DIFFERENT TECHNOLOGIES DURING PÁLINKA PRODUCTION

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INTRODUCTION

Pálinka has been the beverage traditionally linked to Hungary and the Carpathian Basin. Its birth and creation have been favorably affected by the climatic conditions here; which have favored the cultivation of the good quality fruit with high nutrient content value, thus providing the raw material of the pálinka. Pálinka used to play a serious role in the everyday life of the Hungarian people for a long time; it would appear as some kind of a sacred drink of all the most important turning points of human life (Christening, funeral, celebration of a busniess deal). During the 19th century, due to the changes of folk culture and customs, it was somewhat effaced; then, as a result of becoming a drink category of the European Union in 2002, interest in it has newly increased and its popularity has started to rise again in Hungary and the neighboring countries. Supply has polarized, and the number of those commercial distilleries has grown which prepare high quality distillates of more and more kinds of fruit. According to the "Pálinka Law", an alcoholic beverage or distillate can only be called "palinka" if it was fermented exclusively from fruit, grapes or grape marc cultivated or grown in Hungary and if it does not contain any added ingredients like for instance sugar or aroma. The exclusivity of the usage of the name has created the prerequisites for the pálinka to be positioned as a product made of very precious raw material and as a product which bears a national image just like cognac or whisky; and in its communication this relationship can be highlighted. This is fostered and advanced by the fact that numerous pálinkas have gained protected designation of origin or PDO in the origin protection system of the EU.

THE DEVELOPMENT OF THE DISTILLATION OF PÁLINKA IN HUNGARY

Pálinka production is a biochemical process consisting of several parts that have gone through a significant development phase during the past few centuries. Technology development has advanced the product to become better in quality, containing precious aromas and other ingredients. Mankind has known distillation for a long time now; it was possibly invented by the Egyptians or the Chinese, mainly to extract fragrances. The procedure has been known in Europe since the 11th century, when monks had created alcohol from wine with the help of this process (Totth 2017). In Hungary at first distillates were made from wine; then the attention had turned to the cheaper raw materials like potato, fruit, and grains. As far as technology is concerned, the copper cauldron had already been well-known in the 15th century, additionally dephlegmators and cooling devices had appeared (Harcsa, I. M. 2018). Large-scale palinka distillation became widespread in the 19th century. Before WW1, 860 distilleries operated in Hungary, 30 of these were of industrial size (Jónás, J.: 2006).

Between the two World Wars, the technology of pálinka distillation had significantly developed. Experts had started to use alcohol meters for measuring the low alcohol and the use of the steam heated double-walled cauldron. These develpopments had fostered the improvement of the quality of the product (Balázs, G. 1998). After WW2, distilleries were deprivatized, and distillates could only be legally prepared in one of these facilities. Virtually, in the socialist shortage economy only one copper plate with one-size thickness was produced; therefore the sizes of the cauldrons manufactured and put into operation around this time were also the same (Jónás, J. 2006). The last decades of the century, especially the time of the privatization, have advanced distillation; many distilleries have been privatized, and the new owners have been continuously developing technology and equipment.

THE DEVELOPMENT OF THE TECHNOLOGY OF PÁLINKA DISTILLATION

Pálinka can only be produced from fruit, grapes and grape pomace cultivated in Hungary or grown uncultivated (Szegedyné, et al. 2017). During production, raw material is extremely important. Among liquors, pálinka has one of the most precious raw materials; and its quality is influenced and defined to a great extent by the quality of the fruit and its preparation for processing, the so-called mashing. The climatic conditions of Hungary, the average annual temperature, and the number of sunny hours make it especially adapted for fructiculture. Due to the favorable givens here, the sugar-acid ratio is optimal, which fact enables the production of an end-product with a truly high nutrient value. For the mashing process, it is necessary to use fruit preferably at the same degree of maturity, thoroughly washed, properly riped. Stone fruit has to be cored and pomaceous type fruit has to be grinded. The beginning of the fermentation process is triggered by adding pectin-decomposing enzymes (pectinases), special yeast, pectinolytic enzymes and partially aroma- amplifier enzymes. During the mashing process, the primary aromas of the fruit are evolving, and the secondary ones are born (Sólyom, L. 1986). Fermentation control is continuous, the fermented mash is distilled or stored hermetically until distillation. During the so-called controlled fermentation, the process is taking place under controlled temperature conditions in fermentation tanks and specially selected yeast strains and turbo yeast, that are feeding salts (this is a yeast autolysate supplemented with macro- and microelements), which are fed to the mash. There are two kinds of controlled fermentation, the periodic (discontinuous), or batch fermentation, and the continuous fermentation; the former bearing more significance of the two. Usually during the one to four week-long fermentation process with variable times depending on the kind of fruit, the optimal temperature of which is 17°C, alcohol is produced from fructose with the help of yeast. Distillation is a process during which the more volatile components of the liquid mixture are separated from the less volatile ones with the help of vaporization and dephlagmation (condensation). Separation is enabled by the fact that during the vapor phase, the concentration of the more volatile components is higher while being in contact and in thermodynamic balance with the liquid than during the liquid phase. Single distillation is called distillation, while repeated distillation and condensation are called rectification (Harcsa 2018). Pálinka production can be done in two ways, either with a two-phase, pot-still or alembic technology, or the one-phase column-pot technology, depending on whether the end product, pálinka, is obtained by single or double distillation (Soós, K. – Dlusztus, I. 2015). During the application of the pot-still technology, the mash goes into a copper cauldron with capacity of 1000 liters or less. At the end of the first distillation phase, we get what we call low alcohol. It is unsuitable for consumption. During the second distillation phase, we separate the foreshots and the feints containing the unpleasant flavors and aromas in the so-called spirit still. The alcohol content of the resulting pálinka is more concentrated, about twice as much than that of the low alcohol, approximately 55-60%.

During the application of the two-phase technology, the process is the following. The fermented mash is heated to the desired temperature, to the boiling point. Vapors are cooled down, thus we get low alcohol, which is approximately 30% of the original quantity, and spent lees, that is the residue in the still which is not suitable for further usage, thus it is run to waste. Low alcohol is then led to the refining cauldron, where after a similar boiling process, the detachment of the already mentioned foreshots (2.0%) and feints (7.5%) take place. What we have left at this point are the potable spirit (10%) and some distillation residues (Sólyom, L. 1986).

By applying the single-distilled, refining-column still technology, we get pálinka in one distillation. Here, the vapor, which is born during the heating of the mash, does not get from the boiling cauldron to the refining cauldron, but into the refining column (aroma-column) in which the refining is performed by plates, in a way, that the vapor condenses on glass spurs (known as trays or plates), then the heat which arises at this point boils the liquid in the plate, from which the vapor with the higher alcohol concentration flows up to the next plate; so that water precipitates on each level, and and purer alcohol flows upwards. By applying the single distillation technology, distillation time is implicitly shorter, the final result has a fruitier scent, is richer in aromas. The product has to be heated up and cooled down only once; therefore, the heat shock, which does not spare the aromas, influences the distillate only once, and in addition to that, at a slightly lower temperature (Harcsa, I.M. 2018).

The quantity of the final product depends on the type of fruit. Depending on the type of fruit, out of 100 kg mash we gain three to nine liters of pure alcohol, which can reach the desired alcohol content by being attenuated by distilled water. (According to the law, pálinka must contain at least 37.5% alcohol, hence mostly pálinkas are distilled to 40-50% of alcohol strength). Pálinka production is essentially an energy-consuming process, but the two, already detailed technologies have different energy needs. For pálinka production, besides the already mentioned equipment and the differently priced raw materials, fuel, cooling water, electricity and human resources are definitely necessary. Harcsa examined the different energy needs of the two technologies in 2017 (Harcsa, I.M. 2018) calculating with 500 liter mash. Harcsa calculated with the following basic data, determining the boiling point of the mash between the boiling points of ethyl alcohol (78,3°C) and water (100°C). Chart 1 shows the data.

Chart 1: Starting data of the calculation

Quantity of mash	**500 liter**
Pouring in temperature of the mash	20°C
Boiling point of the mash	85°C
Density of the mash	1100kg/m3
Specific heat of the mash	4,2kJ/kgK
Vaporization temperature of the mash (5v/v%)	2100kJ/kg
Alcohol density	4,2kJ/kgK
Quantity of convection material	100 L
Starting temperature of convection material	20°C
Operating temperature of convection material	105°C
Specific heat of convection material	4,2kJ/kgK
Density of convection material	1,000kg/m3

Source: Harcsa 2018

During pálinka production, there are several activities and processes in need of energy which is always needed, regardless of the nature of the technology used. One such example is the boiling of the mash and the separation of the foreshots and the feints.

The evaporation of the low alcohol quantity is part of the two-phase technology, and during the refining phase, the heating up of the low alcohol to its boiling point is part of it as well. In case of the single distillation technology, the heating up and evaporation of the reflux pose as different tasks. The energy consumption of the two technologies, according to the calculations of Harcsa, and under the same heating conditions (wood heating) is as follows, see Chart 2 (Harcsa, I.M. 2018).

Chart 1.: Energy demand of the two-phase technology

Name	Energy demand (KJ)
Energy demand of the heating up of the convection material	35,700
Energy needed for heating up the mash	85,260
Energy demand for the evaporation of the low alcohol	298,384
Refining, the energy demand for heating up the low alcohol	41,561
Refining, the energy demand for the evaporation of the low alcohol	160,559
Sum of energy demands, without losses	621,463

Source: Harcsa 2018

During the comparison, taking practical experience into consideration, calculains were made with the extraction of 25% alcohol by volume low alcohol after the first distillation.

Chart 2.: Energy demand of the single distillation technology

Name	Energy demand (KJ)
Energy demand for heating up the convection material	35,700
Energy demand for heating up the mash	85,260
Energy demand for the evaporation of the foreshots, the middle cut and the feints	195,773
Energy demand for reheating the reflux	1,767
Energy demand for the evaporation of the reflux	141,387
Sum of energy demand without losses	459,887

Source: Harcsa 2018

In case of the single-phase column technology, likewise, based on practical experience, the calculation took place with triple reflux quantity and a cooling down to 75°C.

It is clear from the aforementioned details, that the application of the more modern technology indicates approximately 25% energy savings. The obvious reason for this is that the distillation and the refining take place in one single process, and the temperature of the reflux is not much lower than that of the liquid mixture; therefore, the process does not call for a reheating. On the other hand, the upflowing mixture heats up the plates above it, on which the concentration of alcohol is higher. Accordingly, there is no need to evaporate the water, which is returned to the distillate during the setting of the alcohol level (see Chart 3).

THE PROCESS OF MAKING PÁLINKA

During pálinka production, essentially two technologies can be applied. The different technologies have different device and energy demands, and due to this fact, their profitalbility is different as well. In case of both technologies, the requirements are the same with regards to the handling of the mash and its preparation for distillation. Furthermore, in case of both technologies, the heating up of the mash to its boiling point and the evaporation of the foreshots, middle cut and feints quantities are the same processes.

Mashing

Steps of the preparation of the mash: picking over, removal of contamination, stems, and inferior quality fruit, washing, chopping, removal of seeds, adding pectin decomposing enzymes, yeast, (mash 20g/100 liter) and acid if necessary (pH value should be between 2.8-3.2).

Tools: grape crusher, destemmer for chopping, (maybe sorter and presser), paint mixer machine for drills, home-made chopper

Fermentation 15-20 C°

Tools: clean plastic barrel with lid (optionally fermentation airlock), mash alcohol meter or refractometer for ascertaining the end of the fermentation.

The state of the mash before fermentation starts defines the quality of the end-product to a great extent. Approximately 70% is influenced by the quality of the mash, 20% can be improved by the knowledge of the distiller master, and 10% is determined by the quality of the equipment with regards to the quality of the pálinka we get in the end.

THE PROCESS OF THE DOUBLE-DISTILLED, SMALL POT TECHNOLOGY

The properly prepared fruit puree is pumped into the fermentation tanks (sometimes shoveled e.g. pomace, or from buckets). The properly fermented mash gets into the double-walled cauldron or pot. The pot is usually made of copper and in operating industrial sizes it extends from 150 liters up to 1000 liters in capacity. The vapor which is rich in alcohol gets into the cooler through a copper pipe, after coming through the helmet which is on top of the copper pot, where the vapor condenses and the low alcohol is born (Soós, K. – Dlusztus, I. 2015). This not very aromatic low alcohol with a relatively lower alcohol content is being re-distilled either in the same or a smaller refining pot, a process during which foreshots, middle cut and feints are separated. The middle cut is fit for consumption.

Tools: copper distilling pot, copper helmet, vapor pipe, proofing parrot, alcohol meter, Szőllősy-type fusel oil separator, tanks for low alcohol, foreshots and feints, refrigerator, spirits measuring machine

THE PROCESS OF SINGLE-DISTILLED, REFINING COLUMN TECHNOLOGY

The vapors which originate from the boiling pot during the distillation of the mash, get into the rectification column, where in a heat-exchanger called dephlegmator, the colder water circulating there condenses them. The inside of the column consists of three levels, on each level water condenses and the vapor, which is rich in alcohol flows upwards to the final reflux drum, where it condenses and pálinka is born. In the rectification column, the condensed liquid flows back down onto the so-called Pistorius-plates, where the vapors flowing upwards and permeating through these, heat it up. As a result of this, the volatile materials with a low boiling point evaporate and the vapors heat the plates, which means that the refining is performed with the same energy as the one used for distilling the low alcohol in the small pot system.

Tools: boiling pot, refining column, dephlegmator, cooling water, inlet and outlet pipes for the cooling water, copper catalysator, vapor pipe, post-condensator, pálinka storage tank.

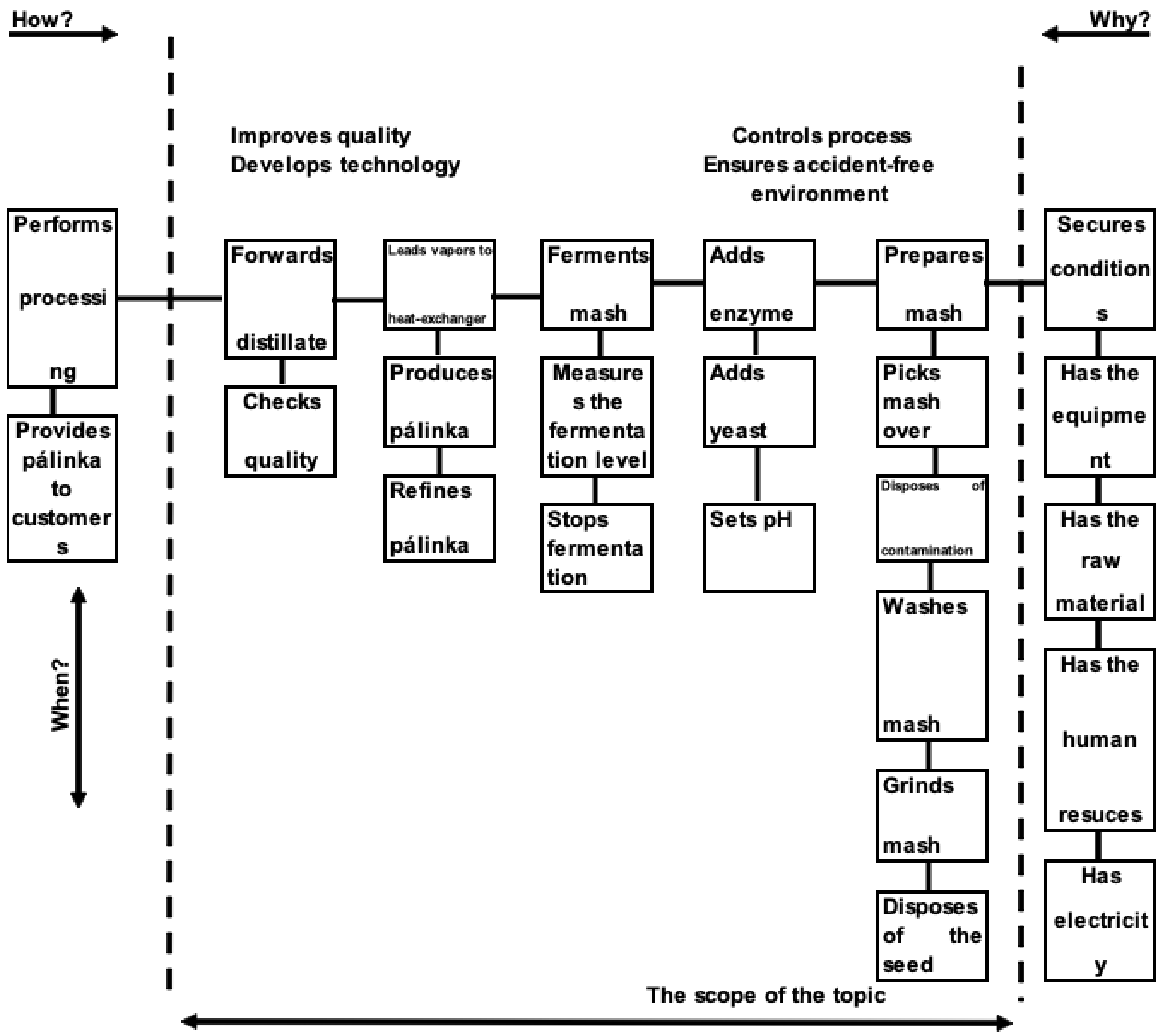
The effect of the material of the distillation equipment on the quality of the pálinka

Pot	**Dephlegmator**	**Vapor pipe**	**Cooler**	**Structural combination**	**Material suitability**
				for the preparation of excellent quality pálinka	for avoiding metallic fractures
copper	copper	copper	copper acid-proof	suitable	unsuitable
copper	copper	copper acid-proof	steel acid-proof	suitable	conditionally suitable
copper	copper acid-proof	steel acid-proof	steel acid-proof	suitable	suitable
copper acid-proof	steel	steel	steel	conditionally suitable	suitable
steel acid-proof	copper acid-proof	copper	copper	conditionally suitable	unsuitable
steel acid-proof	steel acid-proof	copper acid-proof	copper	unsuitable	unsuitable
steel acid-proof				unsuitable	unsuitable
steel	steel	steel	steel	unsuitable	unsuitable

Source: Sólyom, L. 1986

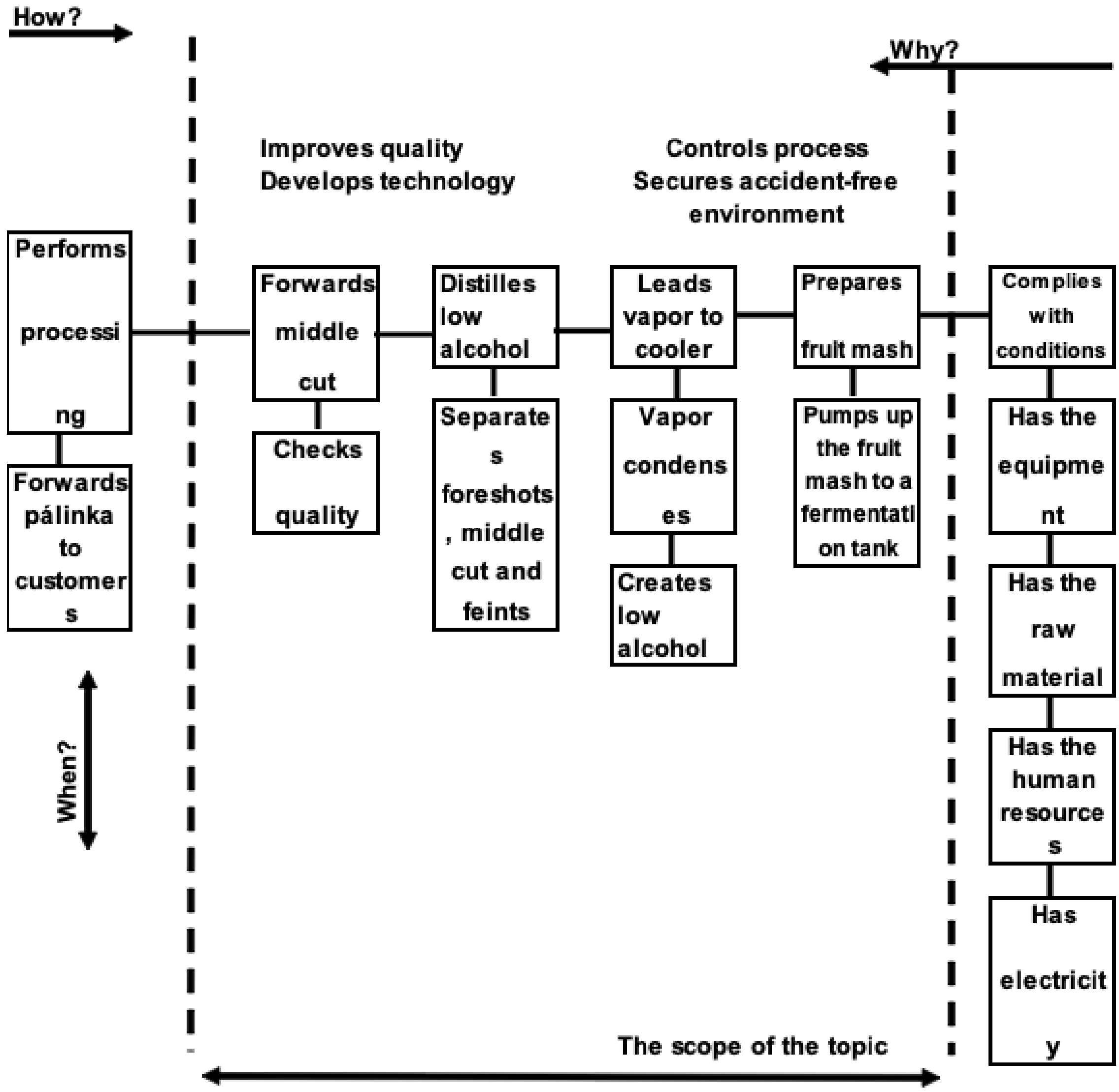
Different pálinka making technologies are shown with the help of FAST-Diagrams. The procedural steps of the single-distilled, column technology are demonstrated in Chart 1. Chart 2 shows the double-distilled, small pot technology.

Chart 1: The single-distilled, refining column technology



Source: own work

Chart 2. FAST Diagram – The small pot (double-distilled) technology



Source: own work

Summary

Pálinka is one of Hungary’s important national products. Usually pálinka is consumed as an aperitif, but it is suitable to be consumed as a digestif as well. Certainly, it is important to keep to the rules of responsible drinking customs. Pálinka soothes the digestive tract, the stomach, and helps relieve tension. At the same time however, its excessive consumption can damage organs (kidney, stomach, liver, etc.). The single-distilled pálinka usually has 40% alcohol content, while the small pot pálinka usually has 55%. According to surveys, the majority of the customers prefer the 40% pálinka. In order to make this typically Hungarian product popular abroad as well, high quality pálinka and constant quality control is necessary.

The application of Value Analysis assited in clarifying which steps of the technology can cause quality management issues and unnecessary costs. One of the most important statements we have made is that the quality of the pálinka is influenced by the following factors: approx. 70% mash, 20% distiller and 10% equipment. According to expert opinions, the creation and processing of the mash is one of

the most important tasks. Mostly in case of the smaller distilleries, experts experienced that the steps listed under the single-distilled technology were not always and fully followed and implemented by the distillers. The skipping of certain steps causes a lower quality of the pálinka later; therefore, it is insufficient and unsatisfactory to create expensive equipment, unless the professional steps of each operation are also strictly implemented. We believe that it would be practical to create "type-technology" materials, which could be taught to the pálinka distillers as educational courses.

Bibliography

Balázs, G. (1998): The Hungarian pálinka. Aula Publishing House, Budapest.
Harcsa, M.I. (2018): The analysis of the economic effects of pálinka distillation. PhD. dissertation plan. Ihrig Károly Doctoral School of Management and Business Administration, Debrecen.
Harcsa I. M. (2017): Energy demand for pálinka production and some practical issues of waste treatment ECONOMIC AND REGIONAL STUDIES / STUDIA EKONOMICZNE I REGIONALNE 10:(3) pp. 82-95. (2017).
Jónás, J. (2006): Master pálinkas, pálinka masters. Korona Publishing House, Budapest
Hungarian Parliament 2008/LXXIII. tvr. 2§.
Sólyom, L. (1986): Distillation of pálinka. Mezőgazda Publishing House, Budapest.
Soós, K. – Dlusztus, I., (2015): Good Hungarian pálinka. Könyvtárház Publishing House, Budapest.
Szegedyné, Fritz Á. – Szakos, D. – Bódi, B. – Kasza, Gy. (2017): Pálinka, consumer knowledge, preferences, consumer habits, marketing opportunities. Gazdálkodás 60. year no. 2. pp. 158-170.
Totth, G. (2017: Pálinkamarketing in Szakály Z ed. Élelmiszermarketing Academic Publishing House, Budapest.