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Serum immunoglobulin G levels in lambs fed colostrum and dam milk or cow milk and milk replacer after birth

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Summary

The purpose of the study was to determine the changes in serum immunoglobulin G (IgG) levels in lambs fed colostrum and dam milk or cow milk after birth. Twenty newborn Sakız lambs were used in the study. The lambs born from same ewe were divided into two equal groups. 10 lambs in group 1 (control) were kept together with their dams. The separated lambs (experimental) (n=10) were fed commercial cow milk ad libitum for first 2.5 weeks after which the lambs were fed milk replacer, hay and concentrate feed ad libitum up to 2 months of age. The lambs kept together with their dams were fed dam milk for the first 2.5 weeks and, following this, the lambs were kept together with their dams by day, separated in the evening and fed hay and concentrate feed ad libitum in addition to dam milk up to 2 months of age. Blood samples were collected from the jugular vein of the lambs at 12, 24 and 48 hours and on days 14, 28, 42 to 56 following parturition. Serum IgG levels were higher in group 1 (control) than group 2 (experimental) in hour 12 after parturition ($p<0.001$). In group 1, serum IgG levels gradually decreased with the advancing days. In conclusion, separated lambs had generally lower serum IgG levels than lambs kept together with their dams. This may indicate that the inflammatory response of lambs fed colostrum and dam milk is better than in other lambs. The findings in the present study support the recommendation that lambs are protected best against disease when they receive colostrum from sheep in sufficient quantity to achieve a high degree of passive immunoglobulin transfer.

Keywords: colostrum-deprived, immunoglobulin G, lamb

Colostrum is the initial secretion in the lactation of the ewe. It contains immunoglobulins which provide the lamb, which has little or no immunoglobulin present in its serum at birth, with passive immunity to certain infectious diseases (17). Immunoglobulins function as antibodies, the antigen-binding proteins that are present on the B-cell membrane and also are secreted by plasma cells. Secreted antibodies circulate in the blood and serve as the effectors of humoral immunity by searching out and neutralizing or eliminating antigens (10). Lambs are born hypoimmunocompetent and with a small store of energy for heat production and metabolism and are dependent on colostrum to supply maternal immunoglobulins and energy. The most satisfactory way of providing the lamb with immunity against disease is to ensure that it gets a large quantity of good quality ewe colostrum in early life (16). Neonatal morbidity and mortality decrease when adequate concenrations of Ig are received via colostrum (19). The primary immunoglobulin in colostrum is immunoglobulin G (IgG) (2). Low serum IgG concentrations in newborn calves and lambs have been associated with increased disease susceptibility and death loss (9).

The newborn requires a sufficient volume of colostrum with high immunoglobulin concentration to ensure availability of a high immunoglobulin mass necessary to achieve adequate passive immunity. Inadequate passive transfer can result from deficiencies in colostrum production, colostrum consumption, or immunoglobulin absorption (7). The purpose of the study was to determine the changes in serum IgG levels in lambs fed colostrum and dam milk or cow milk and milk replacer after birth.

Material and methods

Newborn twenty Sakız lambs were used in the study. The lambs born from same ewe were divided into two equal groups. 10 lambs in group 1 (control) were kept together with their dams. 10 lambs in group 2 (experimental) were

Tab. 1. Chemical compositions of the diets (%)

Components	Hay	Concentrate supplement	Milk replacer
Crude protein	5.42	16.0	23.00
Crude fibre	43.55	10.0	1.00
Crude ash	5.55	10.0	9.00
Crude oil	0.85	3.30	16.00
Dry matter	88.52	88.00	96.50
Calcium	0.11	0.80	0.80
Phosphorus	0.10	0.50	0.85
Sodium	0.10	0.10	0.20

separated from their dams as soon as lambing and taken to the warm boxes. Separated lambs were fed warmed commercial cow milk *ad libitum* five times a day for first 2.5 weeks. Then, the lambs were fed milk replacer, hay and concentrate feed *ad libitum* up to 2 months age (tab. 1). The lambs kept together with their dams were fed dam milk for first 2.5 weeks. After that, the lambs were kept together with their dams by day, separated in the evening and fed hay and concentrate feed *ad libitum* in addition to dam milk up to the 2 months age. Blood samples were collected from the jugular vein of the lambs at hours 12, 24, 48 and at days 14, 28, 42 to 56 after parturition. Blood was allowed to coagulate spontaneously at room temperature, and serum was obtained by centrifugation at 5,000 × g for 15 minutes. Serum samples were stored in –20°C until assayed for IgG level. IgG concentrations in the serum of the lambs were assayed by enzyme linked immunosorbent assay as described by Erhard et al. (6).

Mean serum IgG concentrations for control and experimental groups in each blood sampling day were compared by use of a two-tailed Student's t-test. Data were analysed by use of factorial and repeated measure ANOVA between blood sampling days within each group using a computer program (SPSS, 1990). Results are presented as mean ± SD.

Results and discussion

Serum IgG levels are shown in tab. 2. Serum IgG level was significantly higher in group 1 (control) than group 2 (experimental) only hour 12 after parturition ($p < 0.001$). The levels in other hours and days were insignificantly different between two groups. In group 1, serum IgG levels gradually decreased with advancing days. In group 2, the levels were insignificantly different between each blood sampling time.

Colostrum high in IgG concentration has to be feed sufficiently to achieve adequate passive immunity and disease prevention during the first 2 months of life. Additional major factors that influence the passive transfer of IgG are total quantity of colostrum ingested within the first 24 hours of life, premature lactation, and insufficient IgG absorption by the intestinal epithelium. The disease resistance provided by colostrum is only transitory, and the new-born must become immunocompetent by developing its own immunoglobulins before passive maternal immunity wanes (6).

Morbidity and mortality are very high during a few weeks after parturition in ruminants. Gastrointestinal and/or respiratory system infections may occur in this period. Precolostral serum does not contain IgG. For this, IgG in colostrum is a very important factor because it keeps away lamb from infectious disease. Inadequate passive transfer of immunity can result from deficiencies in colostrum production, colostrum consumption, or immunoglobulin absorption. Colostrum-deprived newborn animals are exposed to abnormally high risk of disease and death. A decrease in passive immunoglobulin transfer in the calves contributes to the increase in prevalence of disease. Circulating low serum IgG concentrations are indicator of poor passive immunoglobulin transfer (1, 8, 13).

The amount of IgG transferred from colostrum is just as important as the spectrum of antibodies present (6). Morris et al. (15) and Stoneham et al. (18) diagnosed failure of passive transfer as < 4 mg/ml IgG foal serum and partial failure of passive transfer ranging from 4 to 8 mg/ml IgG. The epitheliochorial placentation of ruminants prevents the in utero passage of large amounts of maternal IgG to the fetus. Therefore in a study (5), very low mean precolostral serum IgG concentrations were measured, which could be differentiated as 0.15 mg IgG_1 and 0.06 mg IgG_2 per ml serum.

Clover and Zarkower (3) reported that blood sera collected from calves before ingesting colostrum contained trace amounts of IgG and IgG was present in significant amounts in sera of calves after colostrum feeding.

Some studies indicate that the ability of ruminants to absorb immunoglobulins continues until 36 hours and 48 hours of age. Erhard et al. (5), determined 9.3 mg/ml IgG_1 and 0.8 mg/ml IgG_2 twelve hours after the last colostrum meal in calves, and from day 2, the mean serum concentrations decreased continuously to lowest levels of 4.9 mg/ml IgG_1 at day 28 post-natum and of 0.51 mg/ml IgG_2 at day 21 post-natum. Erhard et al.

Tab. 2. Serum IgG levels (mg/ml) (n = 10; $\bar{x}$ ± SD)

Groups	Hour 12	Hour 24	Hour 48	Day 14	Day 28	Day 42	Day 56
Group 1 (control)	31.65 ± 2.93^{a}	25.13 ± 4.02^{ab}	25.62 ± 4.68^{ab}	15.69 ± 1.16^{b}	14.49 ± 1.16^{b}	10.61 ± 1.77^{b}	10.27 ± 1.24^{b}
Group 2 (experimental)	$9.07 \pm 3.52^{*a}$	16.96 ± 5.45^{a}	20.35 ± 6.51^{a}	10.79 ± 3.18^{a}	10.67 ± 2.78^{a}	13.31 ± 3.41^{a}	12.37 ± 2.52^{a}

Explanations: a, b – means within the same line with different superscripts differ significantly at $p \leq 0.05$; * – this shows difference between two groups at $p \leq 0.001$

(6) noted that the mean serum IgG concentration of the mares decreased significantly at day 21 post-partum from 19.0 to 11.2 mg/ml. Dominguez et al. (4) reported that the concentration of active IgG decreased sharply within 96 hours of age to about 48 per cent of the initial value, and afterwards, the level decreased slowly reaching a value of 10 per cent at 32 days of age in lambs.

In the present study, serum IgG levels in colostrum and dam milk-fed lambs decreased with advancing age as similar to the findings of Erhard et al. (5) and (6) and Dominguez et al. (4). This rapid decline in the absorption of immunoglobulins in ruminants with age has been attributed to the maturation of intestinal epithelial cells that lose their ability to absorb intact macromolecules after about 24 hours of age (4).

Colostrum-deprived kittens did not achieve serum IgG concentrations comparable to those for colostrum-fed kittens until 6 weeks of age (12). Contrarily, in the colostrum-fed neonatal goats, the IgG_2 appeared in the fourth week of life whereas in the colostrum-deprived animals the IgG_2 was detected as early as three weeks after birth (14). In the study of LaMotte (11), by 24 hours after birth, all colostrum-fed calves had detectable levels of IgG_1 and IgG_2 and there were significant increases in the mean serum levels of all 2 immunoglobulins. At 24 hours the level of IgG_2 appeared to increase slightly in colostrum-deprived calves, and the mean IgG_1 level increased by 50%. LaMotte (11) reported that, by 144 hours after birth, in colostrum-deprived calves, the level of IgG, also appeared to increase substantially, while the level of IgG_2 appeared to increase slightly. In colostrum-fed calves, by 144 hours after birth, the serum levels of IgG_1 and IgG_2 decreased to various degrees. In the present study, colostrum and dam milk-deprived lambs had detectable serum IgG levels in each blood sampling time as similar to the findings of LaMotte (11). However, the levels in colostrum and dam milk-deprived lambs were generally lower than colostrum and dam milk-fed lambs, especially in $p < 0.001$ level at hour 12. This is an expected situation, because in colostrum-fed lambs, IgG in colostrum is absorbed from intestine.

Whereas in colostrum-deprived lambs, this procedure does not realize and serum IgG levels decrease. Similarly Garry et al. (7) determined that calves fed colostral products had lower IgG values than colostrum-fed calves.

In conclusion, separated lambs had generally lower serum IgG levels than lambs kept together with their dams. This may show that inflammatory response of lambs fed colostrum and dam milk is better than others. The findings in the present study support the recommendation that lambs are protected best against disease when they receive colostrum from sheep in sufficient quantity to achieve a high degree of passive immunoglobulin transfer.

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PAPAZOGLOU L. G., PATSIKAS M. N., PAPADOPOULOU P., SAVAS I., PETANIDES T., RALLIS T.: Zaczopowanie jelita u psa spowodowane przez piasek. (Intestinal obstruction due to sand in a dog). Vet. Rec. 155, 809, 2004 (25)

U 10-miesięcznej suki krzyżówki z labradorem o masie 21,5 kg wystąpił brak łaknienia, wymioty i biegunka. Objawy utrzymywały się przez 4 dni. Przed wystąpieniem choroby pies przebywał nad morzem. Badanie fizykalne wykazało depresję, miernego stanu odwodnienie i zaklinowanie pętli jelitowej. W rentenogramie stwierdzono rozszerzenie jelita cienkiego spowodowane nagromadzeniem materiału przypominającego kontrast o konsystencji ziarnistej oraz dużą ilość gazu. W trakcie laparotmii wykonanej w linii środkowej brzucha stwierdzono wypełnienie 25 cm odcinka jelita cienkiego piaskiem. Po chirurgicznym usunięciu około 350 g piasku stan zwierzęcia w okresie 4 miesięcy po zabiegu był dobry.

G.