

THESES OF DOCTORAL (PhD) DISSERTATION

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**ANALYSIS OF THE LABELLING OF PARTICULAR
FOOD CATEGORIES IN HUNGARY**

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1. INTRODUCTION

Food labelling, i.e. supplying food products with data, figures and textual information (including the indication of these items on the packaging), has a double function. On the one hand, the label serves as a tool of consumer protection and informs consumers about product characteristics as required by the relevant legislation. On the other hand, the label is also a platform facilitating communication between the food business and consumers, thus promoting the achievement of marketing communication goals and influencing purchasing decisions.

Due to the bifunctional nature of food labelling, the Dissertation approaches this subject from more aspects.

2. OBJECTIVES

2.1. Describing the history of current food labelling regulations in Hungary

The Dissertation describes the historical background to the food labelling regulations currently in effect in Hungary. This historical information is important as abundant data have been available in various forms on food labelling since the turn of the millennium, yet references about the preceding period are only unprocessed or partially processed. The Dissertation aims at filling this gap and presenting professional references regarding the legal and other provisions in effect in the 18-20th centuries in a well-organised form.

Discussing the main labelling elements defined by the current Regulation (EU) No. 1169/2011 on the provision of food information to consumers, the Dissertation demonstrates that food labelling is not a modern achievement but rather a field that has been organically linked with food industry and trade activities for decades if not centuries, regarding all kinds of aspects from the fairness of information through indication of denominations and quantities of products to providing the names of food companies.

2.2. Analysis of implementation of new food labelling regulations by businesses in Hungary

The active work of legislative authorities supporting the consumer protection role of food labelling results in new or amended food labelling regulations coming into effect from time to time. We studied the pace of implementation of new food labelling regulations and adaptation to new

requirements by Hungarian food businesses. We also wanted to know whether the dynamics of these processes are influenced by factors such as the nature of the product or the geographical location or economic size of the food businesses.

One of the reasons for the enactment of the Regulation (EU) No. 1169/2011 on the provision of food information to consumers was the realisation that the legal background of food labelling needed to be simplified and rationalised, as the field was regulated by both general provisions applying to all products and specific ones applying to particular categories, to be considered at the same time. Simplification and rationalisation make it easier for businesses to comply with the regulations and they also result in clear requirements. This objective of the legislation can be considered important, as its realization also helps to ensure the right of consumers to information. The analysis of the dynamics of the adaptation to new labelling provisions by food businesses also facilitated the examination of whether the aims of the legislative authorities (as described above) were met in Hungary (regarding the product categories and labelling requirements covered by the research). The trends in compliance with labelling provisions once the new regulation came into effect are good indicators in this respect (higher compliance signifies the meeting of the aims referred above). It is important to note that since our research covered only selected labelling requirements and product categories, the overall assessment of the achievement of the above legislative objective can only be made on the basis of a comprehensive study covering all labelling provisions and product categories.

2.3. Analysis of visual elements on the packaging of food products in Hungary

As a very broad range of food products is available these days, resulting in an immense flood of consumer information and this information is expected to be conveyed in a very limited time as a result of our accelerated lifestyle, marketing communication now essentially relies on visualisation, i.e. the various applications of graphs, pictures and figures. Visualisation grabs the attention of consumers, it can be processed easily in many cases and thus enable faster and more complex transmission of information. Visual elements may suggest values (e.g. naturalness, the importance of home, etc.) that may promote purchase when these values meet consumer trends. Visualisation endows products with a personality that consumers can identify with; purchasing then will not simply satisfy

some physiological need (hunger, thirst, etc.), instead it will become an act of expressing values we consider important.

We studied the application of visual elements as marketing tools used on the packaging of food products with special regard to the relationship between these elements and consumer trends.

3. MATERIALS AND METHODS

For our study, we obtained 180 food items each January in 2013, 2014, 2015 and 2018, i.e. a total of 720 food items. The products involved were prepacked food items as defined by the Regulation (EU) No. 1169/2011 and intended for final consumers. They were purchased in Hungarian retail units and belonged to the product categories established by us earlier. When establishing these categories, we aimed at determining a broad range of products to provide a good basis for the analysis of food labelling. Product categories were established as follows:

- Seasonings (e.g. spices, spice mixes, salt, sugar, vinegar, aromas, seasoning creams/sauces/syrups and similar products);
- Fats / Oils (e.g. oils, fats, margarines and similar food products);
- Dairy products (e.g. yoghurt, quark, sour cream, kefir, milk, butter, cream, cheese and similar products);
- Non-alcoholic drinks (e.g. soft drinks, energy drinks, fruit drinks, fruit nectars, fruit juices, mineral waters and spring waters, other bottled waters and similar products);
- Meat and fish (including offal) and the products using these as primary ingredients;
- Confectionary products (e.g. chocolate, biscuits, candies, waffles and other similar confectionary products).

When selecting products, it was important not to include a food business in the sample in a given year and category more than once. Thus, the comprehensiveness of sampling could be increased. We selected only food items where the label on the packaging indicated a Hungarian business as a producer or distributor.

The labels of the purchased food items were studied according to pre-set criteria (as explained later) and the data obtained were analysed from several aspects.

The ranking of food businesses according to their economic size relying on their net turnover observed the provisions of the relevant regulation on such classification of companies, i.e. Act XXXIV of 2004 on Small and medium-size enterprises and the support provided to them. The

geographical location of food businesses was determined according to the addresses provided on the packaging labels of the studied food items. Regional classification was based on the regions of the NUTS 1 statistical system except that Budapest was also considered a separate regional unit.

3.1. Analysis of implementation of new food labelling regulations by businesses in Hungary (materials and methods)

For the study, we selected the following new/amended provisions of the Regulation (EU) No. 1169/2011:

- Indication of the country of origin or place of provenance for meat of swine, sheep, goat and poultry fresh, chilled or frozen (Article 26 (2) b) and Annex XI);
- Application of minimum font size (Article 13, Annex IV);
- New order of the nutrition information (Annex XV);
- Emphasising of substances causing allergies or intolerances (Article 21 (1));
- Indicating the date of freezing or the date of first freezing for frozen meat, frozen meat preparations and frozen unprocessed fishery products (Annex III, point 6; Annex X, point 3);
- Indication of the origin of vegetable oils and fats (Annex VII).

The labels of the products purchased for our studies were analysed according to the selected provisions of the Regulation (EU) No. 1169/2011 as given above and compliance or non-compliance with these provisions was established.

Provisions similar or related to those of the Regulation (EU) No. 1169/2011 had already been applicable before the enactment of the Regulation, including for the followings:

- indicating the catch area of certain fishery and aquacultural products (Council Regulation (EC) No. 104/2000), the origin of beef (Council Regulation (EC) No. 1760/2000) and the origin of certain olive oils and olive-pomace oils (Commission Implementing Regulation (EU) No. 29/2012),
- indicating the nominal quantity of prepacked products using the prescribed minimum font size (Joint Decree 13/2008. (VIII. 8.) of the Ministry of National Development and Economy and Ministry of Agriculture and Rural Development),

- order of the nutrition information (provision 1-1-90/496 of the Codex Alimentarius Hungaricus),
- indicating refined oils (except for olive oil) and fats as ingredients for food production using collective terms (Joint Decree 19/2004. (II. 26.) of the Ministry of Agriculture and Rural Development, the Ministry of Health, Social and Family Affairs and the Ministry of Economy and Transport).

When studying the labels of food products purchased in January 2014, we also examined whether these labels comply with the provisions listed above, these provisions being related to the selected requirements of the Regulation (EU) No. 1169/2011 and in effect at the time of the study. This way, we could establish a benchmark that could be used as a reference when studying the rate of adaptation to the new requirements (for this, the term “*reference*” is used in the Dissertation). Please note that we found 8 food items in the sample of 180 random items purchased in 2014 where the provisions in effect in January 2014 related to the new requirements of the Regulation (EU) No. 1169/2011 did not apply, thus the reference value was established for 172 food items.

Due to selection of study periods food businesses could have about one year before the first study (January 2013) to adapt their product labels to the new requirements, while the third study (January 2015) was conducted about one month after the selected requirements had come into effect except for the rules on indicating nutrition information. We cannot ignore the fact that products purchased in retail trade units in January 2015 were not necessarily expected to comply with the new European requirements (considering the stocks of producers and retailers, the long shelf life of certain products and the fact that packaging materials complying with the previous requirements but not yet adapted to the new ones could still be used on 12 December 2014.). Hence, the study was repeated in January 2018, more than 3 years after the new labelling requirements coming into effect and more than a year after the mandatory application of the new provisions on the indication of nutrition information. Accordingly, compliance with the new labelling provisions could be studied in 2018, even if with certain reservations.

The data obtained were analysed using the statistical software package SPSS 23.0.

First, the level of compliance for individual products was established using the following formula: *the number of (examined) requirements*

*fulfilled by the food item / the number of (examined) requirements applying to the given food item * 100.*

Next, the annual averages of established compliance levels as per product were compared, broken down by research objectives as necessary (product category, the geographical location and economic size of food businesses). Comparison was based on the independent sample test of averages. As – based on the results of Kolmogorov-Smirnov tests – the normal distribution of data could not be presumed when comparing average compliance levels, the results of the Mann-Whitney U and Kruskal-Wallis non-parametric tests were considered and published.

3.2. Analysis of visual elements on the packaging of food products in Hungary (materials and methods)

To correct for the disruptive (generating false conclusions) effect of sudden and short-lived “hypes” and day-to-day trends, an elongated sampling period was applied, i.e. food product samples from 2013, 2014, 2015 and 2018 were analysed together, without the results being broken down by time. This approach facilitated the observation of significant, ongoing trends.

The packaging of the selected products was analysed using the following criteria:

First, the packaging was checked for visual elements. Please note that nonfigurative ornamental visual elements not bearing even an indirect meaning, the elements of the standardised marking systems related to the packaging materials and the logos of national and international certification bodies were not considered.

Then the relationships between the pictures, graphics and other visual elements found on the packaging and the consumer trends selected by us were examined. Selected consumer trends included “*Naturalness*”, “*Appreciation of home, looking for a snug nest, stability, family*” and “*Tradition, conventions, home-made*”. These trends can broadly apply to the studied food categories, and were hence suitable for analysis. Please note that hereinafter the trend names are also used abbreviated, but these are always clear, e.g. “*Tradition*” instead of “*Tradition, conventions, home-made*”.

Individual products were assigned to the given consumer trend if the packaging had visual elements associated with it as follows:

Visual elements signifying “*Naturalness*”: natural landscapes, flowering meadows, mountains, forests, trees, etc. or parts thereof.

In the case of visualisation referring to the product within the packaging or its raw material, it was important to clearly differentiate between graphics related to the consumer trend *Naturalness* and simple product presentation. We relied on the rule that when the product/raw material was pictured as a part of some natural landscape, forming a section of a complex visual design, it was considered as a symbol referring to the consumer trend *Naturalness*.

Visual elements signifying “Appreciation of home, looking for a snug nest, stability, family”: presentation of idealised or multi-generational families.

Visual elements signifying “Tradition, conventions, home-made”: traditionally presented dishes, manufacturing technologies and tools, people in traditional outfits.

A single food product could be classified into more than one category.

Further analyses were performed to establish whether textual information provided on the packaging supports the message of visual elements referring to consumer trends. The relevance of these examinations is justified by the fact that the most efficient advertisements are those that stimulate both cerebral hemispheres at the same time. These analyses were conducted on those ones of the 180 food products purchased in January 2015 where the packaging contained visual elements referring to any of the selected consumer trends. We examined whether the product label contains textual information supporting the visual message or not. Only Hungarian captions were considered.

Data from the analysis of visual elements were statistically tested using the R programming language (Chi-square, independence and fit tests were applied).

In the case of both studies:

- the significance level was defined as $p \leq 0.05$ (Note: for significance levels of $0.05 < p \leq 0.1$, the difference was considered as a trend),
- in this Theses Book, only some of the statistical results were presented due to the lack of space. For detailed data, please refer to the Dissertation.

3.3. Composition of the analysed product sample

The classification of analysed products is given in *Table 1*. Please note that the tables and figures are presented in *Annex 2*.

4. RESULTS

4.1. Analysis of implementation of new food labelling regulations by businesses in Hungary (results)

4.1.1. General pace of adapting to the new food labelling requirements

We studied the summarised average compliance of the selected food products with the new regulations in each year (*Figure 1*). The summarised average compliance in the period between 2013 and 2018 increased from 34% to 46% in the first year, to 71% in the following year and eventually to 93% in the following 3 years. The compliance level measured in 2015 (71%) was below the reference value (77%) ($p=0.036$), but the result in 2018 (93%) was significantly higher than the level of reference measured in 2014 ($p<0.0005$).

4.1.2. Analysis by product categories

Average compliance of the food products with the selected, new regulations in each year was also analysed by product categories (*Figure 2*). The values measured for individual product categories in 2013 varied between 19% and 44%; however, the difference between categories was not significant according to the results of the Kruskal-Wallis multiple comparison ($p=0.372$).

In the period between 2013 and 2014, the rates of increase in compliance in various product categories were not identical. While the rates of increase in the categories *Seasonings* and *Fats / Oils* were 23 and 21 percentage points, respectively, for *Dairy products* and *Confectionary products* the level of compliance remained practically the same, or changed only to a minimum extent (-1 and 7 percentage points, respectively). Accordingly, compliance with the new requirements in the case of individual product categories varied on a broader scale, as illustrated by the results of the Kruskal-Wallis multiple comparison, already significant in 2014 ($p<0.0005$). The results of the pairwise post-hoc comparison showed a significant difference in 2014 (manifesting only in the measured percentages in 2013) between *Seasonings* and *Confectionary products* ($p=0.001$), *Fats / Oils* and *Confectionary products* ($p=0.003$) as well as *Seasonings* and *Dairy products* ($p=0.027$).

The difference between *Fats / Oils* and *Dairy products* was considered a trend ($p=0.064$).

In 2015, compliance levels increased at different rates in individual product categories, resulting in major changes in the significant differences measured between the categories in 2014. The result of the Kruskal-Wallis multiple comparison performed on annual data was $p=0.004$, so pairwise comparisons were also conducted.

As mentioned before, compliance in the category *Dairy products* changed by -1 percentage point between 2013 and 2014, corresponding to the least dynamic change in a one-year period compared to the other categories. However, compliance with the new requirements increased by 53 percentage points between 2014 and 2015, representing the most dynamic annual change in the 2013-2015 period. In the same time interval, the compliance level for *Non-alcoholic drinks* was 42% in 2014, only increasing by altogether 11 percentage points between 2014 and 2015. This difference between the rates of increase eventually resulted in a significant difference between *Dairy products* and *Non-alcoholic drinks* ($p=0.021$).

The difference between the rates of increase regarding the compliance of *Confectionary products* and *Dairy products* between 2014 and 2015 (34 and 53 percentage points, respectively) also resulted in a significant difference ($p=0.044$).

At the same time, the significant differences between *Seasonings* and *Confectionary products*, *Fats / Oils* and *Confectionary products* as well as *Seasonings* and *Dairy products* measured in 2014 disappeared as a result of difference between the rates of increase in compliance.

The study completed in 2018 indicated high values for each product category, varying between 90% and 97%. The Kruskal-Wallis multiple comparison did not show any significant difference between the categories ($p=0.425$), so pairwise post-hoc tests were not performed.

When analysing the data according to product categories, we also tested the statistical relationships between the reference values measured in 2014. The Kruskal-Wallis test did not indicate any significant difference between product categories ($p=0.804$).

When comparing the 2015 data as per product category with 2014 reference values using the Mann-Whitney U test, we could conclude that

values varied around the reference values in each category in 2015, without any significant differences ($p>0.05$) except for *Confectionary products*, where the value measured in 2015 was significantly lower than the reference value ($p=0.003$). (Note: in the case of *Non-alcoholic drinks*, the difference was considered a trend ($p=0.081$)).

The statistical relationships between the 2018 and reference values were also analysed using the Mann-Whitney U test. The measured values were higher than the reference values in each category in 2018. In the case of *Non-alcoholic drinks*, the difference was significant ($p=0.010$), while for *Dairy products* ($p=0.099$) and *Meat, fish and products made thereof* differences were considered trends ($p=0.100$).

4.1.3. Analysis by the geographical location of food businesses

The implementation of the selected, new labelling requirements was also analysed according to the geographical location of food businesses (*Figure 3*).

Results indicated a variation of regional data between 27% and 45% in 2013, 36% and 54% in 2014, 59% and 78% in 2015 and 89% and 97% in 2018. The Kruskal-Wallis multiple comparison performed on annual data did not indicate any significant differences between the regions, so pairwise post-hoc tests were not performed (remark: in the case of the data of 2014, a difference considered as a trend was identified). Similarly, no significant difference was found when performing the test for the 2014 reference values broken down by regions.

The relationships between the data measured in 2015 and 2018 and the 2014 reference values were analysed using the Mann-Whitney U test. It was obvious that the 2015 regional data varied around the reference values (except for *Central Hungary*) without any significant differences ($p>0.05$). In *Central Hungary*, a backlog of 16 percentage points could be observed compared to the reference values measured in January 2014 ($p=0.038$).

Regional data in 2018 were higher than the reference values for each region; the difference was significant in two cases (*Transdanubia* and *Budapest*; $p=0.046$ and $p=0.005$, respectively.) In one case (*Great Plain and North*) the difference was considered a trend ($p=0.058$).

4.1.4. Analysis according to the economic size of food businesses

The implementation of the selected, new labelling requirements was also analysed according to the economic size of food businesses (*Figure 4*).

Results indicated a variation of data between 29% and 43% in 2013, 41% and 54% in 2014 and 89% and 98% in 2018. The Kruskal-Wallis multiple comparison performed on annual data did not indicate any significant differences between different economic sizes ($p>0.05$), so pairwise post-hoc tests were not performed for these years.

In 2015, however, a statistically significant difference was found between economic sizes ($p=0.008$). Pairwise comparisons indicated a significant difference between *Microenterprises* and *Large enterprises* ($p=0.043$). It is important to note here, however, that in this study period the number of companies in the *Large enterprises* category was only 7. If we accept the calculated p value, the reason for that while in 2013 and 2014 there was no significant difference in the data in this respect, then, by 2015, a significant difference came into being, may be the difference between the rates of increase in compliance in the case of businesses of different economic sizes. While the level of compliance in the case of *Microenterprises* increased by 19 percentage points between 2014 and 2015, this increase was 53 percentage points for *Large enterprises*.

Regarding the 2014 reference data (where the Kruskal-Wallis test indicated a significant difference ($p<0.0005$) just like in 2015), the variances between *Microenterprises* and *Large enterprises* ($p=0.001$) as well as *Microenterprises* and *Medium-size enterprises* were responsible for the measured significance in results ($p=0.015$).

The statistical relationships between the data measured in 2015 and 2018 and the 2014 reference values were analysed using the Mann-Whitney U test.

In 2015, significant differences from the reference values were not found for any of the economic sizes ($p>0.05$).

In 2018, measured data reached or exceeded reference values in each category, with the single significant difference indicated for *Microenterprises* ($p=0.003$).

4.1.5. Conclusions

According to the results presented above, compliance levels regarding the selected labelling requirements during the process of adapting the new provisions reached or exceeded the 2014 reference values in each case.

Summarised average compliance was significantly higher in 2018 than the reference value in 2014 (93% and 77%, respectively; $p < 0.0005$).

Comparisons by product categories clearly indicate that compliance values in 2018 were higher than the reference values in each category. In the case of *Non-alcoholic drinks*, this positive difference was significant ($p = 0.010$), whereas for *Dairy products* and *Meat, fish and products made thereof* the differences were considered trends ($p = 0.099$ and $p = 0.100$, respectively).

Comparisons by the geographical location of food businesses showed that regional results in 2018 exceeded the reference values in each case; differences were significant for two regions (*Transdanubia* and *Budapest*, $p = 0.046$ and $p = 0.005$, respectively). In one case (*Great Plain and North*), a trend could be observed ($p = 0.058$).

The results of the comparisons by economic size of the food businesses supported these findings. 2018 data reached or exceeded the reference values in each case. The difference was significant in the case of *Microenterprises* ($p = 0.003$). It could be also found that compliance in the case of *Microenterprises* had been significantly lower than for *Large enterprises* and *Medium-size enterprises* according to the 2014 reference values ($p = 0.001$, and $p = 0.015$, respectively), but this difference disappeared by 2018, when no significant differences could be found between food businesses of different economic sizes.

Based on the above (study of compliance levels) it can be concluded that the objective of the Regulation (EU) No. 1169/2011 to simplify compliance with labelling requirements for food businesses was achieved in Hungary (regarding the product categories and labelling requirements covered by the research). It is important to note that since our research covered only selected labelling requirements and product categories, the overall assessment of the achievement of the above legislative objective can only be made on the basis of a comprehensive study covering all labelling provisions and product categories.

Comparisons by product category for the entire duration of the study revealed the following:

- Regarding the 2014 reference data on compliance, significant differences were not found.
- Regarding the adaptation to the selected, new requirements of the Regulation (EU) No. 1169/2011 between 2013 and 2015, compliance levels did not increase at the same rate in different product categories. Accordingly, significant differences developed between the

compliance levels of the categories (in 2014, *Seasonings* versus *Confectionary products* ($p=0.001$), *Fats / Oils* versus *Confectionary products* ($p=0.003$), *Seasonings* versus *Dairy products* ($p=0.027$); in 2015 *Dairy products* versus *Non-alcoholic drinks* ($p=0.021$), *Confectionary products* versus *Dairy products* ($p=0.044$)).

- Approaching the end of the adaptation process (i.e. by 2018) the significant differences found between the product categories in the period 2013-2015 disappeared, and similarly to the reference values measured in 2014, statistically significant differences between compliance levels could not be found any more.

The phenomenon described above reminds of the waves generated when we throw a stone in the placid water of a lake. The quiet water in our case is a system of compliance levels without significant differences overall, measured by product categories. The stone is the new regulation that disturbs the tranquillity. The “stone” produces “waves” of different sizes, i.e. adaptation processes that differ in pace in the different product categories. These waves subside, however, and a smooth surface (a system of compliance levels that is free of significant differences) is formed again.

4.2. Analysis of visual elements on the packaging of food products in Hungary (results)

4.2.1. Analysis of the application of consumer trends

First, the packaging of the selected food products was checked for visual elements. Packaging items with visual elements were analysed further regarding the application of the selected consumer trends and the frequency of visual application for individual trends was established (*Figure 5*). Frequencies of visual application were tested using tests of independence that indicated a significant difference ($p<0.0005$), hence pairwise statistical comparisons were performed for individual trends.

On the packaging of the food products selected for our study, the consumer trend *Naturalness* appeared most frequently (relevant graphics/pictures were found on 29% of packaging items with visual elements), followed by the visualisation of *Tradition, conventions, home-made* (19%). The application of visual elements related to *Appreciation of home* was less frequent (2%). Pairwise statistical comparisons indicated a significant difference between the trends *Naturalness* and *Tradition* and *Family* ($p<0.0005$ in each case).

The application of the two dominant trends (*Naturalness* and *Tradition, conventions, home-made*) was analysed further.

The application frequency of *Naturalness* by product category is illustrated by a graph (*Figure 6*). Data were arranged in a contingency table and analysed using the Chi-square test. The result of the statistical test was $p < 0.0005$, indicating a significant difference. Hence, pairwise comparisons were performed which showed that visual elements referring to *Naturalness* were applied at almost the same frequency (between 27% and 40%) in the different product categories, without any significant differences except for *Confectionary products*. The product category where visual elements were applied least frequently was *Confectionary products*, where the packaging of only one in every ten products featured such elements. Hence, *Confectionary products* significantly differed from all the other categories ($p < 0.05$ for each pairwise comparison).

When analysing the consumer trend *Naturalness* by the number of ingredients indicated on the labelling, other relationships were found (*Figure 7*). The application frequency of visual elements referring to *Naturalness* decreases with the increase in the number of ingredients. A significant difference ($p < 0.0005$) could be found between the data (on the basis of the results of the Chi-square test following the arrangement of data in a contingency table). Pairwise comparisons indicated significant differences between products with 1-3 ingredients and those with more ingredients ($p_{1-3vs4-10} = 0.0082$ and $p_{1-3vs11-} < 0.0005$). Such a significant difference could not be identified for food products with 4-10 ingredients and those with 11 and more ($p > 0.05$).

Results regarding the consumer trend *Tradition, conventions, home-made* when using the tests applied above indicated two statistical relationships. When the trend was analysed by product categories (*Figure 8*), a significant overall difference was found ($p = 0.0002$) so pairwise comparisons were also performed. The results of the latter showed that visual elements on product packaging most often referred to the trend *Tradition, conventions, home-made* in the category *Dairy products* (29%) followed by *Fats / Oils, Seasonings, Meat, fish and products made thereof* and *Confectionary products* (25%, 21%, 20% and 15%, respectively, thus differences were not significant). The application of the relevant visual elements was least frequent in the case of *Non-alcoholic*

drinks (5%), yielding a significant difference ($p < 0.05$) when compared to any other category except for *Confectionary products* ($p = 0.2630$).

The application of the trend *Tradition, conventions, home-made* was also analysed by the number of product ingredients (*Figure 9*). Tests showed similar results as in the case of *Naturalness* i.e. a statistically significant relationship was found between the application frequency of the trend and the number of product ingredients ($p = 0.0041$). Pairwise comparisons indicated that visual elements referring to *Tradition, conventions, home-made* were applied more frequently in the case of products with only few (1-3) ingredients, than in the case of those with 4-10 ($p = 0.0112$). When comparing products with 1-3 ingredients to those with more than 11, the difference found was considered a trend ($p = 0.0577$).

Further analyses were performed to investigate whether the message of visual elements on the packaging of products referring to the selected consumer trends is supported by textual information. Textual information supporting visual messages on the packaging in about half of the cases (48%) was found, with regard to the examined consumer trends. Statistical tests in this respect indicated no significant difference was found between the ratios of product with visual messages only and those featuring both visual and textual trend information ($p = 0.7098$).

4.2.2. Conclusions

The findings presented above indicate that the visual elements applied in relation to the selected trends most frequently referred to *Naturalness* (29%).

Comparisons by product category showed that the consumer trend *Naturalness* was applied significantly less frequently in the case of *Confectionary products* (10%) than for other categories.

Visual elements referring to the consumer trend *Naturalness* were applied significantly more often in the case of products with only few (1-3) ingredients ($p_{1-3 \text{ vs } 4-10} = 0.0082$; $p_{1-3 \text{ vs } 11-} < 0.0005$).

Visual elements referring to the consumer trend *Tradition, conventions, home-made* were applied significantly more often in the case of products with 1-3 ingredients compared to those with 4-10 ($p = 0.0112$). In the same examination, a trend could be observed when comparing products with 1-3 ingredients and those with more than 11 ($p = 0.0577$).

In nearly half of the cases food businesses did not apply the practice of supporting visual trend messages with textual information.

5. NEW SCIENTIFIC RESULTS

1. Relying on the results of analysing the pace of implementation of new food labelling regulations by Hungarian businesses, I concluded that the pace of adaptation to the selected, new food labelling provisions set forth by the Regulation (EU) No. 1169/2011 was not uniform on the Hungarian food market; differences could be observed between product categories and food businesses of different economic sizes. The analysis by product categories revealed a dynamic process as the new labelling requirements changed the system of compliance levels, created significant differences in it that did not exist previously, and approaching the end of the adaptation process, a condition has reappeared in which no significant differences could be detected again.

2. By examining compliance levels with labelling requirements I proved that the objective of the Regulation (EU) No. 1169/2011 to simplify compliance with labelling requirements for food businesses was achieved in Hungary, regarding the product categories and labelling requirements covered by the research. During the process of adapting the new provisions, compliance levels regarding labelling requirements selected for the study reached or exceeded the 2014 reference values from each studied aspect; changes were significant in several cases. It is important to note that since our research covered only selected labelling requirements and product categories, the overall assessment of the achievement of the above legislative objective can only be made on the basis of a comprehensive study covering all labelling provisions and product categories.

The results presented in point 1-2 may be of help when selecting and specifying tools to support food businesses in understanding and efficiently implementing new labelling requirements.

3. When studying the application of visual elements on the packaging of food products, I identified the following relationships:

- Visual elements referring to the consumer trend *Naturalness* were applied significantly less frequently in *Confectionary products* compared to the other product categories.
- Visual elements referring to the consumer trend *Naturalness* were applied significantly more often in the case of products with only few (1-3) ingredients. Visual elements referring to the consumer trend

Tradition, conventions, home-made were applied significantly more often in the case of products with 1-3 ingredients compared to those with 4-10. In the same analysis, a trend could be observed when comparing products with 1-3 ingredients to those with more than 11.

4. I concluded that in more than half of the cases (52%) food businesses did not apply the practice of supporting visual trend messages with textual information.

These results presented in point 3-4 may serve as a basis for further research activities which in turn may eventually increase the efficiency of marketing communication techniques.

ANNEX 1: PAPERS PUBLISHED IN RELATION TO THE DISSERTATION

Győrvári, J., Szigeti, J., Varga, L. (2015): Új élelmiszer-jelölési eljárások alkalmazásba vétele ütemének elemzése Magyarországon az élelmiszervállalkozások körében. Élelmiszervizsgálati Közlemények, LXI. évfolyam 1. szám, pp. 529-541.

Győrvári, J., Varga, L., Szigeti, J. (2016): Vizualizáció alkalmazása az élelmiszeripari termékek csomagolásán. Élelmiszer Tudomány Technológia, LXX. évfolyam 2016. 2. szám, pp. 20-29.

Győrvári, J., Szigeti, J., Varga, L. (2018): Labeling of food allergens on prepacked foods intended for final consumption in Hungary. Journal of Agroalimentary Processes and Technologies, 2018, 24 (2), pp. 63-68.

ANNEX 2

Table 1. Composition of the product sample involved in the study

Division of the sample according to product categories		Division of the sample according to the economic size of food businesses		Division of the sample according to the geographical location of food businesses	
2013					
Seasonings	30	Large enterprises	49	Budapest	51
Fats / Oils	30	Medium-size enterprises	49	Central Hungary	43
Dairy products	30	Small enterprises	34	Great Plain and North	43
Non-alcoholic drinks	30	Microenterprises	48	Transdanubia	43
Meat, fish and products made thereof	30				
Confectionary products	30				
2014 (the number of products used for the calculation of levels of reference is given in brackets when it is not equal to the number of samples in 2014; see 3.1.)					
Seasonings	30	Large enterprises	23	Budapest	52
Fats / Oils	30	Medium-size enterprises	35 (32)	Central Hungary	40 (37)
Dairy products	30	Small enterprises	46 (43)	Great Plain and North	48 (44)
Non-alcoholic drinks	30	Microenterprises	76 (74)	Transdanubia	40 (39)
Meat, fish and products made thereof	30 (22)				
Confectionary products	30				
2015					
Seasonings	30	Large enterprises	7	Budapest	56
Fats / Oils	30	Medium-size enterprises	31	Central Hungary	34
Dairy products	30	Small enterprises	62	Great Plain and North	64
Non-alcoholic drinks	30	Microenterprises	80	Transdanubia	26
Meat, fish and products made thereof	30				
Confectionary products	30				
2018					
Seasonings	30	Large enterprises	42	Budapest	55
Fats / Oils	30	Medium-size enterprises	50	Central Hungary	40
Dairy products	30	Small enterprises	47	Great Plain and North	45
Non-alcoholic drinks	30	Microenterprises	41	Transdanubia	40
Meat, fish and products made thereof	30				
Confectionary products	30				

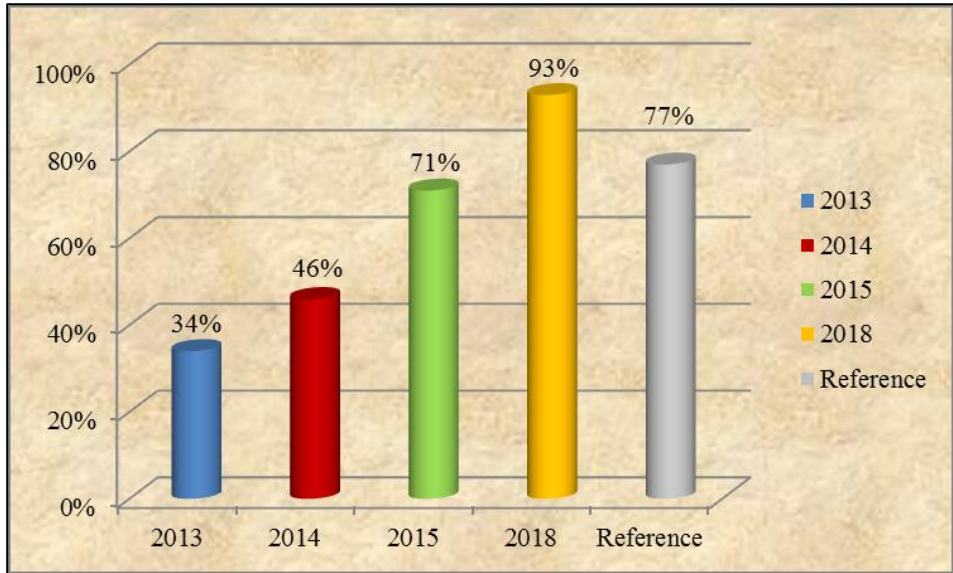


Figure 1. Summarised average compliance with the provisions on labelling involved in the study ($n_{2013}=180, n_{2014}=180, n_{2015}=180, n_{2018}=180, n_{reference}=172$)

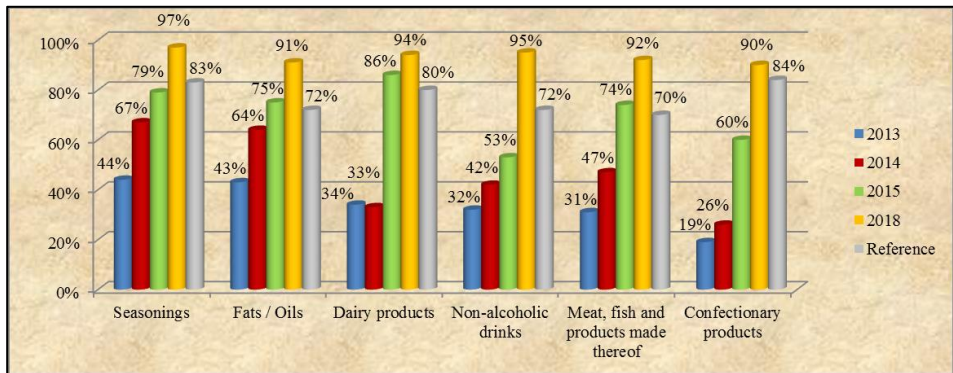


Figure 2. Average compliance with the provisions on labelling involved in the study according to product categories (for n , see Table 1)

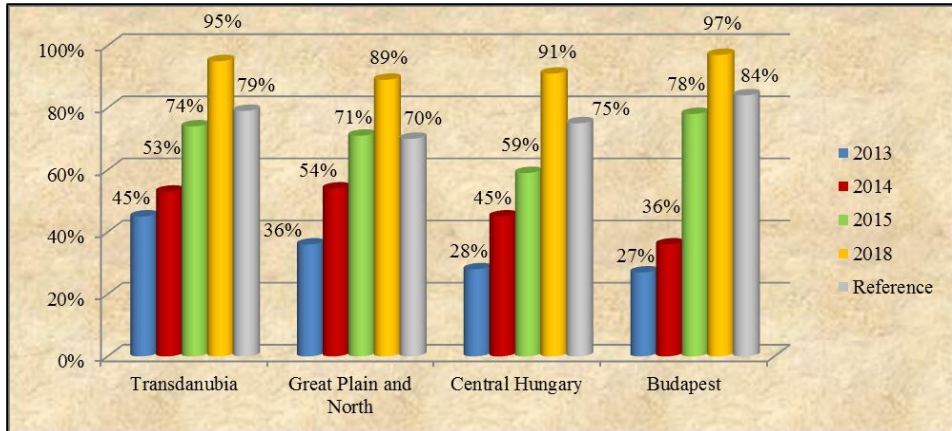


Figure 3. Average compliance with the provisions on labelling involved in the study according to the geographical location of food businesses (*for n, see Table 1*)

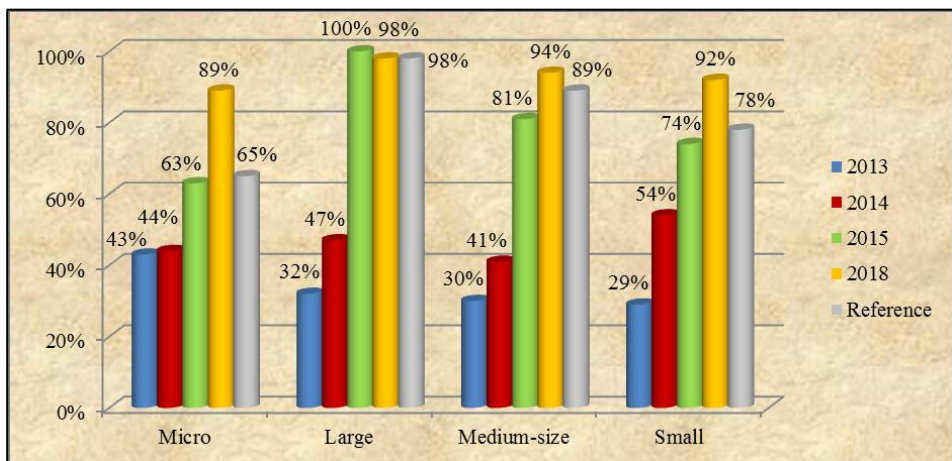


Figure 4. Average compliance with the provisions on labelling involved in the study according to the economic size of food businesses (*for n, see Table 1*)

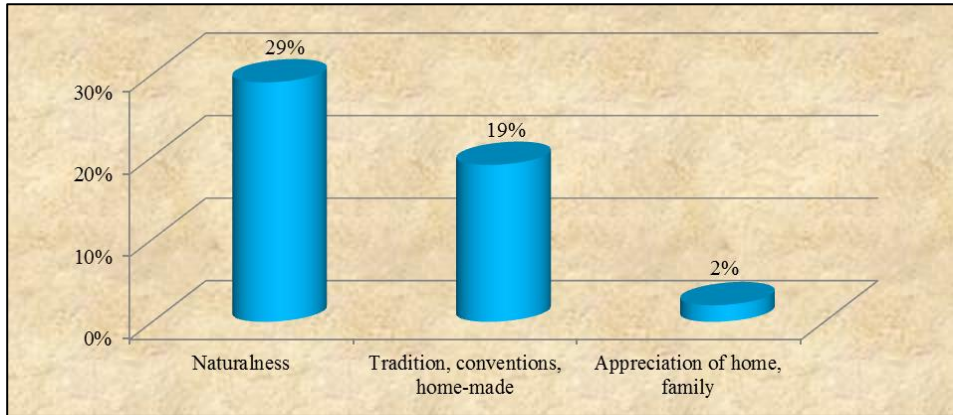


Figure 5. Distribution of visual elements referring to consumer trends as applied on the packaging of products, among the products with graphics ($\chi^2=137.42$, $DF=2$, $p<0.0005$, $n=597$)

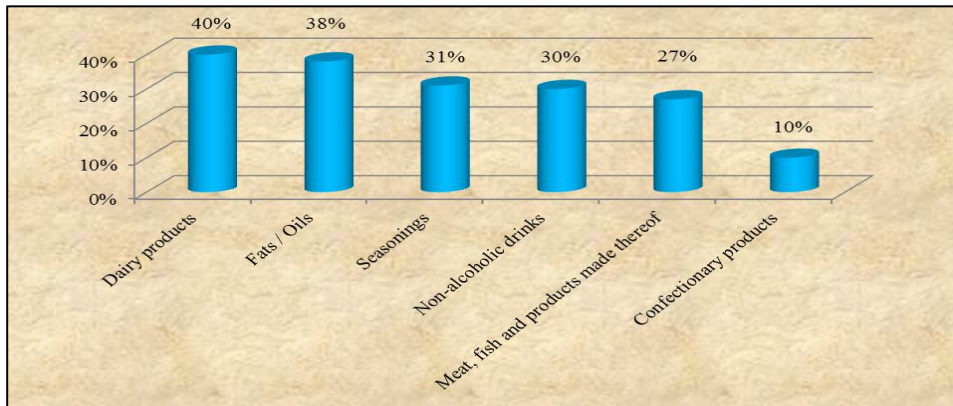


Figure 6. Distribution of visual elements referring to the consumer trend Naturalness as applied on the packaging of food products, according to product categories, among the products with graphics ($\chi^2=28.854$, $DF=5$, $p<0.0005$, $n=597$)

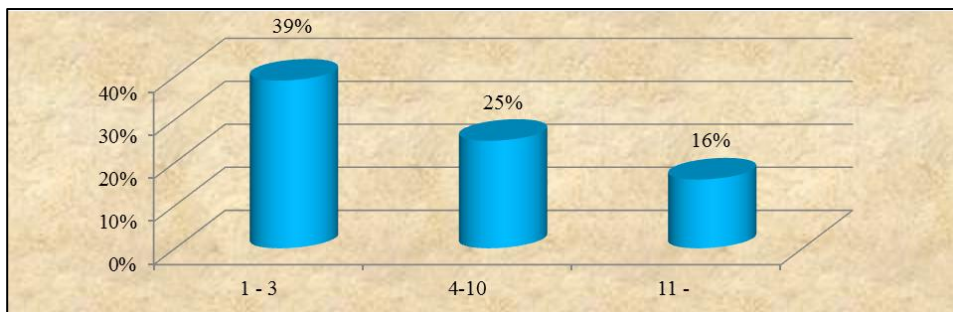


Figure 7. Distribution of visual elements referring to the consumer trend Naturalness as applied on the packaging of food products, according to the number of ingredients in the studied products, among the products with graphics ($\chi^2=26.855$, $DF=2$, $p<0.0005$, $n=597$)

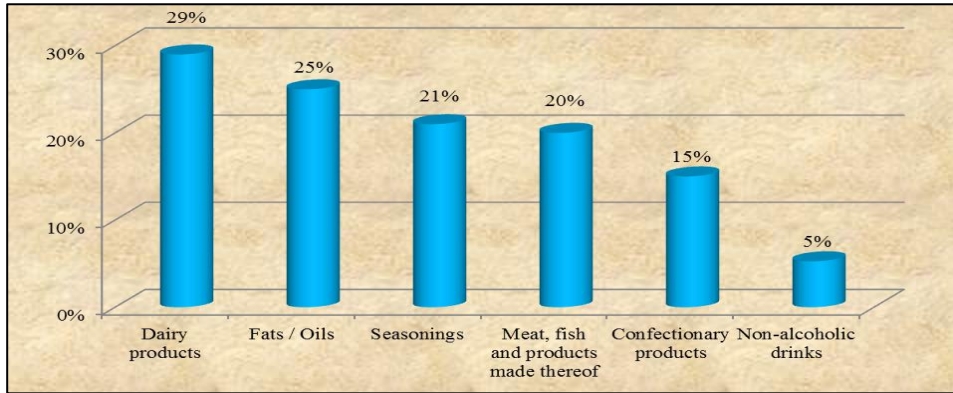


Figure 8. Distribution of visual elements referring to the consumer trend Traditions and home-made as applied on the packaging of food products, according to product categories, among the products with graphics ($\chi^2=24.8$, $DF=5$, $p=0.0002$, $n=597$)

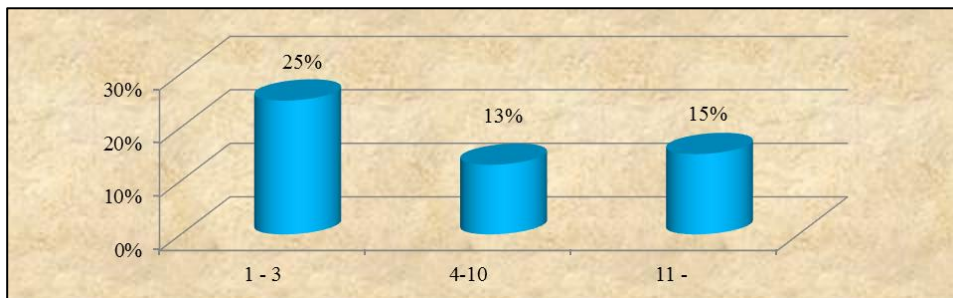


Figure 9. Distribution of visual elements referring to the consumer trend Traditions and home-made as applied on the packaging of food products, according to the number of ingredients in the studied products, among the products with graphics ($\chi^2=10.988$, $DF=2$, $p=0.0041$, $n=597$)