Development of methods for reducing feed costs when growing young goats

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Abstract. Research was conducted to improve the efficiency and reduce the cost of growing young goats in the first three months of life by using cheaper whole milk replacers (WMR) and sprouted cereals with increased biological value in the diet. The work was carried out on kids of the Saanen dairy breed, during the suckling period, in the first three months of life in the peasant farm of M.V. Myakotin and in the private farm of V.N. Kosenko. For germination, we used grain of the Bezostaya-1 wheat variety and the Moskovsky 21 barley variety. The seed germination was 98%. The kids of the two groups received the same amount of roughage (hay) and succulent feed from birth to three months of age. The first group received 64 kg of whole goat milk for the entire period and 14.3 kg of compound feed. The second group received 13.74 kg of dry whole milk replacer, 7.15 kg of compound feed, and 28.6 kg of wheat and barley sprouts. When the goats of the first group were raised on milk and the second group on milk replacer and sprouts up to three months of age, the live weight at three months of age was 11.40±0.06 kg, and the second group - 12.06±0.10 kg, i.e. significantly more by 0.56 kg or 4.9% ($P<0.001$). The cost of feed required to raise one goat raised on milk is 10,014.9 rubles, and for those raised on milk replacer with the addition of grain sprouts - 3,228.2 rubles, which is 3.1 times cheaper.

1 Introduction

The most common method of raising young goats is natural suckling.

One of the positive aspects of suckling young goats is that the kids get used to eating hay and concentrates much faster, since the adult goat is an example for them. The kid starts to taste the brooms on the 4th-5th day, actively chews them by the tenth day, and starts to show interest in compound feed by the 15th day.

The sooner the kids are weaned from their mother, the faster they will eat from a bowl. Milk should be replaced with mixtures, porridges and mash gradually, after the first ten days. In dairy goat breeding, artificial raising of kids is increasingly used. In the first week after birth, kids are fed 5-6 times a day [1-3].

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It is important to apply accelerated rearing of healthy kids of both sexes. In this case, after lambing, the offspring has to be fed 30 minutes later; colostrum is necessary for the first two days. Traditionally, they are raised on suckling under their mothers, the first three months with the addition of dry starter feed to the diet from the tenth day of life. A kid sucks up to twenty times and can suck 1 liter per day. Therefore, when raising young animals on suckling under their mothers, the amount of commercial milk is reduced by 75%. Considering the price of commercial milk (up to 200 rubles per 1 liter), farmers usually leave only female goats on suckling for replacement [4, 5].

A method has been developed for early (possibly from the first or third day after lambing) weaning of kids from their mothers and raising the former on cheap whole milk replacers (WMR) with normal live weight gains. To enhance the positive effect of using whole milk replacer on the subsequent productivity of raised goats, the nutritional value of the kids' diet can be significantly increased by adding sprouted cereal grains and full-fat soybeans [6-8].

During germination of wheat, oats, lentils, beans, mung beans, there is a sharp increase in proteins, amino acids, minerals, including iron and iodine.

During germination of seeds, nutrients are broken down: proteins into amino acids, fats into essential fatty acids, starches into sugars, minerals into chelated form.

Introducing sprouts into the diet stimulates metabolism and hematopoiesis, increases immunity, compensates for vitamin and mineral deficiencies, normalizes the acid-base balance, promotes cleansing of the body from toxins and intensive digestion [9, 10].

In villages and suburbs of cities, there are a large number of individual plots of land with an area of less than one hectare, which are insufficiently used for milk and meat production. In these conditions, attention should be paid to reducing production costs on farms by reducing feeding costs, including as a result of using milk replacer. At the same time, it is necessary to ensure high implementation of the genetic potential of milk production after obtaining offspring. In addition, it is necessary to reduce the period of growing young animals to physiological maturity, as well as their use for the replacement of adult livestock [2, 7].

The objective of the study was to increase the efficiency and reduce the cost of growing young goats in the first three months of life by using cheaper whole milk replacements (WMR) and cereal sprouts with increased biological value in the diet.

2 Materials and Methods

The work was carried out on Saanen dairy goat kids during the suckling period, in the first three months of life in the peasant farm of M.V. Myakotin and in the private farm of V.N. Kosenko.

Wheat (barley) grain was germinated using the following technology. First, the grain is disinfected with a 0.01% solution of potassium permanganate for 5 minutes. Tap water completely covers the grain in a 1:1 ratio. After 8-10 hours of soaking, the water is drained and the grain is left in the container to germinate. Subsequently, the grain is washed with cold water 2 times a day during the germination period (2-4 days). To do this, the grain is poured with cold tap water, and the water is immediately removed from it. Grain germination occurs without water in an open container at a temperature of 18-25º C with or without daylight. Grain is fed in a feeder after 2-3 days of germination. You can use a container made of polyethylene or glass (from 3 to 30 l). Feeding of sprouts is carried out after the emergence of a sprout of 2-10 mm and a root of 10-30 mm in length.

During germination, we used grain of the Bezostaya-1 wheat variety and the Moskovsky 21 barley variety. The seed germination rate was 98%.

As the wheat germinates, the sprout length increases: by 1–2.5 mm after the first day; by 4–5 mm after the second; by 6–10 mm after the third, and by 10–15 mm after the fourth day. The number of roots on the first day is 1–3, and increases to 3 in the following days. The

maximum root length is 5–7 mm on the first day, 7–12 mm on the second, 10–20 mm on the third, and 20–30 mm on the fourth.

During germination, the total energy value of wheat sprouts on dry matter basis in feed units slightly decreases from 1.46 EFU to 1.34–1.37 EFU. At the same time, the metabolizable energy of the feed in dry matter increases during germination. In grain it is equal to 13.40 MJ/kg, in sprouts of 1–4 days old - 13.42–13.78 MJ/kg in terms of absolute dry matter (DM). At the same time, crude protein, determined according to (State standard) GOST 32044:1-2012, decreases in grain from 13.88% to 9.90–5.50%. This should be considered as the effect of the germination process on the breakdown of protein into peptides and amino acids, which occurs in the digestive tract when animals digest protein. Such an effect is not taken into account by the GOST according to the amount of nitrogen-containing products, in contrast to the metabolizable energy, which increases.

The concentration of natural moisture of crude fiber, fat, ash, nitrogen-free extracts (NFE) and calcium in sprouts decreases. The concentration of phosphorus, on the contrary, increases from 1.31 to 1.99-1.93%, which is nothing less than a consequence of atomic synthesis.

In sprouted wheat on the 3-4th day, vitamins C and B increase fivefold, vitamin E - three times, folic acid - four times. In addition to calcium and phosphorus, it contains mineral elements in an easily digestible form: potassium, magnesium, manganese, zinc, iron, selenium, copper, vanadium and others; vitamins: B1, B2, B3, B5, B6, B9, E, F, biotin, carbohydrates, amino acids and pectins, which help to normalize the brain and heart, gastrointestinal tract, improve the condition of the skin and hair.

Thus, during germination, the necessary microelements and vitamins necessary for the animal organism are synthesized, and the absorption of fat and protein is facilitated. Therefore, it is advisable to sprout wheat for two to four days for animal feed.

Sprouted wheat and barley are softened, they contain calcium, phosphorus and other mineral elements, biotin, free amino acids and pectins in an easily digestible organic form, which help to normalize the work of all animal organs, alleviate the effects of stress, and, importantly, are readily eaten by kids.

As the barley germinates, the sprout length after the first day is 1-2 mm, the second - 3-5 mm, two and a half days - 5-12 mm, three days - 20-26 mm. The number of roots on the first day is 2-3 pieces, in the next three days up to 8-10 pieces. Their length also increases: at the end of the first day - 4-7 mm, the second day - 8-11 mm, the third day - 18-24 mm.

Within 1–3 days of germination, the amount of nitrogen, crude fat, and crude fiber in barley grain increases, calculated on the basis of dry matter of the feed. As a result, the metabolizable energy of barley sprouts is almost stable for 2.5 days of germination, despite the fact that the method of its calculation does not take into account the specifics of the process, as well as the growth of the biological value of the feed. It is during this period that it is recommended to use sprouts for animals.

The kids of the two groups received the same amount of roughage (hay) and succulent feeds from birth to three months of age. The first group received 64 kg of whole goat milk for the entire period and 14.3 kg of compound feed. The second group received 13.74 kg of dry whole milk replacer, 7.15 kg of compound feed, and 28.6 kg of wheat and barley sprouts (Table 1).

Table 1. Feeding scheme for kids, per head/day

Periods, days	Feeds					
	Milk, kg	WMR, kg	Compound feed, kg	Wheat+barley sprouts	Hay	Grass
animals of the 1st control group						
0-10	0.8	-	-	-	-	-
11-30	1.0	-	0.1	-	-	-
31-60	1.2	-	1.6	-	0.1	

61-90	-	-	0.25	-	0.25	0.5
Total	64		14.3	-	10.5	15.0
animals of the 2nd experimental group						
0-20	0.8	-	-	-	-	-
3-10	-	0.22	-	-	-	-
11-30	-	0.22	0.05	0.1	-	-
31-60	-	0.26	0.8	0.16	0.10	-
61-90	-	-	0.125	0.25	0.25	0.5
Итого	1.6	13.74	7.15	28.6	10.5	15.0

Table 2. Composition of the starter compound feed

Name of feed	Required for 100 kg, kg	Dry matter content per 1 kg					
		ME, kJ	Crude protein, g	Digestible protein, g	Crude fat, g	Crude fiber, g	NFE, g
Corn	10	1.8	13.3	9.7	2	1.7	66.1
Wheat	20	2.16	26.3	19.4	4	3.4	132.2
Bran	10	0.89	15.1	11.2	4.1	8.8	52.6
Oats	10	0.92	10.8	7.9	4.0	9.7	57.3
Barley	30	3.54	46.2	33.3	4.5	9.0	251.1
Soybeans	20	2.82	63.8	58.2	29.4	14.0	62.2
Total	100	11.40	175.5	139.7	48.0	46.8	621.5

The composition of the starter compound feed included grain meal, wheat bran, full-fat soybeans, and contained 11.4 kJ of dry matter (DM), 11.4 kJ of metabolizable energy (ME), and 139.7 g of digestible protein (DP) per 1 kg (Table 2).

3 Results and Discussion

Over the entire three-month period of growing kids, the first group consumed only 45.2 EFU and 5.2 kg of digestible protein (DP). Over the same period, the second group consumed 51.92 EFU (energy feed units) and 6.38 kg of digestible protein (DP) (Table 3).

Table 3. Feed consumption for 3 months of growing kids

Index	Feed consumption								
	milk	whole milk replacer	Compound feed	sprouts		soybeans	hay	cereal and legume grass	total
				wheat	barley				
Group 1									
Amount, kg	64	-	14,3	-	-	-	10.5	15	-
EFU	18.56	-	16.3	-	-	-	7.04	3.3	45.2
DP, kg	1.79	-	2.0	-	-	-	1.06	0.35	5.2
Group 2									
Amount kg	1.6	13.74	7.15	10.0	10.0	1.43	10.5	15	-
EFU	0.46	18.55	8.15	67.0	5.7	2.03	7.04	3.3	51.92
DP, kg	0.05	2.50	1.00	0.55	0.45	0.42	1.06	0.35	6.38

It was found that the live weight of the goats of the first group (when raised on milk) and the second group (raised on milk replacer and sprouts) was, respectively, 3.0±0.04 kg and 3.06±0.06 kg at birth, and 5.44±0.03 kg and 5.73±0.06 kg at one month of age, with a reliable ($P<0.001$) excess of growth in the second group (Table 4).

Table 4. Dynamics of live weight in goats over three months, kg

Age	Group			
	1 control		2 experimental	
	Live weight, kg	Live weight gain, kg	Live weight, kg	Live weight gain, kg
At birth	3.0±0.04	-	3.06±0.06	-
1st month of life	5.44±0.03	2.44±0.02	5.73±0.06*	2.68±0.04*
2nd month of life	8.37±0.04	2.93±0.01	8.83±0.07*	3.10±0.05*
3rd month of life	11.40±0.06	3.03±0.05	12.06±0.10*	3.23±0.06*
Total	-	8.40±0.04	-	9.01±0.05*

Notes: differences between groups are significant * – at $P < 0.001$

The same reliable differences in growth are observed in the second month. The live weight of animals in the first group is 8.37±0.04 kg, and in the second group – 8.83±0.07 kg. At the age of three months, the live weight of kids in the first group is 11.40±0.06 kg, and in the second – 12.06±0.10 kg, that is, reliably more by 0.56 kg or 4.9% ($P < 0.001$).

The growth rate coefficients of live weight in the second group of goats raised on milk replacer and sprouts are higher than their counterparts consuming milk by 4.2% in the first month and by 4% in total for three months (Table 5).

The growth rate coefficients were determined by the ratio of live weight in the final age period to live weight in the initial period.

Table 5. Live weight growth rate coefficients of experimental goats

Age periods, months	Duration of the period, months	Group		Ratio of group 2 to group 1
		1	2	
0-1	1	1.813	1.889	1.042
1-2	1	1.539	1.533	0.996
2-3	1	1.362	1.366	1.003
0-3	3	3.800	3.954	1.040

The correlation of live weight indicators with the conservation of high growth energy acquired during the intrauterine period and the first month of life in the goats of the first group is very strong ("r" = 0.92). It remains at the same level in the second month of life ("r" = 0.91), but significantly decreases in the third month ("r" = 0.76) when milk feeding is stopped (Table 6). The picture with such a relationship is different in the goats of the second group. In the first month it is quite good ("r" = 0.79), in the second month it increases even more ("r" = 0.88), and in the third month with the cessation of feeding milk replacer it continued to increase to a strong ("r" = 0.91), significantly exceeding the same correlation in the first group by 20%.

Table 6. Dynamics of average daily live weight gains in goats for 3 months

Age	Group			
	1 control		2 experimental	
	Live weight gain, kg	Average daily live weight gain, g	Live weight gain, kg	Average daily live weight gain, g
1st month of life	2.44±0.02	81.3±0.65	2.68±0.04**	89.3±1.3**
2nd month of life	2.93±0.01	97.7±0.49	3.10±0.05*	103.2±1.8*
on average for 2 months	5.37±0.02	89.52±0.30	5.78±0.03**	96.3±0.54**

3rd month of life	3.03±0.05	101.1±0.51	3.23±0.05*	107.6±1.88*
on average for 3 months	8.40±0.04	93.3±0.41	9.01±0.05**	100.1±0.58**

Notes: differences between groups are significant * – at P < 0.05, ** – at P < 0.001

In the first group, the average daily gains during the first, second and third months were 81.3±0.65 g, 97.7±0.49 g and 101.1±0.51 g, respectively. For the same periods of life, the weight gains in the goats of the second group, raised on milk replacer and sprouts, were 89.3±1.3 g, 103.2±1.8 g and 107.6±1.88 g, respectively, that is, significantly higher in all these periods (at P < 0.001). On average, over three months, this indicator for the first group was 93.3±0.41 g, and for the second - 100.1±0.58 g, or significantly higher by 7.3% (Table 6).

The body parameters of the experimental kids at the age of three months were studied. The second group of goats was found to have an excess of withers height by 0.5 cm (or 1%), height at the sacrum - by 0.8 cm, oblique body length - by 1.2 cm or 2.5% (P<0.01), chest width - by 0.3 cm or 3%, chest depth - by 1 cm or 6% (P<0.05) and hip width - by 0.4 cm or 4.6% over the first group (Table 7).

Table 7. Body measurements of kids, cm

Index	Height at withers	Height at sacrum	Chest girth	Chest depth	Chest width	Oblique body length	Pastern girth	Width at hips
1 group								
M	50.4	51.2	46.0	16.0	9.7	48.1	5.4	8.6
±m	0.3	0.4	0.8	0.4	0.2	0.4	0.1	0.3
2 group								
M	50.9	52.0	48.0	17.0	10.0	49.5	5.5	9.0
±m	0.6	0.6	0.9	0.3	0.4	0.3	0.1	0.3
td to group 1	0.76	1.09	1.63	2.20	0.76	3.07	1.05	1.00

Among the body indices, it is possible to note an increase in the body condition score by 3% in the goats of the second group compared to their peers from the control group. The difference in other indices is lower and less significant.

In the goats of the first and second groups, from the first to the third month of life, the body temperature, heart rate and respiration were within the physiological norm with no reliable differences between the groups. This positively characterizes the experimental conditions.

On the twenty-fifth day of life, the kids of both groups begin to chew cud 40-60 minutes after feeding. In the second month of life, the periods of chewing cud reach a duration of 15-30 minutes and consist of chewing cycles of 40-50 seconds with breaks of several seconds between them. The chewing regimes indicate that the forestomaches work in a normal physiological rhythm due to the balance of the diets for the main nutrients.

Our research work on growing experimental goats up to three months of age showed their live weight at the level of the requirements for the Saanen breed. The linear dimensions of the body and physiological parameters of the animals of both groups, grown according to different schemes, indicate their normal development, which is important for the practical organization of production.

Further analysis of the systems of growing groups in accordance with the purpose of the experiment includes taking into account the quality and cost of the feed consumed. Here, all costs should be taken into account by groups (Tables 8 and 9).

Table 8. Feed consumption for live weight gain of goats over a three-month period, kg

Group	Index	Live weight gain, kg	Feed consumption for live weight gain		For 1 EFU DP
			total, kg	per 1 kg of gain, kg	
1	-	11.4	-	-	-
	EFU	-	45.2	3.970	-
	DP, kg	-	5.2	0.456	0.115
2	-	12.06	-	-	-
	EFU	-	51.92	4.30	-
	DP, kg	-	6.38	0.529	0.123

Table 9. Cost of feed spent per 1 head, rubles

Item	Group 1 control			Group 1 experimental		
	kg	Price, rub./kg	Amount, rub	kg	Price, rub./kg	Amount, rub
Milk	64.0	150.0	9600.0	1.6	150.0	240.0
Whole milk replacer	-	-	-	13.74	180.0	2466.0
Compound feed	14.3	18	257.4	7.15	18	128.7
Sprouts:						
Wheat	-	-	-	14.3	6.5	93.0
Barley	-	-	-	14.3	6.0	85.8
Soyabean	-	-	-	1.43	40	57.2
Hay	10.5	10.0	105.0	10.5	10.0	105.0
Grass	15.0	3.5	52.5	15.0	3.5	52.5
Total	-	-	10014.9	-	-	3228.2

The highest cost is for whole milk – 150 rubles per 1 kg. The cost of dry whole milk replacer is 180 rubles per 1 kg. The price of compound feed is 18 rubles per 1 kg, taking into account the low cost of wheat grain (12 rubles/kg) and barley (10 rubles/kg), respectively, the price of sprouts from them is 6.5 and 6.0 rubles/kg. The price of hay is 10 rubles/kg, grass – 3.5 rubles/kg. Taking into account the costs of physical feed, the total cost of all feed for raising one goat in the first group, raised on milk, is 10,014.9 rubles, and in the second group, raised on whole milk replacer using the accepted technology with the addition of grain sprouts – 3,228.2 rubles, which is 3.1 times cheaper.

Table 10. Cost of feed spent on 1 kg of live weight gain of goats, rubles

Group	Costs, rub.	Weight gain, kg	Cost of feed per 1 kg of gain
1	10014.9	11.4	878.5
2	3228.2	12.06	267.7

Per 1 kg of live weight gain, the cost of feed consumed is 878.5 rubles for the first group and 267.7 rubles for the second group, for kids raised on whole milk replacer or 228.1% less than in the first group (Table 10).

4 Conclusion

1. When the first group of goats were raised on milk up to the age of three months, and the second group on milk replacer and sprouts, the live weight at birth was 3.0±0.04 kg and 3.06±0.06 kg, respectively, and at the age of one month - 5.44±0.03 kg and 5.73±0.06 kg with a reliable ($P<0.001$) excess of growth in the second group. At the age of three months, the live weight of the kids of the first group was 11.40±0.06 kg, and the second - 12.06±0.10 kg, that is, reliably more by 0.56 kg or 4.9% ($P<0.001$).

2. The cost of feed required to raise one goat raised on milk is 10,014.9 rubles, and for those raised on whole milk replacer with the addition of grain sprouts is 3,228.2 rubles, which is 3.1 times cheaper.

References

1. J. Liang, P. Paengkoum, Anim Biosci, **32(8)**, 1233–1243 (2019). DOI:10.5713/ajas.19 .0272.
2. A.F. Shevkhuzhev, M.B. Ulimbashev, Zootechnics, **9**, 6-8 (2017) (In Russ.)
3. M.Yu. Sannikov, S.I. Novopashina et al., News of the Timiryazev Agricultural Academy, **6**, 141-149 (2019) (In Russ.)
4. V. Sejian, Animal. **12**, 431–444 (2018) DOI: 10.1017/S1751731118001945.
5. J. Abatzoglou, Sci Data. **5**, 170191 (2018) DOI: 10.1038/sdata.2017.191.
6. A. Fuller, J Exp Biol. **224(1)**, 23811 (2021)
7. B. Scherf, *Livestock Genetic Diversity in Dry Range- lands* (The Future of Drylands. Springer, Dordrecht, 2008) DOI: 10.1007/978-1-4020-6970-3_16
8. M. Mazinani, B. Rude, Am. J. Anim. Vet. Sci. **15(4)**, 291–299 (2020)
9. B. Miller, C. Lu, Anim Biosci. **32(8)**, 1219–1232 (2019) DOI: 10.5713/ajas.19. 0253.
10. D. Mitchell, J Anim Ecol. **87(4)**, 956–973 (2018) DOI: 10.1111/1365- 2656.12818