LOW PROTEIN FEED FOR BEEF CATTLE

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ABSTRACT

Feed is the largest portion which is 70% of the total cost in animal industry. A study was done to evaluate and make a standard of low protein feed in attempt to reduce the portion of feed cost. Based on some research results and application of low protein feed on breeding, fattening and growing beef cattle, standard of feeding low protein diet has been created. This feeding standard is made to meet the basal requirement of beef cattle of certain physiological state. This standard will be further tested and ajusted through further research and assessment, in attempt to provide solution for feeding problems of beef cattle industry that leads to optimation of using feed ingredient that contains protein. Feeding standard for beef cow is targeted to reduce mortality rate and improve ADG of pre weaning calves and shortened calving interval. During dry period or pregnant, beef cow should consume dry matter (DM) ≥ 3% of body weight (BW), feed should contain: crude protein (CP) ≥ 8%. Total digestibility nutrient (TDN) ≥ 58%. Crude fat (CFt) ≤ 6%, crude fibre (CFb) ≤ 23% and ash (A) ≤ 10%. While lactating cow should consume DM ≥ 3% BW, feed should contain: CP ≥ 10%, TDN ≥ 59%, CFt ≤ 6%, CFb ≤ 19% and ash ≤ 10%. Feeding standard for growing cattle is aimed at reducing age at first calving. Beef cattle in this stage should consume DM ≥ 4% of BW, feed should contain: CP ≥ 8%, CFt ≤ 6%, TDN ≥ 58%, CFb ≤ 19% and ash (A) ≤ 10%. While for fattening is aimed to improve ADG and carcass percentage. Cattle raised for fattening purpose should consume DM ≥ 3.5% BW and feed should contain CP PK ≥ 8%, TDN ≥ 58%, CFt ≤ 6%, CFb ≤ 17% and ash (A) ≤ 10%. It is concluded that, understanding balance nutrient (CF, TDN, CFt, CFb and A) is very important.

Key words: Beef Cattle, Technology, Feed, Protein

INTRODUCTION

Feed is the largest portion which is 70 – 80% of the total cost in animal industry. Experience has shown that animal industry operation on local resources basis which use feed ingredient from local specific area surely survive from the crisis over the years. Contrarily, livestock operation which only rely on technology supplies or import resources, develops into bussiness which is not rooted (Soetirto, 1998).

Constraint factor in formulating a good quality ruminant feeding is price and protein feed resource availability. Feed prices are affected by high protein level and quality. Higher protein level and quality makes higher feed prices. The low price feed availability is very important; however the reality on farms showed that to produce feed is not compulsory cheap which affordable for farmers, but it has to fulfill the quality requirement (Diwyanto *et al.*, 2003). In general, feed quality in tropical countries has low quality which is characterized by low energy content (TDN), CP levels, and essential minerals (Santra and Karim, 2003). Besides, the majority of feed are crop residues or agricultural industries. Grain feed or animal protein is not widely used because it competes with non-ruminant and human necessities.

Feed ingredients, which are used for feed formulation, are chosen according to the nutrient levels, price, availability and palatability in order to optimize the intake. Better feed intake levels in cattle may affect directly to growth; therefore, in the short time, the meat grows optimally, as a result, slaughter weight increased (Ngadiyono *et al.*, 2008).

In the heat stress condition, animals are very difficult to release metabolism heat production, so animals respond to heat adjustment by reducing feed intake which will diminish their heat production. Amino static Mellink of theory proves that feed intake which contains high protein tend to cause quickly satiety because of the high levels of plasma's amino acid. If plasma's amino acid is high, it will decrease appetite (Sutardi, 1980). Giving high level of protein without enough energy balance may diminish feed digestibility. Additionally,

it causes ruminal alkalosis because of the increase of ammonia concentration in rumen (Oldham and Smith, 1982).

Feed formulation for ruminant can vary widely, without affecting negatively to their productive performances. The most important consideration is nutrient balance and feeding strategy. Low protein feed is identically low price and it is expected to reduce the price significantly, therefore the product can have high competitiveness. Feed formulation technology supports, which are rational, qualified and affordable, are needed (Mariyono and Romjali, 2007). Feeding in cows is considered to reduce mortality and increase ADG of pre-weaning calves and shorten calving intervals. In growing calves, feed is reflected on shortening the first calving and in the fattening, feed is addressed to increase ADG and carcass percentage.

According to some research results on the use of low protein feed and their application for breeding, growing and fattening for beef cattle; therefore, since 2005, the author has initiated to make feeding standard for fulfilling the lowest nutrient requirement in some physiology status of beef cattle. These standards will be continuously tested and enhanced in relation to further research results and assessment. Carrying on low protein feed research and creating feed requirement standard are expected to overcome to the problem of beef cattle feed, especially for optimizing the use of low protein feed.

RESEARCH RESULTS ON LOW PROTEIN FEED

Protein digestibility and absorption on ruminant

Amino acid supplies into ruminant's small intestines are from protein microbes in rumen, un-degraded feed protein (by-pass protein) and endogenous protein (Egan, 1985). This gives definition that ruminant feed has to evoke microbe growth and supply amino acid requirement for animals, while this feed can be easily absorbed. Amino acid supplies from microbes can reach 40 – 80 percent from total amino acid contribution.

Protein compound or nitrogen is not protein which goes into rumen, will be hydrolyzed by proteolysis enzymes into oligopeptides and amino acids. Those oligopeptides and amino acids are intermediate products which will be catabolized (deaminazed) into VFA, CO_2, CH_4 and NH_3 (Leng *et al.*, 1977).

Protein degradation by rumen microbes are without restriction. The breakthrough will continuously occur, even though ammonia results are already fulfilled, in order to complete microbe growth requirements. Microbe protein biosynthesis reaches a peak at NH_3 levels in rumen fluid, at 5 mg/100 ml (mg %) or 3.57 mM (Satter and Slyter, 1974). Surplus NH_3 production exceeds these values, even though it has been increased into 98.3 mg%, it does not increase microbe growth.

Energy and protein requirement for ruminants

Research results on feed protein requirement for ruminants varry widely because they are based on CP levels. NRC (2000) reveals that feed requirement calculations are based on energy and protein metabolism. One of the weakest literatures on local feed is CP levels which is in general based on proximate analysis results.

Research into energy levels feeding for post weaning calves shows that feeding 50 – 80% of TDN levels (Iso-protein: 17.18%), are not affect on ADG and feed efficiency (Wardhani *et al.*, 1993). Crude protein efficiency decreases while high CP levels in starters are given, but feeding on starters with 8 – 20% of CP does not increase economic values yet until they reach 14 weeks of ages (Mariyono, 2004). Animals' responds on protein intake are better if there are enough energy intakes (Stock *et al.*, 1981; Satter, 1986).

Initiating of low protein feeding standard on some physiological status

As an effort of increasing quality assurance of cattle's feed concentrate which is traded, the Indonesian government sets the quality requirement of beef cattle's concentrate feed. It has been shown on Indonesian National

Standard (SNI), the quality of concentrate feed in Table 1.

Based on some research results and their application in breeding, growing and fattening cattle which are conducted at Beef Cattle Research Station and some experiments agribusiness using low protein feed, since 2005, writer has attempted to make a minimum standard for beef cattle feed which fulfills the lowest nutrient requirement in some physiological status (Mariyono *et al.*, 2005; Mariyono, 2006[a]; Mariyono *et al.*, 2006[b]; Romjali *et al.*, 2006; Mariyono and Romjali, 2007; Mariyono, 2008; Mariyono *et al.*, 2009).

Low protein feed for growing (8 – 12 months of age)

Weaning is a transition period from soft feed (milk) to crude (CF resources). At that period, the rumen function changes from pre-ruminant into true ruminant which is characterized by the increase of volume and papilla rumen growth.

It is better to wean the calves if they reach 7 months of ages (205 days), which is expected that they can consume and utilize crude fibre feed. Minimum feeding standard has been done to increase feed efficiency with the target of ADG > 0.6 kg/head/day, are DM intake > 3% BW, CP > 10%, EE < 6%, CF < 15%, EE < 10%, and TDN > 60%.

Research results on post-weaning calves (7 months) up to 12 months of ages which have been given 2 kg elephant grass, rice straw and corn bran ("tumpi") *ad libitum*; and ± 7% of CP, achieved 0.13 kg of ADG. Low ADG result of these calves reveals that additional feed such as corn bran as single feed is not appropriate to increase post-weaning calf growth up to 12 months of ages (Wijono *et al.*, 2004). Adding corn husk did not increase protein levels in the feeding yet to comply the lowest CP requirement standard (8%); therefore, protein resources in this feeding system are needed.

Low protein feed for growing (> 12 to 18 months of age)

Feeding strategies in this period is expected to achieve the first age of mating at < 18 months and the first birth at ≤ 27 month. The result of low protein feed experiments according to the recommendation (DM intake ≥ 4% BW; CP ≥ 8%; EE ≤ 6%; CF ≤ 20%; Ash ≤ 10% and TDN ≥ 58%) into Ongole cross breed (PO) bulls and heifers which were conducted at Beef Cattle Research Station, obtained 0.81 and 0.61 kg of ADG respectively (Umiyasih *et al.*, 2009; Umiyasih *et al.*, 2010).

Low protein feed for heifers and young bulls (18 months), dry cows and pregnant cows ≤ 8 month

Feeding strategies of breeding at Beef Cattle Research Station refers to feed intake with low cost concepts. The minimal feeding standard for these physiological status are DM intake > 2.75% BW; CP > 8%; EE < 6%; CF < 23%; Ash < 10% and TDN > 58%.

Reproduction performances in heifers which is developed into low external input feed condition, is shown in Table 2.

The experiment on concentrate feed substitution for 25 pregnant PO cows (2 – 3 months) in the age of ± 2 with the initial body weigh of 220 -- 260 kg, using fermented the feed improvement before calving corn husk was conducted at Beef Cattle Research Station.

Table 1. Concentrate quality requirements of beef cattle (based on dry matter)

Feed ingredients	Water content max. (%)	Ash max. (%)	CP min. (%)	Extract ether max. (%)	Ca (%)	P (%)	NDF max. (%)	UDP min. (%)	TDN min. (%)
Fattening	14	12	13	7	0.8 – 1.0	0.6 – 0.8	35	5.2	70
Cows	14	12	14	6	0.8 – 1.0	0.6 – 0.8	35	5.6	65
Bulls	14	12	12	6	0.5 – 0.7	0.3 – 0.5	30	4.2	65

Source: Badan Standarisasi Nasional, 2009

Table 2. Cow reproduction in the low external input condition

Analyses	The number of cows (head)	Explanation
The first pregnancy	75	The first occurrence of pregnancies is 93.33% (70 heads from 75 heads of prospective cows).
Calving intervals	20	Calving interval mean in the first and second birth is 427 days (14.02 months); which the shortest and the longest are 306 and 556, respectively.

Source: Wijono *et al.* (2005)

Basal feed which was given, consisted of 2 kg of dried rice straw and 3 kg fresh elephant grass which eqivalent with 2.5% body weight. Treatments on the experiment of concentrate feed for cow are: (P1*) ad libitum* commercial concentrate feed, (P2) *ad libitum* corn husk, (P3) commercial concentrate feed 1.5 kg + *ad libitum* corn bran. The results of this experiment showed that fermented corn husk substitution could decrease the feed cost on pregnant cow. Feeding corn bran and commercial feed concentrate is needed to ADG increase 0.5 to 0.6 kg (Mariyono *et al.*, 2004).

Low protein feed for the first two months of lactation and 2 last month pregnancy (>8 months)

(steaming up) and before mating (flushing) have been done continuously during 8 months of pregnant cows up to 2 months of calves' ages, are expected to reach the ADG of pre-weaning calves of PO at > 0.4 kg; Bali > 0.3 kg and Brahman cross > 0.5 kg. Minimal standard feeding for the first two months of lactation and > 8 months of pregnant cows, are DM intake > 3% BW; CP > 10 %; EE < 6%; CF < 18 %; EE < 10% and TDN > 58%.

It has been recommended that calves should be weaned at the age of 7 months, because milk is the best feed for calves. Milk can be produced by cows until 7 months of pregnancies without influencing negatively to the next pregnancies. Feeding standards recommended are DM intake ≥ 3% BW; CP ≥ 10%; TDN ≥ 59%; EE ≤ 6%; CF ≤ 19 % and Ash ≤ 10%.

Research results for lactation cows at Beef Cattle Research Station using 3 kg fresh elephant grass, ± 2 % BW of dried rice straw and *ad libitum* corn husk (7 – 9 kg), CP ± 7%, the data were shown at Table 3. In the lactation period, cows' body weight decreases gradually and in the seventh month, it increases. The highest decline of body weight is in the second month. At that period, milk is produced by cows in the highest level which followed by

Table 3. Body weight of Ongole cross breed cows during lactation period

Days of lactation (days)	N (head)	Body weight (kg)	ADG (kg)
Birth	42	279.90 ± 28.58	-
30	38	278.50 ± 28.42	-0.18 ± 0.47
60	38	269.96 ± 30.61	-0.23 ± 0.37
90	36	268.84 ± 30.23	-0.01 ± 0.67
120	34	266.80 ± 37.13	-0.05 ± 0.48
150	30	263.29 ± 36.93	-0.09 ± 0.45
180	30	262.09 ± 40.67	-0.02 ± 0.43
210	29	264.50 ± 45.96	0.10 ± 0.39
Average daily gain during lactation			-0.10

Source: Wijono *et al.*, 2004.

the rise of ADG of calves. The decrease of cows' body weight until 60 days of post-calving is relatively low, at 10 kg influencing positively into cows' reproduction activities.

Low protein feed for fattening

Feeding standard for fattening is expected to produce ADG of PO ≥ 0.7; Bali/Madura ≥ 0.6 kg and BX/Brahman cross ≥ 0.9 kg. The minimal feeding standard for fattening is recommended at DM intake ≥ 3.5 % BW, CP ≥ 8%; EE ≤ 6%; CF ≤ 17%; Ash ≤ 10% and TDN ≥ 58%. Research carried out on fattening for 85 days. Twenty one male cattle were used, it devided into 13 heads of PO and 8 heads of (PO × Simmental or PO × Limousine) at the age of 2 – 3 years, the initial body weight were 288.60 ± 42.30 kg dan 321.88 ± 54.60 kg respectivelly. Feed which was used in this experiment referred into as low cost input, using agricultural industries by product such as corn husk and rice straw. Concentrate feed supplementation was used to increase feed quality. It used commercial concentrate which was produced by "*Yellow Feed*" Kejayan-Pasuruan. Corn husk and concentrate feed were given at 3% of BW and the proportion was 3 : 1, CP level ± 8.5%. Elephant grass was given at 3 kg and rice straw at 1.25% BW. Using this concept, it was obtained economical feed for male fattening and gained > 0.8 kg of ADG (Hartati *et al.*, 2005). The ADG of cross breed was (0.82 kg) and PO was (0.85 kg). At low external input, PO cattle had as many feed efficiency as cross breed cattle. Dry matter intake of PO was 9.36 kg/head/day or equivalent with 3,24% BW, while 321.90 of initial BW was 11.36 kg or equivalent with 3.53 BW. This was in line with study result of Aryogi (2005) that DM intake of PO was lower than cross breed (Simmental × PO). Dry matter intake in this experiment fulfilled the requirement standar which was recommended by Ranjhan (1981), at 8.10 kg/head/day and the target was 0.90 kg of ADG in the same average weight.

Soeharsono *et al.* (2010), conducted low protein feed experiment for fattening of cattle resulted from artificial insemination (AI) and imported *Brahman Cross* (BX). Feed was given at 2.76% BW on DM basis of concentrate feed (CP 8.57% and TDN 65.52%) and king grass (CP 10.62% and TDN 62.48%). Average daily gain of all cattle was 1.62 kg/head/day which is higher than BX, at 1.42 kg/head/day. Another research result using DM 67.65%; Organic Matter (OM) 90.63%; Ash 9.37%; CF 16.12%; CP 8.01%; EE 3.09%; BETN 63.41% and TDN 65.09%. The proportion of concentrate and rice straw was 80 : 20% DM. Feed was given at 2.76% BW (on DM basis) twice a day and *ad libitum* drinking water. The highest ADG in fattening with < 450 kg of initial body weight was 1.63 kg, while the lowest ADG was 1.28 kg (Soeharsono *et al.*, 2011).

CONCLUSION

Protein feed requirement for beef cattle varies widely, without giving influence on cattle productivities. The most important consideration is balanced feed nutrient. It is necessary to deeply understand of the balanced feed nutrient such as CP, TDN, EE, CF and ash which, is needed in feeding low protein feed.

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