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Rural Development, Hungary

International Farmers' Days in Bábolna

This year International Farmers' Days in Bábolna (IFDB) was organised for the 23rd time in Bábolna, one of the strongholds of the Hungarian agriculture. IFDB is the major meeting for the actors of the Hungarian agrobusiness.

For years the host of the exhibition has been the company Bábolnai Nemzeti Ménesbirtok Kft. The co-organiser was the company IKR Zrt. and the tasks of organization were carried out by the company Congress Rendezvényszervez Kft. The number of exhibitors and the area of the exhibition had both seen a further increase by 2007, with approximately 200 exhibitors presenting themselves on an area of 12,000 m^2.

The exhibition was characterised by the participation of Hungarian enterprises but eight foreign exhibitors (including ones from Austria, Germany, Italy, Slovakia, Denmark etc.) were also among those present at the IFDB in this year. 80% of the exhibitors were constituted by the manufacturers and traders of agricultural machines and equipment, but the exhibitors also included enterprises offering chemicals or seeds and ones in information technology, financial and media services.

The highest number of machines were presented by the company IKR Zrt., appearing as the representative not only of the international brands having it as their exclusive distributor, but the Hungarian partners were also integrated into the exhibition area. Also organised by IKR Zrt. visitors had the opportunity to see a live machine demonstration every day. In this framework, the most recently developed machinery of tillage, fertilizer application, sowing, plant protection and harvest were presented in a technological order, which was coupled with professional comments. This way it was possible to have experiences on the new machines also in operation. The exhibition was also accompanied by several special programmes. The special forums organised were entitled as 'Renewable energy sources in use' and 'Effects of climate change in agriculture'. The Agro-Mechanical Committee of the Hungarian Academy of Sciences held a scientific

discussion on the 'Up-to-date issues of agricultural machinery trade'. The manufacturers of agricultural machinery discussed the future of the engineering industry sector in the framework of the 'Forum of Agro-engineering Industry'. As part of the preservation of the special traditions a competition was organised for blacksmiths and horseshoers.

It was also part of the exhibition to give prizes to new inventions. The Grand Prize was granted to the newly developed LM 5000 telescopic loader of New Holland and to the Trimble EZ-Guide 500 GPS machine and implement guidance system. Extra Prize was given to three other new machines and two nutrient supply products and a complex precision plant production technology.

The exhibition also included the show elements. A playful and vivid show of machines entitled as 'Horses and horse powers' was held every day in the arena organised by IKR Zrt., which was made even more colourful by a horse show. The exhibition was seen by tens of thousands of visitors the great part of which were ones returning year by year coming because of finding always something new and interesting in this field for themselves.

József Hajdú

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Photo by Péter Varga,
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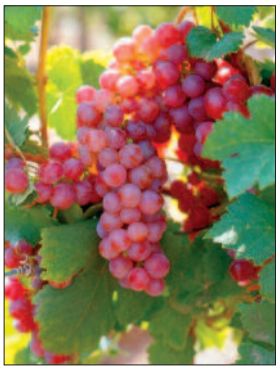

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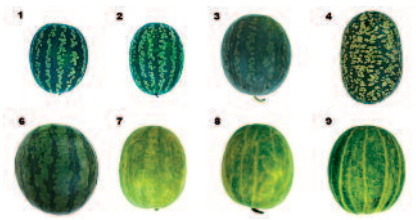

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Edit Hajdu[1]

Breeding of table grape varieties in Hungary and beyond our national borders

Introduction

Table grape is a delicious fruit for man as well as being his food.

Grape is valuable because it helps in digestion and stimulates the appetite. Its consumption is enjoyable which derives from the pleasant sugar:acid ratio, the aroma components and the crisp flesh of the berries. The constituents of its composition, such as minerals, sugars, enzymes, acids and vitamins etc. serve our health. The decorative appearance and the beauty of the clusters and the variable form, colour and waxy bloom of the berries make it one of the most beautiful fruits.

It is the characteristics of having loose tissues that is in the background of the intensively developing vine trunks, clusters and berries of table grapes which is also the explanation of the frost susceptibility of the plant. Owing to this trait it follows necessarily that production is preferably carried out in light-rich and protected areas with a high heat sum. Therefore the main growing areas are situated in the southern countries of Europe and in the southern hemisphere of the world. In the temperate climate zone it is sheltered home gardens and week-end house gardens that provide favourable habitats for them.

Table 1. *Table grape production in the world (t) in 2006*

Country	Yields (t)	Country	Yields (t)
America (USA)	6,093,560	Moldavia	517,000
Argentina	2,708,182	Montenegro + Serbia	240,643
Algeria	334,021	Georgia	250,294
Australia	1,970,530	Germany	1,014,652
Austria	301,869	Italy	8,553,576
Brazil	1,208,680	Russia	333,320
Bulgaria	266,183	Peru	195,540
Chile	2,250,000	Portugal	1,000,000
South-Africa	1,682,813	Rumania	496,096
Egypt	1,300,000	Spain	6,066,800
France	6,793,249	Switzerland	126,864
Croatia	350,000	Syria	310,000
Greece	1,200,000	Turkey	3,650,000
India	1,200,000	Turkmenistan	170,000
Iran	2,800,000	New-Zealand	150,000
Japan	219,900	Ukraine	442,600
China	6,616,000	Uruguay	124,274
Korea	360,000	Uzbekistan	535,800
Macedonia	265,717	Yemen	169,000
Hungary	570,000	Other countries	2,446,077
Morocco	267,000		
Mexico	323,203	World total	65,873,443

(Louw, 2006)

Table grape production

At the world level, table grape production began to develop in the past century. Formerly, wine grape varieties were eaten as sweets. Possibilities opened up with the development of the eating culture and with that of the exchange of varieties and of breeding, where table grape production providing fresh fruit gained ever greater importance (Hajdu 2000).

Table 1 reports the most recent data on the table grape production in the world. Table grapes are being grown and consumed in nearly 50 countries. The largest quantities are produced by Italy, France, China, the US, Spain, Turkey, Japan, Argentina and Chile. These are followed by Australia, South Africa, Egypt, Brazil, Greece, India, Germany and Portugal. Only 570,000 tons of table grapes are produced annually in Hungary. The majority of this quantity comes from home gardens. 15% of the table grape production (9,970,205 t) in the world comes from countries in the

[1]Research Institute of Vine Growing and Oenology of the Ministry of Agriculture and Rural Development of Hungary

Figure 1. *Varieties of berry*

southern hemisphere of the Earth *(Table 2)*.

Clusters which are suitable for consumption because of a nice appearance, in a different way from the production of wine grapes, are produced using a particular growing technique with big grapevine trunks and involving intensive plant care (regular water and nutrient supply, hormone treatment).

The variety structure closely follows the market requirements and supposes a continuous change in the varieties. Of this, the variety, the product of grape breeding is an indispensable condition. The variety, on which the newer and newer traits manifest themselves, is an important means of production in the hand of growers and at the same time a rival in the market competition. Consumers and growers keep demanding something new, something more interesting than the present and the source of it is grape breeding.

Table 2. *Table grape production (t) in the southern hemisphere of the Earth in 2006*

Country	Yields (t)
Argentina	2,708,182
Australia	1,970,530
Chile	2,250,000
South-Africa	1.682.813
Brazil	1.208.680
New-Zealand	150.000
Total:	9.970.205

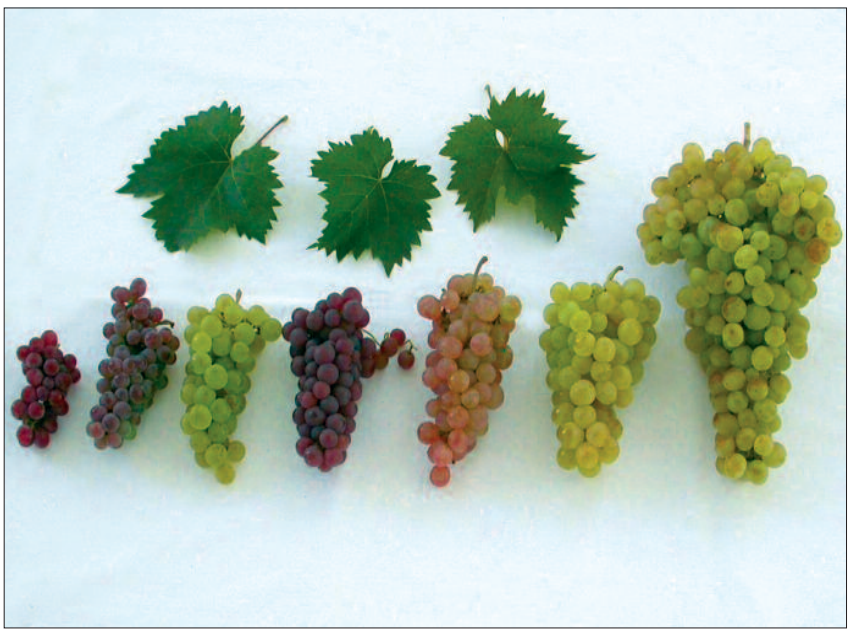

Figure 2. *Varieties of cluster*

Flóra

Heliotróp

Szőlőskertek királynője

Motivations for table grape breeding

Anywhere in the world, breeding is motivated by the milestones of social development and by natural disasters. So far, the great historical milestone was the industrial revolution (1642), launching the rapid exchange of goods and in this framework the exchange of grape varieties became a fashion all over the world (Hajdu 2000). Rich collections of varieties were created for breeding purposes. The varieties and the growing techniques were dictated, in the given historical situations, by consumer demands and by the constantly developing market. This was accompanied by the great natural catastrophes in the late 1800s such as the large devastation by phylloxera (1875), the downy mildew (1847) and the powdery mildew (1878) epidemic or the high trellis system becoming popular in the 1960s. This latter made a selection between the table grape varieties in winter hardiness (Basler 2003).

The explosion-like development of the chemical industry is necessarily accompanied by the use of fertilisers and chemicals (pesticides and herbicides) which has caused the pollution of the environment and the upset of the ecosystem of the grape.

Nowadays, it is the climate change affecting the whole of the Earth, in particular the global warming up and the strong UV radiation that are a threat to table grape production.

These factors give constant motivation for grape breeders to produce resistant varieties. That variety is of interest which can survive environmental stresses, can be grown economically and meets market requirements. It is

Melinda

Narancsízű

Nero

Palatina

Kósa

Teréz

the genotype of the variety that is responsible for the characteristics serving these objectives which can be changed according to the requirements by means of breeding (with hybridisation or biotechnology). Since the grape breeding itself and the introduction of the new variety into cultivation demand lots of time therefore it is important to carry out both continuously and simultaneously.

Table grape breeders and their varieties

The breeding of varieties for table grapes have been going on already since the early 1800s with nice success.

In the United Kingdom the table grape variety *Lady Downes Seedling* was bred by M. Forster in 1835, in France *Madeleine Angevine* by Vitbert Angers in 1859, *Léon Millot* and *Maréchal Foch* by Eugene Kuhlmann in 1886, *Alphonse Lavallée* by Alphonse Lavallée in 1860; in Italy *Italia* by Angelo Pirovano in 1911, in Hungary *Szőlőskertek királynője muskotály* by János Mathiász in 1916.

This breeding work was extending, to an ever greater degree, into every grape producing country of the world. From the 1920s an ever greater number of varieties appeared until the 70s.

In Bulgaria the table grape variety *Trakia* was bred by Z. Zankov (Sophia), *Velika* by I. D. Todorov (Russe), *Bulgaria* by V. Vultchev (Pleven); in California *Cardinal* by E. Snyder and F. Harmon in 1939, *Perlette* by H. P. Olmo in 1936, *Flame Seedless* by J. H. Weinberger in 1962; in the Soviet Union M. *Kismis moldavskii* by S. Zuravelem (Chisinau), *Aygezard* by S. S. Hatsatrian (Jerevan), *Arevsat* by P. S. A. Pogosian (Jerevan), *Souvenir chorniy* by E. N. Docuchayev (Odessa) *Karamo* by J. I. Potapenko (Novotserkassk), to mention some examples from the Encyclopaedia edited by Braskova (1987).

In Hungary the breeding of the table grape varieties received a new impetus from the 1960s. In Czechoslovakia nice results were achieved by D. Pospisilova, in Hungary by S. Szegedi, P. Kozma and in Yugoslavia by L. Avramov and P. Cindrič.

Starting from the 1970s, the new programme of the grape breeders at home and in the world is the production of resistant and seedless table grape varieties in which also the members of the younger generation (B. Reisch, P. Hamsted, V. Blattner, J. Korbuly, P. Kozma, E. Hajdu, P. Clingeleffer etc.) take an active part.

Achievements of table grape breeding in Hungary

The table grape breeding launched by Mathiész has been going on from generation to generation. Pál Kocsis produces the varieties 'Glória Hungariae' and 'Attila', Ferenc Poczik produces 'Pannónia kincse', Sándor Szegedi produces 'Favorit', 'Narancsízű', 'Téli muskotály', 'Kósa', 'Boglárka' and 'Melinda', Kozma Pál produces 'Kozma Pálné muskotály', Lubik István produces 'Anita' (Hajdu, 2003). These varieties are Vitis vinifera hybrids. Hungarian grape breeders carry out a pioneering job with the production of resistant table grape varieties (Szegedi-Ésikné 1979).

Dr. Sándor Szegedi produces the varieties 'Pölöskei muskotály', 'Fanny', 'Esther' and 'Teréz' at the Research Institute of Vine Growing and Oenology in Kecskemét, dr. József D. Csizmazia produces 'Nero' in Eger, at the University of Horticulture (now Corvinus University) Dr. Pál

Csiri-csuri

Esther

Kozma produces the resistant table grape variety 'Palatina' and dr. István Koleda produces 'Borostyán', 'Csépi muskotály' and Pegazus who achieved these results in collaboration with several colleagues (Hajdu 2004; Hajdu-Hajósné-Ésikné-Borbásné 2007).

The achievements in table grape breeding in Hungary are indicated on the one hand by the varieties granted official registration *(Table 3)* and on the other by genetic advance, particularly in berry weight and in cluster weight *(Tables 1 and 2)*. It means that berry weight has increased from 2.5 g to as high as 7.0 g and cluster weight from 250 g to 800 g. This brilliant genetic advance was possible to achieve in a way that breeders made further improvements to the varieties of one another. The pedigree shown in Figure 3 illustrates the enrichment of the genetic material. János Mathiász obtained the variety 'Szőlőskertek királynéja muskotály' with several hybrid generations which brought him world fame. This was from which Sándor Szegedi produced the variety 'Favorit' and Ferenc Poczik 'Pannónia kincse' from which latter Sándor Szegedi produced the variety 'Melinda'. It is also known that the variety 'Szőlőskertek királynéja muskotály' has been used by a number of breeders for their crosses which have caused the early ripening character and the muscatel flavour of the clusters to be transmitted in a favourable manner to the descendant varieties (Csepregi-Zilai 1988). Hungarian table grape varieties have a nice flavour, are appealing and satisfy consumer requirements, though most of them are seeded. The sequence of ripening is opened by Csaba gyöngye at the end of July and is finished by Teréz at the

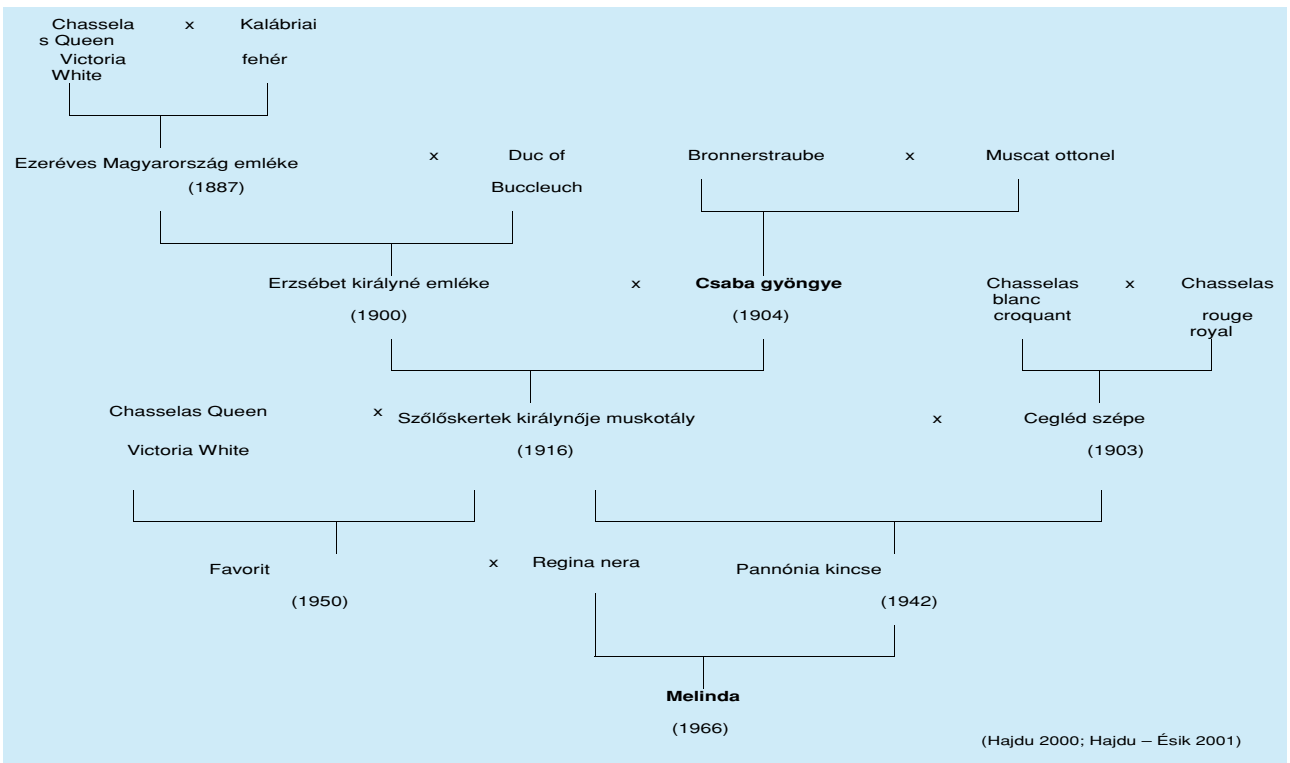

Figure 3. *Pedigree of the variety Ezeréves Magyarország Emléke and its descendants*

beginning of October. There are varieties having a neutral flavour, ones tasting spicy and others with a muscatel flavour. Berries are extremely varied in shape (round, oval, columnar and heart-shaped), in colour (greenish yellow, white yellow, amber, pink, light red, purple red and blue) and in bloom (shiny, slightly bloomy and bloomy). These characters add to the attractiveness and market value of the varieties and satisfy consumer requirements. There is an ever increasing demand for seedless table grape varieties. Therefore the dream of the breeders is the creation of resistant, tasty, well-transportable, attractive and seedless table grape varieties. These varieties are important and also suitable for the environmental friendly grape production where already much lower amounts of chemicals are used than before or a complete elimination of chemicals has been achieved.

Table grapes are popular plants in the gardens of family homes, holiday and weekend houses where the consumption of chemical free grape clusters is important also from the aspect of the protection of our health. As table grape varieties have strong growing branches therefore they are suitable for making pergolas. Pergolas are nice embellishments and shade offering ornamental elements of the garden which provide enjoyment for people in every season.

Recently, together with healthy diet, even though slowly, but the consumption of fresh grapes has been on the increase. Simultaneously, experts, step by step, try to create large-scale surfaces where table grapes are produced in larger quantities. A rich variety assortment from the end of July until the end of October is available for growers. All this is the achievement of successful table grape breeding.

Table 3. *Table grape varieties and clones bred in Hungary and qualified officially*

Name of the variety/clone Vitis vinifera hybrids	Year of Off. Qual.	Director of breeding	Holder of plant variety rights
Anita	1993	István Lubik	Nándor Rábovszki
Attila	1963	Pál Kocsis	FVM SZBKI – Kecskemét
Boglárka	1979	Sándor Szegedi	FVM SZBKI – Kecskemét
Cegléd szépe K.73	1978	József Füri	FVM SZBKI – Kecskemét
Csaba gyöngye*	1956	János Mathiász	FVM SZBKI – Kecskemét
Favorit	1968	Sándor Szegedi	FVM SZBKI – Kecskemét
Kósa	2000	Sándor Szegedi	FVM SZBKI – Kecskemét
Kozma Pálné muskotály	1984	Pál Kozma	Corvinus University of Budapest
Mathiász Jánosné muskotály	1956	János Mathiász–Adolf Stark	FVM SZBKI – Kecskemét
Melidna	2003	Sándor Szegedi	FVM SZBKI – Kecskemét
Narancsízű	2000	Sándor Szegedi	FVM SZBKI – Kecskemét
Pannónia kincse	1959	Ferenc Poczik	FVM SZBKI – Kecskemét
Téli muskotály	1973	Sándor Szegedi	FVM SZBKI – Kecskemét
Fajhibridek			
Borostyán	2006	István Koleda	Corvinus Egyetem – Budapest
Csépi muskotály	2006	István Koleda	Corvinus Egyetem – Budapest
Esther	2003	Sándor Szegedi	FVM SZBKI – Kecskemét
Fanny	2003	Sándor Szegedi	FVM SZBKI – Kecskemét
Nero*	1993	József Csizmazia D.	FVM SZBKI – Eger
Palatina	1996	Pál Kozma	Corvinus Egyetem – Budapest
Pegazus	2006	István Koleda	Corvinus Egyetem – Budapest
Pölöskei muskotály*	1979	Sándor Szegedi	FVM SZBKI – Kecskemét
Szőlőskertek királynője muskotály	1956	János Mathiász	FVM SZBKI – Kecskemét
Teréz	1995	Sándor Szegedi	FVM SZBKI – Kecskemét

Note: *categorized on the national variety list as a wine grape variety;
FVM SZBKI – Research Institute of Vine Growing and Oenology of the Ministry of Agriculture and Rural Development of Hungary

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Szilárd Kun[1], Zsolt Zalán[2], Izabell Perger-Mészáros[1], Ágoston Hoschke[1]

Mono- and mixed culture fermentation with Lactobacillus and Bifidobacterium strains on Jerusalem artichoke medium

Introduction

It has been known for more than a hundred years that nutrition and living bacteria effect human health. Our knowledge on these determinant factors has developed greatly. Nowadays, nutritional aspects of health protection receive increasing emphasis. Instead of mass production, the aim is to make food with biological benefits in addition to considering its nutritive value. Due to this there has been increase in demand for functional foods throughout the world in recent years which has led to the development of more specialized products (Heenan et al., 2002). Pro-, pre- and synbiotic foods compose a large segment of functional food products. Most of probiotic and prebiotic preparations on the market are dairy products (based on milk and its derivatives), which, are no choice for people with milk protein allergy or for those who do not consume animal products out of conviction. Fermented vegetable juices are an alternative for this group of consumers. Through fermentation with probiotic bacteria these juices are preserved: their protective and nutritive properties are improved.

Probiotics are microbial cell preparation that, when ingested in an appropriate number, have beneficial effects on the health and well-being of the host: they may stimulate the immune system; express inhibitory effect towards some food-borne pathogens in several ways; including by producing organic acids (lactic acid, acetic acid etc.), by competing for nutrients and attachment site and by secretion of antimicrobial compounds; protection against infection, reduce the risk of food allergy and colon cancer, etc. Probiotic bacteria are able to reach the large intestine and colonize it by adhering to intestinal mucosa. The majority of the probiotic bacterium strains belong to the species of *Lactobacillus* (*Figure 1/A*) and *Bifidobacterium* (*Figure 1/B*) genera (Saarela et al., 2000).

Among several vegetables i.e. tomato, red beet and carrot, that have positive effects, I would like to direct some attention to Jerusalem artichoke (*Helianthus tuberosus*) (*Figure 2*) of which consumption has unfairly fallen into the background, though it has many health benefits. Jerusalem artichoke is rich in vitamin B_3, phosphorous, potassium and iron. Foods made of Jerusalem artichoke may play role in the prevention of metabolic problems, cardiovascular disease, neurological problems and cancer. The nutritional-physiological values of Jerusalem artichoke are mainly due to its high fibre and inulin content, which is considered as prebiotics (Barta & Pátkai, 2007). Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth of limited number of bacteria in the colon. Among these food ingredients, non-digestible carbohydrates (oligo- and polysaccharides), some peptides and proteins, and certain lipids (both ethers and esters) are candidate prebiotics. Due to their chemical structure, these com-

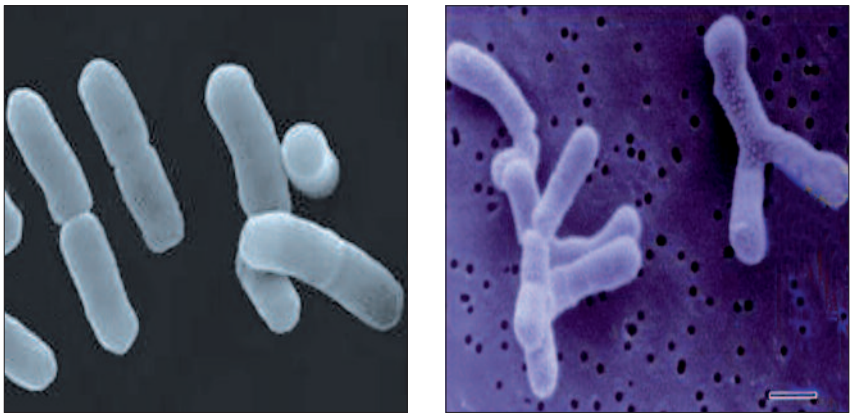

Figure 1. *Micromorphology of a Lactobacillus (A) and a Bifidobacterium (B) strain*

[1] Corvinus University of Budapest, Department of Brewing and Distilling, Budapest, Hungary
[2] Central Food Research Institute, Units of Biology, Budapest, Hungary

pounds are not absorbed in the upper part of the gastrointestinal tract or hydrolyzed by the human digestive enzymes (Gibson & Roberfroid, 1995). In Europe inulin is the most frequently used prebiotic beside fructooligosaccharide in functional food. By means of its inulin content Jerusalem artichoke is an excellent nutrient for the intestinal microbiota and selectively supports the growth of beneficial bacteria in the colon. If it is combined with probiotic bacteria a synbiotic product may be created.

The aim of this study was to determine the optimal Jerusalem artichoke concentration of the medium for propagation of selected bacterium strains; and to investigate the growth ability and activity of the applied probiotics in mono- and mixed culture fermentation.

Materials and methods

In this study one *Bifidobacterium* (*Bifidobacterium lactis* Bb-12), one *Lactobacillus* (*Lactobacillus casei* Shirota) starter culture and four non-starter lactobacilli (*Lactobacillus plantarum* 2142, *Lactobacillus curvatus* 2770, *Lactobacillus curvatus* 2775, *Lactobacillus casei* 2756) were applied. *B. lactis* Bb-12 was obtained from Chr. Hansen A/S (Denmark), *Lb. casei* Shirota from the Department of Pathology of the Faculty of Veterinary Medicine of Utrecht University and non-starter culture from the Dairy Institute of the Agricultural Faculty of Perugia. Fermentation experiments were carried out in Jerusalem artichoke juice. The juice was made from Jerusalem artichoke concentrate, which was purchased from Central Food Research Institute, Budapest. According to product specification, its pH was 5.6–5.9 and concentration was 68.2 (w/w) % dry matter. After the appropriate dilution pasteurization was performed at 85 °C for 20 minutes.

Figure 2. *The plant and the tuber of Jerusalem artichoke*

Fermentations were initiated with a 24-hour culture of *Bifidobacterium* and *Lactobacillus* strain, and the initial cell concentration was adjusted to 10^7 cfu/ml in the juice both in case of mono- and mixed culture fermentation. Experiments were carried out under anaerobic conditions at 37 °C using Bugbox anaerobic chamber (Ruskinn Technology). Fermentation process was followed by counting the colony forming unit of *Bifidobacterium* (on Beeren's agar) and *Lactobacillus* (on MRS agar) strain and measurement of pH.

Results and discussion

Optimization of Jerusalem artichoke concentration and investigation of the fermentation ability of starter and non-starter cultures

Bifidobacterium lactis Bb-12 is one of the well-investigated probiotics. This strain has been marketed for more than 15 years in a wide range of fermented dairy and non-dairy products because this starter culture has numerous physiological and technical advantages, for example, good oxygen and acid tolerance (Meile et al., 1997). *B. lactis* Bb-12 has been reported to reduce the incidence of rotavirus diarrhoea, antibiotic associated and travellers' diarrhoea. Furthermore the strain has been observed to modulate the immune response by improving the antibody titres upon oral vaccination.

The fermentation ability of *B. lactis* Bb-12 starter culture was investigated at first in Jerusalem artichoke juice with four different dry-matter concentrations: 2.5, 5.0, 7.5 and 10.0 % (w/w). *B. lactis* Bb-12 showed the best growth activity in Jerusalem artichoke juice with 7.5 % (w/w) dry-matter and reached significantly higher cell concentration, than in case of other artichoke concentrations. The change of cell concentration and the profile of the pH are demonstrated on *Figure 3*. Considerable increase of the cell number (from $8.07*10^6$ to $1.14*10^8$) was detected by the 6^{th} hour of fermentation. The cell concentration of *B. lactis* Bb-12 showed the maximum concentration – $6.88*10^8$ cfu/ml – in the 12^{th} hour and stagnated at the 24^{th} hour, then started to decrease due to falling pH. Change of the pH values was similar in case of the different dry matter concentration; decreased to around pH = 4.0–4.5, which complies with food safety regulations.

Comparing our data to the results of other researchers

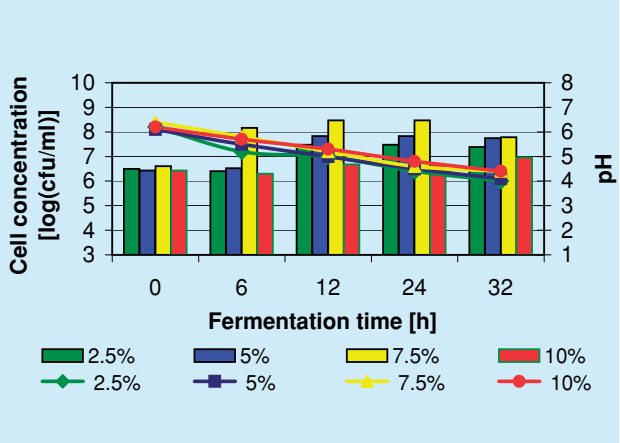

Figure 3. *Change of cell concentration and pH value in Jerusalem artichoke juice of different dry matter concentration fermented with B.lactis Bb-12*

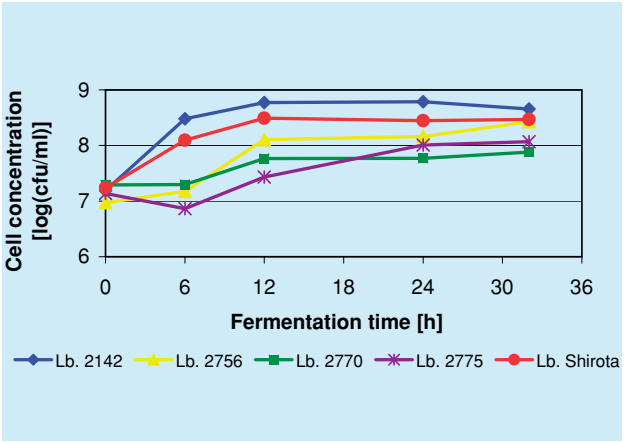

Figure 4. *Growth curves of Lactobacillus strains in the 7.5% (w/w) Jerusalem artichoke juice*

obtained in synthetic medium or in soy milk and carrot juice, adequate cell concentration values were detected in Jerusalem artichoke juice.

The fermentation ability of four non-starters and one starter *Lactobacillus* strains was investigated in the 7.5% (w/w) Jerusalem artichoke juice, because that gave the most promising results in case of *B. lactis* Bb-12 strain, and we planned to use this dry matter content for mixed culture fermentation, as well. Of the tested *Lactobacillus* strains, *Lb. plantarum* 2142, *Lb. casei* Shirota and *Lb. casei* 2756 should be highlighted because all three strains reached 10^8 cfu/ml cell concentration at the 12th hour of fermentation, and kept their viability throughout the course of fermentation. During fermentation the highest cell concentration was reached by the *Lb. plantarum* 2142 strain, while for the strains *Lb. curvatus* 2770 and *Lb. curvatus* 2775 conditions were not suitable for reaching similarly high values (*Figure 4*). In case of all the investigated *Lactobacillus* strains pH values were between 3.8 and 4.2 – independently of their growth activity – that is favourable from the point of view of food safety.

Mixed culture fermentation with Lb. casei Shirota and B. lactis Bb-12

Based on previous results and considering our future product development goals for the mixed culture fermentation *Lb. casei* Shirota was chosen as partner for *B. lactis* Bb-12. *Lb. casei* Shirota has been used commercially for a long time in the food industry (to produce fermented milk, Yakult®). The Shirota strain was originally isolated from the human intestine in 1935. This strain is acid tolerant, produces lactic acid and synthesize vitamin B_1, B_2, B_6 and B_{12}. Various aspects of the effects of *Lb. casei* Shirota have been studied intensively. *Lb. casei* Shirota exhibits remarkable activity against different types of tumours and against various pathogens, such as *Pseudomonas aeruginosa* and *Listeria monocytogenes* (Hori et al., 2001). Jerusalem artichoke juice with 7.5 % dry matter was applied in mixed culture fermentation. Fermentation was initiated with 10^7 cfu/ml cell concentrations of *B. lactis* Bb-12 and *Lb. casei* Shirota strain. Both the *Bifidobacterium* and *Lactobacillus* culture demonstrated good growth character and during the fermentation process reached the 10^9 cfu/ml cell number (*Figure 5*). Maximal cell concentration of the *Bifidobacterium* strain – 1.41* 10^9 cfu/ml – was detected at the 8th hour of fermentation, while the Shirota strain kept growing until the 25th hour when its cell count peaked at 2.12*10^9 cfu/ml. Change of pH also points to the fact that the fermentation process was fast, since the initial 5.8 value decreased below 4.0 within 12 hours, and then to 3.7 by the end of the process. Cell concentrations of the two strains detected in the mono and mixed culture fermentation were compared. We found that the values were higher for both strains in case of mixed culture fermentation. In the mono culture process 3.16*10^8 cfu/ml and 6.88*10^8 cfu/ml were counted for *Lb. casei* Shirota and *B. lactis* Bb-12, respectively.

Our investigation was continued with a scale-up step to obtain further information on the fermentation ability of the two bacteria to be used in future product development. Scaling up was realized in a BiostatB 2-liter fermenter, in which anaerobic conditions was provided by gas mixture containing 10% CO_2 in nitrogen. Initial cell concentration was 10^7 cfu/ml. Based on our results it can be con-

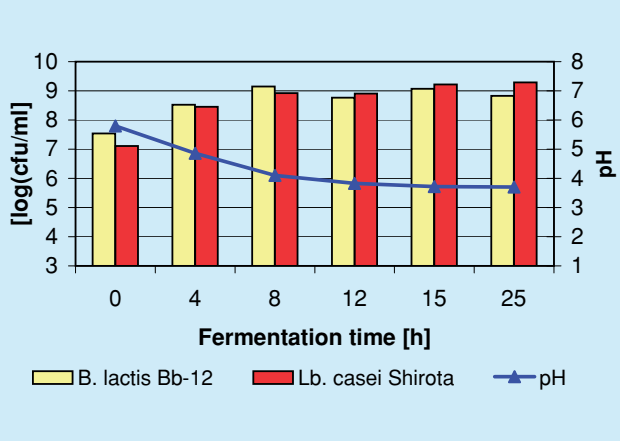

Figure 5. *Change of cell number and pH values in Jerusalem artichoke juice fermented with B. lactis Bb-12 and Lb. casei Shirota, as mixed culture*

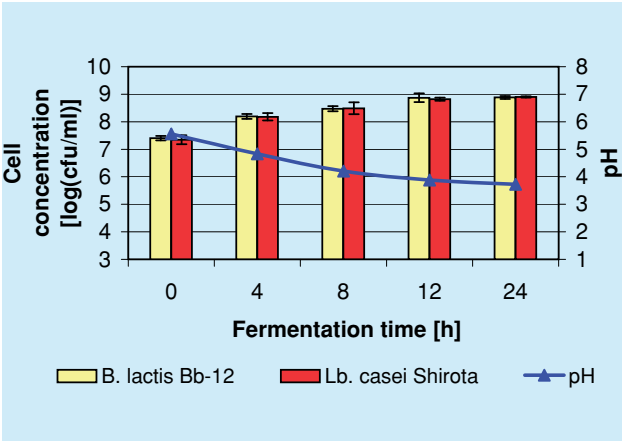

Figure 6. *Change of cell number and pH values in Jerusalem artichoke juice fermented with B. lactis Bb-12 and Lb. casei Shirota, as mixed culture in laboratory fermenter*

cluded that both strains demonstrated gradual growth, and by the 12th hour cell count approached the order of magnitude of 10^9 per millilitre (*Figure 6*). Cells kept their viability until the end of the 24-hour long process. Due to the excellent growth ability of both strains, and to the metabolites synthesized during fermentation, initial pH of 5.56 decreased considerably (to pH=3.73) by the 24th hour of the fermentation.

Conclusion

Jerusalem artichoke is a plant, which is cultivated for its tuber because it is rich in iron, and contains 10–12% of the RDA of fiber, niacin, thiamine, phosphorous and copper. Moreover its inulin content gives the nutritional values of Jerusalem artichoke, as a prebiotic.

Based on these characteristics Jerusalem artichoke offers valuable nutrients not only to the everyday consumer but to people suffering from diabetes, as well. Furthermore if Jerusalem artichoke juice is fermented with probiotic bacteria then it provides an alternative for consumers with milk protein allergy.

Our results have proven that Jerusalem artichoke juice can be fermented with both *Bifidobacterium* strain and *Lactobacillus* bacteria. More promising results were gained when mixed culture were applied containing *B. lactis* Bb-12 and *Lb. casei* Shirota starters. It can be concluded that these two strains create a good combination because the cell number of both *B. lactis* Bb-12 and *Lb. casei* Shirota was higher in mixed culture fermentation than in mono culture fermentation. These findings may establish the development of technology for the production of synbiotic food applying as raw material Jerusalem artichoke. We suggest that this product to be consumed as vegetable-based synbiotic drink or if supplemented with rheology modifying thickener as a jam. Naturally this product can be flavoured with different types of fruit puree. Another possibility is that this product is lyophilized or spray dried and filled in capsules, that meets the demands of modern consumers.

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Watermelon (Citrullus l. lanatus) production in Hungary from the Middle Ages (13th century)

3,000-yr old watermelon seeds in pyramid of Pharaoh Tutankhamum (ca. 1,330 B.C.)

The monotypic genus *Citrullus* is comprised of only four diploid (2n = 4× = 22; 4.25 – 4.54 × 10^8 bp; 0.42 pg DNS) species, including the annual watermelon (*Citrullus lanatus*), the perennial colocynth (*syn.*: bitter apple) (*Citrullus colocynthis*), and two wild species growing in Kalahari Desert, Africa as the *Citrullus ecirrhosus* with bitter-tasting fruit, and the annual *Citrullus rehmii* with pink and olive green spotted, mandarin sized, non-edible fruits.

Unlike genus *Citrullus*, species watermelon (*Citrullus lanatus*) comprises diverse varieties, subspecies, mutants and feral forms such as the cultivated watermelon (*C. lanatus lanatus*) (syn.: *C. vulgaris*) with its ancient form of citron melon (*syn.*: tsamma) (*Citrullus lanatus citroides*); and the seed mutant egusi type watermelon (*C. lanatus mucospermum*). Watermelon ('*görögdinnye*'), citron ('*takarmány dinnye*') and colocynth ('*sártök*') have a history of production in Europe.

The primary gene center for watermelon is not known. The presence of five and six thousand year-old seeds of *C. lanatus* in Egypt and Libya implies that domestication might have occurred in Northern Africa.

The oldest seed remains with proven human activity have revealed only cereals as wild barley (*H. spontaneum*) and wild emmer (*Triticum dicoccoides*) from 19,000 B.P. at Ohalo II., River Jordan. The 15,000 B.P. site in Korea (Chungbuk National University, South Korea) revealed the first ancient rice (*Oryza sativa*) seeds.

The first *Cucurbit* seed remains were excavated from the Spirit Cave (Hoabinh, Thailand) including cucumber type *Cucumis* seeds at least 9,180 ± 360 B.P. as analyzed by C^{14} of bamboo charcoal. The oldest, 6,000-yr old watermelon (*Citrullus l. lanatus*) seeds were excavated in Helwan (Egypt, Africa), from the excavation of a site from 4,000 B.C. About 5,000-yr old seed remains were excavated in Uan Muhuggiag, Lybia, Africa from a site 3,000 B.C. Several watermelon seeds were found in Pharaoh's tomb as in Thebes (New Kingdom: 1,550–1,070 B.C.; stored in Agricultural Museum, Dokki, Giza, Egypt) and in the pyramid of Tutankhamum ca. 1,330 B.C. (*Fig. 1).*

The Greeks and Romans traveling to Egypt must to have known of watermelons probably without discriminating colocynth, citron melon, and watermelon. Pliny wrote about a wild (probably the current colocynth) and two types (one with pale green, and the other with grass green rind) of cultivated "colocynth" (probably the current watermelon), as it has been written: "A*nother kind of*

Figure 1. The most ancient seed remains of watermelon (*Citrullus l. lanatus*). (**1**) 6,000-yr old seed B.P. from Helwan, Egypt (Barakat 1990); (**2**) 5,000-yr old seed B.P. from Uan Muhuggiag (Lybia) (Wasylikowa and Veen 2004) (1mm size bar); (**3**) 3,550-3,070-yr old seeds B.P. Pharaoh's tomb, Thebes (New Kingdom; stored in Agricultural Museum, Dokki, Giza, Egypt) (Warid 1995)

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Figure 2. References and illustration of *Citrullus*: (**1**) Pliny (*Plinius*) II (23-79; '*cultivated Colocynth*'); (**2**) Dioscorides (1st cent, and 512 A.D.; the first colorur painting of *C. colocynthis*); (**3**) Ibn Al-Awwam (1158): *Book of Agricuture*; **(4)** Fresco in the *Villa Farnesina*, Rome, Italy (1517) painted by Giovanni Martini da Udine (Janick and Paris 2006); (**5a**) Herbarium sample of watermelon, G. Bauhin (1560-1624) (**5b**); (**6**) Caravaggio, 1603, *Still Life with Melons and Carafe of White Wine*; (**7**) Linnaeus (1740) Sytema Naturae.

wild gourd is called Colocynthis. The fruit is smaller than the cultivated one, and full of seeds. The pale variety is more useful than the grass-green one…" (Pliny 23-79) *(Fig. 2).*

In the Codex *De Materia Medica* produced not too long after the time of Pliny (Dioscorides 1st century and the second 'edition' from 512 A.D. with colour paintings) contains nearly 400 color paintings of different plants but no watermelon illustration, only a precise colour painting of "colocynth" which looks very much like the current forms of colocynth (*Citrullus colocynthis*) *(Fig. 2).*

Six hundred years later, when the Iberian Peninsula was conquered by the Berbers (Moors) led by Tarik Ibn Ziyad in 711 A.D., new watermelon types entered Europe as shown in the ancient record of *Book of Agricuture* (Al-Awwam 1158). In this book two cultivated forms were compared, a black seed type (with dark-green rind which turns black when it ripens) and a red seed type (with green rind which turns to yellow). Watermelon might have also been introduced to Europe through Crusaders led by either Richard I. The Lion-Hearted (the 3rd Crusaders, 1190–1199), or the Hungarian King, Endre II. of the Árpád Dynasty (the last, 6th Crusaders, 1228–1229). Watermelon spread through Europe quickly and became very popular and commonly cultivated fruit of Renaissance Europe, with the first illustration on the frescoes in *Villa Farnesina*, Rome, Italy, 1517 B.C. (painted by Giovanni Martini da Udine). By 800 A.D., watermelons had been introduced to India and by 1,100 A.D. to China. It reached the New World after Columbus' second voyage in 1493 and dispersed quickly among American natives. One of the most ancient forms of small, round fruit with thin, green rind, red flesh and small black seeds has survived up to the recent times.

One of the oldest watermelon herbarium sample is available from G Bauhin's (1560–1624) collections *(Fig. 2),* who named it *Anguira citrullus* (personal communication, Mark Spencer, The Natural History Museum, London, UK). No watermelon herbarium sample remained from C Linnaeus (1753) collections, who named watermelon as *Cucurbita citrullus*, and clocynt as *Cucumis colocynthis* (personal communication, , The Linnean Herbarium**,** Swedish Museum of Natural History, Sockholm, S).

Archaeogenetics and crop evolution

The aDNA (ancient DNA) samples recovered from excavated remains of plants and animals supply unique materials not only for the analysis of post-mortem DNA degradation, but also for tracing vegetation history and micro-evolution. The complete genome or intact DNA sequences can be reconstructed in the case of optimal preservation conditions (Szabó *et al.* 2005; Lágler et al.

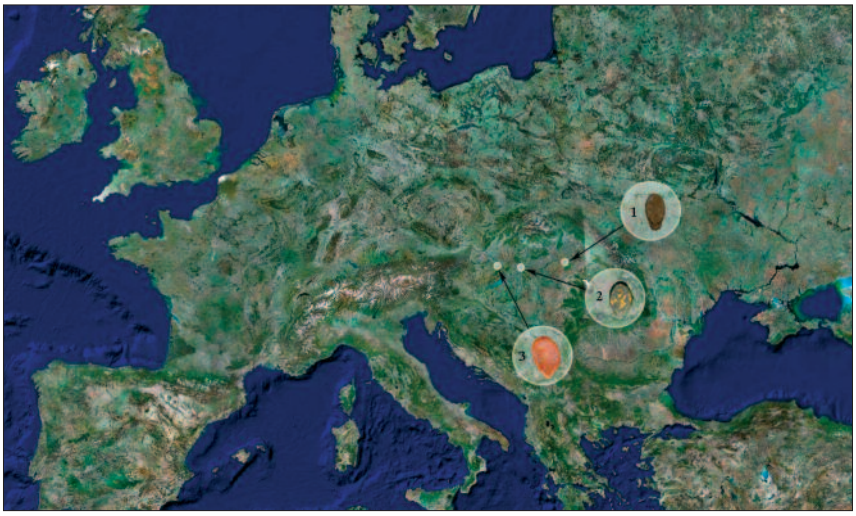

Figure 3. Map of Europe showing the excavation sites from the 13th–14th century A.D. Debrecen (**1**), the 15th century A.D. Budapest (**2**); and the 19th centuryherbarium sample at Pannonhalma (Hungary) (**3**)

Table 1. List of the current cultivars *of colocynth '(sártök')* (*Citrullus colocynthis,* 1–3)*; citron melon* (*'takarmány dinnye'*) (*Citrullus lanatus citroides* 4–6) *and watermelon* (*'görögdinnye'*) (*Citrullus lanatus lanatus,* 7–44) analyzed

#	Cultivars	Short name	Latin name	Code (Tápiószele)
1	Finn 168	Fin.	*Citrullus colocynthis*	RCAT036168
2	Belga 172	Bel.	*Citrullus colocynthis*	RCAT036172
3	Portugál 547	Prt.	*Citrullus colocynthis*	RCAT035547
4	Szeged 099	Szg.	*Citrullus l. citroides*	RCAT036099
5	De Bánát 235	Rom.	*Citrullus l. citroides*	RCAT035235
6	Újszilvás 816	Újs.	*Citrullus l. citroides*	RCAT055816
7	Bácsbokod 917	Bác.	*Citrullus l. lanatus*	RCAT035917
8	Napsugár 257	Nap.	*Citrullus l. lanatus*	00257/05
9	Sándorfalva 105	Snd.	*Citrullus l. lanatus*	RCAT036105
10	Dévaványa 101	Dév.	*Citrullus l. lanatus*	5101/02
11	Szentesi sugárhasú 260	Sts.	*Citrullus l. lanatus*	00260/05
12	Belyj dlinnij 152	Bed.	*Citrullus l. lanatus*	RCAT036152
13	Ráckeve 812	Rác.	*Citrullus l. lanatus*	RCAT055812
14	Csárdaszállás 113	Csr.	*Citrullus l. lanatus*	RCAT035113
15	Tura 389	Tur.	*Citrullus l. lanatus*	RCAT035389
16	Biri 114	Bir.	*Citrullus l. lanatus*	RCAT035114
17	Klondike R7 096	Kln.	*Citrullus l. lanatus*	RCAT036096
18	Charleston gray 263	Chg.	*Citrullus l. lanatus*	00263/05
19	Taktaharkány 790	Tkt.	*Citrullus l. lanatus*	RCAT034790
20	Túrkeve 112	Trk.	*Citrullus l. lanatus*	RCAT035112
21	Ukrainskij 545 149	Ukr.	*Citrullus l. lanatus*	RCAT036149
22	Szirma 782	Szr.	*Citrullus l. lanatus*	RCAT034782
23	Marsowszky 256	Mar.	*Citrullus l. lanatus*	00256/05
24	Háromfa 754	Hár.	*Citrullus l. lanatus*	RCAT034754
25	Debrecen 111	Deb.	*Citrullus l. lanatus*	RCAT035111
26	Sibiriak 098	Sib.	*Citrullus l. lanatus*	RCAT036098
27	Nagyecsed 775	Ngye.	*Citrullus l. lanatus*	RCAT034775
28	Nagykálló 785	Ngyk.	*Citrullus l. lanatus*	RCAT034785
29	Hevesi 258	Hev.	*Citrullus l. lanatus*	00258/05
30	Nagyvárad 767	Ngyv.	*Citrullus l. lanatus*	RCAT034767
31	Nyírbátor 155	Nyrb.	*Citrullus l. lanatus*	RCAT035155
32	Oros 862	Oro.	*Citrullus l. lanatus*	RCAT035862
33	Rákóczifalva 145	Rák.	*Citrullus l. lanatus*	RCAT035145
34	Kömörő762	Köm.	*Citrullus l. lanatus*	RCAT034762
35	Nyíregyháza 778	Nyre.	*Citrullus l. lanatus*	RCAT034778
36	Kecskeméti vöröshúsú 259	Kev.	*Citrullus l. lanatus*	00259/05
37	Ilk 236	Ilk	*Citrullus l. lanatus*	RCAT035236
38	Pusztadobos 146	Pusz.	*Citrullus l. lanatus*	RCAT035146
39	Gyöngyös 969	Gyn.	*Citrullus l. lanatus*	RCAT034969
40	Crimson sweet 262	CrS.	*Citrullus l. lanatus*	00262/05
41	Kibéd 172	Kib.	*Citrullus l. lanatus*	5172./02
42	Sugar baby /Génbanki 261	SuB.	*Citrullus l. lanatus*	00261/05
43	Lipót 970	Lip.	*Citrullus l. lanatus*	RCAT034970
44	Korai kincs 255	Kok.	*Citrullus l. lanatus*	00255/05

2005; Gyulai *et al*. 2006). In this study we present the aDNA analyses of 700, 600- and 170-year-old watermelons together with a comparison to modern cultivars.

How to recover ancient DNA

Seed samples: Seed remains of watermelon (*Citrullus l. lanatus*) from the 13–14th century were excavated in Debrecen, Hungary (by Hajdu Zs. et al. Déri Museum; Debrecen; http://www. derimuz. hu/hirek/2006/kutak.html). In total, 95,133 seed remains of 206 plant species were identified; of them 251 were watermelon seeds with the sam morphological characters. At the 15th century sites (8th well, Mansion Teleki, King's Palace of the Árpád Dinasty, Buda Hill, Budapest; and Debrecen, Hungary) 54,415 watermelon seeds were excavated (Gyulai et al. 2006) *(Fig. 3)*. Wet-sieved sediment samples were processed by floatation followed by seed sorting and identification in the laboratory. The 19th century (ca. 1836) seeds were collected from herbarium samples (Pannonhalma, Hungary). For comparative analysis, forty-four modern *Citrullus* species and varieties were included *(Table 1)*. nSSR analyses were used for molecular genotyping.

SSR analysis has been applied to herbarium samples of 100-yr old common reed (*Phargmites australis*) to track plant invasion in North America. Melon (*Cucumis melo*) specific SSRs were used to identify an *inodorus* type melon recovered from 600-yr old seed aDNA. Allelic diversity of microsatellites were also reliably detected in aDNAs of 4,000-yr old seagrass (*Posidonia oceanica*). Chloroplast microsatellites were amplified effectively in 100-yr old dry samples of the grass species *Anthoxanthum ordoratum* and *Festuca rubra*.

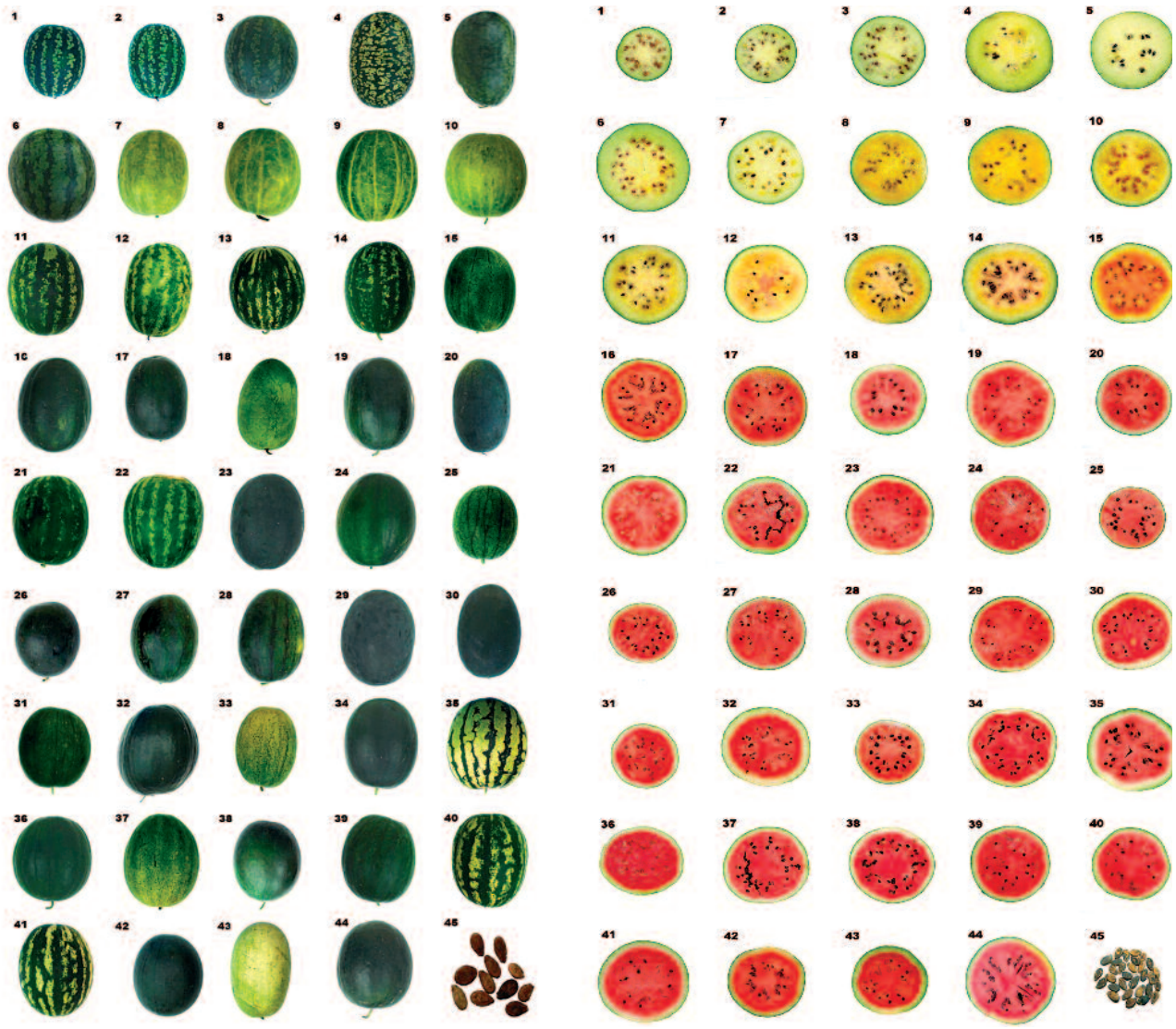

Figure 4. Rind (**4.a**) flash (**4.b**) and seed (**4.c**) types of current *Citrullus* species and cultivars at ripening time used (see Table 1) for comparative analyses. Ancient seeds of 13th–14th century A.D. Debrecen (in **a**), 15th century A.D. Budapest (**b**); and 19th century Pannonhalma (**c**) are included. Colour tool bars indicate 25 cm

Watermelon production in Hungary from the Middle Ages

Seed remains of watermelon (*Citrullus lanatus lanatus*) were excavated from two 15th century A.D. sites in Hungary at Budapest and Debrecen. For comparative analysis an herbarium sample from the 19th century A.D. (ca. 1836, Pannonhalma, Hungary) and forty-four current *Citrullus* species and varieties were used *(Fig. 4)*. Seed remains were processed by floatation followed by seed sorting and identification in the laboratory *(Fig. 5)*. After morphological analysis, aDNA was extracted and analyzed at microsatellite and chloroplasts loci with a final aim of sequence recovery and phenotype reconstruction *(Fig. 6)*.

Molecular dendrogram *(Fig. 7)* based on 737 ALF fragments identified at eleven nuclear microsatellite (nSSR) loci revealed that middle age samples show close lineages to ancient varieties currently growing with red flesh colour. The 13th century Debrecen sample showed similarity to cv. '*Kecskeméti vöröshájú*'; the 15th century Budapest sample showed similarity to cv. '*Belyj dlinnij*' (# 12). These results also reflect the preferencial cultivation of red flesh – and not yellow flesh- watermelon in the Middle Age of Hungary. Red flesh watermelon also appeared in the painting of *Still Life with Melons and Carafe of White Wine* (1603 B.C.) painted by Caravaggio. Molecular data obtained might provide further tools for watermelon breeders. Results of seed morphology *(Fig. 5)* correlated to molecular results *(Fig. 7)*. The 170-yr-old herbarium sample (Pannonhalma) showed close molecular similarity to citron melon (*Citrullus lanatus citroides*) cv.'*Újszilvás*' which reflects the importance of citron melon ('*takarmány dinnye*') with

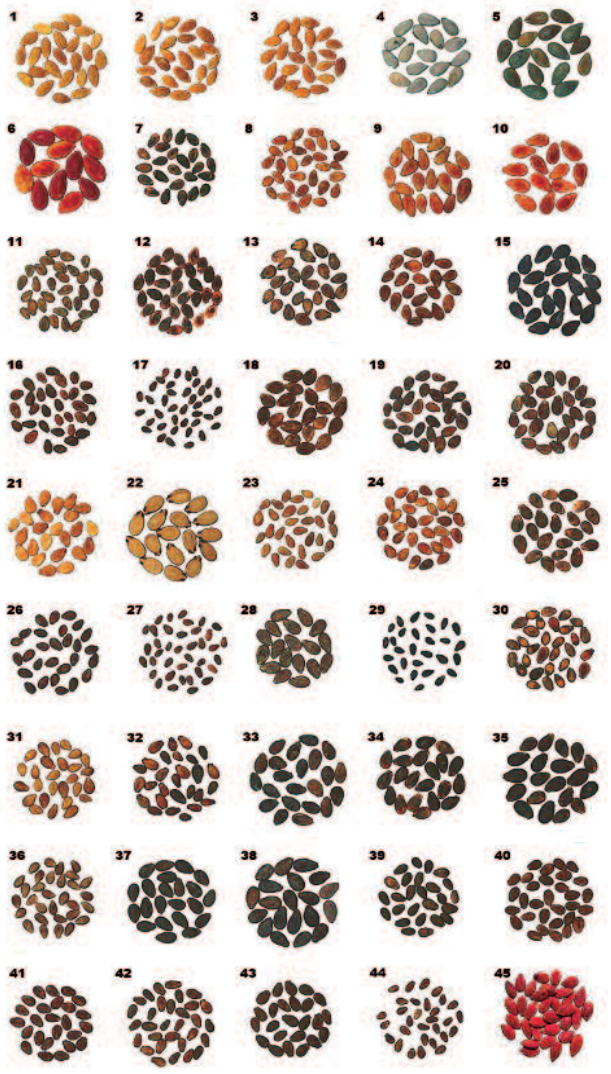

Figure 4.c

Figure 5. Individual samples of ancient *Citrullus* seeds (**a** – dorsal and **b** – ventral view). Watermelon (*C. l lanatus*) seed samples excavated at the 13th-14th cent A.D. Debrecen (**1**), the 15th century A.D. Budapest (**2**); and 19th century herbarium sample of citron melon (*C. l . citroides*) from Pannonhalma (**3**). Comparative samples of current *Citrullus* cultivars similar to 13th-14th century A.D. sample, Debrecen (**4** and **7:** # 36. cv. '*Kecskeméti vöröshúsú*' and # 17. cv. '*Klondike´*'); 15th century A.D. sample, Budapest (**5** and **8:** # 12. cv. '*Belyj dlinnij*', and # 14. cv. '*Csárdaszállás*'); and 19th century herbarium sample of citron melon (**6** and **9**: # 5. cv. '*De Bánát*', and # 6. cv. '*Újszilvás*') (1mm size bar)

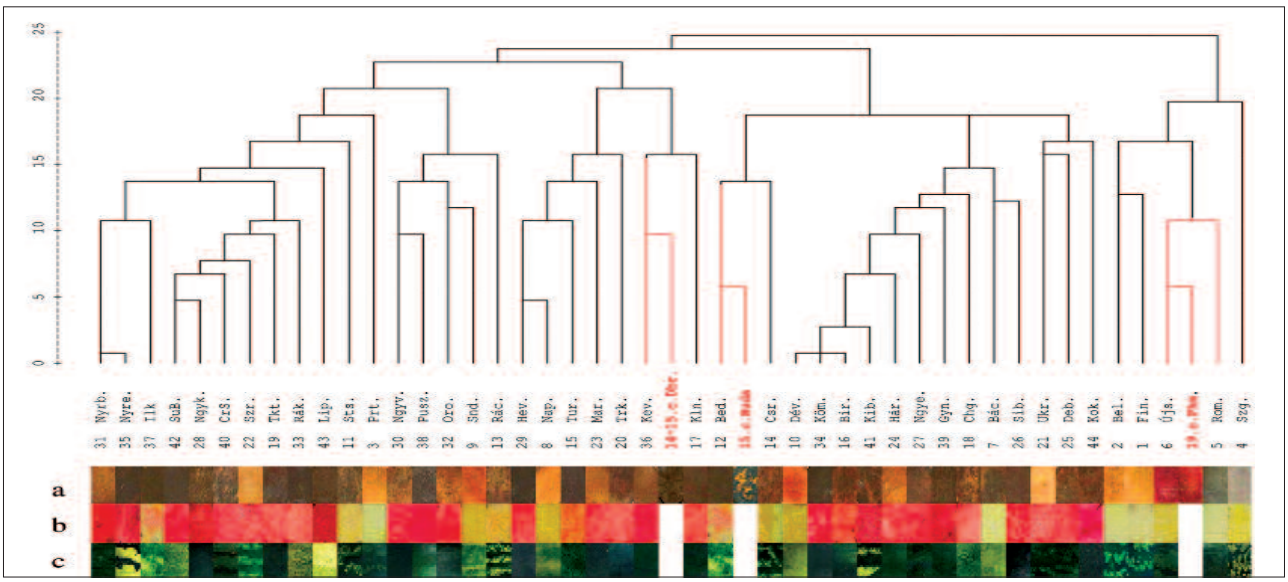

Figure 7. Molecular dendrogram (Rel Genet Dist, 0 – 25) of current varieties of colocynth (*'sártök') (Citrullus colocynthis,* **1–3***),* citron melon (*'takarmány dinnye'*) (*Citrullus lanatus citroides*, **4–6**) and watermelon *('görögdinnye')* (*Citrullus lanatus lanatus,* **7–44**) compared to archaeological and herbarium samples. Colors of seed coat (**a**), flesh (**b**) and rind (**c**) are indicated.

#	cv.	126/cmct168	190/cl2-140	124/bngl118-2	113/bngl339	146/bngl161	124/cmacc146	130/ phi121	139/bngl161	132/phi118-2	306/cmct51	145/cl1-06	136/phi118-2	124/phi121	130/cl1-06	178/cl2-23	131/bngl339	150/cl1-06	187/cl2-23	309/cmct51	132/bngl118-2	183/cl2-23	136/cmacc146	135/ phi121	129/phi118-2	140/bngl339	Total
1 Fin.	C.c.	●	●	●	●	●	●	●	●			●	●			●	●			●	●				●		15
2 Bel.	C.c.	●	●	●	●	●	●	●	●			●				●	●			●							12
3 Prt.	C.c.	●	●	●	●	●		●	●			●		●		●	●		●	●							13
4 Szg.	C.l.c.	●	●	●	●	●	●			●	●	●				●	●			●	●			●			14
5 Rom.	C.l.c.	●	●	●	●	●	●	●	●	●	●	●	●			●	●			●	●	●					17
6 Újs.	C.l.c.	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●			●	●		●				18
7 Bác.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●				●		●	●		19
8 Nap.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●								15
9 Snd.	C.l.l.	●	●	●	●		●	●	●		●	●	●	●			●										12
10 Dév.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●	●			●									14
11 Sts.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●		●	●	●		●	●						●	●	18
12 Bed.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	●	●	●						18
13 Rác.	C.l.l.	●	●	●	●	●	●		●	●	●	●		●			●										12
14 Csr.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●		●	●	●	●		21
15 Tur.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●			●				●	●						15
16 Bir.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●	●			●	●								15
17 Kln.	C.l.l.	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●					●		19
18 Chg.	C.l.l.	●	●	●	●	●	●		●	●	●	●	●	●	●	●		●									15
19 Tkt.	C.l.l.	●	●	●	●	●	●		●	●	●	●	●	●	●	●					●	●					16
20 Trk.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●			●			●	●	●	●	●		●		19
21 Ukr.	C.l.l.	●	●	●	●	●	●	●		●	●		●	●	●		●	●									14
22 Szr.	C.l.l.	●	●	●	●	●	●	●		●	●	●	●	●	●						●	●					15
23 Mar.	C.l.l.	●	●	●	●		●	●	●	●	●	●	●	●		●			●	●	●		●				17
24 Hár.	C.l.l.	●	●	●	●	●	●		●	●	●	●	●	●	●			●									14
25 Deb.	C.l.l.	●	●	●	●	●	●	●		●	●		●	●	●			●					●	●			15
26 Sib.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●				●					18
27 Ngye.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●			●	●									14
28 Ngyk.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●							●					15
29 Kev.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	●						●		17
30 Ngyv.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●				●					●	17
31 Nyrb.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●		●	●						●						14
32 Oro.	C.l.l.	●	●	●	●		●	●	●	●	●	●	●	●			●								●		14
33 Rák.	C.l.l.	●	●	●	●	●	●		●	●	●	●	●	●								●					13
34 Köm.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●	●			●									14
35 Nyre.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●		●	●						●						14
36 Kev.	C.l.l.	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●								16
37 Ilk	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●									●			15
38 Pusz.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●			●				●						15
39 Gyn.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●				●		●			18
40 CrS.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●				●	●		●			●		18
41 Kib.	C.l.l.	●	●	●	●	●	●	●	●	●	●		●	●	●		●	●									15
42 SuB.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●								16
43 Lip.	C.l.l.	●	●	●	●	●	●	●	●	●	●	●	●	●				●				●	●			●	17
44 Kok.	C.l.l.	●	●	●	●	●	●	●		●	●		●	●				●	●			●		●		●	17
13-14.c.Deb.		●	●	●	●	●	●	●				●		●	●	●	●		●	●							14
15.c.Buda		●	●	●	●	●	●	●	●	●	●	●	●		●	●	●			●		●	●	●	●		20
19.c.Pannonh.		●	●	●	●	●	●	●	●	●	●	●	●	●		●	●										15
Total		47	47	47	47	44	46	41	39	42	43	38	39	40	26	21	25	20	14	15	14	14	7	8	10	4	737

Figure 6. Microsatellite allele diversity at eleven SSR loci in the current *Citrullus* species and cultivars cultivars (1–44), medieval (13th–14th and 15th centuries) and herbarium samples (19th century)

extremely high drought tolerance in the Middle-Age Hungary and its use for fodder.

Acknowledgements

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Tibor Varga[1]

Value distortions of agricultural prices[2] *Prices and values in agriculture*

The chronic lack of funds in Hungarian agriculture, in addition to the problems of efficiency criticized with good reason, is also caused by the unfavourable tendency in prices.

From an analysis based essentially on micro-economic relationships it can be seen that the **equilibrium prices of the 'Walrasian market'** can be used as a starting point for studying the **diversion in the values** of our prices. The Walrasian market is a system of world-wide and economy wide sub-markets, which are in a complete connection and in perfect competition with one another, and, as such, this market cannot exist and, in fact, never existed in reality.

The fulfilment of the preconditions for a perfect market on a world-wide level and in every sector of the economy ensures a global balance for every product in which prices can change but the proportion of the different products cannot. In other words, if the price of any single product changes the prices of all products will change to an extent to reach the original price ratios again. **The stability of the price ratios**[3] **is an intrinsic characteristic of Walrasian market equilibrium**, therefore the product prices established here are to be regarded as the value of the products. Prices determined in this manner, which the actual market prices can approach or can fluctuate around, are considered to be the **first level** (theoretical) price centres.

Global market equilibrium will be lost on the presumed Walresian market as soon as only one market actor wishes to use a price differing from the uniform product prices. A chain reaction will start, as a result of which concentration will occur. The participants will procure an ever smaller number of ever greater market shares. If this process happens on the side of supply, it is called oligopolization, while if on the side of demand, an oligopsony is developed.

Applying the instruments of micro-economy it can be demonstrated that an oligopoly can maximise its economic profit by producing less and selling at a higher price compared to the behaviour if it were on the Walresian market. The oligopsony, in a similar manner, will purchase less and at a lower price, compared to when Walresian equilibrium exists. The oligopoly and the oligopsony will **squeeze out** a part of their market partners, the ones that go bankrupt due to low purchase or sale prices. An oligopsonistic market equilibrium will be established in a lasting way with fewer market actors on the counter side and at a lower demand from the latter. Similarly, the oligopolistic market equilibrium will be established in a lasting way with less market actors on the counter side and together with a lower supply.

The situation that the massive retreat of counterpart partners from the market does not take place can only be imagined if the actors threatened with being squeezed out manage to access external sources permitting them to finance their price losses, i.e. the difference in price compared to the price on the Walrasian market, the value of the product. Agriculture, considering its particular agricultural characteristics, **receives aid and subsidies on good grounds**, since a considerable part of these funds, as the price paid in order that agricultural producers be able to remain on the market, will **filter over to** their market partners through purchase and sale prices *(Figure 1)*. Since the subsidisation of agriculture has wide social acceptance historically, its market partners, in practising their price setting roles, can expect this subsidisation to be persistent and lasting without interruption in the long run. Consequently, oligopolistic and oligopsonistic actors, in pricing, can permit themselves to not follow market equilibrium prices, bringing maximum profit for them at optimal quantities, but to apply ones that are still

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[2] The article is based on the research carried out in the framwork of the task entitled 'Theroretical bases and national way of agricultural price setting'
[3] Natural harms (e.g. from droughts) can bring about lasting changes in price ratios which subsists only until the return of the required supply level (e.g. until the next harvest)

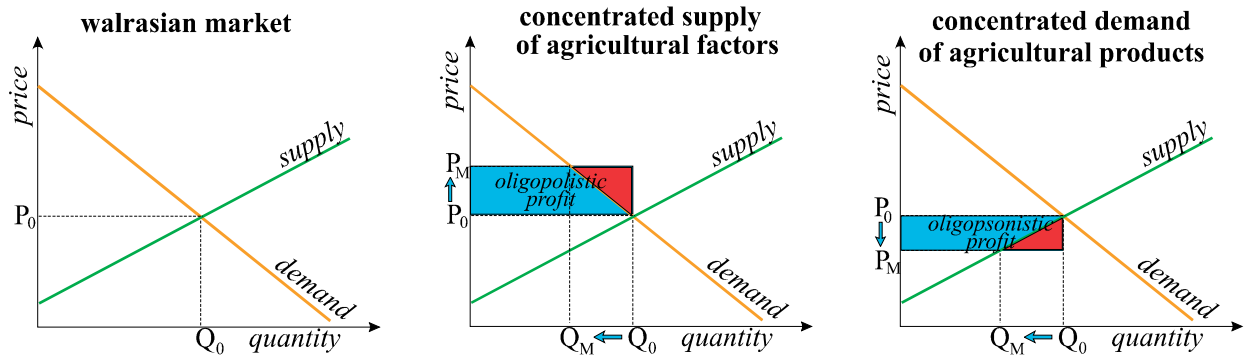

Figure 1. *Price losses of agricultural producers financed from subsidies (subsidies: red area)*

acceptable for agricultural producers with the subsidies. Therefore the purchase and sale prices of agriculture, even when compared to the oligopolistic and oligopsonistic equilibrium prices, are **disproportionate in value in a lasting manner**. Farmers, in calculating their price expectations, have long ago lost sight of those points of reference which could help them in deciding whether the value of a price affecting them is proportionate or not.

The world prices of agriculture and the products produced by it (reference prices), following from what had been said above, have already been subjected to a **primary diversion of prices** in the oligopolistic and oligopsonistic prices compared to the Walrasian prices and a **second**, sector specific **diversion of values** (taking advantage of the subsidised nature of agriculture), compared to the oligopolistic and oligopsonistic equilibrium prices. While, as a market actor, it is true to every sector of the economy consisting of a high number of economic units that its prices are subject to the threat of a primary diversion of values, this second diversion of values **is not included** in the prices of the non subsidised non agricultural sectors.

The world market price **tends to pass through** to local markets, too, and there it is present as a **second level price centre**. In the case that a group of local markets build up a common market protection, such as the EU, the passing through of the price (horizontal price transmission) can be of low efficiency because the world market price and the institutional protective price have poor co-movement or none. In other words, the protection of the market can be successful.

Using a time frame of 18 years, we have examined the co-movement (cointegration) of the world market and EU level prices of the major agricultural produces. We have come to conclude that there are **three categories** of market protection in the European Union, distinguishable on a functional basis.

The first is **effective market protection**. This is an operable strategy elaborated in details capable of giving consistently premeditated and fully-prepared responses to the prescriptions of the World Trade Organisation (WTO). Of the market organisations examined the cereal, beef and dairy regimes are considered to belong here. These are the market organisations that are most vulnerable to overproduction and that have the market protection institutions with the most questionable WTO conformity. The co-movement of world market and EU prices does not apply to them.

The second characteristic market protection category is **potential market protection**. These regimes are also equipped with those market protection means (institutional prices, export reimbursement, import levy with duties, subsidisation of private storage etc.) that exist with the former with the difference that they need to apply them only on rare occasions if at all, because the development of the market situation does not necessitate it. The descriptions of them which are available are rich in conditionals and lacking in detail and in reporting on solutions built on experiences. This is where the examined pig and poultry market organisations are considered to belong to. The influence of the world market prices and the co-movement of the prices are detectable in the prices of their products.

The third market protection category is **symbolic market protection**. No complete system of instruments exists. The protection of the imports is absent but there are intervention and institutional purchase prices. The sector policy debates prevent the construction of a full and consistent system. Of the sectors examined, the market system of the oil plants is considered to be of this type. The market operates practically with no restrictions in a strong co-movement with the world market of the products.

The **prices of the EU** could be the **third level price centre** for

the local market of national agricultural produces. The short history of our EU membership does not permit to carry out horizontal price transmission analyses therefore it is possible to make the only comment that there are indications that a **looser** value transmitting **price transmission** is present between the EU and national prices which manifests itself in the mutual adjustment of the price strategies. A **price convergence** (increase of prices to the same dimensions) **has taken place in a demonstrable manner**, while the close (cointegrated) co-movement of prices can be considered to be only probable and only in the case of a few number of products.

This way, on the national local market the prices of the EU play only the role of constituting a basis for a rough alignment to reach the same dimensions. The local **price centre on the fourth level** is formed in accordance with a longer term market balance of forces. It is unknown for the actors of the market in the same manner as the Walrasian price for the reference prices setters. Nonetheless, there is a method for the quantification of the price transmission level in which method the so-called **cointegration** equation can be considered to be the local price centre.

Product level (vertical) price transmission analysis and its results

Cointegration calculations draw conclusions from the trends in food supply system relative to the balances of forces on the different levels and determine the price profit or loss occurring between the subsequent levels linked to one another. Basically, **cointegration** carries out a regression calculation but is more realistic than regression in **taking into consideration also the dislocations of the regression towards the former state**. The relationship between the two time series is described by the so-called '**cointegration equation**'. In the knowledge of the cause and effect relationship between the two time series the cointegration equation of the time series in the effect position can be considered to be the price centre of the time series of the effect (fourth price centre) on the local market.

The conclusions obtained from the analyses in eight agricultural product groups *(e.g. Figure 2)* are the following:

The sector-level market dominance is **strongly differentiated** from product to product. On the level of the sellers of the pork production and supply chain, relative to the total of the products examined, the market dominance over processors is demonstrable, except for a few products. It can be supposed that commerce, having the dominance, calculates a tactical price loss on certain products.

Part of the existing instances of dominance are **unstable** and can easily shift to the vertical partner level. This also applies to the dominance, actually occurring in favour of commerce, between the processing and distribution levels of the food production and supply system (the level of commerce of 'Gyulai' sausage, the dominance of sunflower seed producers over distributors of fertiliser components).

Changes in prices occurring on the basis of the relationship between weather related yields and prices can also influence prices to an extent which can result in the shift in market dominance (e.g. though a steadily high level of wheat prices has not managed to make the price pressure of fertiliser components turn into its proper dominance but has been sufficient enough to bring about an increase in flour prices to an extent resulting the dominance of mills over the baking industry).

A stable dominance **is not tied to** products or to vertical levels. The dominance of commerce includes similarly the 9% degree as the 57% one. The dominance of the commerce level in the production and supply chains studied in the price transmission calculations and in the in-depth interviews is even higher.

Possible counter steps of agriculture

According to the micro-economic argumentation possible means for limiting the dominance of one of the market actors is concentration. In other words, the **response to concentration should be concentration** also on the other side. This is suggested by theoretical economics through the interpretation of the bilateral oligpolistic market situation. Concentration is going on in a spontaneous manner in agriculture, its degree, on the other hand, **is lower**, compared to the concentration of the market partners. The efficient enforcement of the interests on the market is also favoured by, together with concentration, a concerted market presence through co-ordination.

According to the Walrasian theory **homogenous products have one market**. Therefore, if a producer improves the quality of his product and increases its added value, with the altered product he will become the participant of another market, the market of the higher quality products. In other words, he changes product and market at the same time. This attitude is useful when deliberating the possibilities of producers for enforcing their interests

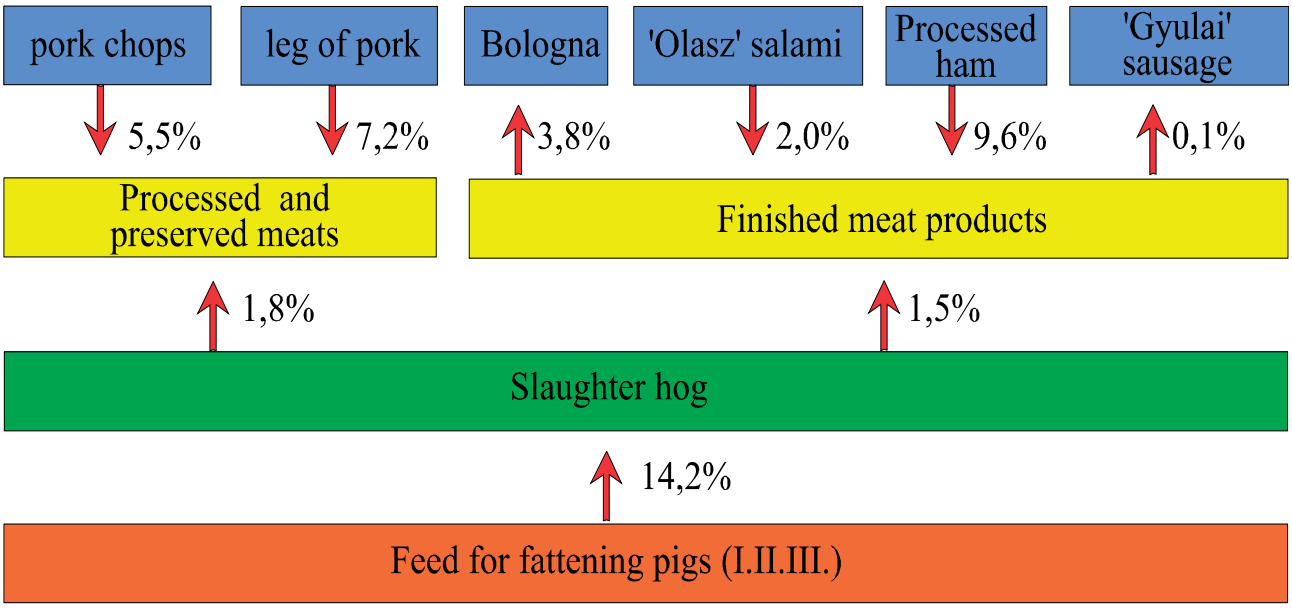

Figure 2. *Market dominance in the pork production and processing system (the starting point of the arrow: price profit in the percentage of price)*

because it helps distinguish on the market of the given product between the enforcement of the interests through fight for position and the solutions avoiding the latter through producing a different product. The latter (the readiness of producers to undertake post harvest activities, the shift to an another product that is also conceptually different, village tourism or the work opportunities offered by local self regulatory organisations [clusters]) can provide alternative income sources and as such are recommended for farmers. At the same time, these solutions can bring about individual improvements of position in the competition fight **on the proper side** versus other farmers and **do not give any** answer for curbing the counterpart dominance existing on the original market. In the event that a producer offers a better quality product for the former purchaser the situation of '**a slightly higher price for a much valuable**' can easily occur since the purchaser is still in possession of the former market dominance.

According to what has been said above, the co-ordinations of producers were evaluated **exclusively in terms of the market interest enforcement capacity**. It was the **groups and marketing organisations of producers** that seemed to be the most suitable for this task. These horizontal organisations can be set up by producers with the objective to procure goods, to collect their products for processing, to store the products and to prepare them for marketable goods and to sell them together. The function is purely that of the enforcement of interests. The profile of the **buying, sale and service organisations** is **similar** but they also provide some other services for the members which can procure the satisfaction of the members even when the enforcement of interests brings modest results. **Co-operatives** fall under a similar estimation which are at the disposition of their members offering a broad range of services in which the enforcement of market interests play an important part. The position improving chances of the horizontal organisations is increased further by the possibility of their integration, occasionally reaching even across the national boarders.

Regional **clusters** can also take part in the improvement of the market position of producers. The cluster built on an intricate system of organisational and contractual relationships can have such a management and institutional infrastructure which are capable and have also interests to strengthen the market position of the farmers and of the organisations of the latter.

Social capital is given an important role in the formation of producers' organisations. Social capital is a very extended concept which is interpreted in several ways. It includes, besides others, the institutions and interrelation systems of the society, the social norms and the trust of individuals in one another and in the institutions. The **state of the national social capital**, following the atomisation of the society and the **unfavourable** historical experiences and because of the exaggerated fear from uncertainty and for many other reasons, is unfavourable also in international comparison. This circumstance must be considered in the encouragement of the formation of producers' organisations.

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