Biological quality of Complete Calf Starter Based on Rumen Development of Friesian Holstein Calf: Ruminal VFA and NH3 Concentrations

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ABSTRACT
The quality of complete calf starter (CCS) was evaluated using Friesian Holstein (FH) calves. The CCS formulation (soybean meal, corn fodder and molasses 5%) was postulated to effectively stimulate the reticulo-rumen development in calf. Calves received CCS and milk for six weeks period of experiment. The observed parameters were dry matter feed intake, ruminal VFA and NH3 concentrations. Dry matter feed intake and concentration of rumen VFA and NH3 increased according to the age development of calves during the observation. It indicated that reticulo-rumen was developed as calf fed on CCS. The created CCS (soybean meal, corn fodder and molasses 5%) could be offered to calf starting from 7 days old for reticulo-rumen development.

Key Words: Complete calf starter, Rumen development, VFA, NH3

INTRODUCTION
The reticulo-rumen is completely developed both metabolically and physically at birth, and may reach optimal function in 2-6 weeks of age, depend on the offered feed immediately after birth. Good quality calf starter needs to contain both grain and good quality forage to be metabolically and physically suitable for the development of reticulo rumen (Baldwin et al., 2004). Grain or other readily available carbohydrate (RAC) in rumen is fermented to produce volatile fatty acid (VFA), especially propionate and butyrate that can stimulate papillary development (Lane et al., 2000). Molasses as RAC has been used not only as a ingredient binder for pelleting, but also as a palatability enhancer for calf starter and stimulate calf rumen development (Lensmeister and Heinrichs, 2005). Therefore, a balanced combination of both grain and fiber sources has been feed formulator’s concern to make a good quality complete calf starter (CCS). In previous research, complete calf starter that is combination of calf starter with corn fodder and 5% molasses produced a good physic quality of pellet CCS (Mukodiningsih et al., 2010). The present research was aimed to further clarify biological quality of the CCS in FH calf. The CCS formulation was postulated to effectively stimulate the development of reticulorumen in calf, focusing on concentrations of ruminal VFA and NH3.

MATERIALS AND METHODS
Preparation of complete calf starter. Composition and ingredients of the CCS used in the present experiment was similar with that previously reported by Mukodiningsih et al., (2010). The CCS was formulated to meet the nutrient requirement of calves that contained 18% protein and 75% TDN (NRC, 2001). Proximate components and starch content of CCS were analyzed according to method of (AOAC, 1990), and NDF content of CCS was determined according to method of Van Soest (1994). Pelleting process of CCS mixture was similar to that reported previously (Mukodiningsih et al., 2010).

Feeding trial. A feeding trial was aimed to evaluate biological quality of the created CCS. Twenty FH calves were used in the feeding trial. Age of calves averaged at 7-14 days with average of initial body weight of 42±5.5kg. All calves were housed in metabolic cages and received 40% CCS and 60% milk according to the recommendation of NRC (2001). Feed
was given twice daily, at 0700 AM and 0300 PM. The CCS (starter feed) was given 30 min after milk (Morisse et al., 2000). Drinking water was available ad libitum, and was renewed twice daily (Lesmeister and Heinrichs, 2005). All calves were recorded their daily feed intake, and their body weight were estimated weekly throughout six weeks of feeding trial period. One calf was slaughtered at week 2, 4 and 6, respectively to determine the VFA and NH3 concentrations of reticulorumen contents. Ruminal VFA concentration was assessed according to destillation method, and ruminal NH3 was analysed using coway disc method. Parameter data were presented as descriptive non parametric.

RESULTS AND DISCUSSION

Feed intake. Table 1 shows daily intake of dry matter CCS and milk. Average feed intake was increased in accordance with developing age of calf. Average of daily feed dry matter intake were 506, 517, 528 and 531 g respectively during age of 5 to 21 days, 22 to 27 days, 28 to 35 days, and 36 to 42 days.

<table>
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<th>Table 1. Complete calf starter and milk consumption</th>
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<td>Dry matter intake (g/day)</td>
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<tr>
<td>CCS</td>
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<td>Milk</td>
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<td>Total (CCS + milk)</td>
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All calves received similar CCS throughout experimental period, increasing feed intake in accordance with age of calves. This means that the experimental CCS was processed by digestive tract and was utilized well by calf body. As increasing the age of animal, the digestice tract (especially reticulorumen) was also developed to process the consumed feed. The average of daily feed dry matter intake in this experiment was in a typical range intake of daily dry matter solid feed. NRC (2001) and Morisse et al. (2005) reported that daily solid feed intake in calf ranges is 50 g at third week of age and 1300 g at twentieth week of age.

Concentrations of ruminal VFA and NH3. The rumen VFA concentration increased concomitantly with increasing age of calves. The rumen VFA concentrations of calf were 72.08 mM; 68.12 mM; and 83.24 mM respectively at ages of second week, forth week, and sixth week (Table 2).

| Table 2. VFA and NH3 rumen concentration |
|--------------------------------=========|
| Parameters                              | Calves age (week) |
|                                        | 2       | 4       | 6       |
| Rumen VFA (mM)                          | 72.08   | 68.12   | 83.24   |
| Rumen NH3 (mM)                          | 4.06    | 20.31   | 22.34   |

More larger size of reticulorumen as increasing age of calf, the digestive tract is more function to process the consumed feed. Cunningham (1998) stated that significant development of calf reticulorumen occurs during 2-6 weeks of age. It is well known that feed carbohydrate is fermented in the reticulorumen to be VFA’s. Thus, in calf throughout 2-6 weeks of age, elevating feed intake (Tabel 1) was followed by increased concentration of ruminal VFA (Table 2). Ingredients of CCS might enhance degradation of feed carbohydrate to VFA in rumen of calf. The CCS contained molasses, corn, and ricebran which are known to be sources of readily available carbohydrate for ruminants. Murphy (1999) and Araba et al. (2002) reported that readily available carbohydrate like molasses is so easier to be fermented in reticulorumen of calf. Calf feeding for 9 weeks with CCS mixed from calf starter with soybean meal as protein sources (65%) and corn fodder as fiber source (35%) produced 35.70 mM of ruminal VFA concentration (Mukodiningsih et al. (2008). Rey et. al. (2012) reported that feeding milk replacer with calf starter in pellet form to calf during 12 – 83 days of age.
produced 19.5 mM - 84.4 mM of ruminal VFA. Protein was fermented to be ammonia (NH3) by rumen microbes. In this experiment, NH3 increased from wk 2 and wk6 (Table 2). Both NH3 and VFA increasing with increasing calves age. Thus calf fed on CCS revealed the enhancement of ruminal VFA and NH3 concentrations. These results indicated that the development of reticulo-rumen occured as calf fed on CCS during experimental period.

**IMPLICATION**

Complete calf starter by incorporating a substantial amount of poor quality local corn fodder in Indonesia with 5% molasses was sufficient enough for improving the pellet quality and therefore the performance as well as the reticulorumen development of Friesian-Holstein calves, in point of view of rumen VFA and NH3 concentrations.

**REFERENCES**


