Growth and development of calves depending on the method of feeding with cereal and milk

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Abstract. The article studies the influence of the milk feeding method on the growth and development of calves. The object of research is newborn Samara black-motley calves. It was established that after drinking the first portion of colostrum, immunoglobulin appears in the blood of calves in 2 hours. Immunoglobulin enters the bloodstream in the first 12 hours of life. The highest content of immunoglobulin (23.40 mg/ml) was observed after 48 hours in case of free suckling. It exceeded that in peers fed manually by 6.7-8.9%. Depending on the feeding scheme and method, the heifers consumed 497.0-509.4 kg of milk for three months in case of manual feeding, 589.5 kg for two months in case of free suckling, and 540.3 kg in case of regulated suckling. The technology of milk feeding, the time spent with a mother, the amount of milk consumed had a significant impact on the health of calves. The degree of calf morbidity had a significant impact on the growth and development of young animals. As a result of a greater consumption of milk and large volumes of feed, heifers under regulated suckling had a larger live weight than their peers aged 18 months by 11.1% ($P < 0.001$) (in comparison with the peers from group I), by 16.0% ($P < 0.001$) (in comparison with the peers from group II), by 17.5% ($P < 0.001$) (in comparison with the peers from group III), by 4.7% ($P < 0.05$) (in comparison with the peers from group IV).

1 Introduction

Modern milk production technologies involve very harsh modes of use of animals. Therefore, when introducing intensive technologies into production, it is necessary to take into account biological and physiological properties of living organisms [1-6].

The intensive milk technology is based on the maximum use of genetically determined abilities of the animal organism. High physiological loads on the body which require the full use of internal reserves of nutrients and energy for their implementation, decrease immunity, natural resistance, resulting in premature departure of animals from the herd [7-11].

The issue of breeding calves and ensuring the herd reproduction is very acute. In modern dairy cattle breeding, the overall mortality rate for newborn calves ranges from 17 to 21%; 55% of cases occur in the first week of life. More than 80% of dead calves do not have anatomical abnormalities [12, 13].

In order to unify and maximize mechanization of the method of feeding with colostrum and milk, newborn calves are immediately taken from their mothers. As a result of drinking colostrum and milk from nipple drinkers, the mortality of calves increases significantly, especially in the first months of their life [14-17].

The purpose of research is to study the effect of the method of drinking colostrum and milk on the health, growth and development of calves.

2 Methods and materials

The studies were conducted in the farm named after Kuibyshev, Samara Region, where the “manual” method is used to feed calves with colostrum and milk, and in the Yuzhny collective farm, Orenburg Region, where the suckling method is used. The research material was black-motley heifers with a Holstein blood share of 62.5%, belonging to the lines of V. B. Aydial and R. Sowering with a milk yield (2-3 lactation) of 6836-7459 kg.

In accordance with the research scheme, five groups were formed (50 animals in each group): control group I - the calves were left with their mothers for 3 days, experimental group II - the calves were left with their mothers for one day; experimental group III - the calves were immediately taken from their mothers, placed in individual houses and fed “manually” from nipple drinkers, experimental group IV – the suckling calves were kept in special sections with nursing cows for two months, experimental group V – the calves’ cells were located near nursing cows, the calves were released three times a day for 10-15 min for regulated suckling. There were five cows in the section. Each cow fed two calves.

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At the exit, electronic scales that recorded the dynamics of a live weight before and after milk consumption were installed.

To study the dynamics of immunoglobulin, blood of 10 animals of each group was taken from the jugular vein during the first five days of their lives after taking the first portion of colostrum. The content of immunoglobulin was determined using an FEK-456M device. During the first three months, all signs of health disorders were recorded in calves, determining the incidence rate.

3 Results

Calves losing contact with their mothers are unprotected from negative effects of environmental factors and various microorganisms that begin to populate their body. In this regard, it is very important to feed calves with colostrum no later than 60 minutes after their birth. Due to it, immunoglobulin appears in blood as soon as possible and protects their immune system. It was established that intensity of the dynamics of immunoglobulin content depends on the colostrum drinking method (Table 1).

After drinking the first portion of colostrum, immunoglobulin appears in the bloodstream. According to Georgiev [11], immunoglobulins performs a protective function at a concentration of at least 10 mg/ml. This concentration is achieved 6 hours after drinking the first portion of colostrum. Immoglobulin enters the blood most intensively in the first 12 hours of life. At the same time, in the blood of calves under regulated suckling, the content of immunoglobulin was higher by 1.85 mg/ml (14.2%) in comparison with group III which was under "manual" feeding, and by 0.16-0.03 mg/ml (1.1-0.2%)in comparison with the group which was under free suckling. The content of immunoglobulin increases within 48 hours after drinking the first portion of colostrum. The highest content (23.40 mg / ml) was observed in the blood of calves under free suckling; it exceeded the content in their peers under "manual" feeding by 1.46-1.91 mg/ml (6.7-8.9%). The difference is statistically not significant, since the groups have a very high coefficient of variability for this indicator (19.4-21.6%).

The studies have shown that the method of drinking colostrum had a certain effect on the intensity of assimilation of immunoglobulin in the body of heifers (Table 2). Sox hours after the first portion of colostrum was drunk, the share of calves with immunoglobulin content of more than 10 mg/ml was the same (58-64%) in groups I, II, IV and V; in group III which was under "manual" feeding, it was 32% (by 26-32% less).

A. Fox [14] notes that when immunoglobulin content is less than 6 mg/ml, colostral immunity does not work. Such calves are susceptible to various diseases, especially those of the gastrointestinal tract. The share of calves poorly absorbing immunoglobulin from colostrum was 2–8% in groups under free suckling, and 28% in groups under manual feeding.

During the "manual" feeding, the calves received whole milk for three months, their peers were kept under nursing cows for two months. The feeding schedule suggested that calves consumed 500 kg of milk during the dairy period (Table 3).

Table 1. Dynamics of immunoglobulin in the blood of newborn calves after drinking the first portion of colostrum, mg/ml

Time after drinking colostrum, h	Group				
	I	II	III	IV	V
Before taking colostrum	0.17±0.01	0.18±0.01	0.20±0.01	0.19±0.01	0.18±0.01
1	0.32±0.13	0.29±0.18	0.24±0.14	0.28±0.21	0.30±0.16
2	2.50±0.30	2.52±0.34	2.39±0.26	2.96±0.39	2.84±0.23
4	6.57±0.54	6.48±0.67	5.96±0.49	6.78±0.852	6.43±0.47
6	10.81±0.88	10.75±0.93	9.48±0.66	10.94±0.74	10.87±0.65
12	14.79±1.21	14.76±1.24	13.07±0.87	14.89±0.95	14.92±0.86
24	22.86±0.93	22.78±0.96	20.79±0.99	22.83±1.04	22.89±0.94
36	22.98±1.36	21.83±0.84	21.34±1.12	22.90±0.93	22.96±0.88
48	23.37±1.12	21.94±0.79	21.49±0.86	23.40±0.96	23.34±0.85
72	22.88±0.97	21.69±0.81	21.38±0.79	22.97±0.82	22.84±0.91
120	21.83±0.86	21.46±0.76	21.25±0.82	22.76±0.87	22.69±0.79

Table 2. Intensity of the transition of immunoglobulin from colostrum to blood of calves during the first 6 hours after feeding

The content of immunoglobulin in blood, mg/ml	Group									
	I		II		III		IV		V	
	heads	%	heads	%	heads	%	heads	%	heads	%
less than 4.0	-	-	1	2.0	6	12.0	-	-	-	-
4.1-6.0	2	4.0	3	6.0	8	16.0	1	2.0	2	4.0
6.1-8.0	8	16.0	7	14.0	10	20.0	7	14.0	6	12.0
8.1-10.0	11	22.0	9	18.0	10	20.0	10	20.0	12	24.0
10.1-12.0	17	34.0	15	30.0	14	28.0	19	38.0	16	32.0
more than 12.0	12	24.0	15	30.0	2	430	13	26.0	14	28.0

Table 3. The number of feedings and the amount of consumed milk during different age periods

Indicator	Group				
	I	II	III	IV	V
Colostrum (1st day after birth)					
Number of feedings	6	5	4	6	5
Colostrum consumption, kg	8.4	8.0	8.0	8.4	9.0
including per one feeding, kg	1.4	1.6	2.0	1.4	1.8
Milk (30th day after birth)					
Number of feedings	3	3	3	9	3
Colostrum consumption, kg	6.0	6.0	6.0	9.9	8.7
including per one feeding, kg	2.0	2.0	2.0	1.1	2.9
Milk (60th day after birth)					
Number of feedings	3	3	3	7	3
Colostrum consumption, kg	6.0	6.0	6.0	9.8	9.3
including per one feeding, kg	2.0	2.0	2.0	1.4	3.1
Milk (90th day after birth)					
Number of feedings	3	3	3	-	-
Colostrum consumption, kg	4.5	4.5	4.5	-	-
including per one feeding, kg	1.5	1.5	1.5	-	-
TOTAL	509.4	500.9	497.0	589.5	540.3

Table 4. The incidence of calves for three months of the dairy period

The age of calves, days	Group									
	I		II		III		IV		V	
	heads	%	heads	%	heads	%	heads	%	heads	%
1-10	1	2.0	3	6.0	8	16.0	-	-	-	-
11-20	2	4.0	5	10.0	6	12.0	1	2.0	1	2.0
21-30	4	8.0	6	12.0	3	6.0	2	4.0	1	2.0
31-60	3	6.0	1	2.0	3	6.0	1	2.0	1	2.0
61-90	2	4.0	2	4.0	1	2.0	4	8.0	4	8.0
Total	12	24.0	17	34.0	21	42.0	8	16.0	9	14.0

Table 5. Age dynamics of a live weight of heifers

Indicator	Group				
	I	II	III	IV	V
New-born calves	33.87±0.54	34.03±0.46	34.45±0.49	34.68±0.47	33.94±0.43
1	53.91±0.89**	53.29±0.67***	52.87±0.93***	57.45±0.78	56.02±0.81
2	76.11±1.46**	74.68±1.35***	73.75±1.58***	82.47±1.29	81.19±1.44
3	99.03±1.88**	96.85±1.73***	95.59±1.64***	107.73±1.78	106.87±1.86
6	163.92±2.56***	158.68±2.34***	156.25±2.18***	176.94±2.43**	186.34±2.29
9	224.67±3.31***	215.74±3.52***	212.32±3.45***	242.19±3.64*	252.85±3.37
12	282.99±4.54***	270.91±4.68***	265.96±4.32***	303.75±4.27*	316.75±4.42
15	339.16±5.48***	323.65±5.26***	319.17±5.39***	361.08±5.43*	376.96±4.98
18	391±5.87***	374.86±6.43***	369.95±6.21***	415.17±5.79*	434.83±6.35

Note: *P<0.05%; **P<0.01%; ***P<0.001

As a result of observations, it was found that calves under free suckling drank 6-7 times more milk. Under regulated suckling, calves were placed under the nursing cow 5 times; under “manual” feeding, they were fed 4 times a day. Thus, on the first day, they received 8.0-9.0 kg of colostrum, while under manual feeding – 8.0 kg. This is higher than the technological norm which is 20% of the live weight – 6.8 kg.

When using nipple drinkers, calves of the first three groups were fed three times a day; under regulated suckling (group V), they were placed under the nursing cows 3 times; under free suckling, the calves determined the mode of milk consumption. During the first 30 days, the average number of sucklings per day was 9, during the next 30 days, it was 7 times. During “manual” drinking, milk consumption was uniform. For one feeding, they consumed 2 kg of milk (6 kg per day). Suckling calves consumed 9.9 kg of milk per day; the single portion was 1.1 kg. The regulated suckling did not limit the duration of a single sucking which ensured the consumption of 8.7 kg of milk per day.

Thus, under manual feeding, the calves consumed 497.0-509.4 kg of milk during three months; under free suckling – 589.5 kg during two months, and under regulated suckling – 540.3 kg.

The milk drinking method, the time spent with mothers, the amount of milk consumed during the dairy period

had a significant impact on the incidence of calves (Table 4).

Taking into account any signs of diseases showed that being with mothers and consuming milk by the suckling method had a positive effect on the health of heifers. As practice shows, the first 10 days are the most dangerous for the health of calves. During this period, the body lacks immunity, and properties of colostrum are the only protection against the influence of pathogenic microflora. In groups IV and V, there were no signs of diseases during the 10th days. Under manual feeding, when new-born calves were left with their mothers for three days, one calf (2.0%) fell ill; in group II, where new-born calves were with their mothers during one day, three calves fell ill (6,0%); in group III, where the newborns were immediately taken away from their mothers, 8 calves fell ill (16.0%).

The incidence of young animals increased after beginning of the manual feeding. Between 11 and 90 days of life, 22% of calves fell ill in group I, 28% in group II, and 26% in group III. The highest incidence was observed in group III, where the calves were immediately taken from the mothers. The study of the main sources of milk infection showed that 220-680 pcs/ml microorganisms are concentrated in the nipple canal of the udder, 8000-16500 pcs/ml - on the surface of the nipples, 1350 pcs/ml - on the surface of the nipple drinkers, and 2700 pcs/ml – on the internal side of the milk tank. Thus, a probability of transmission of pathogenic microflora to the calf is several times higher. For two months of the milk period, only 8% fell ill in group IV, and 6% - in group V. After weaning, 8% of calves in each group fell ill within a month due to the influence of stress.

Specific immunity determines health of calves (Table 5).

The heifers in all groups were bred using the same technology for young dairy breeds. The main objective was breeding young animals with a live weight of 390 kg at the age of 18 months. According to the results of the studies, the task was achieved only using the technology adopted in groups I, IV, and V. The heifers of group IV reached a minimum live weight at the age of 17 months, group V – at the age of 16 months, and group I – only at the age of 18 months.

It was established that the higher the incidence, the more the calves lagged behind their peers in growth and development. At the age of two months, when the calves were weaned, the maximum live weight (82.47 kg) was observed in suckling heifers. The weight exceeded that of their peers in group I by 6.36 kg (8.4%; P<0.01), in group II – by 7.79 kg (10.4%; P<0.001), in group III – by 8.72 kg (11.8%; P<0.001), and in group V – by 1.28 kg (1.6%). It should be noted that the regulated suckling (3 times a day) stimulated calves to consume more voluminous and concentrated feeds which positively affected the development of the gastrointestinal tract. As a result of greater consumption of voluminous feed, heifers of group V had a larger live weight than their their peers (by 22.42 kg (13.7%; P<0.001) in comparison with group I), by 27.66 kg (17.4%; P<0.001) in comparison with group II, by 30,09 kg (19.3%; P<0.001) in comparison with group III, by 9.4 kg (5.3%; P<0.01) in comparison with group IV. At the age of 12 months, the difference was 33.76 kg, (11.9%; P<0.001); 45.84 kg (16.9%; P<0.001); 50.79 kg (19.1%; P<0.001); 13.0 kg (4.3%; P<0.05), respectively. At the age of 18 months, the difference was 43.47 kg (11.1%; P<0.001); 59.97 kg (16.0%; P<0.001); 64.88 kg (17.5%; P<0.001); 19.66 kg (4.7%; P<0.05), respectively.

5 Conclusion

Thus, the method of feeding with colostrum and milk, the duration of being with mothers after birth, the amount of milk consumed have a significant impact on the immune system and determine the resistance to diseases, affect the growth rate and the development of young animals. In accordance with the plan for breeding dairy cows with different levels of milk productivity, the feeding options make it possible to breed heifers with a live weight characteristic of future cows with a milk yield of 6-6.5 thousand kg by the 18 month-age; the use of the suckling method makes it possible to breed cows with a milk yield of 7-8 thousand kg. Regulated suckling reduces the cost of milk per head per 49 kg, stimulates the consumption of bulky feed, which increases the growth rate and the live weight of adult animals.

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