

AgroSym

BOOK OF PROCEEDINGS



IX International Scientific Agriculture Symposium
"Agrosym 2018"
Jahorina, October 04-07, 2018

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Impressum

IX International Scientific Agriculture Symposium „AGROSYM 2018“

Book of Proceedings Published by

University of East Sarajevo, Faculty of Agriculture, Republic of Srpska, Bosnia
University of Belgrade, Faculty of Agriculture, Serbia
Mediterranean Agronomic Institute of Bari (CIHEAM - IAMB) Italy
International Society of Environment and Rural Development, Japan
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<http://agrosym.ues.rs.ba>

CIP - Каталогизacija у публикацији
Народна и универзитетска библиотека
Републике Српске, Бања Лука

631(082)

INTERNATIONAL Scientific Agricultural Symposium "Agrosym
2018" (9 ; Jahorina)

Book of Proceedings [Elektronski izvor] / IX International
Scientific Agriculture Symposium "Agrosym 2018", Jahorina,
October 04 - 07, 2018 ; [editor in chief Dušan Kovačević]. - East
Sarajevo =Istočno Sarajevo : Faculty of Agriculture =Poljoprivredni
fakultet, 2018

Način pristupa (URL):

<http://agrosym.ues.rs.ba/index.php/en/archive>. - Bibliografija uz
radove. - Registar.

ISBN 978-99976-718-8-2

COBISS.RS-ID 7815448

IX International Scientific Agricultural Symposium “Agrosym 2018”
Jahorina, October 04-07, 2018, Bosnia and Herzegovina

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PREFACE

A Word from the Editor-in-Chief

Dear colleagues,

In your hands are the Proceedings of the 9th International Scientific Agricultural Symposium “AGROSYM 2018” held on 4-7 October 2018 in Jahorina, Bosnia and Herzegovina. The Symposium gathers about 1200 participants from 85 different countries and organizers received over 1200 abstracts/full papers. Symposium themes covered all branches of agriculture and were divided into seven sessions: 1) Plant production, 2) Plant protection and food safety, 3) Organic agriculture, 4) Environmental protection and natural resources management, 5) Animal husbandry 6) Forestry and Agro-forestry, and 7) Rural Development and Agro-economy.

In the plenary lectures was presented the importance of new information and communication technologies for agriculture in the 21st century and biological protection in plant production. Furthermore, a particular attention was devoted to avoiding knowledge waste through networking and partnership.

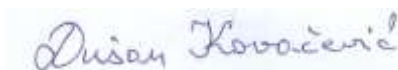
Agriculture has a complex relationship with natural resources and the environment, thus attributing specific environmental effects to agriculture is difficult and not fully understood. Today, it is obvious that conventional methods of agricultural production, in addition to providing sufficient food and other products, have led to a number of negative impacts, including direct or indirect effects on human health. Excessive use of agrochemicals can cause various disorders in the biological equilibrium of agroecosystems and beyond. These negative impacts raise serious questions about long-term sustainability of high-input agriculture. Measures to protect soil and water in agriculture include comprehensive and complex undertakings and pre-planned measures. These problems are a constant reason for ‘popularisation’ of all ecological trends in agriculture (e.g. organic agriculture, permaculture, biodynamic agriculture, conservation agriculture, regenerative agriculture, integrated farming, agroecology, etc.). Meanwhile, there are also calls for a genuine, deep transformation of agro-food systems that goes beyond ‘ecologisation’ of agricultural production. All these developments in agricultural research field, as well their implications on farmers’ fields, were discussed during the 4 days of AGROSYM 2018.

All papers included in the Proceedings were peer-reviewed. Full texts of the accepted contributions are available in electronic form on AGROSYM website (<http://agrosym.unssa.rs.ba>).

I hope that the Proceedings will be useful to many agriculturalists and to those engaged in related fields and enable better collaboration of scientists, researchers and producers.

Many thanks to all the authors, reviewers, session moderators and colleagues for their help in editing the Proceedings “AGROSYM 2018”. Special thanks go to all co-organizers for their unselfish collaboration and comprehensive support.

East Sarajevo, 07th October 2018



Prof. Dušan Kovačević, Editor-in-Chief

QUALITY OF THE POMEGRANATES VARIETIES "HICAZ" AND "KARAMUSTAFA" FROM THE REGION OF MACEDONIA

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Abstract

Pomegranates are valuable fruits due to the high level of anthocyanins in juice and phenolic compounds responsible for antimicrobial activity of pomegranate peel. Significant amounts of phenolic acids, vitamin C and other polyphenolics are responsible for health benefits of the consumers. The objects of our study was the impact of variety on the quality of pomegranates grown in the region of Macedonia. More precisely, morphological parameters for fruits and chemical characteristics of pomegranate juice were significantly affected to the variety of pomegranates. Morphological parameters, in particular fruit weight, fruit height, equatorial and calix diameter favored "Hicaz" variety in comparison to autochthonous "Karamustafa" variety of pomegranates. Furthermore, the pH value of fruit juice, the level of phenolic acid and percentage of glucose and fructose indicate significant differences between varieties. The quantity of anthocyanins (537 mg/L), catechins (50 mg/L) and total phenolic compounds (3367 mg/L) indicated higher quality of pomegranate juice from "Hicaz" pomegranate variety. The effect of pasteurization did not influenced significantly to the quality of pomegranate juices from both varieties.

Key words: *pomegranate juices, morphological parameters, total phenolic compounds, anthocyanins, catechins*

Introduction

Pomegranates are valuable fruits due to the level of anthocyanins in juice and phenolic compounds responsible for antimicrobial activity of pomegranate peel (Dimovska *et al.*, 2018). Significant amounts of phenolic acids, vitamin C and other polyphenolics are responsible for health benefits of the consumers (Dimovska *et al.*, 2017).

Pomegranates are native from Persia and it is believed that the origin is in Central Asia. The morphological changes might have occurring during domestication and the most indicative changes are usually notice on flower, rind and aril colour, fruit size, percentage of sugar and organic acids as well as quality of the seeds (Teixeria da Silva *et al.*, 2013)

The objects of our study were the impact of variety on the quality of pomegranates grown in the region of Macedonia. More precisely, this study examined the effect of variety on morphological parameters for fruits and chemical characteristics (Brix, pH, organic acid, total phenolic compounds, catechins and anthocyanins) of pomegranate juice from the autochthons varieties "Karamustafa" and "Hicaz".

Materials and Methods

Sample preparation

The sampled fruits were selected randomly in order to separate three replicates for analysis, using 20 kg per repetition and cultivar. Pomegranates were weighed, cut in halves, and arils were hand separated from the pith avoiding contamination by components in membranous walls (septum). Juices of each cultivar were obtained by pressure of arils and weighed to determine the juice yield. Samples of freshly prepared juice from both varieties ("Hicaz" and "Karamustafa") were stored frozen one year ($-20\text{ }^{\circ}\text{C}$) until have been analyzed.

Physical properties

Size of the randomly selected 100 dried arils was determined from the axial dimensions of arils. Length was measured using a digital caliper at the accuracy of 0.01 mm. Weight of the hundred dried arils was determined by randomly selecting five samples and weighing in an electronic balance of 0.001 g sensitivity.

Chemical analyses

For determination of titratable acidity (TA), 2 ml of fresh juice was diluted with 70 mL of distilled water and titrating with 0.1 M NaOH to an end point of pH 8.2 using a Metrohm 862 compact titrosampler (Herisua, Switzerland). The results were expressed as percentage of citric acid (% CA). Total soluble solids (TSS, °Brix) was measured using a digital refractometer (Atago, Tokyo, Japan) calibrated with distilled water. The pH values were determined at room temperature using a calibrated pH meter (Crison, Model 00924, Barcelona, Spain). All measurements were made by three repetitions

The total phenolic content of pomegranate juices was determined with Folin–Ciocalteu reagent. For each sample, 50 µL of diluted (1:5) oil extract were added to 750 µL water and 50 µL of Folin–Ciocalteu reagent. The solution with total volume of 850 µL was incubated in the dark for 5 min. Then, 150 µL of 20% sodium carbonate solution was added and samples were incubated in the dark for 1 h. Reference solution was prepared with distilled water instead pomegranate juice and treated with the Folin–Ciocalteu reagent in the same way as the assayed samples. The samples turned to a blue colour with different degrees, depending on the content of phenolic compounds in the samples. The absorbance at 765 nm was recorded against the absorbance of the reference solution. The color intensity was measured spectrophotometrically by UV/VIS spectrophotometer (Shimadzu 1800, Shimadzu corporation, Kyoto, Japan). Determination of monomeric anthocyanins was performed by the colorimetric method of Singleton and Rossi (1965). The measurements were performed by three repetitions

Results and discussion

The chemical parameters of the samples of pomegranate juices from two varieties are presented in Table 1. As we can see, there is no significant difference between results obtained for Brix and pH for both pomegranate varieties. Furthermore, there is no statistical difference between pasteurized and fresh pomegranate juices. On the other hand, there is significant difference between the level of organic acids, monomeric anthocyanins, total phenolic compounds (TPC) and total catechins which were higher for “Hicaz” variety in comparison to “Karamustafa” variety.

Data from physical and morphological characterization of pomegranates from “Hicaz” and “Karamustafa” varieties from 2016 and 2017 vintage years are presented in Tables 2 and 3. The pomegranates from “Hicaz” variety had higher average fruit weight. Percentages of grain and peel were higher for “Karamustafa” variety as well as weight of 100 berries and percentage of skin. The percentage of carpels was more than double for “Hicaz” variety as well as equatorial and calyx diameter and fruit height with and without calyx (Table 3). Pomegranates from “Karamusfata” variety had reddish yellow colour of the fruit and pink colour of the fruit juice. On the other hand, pomegranates from “Hicaz” variety had reddish colour of the fruit and dark pink colour of the fruit juice (Table 1 and Fig.1.). The average fruit weight of pomegranates from “Hicaz” variety was the same as “Chioukhi” variety of pomegranates from Morocco. On the other hand, calix diameter for “Hicaz” variety of pomegranates was similar to Moroccanish “Ounk Hmam” variety and calyx for “Karamusfata” variety was more similar to some Spanish varieties of pomegranates [5].

Table 1. Chemical parameters of pasteurized and fresh pomegranate juice

| Pomegranate juice | Brix | pH | Organic acids | Total phenolic compounds (TPC) | Total catechins | Total antocyanins |
|---------------------|------|------|---------------|--------------------------------|-----------------|-------------------|
| | | | g/l | mg/l GAE | mg/l TCE | mg/l |
| Karamustafa (fresh) | 17 | 3.05 | 5.4 | 2038 | 22.91 | 117.31 |
| Hicaz (fresh) | 16 | 3.04 | 29.6 | 3367 | 50.1 | 537.13 |



a

b

Fig.1. Pomegranate seeds from "Hicaz" (a) and "Karamustafa" variety (b)

Table 2. The technological characteristics of pomegranate fruits

| Variety | Yeas | Repetition | Average fruit weight (g) | Percentage of grain (%) | Percentage of peel (%) | Weight of 100 seeds g | Weight of 100 berries g | Percentage of skin % | Percentage of carpels % | Percentage of juice (%) | Color of fruit | Color of juice |
|-------------|------|------------|--------------------------|-------------------------|------------------------|-----------------------|-------------------------|----------------------|-------------------------|-------------------------|----------------|----------------|
| Hicaz | 2016 | I | 525.00 | 50.24 | 25.95 | 4 | 30.37 | 0.49 | 15.59 | 45.21 | Reddish | Dark pink |
| | | II | 368.75 | 50.85 | 31.36 | 3 | 32.50 | 0.78 | 14.91 | 46.08 | | |
| | | III | 283.75 | 50.92 | 31.72 | 3 | 28.12 | 0.70 | 15.77 | 45.49 | | |
| | 2017 | I | 398.90 | 50.74 | 25.41 | 4.5 | 28.61 | 1.61 | 12.05 | 45.26 | Reddish | Dark pink |
| | | II | 340.44 | 47.42 | 24.30 | 4.0 | 29.32 | 1.74 | 14.84 | 45.58 | | |
| | | III | 240.77 | 50.35 | 23.35 | 3.5 | 23.41 | 1.74 | 13.04 | 47.21 | | |
| Karamustafa | 2016 | I | 285.43 | 53.85 | 42.14 | 3 | 27.86 | 1.50 | 8.10 | 48.26 | Reddish yellow | Pink |
| | | II | 235.00 | 51.06 | 35.56 | 2.5 | 27.86 | 2.13 | 6.08 | 46.48 | | |
| | | III | 198.28 | 53.31 | 37.10 | 2.5 | 29.28 | 2.37 | 7.20 | 48.76 | | |
| | 2017 | I | 370.12 | 64.19 | 22.55 | 2.5 | 33.12 | 0.55 | 5.70 | 50.70 | Reddish yellow | Pink |
| | | II | 246.06 | 61.58 | 21.19 | 2.5 | 35.39 | 0.90 | 5.19 | 51.00 | | |
| | | III | 225.76 | 55.86 | 19.56 | 2.8 | 37.63 | 1.00 | 5.24 | 49.25 | | |

Table 3. The morphological characteristics of the fruits

| Variety | Year | Repetition | Fruit weight (g) | D1 (mm) | D2 (mm) | L1 (mm) | L2 (mm) | L3 (mm) |
|-------------|------|------------|------------------|---------|---------|-------------|-------------|-------------|
| Hicaz | 2016 | I | 525.00 | 101.0 | 26.8 | 90.3 | 101.6 | 27.1 |
| | | II | 368.75 | 90.0 | 23.3 | 80.6 | 87.6 | 26.1 |
| | | III | 283.75 | 84.7 | 18.2 | 75.0 | 85.2 | 25.3 |
| | 2017 | I | 398.90 | 93.6 | 21.8 | 82.2 | 98.6 | 33.0 |
| | | II | 340.44 | 87.1 | 24.5 | 78.0 | 93.6 | 26.0 |
| | | III | 240.77 | 77.4 | 23.0 | 67.1 | 79.0 | 24.0 |
| Karamustafa | 2016 | I | 285.43 | 84.8 | 17.7 | 73.3 | 87.3 | 29.3 |
| | | II | 235.00 | 80.0 | 18.9 | 70.8 | 82.9 | 28.1 |
| | | III | 198.28 | 75.5 | 16.5 | 66.1 | 80.2 | 27.0 |
| | 2017 | I | 370.12 | 91.3 | 14.2 | 82.1 | 94.6 | 25.7 |
| | | II | 246.06 | 79.1 | 11.9 | 96.6 | 79.5 | 25.0 |
| | | III | 225.76 | 79.0 | 11.0 | 67.3 | 74.6 | 25.1 |

D1-equatorial diameter, D2 – calyx diameter, L1 – fruit height without calyx , L2 – total fruit height, L3 – calyx height,

Conclusion

The purpose of the present study was to evaluate the morphological, physical and chemical parameters, in particular organic acids, total phenolic content (TIC), catechins and anthocyanins in two varieties of pomegranates juices from the region of Macedonia. The lower level of phenolic compounds and acids as well as catechins and anthocyanins had pomegranate juice from the autochthonous variety "Karamustafa" and the higher level had the pomegranate juice obtained from "Hicaz" variety. Based on the explanation above, we can summarize that pomegranate juice from "Hicaz" variety is enough rich source with polyphenolic compounds. Finally, we recommend the juice from this pomegranate variety for further investigation in order to identify and quantify the level of polymer compound and other valuable bioactive compounds with significant impact on human health.

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