Integrated Feed of Improved Grass with Legume-Food Crops for enhancing the Growth Performance of Male Fattening Bali Cattle in West Timor

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Abstract. The quality of cattle feed plays a significant role in increasing the performance quality of beef cattle. Most of the farmers are facing constraint to provide the good feed in affordable prices. This research was aimed to determine the effect of given integration feed of improved - legume and food crops to daily weight gain, chest girth, shoulder height and body length of fattening Bali cattle of farmers in West Timor. The research method was arranged as in a double Latin Square Design (LSD), consisted of 5 treatments (T0; local feeds by farmers in West Timor. T1; integration feed of Brachiaria hybrid cv. Mulato + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima, T2; integration feed of Pennisetum purpureum cv. Mott + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima, T3; integration feed Setaria sphacelata + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima, T4; integration feed Brachiaria decumbens + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima) and 5 periods as replications. The observed responses were weight gain, chest circumference, shoulder height and length of fattening. The observed animals were 10 male Bali cattle that belongs to farmers and with an age ranged between 1-1.5 years and body weight ranged between 101-134 kg (average of 114.25 kg and a coefficient variation (CV) of 6.12%). The results showed that the integrated feed gave a significantly different performance of beef cattle. The most economical composition of integrated feed was the T1 which was able to increase the performance of the cattle compared with the control treatment. This results concluded that the integrated feed fed had a very significant effect on the daily body weight gain, chest girth, shoulder height and body length of the fattened Bali cattle. Economically and the ease of use of feed fed indicated that the composition of T1 treatment gave a greater contribution of 23.53% compared with the control treatment.

1. Introduction
The quality of feed plays an important role to improve the production performances of beef cattle. Many beef cattle farmers facing problems in providing good quality feed with affordable prices. Bali beef Cattle, in particular, is one of the most best reliable commodity to provide meat as currently being rapidly developed to meet the National beef demands, although its development is not yet in line with the demand growths [1]. The growth performances of fattening Bali cattle in East Nusa Tenggara (ENT), especially in West Timor is still low under the traditional management practices. Therefore it is resulted in low growth rate of cattle and thus the lowering quality and number of beef cattle being
exported from the region. Feeding practices which are not yet sufficient to meet the animal nutrients requirements, particularly on the balance between protein and energy of feed given, causing a relative longer length of time to reach the market weight [2-4]. Thus it is important to optimally make use of the available land on farm levels to provide sufficient food and feed to meet the demands [5].

Currently, the main land use is focused on one sub-sector, namely food crop. Efforts to increase land use efficiency can be done through the combination of food crop and beef cattle husbandry in an integrated farming mode. Integrated farming is a combination of conventional animal husbandry, aquaculture, horticulture, agro-industry, and the whole farming activities [6]. Integrated Model may help the farmers to overcome the problems in animal feed provision [7]. The integrated crop and livestock system plays important roles so that there will be no waste of produce and the land use become more efficient [8].

The current research is focused on researching the effects of feeding feed obtained from the integration of improved grass – legume Clitoria ternatea and food crops on affecting the daily body weight gain, chest girth, shoulder height and body length of male fattening Bali cattle at farmer level (on-farm). The result of the experiment is expected to obtain an economically good quality feed composition able to increase beef cattle performances.

2. Methods

An experiment was conducted to investigate the effect of feeding on the performances of Bali cattle during a 25 weeks period at Oeletsala Village in Taebenu Sub-District of Kupang District East Nusa Tenggara. The experiment employed the Latin Square with 5 treatments and 5 periods as the replications. The treatments in the experiment included:

$T_0$: Local feeds by farmers in West Timor.

$T_1$: Integration feed consisted of Brachiaria hybrid cv. Mulato + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima,

$T_2$: Integration feed consisted of Pennisetum purpureum cv. Mott + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima,

$T_3$: Integration feed consisted of Setaria sphacelata + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima,

$T_4$: Integration feed consisted of Brachiaria decumbens + legume Clitoria ternatea + corn + Vigna umbellata + Cucurbita maxima

The experiment used 10 heads of male Bali cattle aged between 1 to 1.5 year having body weight ranged between 101-134 kg, with an average of 114.25 kg and with CV of 6.12%. Feed material used is presented in Tabel 1. Each animal was allocated in individual pens of 1.5x 2 m size facilitated with feed and water troughs. Feed was given by weighing the forages at 10% of body weight. Parameters recorded included daily body weight gain, chest girth, shoulder height, and body length[9,6].

a. Daily body weight gain (DBWG)

$$PBBH = \frac{W_2 - W_1}{t}$$

NB: $W_1$ = Initial body weight (Kg)
$W_2$ = End body weight (Kg)
$t$ = Duration of fattening (day/s)

b. Daily chest girth gain (DCGG)

$$PLDH = \frac{LD_2 - LD_1}{t}$$

Note: $LD_1$ = Initial chest girth (cm)
$LD_2$ = End Chest Girth (cm)
$t$ = Duration of fattening (day/s)
c. Daily Body Length Gain (DBLG)

\[ PPBH = \frac{PB_2 - PB_1}{t} \]  (3)

Note:
- \( BL_1 \): Initial body length (cm)
- \( BL_2 \): End Body Length (cm)
- \( t \): Duration of fattening (day/s)

d. Daily Shoulder Height Gain (DSHG)

\[ PTPH = \frac{TP_2 - TP_1}{t} \]  (4)

Note:
- \( SH_1 \): Initial shoulder height (cm)
- \( SH_2 \): End Shoulder Height (cm)
- \( t \): Duration of fattening (day/s)

2.1. Procedure of Variable Measurements

a. Linear Body Measurements

b. Linear Body Size: measurement of the chest girth is done by encircling the chest behind the elbow joint, perpendicular to the vertical plane of the body using the rondo meter which can then be seen in linear figures of the body in units of cm. Body length measurements are measured from the lateral line of the lateral Tuberosity from the Os humerus (front of the shoulder joint) to the Tuber ischii (back edge of the sitting bone hump) using an extech laser. Body height measurements are measured from the highest point of the shoulder to the floor on the front legs using a measuring stick.

c. Measuring Body Weight

Measuring body bweight was conducted by estimation using linear body measurements using rondo measuring tape made in German where on the left side unit scales marked with cm for measuring the chest girth and on the right side marked with kg unit for body weight.

Equipments used consisted of sonic scales with 1000 kg capacity with 0.5 kg sensitivity, moris brand weighing scales having 100 kg capacity with 100 g sensitivity and camry brand weighing scales having 5 kg capacity with 1 g sensitivity to weigh concentrate, and a measuring stick to measure the linear body of cattle.

**Table 1.** Nutrition content of treatments’ feed

| Treatment | BO (%) | PK (%) | LK (%) | SK (%) | CHO (%) | BETN (%) | Energ | MJ/kg BK | Kkal/kg BK |
|-----------|--------|--------|--------|--------|---------|----------|--------|----------|------------|
| P₀        | 27,12  | 71,55  | 12,83  | 3,66   | 27,61   | 55,06    | 27,45  | 13,88    | 3.305,63   |
| P₁        | 36,24  | 81,24  | 18,94  | 6,52   | 24,81   | 55,78    | 30,97  | 16,46    | 3.920,19   |
| P₂        | 34,40  | 82,94  | 19,68  | 6,46   | 21,74   | 56,8     | 35,06  | 16,8     | 4.000,03   |
| P₃        | 33,41  | 78,99  | 15,66  | 5,88   | 28,11   | 57,45    | 29,34  | 15,74    | 3.747,71   |
| P₄        | 30,44  | 80,07  | 16,54  | 6,31   | 22,67   | 57,22    | 34,55  | 16,06    | 3.823,95   |

Note: Nutrition analysis was conducted at IPB lab in 2019. Feed samples were taken every day as much as 10% of the feed given to the animals and were then composited at the end of the experiment for analysis. CP= crude protein, CF= crude fiber.
3. Results and Discussion

The comparison between the growth performances of the fattening Bali cattle (body weight gain, chest girth, shoulder height and body length) between the control farmer feed and the integrated feed as statistically analyzed can be seen in the following Table 2.

Table 2. Daily body weight gain, chest girth, shoulder height and body length caused by the treatments.

| Parameter       | P₀±SD  | P₁±SD  | P₂±SD  | P₃±SD  | P₄±SD  | P-Value |
|-----------------|--------|--------|--------|--------|--------|---------|
| PBBH (kg/e/h)   | 0,26±0,03 | 0,49b±0,02 | 0,47b±0,02 | 0,46b±0,03 | 0,44b±0,01 | 0.00 **  |
| PLDH (cm/e/h)   | 0,11±0,01 | 0,17b±0,02 | 0,16b±0,01 | 0,16b±0,02 | 0,15b±0,03 | 0.00 **  |
| PTPH (cm/e/h)   | 0,08±0,02 | 0,13b±0,02 | 0,12b±0,02 | 0,10b±0,01 | 0,10b±0,02 | 0.00 **  |
| PPBH (cm/e/h)   | 0,10±0,02 | 0,12b±0,01 | 0,12b±0,01 | 0,10b±0,01 | 0,09b±0,02 | 0.00 **  |

Data in Table 2 indicated that integrated feed had significant effect (P<0,01) on the growth parameters of fattening Bali cattle. This might be caused by the higher nutritive values in the integrated feed compared with that of the control feed, especially in crude protein and energy. (Table 1) which thus influenced feed intake and digestibility causing increase in the formation of muscle and fat deposition which will then also seen in the interior and exterior growth performances. One of the factors influencing animal body weight gain is feed consumption and feed quality [10]. Cattle growth performances are highly influenced by the quantity and quality of feed intakes. The better the quality of feed the higher the intake and thus resulted in higher body weight gain obtained.

Duncan test indicated that T1-T2-T3-T4 treatments were significantly different (P<0,01) compared with the control, while there were no significant differences between the T1-T2-T3-T4 treatments (Table 2).

Daily body weight gain and chest girth gain were directly related to protein and energy feed content. Thus the growth figured out that protein and energy played important roles in improving microbes activities in digesting the feed and further resulted in muscle and fat formation and therefore gave significantly better performances of the fattening animals. These have proved also that the farmers’ conventional feed was not yet sufficient nutrition to the animals which resulted in slower growth and finally impacted on the longer length of time for reaching the market weight as well as lower economic returns. In general cattle growth pattern is sigmoid, which in the beginning from birth to the accelerated growth until reaching inflection point or puberty age, and then to body maturity. At the body maturity stage the growth starts to slow down and the relative constant[9. The daily body weight gain was not differed between the integrated feeds, this may be in relation to the sufficient value of nutrition between the integrated feed (> 15% CP, Table 1), though the can be seen that there are differences in CP value between the integrated feed. The higher protein content in this feed however brought about no more improvement in Daily Body Weight Gain and the Daily Chest Girth Gain in these formulations, thus there may be a need to further investigate on different formulation, such as additional feed component e.g RAC (Readily Available Carbohydrate) feed component in order to improve the efficient use of the higher protein content into muscle formation. The gain of 0.44-0.49 kg/hd/d would normally be achieved with adding legumes to the grass only feed or low feed quality at conventional farmer practices in West Timor[10, while further feeding mode with additional of RAC component, such as by adding Cassava, Corn, and other RAC source of 0.5-1% of body weight, gain of +0.8 kg/hd/d may be achieved[11].

Gain of body length and shoulder height is closely related to the meeting of mineral and calcium requirements which then influence the formation of bones and thus body frame of the animals[12]. There was a significant effect of the integrated feed treatments compared to the control of conventional farmer feed in body length and shoulder height. Thus it may be said that the given mineral content of
the integrated feed formulation were equally sufficient for the feeding improvement at the fattening of Bali cattle.

From the economic aspect, T1 treatment, or all the integrated feed in general, gave better contribution (23.53%) to the rate of growth of the animals and therefore provide sufficient reason for better adoption opportunities by the farmers in the dry-land farming systems of East Nusa Tenggara. By gaining between 0.44-0.49 kg/hd/d (Table 2) the animal will reach market weight of between >250 to 300 kg at the age of 2 years, compared to the natural condition or farmer conventional feeding practices at 0.25-0.3 kg/hd/dl, which may be only achieved at the age of 3-4 years. Therefore the integrated feed formulation will be able to give faster economical return compared to the farmer practices feeding mode.

4. Conclusion

Feeding with the integrated feed formulation gave significant effect on the body weight gain, chest girth, shoulder height and body length of the fattening Bail cattle in West Timor, Indonesia. In the economical aspects, the easiness in using the integrated feed e.g T1 composition gave higher contribution to the rate of growth (23.53%) and thus faster to reach market weight (2 years compared to 3-4 years on farmer conventional feed formulation).

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