Corvinus University of Budapest

Special merits of traditional melons and watermelons

Doctoral Theses

Csaba Szamosi

Subject Leader:
Némethyné dr. Uzoni Hanna
Associate University Professor

Written at the
Department of Vegetable and Mushroom Growing
Corvinus University of Budapest

Budapest
2009

Background of research and objectives

Based on material evidences discovered over the past decades, it can be said with certainty that Hungarians were acquainted with melon and watermelon already during their migration into Europe. The country's melon and watermelon cultivation has a great history as Hungary had a leading position in production in the 16th century, topped only by the Turks. Descriptions of cultivation appeared already in printed form in the middle of the 18th century. From them it can be seen that the fruit was among the most important foods for popular consumption. Peasants consumed it as an everyday food. Originating from the 19th century, a number of literature data on melon and watermelon production of that period have survived, testifying an extremely rich variety assortment of both melons and watermelons. In this period, melons showed a very great variety not only in terms of the different fruit shapes, sizes and ripening times, but also in terms of flavour and aroma components.

Traditional melon and watermelon varieties, well adapted to the climatic and soil conditions of the Carpathian basin and representing a hungaricum quality, have disappeared or have become endangered with the broad use of intensive cultivation and uniform hybrid varieties. Fortunately, part of them have been successfully collected in time and conserved in gene bank collections. The genome of the variants disappearing by extinction can not be recovered or reproduced. This is the reason for the high support for national programs, for the world level collaboration and for the increasing interest and role of international organizations in the conservation and utilization of agro-biodiversity.

Gene conservation, on the other hand, is an activity which is labour intensive and incurs considerable costs, while biodiversity from the point of business, especially in the short term, is unimportant according to the majority of people. Consequently, the value of biodiversity constituting the basis sustainable development is an issue of constant controversy between biologists, scientists and researchers.

Unfortunately, as a consequence of human shortcomings and in the lack of financial conditions, the national melon and watermelon gene banks of Hungary are in a catastrophic state and the rescue of the survived seed accessions requires urgent steps to be taken. The landraces still present in Hungarian popular cultivation and the traditional melon and watermelon varieties conserved in the gene banks (which are often under imminent threat due to improper storage) make part of the cultural heritage of the people of Hungary and some of them look back on a history of several centuries. To rescue them can also be considered as a national interest.

A number of international studies demonstrate the importance of conserving the genetic sources of local importance both in the case of watermelon (Citrullus lanatus [Thunb.] Matsum. & Nakai) and melon (Cucumis melo L.). The major reason is the fact that melon and watermelon varieties in production have a relatively narrow gene stock behind them and these local populations can have valuable genes for future plant breeding challenges.

Research results of recent years have demonstrated, besides the already known favourable nutritional effects, various therapeutic effects of melons and watermelons in a number of cases, which are due to the antioxidant compounds present in them.

Among them, in the case of watermelon, citrulline and lycopene have a particularly important role, while in the case of melon the effect can be ascribed to the enzymes superoxide-dismutase and Q10, as well as to carotenoids, to the vitamins C, B1, B2 and E.

The main objective of my work was to try to rescue (regenerate) traditional (Hungarian, in particular) melon and watermelon varieties and landraces, as well as to study their morphological and compositional parameters (refraction, total polyphenol content and antioxidant capacity). Over the three years I worked with a total of 62 different melon and 53 watermelon varieties.
Watermelon, together with tomato, due to the considerable antioxidant capacity, is considered to be the most important source of lycopene successfully applied in the cure of cancer. Certain authors refer to certain watermelon varieties with high lycopene content as so-called functional food. Accordingly, within the limits of my possibilities, I also carried out measurements for the lycopene concentration with 9 watermelon landraces.
The objectives of my thesis included the study of the aroma compounds of the traditional melon varieties having the most intense scent for the nose. Although it cannot be stated unequivocally that the attracting scent of a melon guarantees also a high sensory quality, it is certain that for the majority of consumers this characteristic is a decisive factor in their choice. Therefore, I thought it very important to complete my thesis with the structural analysis of the well-known delicious scent of traditional melons, this way carrying out gas chromatography (GC-MS) analyses as well.
In the tests in 2008 I set myself the objective to study the ancestral relationship of Hungarian and Turkish melon varieties and therefore, fur the purpose of the morphological and molecular characterization, so-called reference varieties were also necessary to help the interpretation of the results. Consequently, the 58 melon varieties and the 50 watermelon varieties, tested in 2008, represented a high diversity in terms of geographical origin and botanical taxonomy.

Material and method

The majority of the seeds of the tested melons and watermelons were provided for me by national and foreign gene banks and part of them came from my own collection. Over the three years I work with a total of 53 different watermelon and 62 melon 'varieties' (landraces, open pollinated varieties, genotypes).
In the experiments in 2008 I set myself the objective to study the relationship of Hungarian and Turkish melon varieties and therefore, fur the purpose of the morphological and molecular characterization, so-called reference varieties were also necessary to help the interpretation of the results. Consequently, the 58 melon varieties and the 50 watermelon varieties tested represented a high diversity in terms of geographical origin and botanical taxonomy. In choosing the melon varieties offering the best representation of the individual growing regions of Turkey I was assisted by the fellows of the Faculty of Horticulture, University of Cukurova in Adana.
In order to be able to study the varietal diversity and the ancestral relationships in a more profound way I arranged for the experiment to include related species (C. lanatus var. citroides (Bailey) Mansf.; C. colocynthis (L.) Schrad.; Praecitrullus fistulosus (Stocks) Pangalo) as well.
The experiments were carried out over 3 years. In the years 2006-2007 the site of my research activity was an unheated greenhouse of the Experimental Farm of the Corvinus University of Budapest at Soroksár. In 2008 I carried out my research at the Experimental Farm of the Faculty of Horticulture, University of Cukurova in Adana in Turkey, under field conditions.
Experiments of the years 2006-2007: As some of the gene bank accessions constituting the material of the research had very poor germination potential (the age of the oldest seed accession was over 20 years), in the year 2006 I used pre-germination treatment according to needs after the removal of the seed coat or without. Pre-germination was carried out in Petri dishes, between layers of filter paper kept wet, in a 30°C thermostat until the emergence of 1-2 cm long root initials.
Depending on the seed accession, dry or pre-germinated seeds were sown in polystyrene trays of 40x60x60 cm in size distributed by the company KITE ZRt. The size of the 96 cells were 4.2x4.2cm (65 cm^3), respectively. In order to minimize transplanting losses seedlings were 'pricked out' in pots of 10 in size at the 2-3 true leaf stage, this way obtaining well-developed plantlets with strong root systems by the time of outplanting.
In order to minimize the possibility of infection by soil-borne diseases and pests, melon and watermelon seedlings were planted in dark grey buckets of 12 litres, in container soil used by the farm.
The melon and the watermelon experiments were set up in respective spans of a traditional plastic greenhouse with 6 spans. Planting took place on May 3 in 2006 and on May 15 in 2007 in the spans with individual lengths of 100 m, widths of 7 m, eaves heights of 1.5 m and ridge heights of 4 m. The objective of the experiments included, besides the maintenance of the variety and in certain cases its retrieval (regeneration), the analysis of fruit composition. The analyses did not include the quantitative study of the yields and this way, using no repetitions, I planted out 15 plants per melon and

watermelon variety in 2006 and 20 plants in 2007 with a row width and intra-row spacing of 175x50 cm.
One plant was planted per bucket. The buckets filled with soil mix up to 12 litres were placed on black plastic mulch strips. I covered the plastic strips with an about 5 cm thick layer of river sand permitting drainage water leaving the buckets to pass. Fertigation was done using drip pipes and drippers, applying 2 drippers per bucket. In order to facilitate the manual self-pollination of flowers, in an unusual way, I trained not only the melon, but also the water melon plants to vertical trellises, pruned to two shoots.
In order to ensure an untroubled self-pollination, each vent of the plastic film was covered with a double raschel net against insects flying in (Figure 6) and plants received insecticide spays with weekly frequency (if necessary, combined with fungicide). Both in the year 2006 and 2007, despite the presence of the vector net, during the first two weeks following the appearance of the first female and androgynous flowers, I also did the isolation of flowers in the late afternoon hours of the days prior to the morning of self pollination.
In the year 2007, in order to observe the combination potential of some varieties seeming to be promising, I also carried out 1 test cross in the case of melon and 2 test crosses between watermelons.
Melons are facultative cross-pollinated plants and therefore traditional melons and watermelons are characterized by being strongly heterozygous under natural conditions (particularly in the case of the landraces constituting the major part of the trial), as a result of which the occurrence of different phenotypes is very frequent. On the other hand, the landraces constituting the subject of my investigations had been subjected to repeated self-pollination due to the nature of gene bank maintenance and therefore they had adequate genetic purity and showed a reliable representation of the individual melon varieties (landraces). Moreover, prior to carrying out the extensive morphological and genetic analyses, also I myself did the self-pollination of the individual accessions for two generations (using different selection methods).
Morphological measurements carried out over the years 2006-2007
Relative to every melon variety tested, on at least 3 fruits picked in the same maturity stage in both years I carried out the following measurements: refraction (%), weight (kg), longitudinal section (cm), cross section (cm), width of seed cavity (cm) and width of fruit flesh in cross section (cm).
In the case of the watermelons I measured refraction (%), weight (kg), fruit cross and longitudinal section (cm) also on at least 3 fruits.
Refraction measurements from the fruits of both species were carried out using an electric refractometer (ATAGO Pocket PAL-I). Although this measurement should logically be part of the capital of chemical analyses, but as the measurements were done from the same part of the fruits prior to the sampling for the laboratory tests, it is to be treated hereby.
Chemical analyses:
Sampling and sample preparation of the melons and watermelons constituting the subject material of the measurements carried out over the years 2006-2007 were done on the same day as the respective picking. Following the removal of the skin and the seeds, I homogenized slices of (water)melon cut from the consumable part of at least 3

fruits per variety using a mixer. Up to the time of the analyses, samples were stored in a deep freezer at -20°C.
Determination of dry weight: dry weight was determined according to the procedures described in the MSZ 2429-1980 Standard.
Determination of titratable acid content: for the determination of titratable acid content I followed the MSZ 3619-1983 Standard.
Determination of total antioxidant capacity: FRAP value, total antioxidant capacity expressed in ascorbic acid was measured by means of spectrophotometry (λ=593 nm).
Determination of total polyphenol content: Measurements were carried out from the float of homogenized and centrifuged samples made from the consumable parts of (water)melons. Total polyphenol content was determined according to the method of SINGLETON and ROSSI (1965) by means of spectrophotometry at λ=760 nm using Folin-Ciocalteu reagent. Total polyphenol content in terms of Gallic acid was described in mg/ml. All the analyses were carried out using 3 parallel measurements.
Determination of lycopene content: in the year 2006 I had the possibility to measure the lycopene content of a limited number of watermelons (9 fruits). Owing to the complexity of the tests and the need for the use of hazardous organic solvents the analyses were performed by the personnel of OÉTI (National Institute for Food and Nutrition Science).
Determination of volatile aroma components of melon: I thought it important to complete my thesis with the with the structural analysis of the well-known delicious scent of traditional melons, this way carrying out gas chromatography (GC-MS) analyses as well. I used the optimal GC-MS parameters already determined experimentally in the earlier measurements of similar nature relative to the volatile aroma components carried out at the Department of Food Chemistry and Nutrition Science of the Corvinus University of Budapest.
In the evaluation of the results I was assisted by the relative aromagramme, with a more expressive name aroma spectrum method, based on the normalation of both of the axes of the chromatograms.
Statistical evaluation: The handling and the primary processing of the great data amount during the experiment was done using the programme Microsoft® Excel 2003. In the years 2006 and 2007 the programme ROPstat was employed in the evaluation of the morphological measurements done on the fruits. Besides the inter varietal comparative analysis of the parameters measured, also the effect of the year was studied in the case of the melon and watermelon varieties present in both of the years.
For the comparison of the varieties, when the conditions were met (normal distribution, standard deviation and homogeneity), we used the traditional variance analysis and robust probes (Welch, James, Brown-Forsythe variance analysis) in the case when the standard deviations were not homogenous.

I carried out my experiments in 2008 at the Experimental Farm of the Faculty of Horticulture, University of Cukurova in Adana in Turkey. For the molecular analysis I collected leaf samples at the 1-2 true leaf stage of plants from 9 plants per variety during transplant growing. The samples then were transported in fluid nitrogen and stored at -80°C until the recovery of the DNA: On March 18 the transplants in the 3-4 true leaf stage were planted in the field at a plant spacing of 0.5 m and 3 m under a

small tunnel in order to facilitate the performance of morphological measurements and analyses. 10 plants per variety were planted and irrigation and fertigation were done using dripping tubes. In the case of most of the melon and watermelon varieties I also carried out isolated self-pollinations in the year 2008.

Morphological measurements and analyses of the year 2008:

Morphological characterization was carried out in the case of both species according to the modified (a few added traits) lists of descriptors issued by UPOV (International Union for the Protection of New Varieties of Plants). In the case of the melon, I observed a total of 70 phenological characteristics, while 58 in the case of the watermelon in the cotyledon stage of plants, at main flowering and on mature fruits. Besides the categorical observations, I also measured 17 numerically describable characteristics in the case of the melon and 16 in the case of the watermelon. Measurements were carried out in three different phenological stages (seedling, developed plant and mature fruit) using a measuring taper, an electric scale and an electric sliding calliper. Refraction measurements indicative of sweetness were performed using an electric refractometer (ATAGO Pocket PAL-31).

Molecular analyses: For the detection of the genetic distance and the ancestral relationships between the Hungarian and Turkish melon and watermelon varieties I used the SSR (Simple Sequence Repeat) method among the molecular marker methods. From the varieties constituting the subject of the morphological characterization of the year 2008 I selected 30 melon varieties and 30 watermelon varieties for the purpose of molecular tests. In my work I used 17 SSR primers for the analysis of the melon samples and other 22 primers for the analysis of the watermelon samples.

Statistical evaluation: Results of the morphological analyses of the year 2008 were evaluated using 3 multi-variable statistical methods. For the analyses of the data measured the principal component (PC) analysis was applied using the programme SAS. The categorical data obtained from the UPOV characterization were evaluated with principal coordinate analysis (PCoA) using the programme NTSYS-PC. In the end, based on the clustering analysis of the categorical data a dendrogram was plotted with the group average method (UPGMA) using the programme NTSYS-PC. Average values of the measured parameters of the Hungarian and Turkish gene sources were compared with p value T test using the programme Microsoft® Excel 2003.

Numerical data obtained after the interpretation of the results of molecular (SSR) analyses were also analysed using the programme NTSYS-PC. In the clustering analysis performed on the basis of genetic distances with the group average method (UPGMA) dendrograms were plotted.

Results

Results of the morphological and refraction measurements over the years 2006-2007:
I made the conclusion that despite of the differences due to the year effect the tendency of the values recorded for the different varieties compared together was the same (watermelon) or very similar (melon) and therefore the results of the morphological and compositional measurements can make good use to detect the differences between melon and watermelon varieties and can thus be successfully applied as a method assisting plant breeding (selection) and for the evaluation of gene bank materials.

Total antioxidant capacity and total polyphenol content:
In the analysis of the total antioxidant capacity present in the water soluble fraction of the melon I measured almost identical and exceptionally high values in the case of three yellow fleshed varieties (Korai Cserhajú, Kősárga and Prescott Fond Blanc). These correspond to the double of the average amount observable in green-fleshed melons. The great difference between yellow and green-fleshed varieties can be ascribed to the highly antioxidant characteristic of pigment materials.
Compounds belonging to the group of flavonoids play an important role in the constitution of the total antioxidant capacity. Accordingly, based on the measurement results of total polyphenol content it can be concluded generally that yellow-fleshed varieties have higher phenol content than green-fleshed melons.
Based on a general consideration of the results of the total antioxidant capacity of the watermelons tested, in accordance with earlier research results, the free radical scavenging capacity of yellow and orange-fleshed varieties is inferior to that of red-fleshed watermelon varieties.
In the comparison of the red-fleshed varieties significant difference could be revealed between the samples with the same flesh colour. the average antioxidant capacity of the varieties Duna 4 and Hevesi was as low as only one fifth of the variety Sándor Pál. Within the red fleshed varieties I saw a close correlation between the intensity of flesh colour and the measured values of total antioxidant capacity.
Based on the test results of total polyphenol content a contrary tendency can be observed compared to the measured values of total antioxidant capacity, since the varieties having the highest phenol content this time came from among the orange and lemon yellow fleshed watermelon varieties.
Based on the measurement results of total antioxidant and total polyphenol content it can be seen that the health protective effect of watermelons is significantly inferior to that of melons as I measured significantly lower values for both parameters in the case of the watermelons compared to the latter species. Nonetheless, the role of watermelon in a healthy diet is not to be belittled, particularly when the per capita annual consumptions of the two species are compared (one Hungarian citizen consumes an average of 1 kg from melon, while 2-3 kg from watermelon).

Lycopene content

In the year 2006, thank to Andrea Lugosi and to the personnel of the OÉTI (National Institute for Food and Nutrition Science) I had the possibility to measure the lycopene content of a limited number of watermelon samples (9 samples).
In accordance with the expectations set forth on the basis of that reported in the international literature, among the 9 watermelon varieties tested the lowest lycopene content was recorded for the orange fleshed varieties *Gyulavári* and *Nagymágocsi* as it is the carotenoids that are responsible in the first place for the flesh colour of orange fleshed watermelons.
Despite the fact that, based on the visual estimation, the brightest red fruit flesh was shown by the varieties *Kecskeméti Vöröshúsú* and *Sándor Pál*, based on the measurement results, it was the landrace *Kömörői* that had the highest lycopene content. Though some research results had revealed a close correlation between the intensity of red flesh colour and the lycopene concentration measurable from the flesh, according to my findings the colour of the flesh by itself is not sufficient for judging the lycopene content of a watermelon variety.

Results of scent analyses of melons

I converted the GC-MS results using the relative aromagram construction method elaborated at the Department of Food Chemistry and Nutrition, named as aromaspectrum method to highlight the structure which is analogue to that of mass spectra. This way in 2006 I constructed the fragrance profile of Muskotály, Togo, Prescott and in 2007 those of PGR and Sweet Ananas, Muskotály, Togo and Dixi. In these latter two years, relative to the varieties Muskotály and Togo, I tried to find a characteristic scent spectrum appearing in both years.
In 2008 I carried out the scent analyses of the 'variety' Togo x Sweet Ananas of my own breeding, produced by test cross and determined the characteristic scent features and compared its characteristic fragrance profile to that of the 'parents'. I concluded that traditional varieties with special aroma can be used for the production of melon varieties of a quality meeting the present day requirements but having an individual scent.
In order to find the components responsible for the fruitlike quality, I revaluated the method and practice setting measurements of the winter type and long shelf life varieties of the types Amarillo and Galia, introducing the measurements, in accordance with the discovered data interpretation aspects and determined the range of the characteristic (conferring a melon nature) compounds.

Results of the morphological and genetic tests over the year 2008

The results obtained in the morphological characterizations and measurements, compared with the compositional measurements, proved to be suitable for the selection of varieties (landraces and lines) from different points (discussed in detail in the thesis) seeming promising for future breeding programmes.
Melon varieties recommended for use as basic material for breeding:
Magyar kincs, Togo, Aranygömb, Carosello, Xantha
Watermelon varieties recommended for use as basic material for breeding:
Sándor Pál, Hevesi, Kömörői, Kecskeméti vöröshúsú, Nyírbátori, Korai Kincs, Sándorfalvi

The clustering analysis carried out on the basis of the SSR analysis revealed a genetic relationship between the Hungarian and Turkish melon landraces, as well as between the watermelon ones.

The closest genetic similarity of 64% revealed in the case of the melon varieties is by itself insufficient proof for the existence of ancestral relationship. Based on the morphological similarities observed and the literature references, however, it can be concluded with high probability that the winter melon (inodoros) landrace Pocok kóty had arrived in Hungary with the mediation of the Turkish occupiers in the time of the Ottoman Empire (16th century). The melons T65 (Şelengo) and H8 (Muskotály) also showed remarkable similitude both on the basis of the molecular and the morphological characterization.

The results of the morphological tests and measurements performed demonstrate the similarity of the Hungarian and Turkish watermelon landraces in several cases. This way they cannot be separated on the basis of origin. The Turkish landraces showing the greatest genetic similarity with the Hungarian watermelon landraces have red flesh which corresponds with the literature reference saying that only yellow-fleshed watermelons had been produced in the country until the middle of the 16th century and the red-fleshed varieties became common in Hungary only in the time of the Turkish occupation.

New scientific results

In the compilation of the thesis the most basic scientific result obtained in my view was the establishment of the melon and watermelon seed collection, with no parallel on national level, obtained through the regeneration of aged gene bank seed accessions, through the unification of varieties and landraces collected from the different regions of the country and of the accessions received form foreign gene banks.

In the tests and observations of the melons and watermelons I obtained the following new scientific results:

I determined the morphological and major compositional parameters (refraction, dry matter, acid, total polyphenol content and total antioxidant capacity) of the individual landraces and varieties.

Based on the measurement results of the lycopene content I concluded that some of the Hungarian watermelon landraces (Kömörői: 95.7 mg/kg lycopene) could be precious basic material of breeding for the production of watermelons with high lycopene content.

Using the relative fragrance profile (aromaspectrum) method in the gas chromatograph tests I demonstrated, in the case of Amarillo, Galia, Muskotály, Togo, Prescott Fond Blanc, PGR, Sweet Ananas and Dixi, that every melon variety has an individual fragrance profile resembling only to the given variety, which profile can be successfully detected with the analytical method discussed in my thesis.

The scent characteristics of the variety Togo x Sweet Ananas of my own breeding (the posterior third part of the relative fragrance profile to Togo and the anterior third part to Sweet Ananas) bear recognizable and graphically demonstrable resemblance the that of the ‘parents’ forming a very fragrant variety of high total aroma value.

I concluded that the most variety typical, particular scent character of the melons was determined by the relative amount of the sulphur components with fruitlike quality (alkyl-thioates and alkyl-thiolesters).

Based on the morphological and molecular (SSR analysis) tests results I determined the close relationship and the differences between the individual Hungarian and Turkish melon varieties (Muskotály type and winter types) and between the watermelon varieties (with dark green skin and red flesh).

Conclusions and recommendations

Based on the summary of the results of the thesis it can be seen that traditional melon and watermelon varieties have notable merits and therefore it would be a great mistake to underrate or neglect them. There is no solution for the long-term and skilful storage and maintenance of the watermelon gene bank established during the compilation of the thesis which is undoubtedly singular on country level and is of proper genetic purity. In order to prevent further losses and to increase the value of the existing collection the following recommendations can be made:

By means of tenders possibility should be created for the proper storage of the seed accessions (cold store) and for their regeneration (renewal of seed reserves, isolated seed harvesting) if necessary.

As the value of a gene bank increases proportionally with the amount of information available on the seed accessions contained, I think it necessary to carry out further tests and analyses of the materials collected, with special attention to the resistance (disease resistance and drought resistance) tests of the watermelon and fodder melon varieties.

The great difference between the total antioxidant capacity of the yellow and green-fleshed melon varieties can be explained by the strong free radical scavenging character of the pigments. Earlier research results show that the carotene content of yellow-fleshed melons (cantaloupe types) is significant, while the amount of carotenes detectable in green-fleshed types is generally insignificant. In contrast, in my tests three green-fleshed melons (Dixi, Moholi Ananász and Vanília) showed a higher free radical scavenging capacity than the light orange-fleshed varieties Amarillo Orange flesh and Petit Gris De Rennes. Though I carried out a deeper analysis of the volatile aroma components only of Dixi of the three abovementioned green-fleshed varities, it can be seen that all three varieties are particularly rich in aroma. This way the antioxidant capacity exceeding the average of the green-fleshed varieties is most probably due to the free radical scavenging capacity of the aroma constituting compounds.

Generally a close correlation can be revealed between the total polyphenolic content and the total antioxidant capacity with fruit and vegetable species. In the case of melon and watermelon the background of the greater differences observed during the tests is most probably that the totality of the phenol compounds of melons and watermelons is more complex: besides the pigments the greater role of aroma components can be supposed in the constitution of total polyphenolic content.

Though some research results had revealed a close correlation between the intensity of red flesh colour and the lycopene concentration measurable from the flesh, according to my findings the colour of the flesh by itself is not sufficient for judging the lycopene content of a watermelon variety. Despite the fact that, based on the visual estimation, the brightest red fruit flesh was shown by the varieties *Kecskeméti Vöröshúsú* and *Sándor Pál*, based on the measurement results, it was the landrace *Kömörői* that had the highest lycopene content. Therefore, in order to determine the actual lycopene concentration, laboratory measurements are recommended at choosing the parent partners in the course of breeding aiming to produce watermelons of high lycopene content considered as so-called functional food.

Based on the literature references cited in the thesis the so-called key-components responsible for the scent of melon are compounds belonging to the group of esters which facts is not intended to be questioned by me. The gas chromatography results of 2006-2007, on the other hand, highlighted the fact that the most variety typical, particular scent character of the melons is determined by the relative amount of the sulphur compounds with fruitlike quality.

In the test cross of the traditional melons (Togo x Sweet Ananas) and in the measuring of the scent of the 'variety' produced I found that traditional melon varieties can be used for the production of melon varieties meeting the present day yield and shelf life requirements (relative to the latter I had no authentic measurement data, but only visual observation) but having an individual scent.

Based on the summary of the morphological characterization and of the measurement results of the phenological and compositional characteristics I made the following conclusions:

It is the fruit morphological characteristics that have the most important role in making a distinction between individual gene bank accessions this way their testing and observation are sufficient for the basic handling of gene banks (maintenance and avoiding of repetitions). Some of the traditional melon and watermelon varieties of the country have special merits that can be useful also for contemporary modern plant breeding as well.

Based on the morphological and molecular (SSR analysis) tests results a close similarity can be detected between certain Hungarian and Turksh (Musktály type and winter types) melon varieties and watermelon ones (with dark green skin and red flesh). As a result of the natural hybridizations due to the character of popular production, based on the genetic distances the Turkish origin of the national traditional melon and watermelon varieties cannot be stated with full certainty. In order to give a definite answer to the question I recommend further thorough morphological and molecular investigations of the abovementioned melon and watermelon types of the two countries. For this purpose, in the first place I think it important to extend the investigations to other Turkish landraces.

Publications in the topic of the thesis

Reviewed periodical articles
Other rateable article
Conference publications (in Hungarian, full text)
Conference publications (in Hungarian, abstracts)
International conferences (in English, full text)
International conferences (in English, abstracts)