

IMPLEMENTATION OF AN ADEQUATE FEED PRINCIPLE IN THE DIET FORMULATION FOR FATTENING BEEF CATTLE

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Diterima : 11 Pebruari 2010; Disetujui untuk publikasi : 20 Juni 2010

ABSTRAK

Implementasi Prinsip Kecukupan Zat Gizi Dalam Formulasi Pakan Penggemukan Sapi Pedaging. Suatu percobaan dilakukan untuk menguji implementasi prinsip kecukupan zat gizi dalam formulasi pakan penggemukan sapi pedaging menggunakan bahan lokal. Penelitian menggunakan 18 ekor sapi jantan Peranakan Ongole berbobot awal 294.997 + 4.833 kg, milik Kelompok Tani Mekar Sari di Desa Ngadirejo, Kecamatan Eromoko, Kabupaten Wonogiri. Ternak dipelihara dalam satu kandang bersekat individual dan dialokasikan secara acak ke dalam salah satu di antara perlakuan pakan kecukupan zat gizi formula 1 dan 2 (AFB₁ & AFB₂) atau pakan tradisional formula petani (Tradisional). Bahan pakan percobaan terdiri dari ubi singkong kering, dedak padi, ampas tahu, jerami padi, tetes tebu, dan rumput gajah. Pakan diransumkan 2 kali/hari, dan air tersedia ad libitum. Hasil penelitian menunjukkan perbedaan konsumsi yang bermakna ($P < 0,05$) di antara ketiga pakan percobaan (5908 g: 5595 g: 7324 g masing-masing untuk AFB₁: AFB₂: Tradisional). Ditemukan bahwa rata-rata pertambahan bobot hidup harian sapi jantan yang menerima AFB₁ (785 g/h) lebih tinggi ($P < 0,05$) daripada yang mengkonsumsi AFB₂: (629 g/h) maupun Tradisional (547 g/h). Secara konsisten konversi pakan AFB₁ (7.5) juga lebih baik ($P < 0,05$) dari pada AFB₂ (8,9) maupun Tradisional (13,4). Hasil penelitian mengkonfirmasi bahwa formulasi pakan untuk penggemukan sapi pedaging berpedoman pada prinsip pakan kecukupan zat gizi lebih efisien dari pada pakan tradisional. Kesimpulannya, bahan pakan lokal yang terdiri dari produk dan limbah pertanian berguna untuk pakan penggemukan sapi pedaging. Meskipun demikian, untuk formulasinya diperlukan implementasi prinsip pakan kecukupan zat gizi.

Kata kunci: Pakan, penggemukan sapi pedaging, formulasi pakan

ABSTRACT

An experiment was performed to examine the implementation of an adequate feed principle for formulating beef cattle fattening diet using the local feedstuffs. The experiment employed 18 Ongole Cross Bull of about 294.997 + 4.833 kg of average initial live weight which were provided by the Mekar Sari Farmers Group at Ngadirejo Village of Eromoko Sub-District in Wonogiri District. The experimental animals were penned individually and allotted to receive either one of Adequate Feed for Bull₁ (AFB₁), Adequate Feed for Bull₂ (AFB₂), or the Traditional feed. The experimental diets were consisted of local dry cassava tuber, rice bran, soybean curd by products, rice straw, molasses, and elephant grass. Diets were offered in 2 meals/d, and water was available ad libitum. Results showed that there were significant ($P < 0.05$) difference between daily feed consumption (5908 g: 5595 g: 7324 g for AFB₁: AFB₂: Traditional diets, respectively). The daily weight gain of bulls consuming the AFB₁ diet (785 g) was significantly ($P < 0.05$) higher than in the bulls fed AFB₂ diet (629 g) or the Traditional diet (547 g). Consistently, feed conversion ratio of AFB₁ diet (7.5) was better ($P < 0.05$) than AFB₂ or (8.9) or the Traditional diets (13.4). The experimental results confirmed that the formulated diet for fattening beef cattle based on the adequate feed principle is more efficient than the Traditional diet. In conclusion, the local feedstuffs consist of the agricultural product and by product were useful for performing beef cattle fattening. However, implementation of the adequate feed principle for diet formulation is necessary.

Key words: Feed, fattening beef cattle, diet formulation

INTRODUCTION

Obviously, beef cattle fattening agribusiness (BCFA) in the villages of Central Java is conducted under the feedlot fattening management system. To some extent, the operational standard of BCFA is that the cattle (bulls/steers) are raised in the animal house for certain period of time (for about four month period) and fed a high plane diet. However, recently Purnomoadi *et al.* (2007) consistent with Umiyasih *et al.* (2000) stated that generally the farmers offered a diet containing insufficient nutrient to their cattle. This phenomenon was speculated to be the responsible reason for the low growth rate of Ongole Crossbred Cattle in Indonesia (Purnomoadi *et al.*, 2007).

Commonly, in such BCFA the farmers use either the traditional or commercial feed for the animals. It is widely accepted that due to lack of nutrition knowledge, the farmers use to combine the unbalance proportion of feed components for feeding their animals. Whilst, the commercial feed is costly and its quality often unsatisfactory. Consequently, since feed is the major capital input of production, so far there has been no optimum benefit from BCFA obtained by farmers.

In order to minimize the amount of capital spending for diet cost in BCFA, there is an opportunity to exploit the local feedstuffs which in its turn will be useful for providing an inexpensive diet. Nevertheless, it is necessary to formulate diet properly to full fill the nutrients requirement of beef cattle. Consistently, McDonald *et al.* (1992) and NRC (1996) explained that the profile of dry matter, crude fibre, and the balance of digestible protein: metabolisable energy of the diet is the major factors in feeding bull. Thus, to conduct BCFA efficiently, it is necessary to take into account those factors to formulate diet properly.

The present experiment is directed toward evaluating the implementation of an adequate feed principle for diet formulation on the Ongole Cross Bull (OCB) fattening using the local agriculture by products as feed components. At the same time the experiment was also aimed to demonstrate the role of adequate feed principle for diet formulation on BCFA advantage to the users.

METHODOLOGY

The present experiment was performed under the collaboration research management between Central Java Assessment Institute for Agricultural Technology and Mekar Sari Farmers Group at Ngadirejo Village of Eromoko Sub-District in Wonogiri District.

Feed Components And Diets

The experiment used most of the feedstuffs that were provided from the agriculture and food industries by products available in Wonogiri District, except for molasses that was purchased from Sukoharjo District. The nutrients profile and character of feedstuffs is listed in Table 1.

The diets formulation were made through computation regarding the adequate feed principle based on the average daily nutrients requirement of bull as was recommended by McDonald *et al.* (1992) and NRC (1996).

The study used three experimental diets namely: Adequate Feed for Bull₁ (AFB₁), Adequate Feed for Bull₂ (AFB₂), and the Traditional feed (farmer version, control diet). Diets AFB₁ and AFB₂ were formulated to contain similar contents of dry matter, digestible protein and metabolisable energy (Table 2).

Minerals in form of CaCO₃ and sodium chlorite (NaCl) as well as molasses included in the AFB₁ and AFB₂ diets.

Animals and Management

Eighteen OCB of about 18 month old having 295 ± 4.8 kg initial live weight, provided by the Mekar Sari Farmers Group were employed in the present experiment. Each OCB was individually weighed, drenched with hexachlorethane to eliminate the possible effect of trematodes, and randomly penned in an animal house belongs to the Mekar Sari Farmers Group at Ngadirejo Village of Eromoko Sub-District in Wonogiri District.

Feeder was provided for each bull separately. The bulls were allotted to receive either one of AFB₁, AFB₂, or the Traditional

Table 1. Nutritive Value of The Experimental Diets Components

Item	Composition (g/kg feed basis)					M E (MJ/kg)
	Dry matter	Crude protein	Digestible protein	Crude fibre	Ash	
Dried cassava tuber ¹⁾	960	33	7	78	31	12.7
Rice bran ¹⁾	860	85	44	170	126	3.10
Rice straw ¹⁾	920	32	1	309	182	4.60
Tofu industry by product ³⁾	194	96	80	47	1.2	3.16
Napier grass ¹⁾	180	16	10	33	27	1.59
Molasses ²⁾	750	40	8	0	-	12

Adapted from: ¹⁾, Hartadi *et al.* (1997); ²⁾, McDonald *et al.* (1992); ³⁾, Mathius *et al.* (1991); ME, Metabolisable Energy; MJ, Mega Joules

Table 2. Nutrients Composition of The Experimental Diets (kg/daily ration/animal) for Ongole Cross Bull Fattening in The Present Study*

Items	Diets		
	AFB ₁	AFB ₂	Traditional
<i>Ingredients:</i>			
Dried cassava tuber	0.5	1	-
Rice bran	2	2.4	4.32
Dried rice straw	5	4	2
Tofu industry by product	4.5	4	1.27
Napier grass	-	-	29
Molasses	0.1	0.1	-
CaCO ₃	0.05	0.05	-
Sodium chlorite (NaCl)	0.24	0.24	-
Total:	12.34	11.79	36.59
<i>Nutritive value (Calculated analyses):</i>			
Dry matter	7.748	7.555	9.124
Rumen degradable protein	0.457	0.437	0.399
Metabolisable energy (MJ/daily ration/animal)	50.97	52.30	71.95

* Expected live weight gain 1.25 kg/d; estimated nutrients requirements (daily ration/animal): 6.5 kg Dry matter, 0.435 kg Rumen degradable protein, and 51 MJ Metabolisable Energy (Adapted from McDonald *et al.*, 1992); OCB, Ongole Crossed Bull.

diets. The experimental diets acclimation was conducted for 14 d period and then the bulls fed their diets for further 90 d. Diets were offered in 2 meals/d. The OCB receiving AFB₁ or AFB₂ were allowed to access to the rice straw after consumed the mixed diet completely. Similarly, the one receiving the Traditional diet were

allowed to consume Napier grass and rice straw after finished taking their rice bran and soybean curd by-product. Water was available *ad libitum* throughout the experimental period supplied using plastic bucket kept at the front part of each pen.

Measurements were made for feed intake, live weight gain, and feed conversion ratio. Feed intake was determined by subtracting the amount of feed delivered by feed refusal. For this purpose, a daily quantitative record was maintained for feed refusal. Live weight gain data of individual bull was obtained by calculating the difference between the final and initial weights of each. However, to monitor the growth rate of the OCB their weight gain was measured fortnightly by weighing the animal directly using the portable digital electric scale (Rudd Weight Ltd., Australia). Feed conversion ratio value (weight gain: dry matter intake) was calculated. Thus, the calculation expressed that the smaller the result of computation, the better value of feed conversion ratio was obtained.

Statistical Analysis

The experiment used completely randomized design 3 (diet treatments) x 6 (replications). The collected data (feed intake, weight gain, and feed conversion ratio) were analysed using analysis of variance (ANOVA) as described by Snedecor and Cochran (1967). Further more, the mean differences were examined using the least significant different analysis (Snedecor and Cochran, 1967).

Financial Analysis

In order to prove the benefit of an adequate feed principle implementation in the diet formulation for fattening beef cattle, to the users of such diet formulation innovation, a simple economic calculation was provided. For this purpose, a financial analysis was made for each experimental diet base on the price of feedstuffs which were employed to obtain of one kg live weight gain of the cattle in the present study.

RESULTS AND DISCUSSION

Results of the study suggested that in general implementation of an adequate feed Principle for diet formulation significantly ($P<0.05$) improved the growth performance of OCB.

Feed Intake

The present experiment documented that the average dry rice straw consumption of OCB cattle received AFB_1 or AFB_2 diets was only 3 kg/d. Such limited consumption consequently influenced the amount of dry matter intake. Thus, expectation for dry matter consumption of the experimental diet (6.5 kg/bull/d) could not be reached in either AFB_1 or AFB_2 diets. Results of the present study indicated that the palatability of rice straw on OCB was not unlimited. Yet, there has been no data available to confirm our experimental results. Some feed trials using rice straw for OCB diet were conducted recently (Hartati *et al.*, 2005; Wiyono *et al.*, 2005; Winugroho *et al.*, 2007), but none of the rice straw intake data was reported. Hartati *et al.* (2005) served rice straw in the diet for OCB in their experiment of about 1.25% of the bull live weight, which were 3.6-4.0 kg /bull/d; however, no rice straw data consumption was declared.

Furthermore, effect of treatments on feed consumption, weight gain, and feed conversion ratio of OCB is presented in Table 3.

Table 3 shows that the average dry matter intake of OCB fed AFB_1 diet is 5.6% larger ($P<0.05$) than that of the bulls fed AFB_2 , but 24% lower ($P<0.05$) compared to that of bulls received the Traditional diet. Apparently, the different between dry matter intake of bulls receiving AFB_1 and AFB_2 diets was a resultant of uncompleted rice straw consumption that impacted on the total daily dry matter intake of both diets.

Regarding the served amount of the Traditional diet (Table 2 and 3, respectively), it was noted that the bull refused 1800 g dry matter/d. It may that the gut of bull already full or because of the form of prepared Napier grass (about 1.5 m length) was not possible to swallow. In fact the bulls fed intact grass of the Traditional diet refused 9 kg grass stem/bull/d. Mc Donald *et al.* (1992) stated that cattle prefer to consume grass leaf rather than the grass stem.

Consistently, the distinction pattern ($P<0.05$) of the rumen degradable protein intake between the bull consuming AFB_1 and AFB_2 diets followed their dry matter intakes. In contrast, the

Table 3. Effect of The Experimental Diets on Growth Performance of Ongole Cross bulls at Ngadirejo Village of Eromoko Sub-District of Wonogiri District

Average	Diet treatments		
	AFB ₁	AFB ₂	Traditional
Dry matter intake (g/d)	5908 ± 82.8 a	5595 ± 15.2 b	7324 ± 102.1 c
RDP intake (g/d)	455.3 ± 0.7 a	435.4 ± 4.3 b	297.6 ± 3.9 c
ME intake (MJ/d)	41.77 ± 0.1 a	43.18 ± 0.6 a	46.85 ± 0.6 b
Weight gain (g/d)	785 ± 16.0 a	629 ± 10.7 b	547 ± 9.3 c
Feed conversion ratio	7.5 ± 1.2 a	8.9 ± 1.9 b	13.4 ± 2.4 c

AFB, Adequate feed for bull; RDP, Rumen degradable protein, ME; Metabolisable Energy; MJ, Mega Joules; Superscript a, b, and c at the same row differed significantly (P<0.05)

amount of RDP intake of the Traditional diet was much smaller (P<0.05) compared to RDP intake of the AFB₁ as well as to AFB₂ diets. In these circumstances, despite the RDP value of the Traditional diet components was low, refusal of some dry matter also rendered RDP intake.

On the other hand, the amount of ME intake of the Traditional diets was larger (P<0.05) than that of the other two experimental diets. It is understood since the EM profile of such diet and its dry matter intake was larger than that of the AFB₁ or AFB₂ diets. Interestingly, there was no significant different effect determined between ME intake of the AFB₁ and AFB₂ diets.

Growth Rate

Table 3 exhibits a remarkable discrepancy of live weight gain among the experimental animals. It is documented that growth rate of the bull consuming the AFB₁ diet was superior compare to the growth performances of the rest OCB. It was found that the bull fed AFB₁ diet grew faster (P<0.05) than the bull fed the Traditional diet, and event compared to the one fed AFB₂ diet. The results indicated that the difference between the growth rate of bull fed AFB₁ and AFB₂ diets were an impact reflection of the RDP intake. In the current experiment, it was documented that the higher the RDP intake, the larger the weight gain was obtained by OCB. Nevertheless, the pattern of fortnightly average weight gain of the experimental animals is presented in Figure 1.

Weight Gain (G/fortnight)

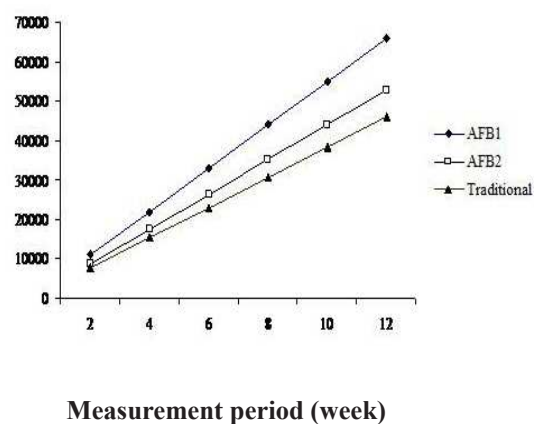


Figure 1. Average weight gain pattern (weighed every two weeks) of OCB fed the experimental diets at Ngadirejo Village of Eromoko Sub-District of Wonogiri District, Central Java.

Figure 1 show that, since there was no illness symptom observed on the experimental animals during the evaluation period, the average weight gain pattern of the OCB used in the present experiment was apparently steady. It was documented that until the end of the measurement period the weight gain performance of OCB did not follow the sigmoid pattern of growth. The explanations of this finding are: (1) it was

possible that the experimental animals were already in the steady stage of growth, and (2) the duration of experimental period in the present experiment may not be appropriate to exhibit the changes of growth rate pattern.

In addition, the present study provided further compelling evidence to the feed trial results of Shain *et al.* (1987) that the level of degradable intake protein affected the live weight gain of finishing cattle.

However, our experimental result is not in agreement with the results of the previous OCB feed trials (Rianto *et al.*, 2007; Winugroho *et al.* 2007). Rianto *et al.* (2007) demonstrated that the daily weight gain of OCB fed diet containing Napier grass, tofu by-product, and cassava tuber was more satisfactory compared to the finding of Nuschati *et al.* (2004) (1.09 kg versus 0.7-0.77 kg/d). The fact finding led Rianto *et al.* (2007) to the conclusion that the difference was due partly to the initial weight of OCB employed in the feed trials, which were 195.9 kg (Rianto *et al.* 2007) versus 300 kg (Nuschati *et al.*, 2000). Similarly, Winugroho *et al.* (2007) employed OCB of about 248.6 kg initial live weight for feed trial found that the average weight gain of the bulls was varied from 0.821-1.03 kg/d.

Moreover, in the previous investigation, Anggraeny *et al.* (2005) performed a feed trial by employing 18 OCB of about 292 kg initial live weight documented that the average daily weight gain of the bulls fed diets containing corn stalk of various variety supplemented with the commercial concentrate feed was 0.53 to 0.63 kg. Anggraeny *et al.* (2005) claimed that concentrate feed inclusion in the diet improve the growth rate of bulls significantly; however, such daily live weight gain was much lower than that achieved in the study of Winugroho *et al.* (2007). It seems that Anggraeny *et al.* (2005) paid no attention to the implementation of adequate diet formulation principle in their experiment.

Recently, Umiyasih *et al.* (2007) reported that the average daily weight gain of OCB having initial live weight of 286 ± 39.67 kg fed diet containing graded levels of fermented corn cob to substitute concentrate feed was only 0.30 to 0.57 kg. In deed, the result was even worse than the daily weight gain of bulls obtained in the

experiment conducted previously (Anggraeny *et al.*, 2005). Although, the diet was formulated according to the proportion of concentrate replacement by corn cob only, but again, no attention was paid for the balance of nutrient requirement of the bull.

Feed Conversion Ratio

The present experiment confirmed that implementation of adequate feed principle in the diet formulation improved feed conversion ratio. Table 3 displays a consistent pattern of feed conversion ratio distinctions with the growth performance differences. Thus, it is understood that the bulls fed AFB₁ diet exhibited more efficiently ($P < 0.05$) nutrients utilization than the bulls consumed either the Traditional or AFB₂ diets. The data can also be interpreted that to reach 1 kg daily weight gain, the bulls fed AFB₁ required 7.5 kg dry matter diet/d, while the bulls received AFB₂ and the Traditional diets needed 8.9 kg and 13.4 kg dry matter/d, respectively.

Consistently, feed conversion ratio of diets in the current experiment is in contrast to the results of the OCB feed trial conducted by Umiyasih *et al.* (2007) previously. Umiyasih *et al.* (2007) found the feed conversion ratio of the experimental diets based on agricultural by product combined with the graded level of the commercial concentrate feed for the OCB were 14.47 – 24.28. In the earlier study, Hartati *et al.* (2005) employed 21 OCB of about 288.6 to 321.88 kg initial live weight which were grown using diets containing rice straw, corn bran, and commercial concentrate feed, documented that the feed conversion ratio was 11.0 – 13.9. It means that to obtain 1 kg daily weight gain, the bulls required 11.0 kg – 13.9 kg dry matter diet/d. Hartati *et al.* (2005) reported that the daily weight gain of the experimental bulls was 0.82-0.85 kg; however, the feed intake was quite high.

In addition, although in the present experiment, both the experimental diet of AFB₁ and AFB₂ were formulated to contain an adequate dry matter, digestible protein, and ME to fulfil the bull requirement, apparently the AFB₁ diet was better than AFB₂. It was possible that the nutrient proportion of the AFB₁ diet was more satisfactory compared to that in the AFB₂ diet.

Furthermore, Table 3 shows that feed conversion ratio of AFB₂ diets is much better ($P < 0.05$) than in the Traditional diet. In these circumstances, among the experimental diets, the nutrients character of the Traditional diet was inferior. In fact the bulls fed the Traditional diet consuming inadequate RDP; consequently, they failed to efficiently utilize the nutrients of such diet. Leng (1991) declared that commonly the forages consumed by ruminants in the tropical countries are almost always of low digestibility (40-45%). Consequently, without supplements, feeding the low digestibility forages lead to inefficient utilization of available nutrients of feed.

The experimental results confirmed that the formulated diet for fattening beef cattle based on the adequate feed principle is consistently more efficient than the Traditional diet.

Economic calculation

Data of the economic calculation based on the price of feedstuffs used in the present experiment showed that there were spectacular differences among the values of diets. At the time being, it was documented that to obtain one kg live weight gain of OCB fed the AFB₁, AFB₂ and Traditional diets the farmers required to spend Rp.4,988.60,-, Rp.6,668.50,- and, Rp.17,376.60,-, respectively. It was proven that the AFB₁ and AFB₂ diets were much cheaper than the Traditional diet. The present experiment suggested that implementation of the adequate feed principle in the diet formulation for fattening beef cattle is more economical than the use of traditional formulation.

CONCLUSION

In conclusion, the local feedstuffs, the agricultural by product, are useful for performing beef cattle fattening in the village in Central Java. However, implementation of the adequate feed principle for diet formulation is necessary.

ACKNOWLEDGMENTS

The present study would not be possible to undertake without keen collaboration of Mr. Maryo and the member of Mekarsari Farmers Group. To them we express our sincere thanks. We wish to thank Mr. Gunawan Sejati for his technical assistance.

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