

14th
INTERNATIONAL
SYMPOSIUM

MODERN
TRENDS
IN LIVESTOCK
PRODUCTION



4 - 6 October 2023, Belgrade, Serbia

Institute for Animal Husbandry

Belgrade - Zemun, SERBIA

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2023
PROCEEDINGS

The number '2023' is rendered in a large, light blue, sans-serif font. The '0' is a simple ring. The '2' and '3' have a slight curve. In the center of the '0', there are two balls of blue yarn. To the right of the yarn, there is a line drawing of a sheep and a cow, both facing right. The sheep is smaller and has a curly woolly texture, while the cow is larger and has a more solid body with a small horn.

4 - 6 October 2023, Belgrade, Serbia

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ORGANIZER

Institute for Animal Husbandry

Autoput 16, P. Box. 23,

11080, Belgrade-Zemun, Serbia

Tel: +381 11 2691 611; +381 11 2670 121; +381 11 2670 541;

Fax: + 381 11 2670 164;

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Address:

Institute for Animal Husbandry,
Autoput 16, P. Box 23,
11080, Belgrade-Zemun, Serbia

Tel:

+381 11 2691 611

+381 11 2670 121

+381 11 2670 541

Fax:

+381 11 2670 164

E-mail: biotechnology.izs@gmail.com

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CONTENT

Martin Wähner

THE SCIENTIFIC CONFERENCES OF THE ZEMUN INSTITUTE - A
REVIEW AND OUTLOOK (Germany)..... 1-7

Vesna Gantner, Maja Gregić, Čedomir Radović

SUSTAINABILITY OF A PLANT-BASED DIET(Croatia, Serbia).... 8-23

*Federica Sportelli, Benedetta Delfini, Costanza Delsante, Carla Giuditta
Vecchiato, Carlo Pinna, Giacomo Biagi*

THE INFLUENCE OF NUTRITION ON CANINE BEHAVIOR AND
THE ROLE OF THE GUT-BRAIN AXIS: A COMPREHENSIVE
REVIEW (Italy)..... 24-39

Giuseppe Bee, Steve Jacot, George Guex, Claudine Biolley

EFFECT OF THE FATTY ACID COMPOSITION OF THE
MATERNAL DIETS OF SWISS LARGE WHITE SOWS ON THE
FATTY ACID COMPOSITION OF THE BACKFAT OF THE
PROGENY (Switzerland)..... 40-60

Sam Millet, Sophie Goethals

BALANCING AMINO ACID LEVELS IN PIGLET DIETS (Belgium) 61-72

*Zaira Pardo, Ignacio Fernández-Fígares, Manuel Lachica, Isabel
Seiquer, Luis Lara, Consolación García-Contreras, Fernando Sánchez-
Esquiliche, Rosa Nieto*

HEAT STRESS EFFECTS ON IBERIAN PIG GROWTH AND
PRODUCTIVITY (Spain)..... 73-82

*Vladimir Živković, Wladyslaw Migdal, Lukasz Migdal, Marija Gogić,
Nenad Stojiljković, Aleksandra Petrović, Čedomir Radović*

ENHANCING PIGLET GROWTH WITH LIVE YEAST: A
NUTRITIONAL SUPPLEMENT STUDY (Serbia, Poland)..... 83-92

*Bojana Savić, Martin Škrlep, Klavdija Poklukar, Nina Batorek Lukač,
Marjeta Čandek-Potokar*

VARIATION IN CARCASS, MEAT AND FAT QUALITY OF
AUTOCHTHONOUS BREED IN CONVENTIONAL AND ORGANIC
PRODUCTION SYSTEM (Slovenia)..... 93-103

<i>Galia Zamaratskaia, Ayaz Mammadov, Javid Ojaghi, Simon Tobias Höxter, Oksana Kravchenko, Nataliia Hryshchenko, Mykhailo Matvieiev, Elina Åsbjer, Birgitta Staaf Larsson, Svitlana Usenko, Anders H. Karlsson, Hallvard Wie, Iveta Kocina, Liene Ansone, Vytautas Ribikauskas, David Richard Arney, Ragnar Leming, Francesca Carnovale, Andriy Getya</i> ATTITUDES OF CONSUMERS TOWARDS ANIMAL WELFARE IN UKRAINE AND AZERBAIJAN (Sweden, Ukraine, Azerbaijan, Latvia, Lithuania, Estonia).....	104-113
<i>Ljiljana Samolovac, Dragan Nikšić, Dušica Ostojić Andrić, Vladimir Živković, Dragan Stanojević, Vlada Pantelić, Nenad Mičić</i> ORGANIZATION OF CATTLE PRODUCTION IN CONDITIONS OF CLIMATE CHANGE (Serbia).....	114-128
<i>Nevena Maksimović, Dragana Ružić-Muslić, Violeta Caro Petrović, Bogdan Cekić, Ivan Ćosić, Nemanja Lečić, Nikola Stanišić</i> GOATS AND CLIMATE RESILIENCE (Serbia).....	129-143
<i>Fatmagül Tolun, Ergün Demir</i> CARBON CAPTURE TECHNOLOGIES FOR LIVESTOCK FARMS (Türkiye).....	144-156
<i>Slavča Hristov, Marko Cincović, Branislav Stanković, Radojica Đoković, Dušica Ostojić Andrić, Ljiljana Samolovac, Dimitar Nakov</i> DETERMINATION OF NEW WELFARE AND STRESS INDICATORS OF THE ANIMALS ON CATTLE AND PIG FARMS BASED ON DIFFERENT PUBLICATIONS (Serbia, North Macedonia)	157-167
<i>Branislav Stanković, Slavča Hristov, Marko Cincović, Radojica Đoković, Dušica Ostojić Andrić, Ivana Milošević-Stanković, Dimitar Nakov</i> DETERMINATION OF NEW BIOSECURITY INDICATORS ON CATTLE AND PIG FARMS BASED ON DIFFERENT PUBLICATIONS (Serbia, North Macedonia).....	168-181
<i>Simeon Rakonjac, Snežana Bogosavljević-Bošković, Zdenka Škrbić, Miloš Lukić, Vladimir Dosković, Veselin Petričević, Milun D. Petrović</i> ORGANIC POULTRY PRODUCTION: GENOTYPE CHOICE AND WELFARE (Serbia).....	182-192
<i>Marko Pajić, Slobodan Knežević, Jelena Maletić, Sava Spiridonović, Biljana Đurđević, Dalibor Todorović, Dušica Ostojić Andrić</i> ASSESSMENT OF THE CURRENT STATE OF BIOSECURITY MEASURES ON BROILER CHICKEN FARMS WITH DIFFERENT CAPACITIES IN VOJVODINA (Serbia).....	193-205

<i>Maria Muñoz, Ángel M. Martínez-Móntes, Almudena Fernández, Josep Maria Folch, Ana I. Fernández</i> EXPLORING PORCINE GROWTH AND FATNESS THROUGH LIVER TRANSCRIPTOME ANALYSES IN DIFFERENT IBERIAN GENETIC BACKGROUNDS (Spain).....	206-213
<i>Martin Škrlep Nina Batorek Lukač</i> ADVANTAGES AND DRAWBACKS OF REARING OF ENTIRE MALE AND IMMUNOCASTRATED PIGS (Slovenia).....	214-231
<i>Dubravko Škorput, Danijel Karolyi, Ana Kaić, Zoran Luković</i> OPTIMUM CONTRIBUTION SELECTION: PRACTICAL IMPLEMENTATION IN BLACK SLAVONIAN AND BANIIJA SPOTTED PIG (Croatia).....	232-240
<i>Fernando Sánchez-Esquiliche, Patricia Palma-Granados, Luisa Ramírez Hidalgo, Alberto Márquez, María Muñoz, Juan M. García Casco</i> IMPROVING THE REPRODUCTIVE CHARACTERISTICS OF THE PUREBRED IBERIAN PIG: A CHALLENGING ENDEAVOR (Spain)	241-250
<i>Aleksandar Stanojković, Nikola Stanišić, Nikola Delić, Ivan Bošnjak, Violeta Mandić, Aleksandra Stanojković-Sebić, Jakov Nišavić</i> STREPTOCOCCUS SUIS, TWO-FACED GAME CHANGER (Serbia)	251-266
<i>Jasna Prodanov-Radulović, Jelena Petrović, Siniša Grubač, Milijana Nešković, Slavča Hristov, Jovan Bojkovski</i> RELEVANT BIOSECURITY MEASURES TO PREVENT THE SPREAD OF AFRICAN SWINE FEVER IN THE DOMESTIC PIG PRODUCTION SECTOR IN SERBIA (Serbia).....	267-275
<i>Igor M. Stojanov, Doroteja A. Maričić, Radomir D. Ratajac, Jasna Z. Prodanov Radulović, Stevan G. Rodić, Jelena B. Apić, Ivan M. Pušić</i> SIGNIFICANCE OF LISTERIA ISOLATES IN ABORTED MATERIALS FROM COWS (Serbia).....	276-285
<i>Ivan Pavlović, Stanko Minić, Violeta Caro Petrović, Milan P. Petrović, Ivan Dobrosavljević, Nemanja Zdravković, Jovan Bojkovski, Ana Vasić, Marija Pavlović, Aleksandra Tasić</i> COENUROSIS OF SHEEP IN SERBIA - CASE REPORT (Serbia).....	286-296
<i>Yunus Emre Ata, Kemal Çelik</i> INVESTIGATION OF THE USE OF PROPOLIS IN BROILER FEEDS AND ITS EFFECTS ON HEALTH AND PERFORMANCE PARAMETERS (Türkiye).....	297-310

<i>Muhittin Zengin, Ergün Demir, Abdulkadir Keskin</i> CURRENT APPROACHES TO THE RELATIONSHIP OF ZEARALENONE AND FERTILITY IN LIVESTOCK (Türkiye).....	311-324
<i>Jack Bergsma</i> THE USE OF STARCH IN THE MEAT PROCESSING INDUSTRY (The Netherlands).....	325-334
<i>Nikola Stanišić, Nikola Delić, Slaviša Stajić, Maja Petričević, Slobodan Lilić, Tamara Stamenić, Aleksandar Stanojković</i> EFFECT OF FAT LEVEL ON QUALITY CHARACTERISTICS OF TRADITIONAL SUCUK SAUSAGES. PART 1: PHYSICO- CHEMICAL CHANGES DURING PRODUCTION (Serbia).....	335-345
<i>Nikola Delić, Nikola Stanišić, Aleksandar Stanojković, Maja Petričević, Tamara Stamenić, Nevena Maksimović, Tanja Keškić</i> EFFECT OF FAT LEVEL ON QUALITY CHARACTERISTICS OF TRADITIONAL SUCUK SAUSAGES. PART 2: TEXTURE, COLOUR AND SENSORY QUALITY (Serbia).....	346-354
<i>Władysław Migdał, Ćedomir Radović, Vladimir Živković, Maria Walczycka, Anna Migdał, Lukasz Migdał</i> MEAT OF NATIVE PIGS BREEDS AS A RAW MATERIAL FOR TRADITIONAL PRODUCTS OBTAINED IN SERBIA AND POLAND (Poland, Serbia).....	355-374
<i>Ana Kaić, Dubravko Škorput, Danijel Karolyi, Zoran Luković</i> ASSESSMENT OF WATER-HOLDING CAPACITY IN DIFFERENT MEATS USING EZ-DRIPLOSS METHOD: A REVIEW OF KEY METHODOLOGICAL FACTORS (Croatia).....	375-383
<i>Yalcin Bozkurt, Mevlüt Türk, Sabahattin Albayrak</i> PATH COEFFICIENT ANALYSIS BETWEEN BODY WEIGHT AND SOME REAL-TIME BODY MEASUREMENTS OF GRAZING CATTLE ON DIFFERENT ARTIFICIAL PASTURES (Türkiye).....	384-395
<i>Jordan Marković, Vladimir Zornić, Ratibor Štrbanović</i> EFFECT OF CONDENSED TANNINS CONCENTRATIONS ON PROTEIN DEGRADABILITY OF RED CLOVER, ITALIAN RYEGRASS AND THEIR MIXTURES (Serbia).....	396-407
<i>Marina Lazarević, Vlada Pantelić, Dragan Stanojević, Dragan Nikšić, Nevena Maksimović, Miloš Marinković, Ljiljana Samolovac</i> TREND OF MILK YIELD TRAITS OF BULL MOTHERS OF THE HOLSTEIN-FRIESIAN BREED (Serbia).....	408-417

Tina Bobić, Pero Mijić, Vesna Gantner, Mirjana Baban, Maja Gregić
FARMER EXPERIENCE IN TRANSITION FROM CONVENTIONAL
TO ROBOTIC MILKING (Croatia)..... 418-424

Savaş Atasever
BROMOTYMOL BLUE TEST SCORES FOR DETECTING RAW
MILK QUALITY OF BUCKET MILK OF JERSEY COWS (Türkiye) 425-431

*Amila Milišić, Zlatan Sarić, Lejla Biber, Amila Oras, Munevera Begić,
Tarik Dizdarević, Miroljub Barać, Svijetlana Sakić-Dizdarević*
PRODUCTION AND QUALITY ASPECTS OF PROBIOTIC
FERMENTED MILK WITH ADDITION OF HONEY (Bosnia and
Herzegovina, Serbia)..... 432-440

POSTER SECTION

*Milun D. Petrović, Vladan Bogdanović, Snežana Bogosavljević-Bošković,
Simeon Rakonjac, Radojica Đoković, Radica Đedović, Miloš Ži. Petrović*
EFFECT OF SYSTEMATIC FACTORS ON MILK PRODUCTION
PER MILKING, PRODUCTIVE AND LIFETIME DAY IN
SIMMENTAL COWS (Serbia)..... 441-449

*Vesna Gantner, Ivana Jožef, Vera Popović, Maja Gregić, Dragan Solić,
Klemen Potočnik*
THE EFFECT OF MASTITIS PREVALENCE RISK ON THE DAILY
PRODUCTION OF DAIRY COWS CONCERNING THE MILK
RECORDING YEAR (Croatia, Slovenia)..... 450-459

*Dušica Ostojić Andrić, Slavča Hristov, Branislav Stanković, Violeta Caro
Petrović, Marko Pajić, Dragan Nikšić, Ljiljana Samolovac, Miloš
Marinković*
MEDICINAL AND AROMATIC PLANTS IN LIVESTOCK
FARMING: A PROMISING APPROACH FOR BOOSTING HEALTH
AND PERFORMANCE (Serbia)..... 460-475

Dragan Dokić, Vera Popović, Maja Gregić, Vesna Gantner
IMPROVING THE DEVELOPMENT OF THE COMPETITIVENESS
OF PIG AND CATTLE PRODUCTION IN THE REPUBLIC OF
CROATIA BY APPLYING GENERIC STRATEGIES (Croatia)..... 476-483

Maja Gregić, Tina Bobić, Dragan Dokić, Vesna Gantner
THERMOREGULATION OF SPORTS HORSES (Croatia)..... 484-492

<i>Ivan Vlahek, Nevena Maksimović, Aneta Piplica, Maja Maurić Maljković, Nikola Delić, Marina Lazarević, Velimir Sušić</i> POPULATION TRENDS OF GOATS IN SERBIA AND CROATIA FROM 2012 TO 2021 (Croatia, Serbia).....	493-507
<i>Alkan Çağlı, Hasan Coğan, Murat Yilmaz</i> COMPARISON OF BODY WEIGHT, FAMACHA © BCS AND HAIR SCORES IN SAANEN GOATS DURING PREGNANCY AND BIRTH PERIOD (Türkiye).....	508-518
<i>Bogdan Cekić, Dragana Ružić Muslić, Nevena Maksimović, Violeta Caro Petrović, Ivan Čosić, Nemanja Lečić, Zsolt Becskei</i> NEW ASPECTS IN RISK STATUS EVALUATION OF SMALL RUMINANT LOCAL BREEDS IN SERBIA (Serbia).....	519-530
<i>Maria Babetsa, Evangelia D. Apostolidi, Loukia V. Ekateriniadou, Evridiki Boukouvala</i> PRNP GENE POLYMORPHISMS IN HEALTHY GREEK SHEEP FROM 2017 TO 2022 - NATIONAL DATABASE FROM RESISTANT RAMS (Greece).....	531-539
<i>Nikola Metodiev</i> THE EFFECT OF THE APPLICATION OF MELATONIN IMPLANTS IN THE SPRING ON THE MANIFESTATION OF ESTRUS AND FERTILITY IN ILE DE FRANCE SHEEP (Bulgaria).....	540-546
<i>Klavdija Poklukar, Marjeta Čandek-Potokar, Nina Batorek Lukač, Marie-José Mercat, David Picard Druet, Martin Škrlep</i> GENE POLYMORPHISMS FREQUENCIES IN KRŠKOPOLJE PIG BREED (Slovenia, France).....	547-555
<i>Klavdija Poklukar, Marjeta Čandek-Potokar, Nina Batorek Lukač, Marie-José Mercat, David Picard Druet, Martin Škrlep</i> THE EFFECT OF PRKAG3 AND RYR1 GENE ON MEAT QUALITY TRAITS IN THE LOCAL KRŠKOPOLJE PIG BREED (Slovenia, France).....	556-565
<i>Vesna Krnjaja, Violeta Mandić, Slavica Stanković, Ana Obradović, Tanja Petrović, Tanja Vasić, Marina Lazarević</i> FUSARIUM AND DEOXYNIVALENOL CONTAMINATION OF WINTER WHEAT DEPENDING ON GROWING SEASON AND CULTIVAR (Serbia).....	566-576

EFFECT OF FAT LEVEL ON QUALITY CHARACTERISTICS OF TRADITIONAL SUCUK SAUSAGES. PART 2: TEXTURE, COLOUR AND SENSORY QUALITY

Nikola Delić, Nikola Stanišić, Aleksandar Stanojković, Maja Petričević, Tamara Stamenić, Nevena Maksimović, Tanja Keškić

Institute for Animal Husbandry, Autoput 16, 11080, Belgrade-Zemun, Republic of Serbia
Corresponding author: Nikola Delić, delicnikola68@yahoo.com
Invited paper

Abstract: Traditional dry fermented sucuk sausages were made from beef and formulated with 10, 20 and 30% of added fat (LF, MF and HF group, respectively). The production was carried out in a traditional smoking house, and fermentation and ripening lasted 28 days. After the end of the production process, colour (CIE $L^*a^*b^*$), texture TPA parameters and sensory quality were analysed. An increase in fat content significantly affected the reduction in TPA values for hardness, springiness, cohesiveness and chewiness ($p < 0.01$). Data obtained in this study indicate that sausages with higher fat content were less firmly bound (lower cohesiveness) and less elastic (lower springiness). Additionally, fat content significantly influenced an increase in lightness (L^*) and yellowness (b^*) and a decrease in redness (a^*) of sucuk sausages ($p < 0.05$). The lowest sensory scores were obtained for HF sausages, especially for consistency, cut appearance and taste.

Key words: sucuk sausage, fat level, colour, texture, sensory quality

Introduction

There is a great variety of dry-fermented sausages, and almost every European country has at least several characteristic products from this group (*Casaburi et al., 2007*). Three types of these sausages are most popular in Serbia: Sremski kulen, Sremska sausage and sucuk. Sucuk is a Turkish-style sausage traditionally made of beef, water buffalo, or mutton (*Gökalp, 1986*). Sucuk has traditionally been produced without the addition of starter cultures and with natural processing conditions, usually in the autumn and winter (*Soyer et al., 2005*).

The dietary regime with lower fat content, saturated fatty acids and cholesterol have been promoted by various health organizations worldwide. In the last decades, due to a negative association of high-fat consumption, especially the ones rich in saturated fatty acids, with various health issues, the meat industry started to produce products with reduced fat content (*Colmenero, 2000; Mendoza et al., 2001*). As fat is an important ingredient that, besides nutritional profile, influences sausage texture, flavour, colour and overall acceptability, its reduction can have adverse technological and sensory effects (*Choi et al., 2010; Stanišić et al., 2012*).

In this regard, dry fermented sausages, as the products that traditionally have a high amount of fat, are unsuitable for fat reduction. Traditionally they contain approx. 30% fat in the recipe, which after drying, due to the loss of moisture, rises to more than 40% in the finished product (*Wirth, 1988*). Consequently, lowering the fat content in these products may have a negative effect on their technological and sensorial characteristics (*Muguerza et al., 2003; Stajić et al., 2020*). Fat reduction can lead to a too-dry product, with a hard and rubbery texture, due to a higher moisture loss (*Keeton, 1994*). This can also lead to decreased sausage appearance due to a wrinkled surface and casing (*Muguerza et al., 2002*).

The main objectives of this study were to determine the effect of different fat levels on the texture, colour and sensory quality characteristics of sucuk sausages produced traditionally, with natural fermentation and ripening.

Materials and Methods

Sausages were produced in a meat processing plant of the Institute for Animal Husbandry (Belgrade, Serbia) from February to March 2022. For the production of sausages, beef, ham meat and tail fat were used. Three groups of sausages with different fat levels were produced: LF (low fat) group was made of beef meat with the addition of 10% fat, MF (medium fat) group was made of beef meat with the addition of 20% fat and HF (high fat) group was made of beef meat with the addition of 30% fat. In all variants, the same amounts of the following ingredients were added: 1.8 % salt, 0.011% NaNO₂, 0.4% sucrose, 0.3% powdered black pepper, 0.2% garlic and 0.2% powdered red paprika.

The production process was as follows: beef ham meat and tail fat were frozen at -4°C and then minced in a meat grinder (Seydelman 114, Germany) to about 1 cm in diameter. Cutting and mixing with the rest of the dry ingredients was carried out in the cutter (Seydelman K60, Germany) to 3 mm particle size. The mixture was then filled in natural beef casings of 38 mm. Sausages were tied with rope and made into characteristic horseshoe shapes. After stuffing (day 0), the sausages were drained in a cold store (4 ± 1°C) for 12 h for the surface to dry, after

which they were hung in a traditional smoking house (without the possibility to control the temperature or humidity), with the parameters varying between 5–10 °C and RH 75–90%. They were then occasionally smoked for 28 days.

A sampling of all three variants of sucuk was carried out after the production process. Nine sausages were taken from each group for colour, texture and sensory analyses.

The colour was measured using Chromameter CR-400 (Minolta Co. Ltd, Tokyo, Japan). The instrument was configured with the following parameters: D65 light source, 10° observer, and 8 mm aperture size and calibrated using a white ceramic tile. The measurements were done according to the CIE L*a*b* system: lightness (L*), redness (a*) and yellowness (b*). C* (chroma) and h (hue angle) were calculated using the available software (CIE, 1976). The colour measurements were performed at room temperature (20 ± 2°C) immediately after cutting the sausages.

Texture analyses were done using a universal testing machine (Instron model 4301, Instron Ltd., England). After cutting into slices of 1-1-2 cm (width-height-length), nine readings were taken for each sausage variant. The samples were held for equilibration to room temperature and compressed twice to their original height, with a compression aluminium platen of 75 mm (P/75) and a 250 kg load cell. The pre-test speed was 3 mm/s, the test speed was 1 mm/s, and the post-test speed was 1 mm/s. The following parameters were obtained: hardness, springiness, cohesiveness, and chewiness.

Sensory evaluation was done by a panel of five trained evaluators using a quantitative–descriptive test (SRPS ISO 6658/2002). Scores were given on a scale from 1 to 5, where score 1 was unacceptable, and score 5 was optimum. Sensory properties investigated were surface appearance, cut appearance, colour, smell, taste and consistency.

The results of texture, colour and sensory analyses were processed by single factor analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of the SPSS 20.0 software (IBM SPSS Statistics Version 20, IBM Corp, USA). The differences between individual averages were tested using Tukey's method, and significant differences were considered for $p < 0.05$.

Results and Discussion

Results from the TPA analysis showed a significant effect of fat level on all analysed characteristics (Table 1). It has been reported that moisture and fat content at the end of the fermentation and ripening are the main factors affecting the binding and rheological properties of dry fermented sausages (González-

Fernández et al., 2006). Hardnesses, springiness, cohesiveness and chewiness values significantly decreased with increased fat content ($p<0.01$).

Table 1. Texture parameters of the three variants of sucuk sausages (means \pm standard deviation)

Parameter	LF	MF	HF	Sig.
Hardness (N)	157.55 \pm 8.62 ^a	128.22 \pm 6.91 ^b	107.83 \pm 7.08 ^c	**
Springiness (mm)	0.51 \pm 0.04 ^a	0.40 \pm 0.02 ^b	0.38 \pm 0.04 ^b	**
Cohesiveness	0.44 \pm 0.02 ^a	0.34 \pm 0.02 ^b	0.29 \pm 0.02 ^c	**
Chewiness (N/mm)	35.14 \pm 4.30 ^a	24.62 \pm 2.04 ^b	16.44 \pm 2.25 ^c	**

LF: low fat (10%); MF: medium fat (20%); HF: high fat (30%)

^{a-c} Different letters within the same row denote significant differences between means

** Significant at $p<0.01$

Several authors found that dry-fermented sausages with reduced fat content have higher values for hardness and chewiness (*Salazar et al., 2009; Liaros et al., 2009; Mendoza et al., 2001; Muguerza et al., 2002*). Additionally, hardness values are negatively correlated to moisture content (*Lorenzo and Franco, 2012*). In this trial, LF sausages had significantly higher hardness, springiness, cohesiveness and chewiness values than the other two groups ($p<0.01$). In contrast, MF sausages had significantly higher hardness, cohesiveness and chewiness values than the HF group ($p<0.01$). Low chewiness values in HF groups indicate that it takes less effort to prepare food for swallowing compared to LF and MF sausages (*Stajić et al., 2014*). Data obtained in this study indicate that sausages with higher fat content were less firmly bound (lower cohesiveness) and less elastic (lower springiness). Similar values for TPA were also reported by several authors (*González-Fernández et al., 2006; Olivares et al., 2010; Beriain et al., 2011; Lorenzo and Franco, 2012*). The results of this trial are in disagreement with *Liaros et al. (2009)*, who reported no significant differences ($p>0.05$) between fermented sausages with different fat levels for springiness, cohesiveness and chewiness.

Of all the quality characteristics of sucuk, colour seems to be the most important one (*Yildiz-Turp and Serdaroğlu, 2008*). Fat content significantly affected the CIEL*a*b* colour parameters of sausages (Table 2). As expected, LF sausages, with the lowest fat content, had the lowest L* values compared with the other two groups ($p<0.01$). These findings are in agreement with previous trials of *Hand et al. (1987)*, *Papadima and Bloukas (1999)*, *Soyer et al. (2005)*, *Bozkurt and Bayram (2006)* and *Olivares et al. (2010)*, who reported increasing of sausage lightness with increasing the fat content. Although HF sausages had a higher fat

content compared to the MF group, there were no significant differences in L* values between them.

Table 2. Colour parameters of the three variants of sucuk sausages (means ± standard deviation)

Parameter	LF	MF	HF	Sig.
L*	40.18 ± 7.59 ^a	45.99 ± 4.68 ^b	50.66 ± 5.61 ^b	**
a*	14.29 ± 2.41 ^a	12.14 ± 2.35 ^b	11.23 ± 1.60 ^b	*
b*	7.77 ± 1.30 ^a	9.07 ± 1.12 ^b	9.05 ± 0.82 ^b	**
C*	16.00 ± 2.31	14.88 ± 2.47	15.63 ± 1.84	ns
h	28.68 ± 6.39 ^a	36.46 ± 4.09 ^b	35.88 ± 4.80 ^b	**

LF: low fat (10%); MF: medium fat (20%); HF: high fat (30%)

^{a-c} Different letters within the same row denote significant differences between means

^{ns} non-significant (p≥0.05); * significant at p<0.05; ** significant at p<0.01

Papadima and Bloukas (1999) found that increasing the fat level of dry fermented Greek sausages significantly increased the lightness (L*) and yellowness (b*) and decreased redness (a*). The redness (a*) values significantly differ only between LF and the other two groups (p<0.05), with no significant differences between MF and HF groups. It has previously been reported that sausages with lower fat and higher lean content are redder (*Candoğan and Kolsarici, 2003*), which agrees with this trial. The faster formulation of nitrosyl myoglobin in low-fat sausages, as *Soyer et al. (2005)* reported, also contributes to a higher redness value.

Low-fat sausages had the lowest degree of yellowness (b*) compared to MF and HF groups (p<0.01), which is also confirmed by other researchers (*Soyer and Ertas, 2007*). The b* value positively correlates to the amount of sausage lipids (*Soyer et al., 2005*). *Muguerza et al. (2002)* and *Olivares et al. (2010)* also reported increasing yellowness due to a higher fat level.

Different fat levels of sausages did not have a significant effect on the chroma values (C*), indicating that there were no differences in colour saturation between groups. Larger values for hue angle (h) indicate a less red product, defined as the development of colour from red to yellow (*Tapp III et al., 2011*). LF sausages had significantly lower h colour values than the other two groups (p<0.01). The hue angle values of sausages from the HF and MF groups were similar.

Sensory characteristics of fermented sausages are strongly correlated to the length and rate of fermentation and drying, breakdown of lipids, smoking and the quality of raw materials used (*Berdagué et al., 1993; Johansson et al., 1994*). In this trial, fat content significantly affected the sensory scores for consistency, cut

appearance and taste ($p < 0.05$). At the same time, there were no differences in surface appearance, surface colour and smell between LF, MF and HF groups of sucuk sausages (Fig. 1). MF and LF sausages had similar sensory scores for all tested attributes, except cut appearance. Higher scores for consistency, taste and cut appearance for lower-fat sausages (LF and MF groups) compared to high-fat sausages (HF group) are reported by other authors (Lorenzo and Franco, 2012).

These results agree with the research of Papadima and Bloukas (1999) that traditionally dried Greek sausages with 30% of fat had the lowest sensory scores for appearance and consistency, while sausages containing 20% fat had the highest. Additionally, the same authors found no differences in odour between sausages. In general, in this trial, all sausages were characterised by a specific flavour and texture of this type of product (Bozkurt and Erkmen, 2002).

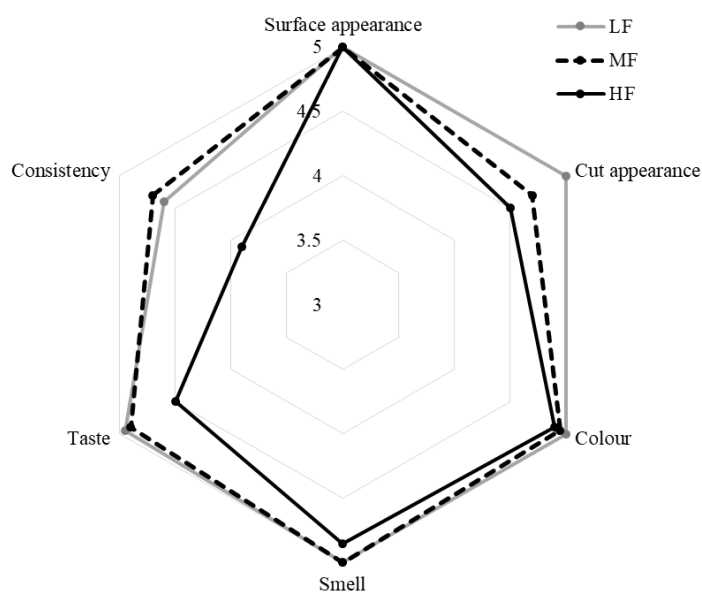


Figure 1. Results of the sensory evaluation (quantitative–descriptive analysis) on three groups of sucuk sausages. LF: low fat (10%); MF: medium fat (20%); HF: high fat (30%).

Conclusion

The findings of this study showed that it is possible to reduce the fat content of traditionally produced dry fermented sucuk sausages, but considerably affecting the TPA parameters and instrumental colour at the end of processing. Sausages

containing 20 and 30% of fat had lower hardness, chewiness, and higher lightness values than sausages with 10% fat. Fat level significantly affected the sensory attributes of sausages, showing high-fat sausages had lower scores for consistency, taste and cut appearance compared to mid- and low-fat ones.

Based on the obtained data, it can be concluded that producing naturally fermented sucuk sausages with 10 and 20% fat has some advantages, like a firmer texture and better sensory scores. However, the production of sausages with 30% fat content resulted in some defects, such as soft texture, pale appearance and lower scores for taste and consistency.

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