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Feed Intake and Feed Conversion Ratio of Ongole Crossbred Cattle Fattened at Different Ages and Feed

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Abstract.
This research aimed to determine the effect of the dietary treatments and age on the fattening process in cattle. Thirty-six Ongole crossbred cattles were allotted into two different dietary treatments and three different age groups, with six replications for 24 weeks period, 4 weeks of preliminary followed by 20 weeks of data collection at the Beef Cattle Research Station (BCRS). The experimental design was completely randomized with a 2 x 3 factorial. The cattle were placed in individual pens and had *ad-libitum* access to water and feed, the feeds were elephant grass and concentrate (25:75). The parameters observed were liveweight, DM intake, feed conversion ratio, feed efficiency, IOFC, and BCR. Liveweight was measured every fortnight and feed intakes were measured daily. The results showed that a 10% substitution of DGGS with cassava did not affect all parameters observed. Age did not affect the total gain. Total DM intake increased with age, although percentage of DM intake on liveweight and efficiency decreased with the increasing age. All parameters observed for 18 months old group were better than those in 30- and 42-months old groups. It was concluded that the fattening process at 18 months old PO cattle was the most profitable.

Keywords: Ongole crossbred, cattle, intake, FCR, age

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1. Introduction

The innovation of technology in the fattening system aims to accelerate the increase of liveweight (LW) of fattened cattle. The high of liveweight gain (LWG) is expected to expedite the length of fattening time, therefore; the cattle can be sold soon and more profitable. In the past, the slaughter age of cattle in developed countries was about 2 to 3 years old, whereas nowadays, the slaughter age is less than 1.5 years old. Male cattle over 1.5 years old will reach mature weight therefore it resulted in less tender meat [1].

The low productivity of livestock and the complexity of the problems in beef cattle fattening business become challenges and opportunities in the development of beef cattle fattening businesses. The variation of the end product of fattening cattle is highly

correlated with feed intake characteristics than other characteristics. The feed has an important role in the improvement of production, both for growth and the other production process [1]. The dry matter intake (DMI) does not only provide the information about the feed uptake but also can be used as an indicator of the suitability of feed formulation to the livestock characteristics and the purpose of the business, and the planning of feed purchase in a

Factors affecting feed intake is very complex and is not fully understood. Feed that has low digestibility, low energy content, and high crude fiber, the feed intake is affected by the rate of passage of the feed in the digestive tract (digestive tract emptying speed). Whereas feed that can be easily digested, has a high energy content, and low crude fiber, the feed intake is affected by energy requirement and metabolic factor [2]. In general, factors affecting feed intake are the body condition score (BCS), sex, age, physiological status, and frame size. Other factors such as the quality and the roughage composition, the amount, and type of supplement, management, and environment also influence the feed intake. The dry matter intake varies between 1 to 4%.

The feed cost in the fattening business is about 70% of the production cost [3] so that intake and the ability of cattle to convert the feed to the LWG is critical to assess the feasibility of the beef cattle business. The income over feed costs (IOFC) value is the difference between income and feed cost [4]. Income over feed costs is a concept of business analysis that can be used as the first indicator of the fattening business in beef cattle in a short period [5].

In the beef cattle fattening business, feed efficiency is commonly measured from the feed conversion ratio, which is the ratio between the dry matter intake of feed (kg) and the LWG (kg/day). FCR is useful for evaluating the effects of feed quality, environment, and management [6].

The aim of this research was to determine the effect of age of male Ongole Cross-breed (PO) cattle at the age of 18; 30; and 42 months on growth profiles, BCS, feed intake, feed conversion and feed efficiency, the value of Income Over Feed Costs (IOFC) and Benefit-Cost Ratio (BCR).

2. Materials and Methods

This research was conducted at the Indonesian Beef Cattle Research Station, Pasuruan Regency, East Java, for 24 weeks, then 4 weeks of a preliminary period that was followed by 20 weeks of data collection. Thirty-six male PO cattle at the age of 18; 30 dan 42 months old, LW 170 kg; 250 kg and 370 kg were housed in individual pens that were

facilitated with feed and water troughs. Every age group consisted of twelve heads, that were divided into two different dietary (concentrate) treatments that had different energy sources, namely *Dried Distillers Grains with Soluble* (concentrate A) or cassava (concentrate B). DDGS and cassava were sources of energy that contained equal total digestible nutrient (TDN) (Table 1). The source of crude fiber (CF) was fresh elephant grass (EG) *(Pennisetum purpureum)*. The DM ratio between concentrate diet and EG was 75:25. The dietary treatments were (1) T1 = EG + concentrate A; (2) T2 = EG + concentrate B.

Table 1: The feed composition of the concentrate diets and nutritional contents.

Feed Ingredients	Composition of the concentrate diet (% DM)		Elephant grass
	Concentrate A	Concentrate B	
Wheat Pollard	23.00	23.00	-
Copra meal	11.00	11.00	-
Cassava	0.00	10.00	-
DDGS	10.00	0.00	-
CGF	24.00	24.00	-
Commercial concentrate	34.00	34.00	-
Limestone	1.00	1.00	-
Salt	1.00	1.00	-
DM content (%)	92.16	91.42	22.10
TDN (%)	75.65	73.40	52.80
CF (%)	18.44	15.45	8.40
Price (Rp/kg as fed)	3,759.00	3,519.00	275.00

Abbreviations: Concentrate A contained 10% DDGS. Concentrate B contained 10% cassava. DM= Dry Matter. DDGS = Dried Distillers Grains with Soluble. CGF = Corn Glutten Fiber. TDN = Total Digestible Nutrien. TDN = Total Digestible Nutien. CF = Crude Fiber.

All cattle were fed *ad-libitum* around 2.75 – 4.00% LW on a DM basis, with the feed refusal, was around a minimum of 10% of feed offered. Feed was offered twice a day at 07.30 AM and 1.30 PM, the ration of feed offered for morning and afternoon feeding was 2:1. The feed ingredients and the nutrient content were presented in Table 1.

At the beginning of the study, the LW and BCS of cattle were randomized and were almost uniform to minimize the LW effect on the treatment. The parameters observed were LW at the beginning and the end of the study, initial and final BCS, DMI, FCR and feed efficiency, IOFC values, and BCR. Cattle were weighed every fortnight, before feeding in the morning. The BCS measurements were conducted using a 1-9 scale [7]. Feed intakes were measured every day for 20 weeks by weighing the feed refusals and

subtracting the weight of the feed offered from the previous day. The feed refusal from each pen was collected and then analyzed for its nutrient content. The feed conversion ratio is calculated based on the DM intake per LWG of individual cattle. Feed efficiency was calculated from the LWG per DM intake. The economic value was analyzed using income over feed cost calculation as formulated by Following Bailey et al. [5]. The BCR was calculated based on the ration of total income from the increase of LW and the total feed cost during the fattening period [8].

The experimental design used in the current study was completely randomized, a 2 x 3 factorial. The first factor was the type of concentrate (concentrate A contained 10% DDGS and concentrate B contained 10% cassava). The second factor was the age of 18 cattle; 30 and 42 months with six replications. The data of each parameter were analyzed using a variance. If there are differences between treatments, then Duncan's multiple range test at the 5% level was applied. [9].

3. Results and Discussion

Fattening is the activity of feeding lean adult cattle to increase the LW in a relatively short time (3 to 6 months). Cattle that will be fattened should be in mature weight although have lean LW, but healthy so that result in high LWG. Age affects slaughter weight, carcass weight, and carcass percentage [10]. The feed formulation and the right age and weight of cattle are expected to optimize the LWG, reduce the FCR, increase feed efficiency so that it is economically profitable.

3.1. Liveweight and the Body Condition Score at the start and the end of the experiment

The mean of initial LW in treatment using DDGS (T1) as the energy source was 312.69 kg and using cassava as the energy source (T2) was 311.78 kg (Table 2). Initial LW in each age group increases with the increasing age of the cattle. The total increase of LW in T1 and T2 was not different ($P > 0.05$). The age of the cattle at the start of fattening did not affect the increase in total LW ($P > 0.05$). Total LWG in cattle aged 18; 30; and 42 months groups were 145.20 kg; 132.75 kg and 136.75 kg respectively. There was no interaction between dietary treatments and the age of the cattle on the increase of total LW during the study ($P > 0.05$). Young cattle can be offered feed such as heifers and adult cattle, from weaning to 341 kg of LW, with the minimum CP was 12%, then 10% of CP was required before slaughter [1].

The increase in BCS in T1 and T2 was the same, around 3.61 from the initial BCS of 4.31. The BCS increase for cattle aged 18 and 30 months was 3.81 and was higher than those at the age of 42 years (P <0.01). The BCS increase in 18 and 30 months age groups was probably due to the smaller body surface area than 42 months cohorts, thus the same increase in LW will affect the BCS increase. There was no interaction between dietary treatment and the age of the cattle on the BCS increase (P> 0.05). The BCS in the current study was 7.85 to 7.94 so it is sufficient to support a high carcass production. Cattle that had those BCS had a smooth and boxy appearance, the bones are not visible, the subcutaneous fat is thick and supple and the chest looks full and dense [7].

Table 2: Liveweight and body condition scores of male PO cattle fed different dietary treatments and had different ages.

	Diet (D)				Age (months) (A)					D*A
	T1	T2	SEM	*P*	18	30	42	SEM	P	*P*
Initial LW (kg)	312.69	311.78	-	-	207.63	326.42	402.67	-	-	-
Final LW (kg)	447.06	453.89	-	-	352.83	459.17	539.42	-	-	-
Initial BCS	4.31	4.31	-	-	4.13	4.04	4.75	-	-	-
Final BCS	7.92	7.92	-	-	7.94	7.85	7.96	-	-	-
Daily LWG	134.37	142.11	5.27	0.49	145.20	132.75	136.75	5.27	0.64	0.71
BCS gain	3.61	3.61	0.12	1.00	3.81^{y}	3.81^{y}	3.21^{x}	0.15	0.01	0.25

Abbreviations: T1 = feed offered was elephant grass + concentrate A containing 10% DDGS. T2= the feed offered was elephant grass + concentrate B containing 10% cassava. SEM= *Standart Error of the Mean*. *P*= *Probability*. D*A= The interaction between dietary treatment and age. LW = liveweight. LWG = liveweight gain. BCS = Body condition score. ^{x,y} different superscripts across a row within nutrition and age main effects indicate significantly different means P<0,01.

3.2. Feed Intake, Feed Efficiency and Feed conversion ratio

Total DM intake (kg/head/day) in cattle fed concentrate containing 10% DDGS (T1) or its substitution with 10% cassava (T2) was not different (P> 0.05). Age has a significant effect on feed intake (P <0.01). There was no interaction between dietary treatment and the age of the cattle on DM intake (P> 0.05). The older of the cattle increased DM intake (Table 2). The DM intake in cattle aged 42 months (10.98 kg) was higher than those at 30 months cohorts (9.53 kg) and higher than that at 18 months group (7.74 kg). The difference in DM intake was caused by differences in LW that probably due to the increasing age of the cattle. Umar et al. [11], reported that DM intake in PO cattle at the

aged 1.5 years fed EG *ad-libitum* and concentrate diet was 5.69 kg/day. Another study also reported that 15 months PO cattle at 157 kg LW fed ad libitum EG, resulted in 3.44 kg/day of DM intake and FCR 24 [12]. The average DM intake in the current study was lower than that of PO cattle at 315.60 kg initial LW fed concentrate diet, EG, soybean hulls, and cassava was 10.97 kg/head/day [13].

The results showed that the percentage (%) of DM intake (kg/ head/day) to LW (kg) showed that the cattle in T1 and T2 were not different (P>0.05) which was 2.48 to 2.59% of LW. The % DM intake in the dryland agricultural areas of Gunungkidul Regency was ranging from 1.91 to. 5.19% with an average was 2.74% [14]. The results of this study were similar to those reported by Paramita et al. [15] in 1.5 years old PO cattle, weighing 180-200 kg, the DM intake was 2.52-2.74%. The DM intake in local cattle of the Kereyu nation (Addis Ababa, Ethiopia) fed different dietary treatment was 2.5% [16]. The results of the current study showed that % DM intake was lower than 1.5-year-old PO cattle fed EG *adlibitum* and concentrate diet was 3.03% [11]; so it was probably the quality of the feed that was provided in the current experiment was better than those other studies. Based on the genetic algorithm calculation, the highest percentage of dietary DM intake was at 150-200 kg LW, was 4%; it decreased to 3.5% at 200-250 BW; 3% at 250-300 kg; and 2% at 450-500 kg LW [17]. Age had a significant effect (P <0.01) on % DM intake. There was no interaction between dietary treatment and age on % DM intake (P> 0.05). The % DM intake of 42 and 30 months old PO cattle was not different but lower than those 18 months old counterparts. Younger cattle needed a higher % DM intake in comparison with the older cohorts.

Table 3: Feed Intakes, feed conversion and feed efficiency of PO cattle fattened at different ages and feed different dietary treatments.

	Diet (D)				Age (months) (A)					D*A
	T1	T2	SEM	P	18	30	42	SEM	P	P
DM intake (kg/ekor/hari)	9.19	9.64	0.32	0.32	7.74^{x}	9.53^{y}	10.98^{z}	0.39	0.00	0.45
DM intake to LW (%)	2.48	2.59	0.05	0.16	2.82^{y}	2.43^{x}	2.34^{x}	0.07	0.00	0.33
DM intake conversion	9.78	10.06	0.47	0.68	7.72^{x}	10.60^{y}	11.44^{y}	0.57	0.00	0.50
DM intake efficiency	0.11	0.11	0.01	1.00	0.13^{y}	0.10^{x}	0.09^{x}	0.01	0.00	0.46

Abbreviation: T1 = feed offered was elephant grass + concentrate A containing 10% DDGS. T2= the feed offered was elephant grass + concentrate B containing 10% cassava. SEM= *Standart Error of the Mean*. *P= Probability*. D*A= The interaction between dietary treatment and age. DM = dry matter. ^{x,y} different superscripts across a row within nutrition and age main effects indicate significantly different means P<0,01.

The feed conversion ratio is the amount of feed needed to produce one kg of LW, calculated based on the DM intake (kg) to LWG (kg). The value of the feed conversion ratio is the amount of feed intake to increase by 1.0 kg/head/day of LWG [18]**.** The higher of the FCR, the worse of the QUALITY of the feed; and this is inversely proportional to feed efficiency. The conversion of DM intake T1 group and T2 was not different (P> 0.05). The feed conversion ratio for 18 to 42 months old PO cattle aged were 9.78 to 10.06; these were similar to the study in 1.5 years PO cattle old cattle fed EG *ad libitum* and concentrate diet was 9.63 [11].

Age has a significant effect on FCR (P <0.01). There was no interaction between dietary treatment and age to the FCR (P> 0.05). Feed conversion ratio increases with the increasing age. The FCR of 30 months old PO cattle was higher than those at 18 months old. Whereas FCR of 30- and 42-months old cattle did not differ. To produce the same LWG, older cattle will require a higher DM intake compared to those younger counterparts. The average conversion rate of DM intake as a result of this study was better than PO cattle with 315.60 kg of the initial weight that was kept in a feedlot and fed a concentrate diet, EG, soybean hulls, and cassava was 22.55 [13]. Another study showed that the FCR of 15 months old PO cattle with the initial LW 157 kg was 24 [12]. The factors affecting the FCR including the quality of the feed offered. The nutrient content differences between DDGS and cassava were the CP level, was 33.0% and 3.3% respectively. The substitution of DDGS with cassava at 10% in the concentrate diet affected the decrease of CP of the concentrate diet from 18.44% to 15.45% so that the CP ration decreased from 15.93% to 13.71%. The reduction in % CP did not affect the conversion and efficiency of DM intake in male 18; 32; and 42 months old PO cattle.

Feed efficiency shows the amount of one kg of certain nutrients to be converted into LW. The greater the feed efficiency, the better the feed quality. The data in Table 2 shows that the feed efficiency of cattle in the T1 group and T2 was not different (P> 0.05). Age had a significant effect on feed efficiency (P <0.01). There was no interaction between dietary treatment and age on feed efficiency (P> 0.05). Feed efficiency for 30 months old PO cattle was lower than those 18 and 24 months old cohorts. This was because the initial LW of cattle aged 18 months old was lower than those at 30 and 42 months, while LWG was not different in all age groups. Cattle with high LW would need more feed than smaller cattle while the LWG was the same. The amount of feed needed to produce one kg of LW for heavier cattle will be more than lighter cattle so that the feed efficiency decreases or the FCR increases. Feed efficiency for 18 to 42 months old PO cattle in this study was better than cattle in smallholder farmers in the

dryland agricultural areas of Gunungkidul Regency, was -0.02 to 0.07 with an average of 0.02 [14].

3.3. Income over feed costs (IOFC) and Benefit-Cost ratio (BCR)

Income over feed cost was calculated to determine the economic value of feed on the income of beef cattle farmers. The IOFC defined is modified from the equation following Bailey et al. [5] : IOFC = PLW x TDG – TFC, where IOFC = income over feed cost (IDR/bull/fattening period); PLW = farm-gate price of liveweight bull (IDR/kg); TDG = Total daily gain (kg); TFC = Total feed cost (IDR/bull/fattening period). Table 3 showed that replacing DDGS with cassava as an energy source for feed for 18 s.d. 42 months old PO cattle resulted in no significant difference of IOFC (P> 0.05). The IOFC values for T1 and T2 were 2,673.41 and 5,687.11 IDR/head/ day respectively. The price of DGGS was IDR 3,000/kg while cassava was IDR 4,400/kg. It has not been able to increase the IOFC. The IOFC values (IDR/head/day) for 18; 30; and 42 months old PO cattle was significantly different (P <0.01) was 13,475.04; 1,612.56; and -2,546.82 respectively. There was no interaction between dietary treatment and the age of the cattle on IOFC (P> 0.05). The IOFC of 18 months old fattened PO cattle was higher than 30 months old cohorts; and there was a loss if we use 42 months old cattle. The disadvantage of using 30 months old PO cattle for fattening was because the weight of cattle was greater than 18 months old cattle. We needed more feed while results in the same growth rate. The feed cost of keeping the 42 months old cattle was high but resulted in a low growth rate, so it caused the losses. A study showed that the efficiency of beef cattle production in smallholder farmers in dryland agricultural areas was relatively low, ranging from -1.238.45 to 13,248.08 with an average of 3,985.55 IDR/head/day [14].

The benefit is the total revenue calculated from the total increase in body weight multiplied by the price per kg of LW of fattened cattle at the current study, was 45,000 IDR/kg. The cost is calculated based on the amount of feed offered during the fattening period multiplied by the price of feed, the price of fresh EG was 275 IDR/kg; concentrate A 3,759.00 IDR/kg, and concentrate B 3,519.00 IDR/kg (Table 1). Other costs were not taken into account, for example, labor, bank interest, depreciation of the pens, etc. The BC ratio in T1 and T2 was not different (P> 0.05). Age had a significant effect on the BC ratio (P<0.01). There was no interaction between dietary treatment and age to BC ratio (P> 0.05). Fattening 18 months old PO cattle had the opportunity to result in the benefits, while 30 and 42 months old would result in losses.

TABLE 4: The analysis of fattening cost for PO cattle at different dietary treatment and age during a period of fattening (24 weeks).

	Diet (D)				Age (months) (A)					D*A
	T1	T2	SEM	P	18	30	42	SEM	P	
Income from LWG (kg)	6,046,250	6,395,000	-	-	6,534,375	5,973,750	6,153,750	-	-	-
Total Feed cost (IDR/head)	5,597,117	5,439,566	151,725	0.47	4,270,568^{x}	5,702,840^{y}	6,581,616^{z}	185,825	0.00	0.49
IOFC (IDR/head)	449,133	955,434	0.00	0.25	2,263,807^{z}	270,910^{y}	-427,866^{x}	0.00	0.00	0.45
BC Ratio	1.12	1.23	0.06	0.18	1.54^{y}	1.04^{x}	0.94^{x}	0.07	0.00	0.29

Abbreviation: T1 = feed offered was elephant grass + concentrate A containing 10% DDGS. T2= the feed offered was elephant grass + concentrate B containing 10% cassava. SEM= *Standart Error of the Mean*. *P= Probability*. D*A= The interaction between dietary treatment and age. DM = dry matter. ^{x,y} different superscripts across a row within nutrition and age main effects indicate significantly different means P<0,01.

4. Conclusions

1. Substitution of 10% of DGGS with cassava in the concentrate diet for 18, 30, and 42 months old PO cattle did not result in differences in LWG, BCS, feed intake, efficiency, FCR, IOFC, and BC ratio.

2. The age of PO cattle did not affect the increase in total LW during fattening. The total DM intake increased with the increasing age, but when calculated based on the percentage of LW, the feed intake would decrease.

3. Feed conversion, feed efficiency, IOFC, and BC ratio in 18 months old cattle were better than those at 30- and 42-months old groups so that fattening at 18 months old would be the most profitable.

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