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Proceeding Paper

Use of Colostrum Enriched with Specific IgY for the Prevention of Diarrheal Infections in Newborn Calves †

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Abstract

Background. Newborn ruminants are born agammaglobulinemic, and colostrum quality (IgG concentration) is often insufficient, especially in heifers, leading to high morbidity and mortality from diarrheal infections. **Objective.** To develop and evaluate colostrum enrichment with specific egg yolk immunoglobulins (IgY) for the prevention of diarrhea in newborn calves. **Methods.** Hens were hyperimmunized with an inactivated vaccine against rotavirus, coronavirus, and *E. coli*. Yolk melange was prepared. Total and specific IgY were measured by chromatography and ELISA. Trials were conducted in three farms with high diarrhea incidence: experimental calves (n = 25) received 100 mL of melange (5 yolks) with the first two colostrum feedings; controls (n = 25) received native colostrum. **Results.** One yolk contained up to 100 mg of polyclonal IgY, with 8% specific antibodies. Diarrhea occurred in 12% of experimental calves (mild, no drugs) vs. 76% in controls (24% required antibiotics/rehydration). Testing in two other farms (n = 42, n = 38) reduced incidence 5.2–6.8-fold compared to the previous period. **Conclusions.** Enriching colostrum with specific IgY from hyperimmunized hens is highly effective and affordable for preventing diarrheal infections in newborn calves, especially in herds with poor colostrum quality in heifers.

Keywords: calves; colostrum; IgY; diarrheal infections; prevention

1. Introduction

Newborn calves are born in a state of physiological agammaglobulinemia, since transplacental transfer of immunoglobulins in cattle is absent [1,2]. The only source of passive immunity is colostrum, which must be fed in the first hours of life. The basis of its protective action is immunoglobulin G (IgG), accounting for up to 85% of the total Ig pool in colostrum [3].

Colostrum quality is subject to significant variation. In 30–50% of heifers, the IgG concentration does not reach the threshold value of 50 g/L, and is often less than 30 g/L, leading to failure of passive immunity [4,5]. Immunoglobulin deficiency makes calves vulnerable to the main pathogens of diarrhea: rotaviruses, coronaviruses, and enteropathogenic *E. coli* [6]. The incidence of diarrhea in dairy farms can reach 60–80%, with mortality of 20–40% [7].

Traditional approaches (antibiotics, chemotherapy) are associated with the risk of antibiotic resistance and disruption of the microbiota [8]. An alternative could be the use of specific antibodies for passive immunization. A promising source is chicken egg yolk

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immunoglobulins (IgY). When hens are immunized, polyclonal IgY accumulates in the yolk at high concentrations; they are stable over a wide pH range and do not cause inflammatory reactions in mammals [9,10].

The aim of the study was to develop and evaluate the effectiveness of enriching colostrum with specific IgY obtained from hens hyperimmunized against rotavirus, coronavirus infections, and escherichiosis of cattle.

2. Materials and Methods

Obtaining IgY. Laying hens (n = 50) were immunized twice with an associated inactivated vaccine against rotavirus, coronavirus infections, and escherichiosis of cattle (FSBI "ARRVH", Russia) with a 14-day interval. Eggs collected from day 21 were used to prepare egg yolk melange (homogenization, lyophilization). The concentration of total IgY was determined by HPLC, and specific antibodies by ELISA (Bio-X Diagnostics, Belgium).

The associated vaccine was used because rotavirus, coronavirus, and enteropathogenic *E. coli* are the main causes of neonatal diarrhea in the study region. Specific antibody activity against each component was determined by separate ELISAs (rotavirus, coronavirus, and *E. coli* F5 (K99) adhesin). No formal endotoxin testing was performed on the eggs. However, the hens were kept in a controlled-access clean facility with strict hygiene protocols to minimize bacterial contamination.

Experimental design. Production trials were conducted in 2023–2025 in three dairy farms in Azerbaijan that were unfavorable for diarrheal diseases in calves. All calves were Holstein-Friesian, aged 0–14 days, with a birth weight of 36–42 kg. Only calves with failure of passive immunity (serum IgG < 10 g/L at 24 h) were included. In each farm, experimental and control groups were formed using the pair-analogue method (base farm: n = 25 per group). Calves in the experimental group received 100 mL of yolk melange (equivalent to 5 egg yolks) with the first and second colostrum feedings. The control group received native colostrum. In the other two farms, the method was tested on groups of n = 42 and n = 38, respectively.

Evaluation of effectiveness. Daily clinical observation was performed for 14 days. Diarrhea was diagnosed with liquid stool >3 times/day, depression, and signs of dehydration. The incidence, duration of diarrhea, and need for antibiotic therapy were recorded.

Statistics. The χ^2 test and Student's *t*-test were used (Statistica 12.0). Differences were considered significant at * $p < 0.05$.

3. Results

Characteristics of the IgY preparation. One chicken egg yolk contained, on average, 98.4 ± 4.2 mg of total IgY, of which 8.2 ± 0.5% were specific antibodies against the target pathogens.

Production trials. In the base farm, the incidence of diarrhea in the experimental group was 12% (3 out of 25), and in the control group, 76% (19 out of 25) (* $p < 0.01$). In the experimental group, diarrhea was mild (duration 1.8±0.4 days), and no antibiotics were required. In the control group, the average duration of diarrhea was 4.6±1.2 days, and antibiotic therapy was required in 24% of calves. Similar results were obtained in the other two farms (Table 1).

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Table 1. Effectiveness of colostrum enrichment with specific IgY in three dairy farms.

Group: Incidence, %	Duration of Diarrhea	Days (Mean ± SD)	Antibiotic Therapy Required, %
Farm 1 (Experimental)	12.0	1.8 ± 0.4	0
Farm 1 (Control)	76.0	4.6 ± 1.2	24.0
Farm 2 (Experimental)	14.3	2.1 ± 0.5	0
Farm 2 (Control)	78.6	4.9 ± 1.1	19.0
Farm 3 (Experimental)	10.5	1.6 ± 0.3	0
Farm 3 (Control)	73.7	4.4 ± 1.0	21.0

Note: n = 25 per group in Farm 1; n = 42 and n = 38 in Farms 2 and 3, respectively.

4. Discussion

The data obtained confirm the high effectiveness of colostrum enrichment with specific IgY for the prevention of diarrhea in newborn calves. The incidence decreased 5.2–6.8-fold, and cases of diarrhea in the experimental groups were mild and did not require antibiotics.

IgY exert a protective effect by neutralizing pathogens in the intestinal lumen: they prevent adhesion of E. coli to enterocytes, neutralize enterotoxins, and block the binding of rotaviruses and coronaviruses to cellular receptors [11–13]. An important advantage of IgY is their resistance to proteolysis in the gastrointestinal tract of ruminants [14].

The proposed method compares favorably with traditional antibiotic prophylaxis, as it does not promote the selection of resistant strains, does not disrupt the formation of microbiota, and does not lead to the accumulation of residues in products [15]. Unlike vaccination of cows, which does not always provide a sufficient level of antibodies in heifers [16], the use of IgY allows specific antibodies to be dosed in a targeted manner, regardless of the quality of the mother's colostrum.

The technology for obtaining lyophilized egg yolk melange is accessible for industrial implementation, and the stability of the preparation during storage (up to 12 months) ensures its practical applicability [17].

5. Conclusions

The method of colostrum enrichment with specific IgY significantly reduces the incidence of diarrhea in newborn calves and eliminates the need for antibiotics. The technology is accessible for industrial implementation.

1. Hyperimmunization of hens with an associated vaccine ensures the accumulation of IgY in the egg yolk with specificity against the target pathogens (up to 8 mg of specific antibodies per yolk).
2. Enrichment of colostrum with IgY at the rate of 100 mL of melange per feeding significantly reduces the incidence of diarrhea in calves (from 73.7–78.6% to 10.5–14.3%; * $p < 0.01$).
3. The use of enriched colostrum completely eliminates the need for antibiotics in calves of the experimental groups.
4. The developed method is technologically accessible, safe, and can be recommended for implementation in dairy farms with an unfavorable epizootic situation for diarrheal diseases.

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