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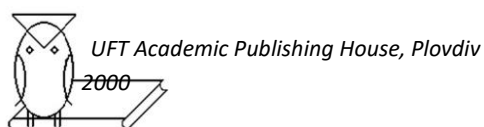
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**THEMATIC AREAS**

- Food Science and Technology
- Food Chemistry, Microbiology, Biotechnology and Safety
- Nutrition, Dietetics, Tourism and Economy of Food Industry
- Food Engineering
- Automation, Electronics and Electrotechnics of Food Industry
- Linguistics and Training

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# CONTENT

## I. Food Science and Technology

### **1. Application of chickpea and chestnut flour in the production of gluten-free cookies and muffins**

Ivayla S. Sopotenska, Valentina M. Chonova

### **2. Influence of the low-temperature storage mode on qualitative indicators of melon sorbet**

Bibipatyma E. Yerenova, Yuliya G. Pronina

### **3. Use of cold-pressed olive oil for improvement the quality of bacon-folk sausages**

Vladimir Kuzmanovski, Aco Kuzelov, Elena Joshevska

### **4. The influence of different starter cultures on cheese yield and mass loss during ripening period of white brined cheese**

Stefche Presilski, Marija Baltadzieva, Borche Makarijoski, Slavko Velevski, Aco Kuzelov

### **5. A technology for processing cigarette butts – a global pollutant with a potential of recycling**

Venelina Popova, Tanya Ivanova, Milena Nikolova, Dimitar Stoev, Tsvetko Prokopov, Lazar Lazarov, Velichka Yanakieva, Pavel Merdzhanov

### **6. Chemical changes in eggs in different storage conditions**

Katerina Petrovska, Elena Joshevska, Tatjana Kalevska, Vladimir Kitanovski, Dimche Kitanovski

### **7. Analysis of the chemical composition of the essential oil of dill (*Anethum graveolens* L.) by the method of infrared spectroscopy**

Milen Dimov, Krasimira Georgieva, Yordan Denev, Krasimira Dobрева, Albena Stoyanova

### **8. The impact of the race on the slaughter results of pigs**

Mitre Stojanovski, Trajan Dojcinovski, Metodija Ilievski, Kuitim Elmazi

### **9. Population perception of active and intelligent food packaging**

Zivko Jankuloski, Hristina Shapardanovska, Kristina Jankuloska-Gacoska

### **10. Technology of new aromatized wines**

Alexandr Bolotko, Natalia Shelegova, Elena Homchenko, Tatiana Urbanovich

### **11. Effect of water-air steeping on the physiological properties of wheat-oat grain mixtures**

Elena N. Ourbantchik, Maryna N. Galdova

### **12. Technological properties of linseeds of Belorussian selection**

Liudmila Rukshan, Tatyana Prohortsova

### **13. Genetic engineering for producing the controversial genetically modified food**

Darko Veljanovski, Vangelica Jovanovska, Gordana Dimitrovska, Mila Arapcheska

# CONTENT

## II. Food Chemistry Microbiology, Biotechnology and Safety

### **1. Development of probiotic oat beverages**

Teodora G. Yaneva-Marinova, Apostol T. Simmitchiev, Ventsislav B. Nenov,  
Svetoslav S. Alexandrov, Angel I. Angelov

### **2. Characterization of antioxidant and antimicrobial activity of (*Thymus vulgaris* L.)**

Albena B. Parhzanova, Snezhana D. Ivanova

### **3. The development of the safety management system on based principles of HACCP for the fermented beverages of special appointments**

Olga Krukovich, Sergey Masanskii

# CONTENT

## III. Nutrition, Dietetics, Tourism and Economy of Food Industry

### **1. Application of thyme (*Thymus vulgaris* L.) in culinary products**

Albena B. Parhzanova, Snezhana D. Ivanova

### **2. Grains – base of human nutrition**

Dorina Petkova, Aneta T. Popova, Dasha S. Mihaylova

### **3. Cash flow and corporate growth in industrial companies**

Asen Konarev, Snezhinka Konstantininova, Gergana Veselinova-Georgieva

### **4. Trends in the development of bread industry**

Magdalena Damyanova-Bakardzhieva, Valentina L. Nikolova-Alexieva

### **5. Social return of investment in food industry**

Snezhinka K. Stoyanova, Gergana Tz. Veselinova-Georgieva

### **6. Price premium dynamics of some chosen organic foods on the Bulgarian market**

Mariana V. Kovachev, Tatyana P. Pancheva

### **7. The emergence of a new product on the market and its impact on consumers**

Goran Mihajlovski, Trajan Dojcinovski, Katerina Bojkovska, Nikolce Jankulovski

### **8. Major trade trends and competitiveness of the European Union food industry**

Nikolce Jankulovski, Katerina Bojkovska, Goran Mihajlovski, Trajan Dojcinovski

### **9. The entrepreneurship in the agro-complex of Republic of Macedonia**

Trajan Dojcinovski, Katerina Bojkovska, Nikolce Jankulovski, Goran Mihajlovski

### **10. The substantiation of the fruit and vegetables additives addition in formulations of culinary sauces at the school food centralized production process**

Tatiana M. Rybakova, Sergey L. Masansky

### **11. The breaking the wall of perception of merchandising: the tools for selling food items**

Natal'ya Y. Azarenok, Kristina Koroleva, Anastasiya Uminskaya

### **12. Complex reengineering of business operations - a key factor for successful international business**

Bozhidar I. Hadzhiev, Ivelina A. Kulova, Iva T. Bachvarova

### **13. Digital Marketing – The Key to Successful Electronic Business**

Ivelina A. Kulova, Mihail I. Mihaylov



# CONTENT

## IV. Food Engineering

### **1. Cereal straw – sole power supply for the thermal energy necessary for a bread factory in North-eastern Romania**

Lucian Mihaescu, Emil Enache, Gheorghe Lazaroiu, Ionel Pisa, Viorel Berbece, Gabriel-Paul Negreanu

### **2. Ecology and energy valorizing of chicken manure**

Gheorghe Lazaroiu, Ionel Pisa, Viorel Berbece, Gabriel-Paul Negreanu

### **3. Impact of the holes type of the pneumatic conveyor for empty PET bottles on its capacity**

Ventsislav B. Nenov, Apostol T. Simitchiev, Ivan N. Shopov, Donka P. Stoeva, Atanas Stalev

### **4. Effect of working temperature on the flux during ultrafiltration of whey from Kashkaval**

Siyka D. Kodinova, Mariya A. Dushkova, Milena P. Miteva-Petrova, Stoyko P. Petrov, Nikolay D. Menkov, Kolyo T. Dinkov

### **5. Study of destruction action at brittle food materials in new crusher design**

Vitali Kharkevich

# CONTENT

## V. Automation, Electronics and Electrotechnics of Food Industry

### **1. Modelling and simulation of the process dynamics of acetic acid fermentation**

Georgi P. Terziyski, Svetla D. Lekova

### **2. Development of a multi-gas-sensing head for early detection of air contamination**

Kamen Boyadzhiev

### **3. Identification of smart sensors for humidity and temperature measurement**

Nikolay Doychinov, Bojidar Markov

# CONTENT

## VI. Linguistics and Training

### **1. Online language resources and technology tools provided by the Institute for Bulgarian Language (Bulgarian Academy of Sciences)**

Svetla P. Koeva

### **2. Multicultural classroom challenges of Bulgarian language teaching**

Emiliya Koycheva, Savina Manevska

### **3. Bulgarian language for foreigners (Textbook for medics)**

Andonia Kutsarova, Antoaneta Kraevska, Maya Andonova

### **4. On the implementation of the Bulgarian grammar in the Common European Framework of Reference for Languages**

Petya I. Nestorova, Nikolay Y. Zhelyazkov



## Use of cold-pressed olive oil for improvement the quality of Kranj sausages

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Running title: **Sausages improvement by cold –pressed olive oil**

### Abstract

This paper presents the results from examination on impact of cold-pressed olive oil on the chemical composition and oxidative changes (degree of acidity and peroxide value) of Kranj sausage. For this purpose, four groups of national sausage have been produced. The first group was produced without addition of olive oil (control group), the second one with addition of 3g/kg, and the third one with addition of 4g/kg and the fourth group with addition of 5g/kg olive oil. After production, the groups of sausages were vacuumed and stored in refrigerator at temperature from 0 to +4°C. The chemical composition of the groups of sausages was examined on the first and on the fortieth day of production, and the degree of acidity and peroxide value were examined on 1<sup>st</sup>, 10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup> and 40<sup>th</sup> day of production. The degree of acidity of the control group of sausages ranges from 3.13 to 5.21, while the degree of acidity of the other groups ranges from 2.03 to 3.84. The peroxide value of the control groups of sausages ranges from 0.39 to 1.31, and the acidity of other groups of sausages ranges from 0.38 to 1.33. The obtained low values of degree of acidity and peroxide value most likely result from small concentrations of cold-pressed olive oil and vacuuming of the sausages. Used concentrations of olive oil in the groups of sausages do not have statistically significant impact on the chemical composition of the sausages.

### Practical applications

The use of cold- pressed olive oil as an functional component that possesses antioxidant, antibacterial and functional properties, it can be successfully declared in the production of Kranj sausages, without changing the sensory properties of the products.

**Key words:** production, oxidative changes, chemical composition



## Introduction

The olive oil is obtained from fruits of olive tree (*Olea europaea sativa*), family Oleaceae. The olive has always been a symbol for glory, peace and abundance. The olive branches have been used for coronation after bloody wars and friendly games (Carrasco-Pancorbo et al. 2005; Conde et al. 2008, quoted by Ćorbo and Djordjevic 2010).

Raising olives and production of olive oil dates from Bronze Age (3150 to 1200 BC), (Vosen 2007), quoted by (Dimic et al. 2016). In that time it has been called liquid gold.

Nowadays, olive oil is spread in the nutrition of people worldwide, especially on the Mediterranean. Garcia-Gonzales et al. (2007) quoted by (Dimic et al. 2016) emphasize that the method of nutrition practiced by people who live on the Mediterranean is recommended for long and healthy life by the World Health Organization. The olive oil has positive and multiple impacts on people's health. The worldwide consumption of olive oil increases constantly, due to the positive characteristics of this oil, compared to other oils in people's nutrition (Ćorbo and Djordjevic 2009).

Olive oil contains alpha tocopherol, carotenoids, sterols, phenols, and chlorophyll, which are biologically active components, and it is also rich in mono non-saturated fatty acids (Ćorbo et al. 2013). The area of raising, method of processing and time of harvesting of the olives has significant impact on the presence of these bio-active components in the olive oil (Ćorbo et al. 2013). Thanks to the rich content of anti-oxidative components, the olive oil has anti-inflammatory effect and decreases the risk from cardiovascular diseases and breast cancer (Pappa et al. 2000; Garcia-Gonzales et al. 2007).

The objective of our examination is to examine the impact of cold-pressed olive oil on the chemical composition, the degree of acidity and the peroxide value of the Kranj sausage, produced in the meat industry in the R. Macedonia.

## Materials and Methods

### Materials

#### Raw materials

The Kranj sausage produced in the meat industry in the R. Macedonia served as a material for

examination. According to the Rulebook for demands regarding quality of minced meat, meat preparations and meat products (Official Gazette of Republic of Macedonia No. 63 from 29.04.2013), this sausage belongs to the group of semi permanent, coarse chopped boiled sausages. According to the Rulebook, the content of total meat proteins in the Kranj sausage should be 12% minimum. The production of the sausage was in compliance with all sanitary and veterinary regulations applicable in Macedonia.

#### Production technology

The recipe used for production of the sausage is as follows: 25.00 kg pork – second category, 15.00 kg pork – third category, 15.00 kg meat dough, 15.00 kg hard fatty tissue, 20.00 kg suspension from pork skin, 10 kg hard water, 15.00 kg emulsifier, 0.7 kg polyphosphate, 2.0 kg nitrite salt, 1.8 kg spice for Kranj sausage 0.400 kg.

The olive oil was added during preparation of the mix. The mix is stuffed in pork small intestines. Four groups of Kranj sausage were prepared for the experiment.

I group – without addition of olive oil (control group)

II group – with addition of 3g/kg olive oil

III group – with addition of 4g/kg olive oil

IV group – with addition of 5g/kg olive oil

After preparation and mixing, the mix is stuffed in natural pork intestines with diameter 32-34 mm. After stuffing and pressing, the sausage were thermally processed, according to the following formula: 35 minutes drying at 62°C, 20 minutes smoking at 62 °C, 35 minutes boiling at 78°C.

After thermal processing, the sausages were vacuumed with vacuum machine Vebomak. After vacuuming, the sausages were stored at refrigerator at temperature of +4 °C.

#### Determination of chemical composition

The chemical composition was examined on the 1<sup>st</sup> and 40<sup>th</sup> day of production. The examination was performed on the content of proteins, fats, water and mineral matters in the groups of sausages. The protein content was examined by using Kjeldahl method. The moisture content was determined by means of drying at 103± 2°C up to constant mass. The fats were determined according the international AOAC method, and the mineral matters were determined by means of burning and combustion (4-5 hours) at 525 - 550°C (ash in meat, 1997).



### ***Degree of acidity and peroxide value***

The degree of acidity and the peroxide value were examined on the 1<sup>st</sup>, 10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup> and 40<sup>th</sup> day of production. The degree of acidity was examined according to the method MKC EN 1410 (2007). The peroxide value was examined according to the method MKC ISO 27101 (2011).

### ***Statistical analysis***

Each parameter was determined after three repetitions, and the results are presented as mean value  $\pm$  Sd. The obtained results are mathematically and statistically processed in Microsoft Excel, 2003.

## **Results and Discussion**

### ***Determination of chemical composition***

The results from the impact of cold-pressed olive oil on the chemical composition on Kranj sausage are given in (Table 1). From the table it could be seen that the differences in the chemical composition of the examined groups of sausages on the 1<sup>st</sup> and the 40<sup>th</sup> day of production are small and statistically insignificant. The protein content in the examined groups of sausages on the 1<sup>st</sup> and the 40<sup>th</sup> day of production is bigger than 12 %, amount stated in the Rulebook for demands regarding quality of minced meat, meat preparations and meat products (Official Gazette of Republic of Macedonia No. 63 from 29.04.2013), which is most likely result of the quality of meat used in the production of Kranj sausage.

From the above mentioned, it could be concluded that the used concentrations of cold-pressed olive oil in the groups of sausages do not have impact on their chemical composition during storage at temperature of 4°C.

### ***Determination of acidity and peroxide value***

The degree of acidity and peroxide value in each examined group of sausages increase from the 1<sup>st</sup> to the 40<sup>th</sup> day of production. Biggest increase of degree of acidity and peroxide value has been noticed in the control group of sausages (3.13 – 5.21 for degree of acidity and 0.39 – 1.31 mmol/kg for peroxide value). Smallest increase of the values of acidity and peroxide value is noticed in group IV (3.14 – 3.60 for degree of acidity and 0.49 – 1.11 mmol/kg for peroxide value). The sensory changes in sausages are noticeable only when the peroxide value is bigger than 5 mmol/kg (Ostrić-Matijashević 1963).

From the obtained results (Table 2) it can be ascertained that oxidative changes in the examined groups of sausages are not emphasized. The obtained values of degree of acidity and peroxide value are low and most likely result from anti-oxidative activity of cold-pressed olive oil and vacuuming of the sausages. Severini et al. (2003) have examined the effect of usage of extra virgin oil, by replacing hard fatty tissue in production of salami with olive oil. For that purpose, four groups of salami have been prepared, and in the production, the hard fatty tissue has been replaced by extra-virgin oil. The first group has been produced without addition of extra-virgin oil, the second group with replacement of hard fatty tissue with 33.5% extra-virgin oil, the third group with replacement of hard fatty tissue with 50% extra-virgin oil and the fourth one with replacement of hard fatty tissue with 66.5% extra-virgin oil. They have determined that the replacement of hard fatty tissue with extra-virgin oil does not have significant impact on physical, chemical and sensory characteristics of the salami. Regarding the oxidation and loss of organoleptic quality, the addition of extra virgin olive oil, rich in monounsaturated fatty acids, did not reduce the shelf life. They say it is possible to produce this kind of product, with a good taste, similar to the traditional, but with healthier features.

Ansorena et al. (2004) have performed an examination of dry fermented sausages produced with partial replacement of hard fatty tissue with virgin oil. Also, they have examined the effect of the oxidation process by adding (VNT and BNA) in one of the modified series, whereby they have determined that addition of olive oil with anti-oxidants combined with vacuumed package gives better results regarding slowing down oxidative changes.

Muguerza et al. (2003) have replaced 20% hard fatty tissue with olive oil in the method of production of Greek sausage, whereby they have determined decrease of the oxidation process of fats in Greek sausages produced with replacement of 20% hard fatty tissue with olive oil.

The differences between our obtained results and the results from examinations of the abovementioned authors are most likely result of used bigger concentration of olive oil and replacement of hard fatty tissue with olive oil in the production of the aforementioned sausages.



## Conclusions

From the performed examinations and the obtained results it could be concluded that the used concentrations of cold-pressed oil in the groups of sausages do not have impact on their chemical composition. Used concentrations of cold-pressed oil do not have impact on the oxidative changes of the examined groups of sausages.

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**Table 1.** Chemical composition of Kranj sausage groups on the 1<sup>st</sup> and the 40<sup>th</sup> day of production (Mean  $\pm$  SD)

<b>1<sup>st</sup> day of production</b>				
<b>Parameters (%)</b>	<b>Group I</b>	<b>Group II</b>	<b>Group III</b>	<b>Group IV</b>
<b>Water</b>	58.38 $\pm$ 0.18	58.70 $\pm$ 0.12	58.94 $\pm$ 0.28	58.21 $\pm$ 0.10
<b>Fats</b>	20.00 $\pm$ 0.22	20.50 $\pm$ 0.15	20.00 $\pm$ 0.16	20.50 $\pm$ 0.24
<b>Proteins</b>	14.93 $\pm$ 0.28	14.98 $\pm$ 0.26	14.71 $\pm$ 0.14	14.77 $\pm$ 0.20
<b>Mineral matters (ash)</b>	3.14 $\pm$ 0.15	3.23 $\pm$ 0.17	3.22 $\pm$ 0.20	3.21 $\pm$ 0.18
<b>40<sup>th</sup> day of production</b>				
<b>Parameters (%)</b>	<b>Group I</b>	<b>Group II</b>	<b>Group III</b>	<b>Group IV</b>
<b>Water</b>	59.16 $\pm$ 0.10	59.21 $\pm$ 0.16	58.26 $\pm$ 0.18	58.43 $\pm$ 0.12
<b>Fats</b>	21.00 $\pm$ 0.22	20.00 $\pm$ 0.15	20.50 $\pm$ 0.17	21.00 $\pm$ 0.28
<b>Proteins</b>	14.56 $\pm$ 0.14	15.44 $\pm$ 0.10	15.31 $\pm$ 0.12	15.67 $\pm$ 0.15
<b>Mineral matters (ash)</b>	3.13 $\pm$ 0.20	3.22 $\pm$ 0.24	4.31 $\pm$ 0.18	4.65 $\pm$ 0.16

**Table 2.** Acidity and peroxide values of Kranj sausages groups during production (Mean  $\pm$  SD)

<b>Acidity value (AV)</b>				
<b>Day of production</b>	<b>Group I</b>	<b>Group II</b>	<b>Group III</b>	<b>Group IV</b>
<b>1<sup>th</sup></b>	3.30 $\pm$ 0.20	3.43 $\pm$ 0.50	3.65 $\pm$ 0.70	3.60 $\pm$ 0.40
<b>10<sup>th</sup></b>	3.51 $\pm$ 0.80	3.19 $\pm$ 0.40	2.98 $\pm$ 0.10	3.19 $\pm$ 0.20
<b>20<sup>th</sup></b>	5.21 $\pm$ 0.04	3.01 $\pm$ 0.20	2.03 $\pm$ 0.08	3.14 $\pm$ 0.70
<b>30<sup>th</sup></b>	3.13 $\pm$ 0.30	3.23 $\pm$ 0.50	3.89 $\pm$ 0.40	3.95 $\pm$ 0.20
<b>40<sup>th</sup></b>	4.45 $\pm$ 0.80	3.84 $\pm$ 0.60	3.65 $\pm$ 0.50	3.31 $\pm$ 0.40
<b>Peroxide value (PV)</b>				
<b>Day of production</b>	<b>Group I Mean<math>\pm</math>SD</b>	<b>Group II Mean<math>\pm</math>SD</b>	<b>Group III Mean<math>\pm</math>SD</b>	<b>Group IV Mean<math>\pm</math>SD</b>
<b>1<sup>th</sup></b>	1.26 $\pm$ 0.80	1.31 $\pm$ 0.30	1.33 $\pm$ 0.60	1.11 $\pm$ 0.20
<b>10<sup>th</sup></b>	1.31 $\pm$ 0.50	0.71 $\pm$ 0.40	1.15 $\pm$ 0.90	0.82 $\pm$ 0.70
<b>20<sup>th</sup></b>	0.62 $\pm$ 0.20	1.17 $\pm$ 0.80	0.93 $\pm$ 0.60	0.81 $\pm$ 0.50
<b>30<sup>th</sup></b>	0.39 $\pm$ 0.70	0.39 $\pm$ 0.50	0.38 $\pm$ 0.30	0.49 $\pm$ 0.02
<b>40<sup>th</sup></b>	0.71 $\pm$ 0.05	0.42 $\pm$ 0.30	0.52 $\pm$ 0.60	0.51 $\pm$ 0.80