Plasma IgG and cortisol concentrations of newborn calves delivered in pens with two different amounts of sawdust: A case comparison

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Abstract

Effects of two different amounts of bedding on plasma IgG and cortisol concentrations of dairy calves were compared. Sixteen newborn Holstein calves were allocated to two post-birth floor conditions. One pen was bedded with sawdust 6 mm deep (Group S), the other was bedded with sawdust 20 mm deep (Group D). Calves were left with their dam for six hours after birth, and colostrum was artificially given immediately after dam-calf separation. Blood was collected from the jugular vein of calves at 48 hours after birth to measure plasma concentrations of IgG and cortisol. Whereas 50% of calves in Group S were diagnosed as having failure of passive transfer (FPT), the proportion of FPT calves was 25% in Group D. The plasma IgG concentration in Group D (31.7 ± 22.8 mg/mL) was significantly (P < 0.05) higher than that in Group S (11.8 ± 8.7 mg/mL). Plasma cortisol concentrations did not differ between groups (Group D: 7.9 ± 7.2 ng/mL, Group S: 8.3 ± 10.9 ng/mL). Most newborn calves delivered in a pen that was bedded with sawdust 20 mm deep and left with their dams for six hours after birth seem to ingest enough IgG from colostrum to achieve passive immune protection and avoid FPT.

Key Words: bedding management, calf welfare, cortisol, IgG, immune passive transfer.

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Introduction

Passive transfer of colostral immunoglobulins from dam to neonate is vitally important because it affects newborn calf mortality and morbidity (Uetake 2013). Calves less than five weeks of age do not have active immunity, and colostral antibodies are only the source of immunoglobulins to protect calves from infectious disease in this period (Weaver et al. 2000). In spite of the importance, a significant proportion of dairy calves most likely suffer from failure of passive transfer (FPT) of antibodies from colostrum (Godden 2008). In fact, 30-40% of dairy calves are estimated to suffer from FPT even when they were left with their dams for 12 to 26 hours following birth in a US investigation (Brignole & Stott 1980).

Various factors are thought to be the cause. For instance, it has been demonstrated that high ambient temperatures (Stott et al. 1976), dystocia (Murray and Leslie 2013), low quality of a dam’s colostrum (Weaver et al. 2000; Fukushima et al. 2004), low birth weight, and lack of vigor in calves (Vasseur et al. 2009) can cause low blood IgG concentrations of calves. In addition to these factors, the success or failure of a calf’s colostrum intake might depend on the condition of the calving pen floor, which determines the ease of a calf’s standing. However, this point has not been focused on yet. A slippery pen floor would also put a pregnant cow under stress before delivery, and her stress might be transferred to her preborn calf though the placenta (Uetake et al. 2014). Therefore, our objective was to compare the effects of two different amounts of bedding on plasma IgG and cortisol concentrations of calves at 48 hours of birth.

Materials and Methods

Sixteen newborn Holstein calves were used in this study. One week before the estimated date of calving, the mother cows were moved to calving pens (2.9 m x 3.4 m) installed with a feed trough (0.75 m x 0.50 m x depth 0.48 m) and water cup (ø 0.30 m x depth 0.07 m). At that time, they were allocated to either two floor conditions. In one group, 450 g (one scoop) of sawdust was spread daily over the floor as bedding material. This is the conventional floor management of the calving pen in the Kanagawa Prefectural Livestock Industry Technology Center. The depth of sawdust in this group (Group S, n = 8) pen was 6 mm. In the other
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Prefectural Livestock Industry Technology Center.

For statistical analyses, a commercial software "Statcel3" (OMS Publishing Inc., Tokyo, Japan) was used. Plasma IgG and cortisol concentrations were compared between groups using Student’s or Welch’s t test. Frequency analysis of the FPT was performed with Fisher’s exact test. For significance, a P-value of <0.05 was selected.

Results and Discussion

Newborn calves of Group D, which were bedded with sawdust 20 mm deep, showed a significantly (t = -2.307, df = 9.005, P < 0.05) higher plasma IgG concentration (31.7 ± 22.8 mg/mL) than calves of Group S (11.8 ± 8.7 mg/mL) with sawdust 6 mm deep (Figure 1). Whereas 50% (4/8) of calves in Group S were diagnosed as having FPT, the proportion of FPT calves was 25% (2/8) in Group D. However, this was not statistically significant (χ² = 1.067, df = 1, P = 0.306). On the other hand, plasma cortisol concentrations did not differ between groups (Group D: 7.9 ± 7.2 ng/mL, Group S: 8.3 ± 10.9; t = 0.083, df = 14, P = 0.935) (Figure 1).

Unfortunately, we could not compare sucking behavior of calves in two groups, but the difference in plasma IgG concentration at 48 h after birth is thought to reflect the difference between success and failure of sucking behavior in Groups S and D because they were artificially fed equal amount of colostrum just

Figure 1. Plasma IgG and cortisol concentrations (Mean ± SD) in each group. Calves of Groups S and D were bedded with sawdust 6 mm and 20 mm deep, respectively. Blood was collected at 48 hours after birth.
after separation. It is reported that FPT not only increases the risk of calf mortality and morbidity (Uetake 2013) but also can reduce average daily weight gain during the first month of life (Virtala et al. 1996). If there is a slight increase in the quantity of bedding material, it is effective in the prevention of FPT, there is no reason not to adopt it. The results of this experiment encourage daily farmers to provide enough bedding material to absorb water from the manure of the cow and secure a dry place in the calving pen.

As for the effect of bedding quality on the growth performance and health of calves, there is a report that weight gain and starter intake of calves in nursery pens with straw bedding were greater and scouring was less than that of calves bedded with sand in the nursery pens and hutches (Hill et al. 2011). However, there is also a report that bacteria counts in the bedding were highest in long wheat straw after 42 days of use compared to other bedding materials including sand, rice hulls, and wood shavings (Panivivat et al. 2004). Staley and Bush (1985) suggest a possibility for intestinal microbial interaction with immunoglobulins that intestinal bacteria decrease absorption of immunoglobulins in neonatal animals. In a choice test, it is reported that calves show a clear preference for drier sawdust bedding and aversion to lying on concrete surfaces (Camiloti et al. 2012).

In conclusion, newborn calves delivered in a pen that was covered with sawdust 20 mm deep and left with their dams for six hours after birth seemed to ingest enough IgG from colostrum to achieve passive immune protection to avoid FPT.

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References


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異なる敷料量の分娩房で出生した新生子牛の血漿 IgG およびコルチゾール濃度

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要 約

分娩房の敷料量を 2 種類用意し、新生子牛の血漿 IgG およびコルチゾール濃度を比較した。16 頭の新生子牛を 2 種類の分娩房の敷料量のいずれかに振り分けた。片方の群の分娩房には、敷料としておが屑を厚さ 6 mm で敷き詰め (S 群)、もう一方の群では敷料の厚さを 20 mm とした (D 群)。いずれの群の子牛も出生後 6 時間は母牛と同居させ、母子分離直後に初乳を人工的に摂取させた。出生 48 時間後に採血し、血漿 IgG およびコルチゾール濃度を測定した。S 群では受動免疫移行不全 (FPT)と判定された子牛の割合が 50%であったのでに対して、D 群では 25%であった。D 群の子牛の血漿 IgG 濃度 (31.7 ± 22.8 mg/mL) は S 群 (11.8 ± 8.7 mg/mL) を比べて有意に (P < 0.05) 高かった。一方で、血漿コルチゾール濃度に群間差は認められなかった (D 群: 7.9 ± 7.2 ng/mL, S 群: 8.3 ± 10.9 ng/mL)。分娩房に厚さ 20 mm で敷料を敷き詰め、出生後 6 時間母牛と同居させた場合には、新生子牛への受動免疫移行が良好であることが確認された。

キーワード: IgG, コルチゾール, 敷料, 受動免疫移行不全, 新生子牛のウェルフェア

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