Efficiency of mineral feed supplement using in maral deer (Cervus elaphus sibiricus) diets

N.O. Korzhikenova[1], A.A. Sambetbaev[1], B.Zh. Kozhebaev[2] , A.S. Koygeldinova[3], O.D. Iglikov[2]

[1]Dep. of Production Technology of Animal Husbandry and Fish Farming Products, Kazakh National Agrarian University, Abay Street, 8, Almaty, 050010, Kazakhstan
[2]Dep. of Animal Husbandry and Hunting Technology, Semey State University named after Shakarim, 071403, Semey, Kazakhstan
[3]Dep. of Veterinary Sanitation, Semey State University named after Shakarim, 071403, Semey, Kazakhstan

Abstract. In a frame of the research an influence of mineral feed supplement in different structure diets on antler productivity of the marals has been studied. It was found that the feeding by silage and haylage diets with added mineral supplement in comparison with the traditional multi-component feeding used in the farm has a positive effect on the growth intensity, on the quality of raw and canned antlers. So, the weight of raw antlers at groups of experimental marals was 5.61 and 5.93 kg, that exceed the index of control group, respectively, on 9.6 and 15.8%. The mass of canned antlers in the experimental groups was 2.40 and 2.56 kg, that exceed the index of control group on 10.6 and 18.0%. The output of final products of experimental animals was higher than in the control group, and reached 42.4 - 43.0%.

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Introduction

The deer breeding is relatively new, specific and a comparatively young branch of animal husbandry in Kazakhstan. The industry provides three types of products: antlers, meat and by-products. Some of the most famous and noted throughout the centuries parapharmaceutical preparations are the maral products (blood, tendons, endocrine glands, under-developed fetuses, genital organs and etc.) [1].

Velvet antlers (panty) – are antlers, which have been cut during the growth period and are main products constituting the economic base of maral deer and sika deer farms [2].

Velvet antlers, in Russian “panty”, have a long tradition as a medicine in Asia. But research about the medical effects still is very unsatisfactory [3]. In traditional medicine of the orient, red deer antler has been used to treat male impotence and female infertility. Emphasis on sexual and reproductive function has placed velvet antler into the category of aphrodisiacs [4].

Velvet antler has also been used as an immune modulator, erythropoetic agent, particularly in cases of anemia and to improve blood circulation, muscle strength and mental aler 071403tness [5]. Empirical evidence and some clinical research suggests that velvet antler may have therapeutically valuable hypotensive, erythropoetic, immune stimulant, antiinflammatory, antiaging, metabolic, protective and rejuvenative effects [4].

Velvet antler is not used solely by adults: it is estimated that about 10% of Korea’s velvet antlers is used to preventive and restorative purposes in children [4]. In Oriental medicine, the different sections of velvet antler have assorted uses. The upper two sections are often used as preventative tonics in children while the middle portion is often used to treat arthritis and osteomyelitis. The lowest part of velvet antler is often administered to older people to help prevent calcium. Velvet antler has also been used in childbirth to assist delivery, anemia, menopausal disorders, impotence and spermatorrhea. [6]

Today, velvet antler is regarded as treatment for osteoarthritis, a possible tumor preventive, and for physical and athletic strength and endurance, in both the Orient and in western medicine. [4]

Antlers are valuable medicinal raw material, used in treatment and prevention of various diseases, and their use as a food supplements improves human life quality and nation health upon the whole.

With increasing demand for velvet antler, deer farming is becoming a rapidly growing industry as an alternative form of animal industry in many parts of the world, including North America, Europe, Oceania and Korea. [7] Because deer are now becoming more and more valuable farm animals, there are abundant demands in many temperature areas [8].

Deer farming has been continuously expanding because it requires less investment, land, animals and labor than other livestock enterprises.

The system of velvet antler production is relatively new, however, it may continue to grow until its full potential [8].

In the Agroindustrial complex development program of Kazakhstan "Agrobusiness – 2020" a special place is allotted to the animal husbandry development sector and to transfer it on a qualitatively new state [9].

Antler production in Kazakhstan is different from the World's by producing the maral deer antlers of especially high quality. The cost of these antlers is estimated in 1,5 - 2 times higher than of the rest, and it allows to our country not to inferior to other countries by this production on international market [10]. Unlimited demand for antler production on the global market provides a powerful impulse for development of this sector in Kazakhstan.

One of the main condition for increasing of animal husbandry production, improving of animal productivity, breeds perfecting and increasing of animals genetic potential is the increase in production of high quality forages and on this basis is the procuring of full balanced animal feeding. Only full and balanced feeding of agricultural animals will help them maximally to display their productive and health genetic potential [11, 12]. High growth rate and feed availability can enhance deer farming. Understanding the feeding system for deer production is essential in achieving maximum productivity. [8]

Velvet antler consumption has largely increased all over the world and consumers have a high interest in the quality, quantity and content of velvet antler. Producers and consumers will then focus more on velvet antler quality and stability in the future and its extremely essential to determine not only the improvement of velvet antler production but also the differences in velvet antler quality by breed, age, growth stage and feeding condition. It's then obvious that the quality of velvet antler partially depends on the source of feed and feeding conditions. Thas, it is partially possible to control velvet quality with feed sources [8].

The increase of maral deer genetic potential by antler productivity is not realized because of the unproven feed systems and normalized feeding [13]. In general, feeding of red deer on open range … Effects on increasing antler size and quality are variable and seem to depend on the degree to which animals may be mineral limited on native range [14]. The analysis of standard marals' feeding diets indicates that in practice all of them are deficient in such mineral substances as zinc, cobalt, manganese, copper. However, reliable data on feeding system, nutrient requirements and feeding standards for deer are scanty by comparison to other ruminants such as cattle and sheep [8]. The lack of a science-based, tested feeding norms and types in the country are constrain the maral deer productivity.

Materials and methods

In Republic of Kazakhstan there are not enough an experimental researches on influence of different structure and preparing technology diets on maral deer antlers productivity in comparative aspect.

Moreover, there is no data on the use of non-traditional cheap feed sources as a polymineral feed supplement in maral's diets.

On this basis, the aim of our research was to study the comparative efficiency of silage and haylage diet types with inclusion of mineral supplement on maral deer antler productivity.

The research was conducted in maral farm "Bagration" at Ulan area of East Kazakhstan region. Thirty-three male maral deer (analogs on live weight, age and physiological state) were allocated to three groups according to diet types. The live weight at the beginning of the experiment was 234,00 kg in control group, 233,09 and 236,55 kg in experimental groups. The experiment lasted 151 days.

HCTD	Hay-concentrate typical diet used in the farm
SDNM	Silage diet with a mineral block
HDMB	Haylage diet with a mineral block

Table 1. Feeding diet of deer marals of the 1st control group (hay-concentrate)

Feed /Food value	Kg	Feed units	Exchange energy, mJ	Dry matter, g	Digestible protein, g	Ca, g	P, g	Mg, g	Cu, mg	Zn, mg	Mn, mg	Carotene, mg	NaCL, g
Norm		5,6	52,6	6200	590	40	25	16	50	280	310	160	45
Lucerne hay	2	0,88	13,14	1660	202	34	4,4	6	16,4	34,8	52,8	98	
Motley grass hay	4	1,84	25,2	3320	164	27,6	6,8	8,4	8,4	72,8	224	100	
Oat	0,7	0,7	6,44	595	55,3	1,05	2,38	0,84	3,43	15,75	39,34	0,91	
Ground pea	1,5	1,077	16,65	1275	288	3	6,45	1,8	11,55	40,05	30,3	0,3	
NaCl	0,1					5,6	3,4	7,83	13,8	1,22			45
Totally		5,097	61,73	6830	709,3	71,23	23,43	24,87	53,38	365,92	346,44	199,21	45
Balance		-0,503	9,13	650	119,3	31,25	-1,57	8,87	3,58	-111,38	36,44	39,21	0

Table 2. Feeding diet of deer marals of the 2nd experimental group (silage)

Feed /Food value	Kg	Feed units	Exchange energy, mJ	Dry matter, g	Digestible protein, g	Ca, g	P, g	Mg, g	Cu, mg	Zn, mg	Mn, mg	Carotene, mg	NaCL, g
Norm		5,6	52,6	6200	590	40	25	16	50	280	310	160	45
Motley grass haylage	10	2,9	34,4	4500	230	49	13	13	51	145	371	250	
Agropyrum cristanum hay	1,5	0,69	10,11	1245	69	7,5	5,7	4,8	4,5	88,5	396	22,5	
Oat	1	1	9,2	850	79	1,5	3,4	1,2	4,9	22,5	56,2	1,3	
Ground pea	0,8	0,8944	8,88	680	153,6	1,6	3,44	0,96	6,16	21,36	16,16	0,16	
Mineral block	0,1					5,6	3,4	7,83	13,8	1,22			45
Totally		5,1844	62,59	7275	531,6	65,2	28,94	27,79	80,36	278,58	839,36	273,96	45
Balance		-0,1156	9,99	1075	-58,4	25,2	3,94	11,79	30,36	-1,42	529,36	113,96	0

Table 3. Feeding diet of deer marals of the 3rd experimental group (haylage)

Corn silage	13	2,6	29,9	3250	182	18,2	5,2	6,5	13	75,4	52	260	
Lucerne hay	2	0,88	13,44	1660	202	34	4,4	6	16,4	38,8	52,8	98	
Oat	1	1	9,2	850	79	1,5	3,4	1,2	4,9	22,5	56,2	1,3	
Ground barley	1	1,15	10,5	850	85	2	3,9	1	4,2	35,1	13,5	0,2	
Mineral block	0,1					5,6	3,4	7,83	13,8	1,22			45
Totally		5,63	63,04	6610	548	61,3	20,3	22,53	52,3	173,02	174,5	359,5	45
Balance		0,03	10,44	410	-42	21,3	-4,7	6,53	2,3	-106,98	-135,5	199,5	0

Table 4. Hay-concentrate diet structure

#	Feed	Quantity, kg	%
1	Motley grass hay	1,84	36
2	Lucerne hay	0,7	18
3	Oat	1,677	13,5
4	Ground pea	0,88	32,5
Diet contents:			
1	Feed units	5,097	
2	Exchange energy, mJ	61,73	
3	Dry matter, mg	6850	
4	Digestible protein, g	709,3	
5	Calcium, g	71,25	
6	Phosphorus, g	23,43	
7	Magnesium g	24,87	
8	Copper, mg	53,58	
9	Zinc, mg	168,62	
10	Manganese, mg	346,44	
11	Carotene, g	199,21	

Table 5. Silage diet structure

#	Feed	Quantity, kg	%
1	Corn silage	13	46,5
2	Lucerne hay	2	15,5
3	Oat	1	17,5
4	Ground barley	1	20,5
Diet contents:			
1	Feed units	5,63	
2	Exchange energy, mJ	63,04	
3	Dry matter, mg	6610	
4	Digestible protein, g	548	
5	Calcium, g	61,3	
6	Phosphorus, g	20,3	
7	Magnesium g	22,53	
8	Copper, mg	52,3	
9	Zinc, mg	173,02	
10	Manganese mg	174,5	
11	Carotene, g	359,5	

Forage chemical composition and nutritiousness analyzes were carried out in "Forage quality assessment, animals and birds normalized feeding" lab of Semey State University named after Shakarim. For the forage analysis were used common methods of P.T. Lebedev, Usovich A.T. [15].

The weighing of forage samples and their leavings was carried out on electronic scales within accuracy up to 0.1 kg. The weight of antlers was weighed on the scale brand BEKA ACS AR-777 within accuracy up to 0.01 kg. The antler's extents were determined by measuring tape in centimeters.

Table 6. Haylage diet structure

#	Feed	Quantity, kg	%
1	Motley grass haylage	10	52,5
2	Agropyrum cristatum hay	1,5	12,5
3	Oat	1	18,5
4	Ground pea	0,8	16,5
Diet contents:			
1	Feed units	5,4844	
2	Exchange energy, mJ	62,59	
3	Dry matter, mg	7275	
4	Digestible protein, g	531,6	
5	Calcium, g	65,2	
6	Phosphorus, g	28,94	
7	Magnesium g	27,79	
8	Copper, mg	80,36	
9	Zinc, mg	278,58	
10	Manganese mg	839,36	
11	Carotene, g	273,96	

The findings were processed by statistical method of Plohinsky N.K. and Microsoft Excel master functions [16]. In order to balance the minerals in diets of 2nd and 3rd experimental animals groups the mineral briquette was used. For this purpose into the sifted zeolite clay from local Mitrofanovskoe field, opened in Ulan area of East Kazakhstan, was added fodder salt and mixed in boiled antler broth. After that the briquettes were prepared using special forms. The weight of one briquette was 3.0-3.5 kg.

The of mineral feed supplement consist the zeolite clay, boiled antler broth and cooking salt in the following components ratio, wt.%: 68-70, 26-28, 2-4.

Content of macro- and microelements was determined on a mass spectrometer with inductively coupled plasma "Varian ICP-MS 820" ("Varian" Co, Australia). As a standard solutions was used the solution Var-TS-MS, IV-ICPMS-71A (Company "Inorganic Ventures", USA). For calibration of the mass spectrometer was used three working standard IV-ICPMS-71A which are consist of 10, 50 and 100 mcg/l of all elements (Ag, Al, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn , Na, Ni, P, Pb, Rb, Se, Sr, V, Zn).

The antler broth is an aqueous extract of the velvet antlers, comprising a complex of various biologically active substances extracted from the skin and blood [17].

The chemical composition of mineral block is given in table 7.

Table 7. Chemical composition of mineral blocks, 1 kg contains:

Indicators name, measurement units	Actually received
Calcium content, g/kg	5,6
Magnesium content, g/kg	7,83
Phosphorus content, g/kg	3,4
Sodium content, g/kg	3,85
Potassium content, g/kg	10,67
Iron content, g/kg	5,6
Cobalt content, mg/kg	10,5
Lead content, mg/kg	9,2
Zink content, mg/kg	1,22
Copper content, mg/kg	13,8
Aluminum content, g/kg	0,003
Barium content, g/kg	0,05
Beryllium content, g/kg	0,008
Manganese content, g/kg	0,11
Strontium content, g/kg	0,0001
Chromium content, g/kg	0,001
Selenium content, g/kg	0,006
Rubidium content, g/kg	0,00004
Vanadium content, g/kg	0,008

Mineral briquettes were given to animals in salt feeder. Maral deer consumed them depend on necessity.

Results and discussion

At the end of the experiment antler were cut. The dynamics of the marals antler productivity is presented in Table 8.

Table 8. Raw antlers mass dynamics

Animal groups	Antler mass, kg		
	Previous year appraisal	At the end of experiment	Difference
1 control group	3,48	5,12	1,64
2 experimental group	3,49	5,61	2,12
3 experimental group	3,48	5,93	2,45

In the control group of animals a freshly cut antlers weight was 5.12 kg, when at 2nd and 3rd experimental groups of animals it was higher on 9.6 and 15.8%. In comparison with the previous year the weight of raw antlers increased on 1,64-2,45 kg, but the marals of in 2nd and 3rd experimental groups, which were fed by mineral feed supplement it was higher on 29.3 and 49.4% than at 1st group.

Antler chemical characterization of animals showed that the content of macro-and microelements at buck-marals of 2 and 3 experimental groups fed diets supplemented with mineral briquette in comparison with the control group of marals was higher by the majority of mineral elements. Thus, from the macronutrients the Ca content was higher at 11.35% and 1.01%; P at 14.45% and 24.56%; K at 15.82% and 43.41%. From microelements in 2 and 3 experimental groups prevailed Cu at 20.24% and 7.10%; Zn at 28.37% and 21.82% respectively. Between control and experimental groups of animals was not found a large difference in content of boron. In addition, the content of vitamins B6 and B1 in marals velvet antlers was determined, in antlers of experimental animals there was more pyridoxine than in control animals antlers at 0.413 mg/kg and 0.523 mg/kg; and thiamine at 0.126 mg/kg and 0,128 mg/kg.

Maral deer antler productivity characteristic is presented in Table 9.

Table 9. Maral deer antler productivity

Indexes	Animal groups		
	1	2	3
Stem lenth, cm	65,91±2,30	70,27±2,10	71,64±1,14
Stem circle, cm	15,82±0,53	16,36±0,45	15,82±0,44
1st shoot, cm	25,82±1,33	26,45±1,40	23,64±2,67
2nd shoot, cm	20,91±2,75	23,73±1,49	21,45±1,53
3rd shoot, cm	17,55±1,95	20,18±1,78	21,18±2,66
Bifurcation depth, cm	3,23±0,59	4,27±0,75	3,82±0,86
Raw antler weight, kg	5,12±0,20	5,61±0,34	5,93±0,27
Canned antler weight, kg	2,17±0,11	2,40±0,21	2,56±0,15
Output of finished products,%	42,37	42,36	43,03

The weight of antlers is necessary in assessing their quality for establishing categories. The weight of the raw antlers in experimental groups animals was 5.61 and 5.93 kg, and that exceeds control group index on 9.6 and 15.8% respectively. In the experimental groups the weight of canned antlers exceeds that index in control group on 10,6 и 18,0%. Considerable distinctions between raw and canned antlers in 2nd and 3rd groups is not established, the difference is not significant.

The output of final products of the maral deer groups, which were consuming the hay-concentrate, silage and haylage diets is reached 42-43%. By stem length and circle the antlers of animals from 2nd and 3rd groups exceed their peers from the 1st group on 4.36 and 5.73 cm. The stem length and circle are signs least subject to change, they are the most conservative in comparison with other measurements.

Conclusion

According to conducted research results it can be concluded that the maral deer antlers productivity is influenced by feeding type and diet balanced by nutritional and mineral substances.

So the usage of silage and haylage diets with mineral supplement (briquette) additions increases antler growth intensity and quality of final products, has no adverse impact on the overall physiological condition of marals.

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Corresponding Author:
Dr.Korzhikenova Nurgul Orungalievna
Kazakh National Agrarian University
Abay Street, 8, Almaty, 050010, Kazakhstan

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