Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964

Vol. 10, No. 2 2016

BIOMASS FROM WOOD PROCESSING INDUSTRIES AS AN ECONOMICALLY VIABLE AND ENVIRONMENTALLY FRIENDLY SOLUTION

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ABSTRACT

Biomass is seen as an economically viable and environmentally friendly solution to energy generation. Biomass is a financially viable investment as well as being environmentally friendly. The development and implementation of biomass technologies could bring many environmental, energetically and economic benefits, solving important problems such as waste disposal and renewable energy supply. The different countries clearly have chosen very different approaches in developing and deploying various bio–energy options. Partly this is caused by the natural conditions (type of resources and crops, climate) and the structure of the energy system, and also by the specific political priorities linked to the agricultural and forestry sectors in those countries. Romania has a significant potential in organic waste, including waste generated in forestry sector, agro–food industry or municipal biodegradable wastes.
Biomass is an emerging renewable fuel that can help to heat homes and buildings at lower impact to the environment and lower costs than fossil fuels. The fuel (usually in the form of biomass pellets) is made from sustainable materials, such as wood, which is easily replaced and in abundance, at a relatively cheap price. As people are becoming more and more conscious about their individual impact on the environment and looking into greener, more efficient alternatives, biomass is slowly becoming one of the nation's favorite renewable heat technologies. Actually, sawdust as by–product from wood sawing process, doesn't have much application because of its low burning efficient. However, by pressing the saw dust into pellets, it becomes a kind of high quality biofuel product – sawdust pellets or wood pellets.

Keywords: sawdust pellets, pelletization process, woody biomass resources

1. INTRODUCTION

Wood pellets are a form of biomass energy that is very popular for the international market either for electricity or heat generation sector. Increasingly needs wood pellets are expected to be increased, or 2024 global production of wood pellets will be 50 million tons.Some of the recent predictions suggest that biomass energy is likely to make up one third of the total world energy mix by 2050.
Romania have an immense bioenergy potential due to plentiful supply of diverse forms of biomass wastes such as the woody biomass which is a good energy resource due to presence of large number of forests in Romania. In addition, the presence of a large number of wood processing industries also generates significant quantity of wood wastes. Wood wastes generally are concentrated at the processing factories, e.g. plywood mills and sawmills, but the wastes generated from wood processing industries varies from one type industry to another depending on the form of raw material and finished product (sawmilling, plywood, wood panel, building component, furniture, flooring etc.). Romania, with its abundant bioenergy resources, can hold a strategic position in the global biomass energy atlas. Unfortunately, recycling of wood wastes is not done by all wood industries, particularly small to medium scale wood industries.
Biomass has rapidly become a vital part of the global renewable energy mix, counting traditional biomass, large hydropower, and "new" renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels). Biomass power is the largest source of renewable energy as well as a vital part of the waste management infrastructure. Biomass may be used for energy production at different scales, including large–scale power generation or small–scale thermal heating projects. Traditional biomass is primarily used for cooking and heating. The use as fuel of some of the wood wastes (like sawdust and chips) is usually practiced in large and modern establishment (Fig. 1). [1-7], [9], [12], [15]

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Figure 1. Wood wastes as sawdust

Biomass energy resources are readily available in rural and urban areas. Biomass has been a primary source of energy for many years, used for domestic heating and industrial cogeneration. Biomass–based industries can provide appreciable employment opportunities and promote biomass re–growth through sustainable land management practices. Wood has been the dominant fuel and has a long tradition in Romanian rural areas based on its availability, sustainability, environmentally friendly and renewable natural resource characteristics. Romania has a significant forestry potential of wood and plant to support the production of pellets and briquettes in terms of quality and protection to meet the requirements and standards [16, 17].

2. MAJOR SOURCES OF WOODY BIOMASS DESTINED FOR PELLETS PRODUCTION

Some of the major sources of woody biomass destined for pellets production are being discussed in the following paragraphs.

The major biomass resources in Romania include the following:

- firewood and woody biomass residues from forests harvesting operations (may occur as thinning in young stands or cutting in older stands for timber);
- woodprocessing residues from wood and furniture industries (sawmilling, plywood, wood panel, building component, furniture, flooring etc.);
- agricultural crops and agro–processing residues;
- urban wood wastes (collected woody materials after a construction or demolition projects, rejected wood pallets and any other construction and demolition wastes made from timber).

Romania's vast biomass potential has been partially exploited through the use of traditional as well as more advanced conversion technologies for biogas, power generation, and biofuels. Wood–related industries are the major potential biomass energy sources. The agricultural crops and agro–processing residues are insignificant, despite the fact that an increased potential exist in Romania.

Sawdust is by–product from wood sawing process. Actually, sawdust doesn't have much application because of its low burning efficient. However, by pressing the saw dust into pellets, it becomes a kind of high quality biofuel product – sawdust pellets or wood pellets (Fig. 2). [8, 10, 11]

Figure 2. Sawdust and pellets

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Pellets and briquettes production increased in Romania mostly after the country inclusion in EU. This was and still is mostly related with the new markets in Europe. Currently, there are many pellet producers in Romania, but information about their production capacities is scarcely accessible. In general, most of the production of large companies is sold on western European markets. Small producers sell also on the Romanian market in the limit of their stocks (most of the production is realized from wood processing residues), based on pre–established contracts (Fig. 3). [14]

a)

b)

Figure 3. solid fuel by woods. a) wood briquettes; b) Wood pellets

The regular geometry and small size of biomass pellets allow automatic feeding with very fine calibration.High density of pellets also permits compact storage and rational transport over long distance. Pellets are extremely dense and can be produced with a low moisture content that allows them to be burned with very high combustion efficiency.

3. PELLET PRODUCTION AND REQUIREMENTS

Over the last decade there have been two major factors that have been driving the growth of the pellet fuel market. The first is the consistent rise in the cost of fossil fuels and price instability, and the second is the increased attention given to the effects of using fossil fuels such as oil and gas on the environment. Other factors that support the case for pellets is that they are a fuel that can be produced locally, from local wood and biomass materials.

Pellets have very similar combustion results to most wood pellets. The other main reasons for pellets over logs are that pellets burn much more efficiently. This means pellets produce less ash, less smoke and more heat. Also pellets have a uniform size, shape, density and moisture content. These consistent qualities make it possible to design highly automated combustion systems such as modern wood pellet stoves and boilers.

One of the reasons pellet fuel is so popular is pellets have moisture content below 10%. This enables the pellets to burn very efficiently, and produce virtually no smoke during combustion. Pellet production is a high temperature process. The right moisture content will produce the best quality pellets, reduce energy consumption and reduce pellet mill downtime.

In pellet production every raw material behaves differently, and some materials produce quality pellets easier than others. Depending on the equipment used, the composition of the raw material may need to be changed to produce quality pellets at a reasonable productivity. Changing the composition can include adjusting particle size or moisture content. However, it may also include adding binders and lubricants to help produce higher quality fuel pellets.

Temperature is a key requirement in pellet production. Unless a certain temperature is reached in the pellet mill natural lignin will not melt. It is not possible to produce some biomass pellets for example wood pellets without sufficient heat. However, if the temperature is too high this can damage the pellet mill.

4. BIOMASS PELLETIZATION PROCESS - AN OVERVIEW OF THE TECHNOLOGY

Woody biomass is the most common and popular biomass of the biomass pelletisation which is a standard method for the production of high density, solid energy carriers from biomass. Pellets are manufactured in

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several types and grades as fuels for electric power plants, homes, and other applications. Pellet–making equipment is available at a variety of sizes and scales, which allows manufacture at domestic as well industrial–scale production. Commercial pelletizing equipment's are widely available across the globe.
The biomass pelletization process consists of multiple steps including raw material pre–treatment, pelletization and post–treatment. The first step in the pelletization process is the preparation of the raw materials which includes selecting a feedstock suitable for this process, its filtration (to remove unwanted materials like stone, metal, etc.), and adequate storage, in such a manner that it is away from impurities and moisture.
Raw materials commonly used are sawdust, wood shavings and wood wastes, but also agricultural residues can be used. In cases where there are different types of feedstock, a blending process is used to achieve consistency. If the pellet size is too large or too small, it affects the quality of pellet and in turn increases the energy consumption. Therefore the particles should have proper size and should be consistent. Size reduction is done by grinding using a hammer mill. Before feeding biomass to pellet mills, the biomass should be reduced to small particles (Fig. 4).

Figure 4.Schematic of pelletization of woody biomass

Most wood pellets are manufactured from clean sawdust and wood chips: waste products from lumber and other wood industries. The raw materials may be green, or freshly cut, may be partial dry or even kiln dried. By processing these raw materials all in the same way, the end product has consistent moisture content, heat value, ash content, and burn characteristics.
Some of the raw material may be sawdust, wood chips, lumber mill scrap, and even full trees unsuitable for lumber. The appearance of quality wood pellets is as varied as the many different species of trees. While a spectrum of colors is perfectly natural, wood pellets should generally not be darker than a cup of black coffee. An excessively dark color may indicate that bark was mixed into the manufacturing process, and those pellets will likely have high ash content (Fig. 5).

Figure 5.Spectrum of colors of pellets

Drying increases the efficiency of biomass and it produces almost no smoke on combustion. Rotary drum dryer is the most common equipment used for this purpose. In fact, the drying process is the most energy intensive process and accounts for about 70% of the total energy used in the pelletization process. The moisture content in biomass can be considerably high and are usually up to 50 – 60% which should be reduced to 10 to 15%. It should be noted that the feedstock should not be over dried, as a small amount of moisture helps in binding the biomass particles.

The next and the most important step is the effective pelletization process where the biomass is compressed throughof fixed diameter's holes and is passes under high pressure. The resulted high temperature causes the lignin and resins present in biomass to soften which acts as a binding agent between the biomass fibers. This way the biomass particles fuse to form pellets.
Binders or lubricants may be added in some cases to produce higher quality pellets, increasing their density and durability. Wood contains natural resins which act as a binder and, similarly, sawdust contains lignin which holds the pellet together. However, agricultural residues do not contain much resins or lignin, and so a stabilizing agent and/or natural additives needs to be added in this case, depending on biomass composition.
Due to the friction generated in the compression process, excess heat is developed. Thus, the pellets are very soft and hot (about 70 to 90^{o}C). It needs to be cooled and dried before its storage or packaging. Additional, the pellets may then be passed through a vibrating screen to remove fine materials.
The characteristics of biomass will determine the production processes including the equipment and characteristics of the wood pellets. The rate of production and electrical energy used in the pelletization of biomass are strongly correlated to the raw material type and processing conditions such as moisture content and feed size.
The heating or calorific value is a key factor when evaluating the applicability of a combustible material as a fuel. The heating value of wood and wood waste depends on the species, parts of the tree that are being used (core, bark, stem, wood, branch wood, etc.) and the moisture content of the wood. In practice, the moisture content of wood during logging is about 50%. Depending on transportation and storing methods and conditions it may rise to 65% or fall to some 30% at the mill site. The moisture content of the wood waste in an industry depends on the stage where the waste is extracted and whether wood has been dried before this stage.

5. CONCLUSIONS

Because of the availability of raw materials is one of the key success factors in the business of wood pellets, so it needs special attention of its own. Therefore, wood sawmill wastes and wood processing wastes could be used for wood pellets manufacturing. Good forest management service that will produce a sustainable supply of raw materials.
Biomass resources, particularly residues from forests, wood processing, agricultural crops and agro–processing, are under–utilized in Romania. There is an urgent need to utilize biomass wastes for commercial electricity and heat production to cater to the needs of the industries as well as urban and rural communities. Biomass technologies which are at present widely used in Romania are need to be improved towards best practice by making use of the latest trends in the biomass energy sector. Therefore, is needed to implement the latest waste–to–energy technologies to tap the unharnessed potential of biomass resources. The development of efficient biomass handling technologies, improvement of agro–forestry systems and establishment of small and large–scale biomass–based power plants can play a major role in rural development.
Wood Pellets are mainly made of sawdust, and that sawdust is the byproduct of wood working factories, lumberyards, and sawmills. This means they are a recycled, reclaimed product, and that is good for the environment.
The wood pellets can be used industrially or domestically, by anyone who wants to optimize heating costs and increase comfort level. [13] Overall, the wood pellets are:

- clean and easy to transport, distribution and storage,
- a sustainable, reliable and renewable energy source,
- low priced,
- easy to handle, convenience transport,
- high efficiency and energy saving, good quality,
- a competitive performance level in all stages of production, transport, storage and end use,
- an easy way to reduce electricity consumption,

» environmentally clean, i.e. when burnt the ash produced can be used in the garden as a fertilizer.

Biomass pellets are a popular type of biomass fuel, generally made from wood wastes, agricultural biomass and forestry residues. In addition to savings in transportation and storage, pelletization of biomass facilitates easy and cost effective handling.Biomass is seen as an economically viable and environmentally friendly solution to energy generation. Biomass is a financially viable investment as well as being environmentally friendly.

Wood pellets have only become an important part of this boom in the past few years. Owners of large coal–fired power stations in Europe started searching for a way to fulfill the new regulations and to find a solution for the declining economic relevance of traditional coal–fired power stations due to their high carbon dioxide emissions. The answer was to give the old dirty giants a green coat of paint by "co–firing" regular coal power plants with wood pellets. The idea of using wood as a renewable source was backed by environment organizations. More recent pellet investment projects as well as facilities currently under construction show that the production of wood pellets is being outsourced by the energy firms to companies specialized in wood pellet production. These firms are 100–percent focused on sourcing the raw material, operating the wood pellet production plant and handling the logistics for transporting the renewable resource.

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ISSN 2064-7964

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CONSUMER HABITS OF FOOD SUPPLEMENTS FROM THE PERSPECTIVE OF FOOD SAFETY

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ABSTRACT

The topicality of the subject has been shown by the fact that the number of food supplements has been increasing. These products are different from the traditional food products and the risks associated with them may also differ from the traditional food risks. Meanwhile, in the market customers are given significant amounts of information about food supplements, but this information sometimes can be misleading and may influence consumer habits.
The aim of my research therefore is to examine the consumption patterns of adult food supplements users, highlighting some of the determinants of food safety, such as quality, availability of information and risks.
Within the framework of primary research, focus group interviews were conducted and a survey was also used. Based on both the focus group and the survey results, it can be seen that the uses of food supplements are judged differently by the respondents. In data processing, factor- and cluster analysis were used to segment consumers based upon how they consider the use of food supplements. Four homogenous groups were identified among the respondents and the research examined which consumer characteristics were applicable to each group.

Keywords: segmentation, marketing strategy, quality, information, risk

1. INTRODUCTION

According to different surveys, in Central Europe the average life expactancy and health condition of people are worse than the average of the EU. Thus, health conscious behavior and nutrition play an important role in health protection.
Because of a change in living conditions, people being in constant stress, not doing enough physical activities and living in polluted cities need vitamins, micro- and macro elements with greater effects. Eating habits have changed; there are plenty of ready-to-eat meals that often do not contain necessary nutrients. Nowadays, it is not enough to consume traditional foods only. Food supplements are those products that can supply us with essential nutrients.
In literature, there are many possible definitions for the term 'functional food', but so far there is no global consensus on its meaning. The term was first used in Japan in the 1980's for food products fortified with special constituents that possess advantegeous physiological effects. Functional foods may improve the general conditions of the body and decrease the risk of some diseases. The japanese interest for functional food has brought awareness for the need of such products in places like Europe and the United States. Experts in these countries realised that besides being able to lower the cost of healthcare of the aging population, functional food might also give a commercial potential for the food industry [4]. This new category of products also bring science and high technology into everyday life by promising certain health benefits [2].
The food industry is one of the most important branches of the national economies in the European Union, playing a central role for the processing of agricultural raw materials and food supply. In this industry, innovations are recognized as an important instrument for companies belonging to the food industry in order to stand out from competitors and to satisfy consumer expectations [1]. Markets for this category show intense competition and in order to survive, companies must carefully plan new product processes. This competitive atmosphere suffers from a lack of information and understanding of consumer attitudes and behaviour and this could lead to poor market acceptance [6].
In the last few years the market of food supplements has increased extremely. A general trend can be observed on health market: consumers tend to switch from Rx (medical prescription) to OTC (over-the-counter) products increasingly. Based on a literature review, prospects of OTC market seem to be good in future, however this requires the accurate understanding of constantly increasing consumer demands.

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As in Ref. [5] globally, Western Europe and The United States are the biggest regions of OTC market - representing about 43% of the sales in the sector. However, the real drivers of the changes are South-East Asia, Latin America and the emerging countries of Central-Eastern Europe, especially the V4 countries (Fig. 1.) As for the yearly change of the expenditure, the most significant development was taken by Russia and Poland.

Tisman in Ref. [5] pointed out that growth of almost a quarter in the European OTC market recently had come from innovation. *"So innovating to provide better products with additional benefits for which consumers are willing to pay more money is really the key"*. Tisman advised innovation should be more than just product development. He emphasized: *"the majority of innovations come from line extensions which probably are not adding huge benefits to the consumer"*. For example, social media is now present in consumers' daily lives, so it should be used better by consumer health care. As well as innovation is dosage or delivery technologies also could add benefits to customers.

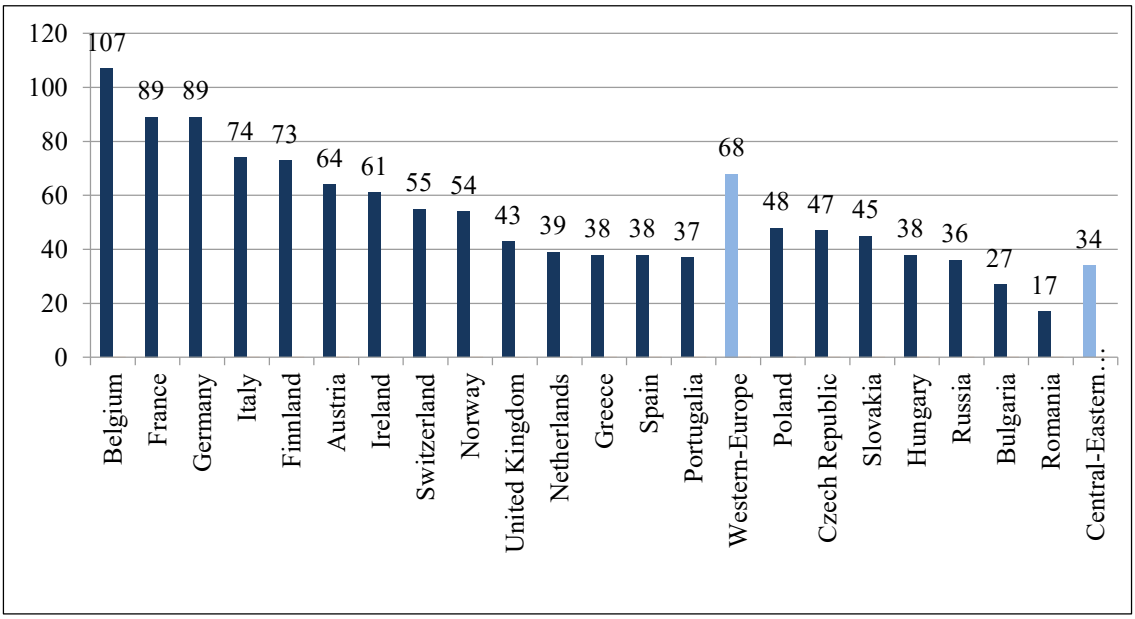

Figure 1. OTC expenditures per capita in the European countries, euro [5]

2. MATERIALS AND METHODS

To base the research, focus group interviews were used as a qualitative technique. The group discussion was conducted twice - with 6-6 persons in each - to identify trends and patterns in perceptions. The results provide clues and insights as to how a product is perceived by the group (Tab. 1).

Table 1. Demographic composition of participants in focus group interviews, person

Educational level	Age				
	18–29	30–39	40–49	50–59	60 yrs +
Basic level	0	0	0	0	2
Intermediate level	1	2	0	1	2
Higher level	1	2	1	0	0

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Criteria for participation in the group: the age of 18 or above and earlier experience in the use of food supplements. A total of 12 individuals participated (3 men and 9 women) in the interviews. In the quantitative technique, online survey was used as the main primer method. The following table shows the definition of target population of the survey.

Table 2. The definition of target population

Basic file (population)	Unit of sampling	Geographical area	Period of survey	Sampling frame
The adult population of Hungary (women and men, 18 yrs+)	Individuals	The area of Hungary	August-September 2014	Predefined list of individuals (database with names and email addresses)

280 survey were sent by email and 104 were successfully completed and returned. The response rate in adult men and women was 37,14% in the research. As a research tool a standardized questionnaire was applied. Questions were grouped around 4 main topics:

1. Attitudes toward health and healthy lifestyle.
2. Consumer judgement of the use of food supplements.
3. Consumption patterns of food supplements.
4. Factors influencing purchase decision; especially

• quality;
• information and
• risks.

The applied sampling is convenience sampling, thus it may limits generelizibility. The survey was carried out in August-September 2014, in Hungary. SPSS statistical softwer was used for data processing and MS EXCEL for presenting the results [3].

3. RESULTS

Participants in focus group interviews shared similar opinion about health and healthy lifestyle. Among factors influencing healthy lifestyle, participants emphasized the importance of healthy nutrition. They agreed that in healthy nutrition diversity is the key. Participants also agreed that there can be different situation in life when the use of food supplements is unavoidable.

Data from the survey results show that respondents feel health protection is rather important (4,58 average). It can also be seen from the results that consumers pay attention to the quality of food (3,97). They are willing to pay extra money in order to protect their health (3,67) and are willing to apply health care products (3,61). Respondents pay attention to their family nutrition moderately (3,06). Doing regular physical activity usually is not applicable to them (2,30).

As for the motivation of food supplement consumption, the most frequent reason of consumption is vitamin intake, followed by health protection and than attractive appearance. Treatment of diseases and pregnancy were choosen less by the respondents.

In this paper, I studied the correlation between gender and the motivation factors and I found that 43,7% of women choosed health protection as their main motivation ($p = 0,0$). Around 41% of men and 33% of

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women choosed vitamin intake as the reason of consumption. Attractive appearance was choosed by 19% of women and only 3% of men (p = 0,02).
As for the consumptiom patterns of food supplements, most of the respondents use food supplements seasonally (42%), followed by the customers who consume such kind of products several times in a month (21%). 18% of respondents use the products daily and 11% consume food supplements relatively frequently (3 or four times in a week). Finally, 8% of customers use them once or twice in a week (Fig. 2.).

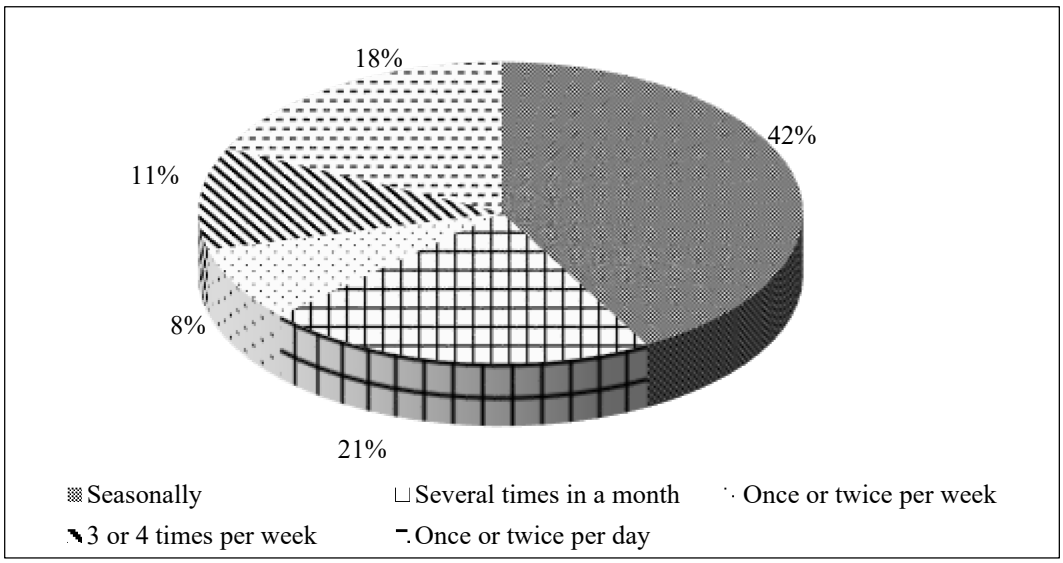

Figure 2. Frequency of consumption of food supplements, percent (n=104)

I examined whether there is a relationship between the different motivation factors and the frequency of consumption. I found that there is a significant relationship between health protection and the frequency of consumption: those customers, who have choosen health protection as a main motivation, they tend to consume food supplements more frequently: once or twice per day (18%), several times per month (21%) and 3 or 4 timer per week (11%). Those customers who comsume food supplements for the reason of vitamin intake consume these products sesonally; whereas those customers who want to be attractive use the products once or twice per day.
Among factors influencing customer decision making, experience in earlier food supplement consumption received the highest value (4,30), followed by quality (4,28) and price (4,02). Other influencing factors, such as function, manufacturer, safety, taste or brand affect consumer behavior less (Fig. 3.)

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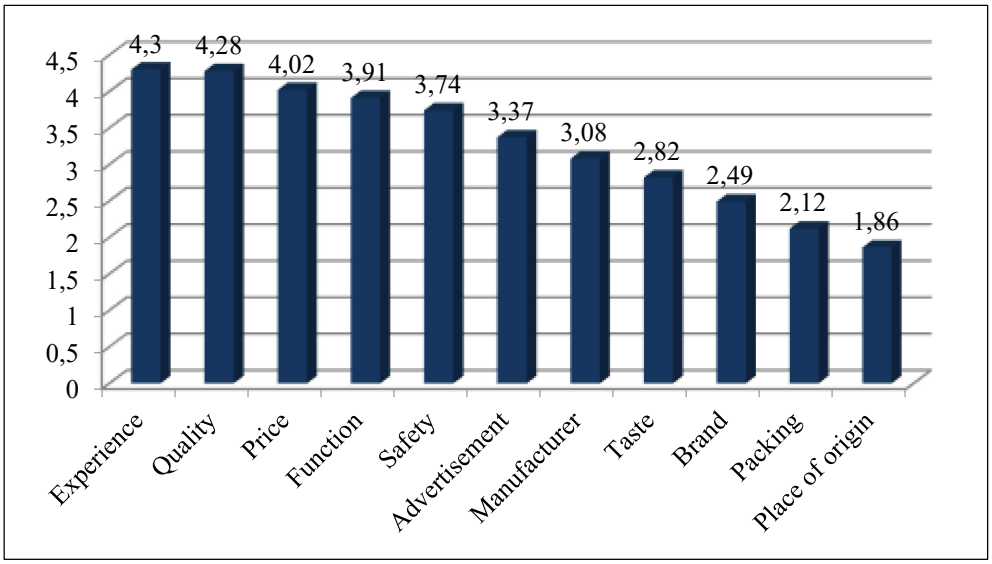

Figure 3. Factors influencing food supplement consumption on 1-5 range scale, based on the average of the answers, (n=104)

Fig. 4. shows the most important sources of information. Respondents believe that the opinion of healthcare professionals (doctors, pharmacists) is the most authentic source of information, followed by sales persons, and then articles and tv/radio programmes connected to the topic. Customers obtain information from the acquaintances moderately. Examining the question on basis of gender, 94% of women and 56% of men listen to health care professionals completely. Whereas, 44% of men and only 3% of women mostly accept doctor's and pharmacist's advice.

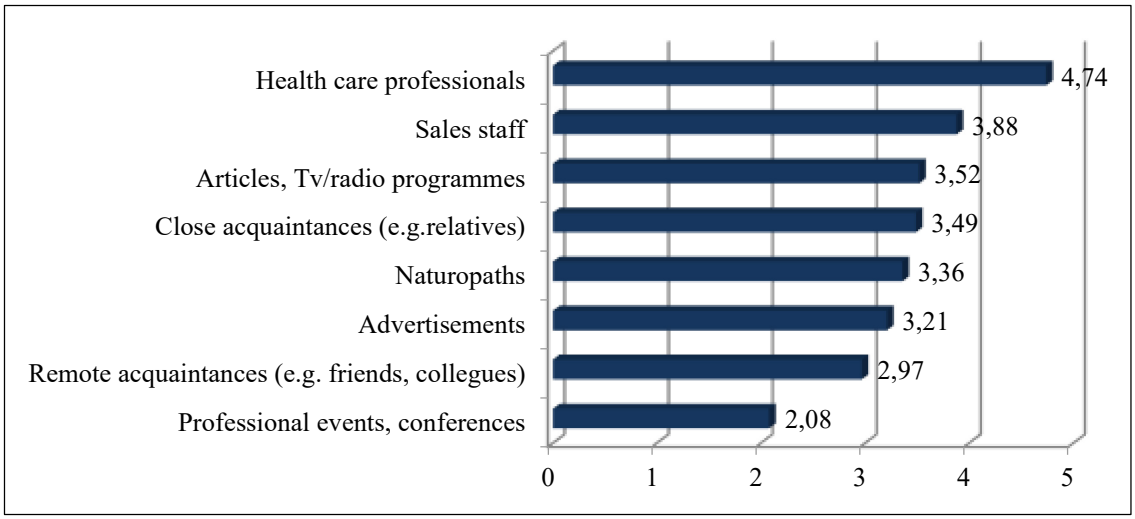

Figure 4. The most important sources of information in the case of food supplements, based on the average of the answers, (n=104)

In the research I examined how customers judge the characteristics of food supplements. To measure respondents' attitude, a five point Likert-scale was applied, where "1" means customers strongly disagree

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with the particular statement and "5" means they strongly agree with the statement. Statements that have received the highest values are as follows:
Food supplements can be purchased without a prescription (4,63), they play an important role in disease prevention (4,59), they must be applied in specific doses (4,50), they supply improper diet (4,34). Since respondents had to assess 12 possible answers at this question, in data processing my aim was to reduce the number of statements for easier legibility (Tab. 3.)

Table 3. Name and contents of the factors, Rotated Component Matrix

Name of the factor	Factor statement	Component				
		1	2	3	4	5
F1 – consideration of health protection	K5_1. Food supplements supply improper diet.	0,77	–0,10	–0,02	–0,04	0,03
	K5_2. They play an important role in prevention of diseases.	0,72	0,29	0,17	0,04	0,14
	K5_4. They can be purchased without a prescription.	0,56	0,18	0,45	0,00	–0,05
F2 – factors of uncertainty	K5_7. A lot of information is required for their use.	–0,21	0,75	–0,06	–0,19	0,20
	K5_8. There is no need for a permission for their distribution.	0,15	0,74	0,29	0,11	–0,03
	K5_12. Their unnecessary use can be dangerous.	0,32	0,68	0,04	0,09	–0,23
F3 – knowledge of ingredients	K5_5. They migh interact with other medicines.	0,00	0,01	0,84	–0,11	–0,24
	K5_6. They contain natural ingredients only.	0,32	0,28	0,61	0,25	0,37
F4 – importance of dosage	K5_9. They can be used without a doctor's supervision.	0,06	–0,12	–0,08	0,74	0,35
	K5_11. They have to be used in specific doses.	0,40	0,42	–0,10	0,63	–0,26
	K5_10. Food supplements are costly.	–0,42	0,00	0,12	0,60	–0,06
F5 – perception of necessity	K5_3. Everybody needs food supplements.	0,08	–0,02	–0,12	0,07	0,85

I have classified the respondents into homogenous groups by the means of the variables that were generated during factor analysis. 104 cases could be included in the analysis. Clusters contain 24, 40,12, 28 elements respectively in a 4-cluster-solution (Fig. 5).

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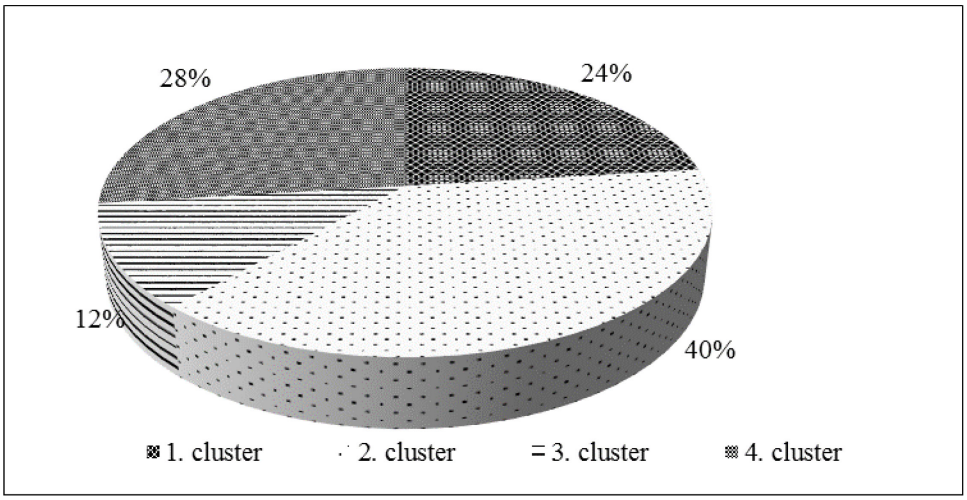

Figure 5. Distribution of respondents in the four cluster, percent

The clusters were characterized by the analysis of clustercentroids, i.e. I defined the average of the factor within each group and I have made our conseqvencies to the specic group. In the case of each segment, the elements of marketing-mix have been identified. I have characterised the generated groups by demograpfic variables as well. Based on chi-square test, I studied the relationship between cluster membership and the following variables:

- gender (P=0,004): significant
- age (p=0,11): no significant
- qualification (p=0,0): significant
- location (p=0,281): no significant
- marital status (p=0,173): no significant relationship.

In summary, the four consumer segments in the food supplement market can be described as follows:
Cluster 1 – the segment of *Comfortable* customers contain those customers, who consider health protection very important, but who are tend to do less in order to protect their health. On the other hand, they are willingly use alternative health products. Customers of this group believe that everybody needs to consume food supplements. Most of them are women (80%); mainly from the young age groups. The main motivation for them is health protection. Attractive appearance is another imortant motivation factor in this segment. In the consumption of food supplements, they are afraid the most that the product is not of a proper quality and they might overuse them. In order to avoid the risks, they usually choose those products that have already been tried by themselves or by their relatives and friends. One of the main characteristics of this cluster is that customers listen to their close or distant acqaintences' opinion.
Cluster 2 – Customers, belonging to the segments of *Skeptics*, think that their health is important, but - unlike Comfortable customers - they live a more active life; however they tend to use alternative therapies less. Skeptic customers answered negatively to the questions regarding to health protection as well as safety. They considered the importance of necessity of food supplements negatively. In this group, men can be found mainly (65%), who are mostly over the age of 40. They purchase food supplements in order to vitamin supplements mostly. Customers of the segment are afraid that food supplements might cause allergy.
Cluster 3 – the members of *Careful users* seem to be rather careful in the usage of food supplements. It is very important for them to use these products carefully: they read the instructions and dosage thoroughuly, They take it into account that food supplements might interact with medicines. Their knowledge of

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ingredients is high. Gender ratio is well-balanced in this cluster. Consumers of this group have low income usually. The members of the group consume food supplements for the reason of vitamin intake mainly.
Cluster 4 – *Conscious Health Protectors* attach high importance to health protection: among all groups, they are most willing to act for the favour of their health: they do sports regularly; they pay attention to their own and their family members' health, and they tend to use alternative health products more than the consumers of the other groups. These are the customers who are less afraid of the risks associated with the usage of food supplements, than the members of other segments and also, they are most willing to spend money in order to protect their health. The main motivation for them is protection of their health. Gender ratio is well-balanced in this groups as well; members are usually middle-aged (30–50). In this cluster, consumers have usually high income and high qualification.

4. DISCUSSION

Based on the characteristics of the clusters and taking the elements of marketing-mix into account, I recommend the following marketing strategy considering each group:
Comfortable customers: at this segment it is advisable to draw customers' attention how important it is to actively take part in the protection of their health.
Skeptics: marketing strategy should convince customers - even with the help of a health care proffesional, such as doctors and pharmacists - about how food supplements can contribute to their health and the prevention of diseases.
Careful users: companies must win the trust of these customers and have to give more detailed information on the products: either by developing proper instructions, either by the training of health care professionals. Regarding to the fact that members of this group can be influenced by advertisements and customers often obtain information from magazine articles and TV programmes connected to the topic, companies should use these tools to send their messages to the customers. In marketing communication messages should emphasize safety. On the other hand, members of this group are price-sensitive and this means that discounts also could draw customers' attention to the products.
Conscious health protectors: have a wide range of knowledge on health care topics and they believe it is important to be active in order to protect their health. For these customers, quality is extremely important, thus the main aim in defining the right marketing strategy could be developing products with high quality. High quality should be emphasize in communication. Since, members obtain high educational level and income, their expectation toward food supplements may be high as well. Therefore, it is advisable to pay attention to other characteristics of the products: such as packing. With the extention of selection (producing different tastes) companies could increase their turnover in this segment.
Although the present study has some limitations. The sample is not representative and it is not randomly drawn. However, the research can still help companies to understand consumers habits and attitudes toward food supplements. Findings can also improve the innovation of new products that suit better to costumers' unique needs The results can also give a good base for the conduction of a further, advanced level of research.
As for further research, I recommend to conduct the research again on a much bigger sample size, in order to notice any relations with other demographic variables as well. In the meantime, it can be observed how consumers attitude have changed over time.

5. CONCLUSIONS

I conclude that in the healthcare market (and, in the food supplement market as well) it can be observed that customers are becoming more health-conscious and they choose carefully the food that they eat. This observation is supported by the results of the literature and my primary research as well. Consumers of food supplements are motivated by different reasons and they attach different degrees of importance to the roles of these products. In summary, segmentation is the technique that can help businesses to define the

right marketing strategy in order to succed among the strong competition relations of food supplement market.

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DEVELOPMENTAL CYCLES OF A FAMILY BUSINESS IN THE CATERING INDUSTRY: CASE STUDY

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ABSTRACT

Small and medium-sized enterprises became relevant actors of the economy due not only to their role in the employment but also in producing GDP and export products. Within the sector, family enterprises constitute ¾ of the enterprises in Europe, their significance is therefore decisive. In our publication, we present the career path of SoReCa Ltd., family enterprise acting in the catering industry.
Having operated for 10 years, the company's portfolio covers child nutrition, company canteens as well as event catering. In our research, we used the corporate lifecycle model of Adizes which was supplemented by corporate medical records, as a useful practical tool. By these medical records, we may explore SoReCa lifecycle stages, their main features, and the signs of crisis, evolution or revolution. These analyses may help the management in the decision process and may form successful management tools in establishing new strategy if needed. We show that among management roles - integrator role - is the key role of organizations in Prime ages.

Keywords: SMEs, family business, lifecycle models, catering industry

1. INTRODUCTION

While private business ownership existed in the initial years of transition in Hungary also, many important aspects of productive entrepreneurship – like innovation, strategy creation, customer orientation, or risk taking – could not evolve. The situation changed in the 2000s, by that time the main transformational changes of setting up market economy institutions were finished, economies were mostly liberalized. [1]
Nowadays, family businesses constitute 70-80% of the enterprises in Europe, meanwhile their role in the employment reach 40-50%, their significance is therefore decisive, they have become relevant actors of the economy by today. [2]
However several researchers deal with the sector, still there is no clear and generally accepted definition for family businesses. [3][4][5]
Wimmer et al [6] defined family businesses as enterprises where a family or an association of families has decisive influence on the development of the enterprise.
According to the definition approved and proposed for use by the European Commission family businesses are:

1. "The majority of decision-making rights are in the possession of the natural person(s) who established the firm, or in the possession of the natural person(s) who has/have acquired the share capital of the firm, or in the possession of their spouses, parents, child, or children's direct heirs.
2. The majority of decision-making rights are indirect or direct.
3. At least one representative of the family or kin is formally involved in the governance of the firm.
4. Listed companies meet the definition of family enterprise if the person who established or acquired the firm (share capital) or their families or descendants possess 25 per cent of the decision-making rights mandated by their share capital." [7]

The basis of operation of family businesses is the emotional attachment, as the family gives its own name for the company and for their products. They might become more successful and competitive, since it is not only a workplace but a life goal for the founder(s), meanwhile the owners coming from the same family cooperate in constant cohesion. [8] In family businesses the work-life balance of the family members will play an important role. [9]

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In family business, the growth ambitions are determined by the family size and the profit motives usually depend on the family needs. [10]

2. MATERIAL AND METHOD

The focus of our examination is on corporative lifecycle models. Several Hungarian and foreign researchers examined the lifecycle of enterprises, presenting the development stages from different aspects. Timmons [11] investigated the running-up path of the enterprises, meanwhile Hisrich – Peters [12] studied the steps prior to the market entry. Management cycles are linked to Greiner [13], while Adizes [14] compared the organization to living organisms and believes that growth and aging manifest in the interaction of flexibility and manageability. The model's most important feature is that it gives the most serious problems and threats, which may endanger the enterprise of that age. The Adizes model emphasizes that company leaders shall be able to recognize the difference between the conventional problems of a given life cycle phase of the organisation and those unconventional and harmful problems which may lead to a crises or the total fall of the company. According to Adizes, conventional problems may be solved by the internal resources of the organization if these problems may be foreseen, while the solution of unconventional problems or dysfunctions need an external help in every cases. Without this extra help, the organizations may face with irreversible situation. The special character of the model of Adizes is that it also refers to the possible death of the enterprises. [15] The length and success of different lifecycle stages are strongly depending on the attitudes and behaviour of managers. [16] Adizes proposes that the fundamental role of management for family business, company, etc. can be defined by four functions. If an enterprise could develop these roles then it will be successful which means short term and long term effectiveness and efficiency. [17]

The four roles of Management – PAEI are the followings:

- Produce: quality production – to satisfy the needs of the customer
- Administer: focusing on how to do things right in processes, procedures and systems
- Entrepreneur: successfully adaptation of change, innovation, risk, new visions
- Integrate: long term efficient organization based on a good team.

Adizes model is described in ten phases, and each phase has its unique PAEI needs. The following figure illustrates the ten stages and their needs. (Fig. 1)

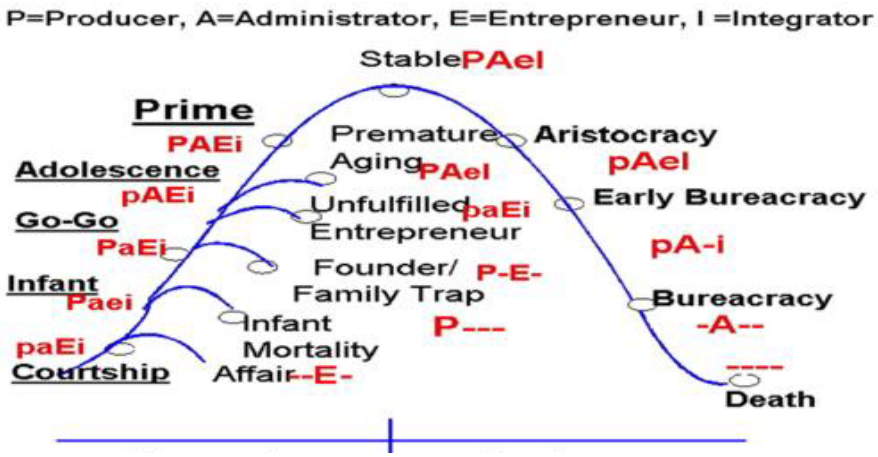

Figure 1. The four roles of management in the Adizes model [17]

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Illés, Dunay and Tatár [15] explored the different signs of evolution and revolution processes in the different lifecycle stages. They suggested to analyse the state of health of the enterprise and to identify the possible symptoms in the form of a "corporate medical record". (Tab. 1) We used this model in our survey. In our opinion, this model may be considered as most detailed, because it gives the possible problems, their solution and manager roles which are extremely important and determine corporate efficiency in family businesses as well.

Table 1: Structure of a "Corporate Medical Record" [15]

NAME:	**Name of the company**
AGE:	**Name of the stage**
Personal data: The usual attributes of the different stages	Symptoms, complaints: Revolution symptoms
Immune system: Dominant evolution characters	Missing symptoms: Symptoms which appears in Adizes model, but not typical in the examined company's life
Temperature: Symbolical indication to the general status of the company	Therapy: Suggestion how to solve the problems

Prototypical Management Styles (PAEI)

In our research, we examined the lifecycle of SoReCa Ltd. – family enterprise having acted in the catering industry for 10 years.
During our research, we took into consideration the unique specificities and features of the stages and based on that we attempted to identify the lifecycles.

3. RESULTS

In the examination of the efficiency of enterprises in our sample, we analysed features of SoReCa Ltd. and used "corporate medical record" prototypical management styles.

Courtship stage of the examined company has started as a forced path: at the beginning of 2005 resulted by the death of a former company. Father and his son – where the father had enough experiences and commitments, his son had economical qualification for the future work – founded a new company. The specific features of the examined company are shown in the medical record of Tab. 2.

Table 2: "Courtship" stage of SoReCa Ltd.

Name: SoReCa Ltd.	**Age: Courtship (initial year – year zero)**
Personal data: - high commitment of father and his son of the company - **Entrepreneurs**	Symptoms, complaints: -
Immune system: - willingness towards risk management	Missing symptoms: ---------
Temperature: - high fever (commitment)	Therapy: - additional risk taking - company foundation

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The risk-taking level of the founders was equal and adequate for starting a new business. Entrepreneurs are typical manager role of this period. They are energized by exciting opportunities, new possibilities and future achievements. The two founders were creative - they decided to reform the school/college cuisine system with its transparency and sustainability, known the market; therefore the company was born and entered into the infancy stage.
The founders were owners and managers in one person, they were very dynamic in their work, because of their former experiences and working morale as well as their very good connections. Producer typecast owners/managers are high energy, active people. As they are managing family business, they are responsible for driving many organizational achievements. As they are father and son the values are the same, so the little patience for brainstorming, etc. characterizing this management type – are not problems in managing business. The only problem was the lack of capital, so almost all the expenditures were financed by profit-sharing loan. Lack of working capital was permanent and the strategic thinking was not typical in the company at that time. Tab. 3 illustrates the medical record of this stage.

Table 3: "Infancy" stage of SoReCa Ltd.

Name: SoReCa Ltd.	**Age: Infancy (2006 - 2007)**
Personal data: - commitment level - no hierarchy, owners worked as well - no system working - staff: total staff change - **Producers**	Symptoms, complaints: - lack of capital - lack of strategic thinking - lack of supports - problems of delegation - crisis management because of lack of payment disciplines
Immune system: - quick decision making - parental love - solve the problem of the lack of working capital	Missing symptoms: - founders did not become numb
Temperature: - high fever (commitment)	Therapy: - stabilization of financial background - stability on production and services - stability of suppliers

Hard work, consciousness and the cooperation with authorities, business partners, leasing companies, temporary work agencies and good condition contracts with them resulted the financial stabilization of the company, thus it could step further into the go-go stage in 2008. In 2008, the company's situation was well developed and stable in the market. The growth of their orders meant good negotiating and payment position and they got huge allowances. They tripled the number of their events. In 2009 as a result of the global financial crisis the reorganization of the operation became necessary. In these ages high energy, activity, result orientation is necessary, but parallel with this flexibility and dreaming appears. Tab. 4 summarizes the features of Go-go stage.

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Table 4: "Go-go" stage of SoReCa Ltd.

Name: SoReCa Ltd.	**Age: Go-go (2008 – 2013)**
Personal data: - realizing the opportunities - delegating authorities - many priorities - **Producers; Entrepreneurs**	Symptoms, complaints: - overconfidence - lack of strategic thinking - crisis management
Immune system: - stable financial background - well-operating organization - good market recognition	Missing symptoms: - many mistakes
Temperature: - high fever	Therapy: - determined growth - formulation of operation networks - planning - improving professionalism

According to Adizes [14], Prime stage is the most successful and favourable phase of the corporate lifecycle, when an organization is in its equilibrium position both in self-control and flexibility. In prime stage, organizational vitality is at its maximum.

Table 5: "Prime" stage of SoReCa Ltd.

Name: SoReCa Ltd.	**Age: Prime (2013 -)**
Personal data: - (control/flexibility) equilibrium status - functional systems - successful performance - planning - growing business - **Producers; Entrepreneurs; Administrators**	Symptoms, complaints: - centralized decision-making - self-complacency
Immune system: - permanent growing - excellent performance	Missing symptoms: ----------
Temperature: - dynamic operation	Therapy: - rules and for encouraging activities - decentralization - encouraging entrepreneurship

The examined family business is in the Prime stage now. As the players of the catering industry are responsible for the food safety in every steps of their processes [18] and a very important tool in this process is the improvement of the knowledge level of the kitchen staff [19], the management shall be conscious about their performance. In the past few years the company focused on the conscious improvement of their services and built cooperation with different scientific organizations, in order to strengthen the food quality and food safety. [20][21] An administration system was introduced, quality management certificates were obtained during this stage. As a result of the professional knowledge, experiences and motivation of the leaders, the company could successfully react the changes of the market,

thus both their revenue and market share increased. The power and responsibility became well balanced. The number of employees increased to 20 persons, which was essential for the realization of the investments projects they applied successfully in those times.
The company had got different new technological innovations e.g. “Sous Vide” and “Cook and Chill” in addition environmental awareness could improve the competitiveness of the company.
The internal decisions also stimulated the growing process. The leadership style was conscious; the brainstorming and ad-hoc decisions were not typical. The former management types completed with the administrators quite and cautious behaviour. The procedure planning and careful decision making is essential features of this stage. The medical record of this stage is shown by Tab. 5.

4. CONCLUSIONS

In this paper – through the example of the examined family business – we identified the evolution and revolution stages of its corporate lifecycle and the management types. The results of our examinations showed that the different development stages could not be separated sharply – especially after the global crisis, because a transition period may be observed in every case, as some of the features of the former stage will survive as a residuum in the new stage. Furthermore, they step over certain stages. The structure and functions of the organization could only be established gradually. In the given case the control functions, like the importance of food safety, the administrative systems, the education of the employees in using these systems, the development of the knowledge are in focus in the Prime stage. The product development, the creativity, and the good harmony of flexibility and control helps companies manage a successful future.
As it was mentioned earlier, it is very complex problem to recognize the particular lifecycle stage of an enterprise, as the differences between stages in most cases are not separated by sharp lines. Thus, the management of family businesses shall pay attention for the warning signs of the expected changes. The “corporate medical record” and the management types we introduced in our paper, may be a useful tool for determining the most important and most specific features of the different lifecycle stages, as the key characteristics, processes and threats may be recognized by this method, as well as the possible therapies, which may give a solution for the problems.

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EXAMINATION ON THE STATE OF HEALTH REGARDING A PROTECTED SESSILE OAK STOCK

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ABSTRACT

It can be observed in more and more fields of science that the results of other disciplines are utilised in order to achieve new results; it is true for nature conservation as well. Global climate change is to be considered as one of the most thoroughly studied topic; scientists pay special attention to the responses given by species and communities to climate change. In case of field examinations the accuracy of samplings and measurements is of key importance. Often solely estimated data is available which deteriorates the accuracy of the assessment. The health status of forests is usually determined by visual observations that imply errors due to human subjectivity. In this examination we surveyed the health status of a protected sessile oak stock within the Botanical Garden of Szent István University in Gödöllő by using not only conventional methods but also instrumental measurements. We have used FAKOPP 3D Acoustic Tomograph. It is an instrument developed in Hungary that is able to determine – in percentage – the extent of deterioration in tree trunks. The method of measurement is the following: this instrument measures the speed of sound propagation in the tree matter, since rotten and healthy tissues conduct sound differently. Prior to the examination we surmised that a predominantly healthy stock would be examined. Nevertheless, instrumental measurements proved that the trees of this stock are considerably decayed; therefore constant instrumental monitoring is required. We found that the extent of decomposition was the most significant in the lowest measurement level (i.e. 40 cm – Layer 1) and it steadily decreased in the higher regions.

Keywords: sessile oak, state of health, Botanical Garden, Fakopp

1. INTRODUCTION

Predictions of climate researchers stating that average temperatures are to be risen in every season in this century have become generally accepted [6]. This temperature elevation will presumably affect species and their ranges. In case of tree species the main influencing factor regarding the Northern limit of their range is temperature while the Southern or xeric limit is determined by the amount of precipitation. The temperature rise may have some positive effects on species as regards of Northern range since it enhances the process of succession due to the more favourable abiotic environment. As for the Southern limit, deteriorating water supply issues may cause the spreading of biotic diseases that reduces the competitiveness of certain species and biological associations [5].
Draught periods can be extremely hazardous since it is revealed that the forests' state of health deteriorates, causing thinning or even total destruction [1][3]. Some prognoses show the narrowing of optimal climate space for sessile oak; the extent of this process can involve 80 to 100 percent of all stocks by 2050 [2]. Thus it is necessary to examine the stress-tolerance ability and health state of sessile oak stocks in order to acquire information needed for the detection of changes [7].
Determining the state of health of individual trees is completed mainly by on-the-spot estimation of different parameters. These examinations try to eliminate errors originated from subjective and visual observations. Nevertheless, measured values also carry some degree of inaccuracy due to the method of estimation. So as to eliminate these inaccuracies instrumental measures have been implemented by using the FAKOPP 3D Acoustic Tomograph in areas covered by natural forests within the Botanical Garden of Szent István University.

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2. MATERIALS AND METHODS

We conducted our examinations on a protected sessile oak stock situated in the Botanical Garden of Szent István University. 20 sessile oaks were selected as subjects of study from the stock that is more than 100 years old. Measures were taken at five different heights (40 cm, 80 cm, 120 cm, 160 cm and 200 cm) regarding the selected specimens in order to determine their state of health. Besides data originated from FAKOPP 3D Acoustic Tomograph we also surveyed the general health status by using methods widely accepted in forestry practice, i.e. counting the chewed leaf area and the percentage of drying branches.
The FAKOPP system has been developed to examine living trees; the measured data provide evidences on the state of the inside of the trees as well as the extent of decomposition. This up-to-date method of tree examination measures the speed of sound propagation in trees. It creates a map of rotten tissues and holes within the trunk by detecting the speed of sound propagation. The theory behind this measurement is that sound propagates better in healthy tree tissue as compared to decaying material. The damage within the trunk can be determined by the decreasing propagation speed. The assessment has been made by computers, thus the process can be considered as computed tomography [4].
During measurement specifically developed detectors have been installed on the trees. The most possible detectors (10 pcs) were applied in the whole process in order to get the most accurate results. Based on literature data these measurements are expedient to conduct when sap circulation is still intense in the plants. This period generally falls between March and mid-November. In 2014 autumn has been significantly warmer than the average; the vegetation period was elongated up to the end of November. Some of our measures have been implemented in between 10th and 26th of November while the rest were conducted in June 2015.

3. RESULTS AND EVALUATION

As a first step visual inspection has been completed. Based on this examination the general state of health of the selected stock has been acceptable, especially when considering the age of the trees. Both the leaf area and the trunks of the oaks suggested that the stock is healthy. The extent of branch drying has not been significant and the damage made by insects did not exceed the expectable amount, either (Tab. 1).

Table 1. Percentage referring to the state of health regarding the examined sessile oak specimens based on the observed parameters

Sample trees	Rot (%)	Leaf chewing (%)	Dry branches (%)
1	5.6	60	15
2	11	60	5
3	14.6	15	2
4	45.6	20	15
5	35.4	20	2
6	13.2	25	5
7	13.2	60	5
8	2.8	50	7
9	11.2	40	5
10	10	35	3
11	48.2	20	15
12	5.6	25	5
13	1.6	20	10
14	14.4	60	3
15	33.2	50	2

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16	8.2	50	3
17	18.4	30	5
18	10.4	30	40
19	20	45	25
20	4.2	45	35
Average	**16.34**	**38**	**10.35**

A trend less palpable than expected has been outlined among the three factors suitable for monitoring the health status of trees. The extent of leaf chewing was the most balanced within the sampled trees since the extent of degradation caused by insects hardly varies within such small area. The average of leaf chewing was 38% that exceeds both the percentage of rotting and branch drying. Stronger correlation has been found between the latter two factors that can be explained by the fact that the decay of the trunk influences the sap circulation within the whole tree. This leads to unbalanced nutrient distribution causing the drying of certain parts of the individual plant. But branch drying is not only a result of inner decomposition: it can be initiated by certain weather anomalies. In our case sleets in December 2014 damaged the stock, too. Based on the results branch drying still showed a lower percentage than the average of rotting. The figures showed 10.35% and 16.34%, respectively.

Average rot of tree trunks exceed 10% in more than half of the examined specimens that refers to a deteriorated state of health. The extent of rot showed differences regarding the five heights of measurement (Fig. 1). It can well be seen that the extent of decomposition was the most significant in the lowest measurement level (i.e. 40 cm – Layer 1) and it steadily decreased in the higher regions. The results are demonstrated in a stacked chart in order to visually accentuate the trend (Fig. 1).

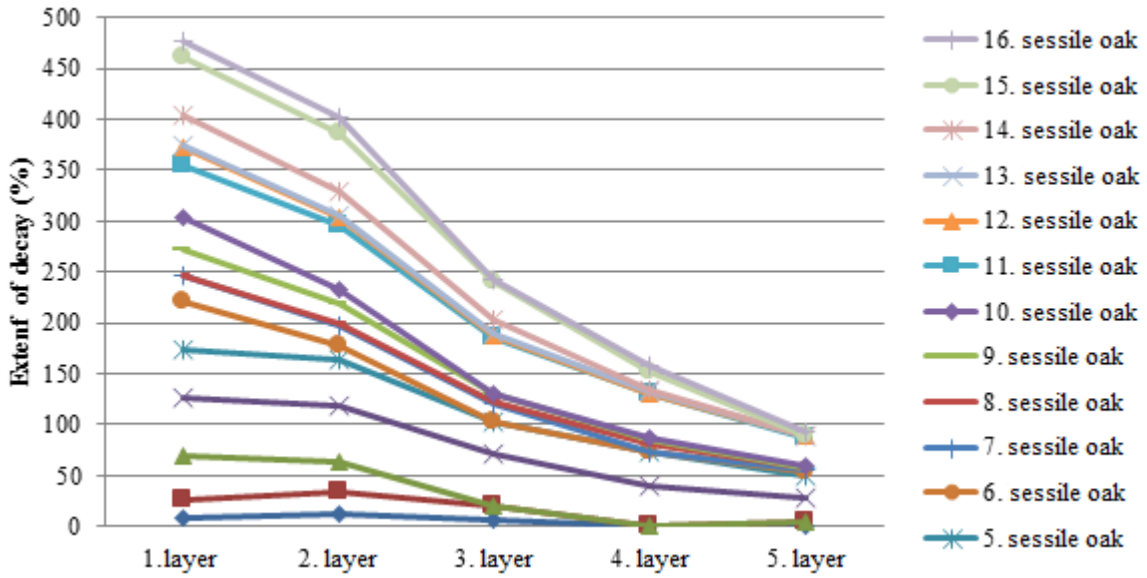

Figure 1. Comparison of the health status of examined specimens in different heights (layers)

Three oaks of significantly poor state of health (sample trees No. 4, 11 and 15) have been examined during the utilisation of FAKOPP. In all these cases the extent of decay exceeded 50% in the lower three layers. These specimens are threatened the most by falling, although the risk is present at those trees having a decay extent of 20 to 30% at the lower layers. These figures are especially high when considering the height of the trees (20m<) even if these oaks stand as a part of a stock.

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The old log can be responsible for the initiation of coppice decomposition. The instrumental measures also imply this explanation (Fig. 2 and 4).

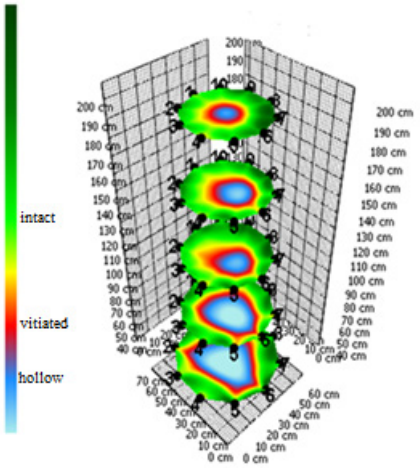

Figure 2. Cross-sectional view of an inwardly rotten sessile oak specimen measured in five different heights

In case of some specimens the decomposition has started outside, in the cortex area (Fig. 3). As for these trees presumably frost ribs are responsible for the decomposition instead of fungal diseases. Not even the presence of more saproxylophagus species leads inevitably to the deterioration of health status since these species consume only dead wood substance.

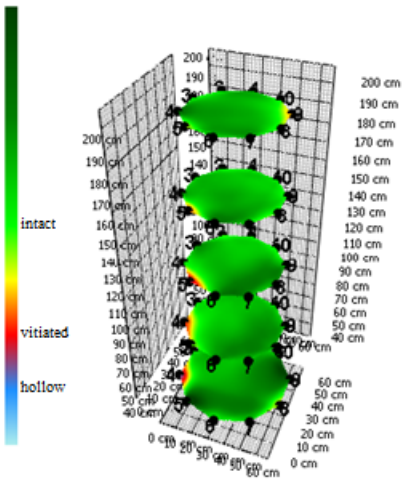

Figure 3. Outward deterioration of health in case of one examined sessile oak

Those sessile oaks had the worse state of health for which rotting had started its way not only from the inside but also from the outside. In this level of decomposition it is hard to determine where the rot originated from (Fig. 4 and 5). In these cases measurement by FAKOPP is more useful than visual inspection since an accurate picture is drawn about the state of the tree. Based on this result it is easier to decide whether some kind of intervention is necessary.

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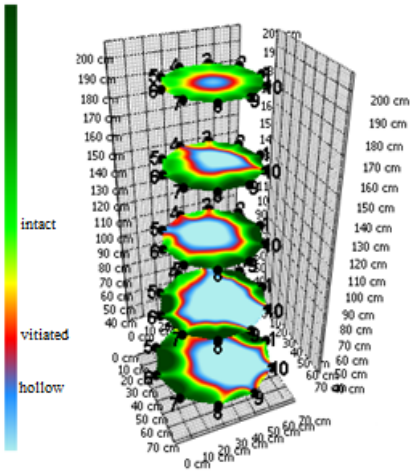

Figure 4. Extent of decay measured by FAKOPP in case of the severely deteriorated sessile oak No. 11

Figure 5. Photo of sessile oak No. 11 having decayed tissue both inside and in the cortex

4. CONCLUSIONS

By taking into account both the results of visual inspections and that of instrumental measurements it seems that the deteriorated health status of this stock is not a consequence of a disease or decaying organisms. By the data of the Botanical Garden it is revealed that this stock is a coppice forest. It can be a reason why this decomposition occurs. In case of all sampled trees the decay started at the root swelling which can also be a sign of natural ageing. With its average lifespan of 200 years sessile oak is a tree species with better longevity but this cycle is generally shorter in case of coppice wood. In forestry oak

forests around 100 years old are usually cut. This means that the root system of trees in our coppice forest is approximately 200 years old and their lifespan draws near to its end.
Decrease of persistence in case of coppice trees can be caused by the fact that these specimens, due to their developed root systems, grow more intensely and develop wider annual rings compared to seedlings. Some decades later these attributes can accelerate the process of decomposition.
Monitoring the health status of forests plays an important role in climate change research. Many new or – in some cases – more accurate data can be gained if the visual inspections are accompanied by instrumental measurements. On the one hand, errors originated from subjectivity and inaccurate estimations can be avoided. On the other hand, health state of tree stocks can be better defined. However, instrumental measurement itself cannot substitute visual inspection since the latter provide important additional information.
The utilisation of instrumental measurement is justified by the fact that not only a clearer picture is given on the extent of decay but its reason can also be revealed. In our case the coppice origin of the forest is responsible for the initiation of rotting. By knowing this the treatment for this protected stock can be determined while also considering the possible consequences as well.
Although this instrumental measurement is rather time-consuming compared to the traditional status check, it can be recommended to use in case of long-term researches dealing with the climate tolerance of biological associations, since the reactions of sample trees on biotic and abiotic damages can be better and accurately monitored.

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FOOD CONSUMPTION OF ELDERLY PEOPLE FROM SUSTAINABLE POINT OF VIEW

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ABSTRACT

Ageing and sustainability are key problems of modern societies. Firstly increasing proportion of elderly people in population is becoming more important both for society and economy. Economy takes into account needs of old people as of consumers remarkable. Secondly sustainable development (SD) seems to be solution to many of global problems. However SD is contested but implementation is indispensable. Role of elderly is not negligible in it. Thirdly food consumption, as one of three essential needs, has exceptional importance in our days not only in the history. The question is how to connect sustainability, food consumption and healthy nutrition. In this case sustainability means to define criteria of foods which are better in terms of sustainability. The data is necessary for the amount of food consumed by older people. Data in territorial level cause a few problems to solve. Healthy nutrition is well known and it is compared to criteria of sustainability. Although all aspects cannot be outlined in this paper but new ideas, approaches are hopefully given.

Keywords: food consumption, elderly people, sustainable development, sustainability, criteria of sustainability, implementation sustainable development

1. INTRODUCTION

The global problems of the Mankind are serious threats for next generation. There are other ones that could not be avoided to take into account on the path-way to find the solutions. One of these is ageing which is specific feature in demography of developed countries. However many states of Third World are in the second phase with permanently growing population year by year. The proportion of elderly people in population is growing mostly all over the world. Their role is more and more increasing not only in social, in economic aspects but in cultural and political ones as well. In market-economies, in western type consumer societies this process results that more attention is paid to elderly people. The more proportion of population they have the more importance of them as consumers is. Food consumption is specific, differs from other age groups and it is has special structure.

Sustainable consumption is a real part of implementation of sustainable development. Based on UN definition the needs of future generation should take into account in our daily lives, in our daily decisions. Having regard to the fact that elders will play more role all over the word their sustainable consumption is a desirable objective. The most important part of it is food consumption. Intake of healthy food is not only personal goal of old persons but it is in focus of a democratic modern state.

The connection of this “triumvirate”, sustainability, food consumption and healthy nutrition is aim of this paper. It is clear that some part of issue is discussed here because its complexity hopefully it will be useful for further thinking.

If we overlook role of old people in demographic structure, especially for Hungary, we can get a clear view of changes and the possible future. Other question is how the food consumption of elderly people looks like in aspect of quantity and quality. It seems to be easy question but in fact it is unanswerable. We could only attempt to access to the real values. Implementation of sustainable development is much more difficult as it seems to be. In the field of nutrition of man, in one of essential needs, specific criteria should state which can help to evaluate it from sustainability point of view. The healthy diet is well-known but connection between healthy diet and that one, which serves sustainable development, is a fundamental question. In nutrition of elderly people it has particular importance.

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2. MATERIAL AND METHODS

According to the extremely widespread literature on each field of "triumvirate" it is not simple to find the most relevant ones. Furthermore there are such difficult problems. The main is a really common question that how much food is consumed by a man per year or day in fact. You find that on regional or on state level we do not know daily or yearly intake precisely!
In Hungarian statistics on food consumption there are two data originated from different methods. The first one is based on household consumption. The cumulated data is calculated from report of about ten thousand households which ones leads household budget and diary and are interviewed by specialists of Hungarian Central Statistical Office. The other one is based on national account trade statistics and it is calculated from internal trade. The two data bases have different values, sometimes sharply different.
How could it be? Household data contain only those foods which are consumed in households. Outdoor consumption in restaurants, in canteen, in school, street food, etc. is not included. The other data have been calculated from balances on major products and their quantity consumed in the country. Every data food, nutrient balance transformed into basic materials. It contains food consumption of foreigners (non-residents), as tourists, visitors but do not include those foods what are consumed by Hungarians abroad or from abroad. Extreme difference can be recognised in consumption of sugar. The consumption data based on product balance is about 2.5 times more than on household consumption. It is caused by method which one calculates in basic materials but household's data do not. Conclusion is that each method can be reference only on the way that user attracts attention to limits of them and methods should be used strictly separately.
Healthy diet is generally well-known but it is disoriented some vogue idea. These ideas can really be based on scientific results but in many cases they are business powered.
Criteria of sustainability are the other not easy task. However generally it has commonly known features but to use them grows up problems.
Decision should take to define who is an old man. Different age limits can be found in literatures. UN uses 60 year as age limit [12] but in US 65 year is applied [3]. In Hungary you can find both of them but sometimes you recognize that limit of retiring is the base of data. Unfortunately in Hungary it does not equal of any mentioned year above, moreover this number is growing slowly up in the next five years up to 65 years. Furthermore retired people not only older but their data contains younger persons also who became retired other reasons. It is easy to find three incomparable data basis that requires handle them very accurately. In the world the highest level of retiring year is in Israel and Lesotho by 70 years. Lowest ones can be found in Africa, Asia and Oceania. Extreme low 50 years can be found in Kiribati, Kuwait, Nigeria, Solomon Islands and Swaziland [12].
Generally in this paper food consumption is used in quantity and quality not in values and 60th year is the limit of old age except other year is signed.

3. RESULTS

Three aspects are discussed here. Firstly the population data are outlined. Not only life expectancy but healthy years are analysed as well.

3.1. Population and demography at the beginning of 21th century

Population of the world is estimated 7 417 million people by World Population Clock and by geohive on April 24, 2016 [16, 4]. It is an acceptable data according to estimated one by UN for 7 349 million in July 2015. However in USA data sources publish less numbers. Population of the world was 7 256 million persons in July 2015 by CIA [2]. The U. S. Census Bureau calculates 7 320 million man on April 24, 2016 [14]. Data for India gives the most part of difference between these world population data, about 45 million people less calculated by U.S. Census Bureau [13]. The Statistical Bureau of India estimates more less people for India than U. S. Census Bureau by nearly 12 million [8].

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This population and its changing structure cause three global problems which are on field of demography: overpopulation, ageing and migration. The first two are not yet studied for long time ago [7]. Ageing is resulted by longer average life expectancy at birth and decreasing fertility [12]. It seems to be the most serious challenge in demography of developed countries especially in Hungary [9]. The phenomena of ageing, baby boom and more or less stable population exist at the same time is unique in human demographic history. Ageing is a general process on Earth and it is unknown when will it reach its peak. Although the maximum human lifespan is around 125 years [14] more important is proportion of old people in the society.

Elderly people were only 8 per cent of world population in 1950. The rate grows up to 9.2 % in 1990 when fast growing has started. In 2013 11.3 % of world population belonged to age group over 60 years by UN. Increasing rate is a continuous tendency. It is very likely that in 2050 this global value can reach 21.1 per cent that is about same data as it is in more developed countries today [12]. The ageing accelerates in developing countries more rapidly than in developed ones. According to the data of World Bank [15] some least countries have lowest rate of population 65+ years in 2014 as Afghanistan, Angola, Bahrain, Burkina Faso, Burundi, Chad, Gambia, Kuwait and Uganda by 2 per cent. However Qatar and United Arab Emirates has 1 per cent resulted by huge number of immigrants workers that caused this extremely low values in rich Arab states in Persian Gulf. The largest per cent of over 65 years can be found in Japan where 26 % of Japanese celebrated already their 65th birthday [15].

Ageing is in typical for older population itself. Ratio of 80+ years in population was 7 per cent of elderly people in 1950. It has grown up to 14 per cent of oldies (over 60 years) in 2013 that is 120 million men in the world. Fastest growing could recognized in cohorts of over 100 years (centenarians). Their estimated number of 441 000 (2013) will reach 3.4 million in 2050 and hopefully 20.1 million in 2100 [12].

These data are relevant of consumption point of view. In future changing patterns of consumption is prognosticated. Although research area relates to gender and regional differences in details but now we could only outlined some health aspects of demography.

3.2. Health of elderly people, life expectancy and some consumption consequences

In consumption of elderly people is an important factor is heath of old persons. The sicker the old man the more the basic needs of life becomes important. It is generally known that state of health is the most important factor in life of old people. Figures of US non-institutional population show sharply growing in needs for assistance according to the increasing ages (Tab. 1).

Table 1. Need for personal assistance with everyday activities by cohorts in USA

(civilian non-institutional population; 1990-91) [3]

Cohort (year)	Persons needing assistance with everyday activities (%)
15 – 64	2
65 – 69	9
70 – 74	11
75 – 79	20
80 – 84	31
85 –	50

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Half of oldest-old people need help over 85 years but about over 75 years the ratio can be defined important. Figures are on the Tab 1. illustrate clearly what is the significance of healthy physical condition. Being in good and healthy condition is useful both for individuals and society also. To live in health is crucial question of old people. It is significantly related to well-being. Importance of is proved by indicator of healthy life years. Healthy life years or disability-free life expectancy is more important indicator for many researchers than life expectancy. European Union publishes values yearly. Data of life expectancy and healthy life years of some countries in 2013 is shown in Tab. 2.

Table 2. Life expectancy at birth, healthy life years at birth and at age 65 by country and gender (2013)

Country	life expectancy at birth; year			healthy life years; year			
	males (M)	females (F)	total	M	F	M 65-	F 65-
hu	72,2	79,1	75,8	59,1	60,1	6,2	6,1
sk	72,9	80,1	76,6	54,5	54,3	4,2	3,7
ro	71,6	78,7	75,2	58,6	57,9	5,8	5,2
pl	73,0	81,2	77,1	59,2	62,7	7,2	7,8
cz	75,2	81,3	78,3	62,5	64,2	8,5	8,9
at	78,6	83,8	81,3	59,7	60,2	8,9	8,8
de	78,6	83,2	80,9	57,8	57,0	7,0	7,0
fr	79,0	**85,6**	**82,4**	63,0	64,4	9,8	**10,7**
gb	79,2	82,9	81,1	64,4	64,8	**10,6**	**10,7**
ie	79,0	83,1	81,1	**65,8**	**68,0**	**10,9**	**12,1**
it	**80,3**	**85,2**	**82,9**	61,8	60,9	7,7	7,1
gr	78,7	**84,0**	81,4	**64,7**	**65,1**	8,0	6,8
mt	79,6	**84,0**	81,9	**71,6**	**72,7**	**12,8**	**12,7**
es	**80,2**	**86,1**	**83,2**	**64,7**	63,9	9,7	9,0
se	**80,2**	83,8	**82,0**	**66,9**	**66,0**	**12,9**	**13,8**
ch	**80**,7	**85,0**	**82,9**	61,5	58,4	**10,6**	10,4
no	**79,8**	83,8	81,8	**71,0**	**68,6**	**15,0**	**14,8**
EU 28	77,8	83,3	80,6	61,4	61,5	8,5	8,6

Key:
hu: Hungary sk: Slovakia ro: Romania
pl: Poland cz: Czech Republic at: Austria
de: Germany fr: France gb: Great Britain
ie: Ireland it: Italy gr: Greece
mt: Malta es: Spain se: Sweden
ch: Switzerland no: Norway

65- : healthy life years at age 65 **in bold**: 5 highest values *in italic*: 3 lowest values

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Data on the Tab. 2 gives clear consequences. Some of them are:

- countries with the highest life expectancy are not sure to be having the best in healthy life years
- divergence between countries in healthy life years is higher than expected life years;
- gender data shows remarkable less gap not to say turning of them in healthy life years;
- healthy life years over 65 are so high in the most developed and some Mediterranean countries that expected years are two-three times more than in those mostly ex-communist EU members having only 4-7 years;
- not taking into account applied methods, some of the richest countries and Malta, further in opposite point of view Germany, Austria, Italy have surprising value.

Unfortunately Hungary is in lower end in this rank. Position is worst than Poland, Czech Republic but in healthy life years was better than Slovakia was in 2013.

Thinking of food consumption those countries have more similar nutrition structure to generally typical for the state where the more healthy population is. The population of less healthy countries consume more specific food (e.g. sugar-free, allergen-free). These types of food are produced more intricately. Those processes need more energy and substances and they are more expensive as well.

3.3. Criteria of SD in food consumption

Sustainable development (SD) in term of UN is more or less well known („...sustainable development, which implies meeting the needs of the present without compromising the ability of future generations to meet their own needs…" [1]). The key words are: future generations and their ability to meet their needs. The needs are different from demands [5]. For example a shoe is a need but the thirtieth one belongs to demands. Moderation in life is other basis of sustainability.
Criteria of sustainability are commonly used all over the world. Less energy and material use are general approaches. According to the natural cycle these types of economic and technological processes are desired. Low-waste technologies are preferred.
What does it mean in practice? Many aspects of food processing could be examined from agricultural fields to the waste of foods. The most typical phenomena of consumer society is absence of seasonal difference of food supply in developed market economies. If we take thought for sustainability it is exactly contrary to idea of UN definition. More energy and material are used for transport. The main two criteria are:

a. production as close to consumption as it can be (local food)
b. use so little material as possible
c. consume less processed food
d. avoid packaging or prefer natural materials

The c. point means that the more natural state is food consumed the more sustainable nutrition is. It is true that nutrition is today more than to be satisfied the needs of essential biological needs, but the less transferred vegetables, fruits are belongs the most healthy aliments. It connects to the type of food in other words:

b. Type of food, produced less use of natural resources (water, land use, etc.)

exactly demand of sustainable consumption. Water, CO2 footprints are widely calculated and readable on internet. It is well known that foodstuffs of animal origin concentrate about one tenth of energy than food plants. Not to go more detail it is an extremely important question that is the more sustainable food

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consumption is fit to the healthy nutrition or no? In the case if the answer is negative we are really in trouble.

3.4. Healthy food consumption vs. sustainable food consumption

Biology, diet of man originated from historic time. The evolution of nutrition is much slower than our customs change. In point of view of digestion we are paleo-man yet. Many of diseases are connected to our changed alimentation. Cancer, diabetes have significantly increasing role in statistics of death. These multifactorial causes of death can be connected to unhealthy food intake.
General specific features of malnutrition are:

- high energy intake
- refined sugar over-consumption
- under dose fibrous food intake

It is necessary to mention insufficient physical activity. It is about one fourth, one fifth of when we lived in tribes. Furthermore the Palaeolithic man ate honey and fruits instead of refined sugar, more edible plants, seeds and meat was much rarer in his food than today is. We are adapted to this food intake and it has not yet changed.
The healthy nutrition consists of more fibrous plants as fruits, vegetables, honey instead of sugar and as much natural food as it is possible. Artificial substances, chemicals and most of processed aliments are not "friendly" for our digestive system.
If we take it into account and compare with main criteria of sustainable food consumption positive correlation can be recognized between them. More sustainable food consumption is healthier, the effect is not opposite.
The renaissance of eco-food, Palaeolithic-diet confirms this. Survey on consumption segments of elderly people has resulted that two of four closely connected to food consumption: focus-on-food and experience-oriented group and focus-on-home and heath-oriented group [6]. Health has been increasing the value in the life of old men.

3.5. How much we eat? And elders?

Although it seems to be easy to answer that how much food is consumed but there no correct data. The nutrition of a man is not clear from the first step! It is true not only in quantity but in quality, also. In Hungary there are two different statistics based on household consumption and on balances drawn up on major products. These are not comparable KSH [10]. For elderly people are household data. However from methodology those are households of old people where the householder is old. There are quantity data more than 60 foods but their production country is not known although it would be important for sustainable evaluation. Territorial point of view region data are accessible only. The analysis is not easy but the data published on base of same method can be compared in time, on long time period too.
Food consumption of elderly people by households shows extremely interesting values. According them the household of old people eat the most food per capita, more than any other cohorts! Even though in real elderly men eat less than adults. It could be caused:

- they are households data, average of members are
- only those consumption is involved which has happened at home (canteen, restaurants not included)
- in younger families the children eat less, there are smaller ones
- elderly people feed their grandchildren
- elders keep more food in reserve

4. CONLUSIONS

Elderly people have more and more important role in all countries of the world. The increasing life expectancy is a general indicator of better life. Ageing is caused by. However healthy life years, as a new indicator, have more relevance for man and country also. There are differences between them in ranks and its values are more extreme in healthy life years by EU data. The gender difference disappears and remarkable is best position of Malta. The state of health effects to the food consumption especially for elderly people.

If we want to survey food consumption for giving assist to implement sustainable development many problems are fund. There are from exact interpretation of sustainable development lasted to the problems of databases. Criteria of sustainability are chosen that are before improving. It is not negligible to define not only elements of food consumption of consumption but of healthy nutrition. Their theoretical comparison resulted positive correlation between them. Bio-food, Palaeolithic diet, vegetarian food are not only more healthy but better fit for sustainable consumption.

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Analecta Technica Szegedinensia
ISSN 2064-7964

Vol. 10, No. 2 2016

INNOVATION AT PAKS NUCLEAR POWER PLANT

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ABSTRACT

In the summer of 2014 at the Maintenance Division of Paks Nuclear Power Plant Ltd. in Hungary there was an opportunity to take part in the preparatory work a new and innovative project for introduction. This is a charge-planner software support using the tests related the new fuel. The necessary calculations were completed and after obtaining the results the conclusion is that the actual 12 month operating period – the so-called campaign length – can be increased to 15 months, by using and shuffling the new fuel with higher enrichment, and by loading six fuel assemblies with gadolinium oxide into the unit. Conclusion is the new Gd-2_4.7 fuel initial expectations were met and managed to find a favorable average enrichment not only considering nuclear physics, but also economic, risk management, material structure and security points of view as well. Testing can be started in the summer of 2015, and the fuel can be loaded into Unit 3 for a test period of 365 days.

Keywords: new nuclear fuel, capacity increase, advantages

1. INTRODUCTION

In the summer of 2014 at the Maintenance Division of Paks Nuclear Power Plant Ltd. there was an opportunity to take part in the preparatory work for the introduction of the innovative project of a 15 month long operating interval (project C15). The main objective of the project C15 was to extend the actual 12 month operating period to 15 months, by means of using and shuffling the higher enriched fuel, and by disposing 6 fuel assemblies with gadolinium oxide into the block. Therefore the actual 4.2% average enrichment goes up to 4.7%. In the Reactor Physics Division computer simulations, such as HELIOS 1.9, C-PORCA 7.0, CERBER and EGYS helped to determine the necessary arrangement and enrichment percentage of the fuel assembly. The computer softwares do not only help to determine the optimal design of the fuel bundle, but also enable to carry out simulations about the process of radioactive decay and the physical impacts on the reactor vessel. It is also necessary to examine the returns/outcomes of the project, and it is expedient to design an opinion poll based on a representative sample [4] [5] [6].

2. STRATEGIC PLAN OF THE PAKS NUCLEAR POWER PLANT LTD.

In Paks, the four VVER 440 units reach their originally planned 30-year operation time between 2012 and 2017. Altogether, the four blocks operate at 2000 MW total capacity and they provide 50.7% of Hungary's total energy production. Based on these facts, the management of the power plant decided to examine the possibility of a life time extension. It is important to point out that the nuclear investments and improvements must always meet the fundamental requirements of nuclear safety, economic efficiency and social acceptance. With regard to these aspects, Unit 1 received its 20 years lifetime extension permission in 2011, while Unit 2 in 2014. Examination of lifetime extension of Unit 3 is still in progress, it is expected to get the permission in late 2015, while Unit 4 in 2016. Therefore, further operation of the power plant is guaranteed, along with the capacity increase. The innovative project C15 examines the benefits of using fuel assembly with gadolinium and increased enrichment. It is also important that the 15 month operation period is in accordance with the national and international safety regulations at all times [1] [3] [6] [8].

2.1. Carrying out project C15

In 2009, the nearly 5% enriched U-235 fuel assemblies designed for VVER-440 reactors were brought to the market by Russian fuel producers. Suppliers offered a fuel assembly with 4.87% average enrichment and 6 rods containing Gadolinium. This fuel was introduced and used with success in Slovakia as well, in

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the 12 month- long operational period. The applied manufacturing technology and the favorable operating experiences showed that the fuel can be used up to a high level (95%) of burn-out with safety, therefore Paks also started to examine the possible introduction of this fuel. Results of inner studies showed that the level of enrichment advised by the supplier is not optimal because of the too high level of unequal heat and capacity distribution within the fuel assembly therefore it would have been disadvantageous for Paks. As a consequence, the management of the power plant decided to consult with the Russian partners and the Centre for Energy Research of the Hungarian Academy of Sciences in order to specify the optimal fuel assembly design. While carrying out the analysis, researchers tried not to change the fuel geometry, and decided that for the necessary modifications only one step should be taken at a time. Furthermore, the flux level that reaches the reactor vessel should not be higher than the originally measured level (while using the Gd-2n fuel assembly).

The first step was to examine the given fuel assemblies: the U-235 (4.95%, 4.6%, 4.4%, 4.0%), the U-235-Gd (4.4%, 4.0%) and the Gd content (3.35%). Simulations of the possible versions (4.87%-4.65%) were carried out by HELIOS software (determination of pp-max, pp-gd levels). The next step was the determination of the optimal zone surface with the VERONA TH subchannel codes (determination of subchannel maximum). As the following step we specified the possible geometries by the HELIOS software for 4 versions. Calculations with the equilibrium operating cycle were carried out with EGYS models, while simulations of the transitional operating cycle were determined by C-PORCA 7.0 software (Fig. 1).

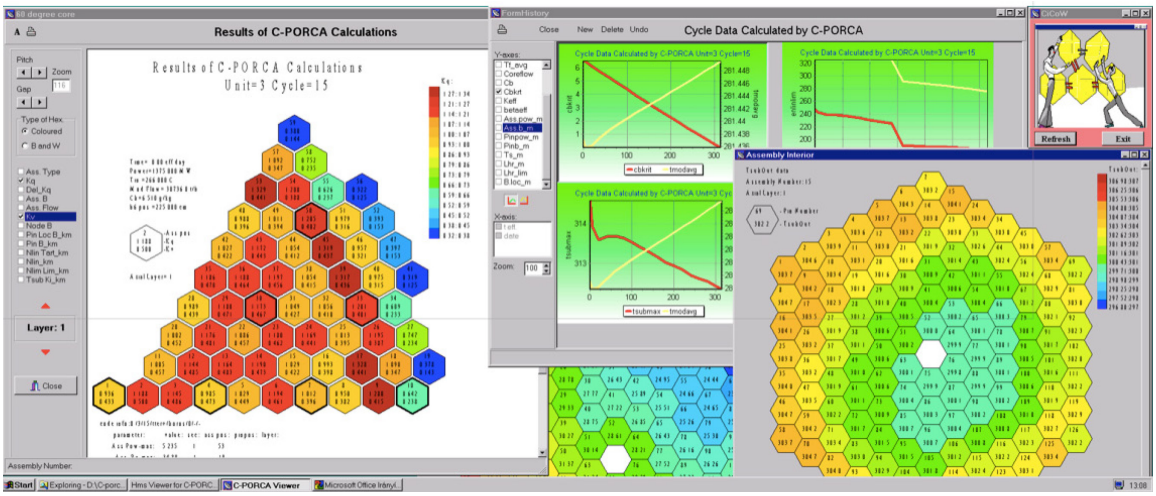

Figure 1. C-PORCA 7.0

2.2. Gd-2_4.7 fuel assembly

The Gd-2_4.7 is a Hungarian invention, a new type of fuel assembly planned by Imre Nemes head of department at the Reactor Physics Division. Simulations showed that the tank wall received less, or the same amount of radiation exposure than with the lower, 4.2% average enrichment fuel assemblies as during the 12 months cycle. The reason for this enhancement is that the use of 4.95% U-235 made it possible to use 6 rods of gadolinium oxide helping to decrease the inequalities in capacity within the fuel assemblies, and a total of 4.7% enrichment can be achieved. The 4.2% enrichment technology made it possible to use only 3 Gd rods, therefore it is less effective. The Gd-2_4.7 requires 102 new fuel assemblies every 15 months: 66 of them with 4.7% and 36 with the currently used 4.2% enriched fuel. In case of longer operational period the ratio of 4.7% fuel assemblies can be increased (Fig. 2), therefore an effective operational period of 425-428 days can be fulfilled. As a consequence, the advantage of the mixed

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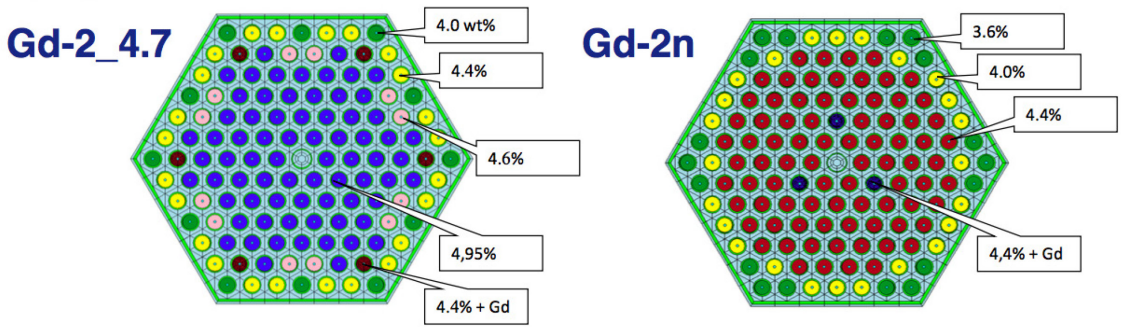
application of the fuel assemblies with different level of enrichment is that it makes the operational period more flexible. A further advantage is that the new configuration allows the possibility to use up a large amount of the 4.2% enriched fuel reserve. The third advantage is that this technique decreases the number of the burnt-out fuel assemblies in the long run [3] [5] [7] [8].



New fuel

	Enriched	Pieces	UO2
	4%	12	48
	4.4%+Gd	30	132
	4.6%	12	55.2
	4.95%	72	356.4
∑	-	126	591.6
Δ	-	**4.695238%**	

Actual fuel

	Enriched	Pieces	UO2
	3.6%	18	64.8
	4.0%	24	96
	4.4%+Gd	84	369.6
∑	-	126	530.4
Δ	-	**4.209524%**	

Figure 2. Gd-2_4.7 – Gd-2n fuel

2.3. The engineering tasks necessary for realization of the project C15 [3] [5] [7] [8]

The introduction of the C15 operational period involves three basic technical changes that affect the power plant:
- Usage of fuel with higher percentage of enrichment;
- Continuous system and subsystems operating periods lasting 3 months longer than previously;
- Lower amount of occasions for scheduled checks, changes, maintenance of the state monitoring systems and pressure tests;

Because of the devices' increased availability, along with fewer occasions for maintenance and periodical checks, each system and system element classified in different safety classes rise the question of necessary technical changes. There are three methods to overview these:
a) Verification of adequacy (e.g. measuring crack propagation);
b) By changing state maintenance programs belonging to the system element: for instance if the system element generalization cannot be verified by crack propagation calculations, changing the state maintenance program in its quality or period can verify the detection of the propositions causing the malfunction;
c) By changing the system element (e.g. changing the blade wheel of the main circulation pump);

The introduction of the C15 mainly means the task of alternating the documentation relating to previously mentioned points a) and b). Altogether only two technical modifications are necessary: changing the impeller of the main circulation pump in Unit 4, and updating the VERONA core-monitoring system (the VERONA system update is necessary for the on-line monitoring of the increased capacity of the Gd containing fuel assemblies) [3] [5] [7] [8].

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2.4. Steps of authorization for introducing C15

The introduction of Paks Nuclear Power Plant's 15 months operating period has to be officially authorized. To use the Gd-2_4.7 fuel assembly the first step is to obtain the certifications for the long time storage, as well as the environmental permission for the Temporary Container of Burnt-out Fuel (the authorization for guaranteeing the safe disposal of the burnt out fuel). Furthermore it is necessary to modify the permit of operation of the storing establishment. It is also necessary to get authorizations for the fuel assembly tests and the carrying containers. Having obtained all the previously mentioned licenses and authorizations, testing could start in the summer of 2015, and 12 Gb-2_4.7 fuel assemblies could be loaded into Unit 3 for a test period of 365 days. For introducing the 15 months long campaigns, modifications had to be made in Paks Nuclear Power Plant's environmental regulations: the operative application form also had to be modified in order to use the Gd-2_4.7 fuel assembly's complete load. In addition, changing the power plant's scheduled state maintenance and operational period to 15 months needed a complex application of modifications. These are all the requirements for starting the 15 months operating cycle. C15 will be applied at first to Unit 2, then 3, 1 and 4 according modifications based on the operational documentations. When the first successful 15 month operational period and evaluation is over at Unit 2, modifications can be made in the permit of operation for Units 1 and 4. Regarding that the introduction of C15 is a complex process, National Security Service classified its case into Category 1, and public hearings will have to be held before all four cases of modifications in the operating permits. The purpose of the public hearings is to inform the public audience and to give chance to share their experiences, express their opinions about the matter, so that the authority can take them into account before bringing a final decision. Notices can be taken on the matter, questions can be asked from the licensed authority and from those who take part in the decision making [3] [5] [7] [8].

3. OPERATING AND MAIN REPAIRS UNDER C15

The introduction of the 15 month operational period involves significant changes in scheduling main repairs. From 2016 in Units 1-4 fuel reallocations will be carried out in three months cycles. The first shut down is planned to be in February, the second in May, the third in August and the fourth in November. Therefore the shut downs can be divided into four equal parts of the year, having nearly two months of pause after each event. These will happen 15 months later in the next year for each unit: the shut down in February will reoccur only in the May of the following year, the unit shut down in May will be conclusively stopped in next August, and the one stopped in November will stop operating in February.
In the first year, just as the actual sequence of unit shut downs is the following: Unit 1, Unit 4 then Unit 2 and 3. After 420 effective days of operation Unit 3 skips the first year and will be shut down only in the February of the following year. In the first year there will be only three unit shut downs, while in the zeroth year unit there will be four. The second year of operation for Unit 2 will be operated during a whole year, while in the fifth year all the units have to be shut down in sequence. Therefore the four units have a cycle of 5 years (or 60 months) but each of them shuts down only 4 times during this period (5x12=4x15=60). Considering the whole power plant with 4 blocks we can state that in a 5 year period in every 4 years there are only 3-3 shut downs.

Every fourth of the unit repairs takes more time and involves more work. As a consequence, in the fourth operating cycle it takes approximately 42 days, while in the eighth operating cycle, due to the pressure tests of the main circulating water, it takes approximately 56 days. The cyclical main repairs require approximately 26 days (Tab. 1). If the longer shut downs are scheduled to those years when only three units have to stop operation, both the production and the time required for maintenance can be made nearly equally proportioned during the five years period: two shorter and one longer stop takes nearly as much time as the four shorter shut downs in total. The following charts represent the cycle differences between the actual C12 and planned C15 fuel assemblies. The 26 days long values show the short, the 42 days long represent the middle and the 56 days long values indicates the length of the main reparations (the values

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are approximate, the exact figures are determined according to the given unit's main reparation schedule (Tab. 2). The "∑" columns represent the total number of days spent with maintenance each year.

Table 1. C12 operational periods:

Block	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	26	26	26	56	26	26	26	42	26	26	26	56	26	26	26	42	26
2	42	26	26	26	56	26	26	26	42	26	26	26	56	26	26	26	42
3	26	42	26	26	26	56	26	26	26	42	26	26	26	56	26	26	26
4	26	26	42	26	26	26	56	26	26	26	42	26	26	26	56	26	26
Σ	120	120	120	134	134	134	134	120	120	120	120	134	134	134	134	120	120

Table 2. C15 operational periods:

Block	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	26	56	26		26	26	42	26		26	26	56	26		26	26	42
2	42		26	26	26	56		26	26	26	42		26	26	26	56	
3		26	42	26	26		26	56	26	26	26	26	42	26	26		26
4	26	26		42	26	26	26		56	26		26		42	26	26	26
Σ	94	108	94	94	104	108	94	108	108	104	94	108	94	94	104	108	94

The main economical advantage of C15's realization is that the reduced number of days spent with main reparations involves the increase of the units' availability time (Tab. 3). The decreased number of the days spent with main reparations can be seen in the following chart (Δ represents the difference between C12 and C15).

Table 3. Real availability time

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Δ	26	12	26	40	30	26	40	12	12	16	26	26	40	40	30	12	26

Introduction of C15 equalizes the resource requirements for maintenance between 12 and 40 days in a year - on the average 26 days of savings - which means that the power plant can produce more electricity by 2% [3] [5] [7] [8].

3.1. Economic outlook

In the following the main items of the cost-benefit analysis will be discussed.

- “The income increase of the MVM Hungarian Electricity Ltd.": it includes the annual average income increase following the initial period of C15. The calculation is based on the average 25 additional block days; of course, the actual number of days varies between 12 and 40.

- The "fuel cost increase" originates from the higher cost of increased fuel assembly enrichment. After the introduction, this additional cost will be reduced proportionally to the used up amount of the 4.2% enriched reserves, because in the first years a power plant uses only 4.2% fuel assemblies and buys only 4.7% enriched fuel which costs approximately 15% higher than the Gd-2n. After having used up the Gd-2n reserves, the proportion of Gd-2_4.7 fuel assemblies can be increased, this can mean further fuel-cost optimization. The conservative cost-benefit analysis employed by the power plant omits this change.

- “The decreasing cost of maintenance" part: it counts with the expected decreasing cost of main repairs that includes the reduced costs of contractors and materials. In order to realize the benefits of the decreased costs and volume of work, modifications have to be made in contracts/drawdown.

- The "growing turnover of MVM Partner Ltd." comes from the electricity sold by the power plant to other contracted energy traders. The MVM Partner Ltd. sells the electricity as a complex product to the universal service providers for a set price. Energy traders realize profit from the difference between the set price of Paks and the actual market price of electricity. By changing to C15, energy trader companies can get nearly 300 GWh more electricity from Paks Nuclear Power Plant Ltd. in a year, which equals to HUF 1 bn, calculated with the currently positive margins, price level and increasing electricity selling [3] [5] [7] [8].

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ISSN 2064-7964

Vol. 10, No. 2 2016

PHYSICO-CHEMICAL CHARACTERISTICS OF WHITE SUGAR FRACTIONS SEPARATED BY CRYSTAL SIZES

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ABSTRACT

According to the EU Council Directive 2001/111/EC, related to certain sugars intended for human consumption, a great attention is paid to color in sugar. On the other hand, the non-sucrose compounds having intensive color tend to build into the sucrose crystals. Since Serbia has to work on the new rules concerned sugar quality and harmonization with EU standards, some investigations on sugar crystals are carried out at the request of some sugar factories. Investigations are carried out on sugar crystal size dependence on sugar color and on dissolution rate of different sugar crystal size fractions with the aim to create new sugar products. In this study, sugar samples with different sugar color are divided into 5 fractions by crystal size, defining size distributions. In each fraction the color in solution and the type of color are measured, as well as other relevant physico-chemical parameters. The conclusion is that the sugar color type depends on the crystal size, but sugar crystal solution is not dependent on crystal size except a fraction smaller than 200 μm, which has 30-75% higher sugar color in solution than the other crystal size fractions.

Keywords: sugar crystal, crystal size, sensory analysis, dissolution rate.

1. INTRODUCTION

World sugar production (from beet and cane) in 2005 was 149.5 million metric tons and consumption was 150.5 metric tons. World sugar consumption has grown by 3% annually since 1985, and the world production has kept up with this increase in demand for sugar. In recent years, world sugar consumption has increased almost yearly, to about 25 kg per capita per year in 2005[1].
Sugar manufacturers in different countries produce sugar of specific crystal sizes, primary depending on the habits of the household and commercial use. Therefore, sugar factories in USA prefer the production of fine sugar, those in Europe prefer medium-size sugar, and those in Asia, Africa, and the Far East prefer coarse sugar [2].
In most countries, fine and medium-size sugars are usually the standard, and extra-fine, coarse, and extra-coarse sugars are considered specialty sugars for which customers pay a premium. The numerous advantages of extra-fine sugar, mostly due to its high surface area, enable shorter mixing and milling processes in baking and chocolate industry [1]. Special-size sugars are usually produced from fractioning the sugar by passing it through a multiple-screening operation [3].
Moreover, sugar producers have to fulfil strict targets for sugar color in order to meet consumer's demands. Therefore, the special interest in sugar production is dedicated to the purification of juice extracted from the crop plant in order to obtain sugar crystal with minimum content of colorants [4].
During the process of sugar production, colored matter are easily adsorbed to the sucrose crystal surface or incorporated into the sugar crystal and thus increase the color of the sugar solution and lower the quality of the final product. The coloring substances occurred in the sugar manufacturing process can be classified as: caramel, melanins, melanoidins, products of the sucrose decomposition and polyphenol ion complexes [3].

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Considering the existing literature information on the different ways of incorporation of certain types of colored matter in sugar crystals, there is a reasonable basis for assuming that the color of various crystal sizes from the same sugar sample differs.
The aim of this paper is to investigate the effect of sugar crystal size of four fractions from the same sugar sample on the determination of sugar color. Furthermore, the analysis of sensory properties and physico-chemical characteristics of different size sugar crystals is presented and discussed.

2. MATERIALS AND METHODS

The samples of the white sugar crystals were obtained from the sugar factory "Crvenka", Serbia. The white sugar crystals were divided into fractions using the laboratory sieve. As presented in Table 1, 4 crystal fractions were obtained. The fraction with crystal sizes under 200μm was classified as sugar powder and therefore was not used in the further investigation. In the further analysis dissolution rate of obtained fractions is calculated. For the purpose of this experiment distilled water was used as a solvent. Distilled water temperature was kept constant at 20 °C and controled using the thermostat (VELP® Scientifica, Italy). The mixing of the solution was conducted using the automatic mixer at a constant rotating speed of 100rpm. Under these conditions, after the addition of sugar crystal fraction, solution was sampled on a 10s period using the micropippete. Disolved sugar was measured using the refractometer (Carl Zeiss, Germany) and dissolution rate was calculated using the obtained results of sugar content in the sample.
Furthermore, in each fraction, the color in solution is measured. Determination of the solution color of white sugar is conducted in accordance to the ICUMSA (The International Commission for Uniform Methods of Sugar Analysis) Methods GS 1/3-7, GS 2/3-10 and GS 2/3-10. According to the ICUMSA, absorbance of white sugar solution is measured using the laboratory spectrophotometer (SPECOL 220-MA 9522) at a wavelength of 420 nm and cuvettes with optical path-length of 5cm. ICUMSA color is calculated as follows (1):

$$ICUMSA\ Color(IU) = \frac{1000 \times A}{l \times c} \quad (1)$$

Where A= absorbency of the solution,
l= the optical path-length,
c= solution concentration (g/mL).

The sensory properties of the sugar crystal fractions were determined in the further research. Sensory analysises is performed according to the ISO standards, adapted to the evaluation of examined white sugar crystals *(ISO 4121, 2003; ISO 8589, 2007; ISO 8586–2, 2008).* The investigated parameters relate to the texture and taste including: granulation, sweetness, mouth melting properties, crystal sharpness and general admissibility. The assessment of these parameters is performed using the numerical scale with seven levels of assessment for each quality parameter.

3. RESULTS

Firstly, dissolution rate of the sugar fractions will be discussed. The results obtained from the experimental determination of dissolution rate are presented in Tab. 1. Moreover, in order to make a clear comparison

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between the inspected fractions, the results from Tab. 1 are illustrated in Fig. 1. As expected, the highest dissolution rate is observed in the experiments where smallest sugar crystals are used. Dissolution rate of the different sugar crystal sizes can be clearly distinguished after 20s of the experiment, where it can be noticed that the Fraction 1 (200/400 µm) has significantly higher dissolution rate, 30% and 50%, comparing to the larger crystal fractions 2 (400/600 µm) and fraction 3 (600/800 µm), respectively. During the time of the experiment, the solubility of all factions increases at 20°C, however with different intensity.

Table 1. Solubility of a different sugar fractions over time

	Solubility (%)			
Range of crystal sizes (µm)	200/400	400/600	600/800	>800
time (s)	Fraction 1	Fraction 2	Fraction 3	Fraction 4
0	0	0	0	0
10	10.0	12.5	5.0	2.5
20	25.0	17.5	12.5	10.0
30	42.5	22.5	20.0	15.0
40	47.5	30.0	22.5	20.0
50	50.0	32.5	30.0	22.5
60	52.5	35.0	32.5	27.5

The most intensive increase in dissolution rate is observed again in the fraction 200/400µm, where the solubility increases linearly up to 30 seconds. The linear increase of dissolution rate continued after 30s but with far less intensity.

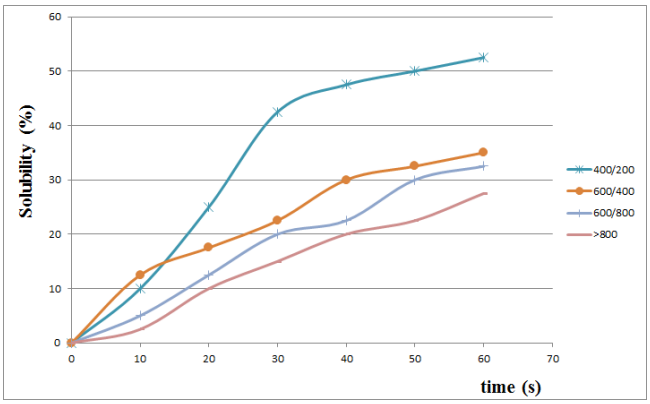

Figure 1. Solubility of sugar crystal fractions over time

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The linear increase of dissolution rate continued after 30 s but with far less intensity. This can be clearly observed in the Fig. 2, where the curve of dissolution rate vs. time is presented. The maximum dissolution rate regarding the smallest crystal fraction (200/400 μm) with value of 0.14 g/s is obtained after 30 s of the experiment. As it can be noticed from Figure 2, significantly lower values are obtained for larger sugar crystals.

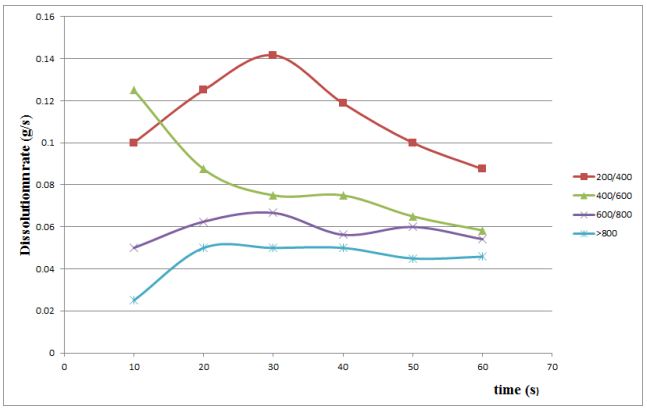

Figure 2. Dissolution rate vs. time curve for the investigates fractions

At the end of the experiment, after 60 s, Fraction 1 solubility reaches 52%, while all other fractions did not exceed 35%. Therefore, from the curves shown in Fig. 1 it can be concluded that the Fraction 1 (200/400μm) of crystal sugar dissolves fastest compared to other fractions of crystal sugar.

The results of the sensory analysis of different crystal sugar granulation are given in Tab. 2 and graphically shown in Fig 3 using the QDA (Quality Descriptive Analysis) diagram. For the purpose of this experiment 5 different parameters are assessed. The parameters are assessed in the following plan range: granulation from extremely small to extremely large; mouth melting from extremely slow melting to extremely fast melting; sweetness from pronouncedly weak sweetness to extremely sweet; crystal sharpness from completely smooth to extremely sharp; general admissibility from not appropriate to completely appropriate. The numeric range between the two extremes is given from 1 to 7 points.

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Table 2. Average ratings of sensory analysis of investigated parameters grouped by different sugar fractions

Parameter	Fraction 1 200/400 µm	Fraction 2 400/600 µm	Fraction 3 600/800 µm	Fraction 4 >800 µm
Granulation	2.5	3.8	5.8	6.9
Mouth melting	6.8	6.1	3.3	105
Sweetness	5.8	3.7	4.5	3.7
Crystal sharpness	3.4	4.1	6.2	7.0
General admissibility	6.8	6.8	4.5	2.0

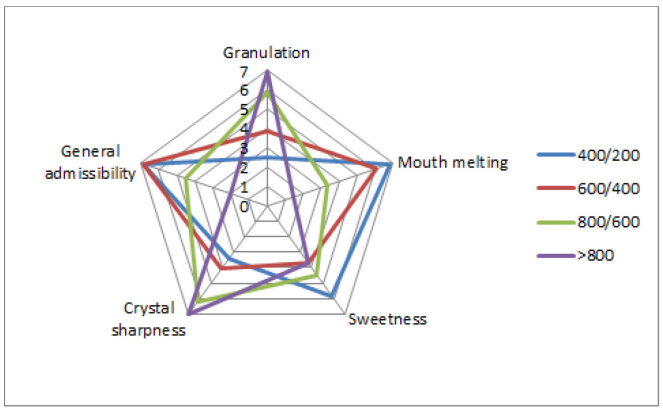

Figure 3. QDA diagram of the sensory evaluation relating to different sugar fractions

After the evaluation of the obtained ratings given by the professional assessors, the highest values for crystal sharpness are, as expected, given to the largest fractions (600/800 µm and >800 µm) emphasizing their crystal size. The sugar fractions 1 and 2 are rated with 3.4 and 4.1, indicating optimal crystal sharpness and a pleasant mouth feeling.

As regards mouth melting properties, it is evident that the fraction 200/400µm has the best melting properties, confirmed by significantly high ratings (6.8), which is in accordance with the examination of the solubility in water of this fraction (Fig. 1 and Fig. 2).

However, Fraction 2 also obtained high rating concerning mouth melting properties with only 0.7 points less than Fraction 1. This can be explained by a high initial dissolution rate of this fraction confirmed in the first experiment (Fig. 2). The extremely low rating (1.5) concerning this characteristic is received for the sugar crystals above 800 µm which is in accordance to the previous experiment.

The sweetness ratings are quite similar for the sugar crystals with sizes from 400 to 800 µm and above, only the sugar crystals below 400 µm received higher assessments (5.8), indicating extremely sweet taste induced by this sugar fraction.

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In the end, general admissibility of the all sugar fractions is assessed. Highest values are obtained for the sugar crystals from Fractions 1 and 2 (6.8) and the lowest value, indicating this fraction as not appropriate, is given to the Fraction 4 with the size of crystals above 800 µm.

Now, the results of the color measurements for each sugar fraction will be given and analyzed. The presented results (Tab. 3) indicate high dependence of solution color on specific sugar crystal size. It can be noticed that the solution color increases as the crystal size decrease. The largest sugar crystals had 35% lower solution color compared to the smallest sugar crystals. This phenomenon can be attributed to the greater surface area of the fractions with smaller sugar crystals. As the surface area increases more colored matter are able to contact the specific sugar crystal enabling adsorption or incorporation of these substances to the crystal. Considerably larger surface will be available to the adsorbent materials enhancing their possibility to permanently adsorb on a sucrose crystal. Moreover, the turbidity of the solution, which is in direct correlation with the absorbance of the unfiltered sample, (expressed as a difference between the color of unfiltered and filtered sugar solution) (Tab. 3) is significantly higher for the smaller crystal fractions. Higher turbidity is attributed to the specific larger number of crystals in the investigated solution resulting in a greater absorbency of the solution at 720 nm.

Table 3. Solution color of the sugar sample

Crystal size (µm)	Color (IU)	Unfiltered sample color (IU)	Turbidity of sugar solution (IU)
200/400	62	324	262
400/600	50	184	134
600/800	43	102	59
>800	46	101	55

4. CONCLUSION

The analysis of sensory properties and physico-chemical characteristics of different size sugar crystals is presented and discussed. On the basis of physical and chemical analysis it can be concluded that already starting from 10 s to 30 s of experiment about 50% more sugar of a fraction with smallest sugar crystals is dissolved compared to the fraction with larger sugar crystals, which is in accordance with the sensory assessment of sweetness and solubility. The maximum dissolution rate regarding the smallest crystal fraction (200/400 µm) with value of 0.14 g/s is obtained after 30s of the experiment. Therefore, it can be concluded that due to the higher initial dissolution rate of corresponding sugar crystal fraction, sweetness sensing is proportionally more intense.
The general acceptability of sugar crystal fractions among evaluators is very interesting. The trained sensory assessors have opted for a fraction 200/400 µm and 400/600 µm with a score of 6.8, with a description "completely appropriate" product, while the fraction > 800 µm is assessed with 2, ie. assessors find this product “not appropriate”.

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ACKNOWLEDGMENT

The authors would like to thank "The Hellenic Sugar industry S.A.", Greece and "SUNOKO", Serbia and Ministry of Science and Technological Development of the Republic of Serbia (Project no. 31014) for donations.

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POSSIBILITIES OF INCREASING THE WEAR RESISTANCE OF STEEL CHAIN WHEELS AS A RESULT OF CHANGES IN THEIR MANUFACTURING PROCESS

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ABSTRACT

The paper describes the problems of the operation of chain wheels of armoured face conveyors and the related assurance of the required wear resistance. An analysis of the current methods of manufacturing the chain wheels used in armoured face conveyors has also been performed. It has been found that a dynamic surface treatment can be used in the process of manufacture of these elements. As a part of the study, the results of wear tests for the standard and modernized variants of chain barrels have been presented, which confirmed the validity of the changes made in the process.

Keywords: wear, shot peening, chain wheel, armoured face conveyors

1. INTRODUCTION

Chain drums, especially those for armoured face conveyors are operated in very harsh operating conditions. An example view of an armoured face conveyor is shown in Fig. 1, while a view of the chain drum installed in the conveyor is presented in Fig. 2. Despite the changes in materials and technology over recent years, there still occurs premature degradation of such drums as a result of the impact of the mine environment and intensified mining operations. Destructive factors include primarily stone dust or stone and coal dust getting to the area of mating between drums and the chain, the moisture contributing to formation of corrosion on drum surfaces, numerous successful and unsuccessful conveyor start-ups, as well as overloads caused, inter alia, by overloading and blocking of the conveyors.

Figure 1. Example view of an armoured face conveyor

The impacts of the aforementioned factors [1] include:
- significant abrasive wear of mating surfaces of drums and chains, which is intensified by the action of hard abrasive (Fig. 3A).
- plastic deformations of mating surfaces of drums (Fig. 3B).
- chipping of teeth in chain drums (Fig. 3C).
- fractures of teeth at the base – of ad-hoc or fatigue nature (Fig. 3D).

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Figure 2. Chain drum installed in an armoured face conveyor

Abrasive wear has a particularly significant impact on the durability of chain drums. Destructive processes, especially the abrasion wear, can be counteracted by the use of appropriate technologies. As it appears from the analyses of damage to chain drums of armoured face conveyors [1], the materials and technologies used so far do not prevent the occurrence of abrasive processes to a satisfactory degree and therefore alternative methods of manufacture should be considered in order to improve the wear resistance of materials used in the manufacture of chain drums.

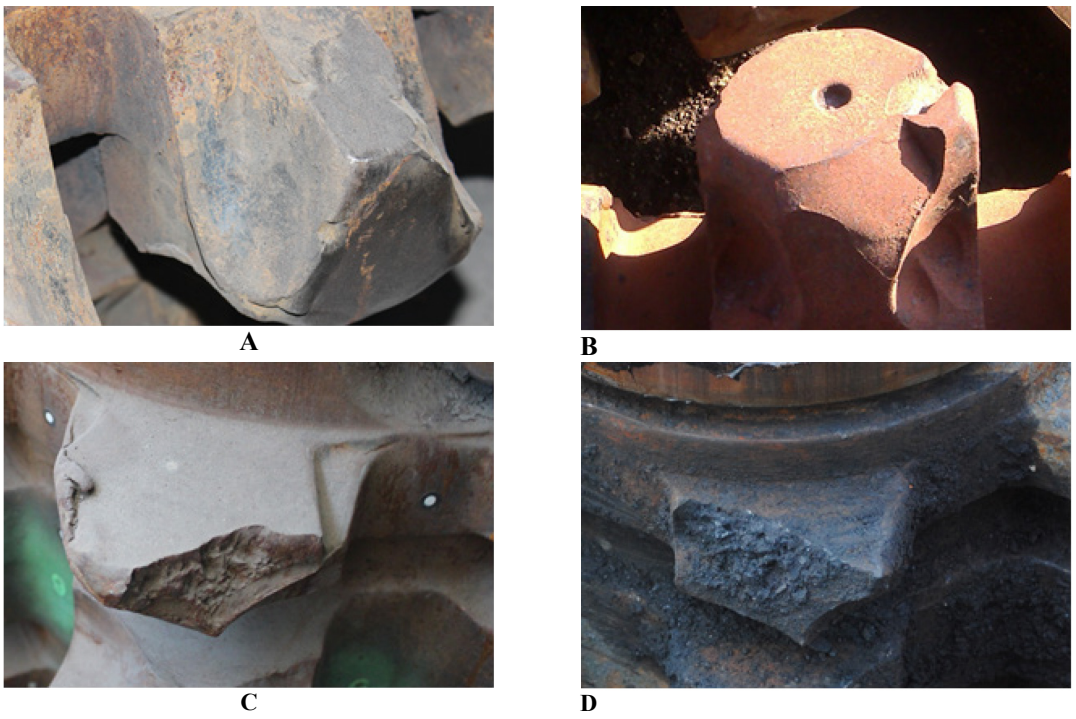

Figure 3. Examples of damage to the teeth of chain drums: A - abrasive wear of surfaces of drums intensified by the action of hard abrasive, B - plastic deformations of teeth, C - chipping of tooth tips in chain drums, D - teeth fractures of ad hoc nature.

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2. CURRENT METHODS OF MANUFACTURING CHAIN DRUMS OF ARMOURED FACE CONVEYORS

In the current practical solutions, split and non-split cast or forged drums are used. Different production technologies are used for individual manufacturing variants.

A. In the case of the split cast variant, it is necessary to make casting from wear-resistant cast steel, clean it, carry out volumetric heat treatment and then quality control (Fig. 4A). The next step involves the treatment of the drum parting surface, drilling holes for connecting bolts (Fig. 4B), machining the inner hole, correcting the shape of the teeth (Fig. 4C), chiselling a key, surface hardening of sockets, and final quality control.

B. In the case of the non-split cast variant, it is necessary to make casting from wear-resistant cast steel, clean it, as well as carry out volumetric heat treatment and then quality control. The next step involves the treatment of the inner hole and faces (Fig. 4D), correcting the shape of the teeth, chiselling a spline, surface hardening of sockets, and the final quality control.

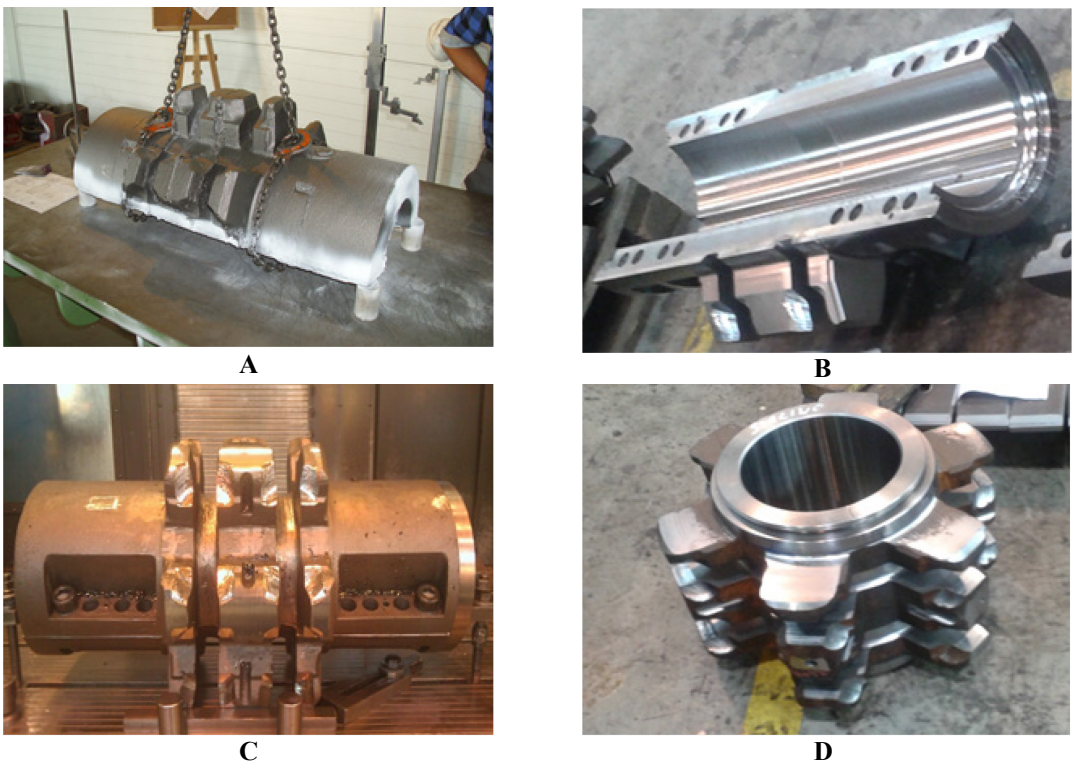

Figure 4. Selected stages of production of the cast chain drums: A - view of split drum casting during the acceptance inspection; B - view of split drum casting after the treatment of the parting surface and drilling of holes, C - view of a split drum when milling the tooth sockets, D - view of a non-split drum after the inner diameter and faces have been turned.

C. In the case of the forged split variant it is necessary to make forging of steel for quenching and tempering, carry out volumetric heat treatment and then the quality control. The next step involves the treatment of the drum parting surface, drilling holes for connecting bolts, joining both halves (Fig. 5A), machining the inner hole, milling the shape of the teeth (Fig. 5B), controlling the shape of the teeth, chiselling a key, surface hardening of sockets, and final quality control.

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D. In the case of the forged non-split variant it is necessary to make forging of steel for quenching and tempering, carry out volumetric heat treatment and then the quality control. The next step involves the treatment of the inner hole and faces (Fig. 4C), milling the shape of the teeth, controlling the shape of the teeth (Fig. 5D), chiselling a spline, surface hardening of sockets, and the final quality control.

Figure 5. Selected stages of the production of forged chain drums; A - view of a split drum after joining the two halves, B - view of a split drum after the teeth have been machined, C - view of a non-split drum when milling the teeth, D - view of a non- split drum during inspection of the teeth shape.

3. ANALYSIS OF THE POSSIBILITY OF USING THE SHOT-PEENING TREATMENT IN THE PROCESS OF CHAIN DRUMS MANUFACTURE

Shot peening is a long-known method for increasing the durability of machine elements exposed to the action of a construction notch or for compensating for the adverse effects of other processes making up the industrial process, but it is not used for shaping the performance characteristics of the mining elements. An example of a possible application of this treatment are toothed components [2,3] used in highly-loaded industrial power units of mining machines. The dynamic action of shot during the shot-peening process [4] substantially modifies the stress distribution in the surface layer, increases the surface hardness, and leads

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to the transition of residual austenite into martensite under the influence of stresses. As a result of the plastic deformation of the surface, in the surface layer of the materials treated there occur also compressive stresses, the value of which depends on the properties of the metal treated and shot peening parameters. A positive effect of the shot peening process is an increase in the resistance of teeth at the base against fatigue fracture as well as a delay in the formation of cracks in the carburized and hardened surface layers of toothed wheels [5,6,7]. The essence of the modification proposed is that the areas of mating with the link chain are additionally subjected to the dynamic surface treatment near the areas of mating with the link chain and at the bases of the chain drum teeth (Fig. 6). In the modified process cycle the shot-peening stage will take place after the surface treatment and hardening of chain drums.

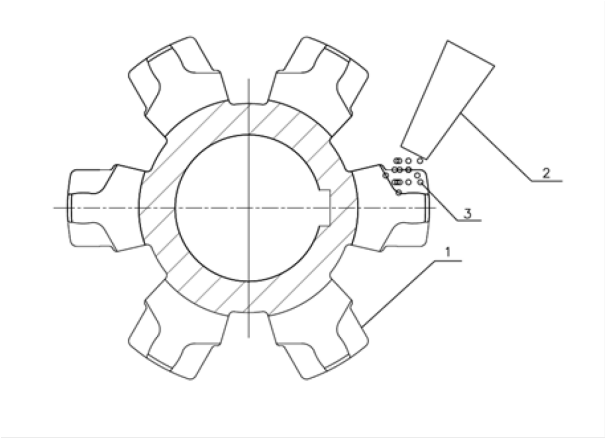

Figure 6. Diagram showing the process of shot peening of chain drums; 1 - the area of mating of the chain drum, 2 - the nozzle of the shot-peening machine, 3 - shot.

4. OPERATIONAL VERIFICATION OF THE PROCESS CHANGES

In order to confirm the usability of the process changes made, tests of wear properties were carried out in the conditions similar to the real ones. The tests of wear properties of 34CrNiMo alloy steel subjected to quenching and tempering were carried out on a test rig designed especially for that purpose, which allows reproducing the real operating conditions of the chain wheels. Details concerning the test rig and the method of determining the abrasive wear are presented in [8,9].
Two identical chain wheels made of steel subjected to quenching, tempering and surface hardening were used in the wear tests. As regards the shot-peened chain wheels, they were subjected to a dynamic heat treatment (Almen intensity: 0.32 mmA, coverage: 2x100%) in the area of contact between the wheel and the chain. Shot peening was conducted with the use of cut and rounded shot with the diameter of 0.6 mm and the hardness of approx. 54 HRC. As a result of this process, no increase in the hardness of the surface was found (the hardness was 555 HB). During the wear tests, there occurred relative movement of the mating surfaces of the wheel and the chain, which resulted in dislocation and crushing of abrasive grains in the mating area. The movement of the abrasive was accompanied by micro-cutting of the wheel surface.
After the completion of the wear tests, the test wheels were subjected to measurements in the area of wear using a coordinate measuring machine in order to determine the measure of abrasive wear (δ_{AVR_MAX}). Tab. 1 presents the values of the measure of abrasive wear (δ_{AVR_MAX}) of the chain wheels tested in the presence of the abrasive material as well as the measures of the dispersion. Tab. 2 summarizes the values of the relative difference in the wear ($\Delta\delta_{AVR}$) of shot-peened chain wheels and non-shot-peened ones. When comparing the results of the wear tests in terms of the impact of the shot-peening treatment, it can be noticed that the values of wear for the shot-peened variant were lower by 5.8%.

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Table 1. The determined parameters characterizing the abrasive wear δ_{AVR_MAX} of 34CrNiMo steel for the materials considered; SP - the variant subjected to shot peening

Tested steel	δ_{AVR_MAX}, mm	S_{δ}, mm
34CrNiMo	0,623	0,041
34CrNiMo (SP)	0,587	0,020

Table 2. Values of the relative difference in the wear ($\Delta\delta_{AVR}$, %) of the shot-peened and not shot-peened chain wheels

Tested steel	$\Delta\delta_{AVR} = (\delta_{AVR\_MAX\_SP} - \delta_{AVR\_MAX}) / \delta_{AVR\_MAX}$
34CrNiMo	-5,77%

5. SUMMARY

The paper presents the possibility of modifying the current technology of manufacturing the drums by the introduction of an additional dynamic treatment of the surface – shot peening. On the basis of the operational tests conducted, it has been found that shot peening of the surfaces mating with the chain resulted in a reduction of the abrasive wear by 5.8%. The reason for the increase in the wear resistance was probably an increase in internal stresses in the surface layer of the chain wheels, which prevented the propagation of cracks (initiated by micro-cutting with crushed abrasive) to the inside of this layer.

ACKNOWLEDGEMENTS

The study was carried out as a part of the project “Innovative technology for production of tension members for transport systems with the use of cast materials”, No. POIG.01.04.00-24-100/11.

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THE EFFECT OF SOY FLOUR ON COOKIE QUALITY

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ABSTRACT

Cookies are a popular confectionery product with a unique texture and taste, long shelf life and a relatively cheap price; therefore, it is a widespread snack among people of all generations. Nevertheless, cookies are usually made of wheat flour and most formulations are highly caloric and have a low fiber content. Soy flour is an excellent source of proteins, fibers, vitamins and minerals and it is being considered as a great supplement to wheat flour because it increases nutritive characteristics of the final product. By their digestibility and amino acid content, soy proteins are very similar to proteins derived from animals. They also contain many essential amino acids, which are deficient in most of the cereals. The purpose of this work was to determine the effect of soy flour on quality of cookies. Wheat flour was supplemented with 35% of soy flour (full-fat toasted, low-fat toasted, defatted lightly toasted, toasted and soy protein concentrate). The supplementation of wheat flour with soy flour had affected nutritive value and sensory characteristics of cookies.

Keywords: soy-flour, cookies, chemical analysis, sensory characteristics

1. INTRODUCTION

Cookies are a popular confectionery product with a unique texture and taste, long shelf life and a relatively cheap price; therefore, it is a widespread snack among people of all generations. Nevertheless, cookies are usually made out of wheat flour and most formulations are highly caloric and have a low fiber content. Soy flour is an excellent source of proteins, fibers, vitamins and minerals and it is being considered as a great supplement to wheat flour because it increases nutritive characteristics of the final product. Soy is being used both for human and animal nutrition because of its great nutritive characteristics, relatively cheap price, high quality and quantity of proteins and oil, as well as functional properties which contribute to the development of different foods for human nutrition [1]. By their digestibility and amino acid content, soy proteins are very similar to proteins derived from animals. They also contain many essential amino acids, which are deficient in most of the cereals. However, Raw Soybean Seed Meal (RSSM) contain high levels of anti-nutritional factors (ANFs), such as protease trypsininhibitors, lipase inhibitors, goitrogens, and hemagglutins, which must be deactivated by proper heat treatmentprior to inclusion in animal and human diets [1]. As improvements in nutritive value can only be considered successful if a product with visual, textural and organoleptic qualities acceptable to the consumer is produced, functional properties of various protein supplements have been the focus of interest of many researchers and technologists. Although many different plant proteins have been studied and used, soy protein still remains the most widely investigated supplement [2].

In ref. [3] researcers examined the development of the dough obtained of mixtures of wheat and soybean flour (12%) and found that it takes more time for the development of the dough in relation to the dough produced only with wheat flour, as well as to thereby absorb a greater amount of water . It was also found

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that replacement of wheat flour, soybean significantly increases the protein content in the final product . It has been proven that soy flour prolongs the shelf life of bread, improves structure and increases the consistency and nutritional quality of bread. It was also found that bread with soy flour has pleasant taste.
Biscuits made from a mixture of wheat flour and soybean flour (30:60) showed better nutritional properties and improved color of biscuit made from pure wheat flour [4].
Reference [5] have examined how much of the wheat flour in making tortillas can be replaced with soy flour and proven that replacing 30% of wheat flour with soy flour can be obtained tasty and a good technology product. Reference [1] contains evaluation of gluten-free spaghetti with soy flour from a mixture of rice and soy flour. This combination gives flour dough beautiful colors that does not stick and which has greater firmness than the dough made from pure rice flour.
Unfortunately, a complete replacement of wheat flour with soy flour is not possible in a number of products due to specific taste and poor texture of soy products, but it is proven that the addition of hydroxypropyl methylcellulose improves the characteristics of gluten-free bread [7]. The addition of soy flour in food products increases the content of crude protein, ash and crude fiber and moisture content significantly decreased [8]. Addition of high-protein soybean flour also reduces the amount of carbohydrates in the products, which makes them more desirable low calorie functional products [9].
The purpose of this work was to determine the effect of soy flour on the cookies quality. Wheat flour was supplemented with 35% of soy flour (full-fat toasted, low-fat toasted, moderately toasted, toasted and soy protein concentrate). The supplementation of wheat flour with soy flour had affected nutritive value and sensory characteristics of cookies.

2. MATERIALS

Wheat flour for cookies and biscuits were obtained from milling company “Ratar”, Pančevo, Serbia. Soy flour: full-fat toasted, low-fat toasted, defatted lightly toasted, toasted and soy protein concentrate were obtained from "Sojaprotein" AD Bečej, Serbia. Other ingredients for cookie making - vegetable fat, salt, sodium bicarbonate, ammonium bicarbonate and powdered sugar were purchased in a local food store.

3. METHODS

3.1. Preparation of cookies

Blends of wheat flour with different type of soy flour, containing 35% of soy flour, on a replacement basis, were prepared using the F-6-RVC agitator (Forberg International AS, Norway). Control cookie sample was prepared using wheat flour without soy flour. Cookies dough was prepared according to the following formula: flour (i.e. flour blend) 200.00 g, vegetable fat 42.00 g, sugar 70.00 g, $NaHCO_3$ 0.6 g, NH_4HCO_3 0.4 g and NaCl 1.1 g. The measured amount of flour was mixed in a mixer for 0.5 min, and after the addition of the total amount of fat and powdered sugar, the mixing was continued for 5.5 min at low speed (60 min^{-1}). All other components dissolved in distilled water were added into the mixer, the mixer closed and the dough mixed for 15 min. The amount of water was calculated in relation to the water content of the flour blends in order to obtain dough samples with 24% moisture content. After mixing, the dough samples were processed by sheeting it between two cylinders of laminator (Marchand LA4-500, Materiel modern marchand, Rueil – Malmaison, France). The gap settings between the cylinders were: 14 mm, 10 mm, 7 mm and 5 mm, with 15 s resting period between each passage. Consequently, the dough was cut using a stainless mould and prepared cookie dough was baked for 15 min at 230°C in a laboratory oven followed by cooling (2h) and packaging (in high-density polyethylene). Cookie sample with defatted lightly toasted soy flour was marked as OUT, with defatted toasted as OT, with lowfat toasted as MT, with fullfat toasted as PT and with soybean protein concentrate as SPK (Tab. 1).

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Table 1. Evaluated cookie samples

Sample	Control	PT	MT	OT	OUT	SPK
Flour type	100% wheat flour	35% fullfat toasted, 65% wheat flour	35% lowfat toasted, 65% wheat flour	35% defatted toasted, 65% wheat flour	35% defatted lightly toasted, 65% wheat flour	35% soybean protein concentrate, 65% wheat flour

3.2. Determination of chemical composition

Moisture, protein, fat, fiber and ash contents of wheat flour, soy flour and cookies based on dry weight were determined according to the method described in the [10]. Total carbohydrates were calculated by difference.

3.3. Alkaline Water Retention Capacity (AWRC)

The AWRC of the wheat flour and blands of wheat flour and different type of soy flour were determined according to the standard method [11].

3.4. Sensory Analysis

Cookie samples were evaluated by a panel of 25 consumers, 24 h after baking. Panelist scored the cookie characteristics (color, hardness chewiness, odor, taste, aftertaste and overall acceptability) using 7 - point hedonic scale (1 - dislike extremely, 2 - dislike very much, 3 - dislike moderately 4 - neither like nor dislike, 5 - like moderately, 6 - like very much, 7 - like extremely) [12]. Cookie samples were served to panelists on white plastic plates labeled with three-digit codes from a random number table. Panelists were asked to swallow samples and to rinse their mouths with water between samples.

4. RESULTS AND DISCUSSION

4.1. Chemical analysis

Comparison of the chemical composition of wheat flour and different types of soy flour are shown in Tab. 2.

Table 2. Chemical composition of wheat flour and different types of soy flour

Flour	100% wheat	100% OUT	100% OT	100% MT	100% PT	100% SPK
Moisture (%)	10.83	5.07	4.59	3.94	4.92	4.25
Protein (%)	10.04	35.99	40.10	34.74	25.52	53.83
Fat (%)	0.95	0.62	0.83	5.86	23.55	0.38
Ash (%)	0.54	6.69	6.79	6.45	3.54	6.57
Fiber (%)	3.80	25.91	22.66	25.07	26.83	26.58
Carbohydrats (%)	77.64	51.63	47.69	49.01	42.47	34.97

On the basis of chemical analysis, it can be seen that the wheat flour has a lower content of proteins (only 10.04%) relative to all 5 types of examined soy flour (from 25.52 to 53.83%). Withal, soy flour has a higher mineral content (about 6%) and fiber (as much as 20%) of wheat flour, while proportion of

carbohydrates is smaller (even twice lower at SPK). There are also differences in the chemical composition among the various types of soy flour (PT and MT are characterized by a higher content of fat (23.55% and 5.86% relative to the OUT, SPK and OT (0.62%, 0.83% and 0 38%)), and SPK has the largest share of protein (53.83%)).

4.2. Alkaline water retention capacity

Tab. 3 shows the results gained by the analysis of AWRC of wheat flour and wheat flour–soy flour blends in alkali. Blends of soy and wheat flour had higher AWRC values comparing with wheat flour.

Table 3. Alkaline water retention capacity (AWRC) of the wheat flour and wheat flour- soy flour blends

Sample	AWRC (%)
Wheat flour	67.74
35% OUT	86.62
35% OT	103.61
35% MT	102.57
35% PT	94.4
35% SPK	107.09

Such high AWRC values (86-107%) are the result of a high content of protein and fiber in soy flour, which are capable for binding the water. AWRC values of soy flour are in accordance with the results of chemical analysis for the determination of protein and fiber (Tab. 2), where it can be seen that soy protein concentrate has the highest protein content (53.83%), and a mixture of 35% SPK has the highest AWRC value (107%), while the lowest values AWRC have blands with OUT and MT (86.62 and 94.4%), which have the smallest protein content (35.99% and 25.52%). The results are in accordance with research of [3], who also came to the conclusion that a mixture of wheat and soybean flour absorbs a greater amount of water compared to wheat flour.

4.3. Chemical caracteristics of cookies

In accordance with differences in the chemical composition of different types of wheat and soybean flour (Tab. 2), there are significant differences in the chemical composition of the final product. In Tab. 4 it can be seen that the cookies containing soy flour were significantly richer in protein (two and even three times more (SPK)). Concurrently, there was increased content of minerals and fiber, on the other hand reduced the carbohydrate content of 74.80% to 63.62%, which could be important for people with diabetes.

Table 4. The influence of soy flour on cookies chemical characteristics

Sample	Control	OUT	OT	MT	PT	SPK
Moisture (%)	5.24	2.28	1.99	2.19	1.20	4.48
Protein (%)	5.79	13.73	13.89	12.24	11.58	16.52
Fat (%)	13.55	13.51	18.10	14.56	13.73	12.86
Ash (%)	0.62	1.87	1.60	1.80	1.90	1.98
Fiber (%)	4.57	5.30	5.29	5.33	4.27	6.18
Carbohydrats (%)	74.80	69.15	68.49	69.21	67.52	63.62

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4.4. Sensory analysis

According to the results of sensory analysis, which are shown in Tab. 5, it can be seen that the panelists have given higher color score for cookie with soy flour, so the addition of soy flour positivelly influences cookies color. Addition of soy flour generally influenced the creation of a darker cookies color, while the highest browning caused toasted soy flour with a lower fat content (OT). It is known that Maillard reactions play an important role in the formation of colored baked goods. Darker color of cookies with soy flour is the result of a higher protein content (free amino acids such as lysine) in soybean flour which causing intensively Maillard reaction [13]. Reference. [4] showed that the biscuits made from a mixture of wheat and soybean flour in which there were more than 60% soy flour had a better color than biscuits made from pure wheat flour. However, cookie samples with soy flour had a wrinkled surface with visible cracks. The negative impact soy flour had on the hardness and chewiness. Samples with soy flour were firm and brittle and had rough and compact structure. Also, these samples were slow in softening during chewing. Cookie hardness is highly dependent on the moisture content in the dough. AWRC values of soy flour are greater than the value of wheat (Tab. 3), which means that soy flour have a higher absorption of water during the mixing procedure, due to higher content of protein and fiber, which results in increased strength of the dough and thus in hardness of cookies with soy flour. The best structure and minimum hardness had a sample with PT soy flour. Although proteins and fibers absorb water causing cookie hardening, higher content of fat in PT soy flour can compensate for hardness.

Table 5. Sensory analysis of cookie samples

Sample	Control	OUT	OT	MT	PT	SPK
Color	4.0	4.0	6.0	6.0	6.0	4.0
Hardness	6.0	3.0	2.0	3.0	4.0	5.0
Chewiness	6.0	3.0	3.0	4.0	5.0	6.0
Odor	6.0	5.0	6.0	6.0	6.0	4.0
Taste	7.0	5.0	5.0	5.0	6.0	4.0
Aftertaste	5.0	4.0	4.0	4.0	6.0	4.0
Overall acceptability	6.0	4.0	5.0	5.0	6.0	5.0

Scores for taste, odor and overall acceptability of cookies with soy flour are close to the values of the control sample, which means that the addition of soy flour did not have effect on deterioration of these characteristics. Taste and smell were inherent to the nature of the product. The samples with the addition of soy flour had residual taste after chewing, which panelists liked and did not affect the reduction in score for taste and overall acceptability of cookies. The highest scores, closest to the control sample had cookie sample with the addition of PT soy flour. The greatest impact on the deterioration of the sensory evaluation had addition of OT soy flour.

5. CONCLUSION

Soy flour is nutrition valuable product rich in bioactive compounds. It can be used for increasing nutritional value of cookies. Addition of soy flour increased protein, fiber and mineral content of cookies, while carbohydrate content was reduced from 74.80% to 63.62%. Soy flour addition had significant influence on cookie color. Cookie surface became darker and number of cracks on cookie surface increased. The negative impact soy flour had on the hardness and chewiness. The addition of soy flour did not have effect on deterioration of taste, odor and overall acceptability of cookies.

6. ACKNOWLEDGEMENT

This work has been fully supported by Croatian Science Foundation under the project 1321.

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ISSN 2064-7964

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THE WEB OF THINGS AND DATABASE MANAGEMENT SYSTEMS

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ABSTRACT

The Web of Things (WoT) is slowly gaining grounds and through the properties of barcodes, QR codes, RFID, active sensors and IPv6, objects are fitted with some form of readability and traceability. People are becoming part of digital global network driven by personal interests. The feeling being part of a community and the constant drive of getting connected from real life finds it continuation in digital networks. This paper investigates the concepts of the internet of things from the aspect of the autonomous mobile robots with an overview of the performances of the currently available database management systems.

Keywords: DBMS performance, Cloud computing, IoT, Web 2.0, Wireless sensor networks

1. INTRODUCTION

Information and communication technology has started on large computers called the main frame of the 1960s, the 1970s minicomputer was a practical solution, workstation appeared with the development of the microprocessor in the 1980s, and personal computers became popular in the 1990s. This progress is largely accelerated due to the development of a semi-conductor integrated circuit technology [1]. As a result, the computer and the network cost, made a remarkable progress in terms of performance, have infiltrated and became embedded into the society at large scale. In a network, stemming from the Internet to research of ARPANET, by the 1990s WWW (World Wide Web), showed the explosive spread. In the background, it may become capable of high-speed large-capacity communication by development of optical communication technology. From the wireless communication technology, to the spread of mobile phones and high-speed wireless LAN, all the equipment leads to the era of the global network [25],[26],[28],[28]. Dramatic improvement in communication speed, and to underpin the transition from e-mail to the video content, the fusion of communication and broadcasting has begun and started an expansion of the IoT devices as shown in Fig. 1.

2. WEB OF THINGS

The Web of Things is not a single standalone technology, it's a concept in which most new things are connected and enabled such as street lights being networked and things like embedded sensors, image recognition functionality, augmented reality, near field communication are integrated into situational decision support, asset management and new services [2]. These bring many business opportunities and add to the complexity of IT.

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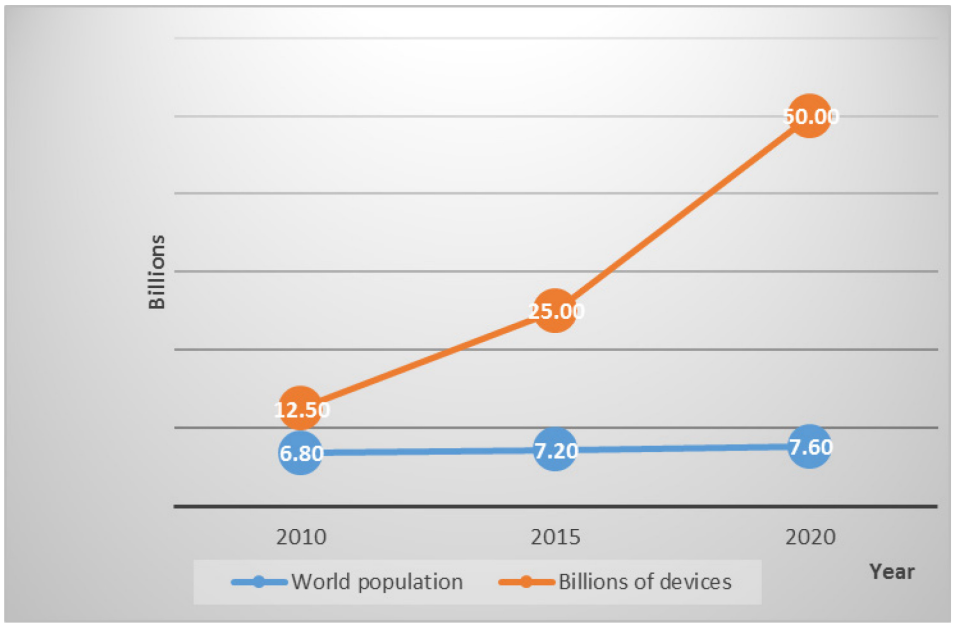

Figure 1. IoT devices and the future evolution

The Web of Things offers solutions based on the integration of information technology, which refers to hardware and software used to store, retrieve, and process data and communications technology which comprises electronic systems used for communication between individuals or groups [3]. The rapid convergence of information and communications technology is occurring at many layers of technology innovation (Fig. 2): the cloud, data and communication pipes/networks and device.

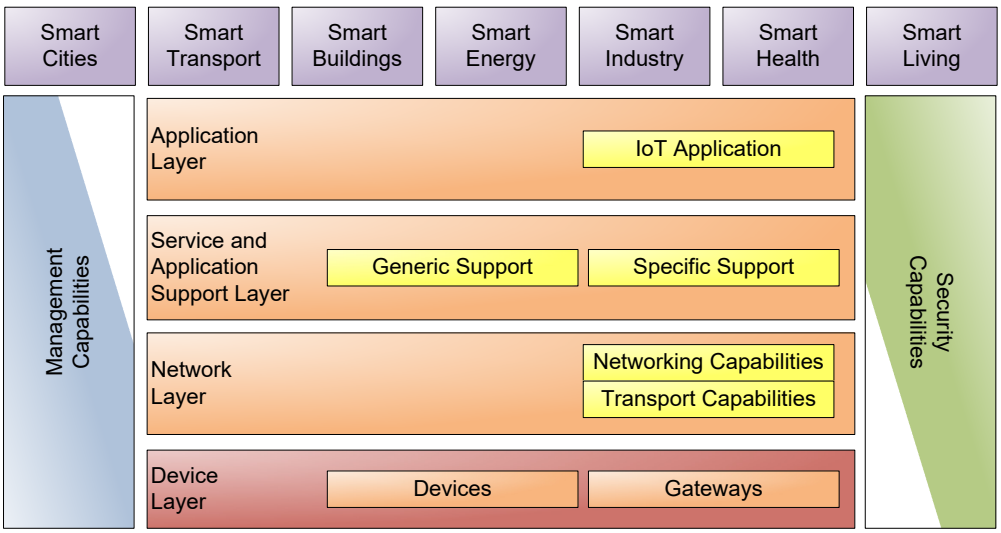

Figure 2. IoT Layered Architecture

The potential market for wireless communication technology is one of the rapidly-spreading segments in the industry of integrated circuits. Rapidly fast innovation, fast changes in communications standards, the

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entry of new players, and the evolution of new market sub segments will lead to disruptions (disorder, confusion) across the industry [4].

3. IOT AND AUTONOMOUS MOBILE DEVICES

The connection of vehicles or mobile robots to the Internet brings about a wealth of new possibilities and applications which bring new functionalities to the individuals and/or the making of transport easier and safer. In this context the concept of Internet of Vehicles (IoV) connected with the concept of Internet of Energy (IoE) represent future trends for smart transportation and mobility applications as depicted (described, shown, illustrated) on Fig 3 [5].

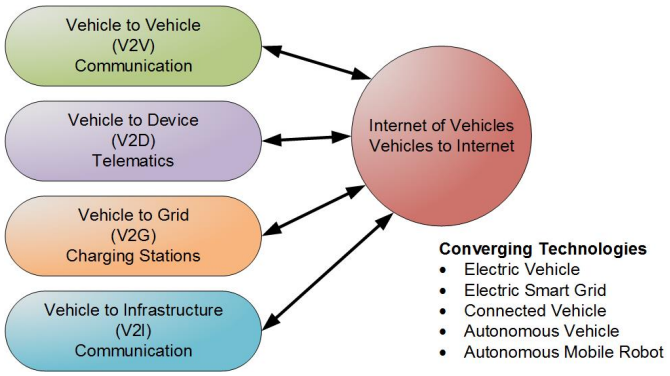

Figure 3. Converging Technologies

Self-driving vehicles today are in the prototype phase and the idea is becoming just another technology on the computing industry's parts list. Using automotive vision chips that can be used to help vehicles understand the environment around them by detecting pedestrians, traffic lights, collisions, drowsy drivers, and road lane markings [6]. Those tasks initially are more the sort of thing that would help a driver in unusual circumstances rather than take over full time.

4. CONTROL DATA STORAGE TO THE CLOUD

By its name, a cloud database is a database that runs on a cloud computing platform, such as MS Onedrive, Dropbox and Google Drive. The cloud platform can provide databases as a specialized service, or provide virtual machines to deploy any databases on. Cloud databases could be either relational or non-relational databases. Compared to local databases, cloud databases guarantee higher scalability as well as availability and stability [12],[19],[20],[21]. Thanks to the elasticity of cloud computing, hardware and software resources can be added to and removed from the cloud without much effort. Users only need to pay for the consumed resource while the expenses for physical servers, networking equipment, infrastructure maintenance and administration are shared among clients, thus reducing the overall cost. Additionally, database service is normally provided along with automated features such as backup and recovery, failover, on-the-go scaling, and load balancing.

Cloud computing has been established as one of the major building blocks of the Internet of Things [13]. New technology enablers have progressively fostered virtualization at different levels and have allowed the various paradigms known as "Applications as a Service", "Platforms as a Service" and "Infrastructure and Networks as a Service". As part of this convergence, IoT applications such as sensor-based services will be delivered on-demand through a cloud environment. This extends beyond the need to virtualize sensor data stores in a scalable fashion. It asks for virtualization of Internet-connected objects and their ability to

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become incorporated into on-demand services such as Sensing-as-a-Service. Fig. 4 shows the performances of tested database management systems.

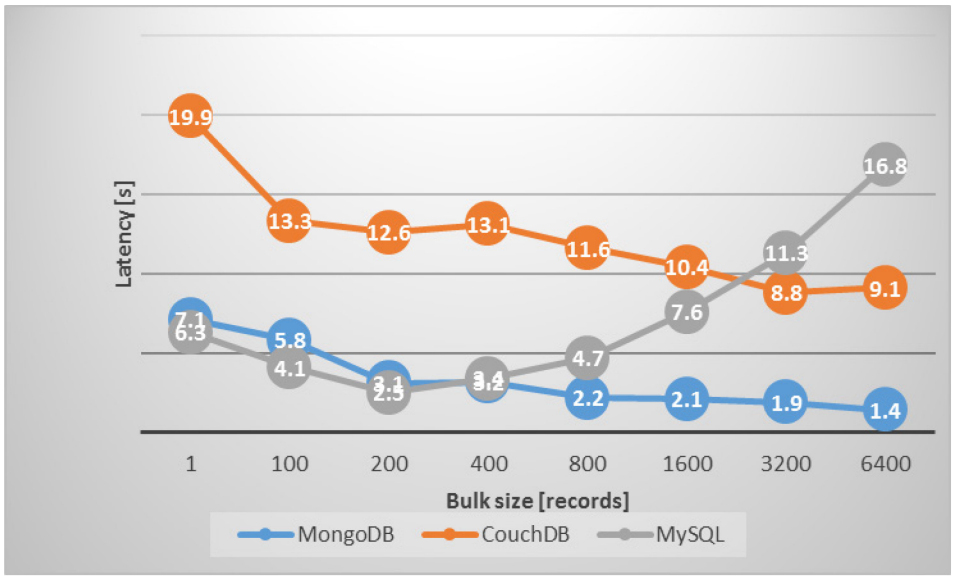

Figure 4. Bulk insert latency test with various DBMS

The choice of the databases was based on the fact that those were among the most popular databases available, and that they were the representatives for their kinds. Many large organizations have been using them in production, such as Facebook, Google, Wikipedia, LinkedIn, Instagram, etc. On the other hand, each database has its own promising strength that is worth exploring. MySQL so far has been the most popular open source SQL database. MongoDB was built to work with very large sets of data [13],[14],[18],[22]. CouchDB has its user-friendly RESTful API. Meanwhile, Redis is said to be very fast thanks to its in-memory storage. Redis is an open source, BSD licensed, advanced key-value cache and store system. With the bulk data, the MongoDB has the smallest latency, but the overall best score goes to MySQL.

Other important issues considering the Web of Things and Database services are system parameters such as Bit Error Rate (BER) and Packet Error Rate (PER). The PER values presented in this research are percentages calculated as a ratio of number of packets with errors divided with the total number of packets sent. Presented results are made during the two separate experiments using Arduino UNO platform and two different communication modules using ZigBee technology in indoor environment. The presented values are illustrative and not comparable because they are not used in the same experimental conditions. More data about the experiment can be found in [23],[24].

In experiment No. 1 [23] from each position ZigBee node sent 2500 packet in 100 ms interval. The duration of data transmission and the distance of the measurement stations from coordinator are given in Tab. 1.

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Table 1. Results Concerning Packet Statistics Experiment No. 1

Position	*Packets Sent (No.)*	*Distance (m)*	*PER (%)*
1	10087	1	0.73
2	10865	10	1.51
3	10091	6.5	0.66
4	10153	18	1.82
5	10126	12.5	0.41
6	10231	26.5	1.29
7	10171	31.5	1.7

In experiment No. 2 [24] data are sent as ASCII bytes. The packets are encrypted which results together with payload with 81 Bytes long packet. The data are sent every 100ms. Very short inter packet interval in both case is defined for the experimental purposes in order to analyse frequent packet transmission which are common for the presented environments.

Table 2. Results Concerning Packet Statistics Experiment No. 2

Loc.	*Packet Sent*	*Data Packets Sent*	*Errors*	*PER (%)*	*Dist. (m)*	*Floor*
1	457d8	4507	22	0.48	1	1st
2	4520	4395	44	0.97	18	1st
3	4553	4356	62	1.36	26.5	1st
4	4328	4049	114	2.63	28	1st
5	1292	669	287	22.21	31.5	1st
6	3067	2729	100	3.26	30.2	1st
7	3080	2777	111	3.6	29	1st
8	3032	2733	117	3.86	25.5	1st
9	2880	2321	267	9.27	22.5	1st
10	2821	1625	546	19.35	16	2nd
11	9	0	0	0	19.5	2nd
12	1693	796	407	24.04	17	2nd
13	2435	1473	484	19.88	9.5	2nd
14	3181	3104	22	0.69	9	2nd

5. WEB 2.0 ENVIRONMENT

A Web 2.0 site may allow users to interact and collaborate with each other in a social media dialogue as creators of user-generated content in a virtual community, in contrast to Web sites where people are limited to the passive viewing of content. Examples of Web 2.0 include social networking sites, blogs, wikis, folksonomies, video sharing sites, hosted services, Web applications, and mashups.
Rapid Web Development means quick and efficient web application building. It is part of the Rapid Software Development described in [15],[29],[31],[32]. Besides the obvious objective of meeting customers' deadline, another characteristic of Rapid Web Development is fast prototyping. Mockups and partial web application versions aid evaluation, usability testing and simulation of planned features.
The Rapid Web Development process uses existing technologies and brings them together allowing us to focus on the real task of application building. It implies integration of readily available open source and free to use software, frameworks, APIs, libraries, data sources, external services and functionality to create a platform for running our Web 2.0 service. This development model is known as "Mashup" - a web application hybrid [16],[30].

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Fig. 5 illustrates a simple mashup model where web services and multiple external and internal data sources are combined.

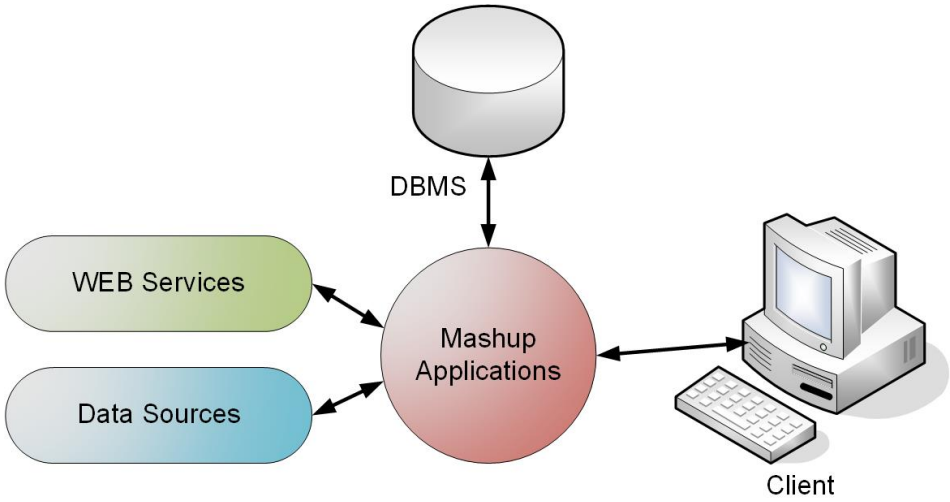

Figure 5. Mashup model illustration

The term mashup originally comes from British - West Indies slang meaning to be intoxicated, or as a description for something or someone not functioning as intended. In recent English parlance it can refer to music, where people seamlessly combine audio from one song with the vocal track from another—thereby mashing them together to create something new.

6. CONCLUSION

The concept of Internet of Vehicles (IoV) is the next step for future smart transportation and mobility applications and requires creating new mobile ecosystems based on trust, security and convenience to mobile/contactless services and transportation applications in order to ensure security, mobility and convenience to consumer-centric transactions and services. This requires robust sensors and actuators which are able to reliably deliver information to the systems mentioned above. Such reliable communication needs to be based on M2M communication protocols which consider the timing, safety, and security constraints.
The vision of the future Internet of Things is setting new challenges and opportunities for data management and analysis technology. Gigabytes of data are generated everyday by millions of sensors, actuators, RFID tags, and other devices. As the volume of data is growing dramatically, so is the demand for performance enhancement. When it comes to this Big Data problem, much attention has been paid to cloud computing and virtualization for their unlimited resource capacity, flexible resource allocation and management, and distributed processing ability that promise high scalability and availability.

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TRANSPORTATION HABITS OF SZEGED CITY RESIDENTS

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ABSTRACT

A smart (or liveable) city is a settlement which is able to utilize the available technological possibilities and particularly the infocommunication devices in an innovative way in order to develop a sustainable environment. A sustainable urban environment is increasingly necessary since the portion of urban population is constantly growing. This might require the rethinking of the development of traffic in the city as well.
In 2015 a survey was conducted in Szeged related to the ongoing smart city project. The main goal of the survey was to get information about the transportation habits, opinions and expectations of the city residents. This paper summarizes some of the interesting results of the research in the field of public transport, bicycling, car transport, parking and walking. The research methods used were descriptive statistics, measuring relationship between variables and hypothesis testing. The results can also be the base of a later similar survey, where the possible financial consequences of the expectations are also communicated to the participants.

Keywords: Smart city, Szeged, transportation, survey

1. INTRODUCTION

The population of Szeged has increased significantly in the last decades, from 104,000 to 162,000 in sixty years. The city's infrastructure has to serve more and more people, it should provide more and higher quality services to its residents and visitors.
The city services must be provided in a sustainable way. Settlements with outdated infrastructure are not able to perform their duties, so the infrastructure has to be developed. If this development is not well planned, this can lead to expensive and – in many cases – forced solutions. City infrastructure (residential, commercial, service and industrial zones, roads, public transport etc.) developments bearing sustainability in mind should not be ad hoc performed. Instead thoughtful planning should take place first in order to create the environment that is suitable from a socio-economic perspective which provides a decent living environment for the inhabitants [1].
Nowadays it is fashionable to talk about smart cities, and try to implement the concept behind it. The "smart city concept" has not yet fully crystallized; there are many interpretations. A comprehensive overview can be found in the paper of [2] and [3]. According to the latter, a smart city has several core components and elements (Fig. 1).
The concept integrates many areas of intervention: economy (dynamism and innovation), energy (sustainability and optimization), mobility (movement), environment (enhancement) and community (participation and communication) [4]. Smart city strategies can be built on local level, although they can also include a region or even the entire country [5]. Both solutions have benefits and disadvantages as well.
The smart (or liveable) city is a settlement where the available technological possibilities and particularly the information and communication devices are used in an innovative way in order to develop a sustainable environment [6]. According to a study financed by IBM, the smart city invests into human capital, traditional and modern information and communication infrastructure which promotes, encourages sustainable economic development and raises the standard of living, while it manages natural resources wisely and responsibly [7]. Services and infrastructure in the smart city are closely related to each other, so they operate more intelligently and more efficiently which creates new exploitable opportunities [6]. Efforts that lead to the smart city are expected to have an effect on efficiency, effectiveness, productivity, transparency and sustainability of the city [3].
The official document about the future vision of Szeged smart city (version 2, February 2016) contains several statements which determine the future of the settlement [8]. According to the document: "The Smart City can achieve a better quality of life and a competitive, sustainable economy by organizing

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intelligently the life of the community ranging from public services through urban transport, health care, education and commerce up to supporting local, self-organized communities."

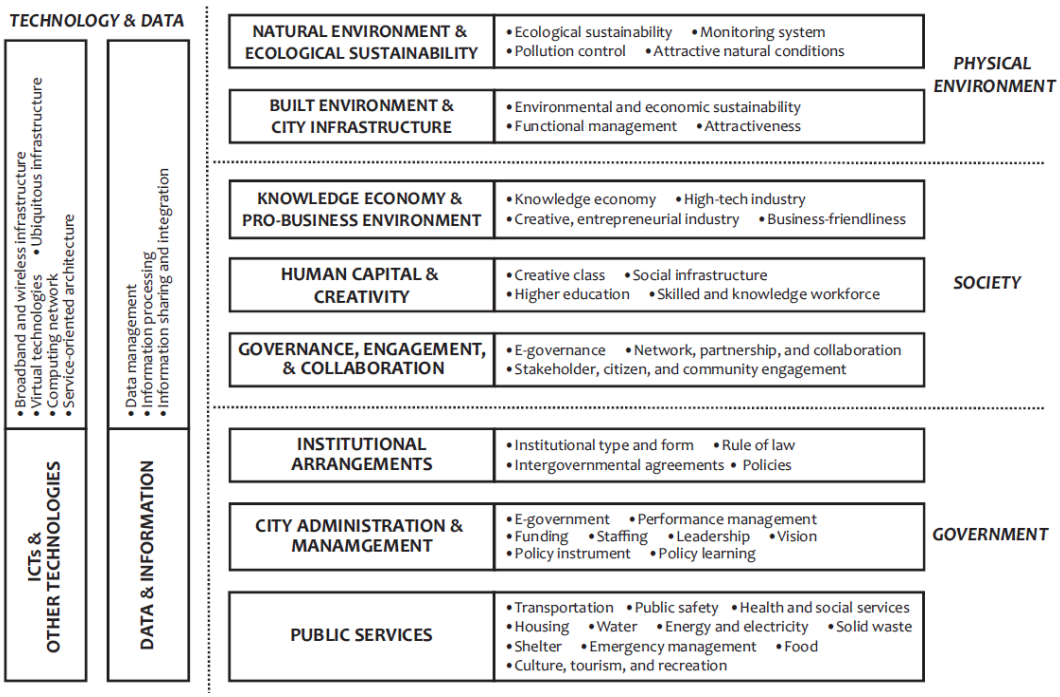

Figure 1. A comprehensive view of smart city components and elements (Source: [3])

A well-organized road network and transportation system is essential for building a modern, smart city. The radial and circular structure of the main road network in Szeged was very advantageous for the traffic in the past with much lower traffic. Nowadays, unfortunately, this is an endowment which diverts traffic mainly to the centre without escape routes and causes traffic jam at peak times. The public transport system is highly developed in the city. A bicycle road network is an essential accessory of a smart city too, for easier access and environment-friend life [9], [10]. The cycling route network began to evolve in the last decade.

2. MATERIALS AND METHODS

The aim of this paper is to summarize and analyse the data collected with a survey carried out in 2015. The residents of Szeged were asked to fill in a questionnaire where several questions related to transportation habits, opinions and expectations.
The survey was performed in different parts of Szeged city (which has a population of around 162,000) in the first part of 2015. The answers of the participants were processed in Excel. The following examinations were performed:

- Frequency distributions: frequency of public transportation, car and bicycle usage by
  - Gender,
  - Marital status,
  - Level of education,
  - Possession of a driving licence,
  - District of residence,
  - Number of persons living in the household,
  - Ability to save money,
  - Current financial situation,
  - Change of financial situation last year,
  - Source of income,
  - Workplace and
  - Job position.

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- Measures of association: Cramér's V was used to determine whether there is a relationship between the frequency of the use of transportation type and the criteria mentioned above. Cramér's V shows the strength of association between two examined criteria. The number can be between 0 (no association) and +1 (strong association). It is computed as in (1) by taking the square root of the chi-squared statistic divided by the sample size (N) and the minimum dimension of the table containing the grouped data minus 1:

$$V = \sqrt{\frac{\chi^2}{N \times \min(row - 1, column - 1)}} \quad (1)$$

- Regression analysis was done to check if the combination of the criteria has significant effects on the frequency of transportation use.
- The existence of correlation was calculated between the frequency of public transport use, the frequency of cycling and the frequency of car usage. The results were tested at 5 per cent significance level. According to the null hypothesis, the criteria are independent (H_0: $r_{yx}=0$, H_1: $r_{yx}\neq 0$ where r_{yx}: linear correlation coefficient). In case of rejecting the null hypothesis the correlation is significant. The test (2) bases on the correlation coefficient estimated from the sample:

$$t = \frac{\hat{r}_{yx}\sqrt{n-2}}{\sqrt{1-\hat{r}_{yx}^2}} \quad (2)$$

The test follows t-distribution with n-2 degrees of freedom if the null hypothesis is true.

3. RESULTS

This section contains information acquired form the data gathered from the 973 randomly selected survey participants.

3.1. The characteristics of the participants

Of the 973 persons, 54 per cent were female and 46 per cent were male. The vast majority (80%) were between the age of 21 and 65. Half of them were born in Szeged and lived in the city since then. One third of the participants were born elsewhere, but lives in the city since school years or adulthood. Slightly more than half had at least secondary school qualification (53%) and a fifth had a higher education degree.
There are several official and unofficial parts, districts in the city; nearly thirty was mentioned in the survey, but most of the collected data came from six of them: Felsőváros (12%), Újszeged (12%), Belváros (10%), Tarján (9%), Rókus (9%) and Móraváros (6%).
According to the collected data, the number of persons living in one household is low: 1 person 14%, 2 persons 36% and 3 persons 23%. Most survey participants were either married and live with their spouse (47%) or unmarried and live with no partner (20%).
More than the half of the asked persons told that they are not able to save money (55%). Nearly half of them get on well every month with tight budgeting (46%), a third of them barely get by from the monthly income (34%). The percentage of those who live without problems (8%) or have financial difficulties (9%) are much less and almost the same.
According to the answers, the basic source of income was mainly a full-time job (49%) or pension (21%). Most of them were subordinate white-collars (28%) and skilled workers (24%).

3.2. The frequency of using different means of transport

The answers show that 72 per cent of the participants use some kind of public transport. It should be noted that this is 10-15 per cent higher than the data acquired from other surveys. A third of interviewed travel by bus, trolleybus or tram every day (Fig. 2).

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It can also be seen that there are a lot of people who almost never use any types of public transport.
Nearly a quarter of the residents taking part in the survey use buses only the most frequently for travelling in Szeged (23%). Almost a fifth of the people selected all three kinds of transport as most frequently used ones (18%). The other possible combinations (trolleybus, tram, trolleybus + tram, bus + tram, bus + trolleybus) were selected by 10-14 per cent of the participants.
According to the data collected about the frequency of cycling (Fig. 2) there are a lot of people using bicycles for their own transportation. There were only 37 per cent who believed that they almost never use a bicycle and a fifth of the asked residents cycle on a daily basis.
Many city residents have driving licence; this answer was marked by nearly two third. Unfortunately, 346 persons did not answer this question, but according to the responses of the rest, two third use a car for daily transport or at least once or twice a week (Fig. 2). According to the parking rules, vehicles need a parking ticket in the inner part of Szeged. It was surprising, that according to the data most people (85%) use daily or hourly tickets instead of season tickets. This may be because they find ways to avoid paid parking zones.

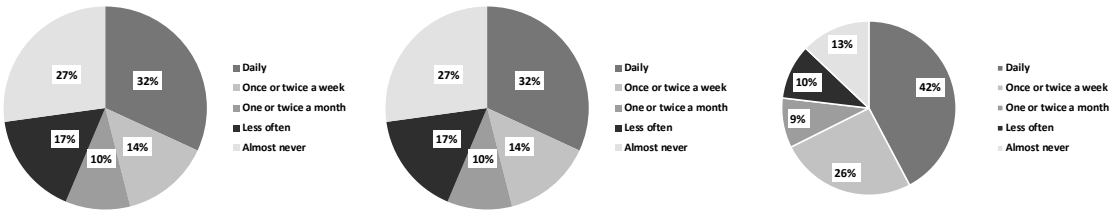

Figure 2. Frequency of public transport (left)(N=960), bicycle (middle)(N=972) and car usage (N=627) (Source: author's editing)

3.3. Frequency of usage by the characteristics of the participants

The frequency of using public transportation, cycling and car usage were examined by several characteristics of the participants (already listed in section: Materials and methods).
Fig. 3 for example shows the relationship of cycling frequency of the people taking part in the survey and their financial situations.

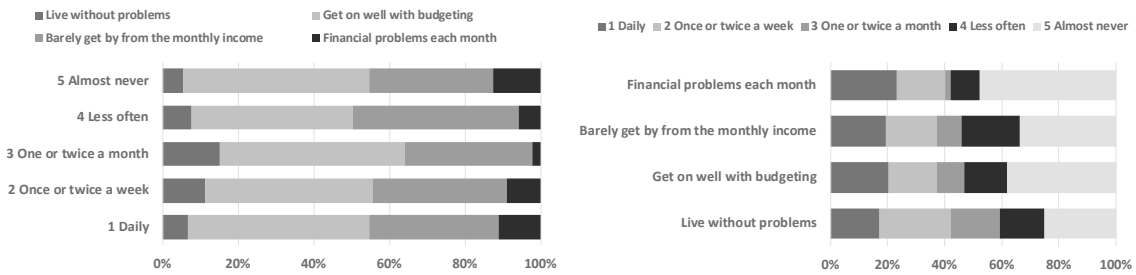

Figure 3. Relation of frequency of cycling and the financial situation (%, N=945) (Source: author's editing)

Although it may seem that there are some connections between transportation habits and the other features based on the charts (of which one example is Fig. 3), examining the criteria with Cramer's V, the relationship proved to be minimal. Tab. 1, Tab. 2 and Tab. 3 shows the values of the strength of associations in descending order. In the case of car usage, driving license was omitted because those answering the related questions all had one.
According to the regression analysis, the twelve characteristics of the respondents have only a very little impact on cycling habits (r^2=0.098) and the public transport usage (r^2=0.183), while they contribute to the value of car usage frequency to a high extent (r^2=0.793).

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Table 1. The strength of association between the frequency of using public transport and the characteristics of the participants (Source: author's editing)

Frequency of using public transport and	χ2	N	min(r-1,c-1)	Cramér's V
Driving licence	79.98	958	1	0.29
Gender	53.12	960	1	0.24
District of residence	194.32	947	4	0.23
Source of income	91.31	946	4	0.16
Job position	69.81	859	4	0.14
Marital status	65.57	942	4	0.13
Level of education	55.07	950	4	0.12
Number of persons in household	39.90	944	4	0.10
Workplace	9.53	496	2	0.10
Financial situation	15.53	933	3	0.07
Change of financial situation last year	16.01	940	4	0.07
Ability to save money	2.54	891	1	0.05

Table 2. The strength of association between the frequency of using a bicycle and the other characteristics of the participants (Source: author's editing)

Frequency of cycling and	χ2	N	min(r-1,c-1)	Cramér's V
District of residence	166.77	959	4	0.21
Gender	36.52	972	1	0.19
Driving licence	34.17	969	1	0.19
Source of income	122.01	956	4	0.18
Number of persons in household	68.94	955	4	0.13
Marital status	62.48	954	4	0.13
Job position	52.43	865	4	0.12
Ability to save money	10.42	902	1	0.11
Workplace	9.64	500	2	0.10
Financial situation	26.55	945	3	0.10
Change of financial situation last year	22.94	952	4	0.08
Level of education	18.85	962	4	0.07

Table 3. The strength of association between the frequency of using a car for transport in the city and the other characteristics of the participants (Source: author's editing)

Frequency of car usage and	χ2	N	min(r-1,c-1)	Cramér's V
Gender	33.66	627	1	0.23
District of residence	121.05	617	4	0.22
Marital status	83.13	621	4	0.18
Source of income	65.99	617	4	0.16
Job position	57.90	564	4	0.16
Workplace	14.92	385	2	0.14
Financial situation	30.91	610	3	0.13
Number of persons in household	40.84	613	4	0.13
Ability to save money	8.95	576	1	0.12
Level of education	28.86	621	4	0.11
Change of financial situation last year	25.59	614	4	0.10
Parking ticket	8.60	478	4	0.07

3.4. Opinions about the funding of transportation

There were several questions asked about opinions on funding different aspects of transportation in Szeged. Questions concerning public transport included:

- Separate season tickets for bus, tram and trolleybus,
- Purchase (season)ticket on smartphone and Internet,
- Increase of line density,
- Public information at stops and terminals,
- More gas operated vehicles (instead of petrol),
- More tram and trolleybus instead of bus,

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- Purchase (season)ticket from vending machine on vehicle,
- Public information on smartphone and Internet,
- More comfortable stops,
- Flexible fare system and
- Boarding possibilities for the disabled.

Fig. 4 shows the responses of the survey participants. The data is arranged by opinions about the funding needs.

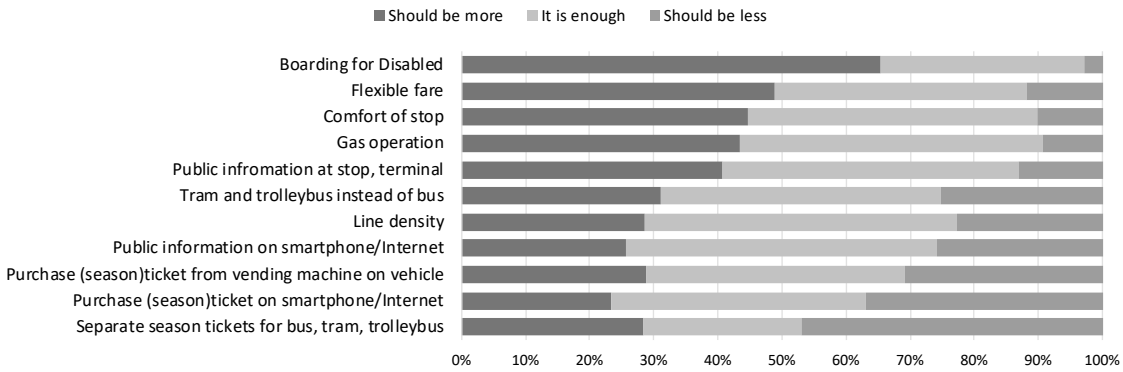

Figure 4. Funding the development of public transport according to survey participants (%, N=973) (Source: author's editing)

Two fifth of the opinions were that the funds are enough and there were nearly as many opinions showing that more money should be spent on the different areas of public transport.
The questions about funding bicycle transport:

- New bicycle paths,
- Renovating bicycle paths,
- Connecting bicycle paths,
- Priority of bicycle paths,
- Expanding storage places,
- Security of bicycle storages,
- Increasing the number of secure storages,
- Bicycle renting,
- Bicycle aid places and
- Mandatory storages near public institutions.

Fig. 5 shows the opinions of the survey participants about funding areas connected to cycling. The chart is arranged by the opinions about the funding needs.

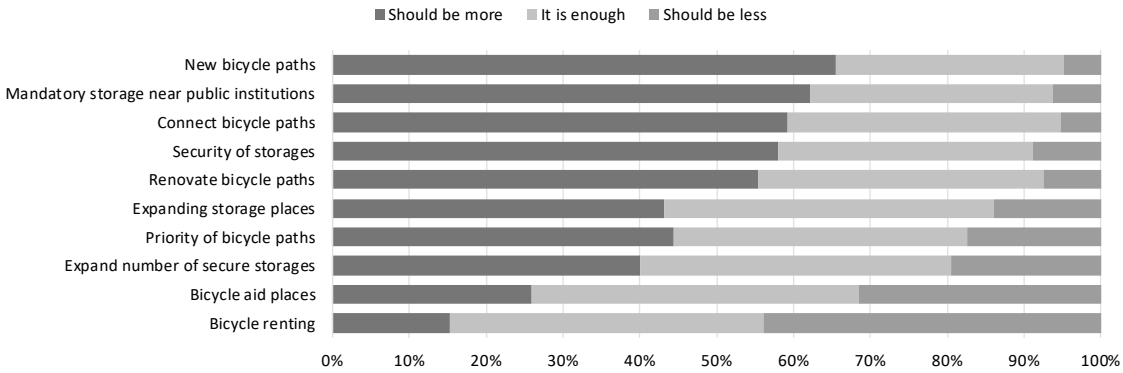

Figure 5. Funding the development of bicycle transport according to survey participants (%, N=973) (Source: author's editing)

Nearly half of the answers (47%) indicated that more money is necessary in this area, while 37 per cent of the answers signed that people are satisfied with the funds.
Enquiries about funding car transportation:

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- Road maintenance,
- Road above railway track,
- More roundabouts,
- Solid surface on roads,
- Roads signs,
- Smart lamps showing remaining time,
- Traffic dependent smart lamps,
- Digital information board above roads,
- Digital speed monitoring signs,
- Mobile dam along quay road and
- City-wide “yellow angel”.

Fig. 6 lists the opinions of the survey participants about the funding to support vehicle transport in Szeged. The list is arranged by the funding needs.

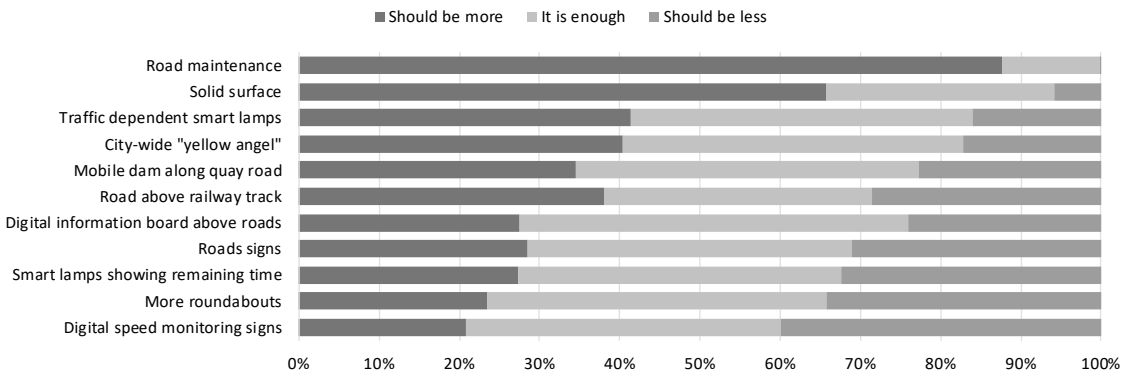

Figure 6. Funding the development of vehicle transport according to survey participants (%, N=973) (Source: author’s editing)

On the one hand, nearly a fourth of the answers indicated that there are some aspects of the vehicle traffic where less money would be enough. On the other hand, forty per cent of the replies specified that more funding is required.

Questions about funding the city parking were the following:

- Increase number of parking places,
- More places to buy parking tickets,
- Installation of parking machines,
- More underground garages,
- More parking places near public institutions,
- More parking places near railway stations,
- More parking places near bus stations,
- Minute-based tariff,
- Discount when arranging official tasks and
- Grace period to buy parking tickets.

Fig. 7 illustrates the opinions of the participants about the funding different aspects of the city parking system. The criteria are arranged by the funding need opinions.

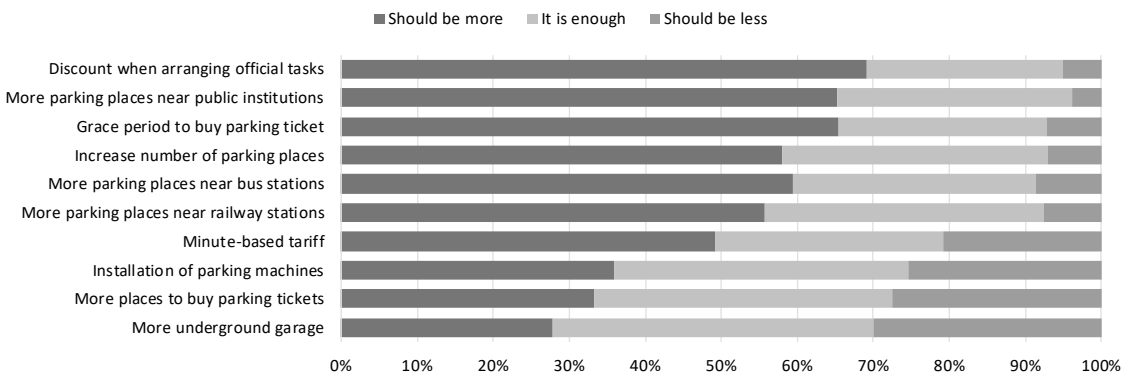

Figure 7. Funding the development of the parking system according to survey participants (%, N=973) (Source: author’s editing)

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By and large the majority is not satisfied with the money spent on the city parking system (only a third is pleased), 52 per cent of the answers point out that the funding should be more.
Opinions about the funding of pedestrian traffic was also evaluated:

- Decrease of vehicle traffic,
- Methods to decrease speed of vehicles,
- Increase the number of pedestrian streets,
- Private traffic-free city centre,
- Railing between road and pavement,
- Security of pedestrian crossings,
- Separation of pedestrians and bicycles,
- Increase the number of pedestrian crossings,
- Crosswalks with traffic light and
- Increase the time of crossing.

Fig. 8 illustrates the opinions about the funding of the pedestrian traffic. The list is sorted according to the funding need opinions.

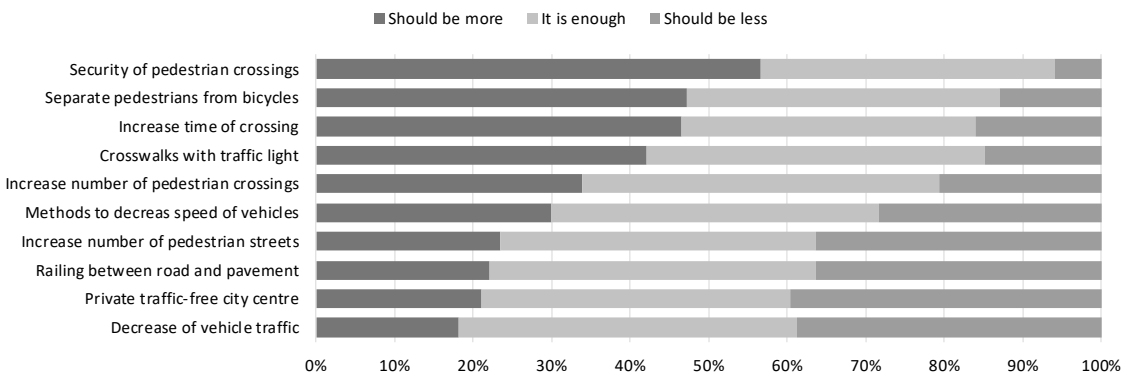

Figure 8. Funding the development of pedestrian traffic according to survey participants (%, N=973) (Source: author's editing)

Based on the answers, one can say that the results are similar to the opinions about funding the public transport: most of the data show that the majority is satisfied (41% of the answers), a little bit less answers indicate that the funding should be more (34% of the answers).

3.5. Hypothesis tests

Hypothesis 1: H_0: Frequency of public transport use and frequency of cycling are independent.
Hypothesis 2: H_0: Frequency of public transport use and frequency of car usage are independent.
Hypothesis 3: H_0: Frequency of cycling and frequency of car usage are independent.
The results calculated in Excel spreadsheet can be found in Tab. 4. According to the tests, there is significant moderate (negative) downhill correlation between the frequency of using means of public transport in Szeged and the frequency of travelling by car. The other two possible combinations show no relationship.

Table 4. The results of the hypothesis testing (Source: author's editing)

Criteria 1 Frequency of…	**Criteria 2 Frequency of…**	**Correlation coefficient**	**t-test**	**P value**	**Decision**		
public transport use	cycling	-0.067	-1.657	0.098	P value > 0.05	not significant	H_0 accepted
public transport use	car usage	-0.469	-13.195	0.000	P value < 0.05	significant	H_0 rejected
cycling	car usage	-0.069	-1.717	0.086	P value > 0.05	not significant	H_0 accepted

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4. DISCUSSION AND CONCLUSIONS

In order to ensure the planned development of the smart city, those responsible have to be aware of the characteristics, habits and opinions of the resident community. In case of the transportation this means travelling habits in the city, the attitude toward the funding of different areas of transport (public, car and bicycle) etc. This was the purpose of the survey carried out in 2015.

Based on the results obtained from the data collected from a random sample of nearly a thousand city residents, the following conclusions can be drawn:

Many city residents use bus, trolleybus or tram to travel in Szeged. The ratio of those who travel every day by public transport, instead of gas-powered cars, could be and should be increased to make the city a more environment-friend settlement.

The above statement also applies to cycling. Measures should be taken to encourage city residents to use their own, or rented bicycles more frequently to travel all over Szeged.

Using cars for transportation is also very popular among city dwellers. The collected data shows that many people can afford to use cars, it would still be preferable to persuade them to use public transport or bicycle instead.

Association test shows little or no connection between the frequency of different means of transport usage and the several characteristics of the city residents. This means that these characteristics (age, gender, marital status, financial situation etc.) do not have impact on the people's travelling habits within city boundaries.

The regression analysis indicates that the different values of the residents' characteristics together have influence on the car usage frequency. The values explain the dependent variable to nearly eighty per cent. The created model may be imported into a simulation system for further analysis.

In case of public transport, people consider boarding the vehicles for the Disabled the most important and a more flexible fare system which takes into account for example the travelled distance is an essential opinion, too. Smart applications to buy (season)tickets and to view the timetable and other public information about traffic is much less important. When surveying the opinions about transportation, the survey and the interviewer did not focus on describing the financial consequences of the different expectations and this is clearly observable in this case.

According to the townspeople, new bicycle paths are essential as well as mandatory storage places near the public institutions. People in Szeged do not put emphasis on bicycle renting. Further examination is needed to determine the cause of this latter result.

Not surprisingly, in the theme of the development of vehicle transport, the most important is to put more money in road maintenance and cover all roads with solid material. There are several roundabouts in Szeged and according to the survey results, replacing crossroads with more roundabouts is not important. Digital speed monitoring signs besides or over the roads are considered less important. This is not surprising, since vehicle drivers can easily monitor their speed by other means.

In the field of city parking, discounts to arrange official affairs, more parking places and a grace period to give enough time to buy the ticket are considered the most important, while spending more money on more parking machines and parking places as well as building underground garages are not supported by the majority. Many public institutions are there in the city centre and when someone visits these places by car, he or she is forced to pay for the parking. There are daily periods when it is difficult to find a free parking place in the inner city, so more garages would be necessary but since it is not possible to build underground garages (and this is also not supported by the residents) the solution may be to create more parking places in the suburbs or move the public offices there.

In pedestrian traffic the most important areas are the security of the crossings, the increase of time to let pedestrians cross the roads and the separation of pedestrians and bicycle traffic. Crossing can be made more secure by traffic lights and the proper placement of clearly visible signs. Changing programmes of traffic lights should be carefully implemented, because the lamps have to be synchronized to avoid traffic

jams during peak hours. Separating the cyclists from the walkers is important to prevent accidents. In my opinion, for an eco-friendly environment less air pollution and to achieve this, less vehicle traffic and a private traffic-free city centre would be advantageous, but to spend more money on the arising tasks is not supported by the survey participants.
There is a significant, but only medium opposite relation between the frequency of car and public transport usage. Those, who use car often for transport are less likely to travel frequently by bus, tram or trolleybus.

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ISSN 2064-7964

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USE OF JUVENILE GRAPE BERRY AS ANTIOXIDANT RICH FOOD INGREDIENT

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ABSTRACT

Both grape and wine production have several useful by-products what have been discovered more and more due their important positive health effects in the last decades. The grape seed is one of them because its high antioxidant power. On the other hand, the marc is also more and more widely evaluated because of its high amount and useful chemical components. However, the grape berries what arise during cluster or grape thinning are rarely evaluated. Their positive properties and high antioxidant activity has been well known for a long time but their utilization is very rare. It is known as verjus, that is known from its sour taste as souring agent, but in Hungary it is not known. In our research we have evaluated six grape varieties in the Tokaj region during grape maturing in three stages of veraison. Clusters were collected and berries were removed from the pedicles manually and the chemical composition of whole berries, separated seeds and peel and flesh were analysed. Furthermore, dried berry parts were grinded and added to wheat flour and biscuits made from them were also analysed both chemically and sensory. We found that their use can result antioxidant rich and tasty bakery products.

Keywords: grape, cluster thinning, by-products, biscuits

1. INTRODUCTION

High amount of wastes are produced in the agriculture and food processing and they requires proper handling. But in several cases these wastes are not useless results of the main process but they can be used in further processing. In the case of viticulture high amounts of juvenile grape berries are produced in the grape thinning. These berries contain high amounts of organic acids, tannins, anthocyanins and phenolic compounds. Ref. [1] presents that the concentrations of tannins are highest in the period of grape veraison, in the further stages of maturing their concentrations decrease. He found that the concentration of malic acid increases until the veraison and decreases after it, while the tartaric acid concentration also increases in the maturing periods before veraison but the increase still remains later with a much more moderate slope. Ref. [2] also found that the total acid content increases until veraison, but in the further growing stages it decreases. Lőrincz et al. also described the same tendency in the change of the concentration of tannins. The concentration of anthocyanins also starts to increase in the veraison but it remains until harvest. Ref. [3] evaluated the changes of the concentration of phenolic compounds during maturing. It was found that total phenol content increased in the first stages of maturing, but later they decreased continuously.

Grape thinning is an important task of viticulture. Due to the thinning, the matured berries will be larger and the bunch will be also larger [4]. The removed grapes are very poor in sugars and therefore sweet taste but contain a lot of acids and phenolic compounds [5]. The use of these berries is very accidental. Almost the only way of use is the production of verjus, what is a pressed and filtered grape berry juice. The ancient Greeks used it for the treatment of ulcers and due its digestive and antiseptic properties and later as dressing. Its popularity decreased in the XVIIIth century due to the expansion of lemon, but nowadays it is experiencing a renaissance and used as salad dressing and component of soft drink, fruit compote [5]. In our research work we have evaluated the changes of acid content, phenol and flavonoid content and antioxidant activity of grapes of six grape varieties three times during the maturing and we used its flour as a component of functional biscuits and we were curious if the advantageous chemical properties can be

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seen in the properties of biscuits too and how the juvenile grape flour addition influences the consumer's opinion about this product.

2. MATERIALS AND METHODS

Six grape varieties were evaluated in the experiments: Sárgamuskotály, Zéta, Furmint, Kövérszőlő, Chardonnay and Hárslevelű. The samples were collected near to Tarcal in the Tokaj Wine Region by the collaboration of the colleagues of Tokaj Wine Region Institute of Vine and Wine Nonprofit Ltd. The samples were collected at three times during maturing: the first sampling was performed at 17th June, the second at 13th August and the third at 17th September, during harvest. 10 bunches of grapes were collected from every variety at all sampling times. The samples were stored frozen at -80°C before the analysis.
The samples were unfrozen just before the chemical analysis. After that the berries were removed from the bunch and were separated into grape seed and grape flesh. The analysed parameters were dry matter content by MSZ 6367-3:1983 [6], the total acid content by the MSZ EN 12147:1998 [7], content of total phenolic components by Ref. [8], content of total flavonoid compounds by Ref. [9], and the antioxidant activity by the DPPH method [10]. All the results are presented on dry matter basis.
Two grape varieties were selected for the biscuit production, Zéta and Chardonnay. Seven products were prepared:

1. control biscuit
2. biscuit made with addition of seed flour of Zéta
3. biscuit made with addition of flesh and skin flour of Zéta
4. biscuit made with addition of whole berry flour of Zéta
5. biscuit made with addition of seed flour of Chardonnay
6. biscuit made with addition of flesh and skin flour of Chardonnay
7. biscuit made with addition of whole berry flour of Chardonnay

The samples used for biscuit making were collected in the first sampling time as it is the common period for thinning. We made biscuits from BL55 winter wheat flour mixed with the seeds, fleshes (with skin) and whole berries. The different berry parts were dried in drying oven at 40°C until reaching of constant weight, than the samples were grinded by household coffee grinder. The concentration of grape seed was 5% in the flour mixtures, while the whole berries and the fleshes were added in 10% concentrations. The biscuits were made from 700 g wheat and grape berry part flour mixture, 250 g margarine, 250 g icing sugar, 4 eggs, 20 g vanillin sugar and 18 g baking powder. The dry raw materials were simply mixed. The margarine, icing sugar and eggs were mixed to foamy stage and were blended with other components. The dough was kneaded, formed and baked at 220°C in kitchen oven for 10 to 12 minutes. Dry matter content, concentrations of total phenolic components and total flavonoid compounds, and the antioxidant activity were measured from the biscuits. A sensory analysis was also performed on a group of 14-15 years old children, as the potential consumers of this product. The biscuits were valuated by their appearance, colour, texture, taste and odour from 1 (poor) to 5 (excellent). The testers also had to make an order from the biscuits by their overall impressions and they had to choose that which ones were consumed willingly or regularly if it would be commercially available.

2. RESULTS AND DISCUSSION

First we have evaluated that how the analysed parameters changed during the maturing in the berries and the different parts of berries. Although the time of thinning depends on the demands of the plant it is important to know that how the concentrations of physiologically important quality parameters of berries changes by time. The dry matter contents were the lowest in the sampling in June. The dry matter contents of Kövérszőlő, Hárslevelű and Furmint were increased continuously until harvest while in the case of Sárgamuskotály, Chardonnay and Zéta an increase was found until august, but later their dry matter contents were decreased in the last month of the ripening. The dry matter contents of grape seeds can be seen on Fig. 1. Both the dry matter contents of seed and flesh were the lowest in June too and significantly

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higher values were measured in the last month of maturing. The order and differences between the values of August and September depended on the variety.

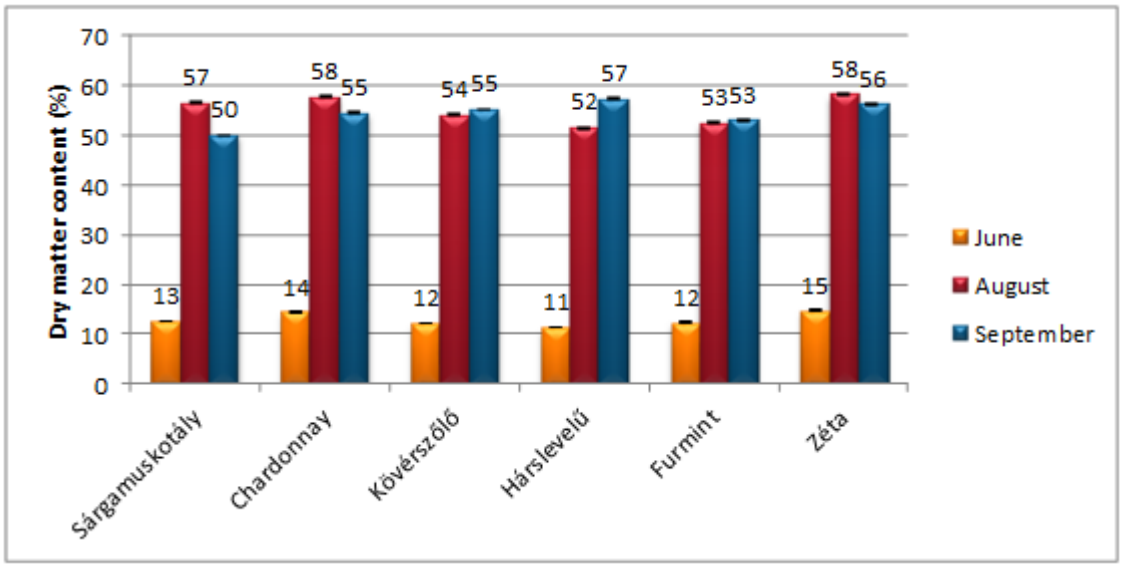

Figure 1. Dry matter content of grape seeds during maturing

The total acid contents were evaluated only from the flesh as the seeds showed extremely low values. The lowest acid values were measured in the first sampling time and the readings were decreased continuously by the time.

The tendencies for the change of concentration of total phenolic compounds of the seeds were similar to the one which was observed in the case of acid content. The phenol contents of the fleshes of the berries were highest in the samples collected in June, much moderated concentrations were determined in August, but the reading were slightly higher in the samples of harvest.

In the case of the changes of total flavonoid content we found differences in the case of the varieties. The highest values for the seeds were measured in the first sampling time. The Sárgamuskotály, Kövérszőlő and Hárslevelű varieties showed continuously decreasing values until harvest, but Chardonnay, Furmint and Zéta varieties showed strong decrease to August, but a slight increase was experienced for September. The total flavonoid contents of seeds can be seen on Fig. 2. The readings for the flavonoid contents of fleshes were high ones in the first sampling time, than a decreasing tendency could be experienced and a slight increase were found for all the varieties.

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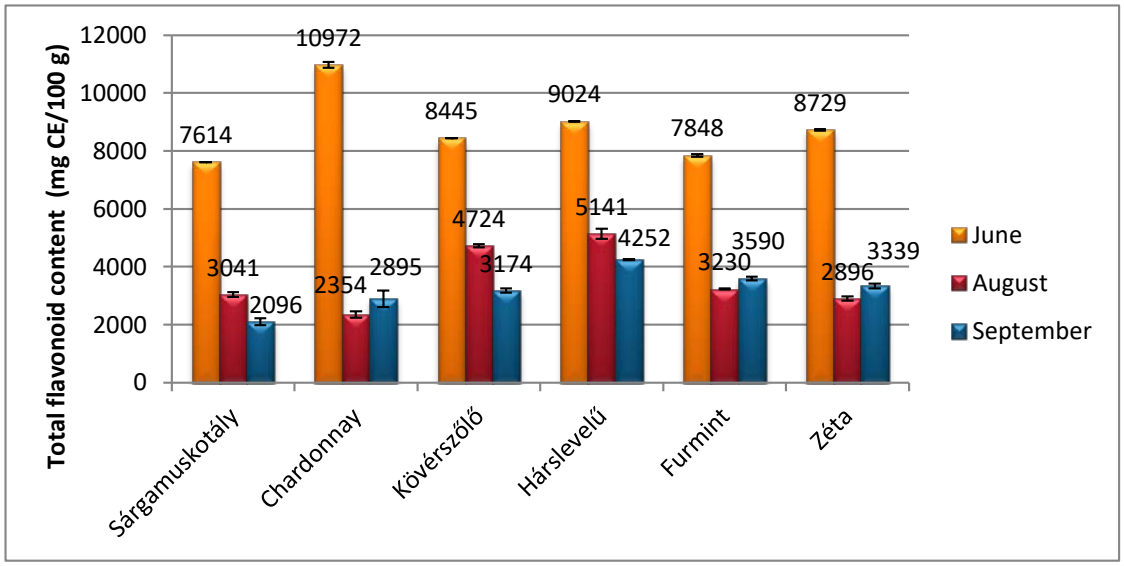

Figure 2. Total flavonoid content of grape seeds during maturing

Both for grape seeds and fleshes decreasing tendencies were experienced for the antioxidant activity. High values were observed in the beginning of ripening, but the values decreased to the third to half values of the initial ones and did not changed significantly in the further maturing. Sárgamuskotály showed a slight decrease to September, but the antioxidant activity increased for all the other varieties. The readings of fleshes can be seen in Fig. 3.

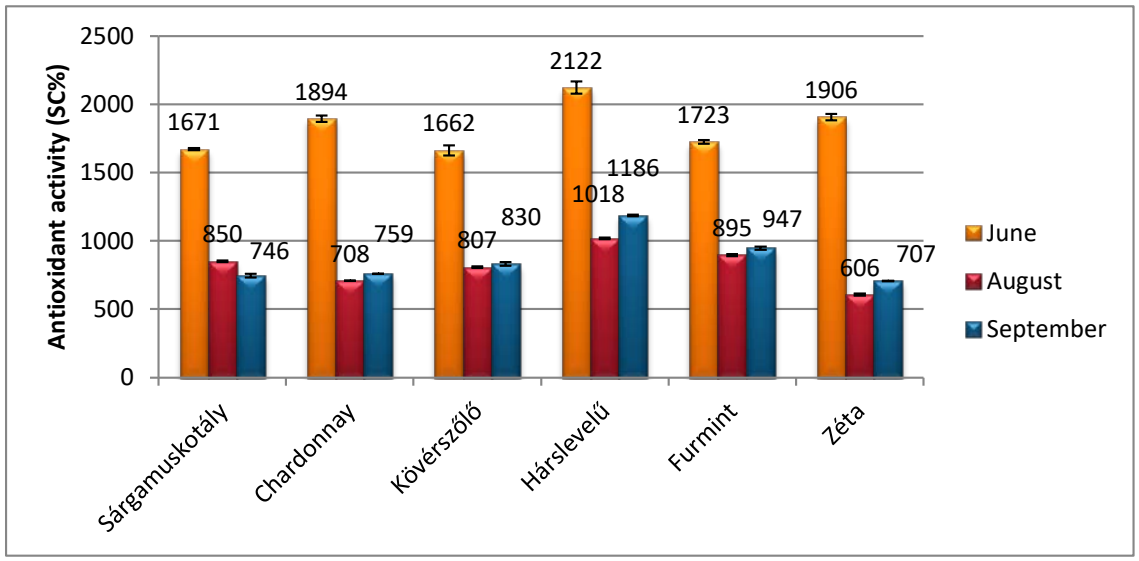

Figure 3. Antioxidant activity of grape fleshes during maturing

Two grape varieties were selected for the biscuit production based on the analysis of grapes: Chardonnay and Zéta, because the highest antioxidant readings were measured in the case of Chardonnay while Zéta

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showed average values. The dried and milled whole berries, the flesh with skin and the seeds were used for biscuit making. The products can be seen on Fig. 4.

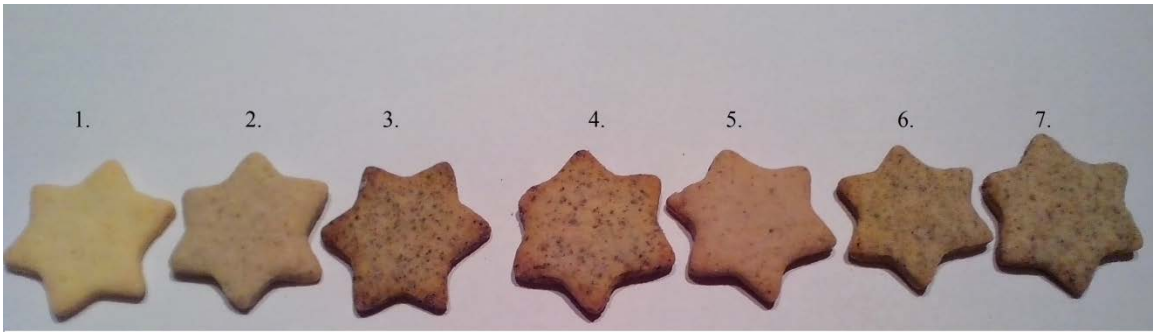

Figure 4. The biscuits made from BL55 flour and dried and milled grape berries and berry parts

Legends: 1: control biscuit, 2: biscuit made with addition of seed flour of Zéta, 3: biscuit made with addition of flesh and skin flour of Zéta, 4: biscuit made with addition of whole berry flour of Zéta, 5: biscuit made with addition of seed flour of Chardonnay, 6: biscuit made with addition of flesh and skin flour of Chardonnay, 7: biscuit made with addition of whole berry flour of Chardonnay

The highest dry matter content was measured in the case of control products, the ones made with addition of grape seed flours showed the highest values while the ones made with berry flash addition showed slightly lower values. The total acid contents were highest for the biscuits made with grape berry flesh addition and the product made with Zéta flesh flour had the highest value. The lowest acid content was measured for the control biscuit. The control biscuit showed the lowest total phenol content too and the addition of berry flour significantly increased the values (Fig 5.).

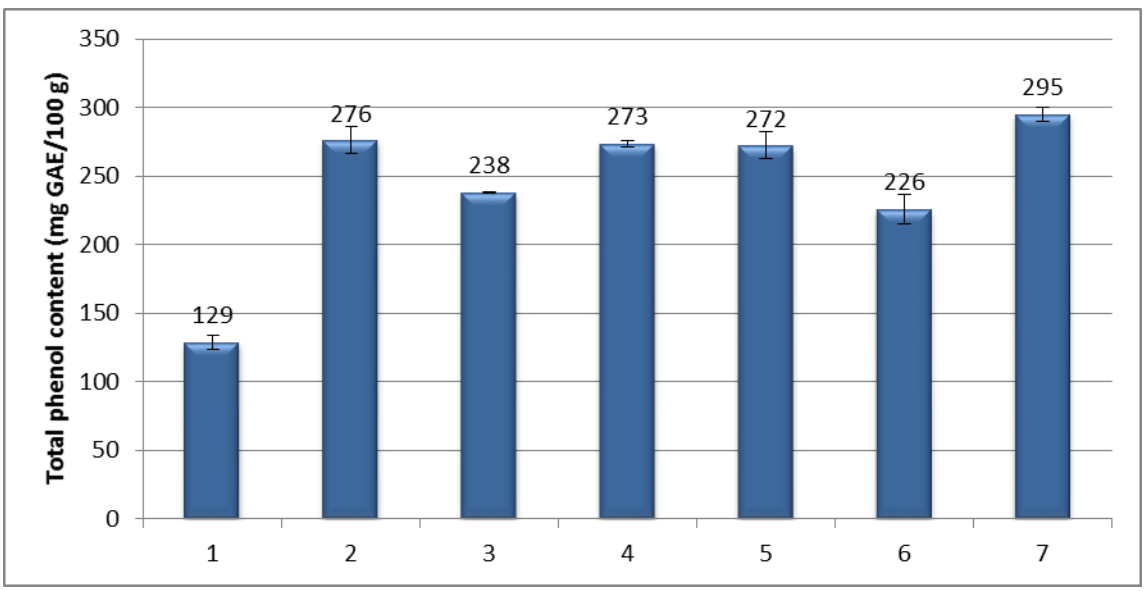

Figure 5. Total phenol contents of biscuits made from BL55 flour and dried and milled grape berries and berry parts

Legends: 1: control biscuit, 2: biscuit made with addition of seed flour of Zéta, 3: biscuit made with addition of flesh and skin flour of Zéta, 4: biscuit made with addition of whole berry flour of Zéta, 5: biscuit made with addition of seed flour of Chardonnay, 6: biscuit made with addition of flesh and skin flour of Chardonnay, 7: biscuit made with addition of whole berry flour of Chardonnay

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The highest total flavonoid contents were found in the case of biscuits made with grape seed flours and the control product had the lowest value. The biscuit made with the addition of flesh of Zéta had also moderate value. The highest antioxidant activity was found the products which were made by the addition of seed flour of Chardonnay while the lowest value was measured in the case of biscuit made with the use of flesh flour of Chardonnay.
The sensory analysis of biscuits was the final step of the tests. The sensory assessors found the biscuit made with the addition of flour of Chardonnay seeds the most appealing. In the case of the valuation of odour and taste the biscuits made with the flesh of Zéta gave the highest points. The sensory assessors found the biscuits made with the addition of seed flour of Zéta to have the best texture and colour. The results of sensory analysis can be seen on Fig. 6.

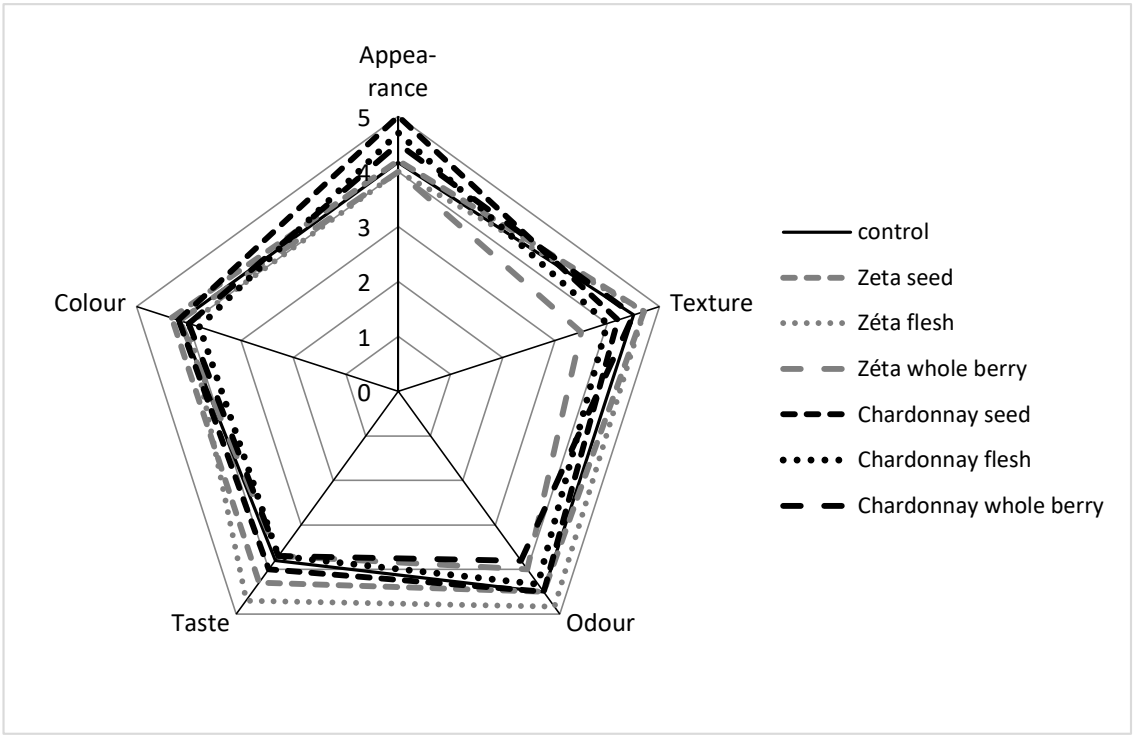

Figure 6. Scores of sensory analysis of biscuits made from BL55 flour and dried and milled grape berries and berry parts

The assessors were asked to make a preference order for the biscuits. The top rated one was the one made with addition of flesh parts of Zéta and the least favourite was the one made with whole berry of Chardonnay. The control biscuit was in the mid-range. The assessors also had to answer that if they would have opportunity to consume these biscuits in the everyday life which would be the most likely consumed one. Generally the assessors would choose more products. The best value was reached by the biscuits made with Chardonnay seeds and the one made with the flesh of Zéta. The control and the one made with Zéta seed flour got a slightly worse readings and the biscuits made with whole berry of Chardonnay was the one what would remain on the shelves of the shops – do not like to buy any of the assessors.

3. CONCLUSIONS

Nowadays it is important to use the by-products of agriculture and food processing as they have physiologically significant chemical components and it is a waste to leave them unused. The grape berries harvested during grape thinning are one of these important by-products but there is only a very low importance of their use. We found an alternative use for their utilization in the food industry. We have evaluated that how the concentrations of valuable chemical components were changing during maturing and we found that not the matured grapes have the highest physiological value but the berries originated from the grape thinning has much higher phenol and flavonoid contents and antioxidant activity, more or less independently from the variety. We found that this value remains when we use the dried and milled grapes in biscuit making in relatively low concentration and their presence results in high antioxidant power for the biscuit products despite the drying and baking process. On the other hand, their presence in biscuits also results in increase in the sensory value too and the consumers would kindly welcome these products if they were commercially available. It was found that the best consumer's scores were experienced in the case of the use of Zéta, while better chemical results were found in the case of use of Chardonnay flour. We can state that these kinds of by-products of viticulture are an untapped resource for the development of healthy foods.

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