Scope and policy of the journal
Agricultural Science and Technology /AST/ – an International Scientific Journal of Agricultural and Technology Sciences is published in English in one volume of 4 issues per year, as a printed journal and in electronic form. The policy of the journal is to publish original papers, reviews and short communications covering the aspects of agriculture related with life sciences and modern technologies. It will offer opportunities to address the global needs relating to food and environment, health, exploit the technology to provide innovative products and sustainable development. Papers will be considered in aspects of both fundamental and applied science in the areas of Genetics and Breeding, Nutrition and Physiology, Production Systems, Agriculture and Environment and Product Quality and Safety. Other categories closely related to the above topics could be considered by the editors. The detailed information of the journal is available at the website. Proceedings of scientific meetings and conference reports will be considered for special issues.

Submission of Manuscripts
All manuscript written in English should be submitted as MS-Word file attachments via e-mail to ascitech@uni-sz.bg. Manuscripts must be prepared strictly in accordance with the detailed instructions for authors at the website http://www.uni-sz.bg/ascitech/index.html and the instructions on the last page of the journal. For each manuscript the signatures of all authors are needed confirming their consent to publish it and to nominate an author for correspondence. They have to be presented by a submission letter signed by all authors. The form of the submission letter is available upon from request from the Technical Assistance or could be downloaded from the website of the journal. All manuscripts are subject to editorial review and the editors reserve the right to improve style and return the paper for rewriting to the authors, if necessary. The editorial board reserves rights to reject manuscripts based on priorities and space availability in the journal.

Subscriptions
Agricultural Science and Technology is published four times a year. The subscription price for institutions is 80 € and for personal subscription 30 € which include electronic access and delivery. Subscription run for full calendar year. Orders, which must be accompanied by payment may be sent direct to the publisher:

Trakia University
Faculty of Agriculture, Bank account: UniCredit Bulbank,
Sofia BIC: UNCRBGSF
IBAN: BG29UNCR76303100117681
With UniCredit Bulbank Stara Zagora

Internet Access
This journal is included in the Trakia University Journals online Service which can be found at www.uni-sz.bg.

Copyright
All rights reserved. No part of this publications may be translated into other languages, reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying or any information storage and retrieval system without permission in writing from the publisher.

Address of Editorial office:
Agricultural Science and Technology
Faculty of Agriculture, Trakia University
Student's campus, 6000 Stara Zagora
Bulgaria
Telephone.: +359 42 699330 +359 42 699446
http://www.uni-sz.bg/ascitech/index.html

Technical Assistance:
Nely Tzvetanova
Telephone.: +359 42 699446
E-mail: ascitech@uni-sz.bg
Агромедия
ПРОДУЦЕНТСКА КЪЩА
ПРИЕЗКАТЕЛ НА СЕРТИФИКАТ ЗА КАЧЕСТВО ISO 9001 - 2008

МЕДИЙНИ ПРОДУКТИ

• АГРОФОРУМ - седмично ТВ предаване за модерно селскостопанство.
  Обхват - 12 ТВ канала
  Периодичност - седмично
  Аудитория - 1,6 - 2,2 млн. зрители
  Всяка седмица предаването започва своите зрители с новостите в агробизнеса, и дана съвети как се прилагат най-новите земеделски практики.
  ▶ www.agroforum.bg

• АГРОКОМПАС – най-големото по обем и тираж списание за селскостопанска информация в България.
  Обем - 80 страници
  Тираж - 14 000 броя
  Периодичност - месечно
  Във всеки брой полезна и актуална информация за възможностите за финансиране по европейски и национални донорски програми.
  ▶ www.agrocompass.bg

• АГРОМАРКЕТ – Един ТВ продукт предлаган на земеделските стопани информация за начините на механизирано производство в растениевъдството и животновъдството.
  Предаването се извършва 2 пъти дневно от понеделни до събота по ТВ ЕВРОПА
  ▶ www.agromarket-tv.bg

• AGRO.BG – селскостопанският интернет портал на България. Актуални статии, интервюта, новини, прояви, листове и обяви.
  Каталог с над 4000 фирми, актуална борсови информация и агрокалендар. Агрокнижарница с над 1 000 заглавия от областта на селското стопанство.
  Всяки ден над 2500 интернет потребители търсят информация при нас.
  ▶ www.agro.bg

1330 София, блк. Възкресение 1, тел. 02/ 920 20 63, 920 06 86, факс 02/ 822 13 17, E-mail: agroforum@agro.bg; office@agrocompass.bg; office@agro.bg; www.agromedia.bg
Production Systems

Quantitative changes in major components of lavender oil during the distillation process

G. Zhekova*, N. Nedkov

Institute of roses and aromatic plants, 49 Osvobozhdenie, 6100 Kazanlak, Bulgaria

Abstract. In 2009 in IREMK lavender variety Seuthopolis was distilled under laboratory conditions and the variation of the basic oil components was traced during distillation. Gas chromatography analysis was performed of the individual oils and organoleptic assessment was made with the aim to use the oil in cosmetics and perfumery. It was established that linalylacetate increased for 15 minutes, then began to decline, hydrocarbons and 3-okatanon distilled in great quantity in the first 5 min and gradually reduced within one hour, terpineol-4 evenly distilled during the process as differences in the content of various fractions are not more than 10%. In relation to flavour the most suitable oils are separated within 30 min of the process.

Keywords: variety Seuthopolis, lavender oil, distillation, quality.

Introduction

Essential oil production is typical for the Bulgarian agriculture sector which is constantly expanding. Recently lavender and production of lavender oil has aroused particular interest. Lavender oil is widely used in perfumery and cosmetics (Battaglia, 2005; Bown, 2002). In perfumery it is mainly used for top notes that create first impression to consumers. (Fortineau, 2004). Lavender oil is known in aromatherapy with its ability to improve mood and reduce anxiety and trouble (Lehrner et al., 2005). It is obtained by steam distillation of lavender blossom (in our country L. Vera, while in other countries L. spica, L. delphinensis, L. fragrans, etc.). The oil is transparent to pale yellow liquid with characteristic odor like about 9-10 a.m. The samples were taken every few days throughout flowering period starting before flowering. The extent of flowering is determined as BDS 3666-75 using lavender clusters of 20%, 60% and 80% degree of flowering. The quality indices of the oils are determined by organoleptic, physico-chemical and gas chromatography analysis by BDS / ISO 3515:2002.

Survey of the dynamics of lavender oil components during the distillation process has been carried out with lavender variety Seuthopolis. The variety was recognized by SVC in 1987. With regard to the development and flowering, Seuthopolis refers to the group of middle flowering varieties (Boiadzhieva et al., 1988). According to its creators, it is characterized by a rich content of essential oil, 2.5%, and high yield of essential oil - 133 kg/ha. The oil from that variety has very good quality: ester content - linalylacetate 56.92-58.97%, low terpinene-4-ol content 3.36% and good flavour (Raev et al., 1987).

Opinions about changing of the main components of lavender oil during the distillation process differ. About linalylacetate some authors noted that it was increased at the end of the process, while others point out initial increase for up to 15 minutes. For some varieties it is indicated that during the process of distillation the amount of hydrocarbon linalylacetate, linalol and β-otcimene reduces. It is noted that the undesirable components for the smell of lavender oil such as borneol and terpeneol-4 increase (Balinova et al., 1988; Stoianova et al., 2009).

In this study the main attention was focused to the variety Seuthopolis which occupies a large area of lavender plantations in Bulgaria but up to now comprehensive investigation of qualitative and quantitative changes of composition of the oil during the distillation process has not been performed.

Material and methods

The studies were conducted in an Accredited test laboratory in IREMK. For the purpose lavender clusters of the variety Seuthopolis were harvested from the land of IREMK - Kazanlak in the morning at about 9-10 a.m. The samples were taken every few days throughout the flowering period starting before flowering. The extent of flowering is determined as BDS 3666-75 using lavender clusters of 20%, 60% and 80% degree of flowering. The quality indices of the oils are determined by organoleptic, physico-chemical and gas chromatography analysis by BDS / ISO 3515:2002.

Essential oil is obtained by steam distilled in a copper tank within one hour at an average speed of distillation 10% and temperature of distillate 25-30 °C. To separate fractions of distillation it is interrupted at 5 min, 15 min, 30 min. and 1 hour. With this method lavender oils are obtained, 0-5 min 5-15 min, 30 min and 15 30 - 60 min.

The experiment was performed in three repetitions and statistically processed by statistical analysis program Biostat.

Results

The information about the yields of essential oils depending on the continuation of distillation at various stages of flowering is given in Table 1. The best extraction of essential oil from the variety Seuthopolis was observed in 60% degree of maturity, as is retained higher than 80%. Although the data are from interrupted distillation, they also confirm the investigation of the quantity of essential oil and
the degree of flowering. Under interruption of distillation it is found that the greatest amount oil is distilled during the first 5 minutes - about 40%, and gradually decreases until the end of the process. Between 5 and 15 minutes 30% go out, in 15-30 min distilling interval - about 18% and to the end rest 12% of oil. Viewed in another way, it appears that in the first 15 minutes 70 percent of the oil is distilled, but up to half an hour - about 88%. Therefore, at the beginning the process has to conducted with extreme care in order to avoid any loss of exhaled steam of the still.

The changes in the quantities of individual components during the distillation process are followed by gas chromatography analysis of individual oils and are listed in Table 2. Hydrocarbons and 3-ocatane distilled in large quantity in the first 5 min and gradually decreased within 1 hour. 1.8 cineole released within the first 5 min. and then up to 15 min. reduced to half its amount and remained such until the end of distillation. Linalylacetate distilled increasingly up to 15 minutes, and started to decrease up to 30 minutes by 6% and up to 1 hour by 12% more. Linalool and camphor also distilled unpleasant, the amount of linalylacetate is the least and the ratio 1.8 cineole released within the first 5 min. Within 15-30 min. the scent is fresh, it looks like lavender with a slight touch of wood, as the quantity of linalylacetate reduced and its ratio decreased within 1 hour. 1.8 cineole distilled with a constant quantity up to 30 min and then decreased to the end by about 10%. Lavandulyacetate, α-terpineol and β-carop at the beginning of distillation are in small quantities, which increase to the end of the process. Terpineol-4 distilled evenly throughout the process as the differences in its content in the separate fractions are not more than 10%.

Changes of the amount of observed main compounds during distillation (Figure 1) were connected with the variations in the scent of the obtained essential oil. The 5 min oil is characterized with the highest content of hydrocarbons, 1.8 cineol and camphor and has a rich, fresh and flowery smell. From 5 to 15 min., although linalylacetate has increased, there is sour, unpleasant partial flavor. Within 15-30 min. the scent is fresh, it looks like lavender with a slight touch of wood, as the quantity of linalylacetate reduced and its ratio to linalool is 1.8. Within 30 min. - 1 hour the scent lost the typical odor of lavender, rather it likes as if the moss and bark and it is defined as unpleasant, the amount of linalylacetate is the least and the ratio than linalool is above 2.

Table 1. Yield of essential oil in %.

| Degree of flowering | Yield of essential oil in % | 5 μl | 15 min | 30 min | 60 min | 5 μl | 15 min | 30 min | 60 min | Total
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20 %</td>
<td></td>
<td>1.08</td>
<td>0.66</td>
<td>0.26</td>
<td>0.175</td>
<td>2.175</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 %</td>
<td></td>
<td>0.97</td>
<td>0.95</td>
<td>0.5</td>
<td>0.29</td>
<td>2.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 %</td>
<td></td>
<td>1.06</td>
<td>0.805</td>
<td>0.43</td>
<td>0.26</td>
<td>2.555</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Quantity composition of lavender oil in 5 min, 15 min, 30 min and 60 min.

<table>
<thead>
<tr>
<th>20% degree of blossaming</th>
<th>60% degree of blossaming</th>
<th>80% degree of blossaming</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 μl</td>
<td>15 min</td>
<td>30 min</td>
</tr>
<tr>
<td>α-pinene</td>
<td>0.374</td>
<td>0.270</td>
</tr>
<tr>
<td>camphene</td>
<td>0.421</td>
<td>0.313</td>
</tr>
<tr>
<td>3 octanone</td>
<td>2.635</td>
<td>1.950</td>
</tr>
<tr>
<td>miron</td>
<td>1.356</td>
<td>1.191</td>
</tr>
<tr>
<td>1.8 cineole</td>
<td>4.903</td>
<td>4.214</td>
</tr>
<tr>
<td>cis β ocimene</td>
<td>3.633</td>
<td>2.535</td>
</tr>
<tr>
<td>trans β ocimene</td>
<td>3.330</td>
<td>2.270</td>
</tr>
<tr>
<td>camphor</td>
<td>0.136</td>
<td>0.380</td>
</tr>
<tr>
<td>lavandulol</td>
<td>0.433</td>
<td>0.451</td>
</tr>
<tr>
<td>terpineol - 4</td>
<td>0.759</td>
<td>0.623</td>
</tr>
<tr>
<td>α terpineol</td>
<td>0.621</td>
<td>0.753</td>
</tr>
</tbody>
</table>
Conclusion

During the distillation process the greatest amount of oil is released within the first 15 minutes. The quantity of linalylacetate increased up to 30 min. The oils separated up to 5 min. and between 15 and 30 min. have the best smelled performance and might be find private used.

References

Balinova A, Georgiev E and S Kurtev, 1988, Changes in the composition of essential oil in lavender distillation, Scientific Session "35 years of HIFTI – Plovdiv", (Bg).


Brief Chemical Encyclopedia, 1971. 1, Technics, Sofia, 538, (Bg).


Figure 1. The quantity changed at same components of lavender oil at the time of distillation.
The Editorial board of Agricultural Science and Technology would like to apologize to the author of the paper Mr. N. Tsenov and all scientists interested in our journal for the technical error, made by the publishing house.
Preparation of papers
Papers shall be submitted at the editorial office typed on standard typing pages (A4, 30 lines per page, 62 characters per line). The editors recommend up to 15 pages for full research paper (including abstract references, tables, figures and other appendices).

The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures. The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors
The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study. The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal? Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. Tables should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn’t be numbered and no new paragraphs be used. Contributions are the core of conclusions.

References: In the text, references should be cited as follows: single author: Sandberg (2002); two authors: Andersson and Georges (2004); more than two authors: Andersson et al.(2003). When several references are cited simultaneously, they should be ranked by chronological order e.g.: (Sandberg, 2002; Andersson et al., 2003; Andersson and Georges, 2004). References are arranged alphabetically by the name of the first author. If an author is cited more than once, first his individual publications are given ranked by year, then come publications with one co-author, two co-authors, etc. The names of authors, article and journal titles in the Cyrillic or alphabet different from Latin, should be transliterated into Latin and article titles should be translated into English. The original language of articles and books translated into English is indicated in parenthesis after the bibliographic reference (Bulgarian = Bg, Russian = Ru, Serbian = Sr, if in the Cyrillic, Mongolian = Mo, Greek = Gr, Georgian = Geor., Japanese = Ja, Chinese = Ch, Arabic = Ar; etc.).

The following order in the reference list is recommended:


The Editorial Board of the Journal is not responsible for incorrect quotes of reference sources and the relevant violations of copyrights.
CONTENTS

Genetics and Breeding
Synchronization of estrous in gilts with Altrenogest
S. Dimitrov, G. Bonev, Hr. Taseva

Phenotypic stability of new cotton varieties with improved fiber quality
A. Stoilova

Effect of age upon the reproductive performance of Japanese quails
A. Genchev

Nutrition and Physiology
Ethological evaluation of a building for free housing of dairy cows.
II. Behavioural activities in the winter
I. Varlyakov, T. Slavov, N. Grigorova

Effect of the addition of VemoZim F (phytase) to diets with decreased content of phosphorus on the microstructure of tibia in broiler chickens
V. Georgieva, D. Yovchev, A. Atanasov

Production Systems
Quantitative changes in major components of lavender oil during the distillation process
G. Zhekova, N. Nedkov

Influence of some stimulators on the grain yield and sowing-seed properties of two durum wheat cultivars
G. Delchev, D. Nenkova, D. Stoychev

Agriculture and Environment
Anthropogenically disturbed soils and methods for thier reclamation
M. Banov, V. Tsolova, P. Ivanov, M. Hristova

Using microwave mineralization in order to determine heavy metal concentration in samples of herbs used for pharmaceutical purposes
L. Dospatliev

Tolerance of lucerne varieties to Apion seniculus Kirby (Coleoptera: Curculionidae)
I. Nikolova, N. Georgieva

Quality and Safety
Probiotic characteristics of lactic acid bacteria isolated from feces of breast-fed infant
S. Boycheva

Heat-induced changes in organic compounds characteristics and properties of sandy soils
I. Atanassova, S. Doerr

Journal web site:
www.uni-sz.bg/ascitech/index.html

Publisher:
www.alfamarket.biz