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Effect of Zoovit LL probiotic and herbal mixture supplementation on growth performance and carcass quality of dairy lambs

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Abstract: The aim of the study was to evaluate the effect of the addition of 50 ml of the Zoovit LL probiotic per animal per day, given orally, and a mixture of herbs added at an amount of 6% to the pelleted feed on the growth and slaughter traits of lambs aged 30±5 days of the Bulgarian Dairy Synthetic Population (BDSP) breed over a period of 44 days. The lambs were divided into three groups of 12 animals each. The control group (K) received a standard compound pellet; the first experimental group (O1) received the same feed along with an oral supplement of 50 ml Zoovit LL probiotic per animal per day, whereas the second experimental group (O2) was fed a compound pellet supplemented with 6% herbal mixture (milk thistle, sage, thyme, elderberry, nettle, and chamomile).

The addition of the probiotic and the herbal mixture to the feed of fattening BDSP lambs resulted in a significantly increased average daily weight gain in the second week compared to the controls. At the end of the experiment, no significant differences were observed in growth parameters between the experimental and control groups. Slaughter traits and spleen weight in the group receiving the herbal mixture were lower compared to the control group. Longer rumen papillae were demonstrated in the group supplemented with the probiotic. Linear carcass measurements did not differ significantly between the groups. The weight of the neck in the group receiving a probiotic supplement was significantly lower than that in the control group, without any significant differences for the other cuts.

Keywords: probiotic; herbal mixture; growth parameters; slaughter traits; cuts; dairy lambs

INTRODUCTION

The use of antibiotics in livestock farming may be a reason for emergence of antimicrobial resistance against microbial pathogens in consumers. For this reason, European Union legislation prohibits the use of nutritional antibiotics in livestock farming. In recent years, this has led to extensive exploration of alternative options for their replacement in the feed of farm animals (Kober et al., 2022). It is thought that some probiotics can improve digestion, intestinal microflora,

growth performance, health status, and reduce methane emissions and neonatal diarrhoea in ruminants (Kober et al., 2022; Devadharshini and Devamugilan, 2024). The impact of probiotics on ruminants depends on the microbial strain, dose, interval of administration and the breed (Reuben et al., 2021).

The bioactive compounds concentrated in different parts of plants are another alternative to antibiotics (Odhaib et al., 2021). It is suggested that the use of phytosupplements in the diet of small ruminants increases the average daily gain, and

improves carcass and meat traits (da Silva et al., 2025). Their antimicrobial, antioxidant and immunomodulatory effects on the intestinal microbiota are also reported (Wang et al., 2024). At the same time, the use of dietary phytosupplements for farm animals is economically more profitable than the use of antibiotics. Thus, they have great potential to replace the nutritional antibiotics in livestock husbandry, yet in-depth studies of their effect in different animal species are needed (Wang et al., 2024).

The milk thistle (*Silybum marianum* L.) is known as an antioxidant with positive effect on blood parameters, liver, intestinal microflora, and reduces the risk of diseases (Guerrini and Tedesco, 2022). Its active ingredient is silymarin - a mixture of silibinin, silychristin and silydianin that counteracts biological and chemical poisons (Fanoudi et al., 2018). The addition of 2% ground milk thistle seeds to the feed of lambs during fattening is recommended as it increases dry matter intake, final body weight and feed conversion ratio (FCR) (Nasiripour et al., 2024). Sage (*Salvia officinalis*), which contains polyphenols and flavonoids, is used for oxidative stress control, prevention of systemic inflammations, blood sugar regulation, and has an antibacterial effect on bacterial pathogens in the stomach (Akacha et al., 2024). The addition of 5 g/kg sage powder to the feed of Awassi dairy lambs increases nutrient digestibility, growth performance, and has a positive effect on rumen fermentation (Al-Bakhata and Al-Wazeer, 2023).

Thyme (*Thymus vulgaris*), an ornamental aromatic plant with thymol and carvacrol as active ingredients, has antibacterial, antiviral, anthelmintic and anti-inflammatory effects (Lasc et al., 2022). Supplementation of Merino lambs during weaning and fattening with 250 mg/day and 500 mg/day of thyme essential oil had antibacterial, immunosupportive and growth promoting properties without negative impact (Cetin et al., 2025).

The flowers and leaves of elderberry (*Sambucus nigra* L.) have anticancer, anti-inflammatory, antiviral and immunostimulating properties due to the content of the biologically active kaempferol, quercetin and rutin (Stepien et al., 2023).

The addition of 0.5% ground elderberry flower to the diet of experimental white rats increased final body weight compared to the control group (Lieshchova and Brygadyrenko, 2024).

Nettle (*Urtica dioica*) contains vitamins, minerals, polyphenols, carotenoids and high amount of tannins. It has anti-inflammatory, antioxidant, analgesic and anti-infective properties, and in combination with other herbal supplements, can increase growth performance in animals (Bhusal et al., 2022). Different nettle types are a traditional food with high nutritional value that improves immune function and animal productivity (Gao et al., 2024). It is a rich source of protein, and is suitable for feeding sheep after the flowering period and in the form of hay in autumn and winter (Zhang et al., 2023).

Chamomile (*Matricaria chamomilla*) has antibacterial, antioxidant and anti-inflammatory effects, its active ingredients are geraniol, rutin, umbelliferone, chlorogenic and caffeic acids (Akram et al., 2024). A ration containing 50% chamomile flower and 50% compound feed improves nutrient absorption, increases body weight and improves feed conversion in five-month-old Ossimi lambs (El-Mola, 2019).

In recent years, the need for replacing nutritional antibiotics used in livestock farming in the past, has necessitated to look for alternative options. At the same time, the latter must increase the productivity of small ruminants, the quality of produce along with being more economically profitable for farmers. The current trend has directed us towards addition of probiotics and herbs to the feed, on the background of conflicting literature data about their optimal amount.

The probiotic Zoovit LL is new to the Bulgarian market, and its effect on growth and slaughter performance in lambs has not yet been established.

The herbs *Silybum marianum*, *Salvia officinalis*, *Thymus vulgaris*, *Urtica dioica* and *Matricaria chamomilla* have been investigated independently as feed additives. According to studies, they have a predominantly positive effect on growth, but their optimal dose in the feed is not yet specified. Regarding the effect of *Sambucus*

nigra on the growth and slaughter performance in lambs, no literature data are available.

In general, the studies conducted so far have determined the influence of a single herb on various parameters of farm animals. However, the biologically active substances in the herbs can complement each other, having a synergistic effect on the studied traits, but such data in the available literature are not enough.

The aim of the study was to evaluate the effect of the addition of 50 ml of the Zoovit LL probiotic/per head/per day, given orally and a mixture of herbs (milk thistle, sage, thyme, elderberry, nettle and chamomile), added at an amount of 6% to the pelleted feed on the growth and slaughter traits of one-month-old lambs of the Bulgarian Dairy Synthetic Population (BDSP) breed.

MATERIAL AND METHODS

Animals, supplements, experimental design

The experiment was conducted at the sheep farm of the Agricultural Institute, Stara Zagora, Bulgaria, with 36 lambs (initial live weight 11 ± 1 kg; about 30 ± 5 days of age) of the Bulgarian Dairy Synthetic Population (BDSP) breed, which is a Bulgarian breed, created through continuous hybridization and targeted selection with the participation of ewes of fine-wool, semi-fine-wool and native dairy Bulgarian breeds and rams of the high-milk imported breeds - East Friesian, Awassi, and the Bulgarians - Pleven Blackhead, Stara Zagora and other sheep breeds. The lambs were divided by the uniformity method into three groups of 12 animals (six males and six females per group), one control and two experimental, with similar live body weight in each group and uniform sex ratio and date of birth. The groups were raised in boxes (4x6 m) bedded with straw, supplied with hay troughs, pellet feeders and drinkers with constantly running fresh tap water in line with Ordinance No. 40 and Ordinance No. 20.

The composition of feeds offered to experimental groups of lambs is presented in Table 1. The control group (K) received a standard com-

pound pellet. The first experimental group (O1) received the same feed and an oral supplement of 50 ml Zoovit LL probiotic/animal/day containing *Lactobacillus delbrueckii subsp. bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus casei*, *Kluyveromyces lactis*, *Lactobacillus rhamnosus* and composition, shown in Table 2, whereas the second experimental group (O2) was fed compound pellet supplemented with 6% herbal mixture (milk thistle, sage, thyme, elderberry, nettle

Table 1. Composition of compound pelleted feed for BDSP lambs

| Ingredients | Groups | | |
|-------------------|--------|------|------|
| | K | O1 | O2 |
| Soybean meal, % | 14 | 14 | 14 |
| Limestone, % | 3 | 3 | 3 |
| Salt, % | 0.5 | 0.5 | 0.5 |
| Premix-16-97-K, % | 0.2 | 0.2 | 0.2 |
| Alfalfa hay, % | 10 | 10 | 10 |
| Sunflower meal, % | 20 | 20 | 20 |
| Maize, % | 52.3 | 52.3 | 52.3 |
| Probiotic, ml | - | 50 | - |
| Herbal mixture, % | - | - | 6 |

Source: Authors' own elaboration

Table 2. Composition of the Zoovit LL probiotic

| Parameter | Content |
|-----------------------------------------|------------------------------|
| Protein, % | 30.29 |
| Lactose, % | 51.14 |
| Fat, % | 0.95 |
| Dry matter, % | 94 |
| Lactic acid, % | 2.75 |
| Propionic acid, % | 3.10 |
| Minerals, % | 8.76 |
| Active cells count | Not less than 3.10^7 cfu/g |
| Colibacteria in 1 g | Not found |
| Moulds and yeasts in 1 g | Not found |
| Salmonellae in 25 g | Not found |
| Coagulase-positive staphylococci in 1 g | Not found |

Source: Authors' own elaboration

and chamomile). The lambs were fed *ad libitum*, with the nutritional composition of the pelleted feed, presented in Table 3.

The experiment continued to average live weight of 25±2 kg, achieved for a period of 44 days. Then, 5 male lambs from each group were slaughtered in a licensed slaughterhouse, observing all requirements for humane treatment of animals during transportation and slaughter as per Ordinance 26 and Ordinance No. 22.

The following parameters were determined: live body weight at birth; body weight at the beginning of the trial; body weights on a weekly basis; body weight at the end of the trial; weekly and total average daily weight gain. The non-consumed feed was weighed every day to determine the feed intake, while the lambs were weighed at 7-day intervals to calculate weekly weight gain and feed conversion rate (FCR). Linear measure-

ments of carcasses and carcass cuts were performed as per BSS 553:1986 for the following cuts: neck, lamb shoulder, rib chop, leg and loin, in order to evaluate the slaughter traits.

Statistical analysis

Data analysis was done with the Statistica software (v. 14.0.0.15; 1984-2020 TIBCO Software inc.). Experimental data were expressed as mean and standard deviation ($\bar{x} \pm SD$) and standard error of mean (SEM). Level of significance was determined by independent t-test by variables, at $P \leq 0.05^*$, $P \leq 0.01^{**}$, $P \leq 0.001^{***}$.

RESULTS AND DISCUSSION

The growth traits live weight at birth, live weight at the beginning of the trial, live weight

Table 3. Nutritional composition of compound pelleted feed for BDSF lambs

| Parameter | Content | Parameter | Content |
|--------------------------|---------|--------------------------|----------|
| Protein % | 19.29 | Linoleic acid % | 1.510 |
| Fibre % | 8.178 | Pantothenic acid (mg/kg) | 3.200 |
| Lysine % | 0.874 | Vitamin A (IU/kg) | 1600.000 |
| Methionine % | 0.372 | Vitamin E (mg/kg) | 4.000 |
| Methionine+cysteine % | 0.703 | Vitamin D3 (IU/kg) | 200.000 |
| Moisture % | 10.905 | Vitamin K3 (mg/kg) | 0.500 |
| Fat % | 2.707 | Vitamin B2 (mg/kg) | 1.000 |
| Limestone units | 1.099 | Vitamin B6 (mg/kg) | 0.400 |
| TDN | 0.174 | Vitamin B12 (mg/kg) | 0.006 |
| Available phosphorus % | 0.103 | Niacin /PP/ (mg/kg) | 4.800 |
| Salt % | 0.555 | Choline (mg/kg) | 32.000 |
| Tryptophan % | 0.206 | Fe (mg/kg) | 140.924 |
| Leucine % | 1.554 | Mn (mg/kg) | 35.618 |
| Threonine % | 0.681 | Cu (mg/kg) | 13.224 |
| Arginine % | 1.246 | Zn (mg/kg) | 59.930 |
| Histidine % | 0.500 | Co (mg/kg) | 0.171 |
| Phenylalanine+tyrosine % | 1.470 | I (mg/kg) | 0.494 |
| Isoleucine % | 0.827 | Se (mg/kg) | 0.228 |
| Valine % | 0.897 | Ca % | 1.335 |
| Glycine % | 1.707 | P % | 0.516 |

Source: Authors' own elaboration

for each week, average daily weight gain, weight gain for the entire experimental period, feed intake and feed conversion rates for each group are presented in Table 4. A higher average daily weight gain by the second week was reported in the groups, receiving feed with probiotic ($P \leq 0.05$) and with the herbal mixture ($P \leq 0.01$), compared to the controls. During the last week of the experiment, the weight gain was lowest in the group, receiving the dietary herbal mixture ($P \leq 0.001$), compared to probiotic and control groups. Higher average daily gain for the entire experimental period was reported by Mao et al. (2023), after addition of 1 g/kg powdered probiotic to the ration of slow-growing Hu lambs. Similar results were reported by Shoukry et al. (2023) with 1 g/kg probiotic, added to the concentrate of lambs compared to the control group. The supplementation of the drinking water with 1 g/l/day probiotic for 30 days significantly increased the body weight of Barki lambs during the third and fourth weeks, therefore the authors affirmed that it can be used as a beneficial supplement with positive effect on health, growth performance and economic efficiency of fattening lambs (El-Sayed and Mousa, 2020). The addition of a 2% mixture of cinnamon, turmeric, rosemary and peppers to the feed, increased the feed intake and growth performance in Afshari \times Chaal crossbred lambs (Hashemzadeh et al., 2022). Allam and El-Elaim (2020) recommended a dietary supplement of 0.3 g/kg garlic, 0.2 g/kg lemon leaves, 0.5 g/kg mint, and 0.2 g/kg rosemary to promote the growth and improve economic efficiency in fattening lambs. Studies have shown that the addition of 20 g/day thyme for 90 days increased the final live weight, total weight gain for the period, and average daily weight gain in Barki sheep compared to the control group (Abd El Tawab et al., 2020). Also, the addition of 0.5 g and 10 g of chamomile flowers per 100 kg feed increased significantly the average daily weight gain in supplemented groups of Farafra lambs, compared to controls (Khatab et al., 2021).

In our experiment, there were no significant differences ($P > 0.05$) between the experimental groups receiving feed with either probiotic or

herbal mixture, in relation to the control group in terms of weekly and final live body weight. Feed intake for the entire period was the highest in lambs from the group supplemented with probiotic (517.68 kg), followed by the control group (456.48 kg), and the herbal mixture group (451.56 kg), again without statistically significant differences ($P > 0.05$). In our study, lambs whose feed was supplemented with a herbal mixture demonstrated the best feed conversion ratio (3.20%), followed by the control group (3.26%) and the probiotic group (3.56), but without significant between-group differences ($P > 0.05$). Mousa et al. (2022) reported increased feed intake, better feed conversion, daily weight gain and higher final weight in male Ossimi lambs, whose feed contained 0.5 kg/ton, 1 kg/ton and 2 kg/ton of a combination of fibrolytic enzymes and probiotics. The average daily weight gain, feed conversion rate and carcass weight of Ujumuqin \times Han crossbred lambs were not affected by the diets with 1:1 concentrate:hemp nettle *Urtica cannabina*, and 1:0.5:0.5 concentrate:hay:hemp nettle (Jin et al., 2018). The addition of 50 ml of aqueous dandelion extract, fermented cow's milk, supplemented with lactic acid bacteria or their 1:1 mixture to the feed, resulted in a significantly higher final live weight in Noemi lambs (El-Mehanna et al., 2017) compared to the control group. Also, better feed conversion, average daily weight gain and final body weight were observed in Romanov \times Shawl lambs supplemented with 2% milk thistle seed powder, compared to non-supplemented controls (Rayni et al., 2023). The addition of 2% chamomile flower meal per animal per day to the feed improved feed conversion in Awassi lambs (Al-Hanna et al., 2018). The inclusion of 5 g/kg and 10 g/kg sage leaves to the feed of Awassi lambs also improved feed conversion, average daily weight gain and nutrient digestibility (Al-Bakhati and Al-Wazeer, 2023).

The values of slaughter traits, including live body weight before 24-hour fasting, pre-slaughter live body weight, hot carcass weight, left half carcass weight, kidney, liver, lung, spleen, heart without pericardium, small intestine, large intestine, rumen papillae length are presented in Table

Table 4. Growth parameters in BDSP lambs

| Parameters | Groups of lambs | | |
|-----------------------------------------------|------------------------|--------------------------------|---------------------------|
| | Control group (K) | Zoovit LL probiotic group (O1) | Herbal mixture group (O2) |
| | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ |
| Live weight at birth, kg | 5.23±1.55 | 5.80±1.37 | 6.00±1.60 |
| Initial live weight, kg | 11.11±1.30 | 11.10±1.23 | 11.12±1.23 |
| Live weight by the I st week, kg | 12.77±1.65 | 12.71±1.71 | 12.45±1.71 |
| Average daily weight gain for the week, kg | 0.24±0.11 | 0.23±0.13 | 0.19±0.14 |
| Live weight by the II nd week, kg | 13.83±1.85 | 14.16±2.34 | 14.08±2.15 |
| Average daily weight gain for the week, kg | 0.15±0.09 ^a | 0.24±0.12 ^b | 0.27±0.10 ^c |
| Live weight by the III rd week, kg | 15.78±1.83 | 16.58±3.27 | 16.11±3.20 |
| Average daily weight gain for the week, kg | 0.28±0.10 | 0.35±0.15 | 0.32±0.14 |
| Live weight by the IV th week, kg | 18.01±2.14 | 17.99±4.25 | 17.90±3.60 |
| Average daily weight gain for the week, kg | 0.32±0.14 | 0.20±0.16 | 0.26±0.16 |
| Live weight by the V th week, kg | 20.77±2.64 | 20.32±4.81 | 20.49±4.18 |
| Average daily weight gain for the week, kg | 0.40±0.11 | 0.33±0.11 | 0.37±0.10 |
| Live weight by the VI th week, kg | 21.99±2.89 | 21.66±5.35 | 22.20±4.43 |
| Average daily weight gain for the week, kg | 0.18±0.10 | 0.21±0.12 | 0.24±0.06 |
| Final live weight, kg | 23.13±2.62 | 22.96±5.85 | 22.73±4.40 |
| Average daily weight gain for the week, kg | 0.42±0.14 ^a | 0.47±0.22 | 0.20±0.09 ^d |
| Average daily weight gain for the 44 days, kg | 0.27±0.04 | 0.30±0.07 | 0.26±0.08 |
| Survival rate, % | 100 | 100 | 100 |
| Feed intake per group, kg | 456.48 | 517.68 | 451.56 |
| Feed conversion rate | 3.26±0.65 | 3.56±1.09 | 3.20±0.90 |

Various superscripts of means within a row indicate statistically significant difference between the groups a-b * ($P \leq 0.05$), a-c ** ($P \leq 0.01$) and a-d *** ($P \leq 0.001$).

Source: Authors' own elaboration

5. The spleen of lambs from the group receiving feed with herbal mixture was significantly lighter ($P \leq 0.05$) than that of control lambs. This disagrees with the findings of Rayni et al. (2023), who found a statistically significantly increased spleen weight in Romanov \times Shawl crossbred lambs receiving a dietary supplement of 2% milk thistle seeds powder, compared to the group receiving 1% and the control group. The rumen papillae length in the group fed probiotic supplement was significantly ($P \leq 0.05$) greater compared to that in the control group. For the remaining slaughter parameters (live body weight before 24-hour fasting, pre-slaughter live body weight, hot car-

cass weight, left half carcass weight, kidneys, liver, lung, heart without pericardium, small and large intestines, no significant differences were found out ($P > 0.05$). The herbal mixture appeared to have no effect on meat traits in lambs, but it improved their productivity (Orzuna-Orzuna et al., 2021). No significant differences were found in pre-slaughter live body weight and hot carcass weight between the groups of male lambs Ujumuqin \times Han crosses fed 1:1 concentrate and *Leymus chinensis* hay, 1:1 concentrate and hemp nettle *Urtica cannabina* or 1:0.5:0.5 concentrate, hay and nettle, compared to the controls (Zhang et al., 2021). The liver of male Pelibüey lambs was sig-

nificantly enlarged after supplementation with 3 g/kg of a polyherbal mixture (from various parts of herbs), compared to controls fed the same herbal mixture at 1 g/kg and 2 g/kg (Orzuna-Orzuna et al., 2021). The addition of 2% mixture of cinnamon, turmeric, rosemary and peppers to the feed of Afshari × Chaal crossbred lambs enhanced the liver function (Hashemzadeh et al., 2022). The ration containing 1:1 concentrate and hemp nettle had no effect on the large intestine, but on the contrary, a significantly lower small intestine length percentage and rumen size were observed compared to controls fed 1:0.5:0.5 concentrate, hay and hemp nettle (Jin et al., 2018). The addition of 2 ml thyme essential oil /day per animal to the feed did not affect slaughter traits e.g. pre-slaughter live body weight, carcass weight and rib area in Barki lambs (El-Essawy et al., 2019). The heart was heavier in male Pelibüey lambs, receiving a dietary polyherbal mixture supplement (from different parts of herbs) at 1 g/kg and 3 g/kg, vs controls, and lambs supplemented with 2 g/kg polyherbal mixture (Orzuna-Orzuna et

al., 2021). There was no evident effect on heart, kidneys and spleen weights in the experimental groups of Pelibüey × Katahdin crossbred lambs supplemented with 30 mg monensin sodium and 150 mg essential oils mixture (thymol, eugenol, vanillin, guaiac and limonene) compared to the control group (Arteaga-Wences et al., 2021).

The linear measurements of the lamb carcass including carcass length, leg length, chest width, large and small leg circumferences are shown in Table 6. The carcass length of all lambs ranged between 49-51 cm, leg circumference: 27.17-32.33 cm, and chest width: 17.17-17.83 cm, without significant differences ($P>0.05$) between the experimental and control groups. The large leg circumference of lambs from all groups was from 30.67 to 32.33 cm, and the small leg circumference: between 22.33 and 22.83 cm, with no significant between-group differences ($P>0.05$). Our data confirm the results reported by other researchers, who also found insignificant differences in linear measurements of hip length, tibia length, chest depth, chest width, chest circumference, and

Table 5. Slaughter traits of BDSP lambs

| Parameters | Groups of lambs | | |
|----------------------------------------|------------------------|--------------------------------|---------------------------|
| | Control group (K) | Zoovit LL probiotic group (O1) | Herbal mixture group (O2) |
| | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ |
| Live weight before 24-hour fasting, kg | 25.17±0.67 | 25.40±1.14 | 24.37±0.47 |
| Preslaughter weight, kg | 23.17±0.87 | 23.27±0.99 | 23.00±0.70 |
| Hot carcass weight, kg | 10.88±0.53 | 11.00±0.39 | 10.38±0.20 |
| Left half carcass weight, kg | 5.26±0.45 | 5.45±0.33 | 5.25±0.18 |
| Kidneys, kg | 0.10±0.00 | 0.11±0.01 | 0.09±0.00 |
| Liver, kg | 0.63±0.02 | 0.65±0.08 | 0.66±0.05 |
| Lungs, kg | 0.40±0.02 | 0.43±0.03 | 0.46±0.08 |
| Spleen, kg | 0.06±0.01 ^a | 0.05±0.01 | 0.04±0.00 ^b |
| Heart without the pericardium, kg | 0.11±0.01 | 0.10±0.01 | 0.11±0.01 |
| Small intestine, m | 22.99±0.50 | 22.79±0.37 | 23.78±0.58 |
| Large intestine, m | 4.11±0.72 | 3.99±0.56 | 4.39±0.23 |
| Rumen papillae length, mm | 0.33±0.06 ^a | 0.48±0.03 ^b | 0.40±0.10 |

Various superscripts of means within a row indicate statistically significant difference between the groups a-b * ($P \leq 0.05$).

Source: Authors' own elaboration

body length after supplementation of lamb feed with 50 ml aqueous dandelion extract, fermented cow's milk with lactic acid bacteria, or their 1:1 mixture compared to the control group that did not receive any supplement (El-Mehanna et al., 2017). Linear measurements in Pelibüey × Katahdin lambs were not affected by the addition of 30 mg monensin sodium and 150 mg mixture of essential oils (thymol, eugenol, vanillin, guaiac, and limonene) to the feed compared to controls (Arteaga-Wences et al., 2021). The inclusion of 1 g/kg, 2 g/kg and 3 g/kg of a polyherbal mixture (from different parts of herbs) did not affect linear carcass measurements in male Pelibüey lambs (Orzuna-Orzuna et al., 2021). In contrast, Ragheb et al. (2017) reported significantly shorter carcass length in Zandi lambs, whose feed was

supplemented with 3 g probiotic per animal in comparison to control and 4.5 g/animal groups.

The results about carcass cuts, including neck, shoulder, leg, rib chop and loin, are presented in Table 7. They were established differences ($P \leq 0.05$), reported in neck weight in lambs, receiving the probiotic feed supplement that was lower, compared to control group. No significant differences were found in the lamb shoulder, leg, rib chop and loin. These results are in line with earlier reports of other authors, about no effect of feed supplementation with 3 and 4.5 g/animal probiotic on the calculated slaughter traits percentages in Zandi lambs compared to the control group (Ragheb et al., 2017). The addition of 1% and 2% powdered milk thistle seeds to the feed neither showed statistically significant differences between carcass cuts

Table 6. Linear measurements of BDSP lambs' carcass

| Parameters | Groups of lambs | | |
|-----------------------------|-------------------|--------------------------------|---------------------------|
| | Control group (K) | Zoovit LL probiotic group (O1) | Herbal mixture group (O2) |
| | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ |
| Carcass length, cm | 49.00±3.61 | 51.00±2.65 | 50.67±2.36 |
| Leg length, cm | 28.83±0.76 | 27.17±2.75 | 32.33±2.08 |
| Large leg circumference, cm | 32.33±1.53 | 32.33±0.58 | 30.67±1.26 |
| Small leg circumference, cm | 22.33±1.15 | 22.50±1.50 | 22.83±0.58 |
| Breast width, cm | 17.17±1.04 | 17.83±0.29 | 17.17±0.58 |

Source: Authors' own elaboration

Table 7. Slaughter cuts of BDSP lambs

| Parameters | Groups of lambs | | |
|---------------|------------------------|--------------------------------|---------------------------|
| | Control group (K) | Zoovit LL probiotic group (O1) | Herbal mixture group (O2) |
| | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ | $\bar{x} \pm SD$ |
| Neck, kg | 0.39±0.06 ^a | 0.28±0.02 ^b | 0.41±0.06 |
| Shoulder, kg | 2.55±0.35 | 2.57±0.22 | 2.51±0.05 |
| Leg, kg | 1.85±0.16 | 1.93±0.13 | 1.81±0.07 |
| Rib chops, kg | 0.33±0.03 | 0.36±0.06 | 0.38±0.09 |
| Loin, kg | 0.36±0.02 | 0.37±0.03 | 0.36±0.02 |

Various superscripts of means within a row indicate statistically significant difference between the groups a-b * ($P \leq 0.05$).

Source: Authors' own elaboration

of supplemented and control Romanov x Shawl crossbred lambs (Rayni et al., 2023).

CONCLUSIONS

The addition of probiotic and a herbal mixture to the feed of fattening BDSP lambs, resulted in significantly increased average daily weight gain in the second week compared to the controls, while during the last week the herbal mixture group showed a significantly lower weight gain. At the end of the experiment, no significant differences were observed in terms of final live body weight, average daily weight gain and survival rate in lambs from the three experimental groups. Although, the feed intake was the lowest in the group, receiving feed with herbal mixture and the feed conversion ratio in the same group was the best, there were no statistically significant between-groups differences.

Regarding the slaughter traits, the average spleen weight in the group receiving the herbal mixture was lower compared to the control animals. Longer rumen papillae were demonstrated in the group fed the probiotic supplement. No significant differences were found for the other slaughter parameters: live body weight before the 24-hour fasting, pre-slaughter live body weight, hot carcass weight, left half carcass weight, kidneys, liver, lung, heart without pericardium, small and large intestines.

The linear carcass measurements did not differ significantly between the groups. Regarding the carcass cuts, the weight of the neck in the group receiving a probiotic supplement was significantly lower than control groups; without any significant differences for the other cuts (leg, lamb shoulder, rib chop, loin).

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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