Using of Clinical and Hematological Indicators for Determination of Stress Phenomena during the Milking of Ewes

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Original scientific paper

SUMMARY

Research has been carried out to evaluate the stress response in machine milking and to determine the suitability of Ascanian Karakul and Ascanian Fine-Fleeced breeds to machine milking on a linear type unit, which was developed by the Laboratory of the Technology and Sheep Breeding Products Processing Production at ITSR "Askania-Nova". Determined by the five-point system is the behavioral response of ewes when fixing them in the milking machine, putting milking glasses on the udder nipples and directly during milking. The clinical and physiological state of ewes is determined by the pulse rate and respiratory rate per minute. Temperature measurements were carried out and hematological parameters were investigated.
It was established that the clinical indicators of both breeds ewes were within the physiological norm. At the beginning of the study, there was a deviation of the pulse rate from the norm in both groups of animals, and at the end of the study this indicator normalized. The behavioral score in the group of Karakul ewes remained at a rather low level throughout the experience, amounting to 3.5-3.8 points. The average live weight over the experimental period in the group of Fine-Fleeced ewes increased by 5%, which can be attributed to the normal response to stress, and the behavioral score of 4.5, as animals in this group were less fearful during the milking process.

Hematologic studies have revealed a decrease in leukocytes in both groups of animals, both at the beginning and at the end of the experiment. Other blood counts were within the physiological norm, which may indicate that there is no stress effect on the sheep during milking or it is not intense and animals are rapidly adapting to this technological process.

**Key words:** machine-milking, ewes, stress, clinical, hematologic parameters

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**INTRODUCTION**

In sheep breeding, along with the production of wool, mutton, and lambskin, sheep milk is also important, from which various varieties of cheeses and other highly nutritious products are made, which have no analogues among products of animal origin. The formation of competitive sheep breeding in Ukraine cannot be achieved without the realization of a huge reserve of the industry, which is the production of milk with its subsequent in-depth processing (Turinsky, 1998; Lutsenko, 2005). The solution to the problem of the widespread introduction of sheep milking in the state is constrained by the laboriousness of this technological process and the lack of domestic
inexpensive and reliable means of mechanization that would have low metal consumption, simplicity of design and provide quick accustoming of animals to machine milking when producing high-quality milk for further processing into competitive products.

The aim of the researches was to determine the stress resistance of the domestic breeding sheep to machine milking on a small-sized milking setting, which has a simple design and provides a sufficiently high productivity with minimal labour.

MATERIAL AND METHODS

Production tests were carried out under the conditions of the EFSE "Askania Nova" in the Kherson region, Ukraine on ewes of the Ascanian Karakul (n=20) and Ascanian Fine-Fleeced breeds (n=26). These animals were from 2 to 7 years old, so their average age was 5 years old. The animals were milked in a linear-type plant, which was developed in the "Askania Nova" IABSR by the laboratory of the Technology of production and Processing of Sheep Breeding Products.

To study the assessment of the stress response during machine milking of sheep according to a five-point system, we used the indicator of the ewe's behavioral response when they were fixed in the milking machine, putting milking cups on the nipples and directly during milking. The clinical and physiological condition of the ewes is determined by the pulse rate and respiratory movements per minute. Temperature measurements were taken, and the quantitative content of hematological parameters was studied - hemoglobin (g/l), erythrocytes (mil/l), leukocytes (thousand/l), total protein (g/l) (Vilzio et al., 2012). Since the content of animals' blood proteins can vary significantly depending on their physiological state, the impact on the body of many environmental factors, including stress factor, the total blood protein...
fractional composition was analyzed according to the albumin (%), α-, β-, γ-globulins (%); and also the protein index was determined (Andreeva et al., 2004).

Statistical processing of research results had been carried by N. A. Plokhinsky method (1969) using the Excel software package.

RESULTS AND DISCUSSION

Structural features and a structural and technological scheme of a double-place installation of a linear type for sheep milking are presented in Figure 1 and 2, which provides high adaptability. The throughput of the installation is up to 120-132 animals per hour and the time spent actually milking one pair of ewes - 65.80 ± 2.34 s.
It was established that the clinical indicators of the ewes (Table 1) were within the physiological norm, only at the beginning of the study was there a deviation in the pulse rate from the norm in both groups of animals: in Karakul sheep, $117.0 \pm 3.62$ beats/min (beats per minute), for Fine-Fleeced - $111.7 \pm 3.89$ beats/min., with the norm - 70-80. By the end of the study, this indicator returned to normal, and amounted to $81.4 \pm 2.81$ beats/min (P <0.001) for Fine-Fleeced, $72.6 \pm 0.79$ beats/min (P <0.001) for Karakul ewes. This state of affairs indicates the successful adaptation of animals to the milking process. Although the behavioral score in the group of Karakul ewes remained at a rather low level throughout the entire experiment (3.5-3.8 points), in the group of Fine-Fleeced it increased and amounted to 4.5 points at the end of the study.
**Table 1. Physiological indicators of ewes during milking**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Ascanian Fine-Fleeced breed</th>
<th>Ascanian Karakul</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n ч ло / start</td>
<td>кр й / end</td>
</tr>
<tr>
<td>начало/край</td>
<td>18,3±0,63</td>
<td>23,6±2,06</td>
</tr>
<tr>
<td>Breathing, movement/min</td>
<td>111,7±3,89</td>
<td>81,4±2,81</td>
</tr>
<tr>
<td>Heart rate, beats/min</td>
<td>39,4±0,08</td>
<td>39,3±0,06</td>
</tr>
<tr>
<td>Behavior, score</td>
<td>3,5±0,21</td>
<td>4,5±0,19</td>
</tr>
<tr>
<td>Live weight, kg</td>
<td>53,2±0,86</td>
<td>56,4±0,87</td>
</tr>
</tbody>
</table>

The live weight index for the period of the experiment in the group of Fine-Fleeced ewes increased by 5% (P <0.05), which can be associated with the behavioral score, since the animals of this group were less shy and quietly consumed more grain during milking, and sometimes even refused to leave the installation after the completion of the process. In the group of Karakul ewes, live weight decreased by 3% because they are more sensitive to the stress load, which was provoked by the previous weaning of the lambs and the movement of the animals to new conditions. A significant part of the animals refused to eat concentrates feeds during milking until the end of the experiment.

As regards hematological parameters (Table 2), in both groups of animals, a decrease in the number of leukocytes was observed, both at the beginning and at the end of the experiment, which may indicate a deficiency of B vitamins, as well as iron and copper in the animals’ diet.
### Table 2. Blood indices of the investigated ewes

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Norm</th>
<th>Ascanian Fine-Fleeced breed (n=26)</th>
<th>Ascanian Karakul breed (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>н ч ло / start</td>
<td>кр й / end</td>
</tr>
<tr>
<td>емоглобин</td>
<td>7-10</td>
<td>7,9±0,07</td>
<td>10,0±0,09</td>
</tr>
<tr>
<td>ритроцити</td>
<td>7-12</td>
<td>8,6±0,36</td>
<td>8,9±1,41</td>
</tr>
<tr>
<td>евкукози</td>
<td>10-13</td>
<td>7,3±0,30</td>
<td>7,02±0,26</td>
</tr>
<tr>
<td>бц протеин</td>
<td>6,0-7,5</td>
<td>6,9±0,11</td>
<td>7,02±0,08</td>
</tr>
<tr>
<td>лий</td>
<td>9,5-12,5</td>
<td>11,2±0,08</td>
<td>10,3±0,14</td>
</tr>
<tr>
<td>оофор</td>
<td>4,5-6,5</td>
<td>5,9±0,25</td>
<td>5,9±0,22</td>
</tr>
</tbody>
</table>

Proteins play a leading role in the metabolism of the body. It is known that they are actively involved in most vital processes. Therefore, the study of their dynamics in animal tissues is one of the important indicators of the physiological state of their body. Proteins are necessary for the growth and development of animals, the synthesis of enzymes and hormones.

Due to the ability to form biochemical complexes, proteins take an active part in the transport of nutrient and biologically active (enzymes, hormones, vitamins, macro- and microelements) substances in the body, which also perform a protective function. One of the main indicators of protein metabolism in the body is the content of total protein and protein fractions in the blood.

In our studies, there was observed a deviation from the norm of the protein composition of the blood (Table 3), so at the beginning of the study, the percentage of albumin in both groups of animals was reduced, which may indicate lack of protein during pregnancy and the first months of lactation in the ewes, later this figure returned to normal, and in the group of Karakul ewes even exceeded the norm by 6%, which may be due to slight dehydration of the body. So the concentration of protein in the blood and the ratio of its fractions are relatively
Съотношението на неговите фракции с относително постоянни, но с в непре-късно то дин мично р вновесие с про-теиновия съст в н телесните тък ни.  

**Table 3. Content of total protein and its fractions (g/l) in serum**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Ascanian Fine-Fleeced breed (n=26)</th>
<th>Ascanian Karakul breed (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>общ протеин</td>
<td>6,9±0,11</td>
<td>7,02±0,08</td>
</tr>
<tr>
<td>альбумин</td>
<td>28,9±1,33</td>
<td>44,9±4,10</td>
</tr>
<tr>
<td>α-глобулин</td>
<td>7,6±2,57</td>
<td>6,1±2,21</td>
</tr>
<tr>
<td>β-глобулин</td>
<td>7,5±2,40</td>
<td>5,6±0,44</td>
</tr>
<tr>
<td>γ-глобулин</td>
<td>55,9±2,17</td>
<td>42,1±6,63</td>
</tr>
<tr>
<td>индекс на протеин</td>
<td>0,4</td>
<td>0,8</td>
</tr>
</tbody>
</table>

В допълнение, понижението на съдържанието на общ протеин, альбумин и гама глобулини в кръвния серум води до увеличаване на катаболните реакции и намаляване на синтезата на протеини и имунобиологичните процеси в органите по време на стрес. Нивото на тези промени зависи от състоянието на адаптивните механизми на организма, поради възрастта и генетичните фактори, както и от силата и продължителността на технологичния стрес. И при двете проучени групи овце се наблюдава понижение на α- и β-глобулини, докато γ-глобулинът значително се увеличава, което е характерно за хронични чернодробни заболявания (хепатит или хепатоза). Последните чрез общият протеин в кръвта е в нормални граници, но в резултат на дисбаланс във фракционния състав на протеините се наблюдава отклонение от нормата на протеиновия индекс.

In addition, a decrease in the content of total protein, albumin and gamma globulins in blood serum leads to an increase in catabolic and a decrease in protein synthesizing and immunobiological processes in the body during stress.

The level of these changes depends on the state of the adaptive mechanisms of their body, due to age and genetic factors, as well as the strength and duration of technological stress factors.

In both studied groups of sheep, a decrease in α- and β-globulins was observed, while γ-globulin was significantly increased, which is typical for chronic liver diseases (hepatitis or hepatosis).

Since the average age of animals in both groups was 5 years, and with sufficiently intense physiological stresses on the body (annual pregnancy and lactation), destructive changes in the liver can occur.

Although the total blood protein is within normal limits, but as a result of an imbalance in the fractional composition of proteins, a deviation from the norm of the protein index is observed.
CONCLUSIONS

The research results allow us to conclude that the Ascanian selection ewes relatively quickly formed a reflex to the milking process using a two-place installation of a linear type. The results of hematological studies indicate the absence of the effect of stress on sheep during milking, or it is not significant and the animals quickly adapt to this technological process.

/ REFERENCES

Effect of the Economic Year on the Milk Yield of ‘Staroplaninski Tsigai’ Sheep Breed

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Original scientific paper

SUMMARY

The objective of the present study is to determine the effect of the economic year on the milk yield of ‘Staroplaninski Tsigai’ sheep breed. It was conducted with 126 ewes of ‘Staroplaninski Tsigai’ on the first, second and third lactation in 2019 (64 ewes) and 2020 (62 ewes). The animals were bred in the Experimental Base of RIMSA in Troyan and fed according to specific rates with free access to water, as animals were grazing on a mountain pasture in the months of April-July. Standard 120-day milking yield was determined individually by the amount of milk in each milk control group controlled by AC method of ICAR. The milk yield of the sheep for 120 days was calculated as the sum of the milk yield from the individual control periods (April-July, with an average duration of 30±3 days). The information was processed by the methods of variation statistics.

The effect of the economic year on the studied indicators was established by
чрез ANOVA модель на еднофакторния дисперсионен анализ, достоверността на влиянието на факторите е определена по стойностите на F-критерия, а достоверността на разликите между изследванияте групи – чрез t-тест на тюдент, със статистическата пакет Data Analysis, Microsoft Excel 2016. Статистически достоверно влияние на фактора стопанска година (F = 4.3*) върху стойностите на млечността (50.5 l и 46.6 l) при овце от породата Старопланински цигай. Наблюдава се нехарактерна форма на лактационната крива за първата година (2019 г.).

Ключови думи: Старопланински цигай, млечност, ефект на годината

INTRODUCTION

‘Staroplaninski Tsigai’ is one of the sheep breeds raised in the region of the Central Balkan Mountain. It is considered that ‘Tsigai’ breed is not characterized by high milk yield, but the diverse natural and climatic features of the region provide conditions for varying this trait in a very wide range for sheep, which are grazing in mountainous areas (Odjakova et al., 2002).

The composition of sheep milk and its yield varies widely and is influenced by various factors, such as breed, age, lactation stage, season, milking and feeding system, geographical region and others (Fegeros et al., 1995; Kafedjiev et al., 1998; Adrian and Arancon, 2011; Gerchev et al., 2018). Environmental factors that affect sheep milk yield have been described by a number of scientists (Gonzalo et al., 1994; Cappio-Borlino et al., 1997; Ploumi et al., 1998; Oravcová et al., 2006). Meteorological factors, such as temperature, humidity, wind speed and radiation, might have an impact on animal comfort and stress levels (Naskar et al., 2012). This in turn leads to a reduction in milk yield, as temperature has a significant direct
на мляко, тъй като температурата има значително пряко въздействие върху биологичните функции на животните (Silanikove, 2000).

Gerchev (1998) установява тенденция за по-висока млечност от овце на планинските и високопланинските пътища, което съответства с вид и фази на развитието на тревостоя (Gerchev and Mihaïlova, 1998). В нашата страна добивът на овче мляко се осъществява през определен сезон, поради сезонността в размножаването на породите отглеждани у нас. Целта на настоящото проучване е да се установи ефекта на стопанската година върху млечността на овце 'Staroplaninski Tsigai'.

МАТЕРИАЛ И МЕТОДИ

Проучването беше проведено с 126 броя овце майки от породата 'Staroplaninski Tsigai' на първа, втора и трета лактация през 2019 г. (64 броя) и 2020 г. (62 броя). Животните бяха отглеждани в Експерименталната база на ИПЖЗ Троян и хранени по норми със свободен достъп до вода, а през месеци април-юли животните пасат на планинско пасище. Стандартната 120-дневна дойна млечност беше определена индивидуално по количеството на мляко в отделните контроли, контролирано по AC метода на ICAR. Млечността за контролния ден беше изчислена като събиране на млечността от отделните контроли на всяка овца. Контролната дойна беше със средна продължителност 30±3 дни. Лечността за мляко, тъй като температурата има значително пряко въздействие върху биологичните функции на животните (Silanikove, 2000).

Gerchev (1998) found a tendency for higher milk yield in ‘Staroplaninski Tsigai’ sheep breed when using mountain and high mountain pastures, which corresponds to the type and phase of development of grassland (Gerchev and Mihaïlova, 1998).

In Bulgaria the production of sheep’s milk is carried out during a certain season, due to the seasonality in the reproduction of the breeds in our country. The objective of the present study is to determine the effect of the economic year on the milk yield of ‘Staroplaninski Tsigai’ sheep breed.

MATERIAL AND METHODS

The study was conducted with 126 ewes of ‘Staroplaninski Tsigai’ on the first, second and third lactation in 2019 (64 ewes) and 2020 (62 ewes). The animals were bred in the Experimental Base of RIMSA in Troyan and fed according to specific rates with free access to water, as animals were grazing on a mountain pasture in the months of April-July.

Standard 120-day milking yield was determined individually by the amount of milk in each milk control group controlled by AC method of ICAR. The milk yield for the control day was calculated by multiplying the milk amount obtained in the individual control in the morning by the herd coefficient, which was established for the control day in relation to the amount of morning and evening milk, to the morning milk in case of double milking.

The milk yield for a standard 120-day milking period (April-July) was calculated as the sum of the milk yields from the individual control periods of each sheep.

The control period was 30±3 days on average. The milk yield for one control...
един контролен период предст вливане дните на контрол и брой дните в контролния период.

Informът е обр ботен по методите и чионът с т стици. Фектърът съ стоп нск годин върху изследв ните пок з тели е уст - новен през ANOVA модел в едноф к- торния дисперсиян н лиз, достоверността на влиянието ф кторите е определен по стойностите н Ф-крите рия н ишер, достоверността н р еликите между изследв ните групи - през t-тест н тюден, със ст стисти ческия п кет Data Analysis, Microsoft Excel 2016.

РЕЗУЛТАТИ И ОБСЪЖДАНЕ

Млечността е силно з висим от влиянието на среда и по-специално от фуражно- климатичните условия през съответната година или по-точно от условията на хранене и гладене във фермите (Zhelyazkova et al., 2014).

Таблица 1. Ефект на стопанската година върху 120 дневната млечност

<table>
<thead>
<tr>
<th>ANOVA</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>ежду групите / Between Groups</td>
<td>477.44</td>
<td>1</td>
<td>477.44</td>
<td>4.294 *</td>
</tr>
<tr>
<td>стък / Within group</td>
<td>13786.53</td>
<td>124</td>
<td>111.18</td>
<td></td>
</tr>
<tr>
<td>общо / Total</td>
<td>14263.97</td>
<td>125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

При проучване ефектът на стопанската година върху стандартната 120-дневна млечност на овцете съответства със статистически висока степен на вероятност (P<0.05) (блъск 1).

Zhelyazkova et al. (2014) със ст обновили при интегриран т населен цял бълг рск млечн, че ефектът на стоп нск годин е док з н ст стистически с висок степен на вероятност (P<0.001) върху млечността.

When studying the effect of the economic year on the standard 120-day lactation of sheep, the obtained value of the F-criterion shows a significant impact (P<0.05) of the studied factor on the variation of milk yield (F=4.294*) (Table 1).

Zhelyazkova et al. (2014) found in the Synthetic population Bulgarian dairy that the effect of the economic year was statistically proven with a high degree of probability (P<0.001) on milk yield.
Figure 1 shows the milk yield of the studied years. The average value of milk yield of ‘Staroplaninski Tsigai’ sheep breed in 2019 was 50.5 l, and that in 2020 – 46.6 l. According to this indicator, the lactating animals during the two studied years were within the limits of milk yield indicated in the Catalogue of farm animal breeds in the Republic of Bulgaria (2017).

The lower milk yield in 2020 could be partly explained by the higher number of young animals lactating for the first time.

Gerchev et al. (2013) reported for at 2.5 years of age milk yield of 41.22 l, and at 3.5 years of 49.31 l, which was lower than we found in 2019.

Milk yield in ‘Tsigai’ sheep of different ages was reported by Genkovski et al. (2003) and is respectively: at 2.5 years – 42.40 l; at 3.5 years – 46.80 l; at 4.5 years – 45.70 l. and at 5.5 years was 46.40 l, which is close to the results we obtained in 2020.

Popova and Plugin (2003) monitored the dynamics of milk productivity of ‘Tsigai’ ewes, establishing...
вяв т групи с по 48.2 l, 75.9 l и 94.4 l мляко з 4-ри месяц н л кт ция. исо-
k т изменчивост н пок з телите млеч-
ност и химичен съст в н млякото поз-
воляв висок ефект при м сов отбор н
овце м ёки по тези призн ци.

The lactation curves reflecting the sheep milk amount for the control day for both experimental years (2019 and 2020) are presented in Figure 2. An unusual shape of the lactation curve in 2019 and a curve with a characteristic profile in 2020 are observed. The low milk yield of the first (in 2019 – 0.421 l) compared to the second (respectively 0.591 l) milking control can be explained by the shorter time from the beginning of milking to the first control, due to which the animals have not yet reached their full potential.

Then, by the end of the milking period, the milk yield decreased following the normal patterns of lactation. Similar to what we found for 2019, an uncharacteristic lactation curve was obtained by Ivanova (2013), with a milk yield of the second milking control significantly higher than the first control.
The data analysis on the average daily milk yield shows that it varied from 0.281 l for IV control (July) to 0.591 l for II control (May) in 2019. Genkovski and Gerchev (2006) also received the highest average daily milk yield in May.

The highest average daily milk yield was found at the I control (April) with 0.712 l, and the lowest at the IV control (July) with 0.131 l in 2020. In April 2020, the milk yield of ‘Tsigai’ sheep was higher compared to the previous year. Our data coincide with the results reported by Gerchev (2010) for ‘Tsigai’ sheep aged 3.5 years, for the same month of the year.

CONCLUSIONS
1. During the study of the effect of the marketing year on the milk yield, a significant impact of the farm year factor (F=4.3*) on the values of milk yield (50.5 l and 46.6 l) was found in ‘Staroplaninski Tsigai’ sheep breed.

2. An unusual shape of the lactation curve for 2019 was established.

REFERENCES


The objective of the present study is to determine the effect of the marketing year on the milk yield of ‘Karakachanska’ sheep breed. It was conducted with 127 ewes of ‘Karakachanska’ sheep breed at the first, second and third lactation in 2019 (63 ewes) and 2020 (64 ewes). The animals were bred in the Experimental Base of RIMSA in Troyan and fed according to the norms with free access to water, as the animals were grazing on a mountain pasture in April-July. Standard 120-day milk yield was determined individually by the amount of milk in each milking control group controlled by AC method of ICAR. The milk yield of the sheep for 120 days was calculated as the sum of the milk yield from the individual control periods (April-July, with an average duration of 30±3 days).

The information was processed by the methods of variation statistics. The effect of the marketing year on the studied indicators was established by ANOVA model.
model of one-way analysis of variance. The reliability of the impact of factors was determined by the values of Fisher’s F-test.

The reliability of the differences between the studied groups – by Student’s t-test, using Data Analysis package, Microsoft Excel 2016. A significant impact of the farm year factor (F=4.3 *) on the values of milk yield (50.5 l and 46.6 l) was found in ‘Karakachanska’ sheep breed. There were noncharacteristic lactation curves in both experimental years.

Key words: ‘Karakachanska’ sheep breed, milk yield, effect of the year

INTRODUCTION

‘Karakachanska’ sheep breed is bred mainly in the mountain and foot-hill regions of Bulgaria. The breed is small-sized, well adapted to the harsh conditions in these areas, besides it is a part of the cultural heritage of people in the region of the Balkans. Local sheep breeds, including ‘Karakachanska’ sheep breed, are a valuable genetic reserve for the preservation of biological diversity (Stojiljkovic et al., 2015; Staykova and Penchev, 2018).

The breed is raised to obtain milk, wool and lambs. The sheep milk yield and its composition vary widely and is impacted by various genetic and non-genetic factors (Morsy, 2002; Hamdon, 2005; Oravcová et al., 2006, 2007, 2015; Allah et al., 2011; Kompreg et al., 2012; Pacinovski et al., 2016; Gerchev et al., 2018), as well as stress levels (Silanikove, 2000; Naskar et al., 2012; Abecia et al., 2017).

The objective of the present study is to determine the effect of the marketing year on the milk yield of ‘Karakachanska’ sheep breed.

MATERIAL AND METHODS

It was conducted with 127 ewes of ‘Karakachanska’ sheep breed’ at the first, second and third lactation 2019 (63
The animals were bred in the Experimental Base of RIMSA in Troyan and fed according to the norms with free access to water, as the animals were grazing in a mountain pasture in April-July.

The standard 120-day milk yield was determined individually by the amount of milk in each milking control group controlled by AC method of ICAR. The milk yield for the control day was calculated by multiplying the milk amount obtained in the individual control in the morning by the herd coefficient, which was established for the control day in relation to the amount of morning and evening milk compared to the morning milk in case of double milking. The milk yield for a standard 120-day milking period (April-July) was calculated as the sum of the milk yields from the individual control periods per each sheep. The control period was 30±3 days on average. The milk yield per one control period is the milk production per the day of the control and the number of days during the control period.

The information was processed by the methods of variation statistics. The effect of the marketing year on the studied indicators was established by ANOVA model of one-way analysis of variance. The reliability of the impact of factors was determined by the values of Fisher's F-test. The reliability of the differences between the studied groups - by Student's t-test, using Data Analysis package, Microsoft Excel 2016.

RESULTS AND DISCUSSION

The variance analysis for establishing the effect of the marketing year on the variation in the 120-day milk yield is reliable (P<0.05) (Table 1).
Table 1. Effect of the marketing year on the 120-day milk yield of ‘Karakachanska’ sheep breed

<table>
<thead>
<tr>
<th>Source of Variation / Източници на вариране</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups / Между групите</td>
<td>4500.32</td>
<td>1</td>
<td>4500.32</td>
<td>4.582 *</td>
</tr>
<tr>
<td>Within group / Остатък</td>
<td>122773.9</td>
<td>125</td>
<td>982.19</td>
<td></td>
</tr>
<tr>
<td>Total / Обща</td>
<td>127274.2</td>
<td>126</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Milk yield is highly dependent on the environmental impact and in particular on the forage and climatic conditions during the respective marketing year or more precisely on the feeding and care conditions on the farms. Although the genetic potential is determined by the animal breed, the environmental impact has a decisive role in reaching the maximum (Zhelyazkova et al., 2014; Staykova et al., 2015).

Zhelyazkova et al. (2014) found in sheep from the Synthetic population of Bulgarian milk breed that the effect of the marketing year was proved statistically with a high degree of probability (P<0.001) on milk yield.

Figure 1 shows the milk yield in the experimental years. The average value of milk yield of ‘Karakachanska’ sheep breed in 2019 was 46.4 l and in 2020 was 34.5 l. According to this indicator, the lactating animals during the two experimental years were within the limits of milk yield indicated in the Catalogue of livestock animal breeds in the Republic of Bulgaria (2017), but in 2020 they registered lower milk yield. The lower milk yield in 2020 could be partly explained by the higher number of young animals lactating for the first time.
Fig. 1. Average milk yield (l) for a 120-day milking period in 'Karakachanska' sheep breed

Thus, the milk yield of 'Karakachanska' sheep registered in the current experiment in 2019 was close to that found by Tsochev et al. (1999), which was 41.131 l. The variation on this basis in different authors is very large, as in Genkovski et al. (2002) it was 55.970 l, and in Boykovski (2003) it was 37.640 l.

The lactation curves reflecting the sheep milk yield for the control day for both experimental years (2019 and 2020) are presented in Figure 2. There were noncharacteristic lactation curves in both experimental years. The lower milk yield of the first (in 2019 - 0.386 l and 0.311 l) milking control can be explained by the shorter time from the beginning of milking, due to which the animals have not yet reached their full potential. Then, by the end of the milking period, the milk yield decreased following the normal patterns of lactation course.
Lactation period are shown by the lactation curve in the studies of Petrova et al. (1998) and Oravcová et al. (2015).

In both years, the highest average daily milk yield was established at the II control (May) 0.556 l in 2019 and 0.391 l for 2020, which corresponds to the findings of Tsochev et al. (1999). The values reported by the authors for the average daily milk yield by months are as follows: April – 0.373 l, May – 0.473 l, June – 0.249 l and July – 0.165 l and is close to what we received.

In May 2019, the milk yield of ‘Karakachanska’ sheep was higher than in 2020.

In ‘Karakachanska’ sheep, depending on the pigmentation of the fleece and the head and legs, Gerchev et al. (2017) found a higher average daily milk yield in April – 0.368-0.440 l. Genkovski et al. (2002) reported an average daily milk yield in the period April-July, from 0.580 to 0.290 l, and also reported the highest value of the indicator in April, which does not coincide with the present study.
However, the average daily milk yield established by the two author teams is close to the results in the present study.

**CONCLUSIONS**

During the study of the effect of the marketing year on the milk yield, a significant impact of the marketing year factor \( F=4.6^* \) on the values of milk yield (46.4 l and 34.5 l) was found in ‘Karakachanska’ sheep breed.

There were noncharacteristic lactation curves in both experimental years.

/ REFERENCES /


проучвание растежните способности, количеството и качеството на месото на агнета от породите Котленска и Тетевенска

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Study on the Growth Abilities, Quantity and Quality Indicators of Lamb Meat of ‘Kotlenska’ and ‘Tetevenska’ Breeds

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Original scientific paper

спериментът бъде проведен в Институт по планинско животновъдство и земеделие - роан. Тоa ѝ е проведено със възможност и цел на уточняване на угоителните способности, меродийност и качество на месото от местните породи етевенска и отленска (включени в списъка на Министерство за земеделие, ветеринария и рибарство за застрашени породи).

животните, включени в опита са отбити на 45дневна възраст при 14-23 кг живо тегло и интензивно угоени до 60 дни. Резултатът от този опит е уточняване на угоителната способност, меродийност и качество на месото от местните породи ‘Котленска’ и ‘Тетевенска’ (включени в списъка на Министерство за земеделие, ветеринария и рибарство за застрашени породи).

възрастът на животните е 45 дни, а живата мазнастост е 14-23 кг. Интензивното угоение е продължено до 60 дни. За изчисляване на растежните способности на животните, меродийност и качество на месото е използван метод на интензивно угоение за 60 дни. Резултатите от изчисляване на растежните способности, меродийност и качество на месото са показвани на таблицата.

A comparative experiment was conducted at the Experimental Base of the Research Institute of Mountain Stockbreeding and Agriculture in Troyan. Its objective was to observe the fattening abilities, meat yield and meat quality of local sheep breeds, such as ‘Tetevenska’ and ‘Kotlenska’ (included in the list of Ministry of Agriculture, Food and Forestry for endangered breeds).

The animals included in the experiment were weaned at 45 days of age at 14-23 kg live weight and intensively fattened for 60 days. As a result of the study, it was found that ‘Tetevenska’ male lambs had the highest growth intensity, higher average daily growth for the whole fattening period with 0.250 kg, while the ‘Kotlenska’ male lambs weighed 0.201 kg. The lowest consumption of fodder in FUG and PDI (Protein digestible in intestine) per 1 kg growth was found in ‘Kotlenska’ male lambs (5.77 FUG and 897g PDI). Male lambs of the Teteven breed spent 18.63% less FUG and 18.64% less PDI per 1 kg of growth than females of the same breed.
Мъжките и женските агнета от Котленската порода са с по- високи стойности по отношение на теглото на топъл и охладен труп, спрямо тези от етевенск т пород.

н й-висок кл ничен р ядем н с женските гнет от етевенск т пород – 42,16%, с н й-нисък – мъжките от същ т пород – 37,72%.

ъотношението кости-месо (коефициент н месод йност) при мъжките гнет от етевенск т пород е 1:2,66, при женските е 1:3,04. оефициентът е н й-висок при женските етевенски и н й-нисък при женските отлески гнет.

ключови думи: етевенск пород овце, отленск пород овце, гнет, угоителни способности, интензитет н р стеж, коэффициент н месод йност

стежът и р звятието н животните се определят от техните следствени з ложби, условия н външ - т сред (гл вно хр ненето), к кто и вз имодействието н тези др ф ктор.

кономическ т ефективност при отглежд нето н овце в н й-висок степен се определя от приходите от месо и от р зходите н фур ж з единиц продукция. ри условият н п з рн т икономик е н ложително з дълбочно проучв н н опим лните срокове з угоя н н мл дите животни и н й-ефективното предкл нично тегло.

роучв нят н много втори върху угоителните способности и кл - ничните к чест и к чест в н месо то н гнет т от местни (грубовълности), полутънкорунни, тънкорунни и млечни породи овце и техните кръстоски пок зв т, че опим лното живо тегло з кл не при тях е между 30 и 40 кг (Stankov, 1983; Boykovski, 1995; Nedelchev and Raicheva, 2001; Slavova et al., 2001; Nedelchev, 2005; Ignatova et al., 2005; Slavov et al., 2005; Laleva et al., 2007; Raschidi et al., 2008; Stancheva et al., 2011 и други).

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Male and female lambs of ‘Kotlenska’ breed had higher values in terms of hot and cold carcass weight than ‘Tetevenska’ breed.

The ‘Tetevenska’ female lambs had the highest slaughter yield (42.16%), and the male lambs of the same breed had the lowest (37.72%).

The ratio of bones to meat (coefficient of meat yield) in ‘Tetevenska’ male lambs was 1: 2.66, and in females was 1: 3.04. The highest coefficient was registered for ‘Tetevenska’ female lambs and the lowest for female ‘Kotlenska’ lambs.

Key words: ‘Tetevenska’ sheep breed, ‘Kotlenska’ sheep breed, lambs, fattening abilities, growth rate, coefficient of meat yield

INTRODUCTION

The growth and development of animals are determined by their hereditary information, environmental conditions (mainly nutrition), and the interaction of these two factors.

The economic efficiency of sheep farming is largely determined by meat revenues and feed costs per unit of production. In a market economy, an in-depth study of the optimal timing for fattening young animals and the most effective pre-slaughter weight is imperative.

Studies by many authors on the fattening and slaughtering abilities and qualities of lamb meat from local (coarse-wool, semi-fine-wool, fine-wool and dairy sheep breeds and their crossings) show that the optimal live weight for slaughter is between 30 and 40 kg (Stankov, 1983; Boykovski, 1995; Nedelchev and Raicheva, 2001; Slavova et al., 2001; Nedelchev, 2005; Ignatova et al., 2005; Slavov et al., 2005; Laleva et al., 2007; Raschidi et al., 2008; Stancheva et al., 2011 etc.).
The preferences of consumers in some European countries (Italy and Greece) to consume lamb from so-called dairy lambs (light carcasses) and the associated certain prices provide for lambs to be sold at 25-28 kg live weight, corresponding to 10.00-13.00 kg carcass weight (Stancheva and Staykova, 2009).

Cunhal-Sendium et al. (2003) from their marketing research in Spain concluded that 68-75% of the lamb carcasses at the market weighed 8.5-13.00 kg.

Pinkas and Marinova (1984) argue that criteria for the taste and technological qualities of meat will in future be included as key criteria in the breeding and selection programs of different species of farm animals.

The objective of the present study was to establish the fattening abilities, meat yield and meat qualities of male and female lambs of ‘Tetevenska’ and ‘Kotlenska’ sheep breeds (included in the list of Ministry of Agriculture, Food and Forestry as being endangered).

**MATERIAL AND METHODS**

The comparative experiment was conducted in 2019 in the Experimental Base of RIMSA in Troyan and the meat laboratory of Trakia University in Stara Zagora. The animals included in the experiment were taken from farms raising purebred herds of the above-mentioned breeds in the areas of Teteven and Kotel. The total number of experimental lambs was 16. Four groups – two of each breed, were formed, including four male and four female lambs, respectively. Experimental animals were weaned at 45 days of age at 14-23 kg live weight. The groups were formed by the method of analogues - an equal number of male and female lambs and an equal number of singles and twins. The animals were raised freely in boxes on non-removable litter, in accordance with the requirements to the parameters.
of the living environment of sheep and goats in stable and pasture breeding, according to Regulation No 44 of April 2006 on veterinary requirements for livestock farms.

The fodder feeding took place in combined feeders, as the animals were fed at their free will with compound fodder for lambs (KF-180), certified and produced by a feed factory in Lovech, containing in 1 kg 0.84 FUG and 132.98 g PDI and ground alfalfa hay containing in 1 kg 0.63 FUG and 96.53 g PDI. Feed consumption was reported daily and periodically. The live weight control of the experimental lambs was performed every 15 days with an accuracy of 0.5 kg.

To establish the quantity and slaughter qualities of the meat, a slaughter analysis was performed after a 60-day fattening period. Three lambs were slaughtered from each experimental group with a live weight closest to the average for the group. The slaughter was carried out in accordance with the requirements of Regulation No22 of 14 December 2005 (To minimize the suffering of animals during slaughter or killing). The carcasses were cooled at 40°C for 24 h, then cut in half by cutting along the spine and cut according to the method of Zahariev and Pinkas (1979). The meat analyzes were performed in the laboratories of RIMSA in Troyan and Trakia University in Stara Zagora, according to the methodology described by Pinkas (1969), and Pinkas and Marinova (1984). The weight ratio of all parts was determined and the content of meat, bones and fats was determined, as well as the ratio of bones to meat in the carcass in the individual sections.

The results are processed through variation statistics, by the software product Statistics for Windows 2015, and graphically in Microsoft Excel.
RESULTS AND DISCUSSION

Growth intensity/rate and feed consumption per unit of lamb production are the factors determining the economic efficiency of sheep farming in the foothills and mountains of Bulgaria, and for herds raised without milking, it is crucial.

The data for accumulation of live weight for a 60-day fattening period of lambs from the studied breeds in the region of the Central Balkan Mountain are showed in Table 1.

<table>
<thead>
<tr>
<th>Breed</th>
<th>№</th>
<th>Sex</th>
<th>Live weight at the beginning of the experiment</th>
<th>Live weight at the end of the experiment</th>
<th>Absolute growth, kg</th>
<th>Average daily gain, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetevenska'</td>
<td>4</td>
<td>M</td>
<td>16.45±0.61</td>
<td>31.25±1.13</td>
<td>14.80±1.14</td>
<td>0.250±0.02</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>F</td>
<td>16.95±1.05</td>
<td>29.00±0.14</td>
<td>12.05±0.93</td>
<td>0.200±0.02</td>
</tr>
<tr>
<td>Kotlenska'</td>
<td>4</td>
<td>M / M</td>
<td>20.75±1.11</td>
<td>32.75±0.63</td>
<td>12.00±0.58</td>
<td>0.201±0.01</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>F</td>
<td>20.00±1.22</td>
<td>30.00±1.94</td>
<td>10.00±1.13</td>
<td>0.170±0.02</td>
</tr>
</tbody>
</table>

Male lambs of ‘Tetevenska’ breed had the highest growth intensity compared to those of the other 3 experimental groups. The average daily gain for the whole fattening period was 0.250 kg, while the males of ‘Kotlenska’ breed was 0.201 kg, which was 20% less. Growth rate of ‘Tetevenska’ female lambs was also higher by an average of 0.034 kg (by 15%) compared to the analogous group of ‘Kotlenska’ breed. When the experiment was set, the lowest average live weight (16.45 kg) was registered for ‘Tetevenska’ male lambs, but in the fattening process they went ahead of the female animals. A higher growth rate was also registered in male ‘Kotlenska’ breed compared to female with 15%.

The feed consumption in FUG and PDI per 1 kg of growth was the lowest in ‘Tetevenska’ male lambs (3.93 and 611 g PDI), and the highest in ‘Kotlenska’
жениските агнета от отлениск т пород – 5,77 и 897 g. Жълките агнета
от етевенск т пород с изр зноили с 18,63% по-м лко и 18,64% по-
м лко в 1 kg прираст ст от женските
от същ т пород (блиц 2).

блиц 2. входн фур ж, и 1kg прираст ст
Table 2. Feed consumption, FUG and PDI per 1kg of growth

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>Sex</th>
<th>Сърцено фур ж</th>
<th>Концентриран фур ж</th>
<th>Бълкъс фур ж</th>
<th>Бромни единици за растеж (FUG)</th>
<th>Протеин смилаем в червата (PDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tetevenska</em></td>
<td>4</td>
<td>M</td>
<td>2.02</td>
<td>3.56</td>
<td>3.93</td>
<td>611</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>F</td>
<td>2.48</td>
<td>4.37</td>
<td>4.83</td>
<td>751</td>
<td></td>
</tr>
<tr>
<td><em>Kotlenska</em></td>
<td>4</td>
<td>M</td>
<td>2.49</td>
<td>4.32</td>
<td>4.81</td>
<td>748</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>F</td>
<td>2.99</td>
<td>5.18</td>
<td>5.77</td>
<td>897</td>
<td></td>
</tr>
</tbody>
</table>

Мъжките агнета на Тетевенската порода спестили 18,63% по-
малко FUG и 18,64% по-малко PDI за 1 kg прираст при женските
от същата порода (Таблица 2).

Таблица 2. Разход на фураж, КЕР и ПСЧ за 1 kg прираст
Table 2. Feed consumption, FUG and PDI per 1kg of growth

Разход на фураж за 1 kg прираст

Порода

Бreed

n

Пол

Sex

Концентриран фураж, kg

Concentrated fodder, kg

Сърбести фураж, kg

Bulky fodder, kg

Концентриран фураж

Concentrated fodder

Сърбести фураж

Bulky fodder

Бромни единици за растеж (FUG)

Fodder units for growth (FUG)

Протеин смилаем в червата (PDI)

Protein digestible in intestine (PDI)

Установените средни стойности

The established mean values of live

weight before slaughter, hot carcass

weight, cold carcass weight and slaughter

yield by breed and sex are shown in Table

3.

Таблица 3. Предкланично живо тегло, тегло на трупа и кланичен рандема
Table 3. Pre-slaughter live weight, carcass weight and slaughter yield

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>Сърбество тегло</th>
<th>Hot carcass weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Tetevenska</em></td>
<td>3</td>
<td>30.67±1.36</td>
<td>11.80±2.14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>27.83±0.17</td>
<td>11.73±0.15</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>33.33±0.33</td>
<td>13.63±0.38</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>30.17±2.24</td>
<td>12.17±1.01</td>
</tr>
</tbody>
</table>

Таблица 3. Предкланично живо тегло, тегло на трупа и кланичен рандема

The data analysis in Table 2 shows

that the male 'Tetevenska' breed

achieved 1 kg growth with 18.30% less

FUG and 18.32% less PDI compared to

those of 'Kotlenska' breed. Female lambs

of 'Tetevenska' breed spent 16.29% less

FUG and 16.28% less PDI per 1 kg of growth than females of 'Kotlenska' breed.

The established mean values of live

weight before slaughter, hot carcass

weight, cold carcass weight and slaughter

yield by breed and sex are shown in Table

3.

The data in the table show that the highest pre-slaughter live weight are male

lambs from the Kotlen breed – 33.33 kg,

and the lowest from 'Tetevenska' female
женските гнет от етевенск т пород, к то р злики т е м тем тически док з н.

ъжжите и женските гнет от отлеснск т пород, с с по-високи стойности по отношение н теглото н топъл труп и тегло н охл ден труп, спрямо тези от етевенск т пород. 

ъжжествуих м тем тически док з ност н р злики между отлеснск т и етевенск т пород. ъжжите гнет от отлеснск т пород превъзхожд т женските по отношение н посочените дв признак к, при етевенските гнет н р злики с миним лин,

то нятите в същ т блиц е видно, че с н й-висок кл нищен р нд не м н с женските гнет от етевенск т пород – 42,16%, с н й-висок мъжките от същ т пород – 37,72%.

идем нът н котленските гнет з ем междинно положение, между женските и мъжките при тях не се н блюд в съществен р злики резулт тите от р зф совк т н трупчет н съгл сно методик т с отр зени н блиц 4.

блиц 4. егл о отделните ч сти при р зф совк т и % от теглото н половин т

Table 4. Weight of the individual parts in the carcass cutting and % of the weight of the half

<table>
<thead>
<tr>
<th>Breed / пород</th>
<th>етевенск / 'Tetevenska'</th>
<th>отлеснск / 'Kotlenska'</th>
</tr>
</thead>
<tbody>
<tr>
<td>м / ж</td>
<td>м / ж</td>
<td>м / ж</td>
</tr>
<tr>
<td>kg</td>
<td>%</td>
<td>kg</td>
</tr>
<tr>
<td><strong>Neck</strong> / р т</td>
<td>0.484</td>
<td>8.50</td>
</tr>
<tr>
<td><strong>Shoulder</strong> / плешка</td>
<td>1.095</td>
<td>19.20</td>
</tr>
<tr>
<td><strong>Loin</strong> / пояна</td>
<td>0.601</td>
<td>10.55</td>
</tr>
<tr>
<td><strong>Leg</strong> / бут</td>
<td>1.877</td>
<td>32.92</td>
</tr>
<tr>
<td><strong>Chest</strong> / гръден кош</td>
<td>1.220</td>
<td>21.41</td>
</tr>
<tr>
<td><strong>Belly</strong> / корем</td>
<td>0.370</td>
<td>6.49</td>
</tr>
<tr>
<td><strong>Tail</strong> / опашка</td>
<td>0.082</td>
<td>1.44</td>
</tr>
</tbody>
</table>

т отр зените в блиц 4 резулт ти з р зф совк т н ляв т половин е видно, че с н й-високо тегло н с н й-голям относителен дял от нея при всички опитни групи е бут.

й-висок среден стойност по този пок з тел е уст новен при мъжките гнет от отлеснск т пород –
2,075 kg (31.01%). The average values for leg weight in the other groups yield by about 0.200 kg from that of the above-mentioned group, as in ‘Tetevenska’ male lambs, the absolute figures are 1.877 kg (32.92%) and 1.859 kg (31.51%) in ‘Kotlenska’ females, and the lowest in ‘Tetevenska’ female lambs with 1.805 kg (30.81%).

The established average indicators for the relative share of the weight of the left half in kilograms and percentages in second place are they, and the chest. The lowest is the absolute weight in kg 1.220 and 21.43% in the group of ‘Tetevenska’ female animals.

It is noteworthy that the averages of the other three groups do not differ significantly. The indicators for the shoulder meat are in the third place, as the differences among groups are relatively small. The results obtained in the rest sections for the weight ratio of the half parts are with similar average values and do not give reason for specifying of breed and sex differentiation.

Data on the content of meat, bones and fat in the individual parts of the carcass after boning, in percentages, are shown in Table 5.

The obtained results show that the highest percentage of meat from the leg was gathered from male ‘Kotlenska’ lambs, followed by the ‘Tetevenska’ female lambs with 66.32%, ‘Tetevenska’ male lambs with 66.22% and the lowest in ‘Kotlenska’ female lambs with 56.79%. The results are mixed, both between breeds and between sexes. The summarized data show that the highest percentage of meat was obtained from the group of ‘Tetevenska’ male lambs with 61.79%, and the lowest in ‘Kotlenska’ female lambs with 56.79%. The highest relative share of bones in the carcass was registered in the males of ‘Tetevenska’ breed with 23.24%, followed by the female ‘Kotlenska’ breed

...
23.09% и н й-нисък при женските етевенски гнет – 19.43%. Въпреки това, женските от етевенската порода държат най-висок процент остатъчна влага. Най-висок процент съдържание на мазнини имат мъжките от етевенската порода с 21.81%, а най-нисък съдържание на мазнини – 14.97% при женските от етевенска порода.

Таблица 5. Съдържание на месо, кости и тлъстини в отделните части на трупа, в %

<table>
<thead>
<tr>
<th>Брой / Breed</th>
<th>'Тетевенска' / 'Tetevenska'</th>
<th>'Котленска' / 'Kotlenska'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Месо / meat</td>
<td>57.81</td>
<td>54.41</td>
</tr>
<tr>
<td>Кости / bones</td>
<td>16.86</td>
<td>17.22</td>
</tr>
<tr>
<td>Мазнини / fat</td>
<td>25.33</td>
<td>28.37</td>
</tr>
<tr>
<td>Месо / meat</td>
<td>55.82</td>
<td>55.57</td>
</tr>
<tr>
<td>Кости / bones</td>
<td>25.72</td>
<td>19.61</td>
</tr>
<tr>
<td>Мазнини / fats</td>
<td>18.46</td>
<td>24.72</td>
</tr>
<tr>
<td>Месо / meat</td>
<td>66.22</td>
<td>66.32</td>
</tr>
<tr>
<td>Кости / bones</td>
<td>25.48</td>
<td>20.00</td>
</tr>
<tr>
<td>Мазнини / fats</td>
<td>9.20</td>
<td>13.68</td>
</tr>
<tr>
<td>Месо / meat</td>
<td>69.55</td>
<td>57.75</td>
</tr>
<tr>
<td>Кости / bones</td>
<td>27.13</td>
<td>23.79</td>
</tr>
<tr>
<td>Мазнини / fats</td>
<td>12.95</td>
<td>24.64</td>
</tr>
</tbody>
</table>

Съотношението кости/месо (коefficient на месодайност) при мъжките агнета от етевенската порода е 1:2.66, а при женските – 1:3.024. При мъжките агнета от етевенска порода е 1:2.808, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението е високо при мъжките агнета, а най-нисък при женските агнета гнет. При мъжките тенденцията е обратна, с коeficient на месодайност е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46. Съотношението на месо към кости при мъжките агнета от етевенска порода е 1:2.66, а при женските е 1:2.46. Резултатите съотношение е 1:2.808, при женските е 1:2.46.
The length measurements of the carcass (large and small) and the circumference of the leg in lambs of both breeds by sex are shown in Table 6.

Table 6. Linear measurement of cold carcass and topographic localization of carcass fats

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>Skin thickness, mm</th>
<th>Large length of carcass, cm</th>
<th>Small length of carcass, cm</th>
<th>Width of carcass, cm</th>
<th>Leg girth, cm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>x±Sx</td>
<td>x±Sx</td>
<td>x±Sx</td>
<td>x±Sx</td>
<td>x±Sx</td>
</tr>
<tr>
<td>Tetevenska</td>
<td>3♂</td>
<td>3.83±0.44</td>
<td>19.92</td>
<td>59.33±2.96</td>
<td>6.13</td>
<td>21.67±0.33</td>
</tr>
<tr>
<td></td>
<td>3♀</td>
<td>3.50±0.29</td>
<td>14.29</td>
<td>59.67±2.33</td>
<td>6.77</td>
<td>22.00±0.58</td>
</tr>
<tr>
<td>Kotlenska</td>
<td>3♂</td>
<td>4.70±0.36</td>
<td>13.29</td>
<td>62.00±4.58</td>
<td>12.80</td>
<td>19.00±0.00</td>
</tr>
<tr>
<td></td>
<td>3♀</td>
<td>4.93±0.07</td>
<td>2.34</td>
<td>54.33±1.33</td>
<td>4.25</td>
<td>17.00±0.58</td>
</tr>
</tbody>
</table>

The highest average value for the skin thickness was measured in ‘Kotlenska’ lambs of both sexes – in males – 4.7 mm and females with 4.93 mm, and they were superior to ‘Tetevenska’ lambs by more than 1 mm – respectively with 3.83 mm and, 50 mm. The highest average value for the large length of the cold carcass was registered in ‘Kotlenska’ male lambs with 62 cm and the lowest in the females with 54.32 cm. The indicators for ‘Tetevenska’ breed occupy an intermediate position, and there is a significant difference between the sexes. The values for the small length of the cold carcass in ‘Tetevenska’ breed exceeded ‘Kotlenska’ breed. In the former, no gender difference was found. The results are significantly different in ‘Kotlenska’ animals, where the average of the males exceeds that of the females by approximately 5 cm. This tendency is also observed with regard to the widths of the carcasses with 22.00 cm for the female and 21.67 cm for the ‘Tetevenska’ male lambs and 19.67 cm for the female and 19.00 cm for the male ‘Kotlenska’ lambs. Within the groups, the male lambs are slightly inferior to the females in both

блици 6. инейни измервания на охладен труп и топографска локализация на тлъстините на трупа
The same table also shows the average values for the circumference of the leg, as the highest value was registered in ‘Tetevenska’ female lambs with 18.00 cm, and the lowest for males of the same breed with 16.00 cm.

No difference between the sexes was observed in the leg girth of a cold carcass in ‘Kotlenska’ breed animals. The results from the present study are close in values and correspond to those published by various authors (Stankov, 1983; Laleva et al., 2007; Stancheva et al., 2010; Markova, 2020).

CONCLUSIONS

Male lambs of ‘Tetevenska’ breed had the highest growth intensity compared to those of the other 3 experimental groups.

The average daily gain for the fattening period (60 days) in ‘Tetevenska’ male lambs was 0.250 kg, while in males of ‘Kotlenska’ breed was 0.201 kg, which was 20% less. Growth rate of ‘Tetevenska’ female lambs was also higher by an average of 0.034 kg (by 15%) compared to the analogous group of ‘Kotlenska’ breed.

The feed consumption in FUG and PDI per 1 kg of growth was the lowest in ‘Tetevenska’ male lambs (3.93 КЕР and 611 g PDI), and the highest in ‘Kotlenska’ female lambs (5.77 FUG and 897 g PDI). Male lambs of ‘Tetevenska’ breed spent 18.63% less FUG and 18.64% less PDI per 1 kg of growth than females of the same breed.

‘Tetevenska’ female lambs had the highest slaughter yield (42.16%), and the male lambs of the same breed had the lowest (37.72%). The indicators of ‘Kotlenska’ lambs occupies an intermediate position, and there is no significant difference between females and males, respectively 40.33% and 40.90%.
The highest percentage of meat from the leg was gathered from ‘Kotlenska’ male lambs (67.71%), followed by ‘Tetevenska’ female lambs with 66.32%, the ‘Tetevenska’ male lambs with 66.22%, and the lowest was in ‘Kotlenska’ female lambs with 64.22%.

The coefficient of meat yield in ‘Tetevenska’ male lambs was 1: 2.66, and in females was 1: 3.024. For ‘Kotlenska’ male lambs this ratio is 1:2.808, and for female lambs it is 1:2.46. The highest coefficient is registered in ‘Tetevenska’ female lambs while the lowest in ‘Kotlenska’ male animals.

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and Its Crossbreeds with the Participation of Australian Merino and Ile de France


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gд лен бл ков , велен в нов *, дя инчев ,
влин рист кiev , итко лев
екция “ звъзд не и технологии в птицевъдството и з йевъдството”,
емеделски институт - т р гор , елскостоп нск к демия, ъл гия

Evaluation of New Slow-growing Chickens Genotypes:
I. Growth Performance and Slaughter Traits

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Original scientific paper

SUMMARY
An experiment was conducted to evaluate the effect of genotype on meat traits of slow-growing chickens until they attained a maximum live weight of 3.000-3.200 kg. To this end, six lines of birds were used.

The experimental design comprised 150 day-old chickens in each group. The live weight, daily feed consumption and feed conversion ratio were followed out. At the end of the trial at reaching maximum live weight close to group average, slaughter analysis was performed separately for each of genotypes.

According to the results, the combination $\sigma^* \times \varphi L$ attained an average live weight for male and female chickens of 2709.29 g at 70 days of age, whereas the combination $\sigma^* \times \varphi F$ attained 3334.75 g at 84 days of age.
The live weight of birds from combinations $\sigma^I x \varphi E$ and $\sigma^I x \varphi F$ at 84 days of age was 2205.88 g and 1924.78 g, respectively.

Throughout the experiment, feed consumption per 1 kg weight gain ranged from 2.303 kg/kg weight gain for the broiler genotype $\sigma^I x \varphi L$ to 3.190 kg/kg weight gain for the combination $\sigma^I x \varphi E$.

The slaughter analysis showed that the proportion of grill from live weight was the highest in combinations $\sigma^I x \varphi E$ and $\sigma^I x \varphi F$: 65.71% and 71.69% respectively (female chickens); 65.80% and 71.10% (male chickens). The most valuable poultry cut – breast meat was the heaviest in $\sigma^I x \varphi F$ birds – 493 g on the average for females and 535 g in males.

The tested combinations of hen and rooster lines were evaluated as suitable for production of slow-growing chickens.

**Key words:** slow-growing chickens, live weight, feed consumption, slaughter traits

**INTRODUCTION**

Modern consumers are increasingly concerned about the safety-quality association of meat products, as well as about animal welfare (Hermansen, 2003; Grunert et al., 2004).

That is why, for fattening of meat type animals, genotypes suited for extensive husbandry are sought in order to improve the welfare of birds.

During the last years, broiler chicken farming is characterised with using combinations with slower growth rates, good feed conversion and better meat organoleptic properties (Sundrum, 2001; Castellini et al., 2002; Gordon and Charls, 2002; Rizzi et al., 2007).

One of the most successful strains of slow-growing chickens in Europe are
those of Label Rouge. Their production traits have been tested in various husbandry systems up to 63 and 120 days of age. Yang and Jiang (2005) reported that Label Rouge chickens attained a live weight of 2.2-2.5 kg after 12 weeks.

A number of researchers have evaluated the effect of genotype on growth performance of slow-growing broiler chickens. Mikulski et al., (2011) compared production traits of fast and slowly growing chicken genotypes and found out that at the end of fattening, the live weight of slow-growing birds was 17% lower. At 65 days of age, they attained 3.64 kg. Fanatico et al., (2009) investigated three chicken genotypes – one fast-growing, two medium-growing and one slow-growing under intensive system up to 53, 67 and 81 days of age. The authors reported a final live weight of 2.61 kg, 2.50 kg, 2.33 kg and 2.11 kg and feed conversion ratios (FCR): 2.13 kg, 2.68 kg, 2.77 kg and 3.58 kg respectively. Tang et al., (2009) found out that at the end of fattening, the live weight of slow-growing chicken genotypes – one fast-growing, two medium-growing and one slow-growing until 49, 56 and 112 days of age, respectively reporting slaughter weight of 2.009 kg for the conventional type, 1.689 kg for local chickens and 1.60 kg, 1.48 kg and 1.47 kg for slow-growing genotypes.

This experiment was designed to evaluate the effect of genotype on meat performance of slow-growing broiler chickens until they attained a maximum live weight of 3.000-3.200 kg through determination of growth dynamics and evaluation of slaughter traits of fattened chickens.

**MATERIAL AND METHODS**

The subject of the study comprised five genotypes of slow-growing broiler chickens, produced as follows:
The experiment was performed in the nucleus farm of the Department of Breeding and Technology in Poultry and Rabbit Farming at the Agricultural Institute - Stara Zagora. To this end, six chicken lines were used. Original maternal forms used in the breeding schedule were Line E (Barred Plymouth Rock), Line Ss (Sussex), Line F, Line L (White Plymouth Rock), and paternal forms: Line (Cornish) and Line I.

Chickens were reared on deep permanent wooden shavings litter in line with the technology adopted at the selection base of the Agricultural Institute - Stara Zagora. The chickens had constant access to compound feeds produced at the feed factory of the institute according to their category and age.

Feeding regimen consisted of starter (1-14 day), grower (15-28 day) and finisher (29-84 day). The composition and nutritional value of compound feeds are shown in Table 1 (AOCA, 1996).

<table>
<thead>
<tr>
<th>Nutritional value</th>
<th>т ретър 1-14 ден (Starter 1-14 day)</th>
<th>роуер 15-28 ден (Grower 15-28 day)</th>
<th>инишиер 29-84 ден (Finisher 29-84 day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>уровень протеин / Crude protein, %</td>
<td>21.16</td>
<td>19.37</td>
<td>18.77</td>
</tr>
<tr>
<td>уровень м жици / Crude fat, %</td>
<td>8.18</td>
<td>5.92</td>
<td>5.90</td>
</tr>
<tr>
<td>общна енергия / Metabol. energy, kcal/kg</td>
<td>1927.77</td>
<td>2148.15</td>
<td>2194.26</td>
</tr>
<tr>
<td>уровень вл жици / Crude fiber, %</td>
<td>4.45</td>
<td>4.11</td>
<td>4.12</td>
</tr>
<tr>
<td>лизин / Lysine, %</td>
<td>0.97</td>
<td>0.90</td>
<td>0.78</td>
</tr>
<tr>
<td>съдом фосфор / Utilisable phosphorus, %</td>
<td>0.80</td>
<td>0.45</td>
<td>0.69</td>
</tr>
<tr>
<td>етионин / Methionine, %</td>
<td>0.46</td>
<td>0.44</td>
<td>0.38</td>
</tr>
<tr>
<td>изин / Lysine, %</td>
<td>1.19</td>
<td>1.11</td>
<td>0.98</td>
</tr>
</tbody>
</table>
Live weight was monitored at 1, 14, 28, 42, 56, 70 and 84 days of age by individual weighing. Feed consumption for each genotype was determined as difference between the amount of offered and non-consumed feed at 14, 28 and 84 days of age. Livability was checked on a daily basis. On the basis of these parameters, the daily weight gain, daily feed consumption and feed conversion ratios were calculated.

For general assessment of used broiler combinations, the European production efficiency factor (EPEF) was calculated using the formula:

\[
EPEF = \frac{\text{Live body weight (kg) \times Livability (%)} \times 100}{\text{Fattening period (days) \times Feed intake per 1 kg weight gain}}
\]

In the end of the experiment, a full slaughter analysis was done on 3 female and 3 male birds from each group with live weight corresponding to the average of the genotype. After 12-hour fasting, birds were stunned and slaughtered in accordance of stipulation of Regulation 22/14.12.2005 of the Ministry of Agriculture. The grill percentage, weight of different cuts (breast, thighs, wings, neck, ribcage), weight of edible offal (heart, liver, gizzard) and abdominal fat were determined. On the basis of these data, ratios between different body parts were calculated.

The results were statistically processed (ANOVA/MANOVA; LSD post hoc test), to evaluate the effects of genotype and sex using statistical software Statistica 8 (StatSoft, 2009). Percentage data were arsine transformed prior to the statistical analysis.
**RESULTS AND DISCUSSION**

Live weights of broiler chickens from different groups and genotype for the different age periods are listed in Table 2.

Until 42 days of age, chickens were not separated by sex. The analysis of data demonstrated that genotype had a statistically significant effect ( <0.001) on weight of day-old chicks.

Also, it was found out that the weight of hatchlings differed among genotypes ( <0.001). Live weight of ay-old chicks from group IV групa (♂ x ♂) had an average weight of 41.04 g. Then followed those from group II (♂ x ♀) with 40.72 g. Day-old chicks from groups I (♂ x ♂) and V (♂ x ♂Ss) were significantly lighter compared to groups IV (♂ x ♀) and II (♂ x ♀) at <0.001.

### Table 2. Live weight of slow-growing broilers from 1-42 day of age (g)

<table>
<thead>
<tr>
<th>Age</th>
<th>Group</th>
<th>I-group</th>
<th>II-group</th>
<th>III-group</th>
<th>IV-group</th>
<th>V-group</th>
<th>VI-group</th>
<th>pooled SEM</th>
<th>p-value genotype</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>д</td>
<td>♀ x ♂</td>
<td>♂ x ♀</td>
<td>♀ x ♂</td>
<td>♂ x ♀</td>
<td>♀ x ♂Ss</td>
<td>♂ x ♂L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 d</td>
<td>d</td>
<td>39.23*</td>
<td>40.72*</td>
<td>38.08*</td>
<td>41.04*</td>
<td>32.03*</td>
<td>35.58*</td>
<td>0.55</td>
<td>0.001</td>
</tr>
<tr>
<td>14 d</td>
<td>с</td>
<td>111.56*</td>
<td>98.44*</td>
<td>143.80*</td>
<td>94.72*</td>
<td>196.84*</td>
<td>2.59</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>28 d</td>
<td>с</td>
<td>371.73*</td>
<td>358.02*</td>
<td>317.64*</td>
<td>448.80*</td>
<td>319.51*</td>
<td>662.84*</td>
<td>8.77</td>
<td>0.001</td>
</tr>
<tr>
<td>42 d</td>
<td>с</td>
<td>714.58*</td>
<td>676.74*</td>
<td>621.78*</td>
<td>880.43*</td>
<td>549.05*</td>
<td>1276.67*</td>
<td>17.96</td>
<td>0.001</td>
</tr>
</tbody>
</table>

* Значимые буквы в ряду м, р, с тест тестики наименьшие и различия (P<0.001)
** Different superscripts within rows indicate statistically significant differences (P<0.001)

In descending order of the weight followed broilers from group I (♂ x ♀) – 118.23 g and group II (♂ x ♀) with 111.56 g. At the end of the starter period, chickens from group III attained 98.44 g, and 196.84 g.
28-я ден от углъван нето т ен-денсия се з п зв и VI груп (♂ X ♂ L) се откара с достоверен р злики в жив т м с (662.84 г), следн х от IV груп (♂F X ♀ ) - с жив м с 448.80 г ( <0.001). Ези резулт ти бих могли да бъд т социир ни с р злики в м - с т н з ложенет и инкуб ция яйц . Изслед не н Hristakieva et al., (2014) m с т н излюпените пилет пок зв зи чителни r злики между генотиповете ( <0.05). Друго изслед не н Pauwels et al., (2015) проведено с четири бройлери хибриди с r злики потенци и н р стеж (Cobb 500, Cobb-Sasso 175, Sasso (XL44 × SA51(A)) и Sussex (Sussex × SA51(A)) се съобщ в, че н 5-седмичен възраст събр орите Cobb 500 достиг т н й-висок жив м с , Sussex × SA51(A) с н й-високо тегло. Енезичен потенци ш п отно-шение н жив т м с във възраст и с тов т дин мик птиците е с р злики н изяв при проучв ните генотипи. Рез първите 42 ден пилет т от VI груп с с н й-високи р стежни способности - 1276.67 г. лед в пилет т от IV груп с 880.43 г. е достоверен превъз-ходж т ( <0.001) резулт тите пок з ни от I, II, III, V групи съответно с 714.58 g, 676.74 g, 621.78 g, 549.05 g.

Поред Gordon and Charles (2002) бързор стащите бройлери им т възраст р стеж и достиг т п з рно тегло н 42-дневен възраст, б вини достиг т п з рно тегло з 62-81 дни. 56-я ден ( блиц 3) след явно проявен полов диморфизмъ бяр отчетени р злики и по пол между с мите групи. Ри проследяв не н получените резулт ти е н лице високо достоверно влияние н генотип по отношение измението н жив т м с с възраст с т ( <0.001).

By the 28th fattening day, this trend was preserved so that group VI (♂ X ♂ L) was outlined with statistically significant different live weight (662.84 g), followed by group IV (♂F X ♀ ) - with 448.80 g ( <0.001). These results could be associated to different weight of incubation eggs. In a study performed by Hristakieva et al., (2014) the weight of hatchlings differed significantly among genotypes ( <0.05). In another report, Pauwels et al., (2015) evaluated four broiler chicken hybrids with different growth potential (Cobb 500, Cobb-Sasso 175, Sasso (XL44 × SA51(A)) and Sussex (Sussex × SA51(A)) and observed that at 5 weeks of age, the live weight of Cobb 500 birds was the highest whereas that of Sussex × SA51(A) – the lowest. The age-related genetic potential with respect to live weight differed among studied genotypes. During the first 42 days of life, chickens from group VI exhibited the highest growth performance - 1276.67 g, followed by birds from group IV with 880.43 g. Those groups were substantially superior ( <0.001) to performance of groups I, II, III, V groups with average weights of 714.58 g, 676.74 g, 621.78 g, and 549.05 g respectively.

According to Gordon and Charles (2002), fast-growing broiler chickens were outlined with a rapid growth rate and market weight at 42 days of age, whereas slowly growing broilers attained slaughter weight for 62-81 days. By the 56th day ( ble 3), after sexual dimorphism was already manifested, sex-related differences among the groups were also considered. The analysis of results showed a very significant effect of genotype on age-related live weight dynamics ( <0.001).
### Table 3. Live weight of slow-growing broilers between 56-84 day of age (g)

<table>
<thead>
<tr>
<th>Group</th>
<th>I-group</th>
<th>II-group</th>
<th>III-group</th>
<th>IV-group</th>
<th>V-group</th>
<th>VI-group</th>
<th>SEM</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ω♂</td>
<td>$1248.49$</td>
<td>$1036.67$</td>
<td>$1142.58c$</td>
<td>$1364.44$</td>
<td>$1545.86c$</td>
<td>$2440.61$</td>
<td>$2108.08b$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♀</td>
<td>$1209.23$</td>
<td>$942.86$</td>
<td>$1076.04cd$</td>
<td>$1626.67$</td>
<td>$1466.44$</td>
<td>$2198.75$</td>
<td>$1926.08a$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♂ + ω♀</td>
<td>$2292.25b$</td>
<td>$1308.67$</td>
<td>$1310.22c$</td>
<td>$2352.03b$</td>
<td>$2132.00$</td>
<td>$2329.25a$</td>
<td>$2329.25a$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♂*</td>
<td>$1314.27$</td>
<td>$1264.26$</td>
<td>$2577.39$</td>
<td>$1540.00$</td>
<td>$2329.25a$</td>
<td>$1968.24$</td>
<td>$1707.75$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♂**</td>
<td>$1308.67$</td>
<td>$2164.67$</td>
<td>$1250.00$</td>
<td>$2198.24$</td>
<td>$1707.75$</td>
<td>$1477.27$</td>
<td>$1707.75$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♀**</td>
<td>$1250.00$</td>
<td>$2221.00$</td>
<td>$2126.67$</td>
<td>$1777.57$</td>
<td>$1707.75$</td>
<td>$1250.00$</td>
<td>$1707.75$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♀**</td>
<td>$1308.67$</td>
<td>$2126.67$</td>
<td>$2126.67$</td>
<td>$2221.00$</td>
<td>$2221.00$</td>
<td>$1250.00$</td>
<td>$1707.75$</td>
<td>$0.001$</td>
</tr>
<tr>
<td>ω♂**</td>
<td>$1250.00$</td>
<td>$2126.67$</td>
<td>$2126.67$</td>
<td>$2126.67$</td>
<td>$2126.67$</td>
<td>$1250.00$</td>
<td>$1707.75$</td>
<td>$0.001$</td>
</tr>
</tbody>
</table>

* VI group - ω♂, ω♀ Инисия L - 70 дни / VI group - ω♂, ω♀ Инисия L - 70 days
** зличните букви в ред м рик t ст тстически зн чими п зики (P<0.001)
*** Different superscripts within rows indicate statistically significant differences (P<0.001)

The best growth performance on the 56th day of life was shown by chickens from group VI ($ω♂ \times ω♀ L$) - 2437.50 g in males and 2221.00 g in females (average of 2329.25 g for both sexes). Then followed group IV ($ω♂ \times ω♀ F$) with males weighing 1802.50 g and females weighing 1752.63 g. The birds from groups I ($ω♂ L \times ω♀ E$), II ($ω♂ L \times ω♀ F$), III ($ω♂ E \times ω♀ F$) and V group ($ω♂ L \times ω♀ Ss$) had statistically significantly lower live weight at that time.

At 70 days of age, group VI ($ω♂ \times ω♀ L$) had a live weight of 2709.29 g, followed by group IV ($ω♂ \times ω♀ F$) with 2352.03 g; they were significantly superior to chickens from group I ($ω♂ L \times ω♀ E$) with average weight of 1545.86 g, group II ($ω♂ L \times ω♀ E$) - 1491.78 g, group III ($ω♂ E \times ω♀ F$) - 1466.64 g and group V ($ω♂ L \times ω♀ Ss$) - 1395.00 g.

The comparison between sexes from point of view of sexual dimorphism is also important with regard to live weight uniformity and slaughter processing. Due to the greater difference in live weight between male and female chickens, the use of slow-growing genotypes could influence uniformity and consequences could become more evident with age.
In this specific case, sexual dimorphism differences for live weight at 84 days of age are shown in Table 3.

Until the end of the fattening period (70 days of age), male birds from group VI attained 2932.50 g, females weighed 2486.09 g with 2709.29 g average weight for both sexes. They were the first to attain a live weight of 3000 g. Fattening period continued for the other groups. So, chickens from group IV ($\delta$ x $\delta$F) attained 3334.74 g vs females, 2660.00 g.

differences between the last two groups were significant. The lowest average group weight (males + females) was observed for hybrids from group V ($\delta$I x $\delta$Ss) - 1707.75 g. The results for live weights were statistically significant in various genotypes and sexes (<0.001).

The genotype-dependent trend for live weight and sex was in general preserved until the end of fattening period. Comparing males and females within each group, it was found out that the weight of males exceeded that of females confirming the sex effect (Musa et al., 2006).

At 70 days of age, conventional male broilers from group VI ($\delta$ x $\delta$L) were superior to females by 15.22%, whereas in groups V ($\delta$ x $\delta$F) and ($\delta$ x $\varphi$) – by 17.48% and 21.29% respectively. The poorest growth performance was exhibited by hybrids from groups V ($\delta$I x $\delta$Ss) and . According to Gordon and Charles (2002), the growth of different birds is influenced by numerous factors, including genotype, age, sex, compound feed, population density, environment and pasture husbandry. Faria et al., (2010) have conducted an experiment to evaluate fattening performance of two genotypes of birds reared until 65, 75 and 85 and 95 days of age. One of genotypes Paraíso Pedres – was outlined with better growth performance than the other (Fescoco Pelado).
оментирни тенденции по отношение на жив т м с в з висимост от генотип и пол в общи линии се з п зв и до 84-ия ден. Идею, че върху експерименталния на върху статия тип пилета от IV група ($\sigma^\prime \times \varphi^\prime E$) достигат тнъжъриски жив мс съответно 3334.74 г в мъжките и 2660.00 г в женските, следователно от I група ($\sigma I \times \varphi^\prime E$) 2440.61 г (мъжки) и 1775.56 г (женски) със средно за груп 2108.08 г.

Върху статия търсят от II група ($\sigma^\prime \times \varphi^\prime E$) достигат тпредпочтител т от потребителя жив мс съответно 3.200 kg н 84 ден със 2198.75 г в мъжките и 1653.33 г в женските и средно за груп 1926.04 г ( <0.001). Впълнение III група ($\sigma I \times \varphi^\prime F$) достигат тето тегло е 2275.56 г в мъжките и 1699.29 г в женските, средно 1987.42 г. е им т регистриран при сходна стойности на по-къс теля жив мс и ем т меджинно положение в н шото изследство не.

Йо-йоюм бихме могли да отбеляжим, че при отчитане на генотип и пол 84 дневни върху съпротивност в жив т м с между птиците от V групи ($\sigma^\prime \times \varphi^\prime F$) и тези от I ($\sigma I \times \varphi^\prime E$) със 28.95 %, тези с груп ($\sigma I \times \varphi^\prime E$) и груп ($\sigma I \times \varphi^\prime E$) групи, съответно 5.72% ( <0.001).

Блиц 4 е отр зен консумация на фурж з едно пиле (г/ден) по периода. Ъвисок консум ция на фурж през ст ретерния период (1-14 ден) им т бройците от VI и I груп съответно 15.72 г и 12.36 г. Ъвисък рход от 7.74 г е отчетен при пилет т от II груп ($\sigma^\prime \times \varphi^\prime E$).

The live weight dependency on genotype and sex was generally preserved until the 84th day of age. It was evident that at the end of the experiment, the slow-growing chickens from group IV ($\sigma^\prime \times \varphi^\prime F$) attained the highest ultimate live weight: 3334.74 g for males and 2660.00 g for females, followed by group I ($\sigma I \times \varphi^\prime E$) with 2440.61 g (males) and 1775.56 g (females) with group average of 2108.08 g.

Slow-growing birds from group II група ($\sigma^\prime \times \varphi^\prime E$) attained the live weight >3.200 kg preferred by consumers on 84 days of age with 2198.75 g for males and 1653.33 g for females and group average of 1926.04 g ( <0.001). In group III ($\sigma I \times \varphi^\prime F$) attained weight was 2275.56 g for males and 1699.29 g for females (average of 1987.42 g). Their live weights were similar and intermediate in our study.

In general, it could be stated that with regard to the genotype, the difference in live weight at 84 days of age between birds from group V ($\sigma^\prime \times \varphi^\prime F$) and group I ($\sigma I \times \varphi^\prime E$) was 28.95 %, and that between group ($\sigma I \times \varphi^\prime E$) and група ($\sigma I \times \varphi^\prime E$) was 5.72% ( <0.001).

Table 4 depicts feed consumption of one chick (g/day) according to growth periods. The highest feed consumption was observed during the starter period (1-14 day) in broilers from groups VI и I - 15.72 g и 12.36 g respectively. The lowest feed intake was found out in group II ($\sigma^\prime \times \varphi^\prime E$) - 7.74 g.

Table 4. Feed consumption per chicken (g/day)

<table>
<thead>
<tr>
<th>Група</th>
<th>I-група</th>
<th>II-група</th>
<th>III-група</th>
<th>IV-група</th>
<th>V-група</th>
<th>VI- група</th>
</tr>
</thead>
<tbody>
<tr>
<td>Възраст</td>
<td>$\sigma I \times \varphi^\prime E$</td>
<td>$\sigma^\prime \times \varphi^\prime E$</td>
<td>$\sigma I \times \varphi^\prime F$</td>
<td>$\sigma^\prime \times \varphi^\prime F$</td>
<td>$\sigma I \times \varphi Ss$</td>
<td>$\sigma^\prime \times \varphi L$</td>
</tr>
<tr>
<td>1-14 ден / ден</td>
<td>12.36</td>
<td>7.74</td>
<td>8.71</td>
<td>11.91</td>
<td>9.09</td>
<td>15.72</td>
</tr>
<tr>
<td>15-28 ден / ден</td>
<td>50.08</td>
<td>34.41</td>
<td>41.20</td>
<td>46.88</td>
<td>41.67</td>
<td>65.15</td>
</tr>
<tr>
<td>29-64 ден / ден</td>
<td>105.01</td>
<td>75.09</td>
<td>96.24</td>
<td>122.41</td>
<td>79.27</td>
<td>124.44</td>
</tr>
<tr>
<td>1-64 ден / ден</td>
<td>78.57</td>
<td>55.78</td>
<td>70.84</td>
<td>89.39</td>
<td>59.87</td>
<td>87.94</td>
</tr>
</tbody>
</table>

*VI група - $\sigma^\prime$ иния x $\varphi$ иния L - за 70 дни / *VI група - $\sigma^\prime$ Line x $\varphi$ Line L - for 70 days
During the starter period (1-14 day), feed consumption per chick was the highest in group IV ($\sigma^I x \varphi F$) - 122.41 g, followed by group I ($\sigma^I x \varphi F$) - 105.01 g and group III ($\sigma^I x \varphi F$) - 96.24 g. The least feed intake was that of group II ($\sigma^I x \varphi E$) - 75.09 g. The data in abovementioned were registered until the 84th day, and for the genotype $\sigma^I x \varphi L$ – until the 70th day when it attained the desired live weight of 3000-3200 g. Over that period, one chick from this group has consumed 124.44 g feed per day.

For the entire rearing period (1-84 day), daily feed consumption per one chick from group IV ($\sigma^I x \varphi F$) was 89.39 g; in that group, birds had the highest average ultimate live weight (2967.37 g).

Then followed group I ($\sigma^I x \varphi F$) with the live weight of 2108.08 g and daily feed intake of 78.57 g. The lowest feed consumption was found out in groups II and V – 55.78 g and 59.87 g respectively. In a 84-day fattening of slow-growing chickens with various genotype, Takahashi et al., (2006) reported total feed consumption of 12631 g for Ross - 308, 9316 g for Paraíso; 6737 g for Pescoço Pelado; and 7359 g in Caipirinha, reared indoor.

Figure 1 shows feed conversion ratios in slow-growing broiler chickens for the respective periods.
During the grower period (15-28 days), the tendency in FCR was similar with lowest values in VI group - 1.789 kg/kg, followed by groups II and IV (1.815 kg/kg and 1.998 kg/kg respectively). The highest feed consumption per 1 kg weight gain was found again in groups I-III-V (2.568 kg/kg; 2.444 kg/kg; 2.410 kg/kg). A more progressive increase of feed consumption per 1 kg weight gain during the last fattening period was observed in groups I-III-V (by 33.41%; 27.15%; 26.00% compared to broilers from group VI with 2.493 kg/kg). The difference in FCR vs group VI was lower for groups II and IV: by 5.65% and 7.22%,
ж спрямо VI-груп се уст новяв при
II-IV групи съотвтно с 5.65% и 7.22%.

цеция опитен период н от-
гляд от 1 до 84-я день, р зход н
фур жз 1 kg прир ст е в гр ниците от
2.303 до 3.190 kg/kg прир ст ( игур 1),
к то р злик т между бройлерите от
VI-груп и II-IV-груп по този пок з тел
в р мките н – 7.94%-11.42%. езин
ши резултат ти з пок з теля р зход
н фур жс близки до тези получени
от Mikulski et al., (2011). зход н фу-
р ж при тяхното проучване не е в поря-
дък от 2.53 до 2.56 при б вър стящи
пилет отглеждани до 65 днев
възраст при р злики технологии.

лице е по-големо увеличение
н р зход н фур жз 1 kg прир ст,
съотвтно при I-в (38.51% ), III-т
(32.57%) и V-т груп (30.17%) спрямо
бройлерите от VI-груп (2.303 kg/
kg прир ст).

чевидно е влиянието н б щи-
н т форм при кръстосването Line
(Cornish), чрез което уч сте се добли-
жава т до т к н речения средно-р стя-
щи пилет от Quentin et al., (2003), спо-
ред, който р зход н фур ж от 2.4 kg;
2.23 kg, 2.78 kg/ 1 kg прир ст между
42-56 ден при F,M,S р стящи бройleri.
р ви впечатление добрия резултт
т при определянето н р зход н фур жз
единиц прир ст. поред н с тов
се дължи н добър т комбин тив
способност между използваните линии,
кто отглеждането е в крити помени-
върху дълбок несменяем постел.
поред Wang et al., (2009) жив т
мс и среднодневния прир ст н
пилет т при свободно отглеждане се
значен по-низки от тези н пилет-
t при з творен н чин н отглеждане
( <0.05). Castellini et al., (2002) също
уст новяв т, че темповете н р стег и
ефект н фур ж при открито отглежда
ние с по-низки, отколкото при ст н-
d ртното отглеждане не.

по-обективен оценк на проучване
ните бройлерни комбинатции е опреде-
лен индекс н продуктивност (EPEF),
respectively.

For the entire rearing period (1-84
days), feed consumption per 1 kg weight
increase ranged from 2.303 to 3.190 kg/kg
(Figure 1), and differences between
broilers from group VI and those from
groups II-IV ranged within 7.94%-11.42%.

hese results of ours for FCR were similar
to those of Mikulski et al., (2011). FCR
values in their study was from 2.53 to 2.56
in slow-growing chickens reared to 65
days of age under different production
systems.

A more pronounced feed
consumption per 1 kg weight gain was
found out in group I (38.51%), III (32.57%)
and V (30.17%) as compared to birds
from group VI (FCR 2.303 kg/kg).

The influence of the paternal form
Line (Cornish) used in crossbreeding
schedule was evident; thus, hybrids were
closer to the so-called medium-growing
birds as per Quentin et al., (2003) who
reported feed consumption of 2.4 kg; 2.23
kg, 2.78 kg/1 kg weight gain between
days 42-56 in fast-, medium- and
slow-growing broilers. The good results
determined from determination of FCR should
be acknowledged. This, in our opinion, was
due to the good combination between
used lines and to indoor rearing on deep
permanent litter.

According to Wang et al., (2009), the live
weight and daily weight gain of free-range
chickens were significantly lower than
those in birds reared indoor ( <0.05).

Castellini et al., (2002) also found out that
the growth rates and the feed effect in
free-range systems were lower compared
to standard rearing systems.

The European production efficiency
factor (EPEF) – a measure of the level of
profiting from the potential of reared
които предст вля в пок з тел, измерението на използване на потенциал на отглеждане на бройлери включва основните по- къси влияещи върху икономическите ефективности: живото тегло на бройлери, продължителност и отглеждането, отношение на фураж за 1 kg прираст и преживяемост. ЕПФ включва основните показатели влияещи върху икономическиата ефективност: животото тегло на бройлери в края на експеримента, продължителността на отглеждане, разхода на фураж за 1 kg прираст и преживяемост. Анализирайки данните за този индекс (Таблица 5), в абсолютни и относителни стойности се вижда, че най-високи стойности са установени за VI група (♂ M х ♀ L) – 157.96%, IV група (♂ M х ♀ F) – 133.75% следвани от II група – 87.46%.

Най-ниска стойност за индекс на продуктивност е изчислена при I-ва (75.54%), III-та (75.16%) и V-та (76.45%) група, което се дължи на по-големия разход на фураж през угоителния период.

Таблица 5. Индекс на продуктивност (EPEF)

<table>
<thead>
<tr>
<th>Групи/Groups</th>
<th>Изв. тегло на 84 ден, kg/Live weight at 84 days of age</th>
<th>Преживяемост%/Livability rate %</th>
<th>Зход на фур ж (kg/kg)/Feed conversion ratio (kg/kg)</th>
<th>ЕПФ/absolute EPEF</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I група/group (♂ I х ♀ E)</td>
<td>2.108</td>
<td>96.03</td>
<td>3.190</td>
<td>75.54</td>
<td>47.82</td>
</tr>
<tr>
<td>II група/group (♂ I х ♀ E)</td>
<td>1.926</td>
<td>94.83</td>
<td>2.486</td>
<td>87.46</td>
<td>55.37</td>
</tr>
<tr>
<td>III група/group (♂ I х ♀ F)</td>
<td>1.987</td>
<td>97.00</td>
<td>3.053</td>
<td>75.16</td>
<td>47.58</td>
</tr>
<tr>
<td>IV група/group (♂ I х ♀ F)</td>
<td>2.967</td>
<td>97.17</td>
<td>2.566</td>
<td>133.75</td>
<td>84.67</td>
</tr>
<tr>
<td>V група/group (♂ I х ♂ Ss)</td>
<td>1.707</td>
<td>96.67</td>
<td>2.998</td>
<td>76.45</td>
<td>48.39</td>
</tr>
<tr>
<td>VI* група - ♂ инина / ♂ Line</td>
<td>2.709</td>
<td>94.00</td>
<td>2.303</td>
<td>157.96</td>
<td>100</td>
</tr>
</tbody>
</table>

VI* група - ♂ инина / ♂ Line L - за 70 дни / VI* group - ♂ Line / ♂ Line L - for 70 days

Други изследвания Mincheva et al., (2015) проучват и нейните продуктивности на бързорастящи бройлери от комбинацията ♀ M х ♂ L съобщът в този индекс на продуктивност - 210.12 в босненски стойности. Във връзка с късметството на конвенционалните бройлери от Cobb 500 и Ross 308 със съобщението на стойности на индекс на продуктивност (EPEF) - 240.76 и 225.89 (Hristakieva et al., 2014).

Mincheva et al., (2015) have investigated the meat production of fast-growing ♀ M х ♂ L broiler chickens and reported absolute EPEF of 210.12.

For comparison, conventional Cobb 500 and Ross 308 broilers had EPEF values of 240.76 and 225.89 respectively (Hristakieva et al., 2014).

Tables 6 and 7 present the results.
from the slaughter analysis of studied groups of slow-growing broilers from different genotypes.

Table 6 gives data about the slaughter weight of female birds. It was 2386.67 g for group VI (♂M x ♀L), whereas group IV (♂ x ♀F) had a slaughter weight of 2766.67 g – statistically significantly higher than all tested broiler combinations (P <0.05). Females from group I (♂I x ♀E) had a lower live weight - 1733.33 g on the average (P<0.05).

Slaughter traits largely depended on live weight. The genotype-related differences, as well as those associated to the sex of birds influenced bratfertig and grill weights, which followed the same dynamics.

In line with other reports (Fanatico et al., 2005; Aksoy et al., 2010; Wang et al., 2013) affirming a higher slaughter yield in fast-growing chickens compared to slow-growing ones, our experiment confirmed the effect of genotype on this parameter.

Slow-growing female birds with genotype of conventional broilers from group VI (♂M x ♀L) demonstrated the highest slaughter yield 77.60%, followed by group IV (♂ x ♀F) with 75.72%. Lower relative proportions of cleaned carcass vs slaughter weight were found out in groups I, II and III with 70.46%, 70.56% and 69.61%.

There were statistically significant differences among the groups with respect to bratfertig and grill weights - <0.05 between groups IV (♂ x ♀F) and VI (♂M x ♀L), as well as between groups IV and VI and those with lower absolute values of parameters.
Таблица 6. Сlaughter traits of female broiler chickens

<table>
<thead>
<tr>
<th>Група</th>
<th>I-група</th>
<th>II-група</th>
<th>III-група</th>
<th>IV-група</th>
<th>V-група</th>
<th>VI-група</th>
</tr>
</thead>
<tbody>
<tr>
<td>Тегло</td>
<td>1733.33±33.33</td>
<td>1546.67±24.04</td>
<td>1553.33±6.67</td>
<td>2766.67±63.60</td>
<td>1446.67±86.67</td>
<td>2386.67±46.67</td>
</tr>
<tr>
<td>Грил</td>
<td>1221.33±22.51</td>
<td>1091.33±6.63</td>
<td>1081.33±5.36</td>
<td>2095±86.12</td>
<td>995±70.19</td>
<td>1852±28.04</td>
</tr>
<tr>
<td>Риз / Grill</td>
<td>1139.33±31.80</td>
<td>1012±5.03</td>
<td>1012±5.33</td>
<td>1983.33±69.44</td>
<td>933±65.58</td>
<td>1672±33.73</td>
</tr>
</tbody>
</table>

| Тегло | 65.71 | 65.43 | 65.17 | 71.69 | 64.49 | 70.07 |
| Грил | 17.32 | 15.58 | 15.39 | 19.59 | 16.36 | 22.30 |
| Риз / Grill | 405.33±5.55 | 349.33±2.33 | 350±5.13 | 592.33±40.4 | 328.33±16.7 | 504.33±22.4 |

| Тегло | 35.59 | 34.52 | 34.57 | 29.86 | 35.19 | 30.16 |
| Грил | 163.67±0.8 | 149±1.5 | 153.33±2.4 | 219.33±9.24 | 140.33±8.45 | 203.33±3.76 |
| Риз / Grill | 39.67±0.8 | 42±2.5 | 45.33±6.6 | 47.33±4.8 | 34±0.04 | 46.3±2.96 |
| Бъбрчики | 3275.03 | 3263.33±19.32 | 238.67±28.26 | 584.67±14.26 | 270.33±21.11 | 534.67±15.30 |
| Бъбрчики | 76.33±9.21 | 75±4.93 | 73.33±2.96 | 85.67±4.06 | 60.67±3.71 | 106.67±4.98 |

* VI груп - 7 дни / VI group - 7 days
** Страничните букви в реда м - риз с т ст тъстически значими разлики (<0.05)
*** Различните букви в реда р - грил с т ст тъстически значими разлики (<0.05)

Професорът Н Грил от животното тегло при IV група и VI група е най-висок, съответно 70.07% и 71.69%.

Grashorn (2006) съобщи в 3 процент на грил при дви в нар с-т язи тип пилет от 67.9 до 70.9% от животото тегло.

Броят в същия тенденция в получените резултати по отношение на бъбречния и едническият дял на гърдите при женските пилета, тези от IV-група (a x F) изправ резултати от 493 g (24.86%) остали пилети при висок степен на достоверност (<0.05).

Учетът на този статистически значим разлика между групите (с <0.05).

The grill percentage from live weight in groups IV and VI was the highest, e.g. 70.07% and 71.69% respectively.

Grashorn (2006) reported grill percentage from 67.9 to 70.9% of live weight in two slow-growing types of chickens.

The results about the absolute weight and proportion of breast in female birds showed the same trend: group IV (♂ x ♀F) was significantly superior by 493 g (24.86%) compared to the other groups ( <0.05).

The proportion of thighs, as part of dressed carcass, was the highest in slow-growing chickens: 592.33 g in group IV (♂ x ♀F) and 504.33 g in group VI (♂M x ♀L) ( <0.05). Relative shares of thighs vs grill weight in birds from groups I, II, III and V (which had lower absolute
The weights of wings and ribcage were with lowest values in chickens with lower live weight at the end of the 84-day fattening period. The chickens from group V had a statistically significantly lower weight of wings (140 g) vs all other groups (>0.05).

The ribcage weight followed the tendency shown for live weight. Lighter ribcage was found out in birds with lower dressed carcass weight. Thus, the ribcage of birds from group IV (♂ x ♂F) was 584.67 g, and that of group VI (♂M x ♂L) - 534.67 g, values, statistically significantly higher compared to other groups.

In their study Mikulski et al., (2011) demonstrated that the proportion of ribcage and neck from dressed carcasses of slow-growing chickens was higher. These parameters differed also with respect to sex, with higher values in male broiler chickens (>0.05).
As to the weight of edible offal (heart, liver and gizzard) with regard to genotype, the highest weight was found in broilers from group VI rpyн (106.67 g), and the lowest – in the group with lowest live weight (group V; 60.67 g; <0.05).

According to Kokoszynski et al., (2013) the origin of broilers had no significant effect on this parameter.

The analysis of data revealed a statistically significant effect of genotype on abdominal fat weight, with superiority of slow-growing broiler chickens from group VI with highest values vs group V (21.67 g and 56.67 g respectively).

In male chickens (Table 7) slaughter traits were considerably higher ( <0.05) in the same broiler combination: group IV (♂ x ♀) who attained slaughter weight of 3306.7 g, with slaughter yield 73.65% and grill percentage 71.10% by the 84th day of life, followed again by group VI with 2693.33 g and grill percentage 66.94%.

The slaughter yield in male chickens was the highest in group VI (♂ x ♀) - 77.20% despite that their slaughter weight was not the highest one. Lower slaughter yield was observed in group IV (♂ x ♀): 73.65%.

Połtowicz and Doktor (2012) reported relative proportion of bratfertig in slow-growing broiler chickens at 84 days of age of 74%, therefore, it may be concluded that our result was not inferior.
<table>
<thead>
<tr>
<th>Trait</th>
<th>I-group</th>
<th>II-group</th>
<th>III-group</th>
<th>IV-group</th>
<th>V-group</th>
<th>VI-group</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of live weight</td>
<td>70.24</td>
<td>69.79</td>
<td>72.19</td>
<td>73.65</td>
<td>67.52</td>
<td>77.20</td>
</tr>
<tr>
<td>% from live weight</td>
<td>65.80</td>
<td>65.48</td>
<td>65.85</td>
<td>71.10</td>
<td>62.58</td>
<td>66.94</td>
</tr>
<tr>
<td>% from live weight</td>
<td>254.67±3.71</td>
<td>220.00±18.03</td>
<td>255.33±17.91</td>
<td>535.00±15.01</td>
<td>194.33±11.62</td>
<td>432.00±30.66</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>16.68</td>
<td>15.80</td>
<td>17.95</td>
<td>22.76</td>
<td>15.79</td>
<td>23.96</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>35.63</td>
<td>35.59</td>
<td>35.95</td>
<td>31.11</td>
<td>36.38</td>
<td>32.54</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>221.33±2.60</td>
<td>196.33±4.70</td>
<td>215.33±10.09</td>
<td>285.67±5.36</td>
<td>195.00±7.21</td>
<td>213.67±6.89</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>61.00±3.79</td>
<td>58.67±5.78</td>
<td>64.04±0.00</td>
<td>65.67±0.88</td>
<td>48.67±0.33</td>
<td>56.67±3.67</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>454.33±13.78</td>
<td>445.00±12.29</td>
<td>405.67±15.06</td>
<td>708.00±30.01</td>
<td>377.00±42.71</td>
<td>629.8±50</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>91.00±4.62</td>
<td>89.67±2.60</td>
<td>88.67±6.33</td>
<td>107.00±5.03</td>
<td>92.33±1.33</td>
<td>125±3.21</td>
</tr>
<tr>
<td>% of grill / from grill</td>
<td>30.67±1.76</td>
<td>6.00±6.00</td>
<td>1±1.00</td>
<td>23.00±11.59</td>
<td>12.33±2.91</td>
<td>36.67±2.73</td>
</tr>
</tbody>
</table>

* VI group - ©, ©, ©, ©, ©, ©, ©, © Line - for 70 days
** Значимите букви в ред мреж стават тесно зчим р злики ( <0.05)
*** Отличният материал съдържа значимо статистически различия ( <0.05)

An important trait characterising meat traits of broilers is not only the proportion of different cuts with high relative share of meat – breast with or without bone, but also legs that included thighs + drumsticks. Thighs as a part of the dressed carcass presented the largest part of the dressed carcass in slow-growing chickens from group V - 36.38%, 35.95% - group III, 35.63% in group I.

As anticipated, slow-growing genotypes were outlined with lower proportion of breast meat yet with larger
The weight of wings was the lowest in slow-growing chickens from group V - 195 g and group - 196.33 g. The analysis of comparisons of genotypes with heaviest wings from group IV (♂M x ♀F) showed a difference by 31% against fast-growing broilers from group V. In a study of Mikulski et al., (2011) the proportion of ribcage and neck was higher in carcasses of slow-growing chickens.

Edible offal weights (heart, gizzard and liver) was the highest in broiler combination from group VI (♂M x ♀L): 125 g, which were with highest live weight and lowest in the lightest group – group (88.67 g; <0.05).

According to Kokoszynski et al., (2013) and Oblakova et al., (2017) the origin of broilers had no significant effect on this parameter.

The comparison between sexes showed higher edible offal weight in male birds ( <0.001).

Abdominal fat percentage in male slow-growing chickens (Table 7) varied from 36.67 g in group VI (♂M x ♀L) to 1 g in group III (♂I x ♀F). In relative units, the respective values were from 2.03% to 0.07% of grill weight.

Having performed slaughter analysis in slow-growing chickens at 56, 70 and 80 days of age, Połtowicz and Doktor, (2012) obtained abdominal fat proportions of 1.53%, 1.22% and 1.73% respectively.

The analysis of data revealed a statistically significant effect of genotype on abdominal fat with superiority of slow-growing broilers from group III, who exhibited the lowest values compared to group V (1 g vs 36.67 g).
Grashorn (2006) also found no difference in abdominal fat proportion between fast- and slow-growing broilers, whereas Mikulski et al., (2011) reported increased deposition of abdominal fat in slow-growing chickens, and attributed this fact to the rather high dietary energy and protein contents compared to nutritional needs of birds.

On the other side, Castellini et al., (2002) concluded that the relative share of abdominal fat was higher in fast-growing birds compared to slow-growing hybrids, in line with our results.

Sex had a significant influence on weight and abdominal fat proportion from grill weight, more pronounced in female birds ( <0.05). According to results reported by Corzo et al., (2005), Niklova et al., (2007), Koreleski et al., (2008), Almasi et al., (2012) female chickens had more abdominal fat than males.

We also found this relationship in our study, with 9.33 g to 65.67 g in females from groups and vs. 1-36.67 g in males.

Our data did not however agree with those of Koreleski et al., (2008) where abdominal fat share in slow-growing female chickens did not exceed 4.28%.

Tůmová and Teimouri, (2010) presumed that these differences resulted from different metabolism, higher competition among males, different capacity for fat deposition, various nutritional needs and more pronounced effect of hormones in females.

CONCLUSIONS
The results from the present studies demonstrated that among the studied broiler combinations, the best results were obtained in crosses whose paternal form was Line (Cornish).
At 70 days of age, female and male chickens from group VI, conventional broiler type (♂ x ♀ L) attained an average live weight of 2709.29 g, followed by group IV (♂ x ♀ F) - 2352.03 g. At 84 days of age, male chickens from group IV (♂ x ♀ F) attained a live weight of 3334.74 g, whereas females - 2600 g (on the average 2967.37 g; close to target values of this trial). Then followed male and female chickens from group I with average live weight of 2108.08 g, group III – 1987.42 g, group II – 1926.04 g and group V – 1707.74 g.

The combinations of traits of used hen and rooster lines at the Agricultural Institute - Stara Zagora, were appropriate for production of slow-growing chickens.

REFERENCES


