The growth and mortality of Ongole cross bred and Bali calves given calf milk replacer (CMR) in palm oil plantation-cow integration

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Abstract. This research was conducted in order to test the application of technology for pre-weaning calves kept in Integrated-palm-cow business units (PTPN VI) in Jambi province. The experiment consisted of a 2-month period, after calving to 2 months old. The treatments were: Group I. Ongole crossbred calves freely suckled to the cows and were offered calves milk replacer (CMR). Group II. Ongole crossbred calves are freely suckled to the cows without additional CMR. Group III. Bali calves freely suckled to the cows and offered CMR while Group IV. Bali calves are freely suckled to the cows without additional CMR. The results showed that regardless of the breeds, calves offered CMR tended to maintain ADG, 163.8±82.8 and -166.5±52.5 g/day in Group I and III, respectively, compared to their control counterparts (P<0.05) that experienced decreased ADG -558.1±128.3 and -283.0±77.9 g/day for Group II and IV, respectively. The percentage of the calf mortality rate was higher in calves that did not receive CMR, 33 and 25% for Bali and Ongole crossbreds, respectively. While CMR offered calves had lower calf mortality, 17 % for Bali and 8% for the Ongole crossbreds. In conclusion, treatment with CMR was able to increase the survival life in pre-weaning calves. Therefore, calf milk replacer was needed for pre-weaning Bali calves to minimise calf mortality.

1. Introduction
One of the problems of integration cow and palm oil than reproduction and calf growth is the rate of death calves are quite high due to lack of adequate nutrition feed mains, lack of mothering abilities [1] and milk production holding, especially in cows Bali very little, models weaning as well as other factors such as health problems [2] and the diseases that result in death raises calves >20% [3]. The application of research technology in the form of calf and mothering ability management is expected to reduce the mortality rate of calves raised in the integration of cow and palm oil.

The body weight of pre-weaning calves before the age of four months to provide additional feed to the cows after birth showed ADG 705.9±155.2 g; whereas without additional feed on cows ADG it reaches 261.5±190.9 g [4], this shows that the growth of calves during pre-weaning is very much determined by feed cows, especially in meeting the needs of calf milk [5]. The pre-weaning calf growth rate depends on the condition of the cows during the lactation period, so it is necessary to improve the cows feed to get the calf with optimal weaning weights [6]. The breeder calf weaning management on system maintenance with a group housing (natural mating) are advised to wean six months with regard cows feed requirements [7]. Performan calf is determined by the quality of feed nutrients to the cows in the period of lactation so that improved nutrition on the cows for the period is absolutely necessary.
One study of pre-weaning calves supplemented feed on post-birth cows showed increased faster ADG every month, namely 650 g compared with the calf whose cows did not receive supplementation, ADG 440 g [8]. The results of the cows were given additional feed in the form of a combination of concentrate and legume (leaf *Gliricidia* sp, *Sesbania* sp and *Leucaena* sp) in the two months before and after birth can maintain BCS calf and lower mortality calf [9,10]. Improvements feed through supplementary feeding in cows Ongole cross bred with gestation of 30 weeks (seven months) up to two months after giving birth gives a better effect on birth weight, ADG, and estrus postpartum compared with feeding by means of breeders [11,12].

The improved management in the calf phase can reduce the calf mortality rate to 9.0% and increase growth by around 50% [13]. Calf starter with ingredients of skim milk and pollard with a ratio of 60:40 gives the best increase in body weight and efficiency in the pre-weaning calf crossing [14]. The results of other studies reported that making substitute milk, skim milk ingredients can be used with a dose of about 40%, fish meal with a dose of about 15%, and it is necessary to add about 1.5% emulsifier and vitamin E around 20 ppm [15]. Provision of substitute milk which has a biological value close to fresh milk, further research is still needed especially to determine its constituent ingredients and formulations for their use.

Improved management of cow feed in post-breeding is absolutely necessary and the addition of calf feed, especially in cows whose milk production is low, is important to improve body weight growth and reduce mortality of pre-weaning calf.

### 2. Material and method

#### 2.1. Research materials and locations

This study was a technological applications maintenance calf pre-weaning in a palm oil breeding business at Palm Cow Integration (ISS), PTPN VI Jambi province, using 24 heads (12 Bali calf and 12 Ongole crossbred calf) pre-weaning, which was divided into four treatment groups namely the first group: calf free suckle the cows and calf milk replacer supplement (CMR) from birth to two months in Bali cows, second group: calf free suckle the cows for up to two months without additional treatment CMR feed on Bali beef calves, the third group: free suckle calves in the cows and calf milk replacer supplement (CMR) from birth to two months in Ongole crossbred cows, fourth group: free suckle calves in the cows for up to two months without additional treatment CMR feed in Ongole crossbred calves. Each treatment group consists of 6 pre-weaning calves from the Bali and Ongole cross-bred cattle.

All cows were given additional feed two weeks before the end of the study in the form of palm oil base reinforcement feed with the addition of minerals (lime and salt); cows feed was expected to reach a cows body condition score (BCS) > 3 (scale 1–5); calf weaning 6–7 months. The main housing used a special lactation individual housing equipped with calf insulation with a size of 2 m x 1.5 m.

Parameters observed included: calf birth weight, daily body weight gain (ADG), parent body condition score (BCS) scale 1–5, estimated calf price, calf death percentage. Data were analyzed by randomized block design (RBD).

The CMR feed formula given to the pre-weaning calf comes from a mixture of rice flour, soy flour, egg whites, and coconut oil (table 1).

**Table 1.** CMR formula on calf aged 1–60 days.

| Ingredients CMR | Total (g) | Crude protein (%) | Crude protein Total (%) | Price (IDR) |
|-----------------|-----------|-------------------|-------------------------|-------------|
| Rice flour      | 100       | 6.8               | 6.8                     | 700         |
| Soybean flour   | 50        | 35                | 17.5                    | 400         |
| Egg white       | 12.5      | 100               | 12.5                    | 562.5       |
| Coconut oil     | 10        | 0                 | 0                       | 110         |
| **Total**       | **1,773** | **17.5**          | **17.5**                | **1,773**   |

Information: CP = Crude Protein.
3. Results and discussion

3.1. The performance of Ongole cross bred and Bali cows lactation

The performance of Ongole cross bred and Bali cows lactation at PTPN VI Jambi for two months post-breeding with a palm-based feed model was presented in figure 1.

![Cow Lactation Performance](image)

**Figure 1.** Performance of Bali and Ongole cross-bred cows lactation with palm-based in PTPN VI Jambi.

| No | Feed sample nutrition                  | %    |
|----|----------------------------------------|------|
| 1  | Dray matter/ DM                        | 70.71|
| 2  | Crude protein / CP                     | 7.94 |
| 3  | Crude fat/ CF                          | 2.83 |
| 4  | Crude fiber/ CFb                       | 35.76|
| 5  | Ash content/ Ash                       | 8.83 |
| 6  | Extra material without nitrogen        | 44.64|
| 7  | Total digestible nutrient/ TDN         | 51.32|

*Source: The Result of Lab Analysis. Nutrition and Animal Feed, BCRI on December 23th, 2016.*

Generally, post-calf lactation cows experience a decrease in ADG, due to their nutrition being used to produce milk for their calves, so that when the cows feed nutrition was not sufficient for basic living needs [16] which resulted in calf growth, even calf deaths will occur. Another study reported comparing the effects of breastfeeding, controlled intake, and post-calving ad libitum feeding to calves up to 56 days of age has resulted in increased milk during first lactation, ranging from 450 to 1,300 kg compared to cows who were fed limited feed during the period same [17]. Likewise research results. In this study, it was produced that Ongole cross bred and Bali cows whose calves were given CMR in Groups I and III seemed to decrease ADG lower -163.8±82.8 and -166.5±52.5 g / head (P<0.05 ) compared to groups II and IV in feed cows without CMR, ie the respective ADG were -558.1±128.3 and -283.0±77.9 g / head (figure 1 and table 2). The low decrease of ADG in cows whose calves were given CMR because cows milk has been fulfilled with the additional CMR in calves so that the need for milk for calves did not take all of cows milk. Some research results showed that calf growth during pre-weaning was highly
determined by the cows, especially in meeting the milk needs for calf through milk, so that lack of feed caused growth was not optimal/stunting [18].

During the initial period of lactation, energy needs are very needed in addition to milk production as well as to restore reproductive function. If the energy intake does not meet the needs, it will affect the decrease in milk production and body weight which in turn will affect the changes in reproductive function (spontaneous heat), the length of the postpartum anoestrus period, obstruction of ovulation and a decrease in the average conception [19]. The lactation period of the parent cow will affect the nutritional needs, so that the calf feeding period will have an impact on feed consumption and weaning time related to supplementation strategies that affect cattle weight and conditions during the dry period [20]. Likewise, low parent feed nutrition will affect other reproductive disorders, namely disorders of ovulation, sperm transport, fertilization, cell division and embryonic/fetal development [21,22].

### Table 3. Feed consumption and ADG of cow.

| Description | Treatment |
|-------------|-----------|
|             | I         | II        | III        | IV         |
| DM (kg/head) | 4.84±3.84 | 8.35±1.06 | 7.21±0.55 | 7.50±0.16 |
| CP (kg/head) | 0.74±0.05 | 0.66±0.85 | 0.57±0.04 | 0.60±0.01 |
| CFb (kg/head)| 3.35±0.24 | 2.99±0.39 | 2.41±0.15 | 2.72±0.03 |
| TDN (kg/head)| 4.81±0.49 | 4.29±0.95 | 3.17±1.53 | 3.85±0.15 |
| ADG cow (g/head) | -163.8±82.8a | -558.1±128.3b | -166.5±52.5a | -283.0±77.9b |

Information: I=Ongole cross bred calf with CMR, II= Ongole cross bred calf without CMR, III= Bali calf with CMR, IV= Bali calf without CMR. a,b = Different superscripts on the same line showed a real difference (P<0.05).

The results of statistical analysis of ADG for Ongole cross bred and Bali cows, both calves given CMR and non-CMR showed significant differences (P<0.05) (table 3). Besides feed consumption was still in accordance with their needs, this was in accordance with the report [23] which stated that the need for CFb and CP for body weight ±300 kg with a lactation period of one to two months required DM consumption of 6.1 kg/head and CP 512 g/head. Thus, energy intake was a determining factor in the survival of post-breeding cows, so it needs serious attention.

### 3.2. Calf performance in Ongole cross bred and Bali

Calf growth is one thing that needs special attention, because in the early months after birth is crucial to the growth of the calf next month.

![Calf Performance](image)

Figure 2. Calf growth in Ongole cross bred and Bali cattle with and without CMR.
Based on the research results figure 2. Bali cattle performance with the addition of CMR was better than without CMR; as well as Ongole cross bred cows. Previous studies have also shown that the addition of CMR increased the ADG of preweaned calves, the more CMR administration was the optimal ADG [24]. Differences in maintenance management or different farm environments can cause differences in growth in calves affected by feed, birth weight, environment and disease [25]. In addition, the potential for calf growth is also influenced by cattle, sex, and maintenance management.

The patterns of consumption of CMR and protein were shown in figure 3. Calf milk replacer intake in Bali and Ongole crossbred calves increased with age and weight as well as crude protein intake. During the pre-weaning period, the calf's immune system was weak because of limited milk consumption plus the calf was still unable to digest the forage and concentrate completely.

Conventionally the administration of CMR up to 3.8 liters per day in pre-weaning calves was able to produce optimum ADG without the addition of other solid feed [26]. Thus, the pre-weaning period was a critical period for a calf to get additional nutritional intake in the form of CMR to be able to survive. The slow growth of the calf in the period of growth will have a negative impact on further productivity. The adequacy of nutrient intake during pra mating will greatly determine calf performance in adulthood, one of which was the first milk production [17]. Adequacy of nutrition affects calf performance as an adult.

### 3.3. Calf mortality

The most important stages of beef cattle productivity were feeding and calf management. The calf mortality rate on community farms was still quite high, around 7–27%. High nutritious feed for pre-weaning calves was expected during the calf period will give a positive value when weaning off, heifer, and ready to be primed so that optimal productivity can be achieved.

#### Table 4. Average percentage mortality of calf Bali and Ongole cross bred during treatment.

| Treatment                  | Liveability | Mortality | ADG (g/heads) |
|----------------------------|-------------|-----------|---------------|
|                            | Heads %     | Heads %   |               |
| Ongole cross bred calf with CMR | 11 91.67  | 1.00 8.33 | 263.7±21.6     |
| Ongole cross bred calf without CMR | 9 75.00  | 3.00 25.00 | 140.1±17.4     |
| Bali calf with CMR          | 10 83.33  | 2.00 16.67 | 375.1±44.9     |
| Bali calf without CMR       | 8 66.67   | 4.00 33.33 | 321.8±44.1     |

Note: ^a,b Different superscripts on the same line showed a real difference (P<0.05).

Percentage mortality of Bali and Ongole crossbred calves was shown in table 4. The results showed that the highest percentage of mortality occurred in Bali and Ongole crossbred calves non CMR
respectively 33.33% and 25.00%. The mortality rate for Bali and Ongole crossbred calves was still relatively high, this was likely due to the low birth weight, poor mothering ability for Bali cows and heifers where the size of the udder was relatively undeveloped. Several studies supported the findings in this study, among them was that the size of the udder greatly determines the survival rate of the calf [1], low milk production in Bali cows was the cause of high calf mortality [27]. Poor nutritional intake has been understood to be the cause of the difficulty of increasing body weight at the same age as a calf with adequate nutrition [28], so that feeding replacement to a calf has a positive impact in the form of high body weight gain [29, 30] but immunological problems occurred which caused the incidence of diarrhea to increase [31].

Poor postnatal calf management resulted in calf mortality in the tropics up to 50%. The vulnerability of calves to impaired health and growth performance causes calves to need special attention, so giving colostrum from birth was needed which was an important process for transferring immunity to calves until their immunity develops to deal with various kinds of infectious attacks so that their growth and health were maintained [32–34]. In pre-weaning calves, it was also necessary to be given the opportunity to consume enough cows milk so that growth could be optimally expressed in accordance with its potential [35].

3.4. Economic analysis of CMR costs
The cost of making CMR for one calf per day amounted to IDR 1,773,00 derived from a mixture of rice flour, soybean flour, egg whites and coconut oil (table 1), so that for two months one calf spent the CMR cost of IDR 106,380 (table 5).

| Description                  | Treatment I | Treatment II | Treatment III | Treatment IV |
|------------------------------|-------------|--------------|---------------|--------------|
| Cost of CMR (IDR/ heads)     | 106,380     | -            | 106,380       | -            |
| Final Calf Body weight (kg)  | 64.08       | 49.67        | 39.17         | 24.00        |
| Estimated calf price (IDR)   | 3,204,000   | 2,483,500    | 1,958,500     | 1,200,000    |
| Profit (IDR)                 | 3,097,620   | 2,483,500    | 1,852,120     | 1,200,000    |

Note : I= Ongole cross bred calf CMR, II= Ongole cross bred calf non CMR, III= Calf CMR, IV= Non CMR; Estimated live weight price/ kg IDR. 50,000.

The best bruto profit calculation results were the treatment group I, namely Ongole cross bred cattle calves that were given additional CMR, then sequentially in groups II, and III, each of which was the result of profits of IDR 2,483,500 and IDR 1,852,120. While the least profit level was the calf of Bali cattle that were not given CMR, which amounted to IDR 1,200,000. Therefore, supplementation of milk was still needed especially in Bali cattle so as not to cause a high enough death as presented in table 5, that in general the mortality rate of pre-weaning calf was quite high especially in Bali cattle up to 30–50 % due to the low mothering ability and milk production of Bali cows [13].

4. Conclusion
The conclusion obtained, treatment with CMR was able to increase the survival life in pre-weaning calves. Therefore, calf milk replacer is needed for pre-weaning Bali calves to minimize calf mortality.

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