Improved Dairy and Meat Goat Production for Small-scale Farmers in Asia

Proceedings of the International
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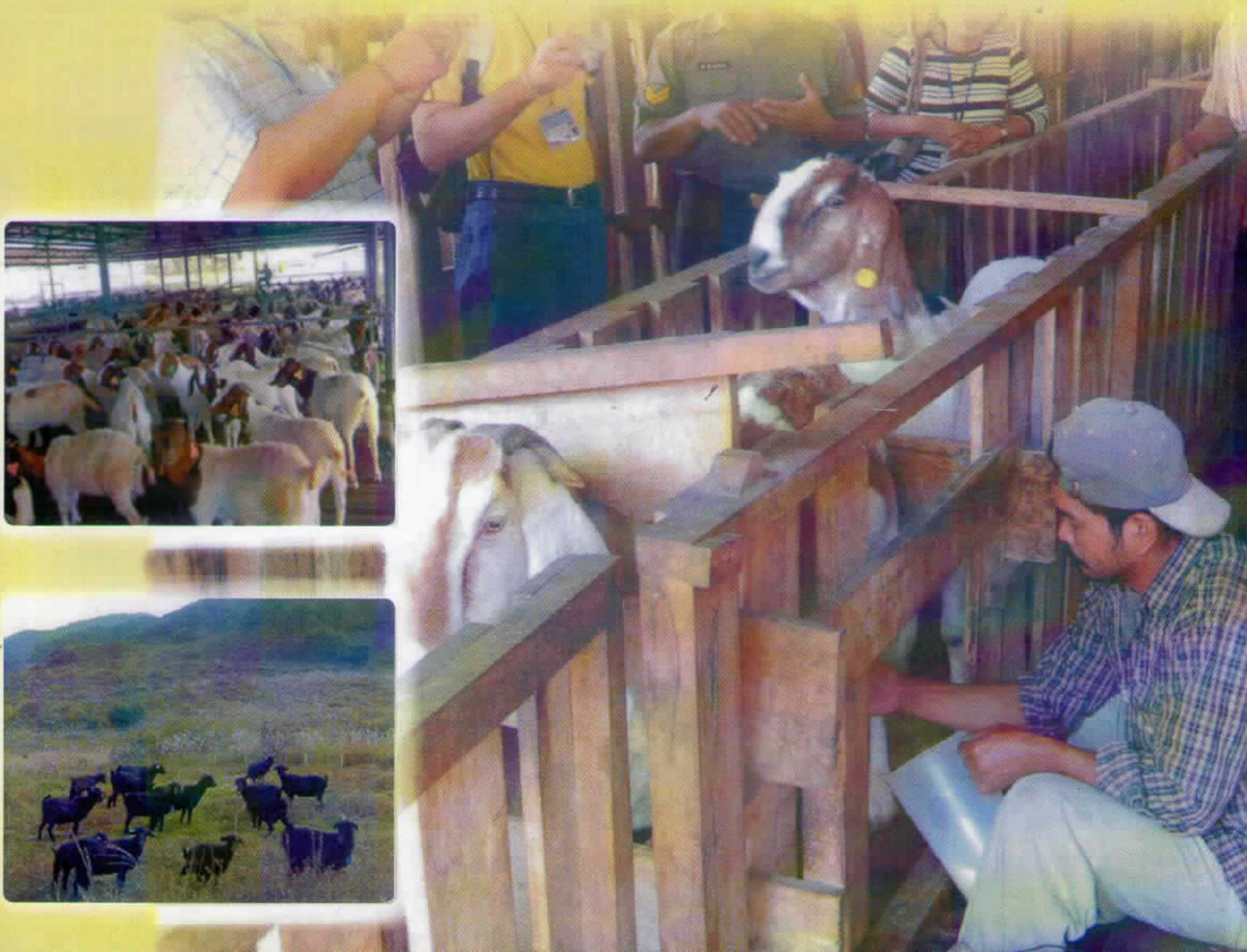
by Incremental Improvements in Technology and Infrastructure
for Small-scale Farmers in Asia
August 04-08, 2008, Bogor, Indonesia

Food and Fertilizer Technology Center for the Asian and Pacific Region
Indonesian Research Institute for Animal Production
Livestock Research Institute, Council of Agriculture, Taiwan ROC



DR. Anita

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Supporting papers

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CONTENTS

SERUM ANTIBODY CONCENTRATION OF ETTAWAH CROSSBRED NEONATUS FOLLOWING VARIOUS COLOSTRUM CONSUMPTION

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ABSTRACT

For many reasons, a lot of newborn kids have no access to their mother's colostrums and are therefore not protected against neonatal diseases. These problems may be avoided by giving an alternative source of immunoglobulin such as natural bovine colostrum, bovine colostral product, and more recently colostrum replacers (commercially available colostral-supplement products), but their efficacy in providing immunoglobulin for passive transfer on newborn kids is not well established. Therefore, this experiment was conducted to determine the serum IgG concentration of Ettawah crossbred neonates following various colostrum consumptions. Twenty four healthy neonatal kids were used in this experiment, and were divided into four groups. Each group received fresh maternal (goat) colostrum (Group A), frozen-thawed bovine colostrum (Group B), bovine spray dried colostrum (Group C), and bovine powder commercial colostrum (Group D), respectively. Colostrums were given to the kids at amounts of 10% of body weight directly after kidding and followed by the same amount every 12 h, for three days. Total IgG in the colostrums given are as follows : 2.9, 5.2, 2.1, and 2.2 g at the first feeding, and 1.3, 3.2, 2.1, and 2.2 g at the second feeding, for kids fed fresh maternal, frozen thawed bovine, bovine spray dried, and commercial bovine colostrums, respectively. Blood samples of kids were drawn from jugular vein at 0, 12, 24, 48, 72, and 168 h after birth to determine serum IgG concentration. IgG concentrations were analyzed using ELISA technique. Results of this experiment indicated that serum IgG concentration of all group of neonates reach the highest level at 24 h after birth ($P<0.05$). The serum IgG concentration of the neonates consumed fresh goat colostrums, fresh bovine colostrums, spray dried bovine colostrums and commercial bovine colostrums were 4.96 ± 0.12, 3.91 ± 1.23, 2.20 ± 0.25, and 3.08 ± 0.49 mg/ml, respectively. IgG concentration of neonates consumed fresh goat and bovine spray dried colostrums were then decreased significantly ($P<0.05$) until 72 h after birth, while in neonates received spray dried bovine colostrums, the IgG decrease during 24 to 48 h ($P<0.05$). The IgG concentration were then remained constant except in neonates consumed commercial bovine colostrum which continued to decrease until the observation commenced at 168 h after birth ($P<0.05$). In conclusion, the highest concentration of IgG were on the neonates consumed fresh goat colostrum (Group A), followed by frozen-thawed bovine (Group B), commercial bovine (Group D), and bovine spray dried colostrum (Group C), respectively.

Keywords : passive transfer, IgG, neonates, kid, colostrum, goat, bovine

INTRODUCTION

Newborn kids as well as all other ruminants and ungulate animals are born virtually agammaglobulinaemic because of placental impermeability to immunoglobulin (Ig) molecules (Roberts and Anthony, 1994; Tizard, 2000; Lazzaro, 2000). On the other hand, neonatal immune system functionally immature, and humoral immune system could not response the pathogen invasion effectively as in adult animals (Roy, 1990; Tizard, 2000). Therefore, they are very sensitive to neonatal infections. The sole immediate and efficient immunological protection is by passive immunization with maternal antibodies (Roberts and Anthony, 1994; Tizard, 2000; Lazzaro, 2000). These antibodies are transmitted from the intestinal lumen to the blood of the newborn by quick ingestion within 24 h postpartum (Constant et al., 1994; Davis and Drackley,

1998) of an abundant quantity of colostrums rich in immunoglobulins (Ventorp and Michanec, 1992). Failure in the transfer of these immunoglobulins endangers the survival and health of the kids (Besser and Gay, 1994; Waterman, 2002). Absorption of colostral immunoglobulins is essentials for acquisition of passive immunity (Perino et al., 1993). Among the most important factors that influence passive transfer of colostral immunoglobulins are age at first feeding and mass of immunoglobulins ingested (Besser et al., 1991).

In some circumstances, sufficient maternal colostrums may not be available within the first 24 hours after birth. For many reasons, a lot of kids, calves, lambs, and foals, have no free access to their mother's colostrums due to i.e. multiple births, maladapted maternal behaviour mostly at first parturition, acute mastitis. These difficulties may be avoided by giving another alternative source of immunglobulins for passive transfer and disease protection with source of high-quality colostrums. Natural colostrum from other spesies such as bovine colostrum, and more recently, colostral products (colostrums replacers) which are essentially produced by the newly established colostrums industry (commercially available colostral-supplement products) can be considered. Availability of an alternative source of high-quality colostrums is important for circumventing colostral deficiencies (White, 1993).

Natural bovine colostrum and also colostral products can provide immunoglobulin for passive transfer to newborn when the dam's colostrum is deficient. Commercially available products can provide disease protection to newborn when fed as directed (White, 1993; Francisco and Quigley, 1993). The purpose of this study was to determine the serum IgG concentration of Ettawah crossbred neonates following various colostrum consumptions.

MATERIALS AND METHODS

Animals and Colostrums

Twenty four healthy neonatal kids, with body weight average at birth of 3.6 ± 0.38 kg, were used in this experiment. Immediately after birth, the kids were separated from their dams, and kept in the separated pens depending on the group. Several kind of colostrums were used in this experiment i.e fresh maternal (goat) colostrum, frozen-thawed bovine colostrum, bovine spray dried colostrum, and bovine powder commercial colostrum.

Bovine colostrum obtained during 1-6 milking after parturition from several multiparous healthy Frisian Holstein cows in the dairy was pooled and mixed thoroughly, according to milking to provide a single source of natural bovine colostrums. A sample of the mixed colostrum was obtained for analysis of IgG concentration. After mixing, the pool of natural colostrums according to milking, was divided into several aliquots, placed in plastic freezer bags, and stored frozen at -20°C for later use. The frozen colostrums was thawed with warm water to approximately 38°C before giving for the kids (Zaremba et al., 1993).

The fresh goat colostrum was obtained from the dam within one hour after parturition. A sample of colostrum was obtained for analysis of IgG concentration. Spray dried colostrum was obtained from processing the fresh bovine colostrum to be powder form using spray dryer technique. The combination of inlet and outlet temperature was 140°C and 52°C, respectively. A small quantity of sample was analyzed fo IgG concentration. Commercial colostral product was obtained from manufacture available on market. A small quantity was analyzed for IgG concentration.

Administration of Colostrum

Twenty four healthy neonatal kids were used in this experiment, and were divided into four groups. Each group (n=6) received fresh maternal (goat) colostrum at amounts of 10% of body weight (Group A), frozen-thawed bovine colostrum at amounts of 10% of body weight (Group B), bovine spray dried colostrum (Group C), and bovine powder commercial colostrum (Group D). For the commercial colostrum, the dosage was given according to manufacturer's direction.

Immediately after birth, kids were weighed and the volume of colostrum to be fed was calculated. The fresh maternal (goat) colostrum, frozen-thawed bovine colostrum, bovine spray dried colostrum, and bovine powder commercial colostrum, were fed for the first time to kids of different groups as soon as possible after birth within one hour after birth, and followed by the same amount of colostrum every 12 hours, for three days. Fresh water was available at all times.

Maternal (goat) colostrum was collected from the dam and given to her kid immediately after milking. Before use, the frozen-thawed bovine colostrum was thawed and its temperature was adjusted with warm water approximately 38˚C (Zaremba et al. 1993). Whereas bovine spray dried colostrum and bovine powder commercial colostrum were diluted with warm water (approx. 38˚C). Kids were fed colostrum by using a nipple bottle (Besser et al. 1991). Total IgG in the colostrums given are as follows : 2.9, 5.2, 2.1, and 2.2 g at the first feeding, and 1.3, 3.2, 2.1, and 2.2 g at the second feeding, for kids fed fresh maternal, frozen thawed bovine, bovine spray dried, and commercial bovine colostrums, respectively.

Blood Collection and Analysis of IgG Concentration

Blood sample (10 ml) was obtained from jugular vein of each kid as soon as possible after birth (0 hours, prior to the initial colostrum feeding) and 12, 24, 48, 72, and 168 hours thereafter. Blood was collected into plain glass tubes and was allowed to clot, and serum was obtained by centrifugation (1500 x g) for 5 minutes. Serum was taken off and stored at -20˚C prior to analysis of total IgG concentrations.

Serum and colostral IgG concentration were determined by use of ELISA (Enzyme Linked Immunosorbent Assay) technique, use *competitive inhibition* and *competitive* methods. *Monoclonal anti-goat IgG* (Cat no. G-9019, SIGMA Chemical Co, USA), *goat anti-human IgG peroxidase conjugate* (Cat no. A-5420, SIGMA Chemical Co, USA), *standard goat IgG* (Cat no. I-5256, SIGMA Chemical Co, USA), *standard bovine IgG* (Cat no. I-5506, SIGMA Chemical Co, USA), *rabbit anti-bovine IgG peroxidase conjugate* (Cat no. A-5295, SIGMA Chemical Co, USA) were used.

Statistical Analysis

Differences in serum IgG concentration within groups over time and between groups at each evaluation period were determined by use of ANOVA. A value of $P<0.05$ was considered significant.

RESULTS AND DISCUSSION

IgG Concentration

The dynamic serum IgG concentration recorded for the kids of the four groups at birth until 168 hour of age are reported in Figure 1. None of the kids had measurable serum IgG concentration prior to feeding colostrum. Serum IgG concentration of the four groups were very low at birth (<0.1 mg/ml), and increased significantly at 12 and 24 hours after feeding colostrum ($P<0.05$). This trend was observed in all group ($P<0.05$). Peak IgG levels were observed at 24 hours for all groups with values of 4.96 ± 0.12 mg/ml for groups fed A (fresh goat colostrum), 3.91 ± 1.23 mg/ml for groups fed B (fresh bovine colostrum), 2.20 ± 0.25 mg/ml for groups fed C (spray dried bovine colostrum), and 3.08 ± 0.49 mg/ml for groups fed D (commercial bovine colostrum).

Twelve hours after feeding colostrums for the first time, serum IgG concentration increased to 4.02 ± 0.57 mg/ml for group A (feeding fresh goat colostrum), 1.80 ± 0.31 mg/ml for group B (feeding bovine frozen colostrum), 1.42 ± 0.49 mg/ml for group C (feeding *spray dried* colostrum), and 1.62 ± 0.86 mg/ml for group D (feeding commercial powder colostrum). Twelve hours after second feeding (the first 24 hour), serum IgG concentration increased to 4.96 ± 0.12 mg/ml, 3.91 ± 1.23 mg/ml, 2.20 ± 0.25 mg/ml, and 3.08 ± 0.49 mg/ml for group A, B, C, and D respectively, or increased 23.40%, 117.22%, 54.26%, 90.05% for group fresh colostrum, frozen-thawed bovine colostrum, bovine spray dried colostrum, and bovine powder commercial colostrum, respectively.

Serum IgG concentration at the first 12 hour varied, with concentration of 0.52 – 4.52 mg/ml (2.96 – 4.52 mg/ml, 1.44 – 2.11 mg/ml, 0.60 – 2.13 mg/ml, and 0.52 – 2.85 mg/ml, for group fresh goat colostrum, frozen-thawed bovine colostrum, bovine spray dried colostrum, and bovine powder commercial colostrum, respectively. By 24 hours after birth, serum IgG concentration was ranging on 1.90 – 6.80 mg/ml (4.11 – 6.80 mg/ml, 2.11 – 5.54 mg/ml, 1.90 – 2.57 mg/ml, and 2.56 - 3.93 mg/ml, for group A (fresh goat colostrum), for groups B (frozen-thawed bovine colostrum), for groups C (spray dried bovine colostrum), and for groups D (commercial bovine colostrum), respectively. Until 168 h after birth, IgG concentration of neonates consumed fresh goat, frozen-thawed bovine, bovine spray dried, and bovine powder commercial colostrum was 3.98 ± 0.45, 1.31 ± 0.68, 0.88 ± 0.43, and 0.88 ± 0.31 mg/ml, respectively.

IgG concentration of neonates consumed fresh goat and bovine spray dried colostrum were then decreased significantly (P<0.05) until 72 h after birth, while in neonates received spray dried bovine colostrum, the IgG decrease during 24 to 48 h (P<0.05). The IgG concentration were then remained constant except in neonates consumed commercial bovine colostrum which continued to decrease until the observation commenced at 168 h after birth (P<0.05).

Peak serum IgG concentration was highest in kids fed fresh goat colostrum (Group A) than other groups, followed by Group B (frozen-thawed bovine colostrum), D (commercial bovine colostrum), and C (spray dried bovine colostrum) respectively. All groups reach the highest serum concentration 24 h after birth. This finding in accordance to Tizard (2000) reported the highest neonatal serum IgG concentration at 12-24 h after birth.

Mean serum IgG concentration peaked at 24 hours in kids of all group. Figure 1 showed that serum IgG concentration was higher in kids fed maternal colostrum (fresh goat colostrum) than other groups. Enzymes, hormones, and growth factor in colostrum may enhance absorption of IgG by the small intestine (Besser and Osborn, 1993). In calves and pigs, a trypsin inhibitor protein (Brock et al. 1978; Jensen and Pedersen 1982) accelerates IgG absorption and protects against the degradation of IgG in the intestine prior to absorption. Mare colostrum contains an epidermal growth factor that inhibits gastric acid secretion and promotes gastrointestinal mucosal growth (Murray et al., 1992). Without the benefit of these factors, absorption of IgG in the colostrum substitute may not have been maximal.

The serum IgG concentration of neonates received fresh goat and bovine colostrum 24 h after birth were ranging 1.59 – 6.80 mg/ml. This is slightly lower if compared to Constant et al. (1994), who reported serum IgG concentration to reach 17.27 ± 2.44 and 14.60 ± 2.88 mg/ml at 24 h after consumption of goat fresh colostrum at 3.0 and 1.5 g/kg BW, respectively. Moreover, Francisco and Quigley (1993), Chelack et al. (1993), Quigley et al. (1998) and Arthington et al. (2000) reported average concentration of serum IgG of Holstein newborn received fresh bovine colostrum at 18.7 mg/ml (range 3-21 mg/ml). However, Nocek et al. (1984) has reported the range of 0.01-17.85 and 3.2-17.0 mg/ml. IgG serum concentration 24 h after consumes *pooled colostrum.*

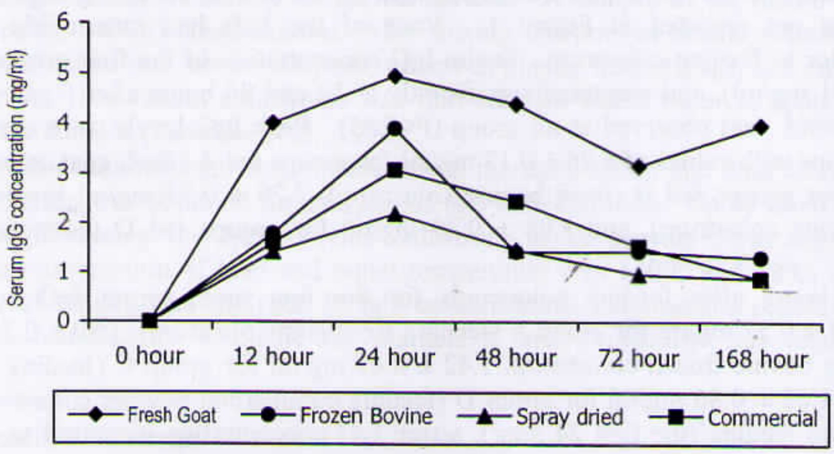

Figure 1. Serum IgG concentration in kids of the four groups fed different colostrums

Serum IgG concentration at 24 jam after birth in kids fed bovine spray dried and commercial bovine colostrums were ranging of 1.90 – 2.57 mg/ml and 2.56 - 3.93 mg/ml, respectively. Chelack et al. (1993) reported that in calves fed spray dried colostrums had have IgG concentration was not different compared to calves fed frozen-thawed colostrums at 48 hours after birth. Todd et al. (1993) reported that IgG concentration in calves fed fresh colostrums with addition to spray dried colostrums reached optimal passive immunity and calves healthy along pre weaning periods. In the other hand, Zaremba et al. (1993) reported that calves fed powder spray dried colostrums had lower serum IgG concentration at 24 hours after birth, compared to calves fed fresh colostrums and fresh colostrum that supplemented with dried powder colostrum.

Serum IgG concentration was higher in kids fed maternal colostrum (fresh goat colostrum) than other groups. The macromolecular transport mechanism in the small intestine is capable of transferring intact colostral-derived immunoglobulin and a variety of non-immunoglobulin macromolecules from the intestinal lumen to the circulation. However, the transport mechanism's capacity for absorption is limited and can be exhausted. Albumin in the colostrums substitute may have interfered with absorption of IgG. Efficiency of IgG1 transfer in newborn calves was reduced from 59% to 36% by the addition of bovine serum albumin to colostral whey ((Besser and Osborn, 1993).

The low level of IgG concentration normally related to its risk against morbidity and mortality rate of the newborn. Bovine neonates with the concentration of IgG less than 8 mg/ml within 24 h after their birth have a risk of 3-9 times higher to infection of the disease. Mortality risk before weaning 5 times greater if compared to the newborn consumes more than 16mg/ml of IgG (Perino et al., 1993; Wittum and Perino, 1995). Kids with serum IgG concentration less than 4 mg/ml within 48 h after birth has a morbidity and mortality risk compared to of those with 8 mg/ml serum IgG concentration (Constant et al. 1994).

More than 40%, calves showed IgG concentration at 24-48 h lower than 10 mg/ml, and more than 25% of it has had IgG concentration <6.2 mg/ml. The mortality rate of bovine newborn with IgG concentration <10 mg/ml tend to suffer almost twice if compared to of those received lower concentration (Wells et al. 1996). Although the IgG concentration was slightly lower than other findings no indication to affect the health performance of the neonates.

The conclusions of this experiment suggest that the consumption of various colostrums (fresh goat, frozen-thawed bovine, commercial bovine and bovine spray dried colostrum) would increase the rate of IgG concentration of Ettawah crossbred neonates at 24 h after birth. The highest concentration was indicated on the kids consumed fresh goat colostrum, followed by frozen-thawed bovine, commercial bovine, and bovine spray dried colostrum, respectively.

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