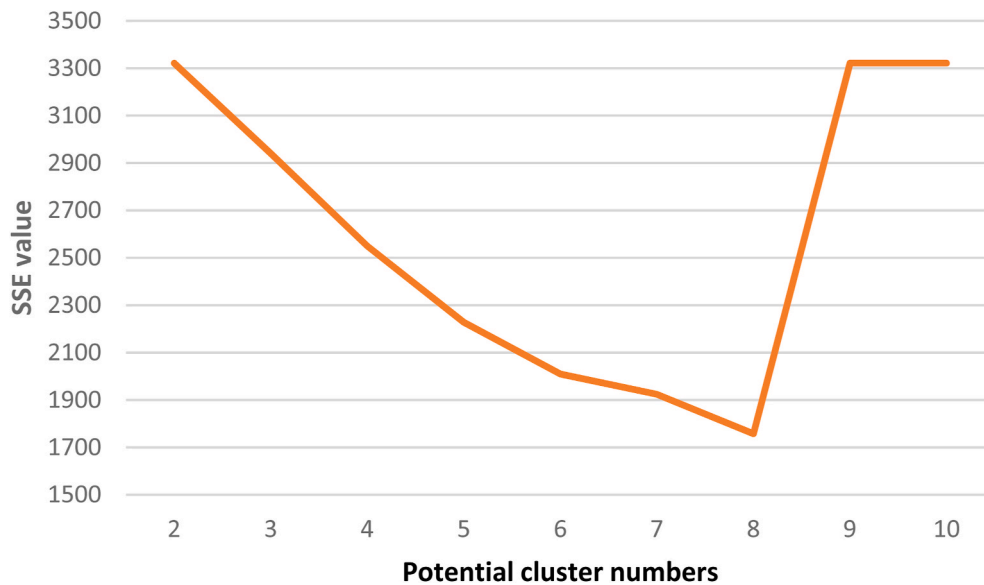


Fig. 3. Elbow method for determining the optimal number of clusters.

of Variance (ANOVA) was conducted. ANOVA is a statistical technique used to determine whether significant differences exist between groups, making it particularly valuable in cluster validation [68]. By comparing mean values across the six clusters, the test revealed statistically significant differences ( $p < 0.001$ ), confirming that each cluster represents a distinct segment with meaningful differentiation. The significant ANOVA results underscore the reliability of the clustering solution by ensuring that within-group variance is minimised, while between-group variance is maximised. This distinction is crucial in segmentation studies, as it validates that each group possesses unique characteristics rather than arbitrary or overlapping classifications [91]. Furthermore, the number of respondents per cluster ranged from 63 to 208, ensuring adequate sample sizes for meaningful interpretation. The integration of hierarchical clustering, the elbow method, and ANOVA collectively ensures a robust, well-validated segmentation model. Hierarchical

clustering provided an initial estimate of cluster structure, the elbow Method confirmed the optimal cluster number, and ANOVA statistically validated the distinctions among clusters. This multi-step approach reduces the risk of misclassification and strengthens the overall segmentation framework. As a result, 806 respondents were successfully assigned to one of the six clusters, representing a segmentation rate considered statistically reliable. Prior research suggests that sample sizes exceeding 500 respondents yield stable and generalisable cluster solutions, reinforcing the credibility of the findings [91].

3.4.2. Profiling consumer groups

The “final cluster centres table” was utilized to identify the dominant factors within each of the six clusters, providing a comprehensive understanding of the key characteristics defining each segment. Additionally, a heatmap was created based on the final cluster centres table

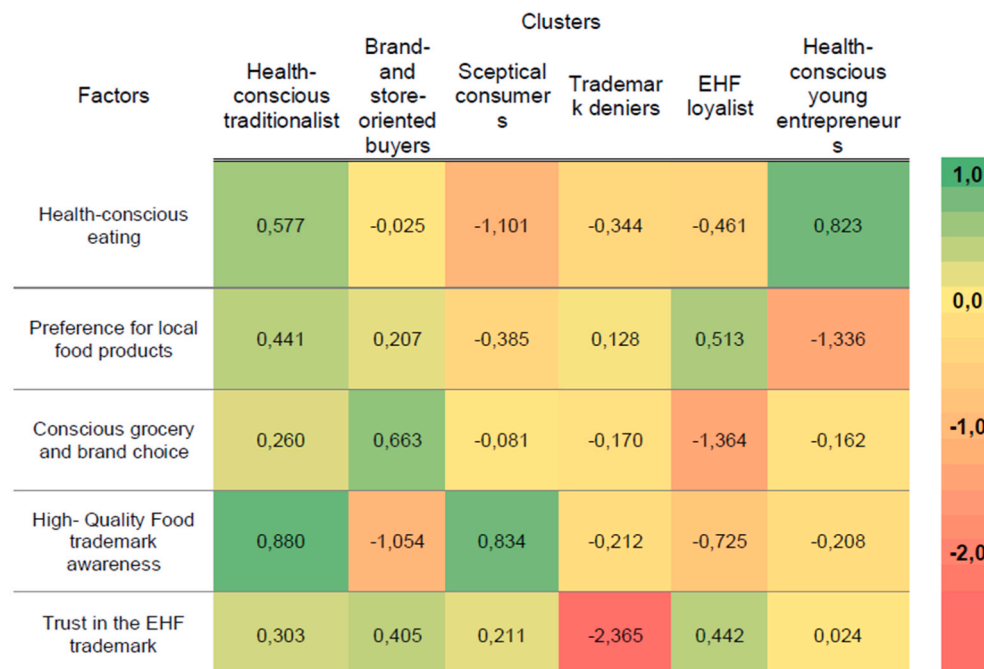


Fig. 4. Heatmap of factor dominance across clusters.

to visually illustrate which factors are most prominent in each cluster (Fig. 4). Heatmaps are an effective tool for identifying patterns in multidimensional data, allowing for the quick detection of dominant attributes within groups [92].

Additionally, cross-tabulations based on socio-demographic parameters were conducted to assess the distribution of clusters across various variables. The results of the Pearson chi-square tests indicated statistically significant differences across residence ( $\chi^2 = 19.785$ ,  $p = 0.031$ ), economic status ( $\chi^2 = 62.058$ ,  $p < 0.001$ ), special dietary needs ( $\chi^2 = 21.319$ ,  $p < 0.001$ ), and age group ( $\chi^2 = 41.982$ ,  $p < 0.001$ ). For gender ( $\chi^2 = 15.943$ ,  $p = 0.07$ ) and the presence of children under 15 years ( $\chi^2 = 10.894$ ,  $p = 0.054$ ), the differences between clusters did not reach conventional significance thresholds ( $p < 0.05$ ). While not statistically significant at the 5 % level, the observed distribution patterns suggest potential associations, which may warrant further investigation in future studies [93]. Notably, income did not emerge as a significant determinant in this case. The distinct consumer profiles, derived from the final cluster centres table and cross-tabulation analyses, are summarised in Table 4.

The largest consumer group, the “Health-conscious traditionalists” (25.8 %) consists primarily of individuals aged 40 and above, with a slight overrepresentation of women. They predominantly reside in urban areas, with a notable proportion being pensioners or active workers. Their purchasing decisions are strongly influenced by health-conscious eating habits, and they demonstrate the highest awareness of the HQF trademark. Additionally, they exhibit a relatively high preference for locally sourced products while maintaining a moderate level of trust in the EHF trademark. The “Brand- and store-oriented buyers” (22.5 %) form the second-largest cluster, displaying a balanced age distribution, with a slight concentration in the 40–59 age range. Gender representation is fairly equal, though women are slightly more dominant. Most members of this group reside in cities and are actively employed. This cluster is characterised by moderate interest in locally sourced products, strong brand and store loyalty, and a pronounced preference for the EHF trademark. However, their awareness of the HQF trademark remains notably low. The “Sceptical consumers” (17.1 %) are primarily found in the 40–59 age group and are slightly male-dominated. This segment contains the highest proportion of rural residents, though members are also distributed across suburban and urban areas. The majority are active workers, and this cluster exhibits the highest proportion of households with children under 15. While they display high awareness of the HQF trademark, their preference for local products is relatively low, and their health-conscious eating behaviours are only moderate. The “Trademark deniers” (7.8 %) constitute the youngest consumer segment, with a significant share belonging to the 18–29 age group. This group is typically childless, with a balanced gender distribution, and most members reside in urban areas. Students and active workers make up a large proportion of this cluster. They exhibit low awareness of the HQF trademark and a moderate preference for local products. Importantly, they display little interest in either the HQF or EHF trademarks, indicating a general scepticism towards certification marks. The “EHF loyalists” (11.8 %) are largely composed of individuals aged 40 and above, with an almost equal distribution of men and women. They have the highest proportion of capital city residents and are predominantly active workers or pensioners. This group strongly prefers local products and maintains a high level of trust in the EHF trademark. However, they show little interest in health-conscious eating and often lack awareness of where to buy products or which brands to purchase. Finally, the “Health-conscious young entrepreneurs” (15.0 %) represent a younger profile, with a significant proportion between the ages of 18 and 39. This cluster is slightly male-dominated and has a strong presence in the capital city. Notably, this group contains the highest share of self-employed individuals and a considerable number of consumers following a special diet. They prioritise health-conscious eating but display low trust in the EHF trademark and remain largely unfamiliar with the HQF trademark. Moreover, they express scepticism

**Table 4**

Consumer profiling based on food purchasing behaviour and trademark awareness.

Name of the cluster	Demographics	Attributes
Health-conscious traditionalist (25.8 %)	<ul style="list-style-type: none"> <li>- Predominantly aged 40+ (74 %)</li> <li>- Skewed toward women (62 %)</li> <li>- Mostly city dwellers (65 %)</li> <li>- Pensioners (30.5 %) and active workers (53.5 %)</li> <li>- 34 % follow a special diet</li> </ul>	<ul style="list-style-type: none"> <li>- Strong focus on health-conscious eating</li> <li>- Highest awareness of HQF</li> <li>- Medium level of confidence in EHF trademark</li> <li>- Relatively high preference of local food products</li> </ul>
Brand-and store-oriented buyers (22.5 %)	<ul style="list-style-type: none"> <li>- Balanced age distribution with a skew toward 40–59 (39 %)</li> <li>- Balanced gender ratio (56 % women, 44 % men) with a slight female surplus</li> <li>- Predominantly city residents (67 %)</li> <li>- Mostly active workers (63 %)</li> <li>- More than a quarter follow a special diet (27 %)</li> </ul>	<ul style="list-style-type: none"> <li>- Moderate preference for locally sourced products</li> <li>- Very low awareness of HQF trademark</li> <li>- Loyal to EHF trademark</li> </ul>
Sceptical consumers (17.1 %)	<ul style="list-style-type: none"> <li>- Concentrated in 40–59 age group (46 %)</li> <li>- Gender balanced (45 % women, 55 % men), but slightly male dominated</li> <li>- Mixed residence patterns (villages, cities, capital)</li> <li>- Majority are active workers (68 %)</li> <li>- Highest proportion living in rural villages (23 %)</li> <li>- Highest proportion of households with children under 15 (29 %)</li> </ul>	<ul style="list-style-type: none"> <li>- Moderate health-conscious eating</li> <li>- Low preference for local products</li> <li>- High awareness of HQF</li> <li>- Medium level of EHF trademark credibility</li> </ul>
Trademark deniers (7.8 %)	<ul style="list-style-type: none"> <li>- Mixed aged group but slightly younger than the total sample, mostly 18–29 (38 %)</li> <li>- Typically childless households (no children under 15)</li> <li>- Balanced gender distribution (48 % women, 52 % men)</li> <li>- Primarily city residents (67 %)</li> <li>- Predominantly students (25 %) and active workers (37 %)</li> </ul>	<ul style="list-style-type: none"> <li>- Low focus on health-conscious eating</li> <li>- Low HQF awareness</li> <li>- Medium preference for local products</li> <li>- Indifferent to both HQF and EHF trademarks</li> </ul>
EHF loyalist (11.8 %)	<ul style="list-style-type: none"> <li>- Majority aged 40+ (68 %)</li> <li>- Balanced gender (51 % women, 49 % men)</li> <li>- Highest proportion of residents in the capital (23 %)</li> <li>- Mix of active workers (56 %) and pensioners (20 %)</li> <li>- Only 15 % follow a special diet</li> </ul>	<ul style="list-style-type: none"> <li>- Strong preference for local products</li> <li>- High trust in EHF trademark</li> <li>- No significant importance placed on health-conscious eating</li> <li>- Lack of awareness of where to buy and which brands to purchase</li> </ul>
Health-conscious young entrepreneurs (15.0 %)	<ul style="list-style-type: none"> <li>- Younger profile, 41 % aged 18–39</li> <li>- Slightly male-dominated (56 %)</li> <li>- Higher representation in the capital city (32 %)</li> </ul>	<ul style="list-style-type: none"> <li>- High focus on health-conscious eating</li> <li>- Low trust in EHF</li> <li>- Unfamiliar with the HQF</li> </ul>

(continued on next page)

Table 4 (continued)

Name of the cluster	Demographics	Attributes
	- Highest share of self-employed individuals (13.3 %)	- No confidence in Hungarian products
	- 29 % follow a special diet	

towards Hungarian products. The results highlight key differences in consumer attitudes towards food certification, indicating that while some groups, such as the “Health-conscious traditionalists”, are already highly engaged with the HQF trademark, others remain indifferent or unaware of its benefits. Understanding these profiles enables a more targeted approach to increasing HQF recognition, particularly among sceptical consumers and younger segments who currently lack trust in this food certification system.

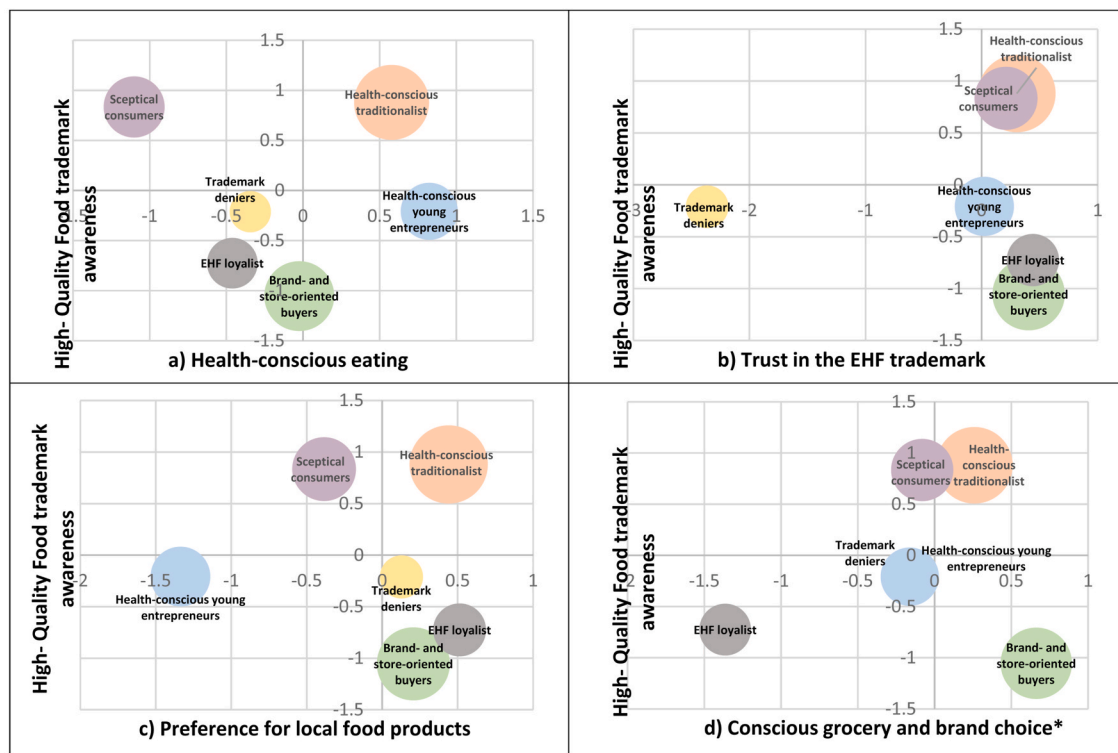
3.5. Strategic communication directions by consumer clusters

Based on the cluster analysis, it is evident that different consumer segments require tailored communication strategies to effectively increase awareness, credibility, and trust in the HQF (High-Quality Food) trademark. To maximise the reach and impact of HQF, strategic messaging should be aligned with the unique preferences, values, and behaviours of each segment. The segmentation map serves as a foundational analytical tool, visually representing the dominant latent factors characterising each consumer cluster, while simultaneously assessing their association with HQF awareness. By utilising a bubble chart, the map effectively illustrates the relative positioning of different clusters within a two-dimensional space, enabling the identification of key patterns in consumer attitudes. This approach aligns with previous studies that emphasize the importance of segmentation mapping using graphical elements to enhance the understanding of customer behaviour

and brand perception [94–96]. The primary function of this segmentation map (Fig. 5) is to identify which latent consumer attributes – such as health-consciousness, local food preference, or trust in food certifications – are most pronounced within each cluster. Simultaneously, it provides insight into the level of HQF awareness across these segments. This dual-perspective approach is crucial, as a comprehensive analysis of the segmentation map facilitates the development of tailored communication strategies and tools. These, in turn, can enhance the visibility of the HQF brand across all consumer segments while simultaneously strengthening its perceived credibility.

4. Discussion

The findings of this study provide critical insights into consumer segmentation regarding the HQF trademark and highlight strategic approaches to enhance its recognition and acceptance. The cluster analysis identified six distinct consumer segments, each exhibiting unique preferences in food choices, attitudes, and levels of recognition and trust in the examined trademarks, necessitating tailored communication strategies. One of the most notable insights is that while “Health-conscious traditionalists” and “EHF loyalists” already display significant engagement with food trademarks, other groups, such as “Trademark deniers” and “Sceptical consumers”, remain indifferent towards certification systems. These findings align with previous research on the role of consumer trust in food certification adoption [14,22]. The strong recognition and credibility of the previous EHF trademark suggest that HQF requires clearer differentiation while maintaining continuity – a strategy successfully employed in Austria’s AMA-Gütesiegel, where incremental rebranding ensured consumer trust retention [97]. Another key finding is the emergence of younger, urban consumers, particularly the “Health-conscious young entrepreneurs”, who are highly interested in premium, sustainable food products but currently exhibit low awareness of HQF. This reflects broader trends in European food



\*The “Trademark deniers” cluster is not depicted in the figure because the “Health-conscious young entrepreneurs” cluster comprises a larger proportion of the sample. As a result, the smaller cluster’s representation is obscured when visualized using bubbles.

Fig. 5. Segmentation map of consumer clusters based on High-Quality Food trademark awareness and examined attitude factors.

markets, where young professionals actively seek quality-oriented and eco-conscious options [97,98]. Given their engagement with digital platforms, targeted strategies using business networks, premium food subscription services, and eco-conscious marketing could effectively increase HQF's reach among this demographic. The "Brand- and store-oriented buyers" demonstrate loyalty towards specific retailers rather than certification marks, suggesting that collaborations with supermarket chains would be an effective branding approach. Research on retailer-driven certification schemes, such as the UK's Red Tractor programme, highlights how integrating food certification schemes into well-established shopping habits fosters consumer trust [99]. Additionally, "Sceptical consumers", who express concerns regarding Hungarian food safety, require transparency-driven educational campaigns to reinforce trust, – similar to the EU's Organic Label System – which successfully leveraged scientific validation to gain credibility [100]. Meanwhile, "Trademark deniers", who generally disregard food certifications, present a challenge but also an opportunity for youth-oriented digital engagement. Past research on ethical consumption [101] indicates that gamification strategies and influencer-led branding – such as those used by the Fair-Trade movement – can effectively reposition certification schemes as aspirational lifestyle choices rather than rigid regulatory marks. Gamification-based loyalty programmes and social media influencer campaigns could be leveraged to reshape their perception of HQF. Finally, "EHF loyalists", who trust the previous certification but remain hesitant towards HQF, require reassurance that the new system is a continuation rather than a complete replacement. A similar approach was successfully implemented in France's Label Rouge, where marketing efforts emphasised continuity and product quality differentiation to maintain consumer trust [40]. Traditional media campaigns, coupled with direct supermarket engagement, could effectively communicate HQF's credibility to this segment. Overall, this study underscores the need for a multi-channel, consumer-specific approach to HQF branding, rather than a universal marketing strategy. International certification programmes, such as Austria's AMA-Gütesiegel, France's Label Rouge, and the UK's Red Tractor Scheme, offer strong precedents for Hungary's HQF implementation [36,97]. By aligning communication efforts with distinct consumer preferences, HQF can gradually enhance trust, increase adoption, and strengthen its market position as a leading food certification scheme in Hungary.

## 5. Market implications

Building on the findings of the segmentation map (Fig. 5) and consumer profiling (Table 4), these analytical insights are translated into a practical communication strategy (Table 5), ensuring that the proposed methods align precisely with consumer expectations and attitudes.

The "Health-conscious traditionalists", who already exhibit strong trust in certification systems, can be effectively reached through health-focused media and influencer campaigns, emphasising the certification's credibility and health benefits. In contrast, the "Brand- and store-oriented Buyers", who have low HQF awareness, may respond best to retailer collaborations and in-store promotions, integrating certified products into their established shopping habits. The "Sceptical consumers" require scientific validation and transparency-driven educational content, addressing concerns about Hungarian food safety. The "Trademark deniers", who generally dismiss food certifications, can be engaged through youth-oriented social media initiatives and gamified loyalty programmes. The "EHF loyalists" need reassurance that HQF is a continuation of the well-established EHF trademark, necessitating traditional media campaigns that differentiate the two while maintaining continuity. Meanwhile, the "Health-conscious young entrepreneurs", who are driven by premium quality and sustainability, can be targeted through LinkedIn, business forums, and premium food subscription services. By aligning HQF's messaging with consumer preferences, the trademark can enhance market adoption and credibility, ensuring long-term recognition and success in Hungary.

**Table 5**

Strategic communication approaches for different consumer clusters in HQF branding.

Consumer cluster	Strategic communication focus	Proposed channels
Health-conscious traditionalists	Emphasize health benefits and certification credibility of HQF. Leverage their strong preference for local food.	Health-focused media, influencers, printed guides in supermarkets, certification-based promotions
Brand and store-oriented buyers	Highlight brand partnerships and retailer collaborations to integrate HQF into their trusted brands and shopping habits.	Loyalty programs, in-store promotions, supermarket collaborations
Sceptical consumers	Build trust through transparency, showing scientific validation and quality control processes behind HQF. Address their concerns with Hungarian food safety.	Educational campaigns, expert testimonials, targeted social media content
Trademark deniers	Address misconceptions about trademarks, positioning HQF as an objective quality mark rather than a marketing tool. Emphasize ease of recognition.	Youth-oriented social media, TikTok, influencer campaigns, gamification-based loyalty programs
EHF loyalists	Differentiate HQF from EHF while maintaining continuity. Position HQF as an improved and modernized version of EHF.	TV, radio, print ads, direct supermarket engagement, traditional media
Health-conscious young entrepreneurs	Focus on innovation, sustainability, and exclusivity of HQF products. Leverage their interest in self-improvement and premium quality.	LinkedIn, business forums, premium food subscription services, eco-conscious marketing

## 6. Conclusions

This study examined consumer segmentation and the strategic positioning of the HQF trademark, the successor of an almost three-decade-old quality system, by identifying six distinct consumer clusters and their varied attitudes toward food certification marks. Using representative consumer data, we conducted a validated cluster analysis that revealed differences in awareness, trust, and preference for HQF among Hungarian consumers. The findings underscore the need for customised communication strategies to effectively engage different consumer segments, particularly those who are unfamiliar with or sceptical about HQF. The results demonstrate that while some groups already exhibit strong awareness and preference for food certification marks, others require educational initiatives, retailer-based integration, or reassurance regarding food safety and quality. Lessons drawn from successful European certification schemes suggest that HQF could benefit from a multi-channel marketing strategy, incorporating influencers, loyalty programmes, targeted social media campaigns, and traditional media to enhance consumer trust and engagement. These insights are relevant for policymakers, nutrition and food experts, and managers of quality certification systems seeking to strengthen adoption and credibility of national food certification schemes. The limitations of this study include an inherent challenge generally associated with in-person data collection, which may have underrepresented the most impoverished rural communities and highly affluent individuals, making the sample more reflective of the broadly defined middle class. Future research should focus on longitudinal tracking of HQF adoption trends, evaluating the effectiveness of targeted communication campaigns, and exploring additional social factors (such as gender or household composition) that may influence consumer acceptance, potentially with larger or more targeted samples to uncover important

correlations.

### CRedit authorship contribution statement

**László Fekete:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation. **Barbara Szabó-Bódi:** Writing – original draft, Visualization, Validation, Methodology, Formal analysis. **Dávid Szakos:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. **Miklós Süth:** Writing – review & editing, Validation, Supervision, Methodology. **Judit Oláh:** Writing – review & editing, Validation, Supervision, Methodology. **Csaba B. Illés:** Writing – review & editing, Validation, Supervision, Methodology. **Gyula Kasza:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Conceptualization.

### Ethical statement

The study adhered to the ethical practices of the Hungarian National Food Chain Safety Office. Appropriate protocols for protecting the rights and privacy of all participants were utilized during the execution of the research. It involved only voluntary and anonymous questionnaire responses, with no identifiable information collected. In accordance with ethical standards for non-interventional research (e.g., surveys, questionnaires), all participants were fully informed about the purpose of the research and the intended use of their data. The respondents were able to withdraw from the study at any time.

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### Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: David Szakos reports administrative support was provided by National Food Chain Safety Office (NFCISO). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Data availability

The data that has been used is confidential.

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