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Investigations

Improvement of the Technology for Young-Stock Breeding of Black-and-White Diary Cattle in the Southeast of Kazakhstan

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Abstract: It was found that it is possible to give high-quality starter feeds to calves beginning from the 4th day of age and not later than from the 10th-12th day of age. A high-calorie starter contains 16-18% of raw protein or 20% of protein, if calves are weaned when they are four weeks old or younger. Whole milk in the ration of calves from the 11th day of age can be replaced by an adequate Calf Milk Replacer (CMR) at a rate of 1.1 kg of dry replacer per 10 kg of milk. For heifers older than 6 months of age, grain feed (starter) is recommended in a maximum amount of 2.3-2.7 kg per head per day. Initially, the starter should contain 18% of crude protein on the dry basis. After transferring a calf to a new place, the starter can contain up to 16% of protein on the dry basis. Corn and soybean meal should prevail in the starter with the addition of oats and low content of fiber in grain mixes.

Keywords: Black-and-White Dairy Stock, Calves, Young Stock, Calf Rearing Methods, Cattle Management Technology, Preweaning Period

Introduction

Dairy cattle breeding is the main subsector of productive animal industry. It is characterized by a specific scheme of milk production in conditions of using an automated high-tech system for mechanization of labor-intensive processes, the organization of replacement young stock breeding and a long technological cycle of reproduction.

The experience of Russia, the Republic of Belarus, as well as the domestic practice of dairy cattle breeding shows that the Holstein breed is the best and most productive breed that blends well with the black-and-white breed adapted to the continental climate of Kazakhstan. The use of the Holstein breed minimizes the shortcomings inherent in "pure" species, improves and enriches the gene pool of the domestic breed of black-and-white cattle.

There is experimental evidence that in conditions of average feeding level (feed consumption by nutritional value is about 3,000 feed units per year per cow), the efficiency of crossing is not observed. With full and balanced feeding, the efficiency of crossing is well observed when breeding young animals. The same thing can be seen when we study postembryonic growth and development of Holstein and black-and-white heifers (weight gain is 9-12% for the 12-month growing period). Mongrel heifers have an intermediate position between the maternal and paternal breeds. Holstein cows in their adulthood are characterized by improved morphological and physiological properties of the udder (Strekozov and Amerkhanov, 2006; Adzhibekov, 1995; Antipov *et al*., 2005).

According to the academician of the Russian Academy of Sciences, Strekozov and Amerkhanov, (2006) the most important element in increasing the productivity of dairy cattle is the intensive breeding of heifers with an average daily gain of 750-800 g, free access to pasture in summer, large fodders and the use of concentrates in rations during stall and pasture periods depending on their age.

A lot of factors are involved in the process of breeding heifers. The main goal is to get a well-breed heifer ready for calving at the age of 24 months and to compensate for the cost of the invested funds through the production of milk.

Various schemes for breeding replacement young animals of the cattle in terms of average daily gain can vary according to the conditions and goals of breeding. That is why taking into account different dietary plans of heifers, we can take different planned average daily gain; the level of growth of animal and its contribution to future productivity is one of the most important factors (Adzhibekov, 1995; Antipov *et al*., 2005).

There are data about the average daily gain of body weight from birth to 9 months of age within 850-950 g, 9-12 months of age-750-850 g, 13 months of age and older-650-750 g (Batanov *et al*., 2011). At the same time, a number of researchers recommend providing an average level of growth before the age of puberty and accelerated growth after that, since the accelerated growth after age of puberty has a positive impact on the future dairy productivity of a cow. An optimal increase in body weight of heifers gives some clear signs of estrus and fertilization during the period of insemination (Kalievskaya, 2002).

The modern technology of dairy cattle breeding is aimed at creating herds that meet the stringent requirements of highly mechanized farms. In this regard, it is necessary to tighten the requirements for the technological selection of cows for further selective and stock breeding. The performance of this work is possible with a reliable assessment of cows for technological and morpho functional parameters of the udder.

The appropriate genetic material, the modern technology of directed breeding of young animals and the optimal way of cows management of dairy breeds can give high and stable milk production. Therefore, the development of a scientifically based technology of directed breeding of young animals, the determination of optimal methods for cows management of dairy breeds is the right choice of the theme of the research.

The development of the most effective methods of animal management has a certain scientific and practical interest and it is aimed at high safety of young animals ensuring intensive growth and development and reducing the cost of growing.

In this regard, the improvement of methods for dairy cows management according to the results of their comprehensive assessment of milk productivity and reproductive abilities, the improvement of technology for directed growth of young animals is an urgent area of the studies when developing intensive technologies for the development of dairy cattle.

The study of the influence of various technologies of the directed breeding of the young-stock of black-and-white and Holstein dairy cattle on objective laws of growth and development in the southeast of Kazakhstan is a necessary direction of the studies.

Goal of the Research

Improvement of technological methods of preservation of newborn calves in the conditions of the southeast of Kazakhstan.

Object and Methods of the Study

The object of the study was cattle of the Holstein and black-and-white breed, replacement calves from cows of the selection group from the stock farm of Adal agro-industrial complex in Enbekshikazakh district, Almaty region.

In practical terms, the division of animals into 6 groups is the most optimal. 1 – fresh group (up to 45 days of lactation), 2 – highly productive, 3 – medium-productive, 4 – low-productive, 5 – first 40 days of dry period, 6 – last 20 days of dry period. The practice of distribution of animals by physiological groups without taking into account the level of milk productivity is ineffective due to large differences within the group, especially in young flocks.

Groups of animals were formed according to the principle of analogues.

The rations were balanced in accordance with the norms of the All-Russian research institute of animal husbandry (Lebedko and Nikiforova, 2008; Kalashnikov *et al*., 1985; 2003; 1993; Kirilov and Fedorova, 1998).

Feeding in Adal in Enbekshikazakh district of Almaty region is based mainly on the production of its own feeds.

The main digital material obtained in the experiment was processed biometrically in the Excel program taking into account the recommendations of Plohinskiy (1969; Merkureva, 1970; Lakinu, 1990).

Results

Scheme of Heifers Breeding

For breeding heifers up to 6 months, various feeding schemes are recommended depending on the growth plans, consumption of milk fodders and specific economic conditions. They are given in Norms and Rations of Feeding Farm Animals manual (2003).

The schemes are calculated for the average daily gain of 650-700 g with 155 kg of body weight at the age of 6months and with 200 kg of whole milk consumption and 400 kg of skim milk. The norm of whole milk is increased to 350 kg without CMR and skim milk.

When an average daily gain is 750-800 g with 170-185 kg of body weight at the age of 6months, the whole milk consumption is 200 kg with 400 kg of skim milk (Table 1).

Whole milk in the ration of calves from the 11th day of age can be replaced by an adequate CMR at a rate of 1.1 kg of dry replacer per 10 kg of milk. CMR is mixed with warm boiled water assuming the following calculation (Table 2).

Currently, the schemes for breeding dairy calves down to the age of 10 days include prestarter rations, then starters. When calves are in small houses during very cold weather, they need to eat the replacer with 20% of fat three times a day. There is also a need to increase the food use rate 1.25-1.5 times to ensure their higher energy demands. Poorly growing young animals should be transferred to a warm place.

Table 1. Plan of feeding calves up to 6 months of age in winter stall-feeding period

Age			Daily feed (kg)							
		Body	Milk						Supplementary	
Month	Ten-day period	weight, (kg)	Whole	Skim	Hay	Silage haylage	Roots fruit	Strength fodders	Salt	Phosphate
1	1st		7	-	-	-	-	-	-	-
	2nd		7	-	accustomed	-	-	0.1*	5	5
	3rd	60		-	-	-	accustomed	0.2*	5	5
For the first month		210	-	-	-	-	3*	100	100	
2	4th		4	4	0.2	-	0.2	0.3*	10	20
	5th		-	8	0.3		0.3	0.6*	10	20
	6th		-	8	0.5	accustomed	0.5	0.8*	10	20
For the 2nd month	83	40	200	10	-	10	17*	300	600	
	7th		-	8	0.7	0.5	0.5	0.8	15	20
	8th		-	8	1.0	1.0	1.0	0.8	15	20
	9th	106	-	8	1.3	1.5	1.5	0.8	15	20
For the 3rd month		-	240	30	30	30	24	450	600	
	10th		-	7	1.5	2	1.5	1.0	15	20
	11th		-	6	1.5	2	1.5	1.2	15	20
	12th	130	-	3	1.5	3	2.0	1.5	15	20
For the 4th month		-	160	45	70	50	37	450	600	
	13th		-	-	2.0	3.0	2.0	1.7	20	25
	14th		-	-	2.5	4.0	2.0	1.7	20	25
	15th	153	-	-	3.0	5.0	2.0	1.7	20	25
For the 5th month		-	-	75	120	60	50	600	750	
	16th		-	-	3.0	5.0	20	1.6	25	30
	17th		-	-	3.3	6.0	20	1.6	25	30
	18th		-	-	3.5	7.0	20	1.6	25	30
For the 6th month	175	-	-	100	180	60	48	750	900	
For six months in total		250	600	260	400	210	177	2650	3550	

Note: * a mixture of concentrated feeds (%) is recommended for calves up to 2 months: Linseed oil meal-20, sunflower oil meal-20, wheat middling-20, oatmeal-20 and corn flour (barley) -20

**a mixture of feeds (%) is recommended for calves down to the age of 2 months: Sunflower oil meal or linseed meal-20, wheat middling-30, oatmeal-20 and corn flour (barley) -30

Table 2. Amounts of whole milk, colostrum and water per day when feeding with CMR

Body weight (kg)	Whole milk (kg)	Colostral milk (kg)	Water (kg)	Calf milk replacer (CMR) (kg)	Water (kg)
28-31	2.5	1.9+	0.65	0.32+	2.3
32-36	2.9	2.2+	0.73	0.36+	2.5
37-40	3.2	2.4+	0.82	0.41+	2.7
41-45	3.6	2.7+	0.91	0.45+	3.2
46-50	4.1	3.0+	1.00	0.50+	3.6

The studies have found that when the calves are weaning at an earlier age they show some temporary delay in growth which is then balanced when they are 12 weeks. A good indicator in the practice of excluding dairy feed from the ration is the amount of eaten mixed fodder starter. When consuming 700 g of concentrates, the dairy feed can be stopped. To encourage the consumption of mixed fodder you should put a pinch of concentrates into a bucket of milk. In general, the early exclusion of dairy feed (35 days after birth) reduces the cost of feed and labor. Calves that eat less than 0.5 kg per day of concentrates or grow poorly should receive liquid feeds for a longer period of time until they bounce back and eat enough concentrates. The calves after the 2nd month of life are taught to eat green fodder during summer pasture period.

As a result of the studies, it is possible to characterize the dynamics of growth from birth to 3 and 6 months of age according to the data of experimental farms (Table 3).

The intensive breeding of heifers up to 18 months with a lack of exercise often results in obesity which reduces reproductive functions and subsequently decreases productivity and reduces the overall period of using cows. In this connection, in the herds of Adal replacement heifers are inseminated at the age of 15-17 months at the body weight of 360-420 kg (Table 4).

It is established that the season of calving of animals affects the milk yield. Autumn and winter calving contribute to the production of larger and more viable calves. The dynamics of the body weight of heifers in relation to the season of their birth was studied by Adal (Table 5).

Table 3. Body weight and average daily gain of heifers in the dairy period according to the data of 2016

Groups	Age, months	Born	1	2	3	4	5	6
Control group of calves	Body weight, kg	33.6±0.7	49.8±1.1	67.6±1.4	91.2±1.5	112.0±1.7	136.6±1.9	158.6±2.1
	Average daily weight gain, g	-	540 ±21	593 ±23	787 ±19	693 ±23	820 ±25	733 ±24
Experimental group of calves (n = 10)	Body weight, kg	33.2±0.6	52.2±0.9	73.8±1.1	98.0±1.3	120±1.7	146.6±2.0	169.2±2.2
	Average daily weight gain, g	-	633±19***	720±21***	807±24	750±27*	880±23*	753±21
Difference, %	Body weight,	98.81	104.8	109.1	107.4	107.1	107.3	107.3
	Average daily weight gain	-	117.2	121.4	102.5	108.2	107.3	102.7

Table 4. Growth, development and age of productive insemination of heifers (2015-2016)

Indicators	Body weight at the age (kg)			
	2016		2015	
	M±m	Cv (%)	M±m	Cv (%)
6 months	173.4±2.48*	16.4	170.4±3.01**	14.1
10 months	273.2±2,61*	16.8	271.9±3.05*	17.2
12 months	302.4±2.86**	15.2	301.8±2.78**	14.3
18 months	391.0±3.19**	11.9	418.1±6.07**	10.4
Age of the 1st insemination, month	17.6±0.20**	18.7	17.5±0.22**	15.7
Body weight when insemination, kg	386.7±2.79**	10.6	379.3±7.3**	12.5

*R<0.05; **R<0.01; ***R<0.001

Table 5. Dynamics of body weight of heifers depending on the birth season in kg

Parturition time	Total amount of heifers, heads	Body weight at the age				
		Birth weight	6 months	10 months	12 months	18 months
Winter	57	34±0.6	180±3.1***	276±3.0***	311±2.7**	419±3.1***
Spring	65	32±0.4	165±2.8**	251±2.9	285±3.0	380±3.2**
Summer	34	33±0.5	153±3.3	251±3.2	285±3.3	367±3.5
Autumn	49	34±0.7	173±2.4***	273±2.5***	302±2.4***	398±3.0***

It is established that heifers born in autumn-winter period have high growth rates at all age periods. Therefore, we should strive to ensure that the percentage of summer cows in the herd does not exceed 7-10, that is why it is desirable to take an interruption each year in the fertilization of heifers from August to October. This method allows excluding summer calving of heifers; then the proportion of summer calving in the herd will decrease significantly in 2-3 years.

Discussion

It has been established that the early transfer of calves at the age of 10-12 days in the prophylactorium calf house for group housing has a positive effect on the development of calves and the formation of the response to the environment. This facilitates their rapid adaptation to similar housing in the conditions of subsequent breeding in a common calf house. As a result, in the first 3 months of life calves can eat by 16-22% more of large fodders and have a daily gain by 8-17.5% higher than those that are kept in individual boxes throughout the preventive period.

High quality starter for calves. It is possible to give a high-quality starter feed to calves beginning from the 4th day of age and not later than from the 10th-12th day of age. A high-calorie starter contains 16-18% of raw protein or 20% of protein if calves are weaned when they are four weeks old or younger. The calf grows not due to "the percentage of protein", but due to the amount of protein and other nutrients that it actually consumes. To stimulate eating, it is recommended to include in starters whole, coarsely ground, crushed or flattened grains. 5% molasses addition improves the flavor properties and minimizes dust. Whole grains, especially oats, can be fed to young animals up to 3 months of age. Mixed feeders are given to calves from 12 days of age until they eat 2.0-3.2 kg per day.

The starter for calves is produced in various types, from granulated full rations to patented coarse textured mixtures which often consist of grain cereals and granulated protein concentrate. Unfortunately, there is no

test for the quality of starters for calves. The freshness of the starter is important. The starter should be given in small portions in each feeding during the first days; the uneaten remains should be removed on a daily basis. The starter should be tasty and provide sufficient energy in the form of ready fermentation carbohydrates in order to ensure rapid development of the larding bag. That's why feed consumption is important.

According to the US researchers, a calf of 36-45 kg from birth to weaning at 4 weeks of age requires 454 g of dry matter of whole milk, colostrum or whole milk replacer every day.

Conclusion

In practical terms, the division of animals into 6 groups is the most optimal. 1-fresh group (up to 45 days of lactation), 2-highly productive, 3-medium-productive, 4-low-productive, 5-first 40 days of dry period, 6-last 20 days of dry period. The practice of distribution of animals by physiological groups without taking into account the level of milk productivity is ineffective due to large differences within the group, especially in young flocks.

It is possible to give a high-quality starter feed to calves beginning from the 4th day of age and not later than from the 10th-12th day of age. A high-calorie starter contains 16-18% of raw protein or 20% of protein, if calves are weaned when they are four weeks old or younger.

While weaning, milk can be taken away at once or gradually, but it is necessary to make changes with dry food gradually. It is necessary to feed a certain amount of starter within a week after weaning and then mix it with grain so that calves can get used to the ration. For calves that have been taken away, high-quality hay can be given and the consumption of grain (Concentrated feed) should be 2.5-2.7 kg in 1-2 weeks after weaning or when they are 6-7 weeks old.

When an average daily gain is 750-800 g with 170-185 kg of body weight at the age of 6months the whole milk consumption is 250 kg with 600 kg of skim milk Table 1.

Whole milk in the ration of calves down to the age of 11 dayscan be replaced by an adequate CMR at a rate of 1.1 kg of dry replacer per 10 kg of milk.

It has been established that the early transfer of calves at the age of 10-12 days in the prophylactorium calf house for group housing has a positive effect on the development of calves and the formation of a response to the environment. This facilitates their rapid adaptation to similar housing in the conditions of subsequent breeding in a common calf house. As a result, in the first 3 months of life calves can eat by 16-22% more of large fodders and have a daily gain by 8-17.5% higher than those that are kept in individual boxes throughout the preventive period.

For heifers older than 6 months of age, grain feed (starter) is recommended in a maximum amount of 2.3-2.7 kg per head per day. Initially, it should contain 18% of crude protein on the dry basis. After transferring a calf to a new place, the starter can contain up to 16% of protein on the dry basis. Corn and soybean meal should prevail in the starter, with the addition of oats and low content of fiber in grain mixes.

Table 6 presents rations for heifers when breeding cows with the body weight of 600-650 kg which can be taken by farms as examples when feeding heifers older than 6 months.

If the protein content of the coarse feed is good, then a small addition of the protein component to the grain mixture is required. Fodder antibiotics can be fed to improve the growth of heifers according to the instructions for their use.

Replacement heifers down to the age of1 year until insemination and calving. Hay of good quality can be the only food for heifers older than one year. It is necessary to ensure free access of animals to the corresponding mineral mixture. The gain should be about 800 g/day. If the gain is insufficient, then it is necessary to include a certain amount of grain mixture in the ration. When using good pasture, heifers do not need concentrates or other coarse fodder. When grass does not grow enough in the pasture or burns out, animals should take supplements. Heifers that are deficient in energy, phosphorus or vitamin A can show no signs of estrus.

The manifestation of the first estrus of heifers depends on the size and basically on weight. Animals that are grown using high feeding schemes will strive for fertilization sooner than those who have low feeding schemes; underfeeding of animals delays estrus. Underfed or slow growing heifers' ovulation will occur, but the signs of estrus are often hidden.

Table 7 shows the recommended body weight of heifers of large breeds during the first insemination at the age of 15 months, as well as the body weight of animals of other age categories for the southeast of Kazakhstan.

The main error measurements of the black-and-white breed are presented in Table 8. An insignificant increase in the main parameters of the exterior has been established.

One of the indicators of successful adaptation to environmental conditions along with high productivity is their good reproductive ability, as a violation of the reproductive function necessarily leads not only to a decrease in their fertility, but also to a decrease in productivity.

Reproduction of animals is one of the urgent problems of dairy cattle breeding Table 9.

Table 6. Approximate rations for replacement heifer when growing cows with body weight of 600-650 kg, per head per day

	Average daily gain, g			
	650-800		650-700	
	Age, months			
Fodders	7-9	10-12	13-15	16-18
Hay, kg	3.0	3.0	3.0	3.0
Silage, kg	6.0	8.5	8.5	9.0
Haylage, kg	3.0	4.0	4.5	6.0
Straw, kg	-	1.0	2.0	2.0
Concentrates, kg	1.3	1.2	1.2	1.2
Feed phosphates,	40.0	45.0	50.0	60.0
Fine salt, g	30.0	36.0	40.0	45.0
Copper sulphate, mg	24.0	32.0	36.0	38.0
Zink sulfate, mg	180.0	350.0	360.0	380.0
Cobaltic chloride, mg	9.0	12.0	12.0	12.0
Carotene, mg	125-140	150-175	190-220	265-290
Vitamin D, thous. IU	2.7-3.2	3.5-3.8	4.3-5.2	6.3-7.4

Table 7. Plan for the growth of replacement heifer during intensive breeding

Age, months	Large breed (kg)	Average breed (kg)	Small breed (kg)
Birth weight	41-45	30-34	25-27
1st month	54	41-45	32-36
2nd month	77	61-66	50-54
4th month	123	102-148	86-91
6th month	168	143-148	123-127
12th month	304-318	266-272	232-236
15th month	363-397*	327-341	286-295
18th month	440-454	363-397*	341-352
22nd month	527-545	465-488	409-431

Table 8. Basic examples of first-calf cows

	Group of cows	
Indicators	2016	2014
Height at hips	136±1.15	133,5±0.8
Body length	159.03±0.09	156.8±0.2*
Chest depth	72.1±0.49	72.4±0.36***
Width of chest	46±0.26	44.5±0.22
Width of hips	55.4±0.16	55.2±0.21
Chest girth	202.8±2.14	198.7±1.44
Pastern girth	19.9±0.01	19.1±0.04
Head length	55.2±0.24	55.2±0.16
Forehead width	21.99±0.19	22.05±0.31

Note: *B>0.95; **B>0.99; ***B>0.999

Table 9. Reproductive capacity of cows (n = 150)

	Duration, days				
Group	Service period	Calving interval	First parturition age	Dry period	Reproductive capacity coefficient
2016	149±5.4	432.6±5.45	843±7.2	64.9±1.08	0.84
2015	153.4±6.1	437.1±4.8	876±7.1	66.8±1.2	0.83

The duration of the period from ovulation to fertilization (service period) has a significant effect on the duration of lactation and depends on the involution of the uterus after calving and the state of the ovaries. Our studies have revealed that the duration of the service period of black-and-white cows varied from 149 to 153.4 days. Calving interval fluctuated from 432.6 to 437.1 days that exceeds the requirements by 18.3 and 19.8%.

Table 10. Difficulty level of cows calving

	Group	
Calving course	2016	2015
Mild (%)	85.3	85.9
Emergency case but without complications (%)	3.5	6.7
Birth complications (mother or fetus) (%)	2.9	3.1
Very difficult with mortality of fetus (%)	2.1	4.3
Body weight of calves at birth (kg)	33.6	32.8

The degree of difficulty of calving in the examined cows is presented in Table 10. The table shows that most cows have an easy degree of calving difficulty.

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Author's Contributions

Dinara Asylbekovna Begaliyeva: Participated in all experiments, coordinated the data-analysis and contributed to the writing of the manuscript.

Aleydar Saldarovich Alentayev: Coordinated the mouse work.

Abdirakhman Moldanazarovich Ombayev: Designed the research plan and organized the study.

Dastanbek Asylbekovich Baimukanov: Participated in all experiments, coordinated the data-analysis and contributed to the writing of the manuscript.

Ethics

The authors declare no conflict of interest.

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