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Potential of Fermented Coffee Peel as Legume Substitution for Male Etawah Crossbred Goat Fodder

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ABSTRACT

This study aims to examine the potential of fermented coffee peel for substitution fodder of legume (*Gliricidia sepium* and *Calliandra calothyrsus*) toward the performance of male Etawah crossbred goats. The observed parameters were: (1) the dynamics of body weight and body weight gained, (2), consumption of Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Crude Fiber (CF) and Crude Energy (CE), (3) fodder conversion, (4), physiological status and (5), financial analysis. The study showed that from the average body weight gained, the use of fermented coffee peel up to 45% as forage substitution would give body weight gained not significantly different ($p>0.05$) compared with the use of legume alone. The use of fermented coffee peel up to 60% as a substitute legume give highly significant effect ($p<0.01$) compared with other treatments. Feeding fermented coffee peel (30%) and legume (70%) of *Gliricidia* and *Calliandra*, produced the best growth for Etawah crossbred goat. Lowest fodder conversion was P3 treatment (7.42). It means goats fed legume-based (*Gliricidia, Calliandra,* 45% coffee waste) were more efficient in the use of rations. Goat with P3 treatment requires 7.42 kg of ration dry matter to increase 1 kg the body weight. Economically, the fermented coffee peel for substitution fodder of legumes substitution is feasible to be developed, as well as farmers in plantation areas could use coffee peel waste at 30% for legumes substitution (*Calliandra and Gliricidia*), because it will provide the preeminent goat's growth and provide the highest economics profit.

Key words: Coffee peel, substitution fodder, body weight status, Etawah crossbred goats, *Gliricidia, Calliandra*

INTRODUCTION

At the plantation area, green fodder only able to produce for five months. The highest production occurred at the end of the rainy season. This is as same as perennial shade plants of *Gliricidia sepium* and *Calliandra calothyrsus*, that the highest production occurred in March and April. During the rest six months, there was fodder shortage, especially at July and August (Surjowardojo *et al*., 2011). These conditions caused problems for goat breeding production. Therefore, there was the need for alternatives to overcome the fodder shortage. One of the alternatives is use of fermented coffee peel which is numerous available in the plantation area. Coffee production in Indonesia reached 689057 tons year^{-1}, the province of Bali was produce 2.16% of total Indonesian coffee production that is 14887.6 tons year^{-1} (Anonymous, 2009). Physically, the coffee fruit waste is very large, it is about 48% of the coffee fruit composition

(Zainuddin *et al.*, 1995). Coffee peel potential in Indonesia is about 330,747 tons year^{-1} , whereas Bali province only could reached 7146.10 tons year^{-1}. Therefore, the coffee plant waste has potential to be used as fodder material for livestock. Through processing, nutrient content of coffee peel can be improved, especially the protein content. According to Kompiang (2000), through the fermentation process, some wastes that high in fiber can be increased its nutrients value, including coffee fruit. Using *Aspergillus niger* inoculants fermentation, protein levels of coffee fruit can be increased, from 9.8 to 12.43%. Parwati *et al.* (2006) stated that the waste oil, such as peel of coffee, cocoa and cashews can be fermented to be source of concentrates for cattle. Coffee plantation area has a lot of grass that was maintained on the sidelines of the plant. In addition, many also planted legumes, especially *Gliricidia sepium* and *Calliandra calothyrsus* as shading for coffee plants. Sukanten *et al.* (1996) reported that feeding *Gliricidia* or *Calliandra* only can increase the goat body weight 80.12 g head^{-1} day^{-1}. This study aims to examine the potential of fermented coffee peel for substitution fodder of legume (*Gliricidia sepium* and *Calliandra calothyrsus*) toward the performance of male Etawah crossbred goats.

MATERIALS AND METHODS

Field study was conducted in Mekar Sari Livestock Group, Sepang Village, Busungbiu subdistrict, Buleleng District, Bali, from August 2011 to December 2011. Chemical analysis of composition and nutrient content of fodder conducted in laboratory of Faculty of Animal Husbandry at Brawijaya University and Livestock Research Institute at Ciawi, Bogor. This study uses samples of 16 male Etawah crossbred goat, aged 5-6 months with initial average weight 20 kg.

Experimental design of this study was Randomized Design Group, consisting of 4 treatments and each treatment consisted of 4 groups as replication. Treatment used was the forage (*Gliricidia and Calliandra*) substituted by fermented coffee peel at different levels, namely:

P1: 100% legume (*Gliricidia:Calliandra*, 1:1)
P2: 70% legume (*Gliricidia:Calliandra*, 1:1)+30% fermented coffee peel
P3: 55% legume (*Gliricidia:Calliandra*, 1:1)+45% fermented coffee peel
P4: 40% legume (*Gliricidia:Calliandra*, 1:1)+60% fermented coffee peel

Ration treatment preparation was based on DM (Dry Matter) need, 3.8% of body weight (Kearl, 1982) (Table 1-2).

In this study, the observed parameters were: (1) The dynamics of body weight and body weight gained, (2) consumption of Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Crude Fiber (CF) and Crude Energy (CE), (3) fodder conversion, (4) physiology status and, (5) financial

Table 1: Composition and nutrient content of green forage and fermented coffee peel

		Legume	
Nutrient	Fermented coffee peel	*Gliricidia*	*Calliandra*
DM (%)	82.70	18.54	15.52
OM (%)	89.17	92.33	93.24
CP (%)	13.68	23.01	25.08
CF (%)	52.94	21.94	21.49
CE (kcal kg^{-1})	3753.00	4409.00	4489.00

Fodder analysis conducted at Laboratory of Faculty of Animal Husbandry, Brawijaya University and Laboratory of Livestock research Institute, Ciawi-Bogor

Table 2: Treatment of nutrient content rations

	Treatment			
Nutrient	P1	P2	P3	P4
DM (%)	17.03	36.73	46.58	56.43
OM (%)	92.79	91.70	91.16	90.62
CP (%)	24.05	20.94	19.38	17.83
CF (%)	21.72	31.08	35.77	40.45
CE (kcal kg^{-1})	4449.00	4240.20	4135.80	4031.40

Fodder analysis conducted at Laboratory of Faculty of Animal Husbandry, Brawijaya University and Laboratory of Livestock Research Institute, Ciawi-Bogor

analysis. Analysis of variance used for data analysis, based on GenStat Release 12.2 Program with an error level 1-5%. If the variance test showed significant differences, the testing average of two treatments performed using LSD.

RESULTS AND DISCUSSION

Body weight gained: Average initial body weight of male Etawah crossbred goat with green forage feeding, namely legume for P1 treatment was 23.55 kg $head^{-1}$, P2 treatment (23.85 kg $head^{-1}$), P3 treatment (23.75 kg $head^{-1}$) and P4 treatment (24.08 kg $head^{-1}$). The result showed the difference statistically insignificant ($p>0.05$), as shown in Table 3.

The average daily body weight gained of crossbred Etawah goat with green forage, namely legume for P1 (88.93 g $head^{-1}$ day^{-1}), P2 (100 g $head^{-1}$ day^{-1}), P3 (99.64 g $head^{-1}$ day^{-1}) and P4 was 71.79 g $head^{-1}$ day^{-1}. After statistic test among the treatments, the result showed that P1, P2 and P3 showed highly significant different ($p<0.01$) for treatments P4, whereas P1 significantly not different ($p>0.05$) to P2 and P3 treatments, as shown in Table 3. From the average body weight gained above, it can be shown that the use of fermented coffee peel up to 45% as forage substitution would give body weight gained not significantly different ($p>0.05$) compared with the use of legume alone. The use of fermented coffee peel up to 60% as a substitute legume give highly significant effect ($p<0.01$) compared with other treatments.

Respond shown by goat can provide an overview that the possible cause's body weight gained was the effect of quantity and quality rations tested. It can be assumed that the quality of the four rations treatment given were different. Based on this research, the best growth performance was shown by P2 treatment. This means that the quality of P2 treatment rations was better than the other treatments. Growth gained of goat could be viewed from forage intake (Table 4), P2 treatment use forage from dry matter and nutrient consumption (crude protein, organic matter and energy), significantly ($p<0.01$) higher compared with treatment other. The higher consumption of dry matter and forage nutrient, effect to the higher availability of nutrients for the rumen microbes and host animal. High nutrient forage availability in rumen would likely increase the nutrients that can be used by livestock to increase the body weight.

Body weight gained will increase the growth rate. Conversely, decreased body weight will result decreased growth. Decreased growth of Etawah crossbred goat which given fermented coffee peel ration (P4) was caused by an anti-nutrient contained in fermented coffee peel waste, namely tannin at 0.495% and caffeine at 0.032%. The energy from fodder intake cannot be fully utilized for growth. Too much tannins in ration can reduce protein digestion, because it inhibits the enzyme protease and cellulose to work (Soebarinoto *et al*., 1991). P4 treatment produces a low body weight gained with lower body weight gained. High content of fermented coffee peel waste causes the

Table 3: Effect of fermented coffee peel to body weight gained of male Etawah crossbred goat

	Treatment				
Parameter	P1	P2	P3	P4	F-p-value
Initial body weight (kg head^{-1})	23.55	23.85	23.75	24.08	0.983^{ns}
DBWG (g head^{-1} day^{-1})	88.93^{b}	100.00^{b}	99.64^{b}	71.79^{a}	0.001**

DBWG: Days body weight gained, **Highly significant influence at p<0.01 ns: Insignificantly different at p>0.05, Values with different letters in the same row indicate significant (p<0.05) to highly significant (p<0.01) differences

Table 4: Effect of nutrient consumption behavior Etawah crossbred goat rations

	Treatment				
Parameter	P1	P2	P3	P4	F-p-value
Nutrient consumption (g head^{-1} day^{-1})					
DM	733.78^{b}	755.20^{b}	741.72^{b}	597.11^{a}	0.014*
OM	675.58^{b}	693.25^{b}	673.12^{b}	543.22^{a}	0.011*
CP	193.65^{b}	177.14^{b}	170.12^{b}	104.58^{a}	0.001**
CF	174.71^{a}	242.58^{b}	247.85^{b}	254.12^{b}	0.006**
CE	3091.55^{b}	3222.27^{b}	3164.89^{b}	2480.03^{a}	0.006**
Forage conversion	8.27^{a}	7.61^{a}	7.42^{a}	8.53^{a}	0.621^{ns}

*Significant influence at p<0.05, **Significant high influence at p<0.01, ns: Insignificantly different at p>0.05, Values with different letters in the same row indicate significant at p<0.05 to highly significant at p<0.01 differences

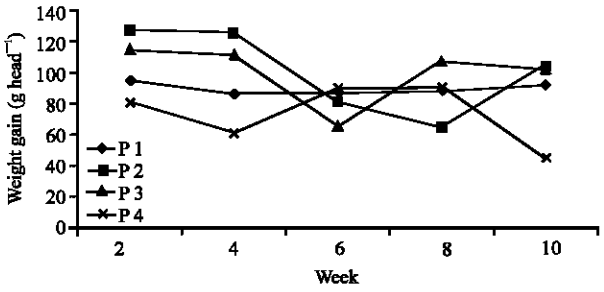

Fig. 1: Fermented coffee peel effect to mean body weight gained of male Etawah crossbred goat

decrease in palatability of forage rations. Low palatability of livestock rations also resulted lower consumption. Consequently, cattle can only meet the basic needs only (Fig. 1)

Nutrient consumption: Dry Matter (DM) ration consumption of male Etawah crossbred goats were: P1, P2 and P3, statistically have a significant effect (p<0.05) towards increased consumption of ration dry matter compared with P4 treatment. The highest dry matter intake by goats was in P2 treatment, followed by P3 treatment, P1 treatment and the last P4 treatment. Dry matter ration consumption of P1, P2 and P3 treatments was significantly different (p<0.05) than P4 treatment. P1 with P2 and P3 treatment were not significantly different (p>0.05). Statistically, the Organic Matter (OM) consumption of Etawah crossbred goat with P1, P2 and P3 treatment were 19.60% 21.65 and 19.30%, respectively, significantly higher (p<0.05) than P4 treatment. The consumption of organic matter for P1, P2 and P3 treatment were not significantly different (p>0.05) (Table 4).

For the crude protein (CP) consumption, the results showed that goat with P1, P2 and P3 treatment consumes crude protein 46.00, 40.97 and 38.53%, respectively, highly significant ($p<0.01$) compared with P4 treatment. P1 Treatment consumed crude protein 8.53 and 12.15% higher than P2 and P3 treatments, but insignificantly different ($p>0.05$). Forage consumption of Crude Fiber (CF) with P1 treatment significantly lower ($p<0.01$) compared to treatment of P2, P3 and P4, at 27.98, 29.51 and 31.25%, respectively. Treatments of P2, P3 and P4 show the crude fiber consumption not significantly different ($p>0.05$). Forage consumption of CF, at experimented treatment was highly significant ($p<0.01$), to effect the Etawah crossbred goat. For Crude Energy (CE) consumption Statistically, P4 treatment was significantly different and lower than P1, P2 and P3 treatment ($p<0.01$) at 19.78, 23.04 and 21.64%, respectively. Between P2 treatment with P1 and P3 treatment was not significantly different ($p>0.05$) (Table 4).

Basically, the forage consumed by livestock was intended to meet energy needs, both for the microbes in the rumen and animal itself. Theoretically, the goat will continue to consume the forage (dry matter and organic matter) until the energy needs ware met, although the stomach (rumen) capacity still could be filled fully. In contrast, animals will stop eating when the rumen full, although the energy requirements have not been met yet.

Consumption of goat rations for 10 weeks ware presented in Table 4. DM and OM consumption was significantly higher ($p<0.05$) in goats with P2, P1 and P3 treatment compared with P1 treatment. This based on Crude Energy (CE) content, where the highest ration was P2, then followed by P3. It is means consumption of high DM and OM ration in P2, P1 and P3 treatment due to the availability of relatively low energy, so the ration consumption (DM and OM) was high. Increased consumption was expected to meet energy needs. In addition, the ration of P2, P1 and P3 treatment, containing legume, according to the natural habitat when goat search forage, namely penetrated/bite, would increase the dry matter. Ration experimented to energy consumption would have effect due to crude energy content of rations. Crude energy content of rations was high in P2 treatment, plus high DM consumption will further increase the energy consumed by livestock. This condition indicates that the P4 treatment has a low digestibility and palatability due to higher crude fiber content. Arora (1995) stated that forage with high lignin content has low palatability and forage intake was lower than forage with low lignin. In addition, legume bulky nature will effect on consumption levels. Another factor affecting the dry matter consumption was goat digestive system. Ruminants will reduce forage intake if the retention time of forage increases, so the capacity to hold food decreases rumen (Orskov, 2001).

Putra (1992) stated the high forage bulky cause goat to eat a little, because the stomach feels full faster. He also explained that, the higher the crude fiber content, the lower dry matter intake (negative correlation). As a result, animals were less able to meet its energy needs. In addition, Parakkasi (1999) stated that the rate of consumption is determined by the calorie content and crude fiber. Increased consumption of dry matter would results the increased consumption of DM and CP rations. This was in line with the opinion of Arora (1995) and Tillman *et al.* (1998), the increasing amount of dry matter intake will be followed by the increased consumption of nutrient rations.

Ration with low level protein can limit or suppress voluntary forage intake or consumption of Dry Matter (DM) (Minson, 1976). Low ration protein affect on the N low supply of for rumen microbes. Therefore, the physiological activity was inhibited. Consequently, degradation of forage was hampered and eventually suppress consumption. According Soebarinoto *et al.*(1991), the protein that exceeds the needs of livestock will be used for growth and production (UN). factors that

can affect protein consumption was body weight, protein content and digestibility, forage quality, physiological condition and health of livestock and feeding area.

The increased of protein intake will increase rumen microbial population, microbial digestion in the rumen increases. Further, this can be used as a source of protein, other than pure protein, to increase the amount of protein deposited in the goat body and used to meet basic living and production. According to Orskov (1992), influenced by others factors than forage, protein deposition was also influenced by body weight. Goat with low body weight and in growth period will require more protein than adult goat that had entered the fodder lot.

Based on nutrient content (Table 4), CF content of forage treatment, much higher fermented coffee peel waste ration, resulted much higher the content. A mixture of different types of concentrate forage ingredients can complement and enhance the efficiency and overall palatability of forage, so that goat can achieve maximum production. Protein mixture of forage ingredients and energy sources will ensure adequate micro-nutrient, so deficiency can be prevented if cattle were fed for a longer period.

Fodder conversion: Fodder conversion that obtained from this study were: 8.27 for P1 treatment, 7.61 for P2 treatment, 7.42 for P3 treatment and 8.53 for P4 treatment. P1 Treatment and P2, P3 and P4 were insignificantly different ($p>0.05$), as shown by Table 4.

Fodder conversion was an efficiency picture of forage ration usage conversion. Forage conversion was calculated by dividing the amount of dry matter intake per day with body weight gained per day. In this study, the average forage conversion was highest at P4 treatment, namely 8.53. This is because the consumption of the DM ration was lowest in P4 treatment and daily body weight gained was also low, so the impact to forage conversion become higher.

Lowest fodder conversion (efficient) come from P3 treatment, namely 7.42. It means that goats fed by legume forage legume-based (*Gliricidia, Calliandra,* 45% coffee waste) were more efficient in the use of rations. Goat with P3 treatment requires 7.42 kg of ration dry matter to increase 1 kg the body weight.

Physiology status: The fermented coffee peel contains tannin 0,495% and caffeine 0.032%. Seen from Etawah crossbred goats physiology (body temperature and heart rate), Etawah crossbred goat that given leguminous (*Calliandra* and *Gliricidia*) at P1 treatment was insignificantly different ($p>0.05$) compared with Etawah crossbred goat fed by fermented coffee peel (P2, P3 and P4 treatment). Body temperature of Etawah crossbred goat with P1 treatment was 39.43%, P2 treatment was 39.40%, P3 treatment was 39.40% and P4 treatment was 39.43%. Heart rate of Etawah crossbred goat in P1 treatment was 69 beats min^{-1}, P2 treatment was 70 beats min^{-1}, P3 treatment was 70 beats min^{-1} and P4 treatment was 71 beats min^{-1} (Table 5).

Table 5: Effect of fermented coffee peel to temperature and heart rate of Etawah crossbred goat

	Treatment				
Parameter	P1	P2	P3	P4	F-p-value
Body temperature (°C)	39.43	39.40	39.40	39.43	0.995^{ns}
Heart rate (beats min^{-1})	69.00	70.00	70.00	71.00	0.120^{ns}

ns: Insignificantly different at $p>0.05$

In this study, the use fermented coffee peel as a substitute for legume, namely P1, P2, P3 and P4 treatment, did not show significant effect ($p>0.05$) on body temperature and normal body temperature of all goats. As proposed by Smith and Mangkuwidjoyo (1988), goat rectal temperature in normal conditions was 38.5-40°C with average 39.4°C or between 38.5 and 39.7°C with the average 39.1°C. Heart rate frequency was determined by pulse calculation for 1 min. Livestock trying to balance the negative effects of increased temperature using various ways, including: increased blood flow to skin through vasodilatation near the skin surface, increased sweat, panting, increased the body temperature, increase water consumption and reduce forage consumption.

Financial analysis: Marginal Benefit Cost Ratio (MBCR) was used to determine or measuring the feasibility of the introduction of fermented coffee peel technology package in order to combine with the farmer technology. According to FAO (1990), MBCR is a ratio between profits and marginal costs (fixed costs+variable costs). MBCR calculations describe, if its value is less than 1, economically the technology introduction have not potential to be developed. Conversely if it greater than 1, economically, the technology introduction has the potential to be developed. The study showed, MBCR value of fermented coffee peel usage for animal forage of Etawah crossbred goat in the P2 treatment was the most profitable with the highest MBCR, that was 1.09, whereas the P1 and P3 treatments were 1.01 and 1.08, respectively. Therefore, the technology was feasible to be developed. Whereas P4 treatment, although it had economic benefit but the MBCR value was 0.98, so it was not feasible to be developed (Table 6).

Table 6: Financial analysis of fermented coffee peel usage to males Etawah crossbred goat forage (per head per 70 day)

	Treatment			
Parameter	P1 (Rp)	P2 (Rp)	P3 (Rp)	P4 (Rp)
Cost				
Seed procurement 20 kg @ Rp. 25.000	500.000	500.000	500.000	500.000
HPT procurement @ Rp. 200 kg^{-1}				
P1 = 410,137 kg		82.030		
P2 = 297,028 kg			59.405	
P3 = 230,374 kg			46.075	
P4 = 165,085 kg				33.015
Fermented coffee peel procurement @Rp. 950 kg^{-1}				
P1 = 0,00 kg	0.00			
P2 = 23,229 kg		22.050		
P3 = 33,908 kg			32.215	
P4 = 44,625 kg				42.395
Medicine and vitamins	10.000	10.000	10.000	10.000
Stable shrinking	75.000	75.000	75.000	75.000
Total cost	667.030	666.475	663.290	660.410
Income				
Goat selling income				
P1 = 29,58 kg @ Rp. 45.000	1340.500			
P2 = 30,65 kg @ Rp. 45.000		1388.250		
P3 = 30,73 kg @ Rp. 45.000			1382.850	
P4 = 29,10 kg @ Rp. 45.000				1309.500
Profit	673.470	721.775	719.560	649.090
MBCR	1.01	1.09	1.08	0.98

Sources: Mekar sari livestock group

CONCLUSION AND RECOMMENDATION

Feeding fermented coffee peel (30%) and legume (70%) of *Gliricidia* and *Calliandra* (P2), produced the best growth for Etawah crossbred goat. Forage conversion in P3 treatment tends to be most efficient in the forage usage. Economically, the P1, P2 and P3 treatment is feasible to be developed, as well as farmers in plantation areas could use coffee peel waste at 30% for legumes substitution (*Calliandra, Gliricidia*), because it will provide the preeminent goat's growth and provide the highest economics profit.

REFERENCES

Anonymous, 2009. Plantation Statistics 2009. Ministry of Agriculture Republic of Indonesia, Jakarta.

Arora, S.P., 1995. Microbial Digestion in Ruminants. Gadjah Mada University Press, Yogyakarta.

FAO, 1990. Guidelines for the Conduct of Training in Farming System Development. Food and Agriculture Organization. Rome, Italy.

Kearl, L.C., 1982. Nutrient Requirements of Ruminants in Developing Countries. 1st Edn., International Feedstuffs Institute, Utah State University, Logan, Utah, USA, ISBN: 9780874211160, Pages: 381.

Kompiang, I.P., 2000. Quality improvement of feed raw materials. IP2TP Denpasar.

Minson, D.J., 1976. Nutritional Significance of Protein in Temperate and Tropical Pastures. In: Reviews in Rural Science II. From Plant to Animal Protein, Sutherland, T.M., J.R. McWilliam and R.A. Leng (Eds.). University of New England, Armidale NSW., pp: 27-30.

Orskov, E.R., 1992. Protein Nutrition in Ruminants. Harcount Brace Jovanovich, London.

Orskov, E.R., 2001. The Feeding of Ruminants Principles and Practice. Chalcombe Publication, London.

Parakkasi, A., 1999. Nutrition Ruminants Sciences. Indonesia University Press, Jakarta.

Parwati, I.A.P., S. Guntoro. N. Suyasa. I.M. Raiyasa, I.M. Londra and Sriyanto, 2006. Adaptive research on waste oil for animal feed. BPTP Bali.

Putra, S., 1992. Evaluation on chemistry composition and consumption level on 16 provenance gamal (*Gliricidia sepium*) planted in bali dry land. Master Thesis, Bogor Agricultural University, Bogor.

Smith, J.B. and S. Mangkuwidjoyo, 1988. Maintenance and Use of Animal Breeding Study in the Tropics. Indonesia University Press. Jakarta.

Soebarinoto, S., Chuz.aemi and Mashudi, 1991. Ruminant Nutrition: Department of Nutrition and Animal Feed. Brawijaya University, Ma.

Sukanten, I.W., I.M. Nitis, S. Uchida, S. Putra and K. Lana, 1996. Performance of the goat fed grass, shrub and tree fodders during the dry season in Bali, Indonesia. Asian Austr. J. Anim. Sci., 9: 359-482.

Surjowardojo, P., S. Chuzaemi, I.K. Sutama and I.M. Londra, 2011. Report of participatory rural appraisal. Research partnership of Indonesian agricultural research agencies and university (KKP3T) with Brawijaya University, Ma.

Tillman, A.D., H. Hartadi, S. Reksohadiprodjo, S. Prawirokusumo and S. Lebdosoekojo, 1998. Animal Feed Sciences. Gadjah Mada University Press, Yogyakarta.

Zainuddin, D., I.P. Kompiang and H. Hamid, 1995. Utilization of Coffee in the Rations of Poultry. Livestock Research Institute, Ciawi-Bogor.