



Beta-Carotene in Prevention of Cow's Obstetric-Gynecological Diseases

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Carotene, preventive measures, high-productive cows, stall period

Abstract

The intensification of the livestock industry is the decisive role of healthy reproduction. The aim of this study was to use "Carofertin" for the preventive purpose of obstetric pathology in high-productive cows (every 10 days) and compare with the action of vitamin A. Prophylactic effectiveness of "Carofertin" was defined for prevention of obstetric pathology of high-productive cows whose were predisposed to diseases of parturient (the incidence of retention placenta: 21.7±0.4%, 43.5±0.41%, 65.2±0.38% (P<0.01)) and postnatal periods too. The incidence of uterus subinvolution was 13.0±0.34% in the first group, 43.48±0.5% in the second group and 56.5±0.49% in the third group (P<0.001). The incidence of acute puerperal endometritis was 26.0±0.44% in the first group, 34.78±0.49% in the second group and 52.0±0.49% in the third group (P<0.001). We used biochemical and clinical analysis of blood samples to assess the impact of the drug on the functional metabolism and general methods of clinical examination (including rectal and vaginal examination) for control over the parturition and puerperal period. It is important to study the problems of obstetric pathology in cows especially during the late stall period and to improve preventive measures.

Özet

Beta-Karotenin İneklerde Obsterik-Jinekolojik Hastalıklara Karşı Koruması

Sağlıklı üremenin hayvancılığın entansifleşmesinde önemli bir rolü bulunmaktadır. Bu çalışmanın amacı yüksek döl verimli ineklerde obsterik hastalıklara karşı korumada A vitamininin etkisi ile karşılaştırmalı olarak "Carofertin" in kullanılmasıdır (her 10 günde). "Carofertin" in koruyucu etkisi, parturient hastalığına (plasenta retensiyonu) karşı predispoze olan yüksek döl verimli ineklerin doğum patolojisinden ve doğum sonrasında da korunması olarak %21,7±0,4, %43,5±0,41, %65,2±0,38 (P<0,01) tanımlanmaktadır. Uterus subinvolyasyon yüzdeleri birinci grupta %13,0±0,34, ikinci grupta %43,48±0,5 ve üçüncü grupta %56,5±0,49 olarak saptanmıştır (P<0,001). Akut puerperal endometritis yüzdeleri birinci grupta %26,0±0,44, ikinci grupta %34,78±0,49 ve üçüncü grupta %52,0±0,49 olarak saptanmıştır (P<0,001). Doğum ve puerperal periodu kontrol edebilmek için, ilacın fonksiyonel metabolizma üzerindeki etkisini belirlemek üzere kan örneklerinin biyokimyasal ve klinik analizleri ile klinik muayenenin temel metotları (rektal ve vajinal muayeneler dahil) kullanılmıştır. İneklerde özellikle geç dönemde doğumla ilgili patolojik problemlerin üzerinde çalışılması ve koruyucu ölçümlerin geliştirilmesi önemlidir.

Introduction

The reproduction efficiency of high-productive cows depends on quality of food and their metabolism. Cow's dry period is one most complex periods of reproduction which require additional preventive measures at the end of the stall period (Batrakov, 1980; Nezhdanov, 2007; Nikitin, 2001). The stall period brings out a lot of stress factors such as lack of vitamins, macro- and micronutrients in fodder. Lack of beta-carotene has a great value for the cow's metabolism (Lammoglia, 1997; Nezhdanov, 2007).

"Carofertin" is an enjectable drug based on the synthetic beta-carotene. This drug affects the organism in two ways. Firstly, the synthetic beta-carotene transforms into vitamin A and then this vitamin A affects the reproduction system. Secondly, the synthetic beta-carotene has antioxidant activity, adaptogenic effects, and antimutegenic and immunomodulation effects. Carotenoids have two characteristics: easy stereoisomerisation and a lot of unsaturated conjugate dual links. On the other hand, it explains the reason of good electron-donor / electron-acceptor carotene

characteristics. If cows fodder includes sufficient quantity of vitamin A, beta-carotene improves reproductive qualities of cows. Carotene plays the important role in the processes of reproduction. It cannot be fully replaced with Vitamin A as was noted by Sanochemia Pharmazeutika AG. Bendich (1989) reported that beta-carotene can protect phagocytic cells from auto oxidative damage, enhance T and B lymphocyte proliferative responses, stimulate effectors T cell functions, and enhance macrophage, cytotoxic T cell and natural killer cell tumoricidal capacities, as well as increase the production of certain interleukins. It has been reported beta-carotene has the ability to function as a chain-breaking antioxidant in a lipid environment at physiological O₂ partial pressures as noted by Bendich (1989) and Wendler et al. (1950).

Hambartsoumian (1998) reported that the glycoprotein leukemia inhibitory factor (LIF) is produced by the endometrium and is involved in the control of implantation. Karer and Jucker (1949) reported that β -carotene had been identified as the major carotenoid pigment in two Ascomycetous fungi, the parasitic *Epichloë typhina* (with restriction to the sexual stroma and additional presence of traces of α -carotene) and the ascocarp of *Helotium citrine*. Knopp (1992) reported that sex hormone mediated modifications of lipoprotein physiology are described in pregnancy which may enhance triglyceride fatty acid transport to muscle for oxidation and cholesterol delivery to growing maternal and fetal tissues, a process that diabetes could globally disrupt. Olson (1989) reported that excentric cleavage of carotenoids unquestionably occurs in plants and microorganisms and might also occur in mammals.

The aim of this research was to study features of the dry period at the end of the stall period in high-productive cows which had pathologies of the reproductive tract after the last parturition on the research farm establishment of ZAO "Luban" Ltd, Russia, and to work out preventive measures of obstetric pathology in high-productive cows by using synthetical beta-carotene.

Materials and Methods

The clinical study was carried out in ZAO "Luban" Ltd, Russia. The aim of this study was to investigate the benefits of "Carofertin" for preventive purposes of obstetric pathology in high-productive cows. There were 69 cows of black-and-white breed that were selected for farm scale trial. Experimental cows were adult animals that had pathology of the reproductive tract after the last parturition. The choice of the animals was carried out according to the principle of conditional analogues.

Rations of cows were calculated according to the norms of the All-Russian research institute for animal husbandry and were approved for the breeding farms. The research was conducted at the end of the stall period. Start cows spent 60 days before calving. The cervical method with rectal fixation of the cervix was used for the artificial insemination of cows. The animals were clinically examined in the Department of the Calving, Milking and Insemination. Gynecological examinations of livestock were conducted during the postpartum period every week. General indicators of reproduction, such as the service period, the duration of dry period, the percentage of cull cows, were recorded.

During the experiment the dynamics of biochemical and clinical blood results of cows were studied. Blood samples were taken from subcaudal vena into tubes fivefold during the dry period. Erythrocyte sedimentation rate was determined by the micro method according to Panchenkov. The number of blood cells was determined according to the counting chamber of Goryaeva. The method of the differential leukocyte count was carried out according to the painted strokes method of Romanovsky-Gimsa. As was noted by Vasiliev (2003).

Concentration of calcium and inorganic phosphorus in the blood serum was determined by the colorimetric method. Alkaline phosphates activities in the serum were determined by colorimetric method with ACE-buffer and concentration of total protein was determined by the biuret method. Concentration of carotene and vitamin A in the blood serum was determined by method of Bessiya in the modification of Anises method. As was noted by Cholod and Ermolaev (1988), Menshikov (1999) and Tietz (1997).

The animals were divided into 3 experimental groups of 23 heads. In the first group, four parenteral "Carofertin" injections were used every 10 days during the dry stable period (dose per cow was 25 ml). In the second group three parenteral injections of vitamin A were used every 5 days during the dry stable period (dose per cow was 5 ml). The cows of third group were without medical treatment. The group of clinical examinees methods was used for the definition of the status of the tested animals.

The computer mathematical package SPSS 17 was used for statistical processing of the results. Descriptive statistics and the nonparametric Mann-Whitney criterion were applied for independent samples, and nonparametric Friedman criterion - for dependent samples. The criterion of reliability was determined by the table of Stydenta descriptive statistics.

Table 1. Biochemical parameters of the blood serum of cows.**Tablo 1.** İneklerde kan serumunun biyokimyasal parametreleri.

Indicators	Units of Measurement	Norm	Group	The Dry Period (Day)		P
				11	50	
Total protein	g/l	60.0-85.0	1	76.01±6.88	64.72±5.39	P<0.01
			2	72.63±13.5	61.83±9.76	P<0.01
			3	76.36±11.5	63.92±12.8	P<0.01
			P	P<0.01	P<0.01	
Alkaline reserve	%CO ₂	46.0-66.0	1	41.46±13.6	48.4±8.18	P<0.01
			2	39.8±14.4	48.14±7.7	P<0.01
			3	45.95±10.08	38.93±10.8	P<0.01
			P	P<0.01	P<0.01	
Vitamin A	umol/l	0.46-6.30	1	2.9±1.43	3.9±1.77	P<0.05
			2	2.63±1.3	4.9±1.4	P<0.05
			3	3.57±1.84	4.43±2.35	P<0.05
			P	P<0.05	P<0.05	
Carotene	umol/l	0.95-66.50	1	8.09±5.68	23.59±6.61	P<0.001
			2	7.9±5.73	11.2±2.5	P<0.001
			3	8.09±6.18	10.9±4.68	P<0.001
			P	P<0.001	P<0.001	
Ca	mmol/l	1.26-3.37	1	2.08±0.6	3.3±0.36	P<0.001
			2	2.1±0.6	2.65±0.74	P<0.001
			3	1.87±0.41	1.96±0.5	P<0.001
			P	P<0.001	P<0.001	
P	mmol/l	0.81-2.72	1	1.9±0.31	1.78±0.49	P<0.05
			2	1.87±0.3	1.96±0.5	P<0.05
			3	2.19±0.31	2.08±0.29	P<0.05
			P	P<0.05	P<0.05	

Results

Pharmacokinetics of "Carofertin" are characterized by their highly bioavailability to the organism of the cows. Concentration of carotene in the blood exceeded the baseline studies by 1.4 times (the difference minimum performance was 4.8 times) in the injected cows ($P < 0.001$). The average concentration of retinol serum increased by 1.5 times ($P < 0.05$). Pharmacodynamics "Carofertin" is characterized by its comprehensive influence on the metabolism. "Carofertin" influences the stabilization of the calcium-phosphorus ratio. This process was obtained by increasing the level of calcium by 1.8 times and reducing the phosphorus levels by 1.15 times ($P < 0.001$).

The results of clinical blood analysis show positive effects of "Carofertin" on stabilization of the erythrocyte

levels in the blood. In the first experimental group the level of erythrocytes was $3.343 \pm 0.087 \cdot 10^{12}/l$ in the early dry period. After the first injection of "Carofertin" there were $4.219 \pm 0.051 \cdot 10^{12}/l$ stabilizing after each injection, reaching the normative values $6.174 \pm 0.628 \cdot 10^{12}/l$ by the end of the dry period. In the second experimental group the levels of erythrocytes were $3.493 \pm 0.076 \cdot 10^{12}/l$ in the early dry period and $3.427 \pm 0.036 \cdot 10^{12}/l$ in the end of the dry period. In the third experimental group the levels of erythrocytes were $3.571 \pm 0.077 \cdot 10^{12}/l$ in the early dry period and $3.434 \pm 0.044 \cdot 10^{12}/l$ in the end of the dry period.

Long service period induces loss from an economical point of view. On the other hand, too short calving intervals of high productivity cause the reduction of lactation period.

Table 2. Service period and fertility rate of cows

Tablo 2. İneklerin servis periyodu ve fertilitte oranları

Indicators	Units of Measurement	Group	Level	P
Service Period	Days	1	110 ± 4.66	$P < 0.01$
		2	154.6 ± 5.5	$P < 0.01$
		3	189 ± 9.4	$P < 0.01$
		P	$P < 0.01$	
		1	68 ± 0.46	$P < 0.01$
Fertility Rate from the First Insemination	%	2	52.17 ± 0.49	$P < 0.01$
		3	47.83 ± 0.5	$P < 0.01$
		P	$P < 0.01$	
		1	34.78 ± 0.49	$P < 0.001$
		2	52.0 ± 0.49	$P < 0.001$

In the puerperal period, the presence of retention placenta, and the presence of the uterus subinvolution as well as the incidence of acute puerperal endometritis was estimated. The puerperal period lasted 5.0 ± 2.37 hours in the first group, 8.6 ± 3.0 hours in the second group and 9.6 ± 4.32 hours in the third group ($P < 0.01$). The incidence of retention placenta was $21.7 \pm 0.4\%$ in the first group, $43.5 \pm 0.41\%$ in the second group and $65.2 \pm 0.38\%$ in the third group ($P < 0.01$). The incidence of uterus subinvolution was $13.0 \pm 0.34\%$ in the first group $43.48 \pm 0.5\%$ in the second group and $56.5 \pm 0.49\%$ in the third group ($P < 0.001$). The incidence of acute puerperal endometritis was $26.0 \pm 0.44\%$ in the first group

$34.78 \pm 0.49\%$ in the second group and $52.0 \pm 0.49\%$ in the third group ($P < 0.001$).

Discussion

After parenteral injection of "Carofertin" β -carotene enters the blood stream, part of it goes into the liver where it is converted into vitamin A. And the other part of unchanged β -carotene goes into all organs and tissues where it has immediate effect on the metabolism, it protects the hemoglobin of the blood from the damaging effects of nitrates, and stimulates the non-specific factors of natural resistance of the organism as noted by Bendich (1989), Karer and Jucker (1949), Karnaukhov (1973), and Koltsova and Mishin (1984).

After "Carofertin" injection is there positive effects on stabilization of the erythrocyte levels in the blood which is $6.174 \pm 0.628 \cdot 10^{12}/l$.

It has also proved to have antioxidant effects as noted by Takakashi et al. (1999), and Van Poppel et al. (1993). Thus, we noted a decrease in the incidence of retention placenta and acute puerperal endometritis after "Carofertin" injection. The incidence of retention placenta was $21.7 \pm 0.4\%$ after "Carofertin" injection ($P < 0.01$) and the incidence of acute puerperal endometritis was $26.0 \pm 0.44\%$ ($P < 0.001$).

The application of "Carofertin" in cows during dry period at the end of the stall period positively affects births by normalization of carotene and vitamin A levels and calcium:phosphorus ratio and indirectly normalizes hormonal regulation of the parturition process, reduces the rate of morbidity uterus subinvolution and postpartum endometritis. The length of the third stage of postpartum was decreased by 4.6 ± 1.95 hours by using beta-carotene. During the dry stable period and reduction of the cases of retention placenta was $43.5 \pm 0.18\%$ ($P < 0.01$). The reduction of the cases of uterus subinvolution was $43.5 \pm 0.15\%$ and the reduction of the cases of the incidence of acute puerperal endometritis was $26 \pm 0.05\%$ ($P < 0.001$), and the service period decreased by 79 days ($P < 0.01$).

The necessity of application of "Carofertin" in cows during the dry period has been considered in the article. "Carofertin" supplies blood with the necessary level of carotene, this helps to normalize the exchange processes in the organism; to maintain the most physiological course of the parturition and postnatal period and to stabilize the industrial parameters.

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