Sheep productivity when probiotic feed additive "Amilotsin" introduced into the diets

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Abstract. The paper presents the results of a study on the effect of probiotic feed additive “Amilotsin” on the productivity of pregnant ewes and castrate rams. The ewes who received the optimal level of Probiotic feed additive (PFA) “Amilotsin” in the diet throughout the entire experiment were significantly superior in their live weight to their analogues. Animals of the second group at the end of the experiment had a live weight higher by 3.4% than in the first and by 2.4% compared to the third group. The highest average daily gains during the study period were in ewes of the second group, then in animals of the third group. Castrate rams of the first experimental group treated with the composition of the basic diet of the feed additive “Amilotsin” in the amount of 0.38 and 0.19 g/kg of live weight per day during the entire experimental period had an average and absolute live weight higher than the control group, the second and the third experimental groups.

1. Introduction

The problem of increasing the production of meat and wool, reducing its cost and increasing competitiveness, is still an important economic task [1, 2].

In the successful solution of this problem, a special role belongs to sheep breeding, which occupies a significant place in the formation of livestock products [3].

The increase in sheep production largely depends on the need to provide farms with feed of its own production and the organization of full-fledged feeding of all age and sex groups of sheep, taking into account the zonal features of sheep breeding. An important task is to create conditions in the rumen of ruminants, in which feed mixtures are maximally digested and absorbed by the body, and also serve as preventive means against diseases [4, 5, 6].

In recent years, there has been a significant number of studies on the use of probiotic drugs, which formed an alternative to antibiotics [7, 8, 9]. Therefore, a significant role is given to the use of new, inexpensive and environmentally friendly and safe probiotic feed additives in animal diets.

One of the new probiotic feed additives is “Amilotsin” produced by LLC “Arlen”, which has a wide physiological spectrum of action on the body of animals.
However, to date, zootechnical science animal farming has not scientifically and practically justified the amount of information on the influence of probiotic feed additive (PFA) “Amilotsin” on the body of ewes and castrate rams of Kalmyk fat-tailed breed. Therefore, the establishment of science-based optimal dosage of the feed additives for pregnant ewes and castrate rams meet-fat directions and study its impact on productivity is relevant and will be of particular interest to science and industry.

2. Aim of the study
Identify the actions of different levels of feed additive “Amilotsin” on the productivity of pregnant ewes and castrate rams of Kalmyk breed.

3. Materials and methods of the research
For the fulfillment of tasks in terms of “Agrofirm Aduchi” in Tselinny district, and the agricultural artel “Tavn-Gashun” of Yashkul district of the Republic of Kalmykia held 2 scientific and business experiences. For the first scientific and economic on the principle of analogues, taking into account age, live weight, fatness and physiological state were selected 300 heads of ewes, distributed into 3 groups of 100 heads each. For the second scientific and economic experience, 40 heads of Kalmyk breed castrated rams of 4-month age were formed on the principle of analogues, divided into 4 groups of 50 heads each. All experimental animals were clinically healthy and were in the same conditions (table 1).

### Table 1. Scheme of scientific and economic experiments.

| Group         | Number of animals, heads | Days of ewes pregnancy | Level of PFA “Amilotsin”, g/day for 1 head |
|---------------|--------------------------|------------------------|---------------------------------|
|               |                          | 45                     | 90                             | 130                             |
| I scientific and economic experiment |                          | I                      |
| I             | 100                      | Basic diet (BD)        | -15 g PFA                      | BD +17 g PFA                    | BD +20 g PFA                    |
| II            | 100                      | Basic diet (BD) +15 g PFA | BD +17 g PFA                     | BD +20 g PFA                    | BD +23 g PFA                    |
| III           | 100                      | Basic diet (BD) +17 g PFA | BD +20 g PFA                     | BD +23 g PFA                    |                                |
| II scientific and economic experiment |                          | II                     |
| Control       | 50                       | Basic diet (BD)        | -                           | -                              | -                              |
| I-st experimental | 50                      | BD +0.38 g PFA per 1 kg of live weight | BD +0.29 g PFA per 1 kg of live weight | BD +0.24 g PFA per 1 kg of live weight | BD +0.19 g PFA per 1 kg of live weight |
| II-nd experimental | 50                      | BD +0.56 g PFA per 1 kg of live weight | BD +0.43 g PFA per 1 kg of live weight | BD +0.35 g PFA per 1 kg of live weight | BD +0.27 g PFA per 1 kg of live weight |
| III-rd experimental | 50                      | BD +0.75 g PFA per 1 kg of live weight | BD +0.57 g PFA per 1 kg of live weight | BD +0.47 g PFA per 1 kg of live weight | BD +0.36 g PFA per 1 kg of live weight |

Feeding rations of ewes and young rams of all experimental groups were taking into account the chemical composition of the farm feed, age and live weight of animals, according to the recommended norms of Russian Academy of Agricultural Sciences (2003).

The composition of the main diets included cereal-sagebrush pasture, hay cereal-legume, barley turf, a complex of mineral feedings in an amount that compensates for its lack to the recommended norms.

Ewes of the first and castrate rams of the control groups received the diet without the PFA “Amilotsin” introduction, and the animals of the second group in the period of pregnancy was added the drug in the amount 15.0-20.0 g and second, respectively 17.0-23.0 g.

Castrate rams of the first experimental group in addition to the basic diet received 0.38-0.19 g PFA per 1 kg of live weight, the second-0.56-0.27 g and the third-0.75 -0.36 g.
The feed additive was thoroughly mixed with barley turf and other mineral additives and was given for the whole group.

Clarification of rations and recalculation of feed additives, as well as mineral feedings was carried out once a month.

General methods of scientific cognition (analysis, comparison, generalization of results) were used in the experimental work.

Zootechnical (setting experiments, taking into account the dynamics of live weight and quality of meat). Statistical and mathematical methods of analysis were used to process experimental data. Application of these methods allowed providing objectivity of the received data.

Under the influence of internal and external factors, animals develop at different rates. One of the strongest environmental factors causing complex biochemical changes in the body and, as a consequence, causing different rates of growth and development of animals are different feed, hormonal and enzyme preparations, medicinal and mineral substances [10, 11].

Therefore, the feeding conditions of pregnant animals are directly proportional to the growth and development of young animals after birth.

Our observations of productivity suggest about the existence of its dependence on the level of PFA “Amilotsin” in the diet (table 2).

| Indicators                                      | Group          |
|------------------------------------------------|----------------|
|                                                | I              | II             | III            |
| Live weight, kg                                | 68.4±0.88      | 68.2±0.96      | 68.3±1.06      |
| in the beginning of the experiment             | 75.6±1.13      | 78.3±0.99      | 76.4±1.02      |
| at the end of the experiment                   | 7.20±0.34      | 10.1±0.45      | 8.10±0.56      |
| Live weight gain, kg                           | 48.0±0.82      | 67.3±1.06      | 54.0±0.94      |
| Average daily growth, g                       |                |                |                |
| -spring                                        | 1.06±0.05      | 1.29±0.09      | 1.17±0.07      |
| -autumn                                        | 0.89±0.01      | 1.02±0.06      | 0.93±0.05      |
| Wool yield, kg                                 | 96.0±3.93      | 1060±3.90      | 98.0±2.84      |
| Fertility, %                                   | 4.88±0.26      | 5.48±0.31      | 4.96±0.42      |
| Live weight of lambs at birth, kg              |                |                |                |

The data in the table show that the ewes that received the optimal level of Amilocin PKD in the diet throughout the experiment significantly exceeded their analogues in terms of live weight. Animals of the second group at the end of the experiment had a live weight higher by 3.4% than in the first and 2.4% compared with the third group.

The highest average daily gains during the study period were in ewes of the second group, then in animals of the third group (67.3-54.0 g).

The optimal level of PFA “Amilotsin” for pregnant ewes has a positive impact on the growth rate of wool. Wool production in animals of the second group was 2.31 kg in the first and third group of 1.95-2.10 kg, lambs born from ewes of the second group were 10.9-9.5% (P<0.01) larger in comparison with lambs born from animals of the first and third groups.

At the end of the second scientific and economic experience, in order of more and full assessment of the impact of different dosages of the new studied feed additive on meat quality, a control slaughter of three heads from each group was carried out according to the method of all-Russian Institute of animal husbandry (1956).

The control slaughter showed that feeding the castrate rams of first experimental group by the diet of probiotic feed additive in the amount of 0.38-0.19 g/kg of live weight per day, contributed to an increase not only in the energy of their growth, but also meat indicators (table 3).
Thus, the castrate rams from the first experimental group had 2.37 kg or 10% (p<0.05) more weight of the cooled carcass, compared with analogues from the control group, 1.67 kg or 6.9% (p<0.05) compared with the second experimental group by 2.03 kg or 8.5% (p<0.05) compared with the third experimental group.

At the same time, in the first experimental group, the slaughter yield with fat tail increased slightly, compared with the control group - by 23.9% (p<0.05), compared with the second group - by 6.7% (p<0.05) and compared with the third experimental group - by 8.8% (p<0.05).

The chemical composition of animal meat depends on the composition and quality of feed diet. Therefore, in order to identify the effect of the studied feed additive on the quality of meat of experimental castrate rams, an analysis of its chemical composition was carried out.

The analysis of the average sample of animal meat showed that the addition of feed additives in the optimal dosage helps to reduce moisture from meat of castrate rams from the first experimental group of and increase the amount of protein (table 4).

Table 3. The indicators of control slaughter of castrate rams.

| Indicators                        | Control            | 1-st experimental | 2-nd experimental | 3-rd experimental |
|-----------------------------------|--------------------|-------------------|-------------------|-------------------|
| Pre-slaughter weight, kg          | 53.28±0.65         | 57.60±0.46        | 54.53±0.54        | 53.80±0.36        |
| Weight of the cooled carcass, kg  | 23.53±0.26         | 25.90±0.28        | 24.23±0.29        | 23.87±0.21        |
| Yield of the cooled carcass, %    | 44.13±0.23         | 44.96±0.13        | 44.43±0.11        | 44.36±0.11        |
| Weight of internal fat, g         | 402.0±23.51        | 498.0±14.00       | 446.0±5.29        | 422.0±7.86        |
| Weight of the tail, kg            | 4.00±0.15          | 4.60±0.17         | 4.37±0.08         | 4.20±0.11         |
| Slaughter weight without tail, kg | 23.93±0.26         | 26.40±0.30        | 24.68±0.29        | 24.29±0.21        |
| Slaughter weight with tail, kg    | 27.93±0.27         | 31.00±0.47        | 29.04±0.36        | 28.49±0.33        |
| Slaughter yield with tail, %      | 52.43±0.60         | 53.81±0.39        | 53.26±0.23        | 52.95±0.26        |
| Slaughter yield without tail, %   | 44.91±0.26         | 45.83±0.16        | 45.25±0.11        | 45.15±0.10        |

Thus, the amount of moisture in meat from this group, compared with the control group decreased by 2.68% (p<0.05), with the second experimental group – by 1.6% (p<0.05), with the third experimental group – by 2.26% (p<0.05).

The amount of protein in meat of castrate rams from the first experimental group was higher than in the control group by 1.25% (p<0.05), from the second experimental group – by 0.98% (p<0.001) and from the third experimental group – by 1.22% (p<0.01). As for fat, its quantity in meat of castrate rams

Table 4. Chemical composition (%) and caloric content (MJ) of meat of castrate rams.

| Indicators | Control            | 1st experimental | 2nd experimental | 3rd experimental |
|------------|--------------------|------------------|------------------|------------------|
| Moisture   | 66.58±0.44         | 63.90±0.21       | 65.50±0.16       | 66.16±0.19       |
| Protein    | 18.27±0.19         | 19.52±0.04       | 18.54±0.03       | 18.30±0.06       |
| Fat        | 14.20±0.25         | 15.60±0.17       | 15.00±0.11       | 14.60±0.11       |
| Ash        | 0.95±0.01          | 0.98±0.01        | 0.96±0.02        | 0.94±0.01        |
| Calories   | 8.55±0.12          | 9.42±0.07        | 9.02±0.05        | 8.82±0.05        |
from the first experimental group made 15.60% that on 1.4% (p<0.05) is higher, than in control group, on 0.6% (p<0.05), than in the second group and on 1% (p<0.05), than in the third experimental group.

In addition, the meat of animals from the first experimental group is also distinguished by its energy value. So, according to this indicator, the castrate rams from this group were superior to the peers of the control group – by 10.2% (p<0.05), from the second – by 4.4% (p<0.05) and from the third experimental group – by 6.8% (p<0.05).

It is also known that the nutritional value of meat also depends on the ratio of essential and essential amino acids in it, i.e. on the so-called protein-quality indicator, the higher this ratio, the meat is more valuable in nutritional terms. To evaluate the meat quality of experimental castrate rams was also conducted its analysis on the concentration of tryptophan and oxyproline (table 5).

The analysis showed that in the samples of the longest back muscle of castrate rams of the first experimental group, the content of amino acid tryptophan was 10.3% higher than in the control group (p<0.05), 6.9% higher than in the second experimental group (p<0.05) and 9.4% higher than in the third experimental group (p<0.05).

As for oxyproline, its concentration in the meat of animals from the first experimental group was also higher by 6.3% than in the control and third experimental group (p<0.05) and by 4.7% than in the second experimental group (p<0.05).

The best ratio of tryptophan to oxyproline (protein-quality indicator of meat) were in the group of castrate rams who received “Amilotsin” in the amount of 10 g/head per day. This indicator in this group was higher than in the control group by 0.15 g or 3.8%, than in the second experimental group - by 0.09 g or 2.2% and then in the third experimental group - by 0.12 g or 2.9%.

The nutritional value of meat can also be judged by the amount of saturated and unsaturated fatty acids. Amino acids and fatty acids create a characteristic for each type of meat and flavor (organoleptic characteristics).

The quality of fat is determined by the physical and chemical properties of fatty acids that are part of fats. In order to determine the qualitative composition of fat, an analysis of the fatty acid composition of the longest back muscle was carried out (table 6).

The largest number of unsaturated fatty acids, such as oleic, linolenic, was contained in the fat of young rams of 3rd experimental group – 32.7 and 1.53%, and the smallest number of it was noted in the meat of animals of the control group – 17.1 and 0.81%.

Table 5. Protein-qualitative indicator of meat of castrate rams.

| Groups          | Tryptophan, mg % | Oxyproline, mg % | Protein-qualitative indicator |
|-----------------|------------------|------------------|-------------------------------|
| Control         | 252.0±2.64       | 63.0±1.00        | 4.00                          |
| 1st experimental| 278.1±4.58       | 67.0±0.57        | 4.15                          |
| 2nd experimental| 260.0±2.51       | 64.0±1.00        | 4.06                          |
| 3rd experimental| 254.2±3.05       | 63.0±1.00        | 4.03                          |

The ratio of tryptophan to oxyproline (protein-qualitative indicator of meat) were in the group of castrate rams who received “Amilotsin” in the amount of 10 g/head per day. This indicator in this group was higher than in the control group by 0.15 g or 3.8%, than in the second experimental group - by 0.09 g or 2.2% and then in the third experimental group - by 0.12 g or 2.9%.

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Table 6. Fatty acid composition of the longest back muscle (mass fraction of fatty acid in % to the sum of fatty acids).

| Name of the acid | Control       | 1st experimental | 2nd experimental | 3rd experimental |
|------------------|---------------|------------------|------------------|------------------|
| Myristic         | 2.38±0.21     | 2.19±0.20        | 2.14±0.18        | 2.09±0.26        |
| Pentadecanol     | 0.81±0.03     | 0.68±0.04        | 0.59±0.03        | 0.54±0.02        |
| Palmitic         | 4.40±0.46     | 4.51±0.52        | 4.61±0.71        | 4.68±0.82        |
| Palmitoleic      | 4.40±0.46     | 4.51±0.52        | 4.61±0.71        | 4.68±0.82        |
| Heptadecanoyl    | 2.62±0.37     | 1.93±0.19        | 2.10±0.21        | 2.21±0.16        |
| Heptadecenoic    | 2.10±0.19     | 1.40±0.06        | 1.19±0.07        | 1.10±0.09        |
| Stearic          | 49.8±0.83     | 36.7±0.64        | 31.3±0.45        | 26.4±0.75        |
| Oleic            | 17.1±0.40     | 28.2±0.49        | 31.6±0.52        | 32.7±0.65        |
| Linolenic        | 0.81±0.06     | 0.93±0.05        | 1.20±0.14        | 1.53±0.25        |
Castrate rams of 1\textsuperscript{st} experimental group took on these indicators the intermediate position. For other fatty acids, the difference between the groups was insignificant.

After completion of control slaughter of animals, commission tasting of meat and broth was carried out. A five-point assessment was carried out on appearance, smell, taste, juiciness and tenderness (Table 7).

The results of the tasting evaluation of meat experimental castrate rams showed that meat from animals of the first experimental group were predominant in all investigated organoleptic characteristics.

So the meat of castrate rams from this group in appearance were superior to control samples of 11.9%, meat samples of castrate rams from the second experimental group - by 6.8%, from the third – 9.3%.

Meat of castrate rams from the first group had the best taste compared with the control group, 9.1% in the second experimental – 4.3% and from the third group – by 6.6%. Similarly, the best results of the tasting evaluation of castrate rams from the first experimental group had also the rest of the indicators.

| Indicator      | Control | 1\textsuperscript{st} experimental | 2\textsuperscript{nd} experimental | 3\textsuperscript{rd} experimental |
|----------------|---------|-----------------------------------|-----------------------------------|-----------------------------------|
| Appearance     | 4.2     | 4.7                               | 4.4                               | 4.3                               |
| Smell (aroma)  | 4.3     | 4.6                               | 4.4                               | 4.3                               |
| Taste          | 4.4     | 4.8                               | 4.6                               | 4.5                               |
| Tenderness     | 4.3     | 4.7                               | 4.5                               | 4.4                               |
| Juiciness      | 4.5     | 4.7                               | 4.6                               | 4.5                               |
| Average point  | 4.34±0.05 | 4.70±0.03 | 4.50±0.03 | 4.40±0.04 |

When assessing the quality of the broth, no foreign smells and tastes were detected.

It should be noted that the broth from the meat of castrate rams of the experimental groups, especially the first experimental, had better transparency, pleasant smell and taste (Table 8).

| Indicator               | Control | 1\textsuperscript{st} experimental | 2\textsuperscript{nd} experimental | 3\textsuperscript{rd} experimental |
|-------------------------|---------|-----------------------------------|-----------------------------------|-----------------------------------|
| Color and transparency | 4.3     | 4.7                               | 4.5                               | 4.5                               |
| smell (aroma)           | 4.4     | 4.8                               | 4.6                               | 4.4                               |
| Taste                   | 4.5     | 4.8                               | 4.6                               | 4.6                               |
| Richness                | 4.0     | 4.6                               | 4.4                               | 4.2                               |
| Average point           | 4.30±0.10 | 4.72±0.04 | 4.52±0.04 | 4.42±0.08 |

In general, the average point on all indicators was better in the broth from the meat of castrate rams of the first experimental group. Average point comparing with the control group was higher by 9.8%, with the second group-by 4.4% and with the third experimental group-by 6.8%. Thus, for all organoleptic indicators the best results were meat and broth from the castrate rams of first experimental group.

Thus, it is possible the meat of castrate rams of the first experimental group differs somewhat better nutritional qualities than meat of castrate rams from other groups. Although the meat from these groups also has fairly high quality indicators.

In addition of studying the effect of the studied feed additive on protein-quality indicators of meat of castrate rams, we have also studied its effect on the development of its internal organs (Table 9).

Weighing internal organs of castrate rams showed that supplementation of probiotic feed additive in the diets of growing castrate rams had a significant impact on the development of internal organs, except the liver, the mass of which in all the study groups were similar (638-640g).

In the first experimental group who received “Amilotsin” in the amount of 10 g/head per day, weight of the hearts was higher than that of control counterparts by 14.7% (p<0.05) than the counterparts of the second experimental group - 7.9% (p<0.05) and then the third experimental group by 12.9% (p<0.001).
Table 9. Development of internal organs of the castrate rams, g.

| Internal organs | Control | 1st experimental | 2nd experimental | 3rd experimental |
|----------------|---------|------------------|------------------|------------------|
| Liver          | 640±5.77| 638±2.00         | 638±2.08         | 638±4.16         |
| Heart          | 190±5.70| 218±2.00         | 202±3.21         | 193±0.02         |
| Lungs          | 500±11.54| 537±1.52        | 510±4.04         | 506±4.58         |
| Kidney         | 110±5.77| 136±2.08         | 120±3.05         | 114±3.05         |
| Spleen         | 73±2.51 | 88±1.52          | 78±3.21          | 75±2.89          |

The weight of lungs in the first experimental group was also higher than castrated rams in the control group - by 37g (p<0.05), than in the second experimental group - by 27g (p<0.05) and then in the third group - by 31g (p<0.05). A similar trend was observed in the mass of the kidneys and spleen.

In addition to the mass of internal organs, we studied the effect of feed additives on the value of the mass of the gastrointestinal tract of the castrate rams, without its contents (table 10).

Table 10. The development of the digestive tract of castrate rams, g.

| Parts of gastrointestinal tract (without content) | Groups |
|-----------------------------------------------|--------|
|                                              | Control | 1st experimental | 2nd experimental | 3rd experimental |
| Rumen                                         | 1008±4.16| 1038±2.30        | 1012±5.03        | 1002±4.04        |
| Grid                                          | 118±1.52 | 140±1.15         | 126±3.21         | 120,0±5.77       |
| Bible-bag                                     | 450±5.29 | 482±3.17         | 462±3.05         | 456±4.00         |
| Abomasum                                      | 1080±5.77| 1125±8.14        | 1090±5.77        | 1083±9.16        |
| Thin bowels                                   | 960±6.42 | 987±6.08         | 978±4.16         | 975±3.6          |
| Thick bowels                                  | 129±3.0  | 142±2.0          | 137±3.21         | 134±4.58         |

The analysis showed that the mass of the digestive tract of the castrate rams is similar to the mass of internal organs, slightly changed under the influence of the probiotic feed additive.

For example, the highest weight of gastrointestinal tract without its content, was in castrate rams of first experimental group. Mass of rumen content it was superior to the control counterparts 30 g or 2.9% (p<0.05), analogues of the second experimental group - 26 g or 2.6% (p<0.05) and the third experimental group at 36 g or 3.6% (p<0.01). As for the remaining sections of the digestive tract of the castrate rams, the animals from the first experimental group were also superior in weight to all other groups.

Of the increased dosages of “Amylocin”, the best effect on the development of the digestive tract sections of the castrate rams was exerted by a dosage of 15 g/head per day.

4. Conclusions

Inclusion of probiotic feed additive Amilotsin” in the composition of the diet of pregnant ewes and castrate rams in the optimal amount provides a more stable and intensive growth. At the end of experiment, the live weight of the experimental ewes and castrate rams treated as part of the basic diet with feed additive “Amilotsin” in the optimum quantity was equal to 78.3-59.0 kg, which is 8.1% (p<0.05) higher than that of peers from other groups.

The transformation of protein and feed energy into meat products proceeded more intensively in the body of the first experimental group of castrate rams in comparison with analogues from other groups. In the edible part of its body, protein was deposited more by 6.8% (p<0.01) and energy – by 10.2% (p<0.01).

Fodder additive “Amilotsin” improves the quality indicators of the muscle tissue of animals. The fatty acid composition of lipids, the protein-quality indicator and the organoleptic characteristics of meat are improved in muscle tissue.

Probiotic feed additive contributes to better development of internal organs and the digestive tract of castrate rams.
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