Effects of fiber levels and curcuma levels on the growth performance and incident of enteritis of weanling rabbits

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ABSTRACT

High incidence of diarrhoea in weanling rabbits caused high rate of mortality. Diarrhoea or enteritic problem in rabbits is usally triggrede by the increase population of pathogenic bacteria in the caecum. This population may, however be controlled by high dietary level of indigestible fiber, and low protein and carbohydrate, and also by some feed additives that have bacteriostatic and peristaltic ragulation properties, including herbals. Among them, Curcuma (Curcuma longa) has been reported to have curing effect on the diarrhoea in human. In this experiment, levels of dietary fiber and curcuma is studied. Three levels of dietary fiber (12, 14 and 16%) and four levels of curcuma (0.0; 0.1; 0.2 and 0.3% air basis). All treatments contained 13% crude fiber, 17% cude protein and 2500 to 2550 kcal/kg DE. Each treatment consisted of 5 replicates, each of 5 weanling rabbits (about 650 + 50 g initial body weight). Feed and water were provided ad libitum throughout the experimental period. Measurements were made on body weight, bodyweight gain, feed consumption, feed conversion, mortality, carcass percentage and digestibility of dry matter. Results showed that higher crude fiber reduced the feed consumption, bodyweight, bodyweight gain, feed efficiency and also digestibility of dry matter and slightly decrease the carcass percentage. Some of them did cause significant differences. No interaction were detected among levels of fiber and curcuma. Curcuma has a slight beneficial effects on the body weight gain and also survivability of the animals, but not on the other parameteres measured. Crude fiber levels of 14 and 16% at 0.2% curcuma in the diet gave the highest bodyweight gain and lowest rate of mortality.

Key Words: Fiber, Curcuma, Rabbit Growth

INTRODUCTION

Rabbits are herbivorous monogastric livestock, which requires the availability of fiber in high enough quantities, not only to support the normal peristalsis, but also helps balance between nutrient digestion with intestinal microbiota (Gidenne & Garcia 2006). In the rabbit, the fiber may be a component of a highly controversial chemical feed. Low-fiber rations produce high feed efficiency (Lang 1981; Potte et al. 1981) but the physiological (Laplace 1978; Cheeke & Patton 1980) and nutritional (Patton et al. 1983; Cheeke et al. 1987) which causes diarhea often resulting in mortality, a rabbit disease that causes the most deaths, especially in young rabbits 2-8 weeks (Furtun-Lamothe & Gidenne 2006). Diarhea caused by an imbalance of bacteria/other microbiota in the digestive system of the rabbit. This balance must be maintained to ensure the process of movement, digestion, nutrient absorption and elimination of residual feed digestion (Fortune-Lamothe & Gidenne 2006). Diarrhea may occur by bacterial *i.e.* cocci, coli, salmonella, and clostridia (Carabano et al. 2006) due to the high density, poor sanitation, environmental changes and stressful. Reported more than 13 causes diarrhea which causes high mortality (Soeripto 2007). Fiber plays an important role in keeping the digestive processes running normally and nutritional balance with the microbiota populations (de Blaas et al. 1999; Gidenne 2003). However, the mechanism is unclear and inconsistent. At high levels, lower fiber digestibility (Fekete & Gippert 1985; Raharjo et al. 1990) but stimulates motility of the caecum and colon (Ehrlein et al. 1983) and reduce the occurrence of enteritis (Cheeke 1983). However Morisse et al. (1985) reported that a high-fiber diet and low starchy even cause diarrhea.

In the rabbit rations, crude fiber content should be more than 12%, and is largely a fraction of 'indigestible'. But never mentioned how much needs 'indigestible fiber fraction' and how tolerances for fractions are

'digestible'. There is a recommendation that the use of the fiber is no longer as crude fiber, but more specifically the level of ADF and ADF-lignin. Research in 2007 related to the digestibility and growth of rabbits from 4 different types of fibers. The results of the digestibility trial are presented in Table 1. The results are 4 types (source of fiber) gives the data of fiber that provide the most optimal growth or the lowest mortality.The digestibility of the fiber fraction, with the potential as a great source of 'indigestible' fiber is rice straw. But rice straw is not consisten in composition. Raharjo et al. (1990) showed a decrease in weaning mortallitas through the use of rice husk to 20%. However, the analysis of fiber composition and digestibility of rice husk as a source does not support the 'indigestible fiber'. These results require a re-analysis. Moreover, it will be considered the result of the *in vivo* test is the fourth source of fiber.

Fibers, especially the 'indigestible' important role in maintaining the balance in the digestive process of rabbits. Fiber deficiency causes diarrhea that resulted in high mortality at weaning rabbits. Fiber types 'indigestible' also allegedly very decisive in maintaining the balance of the digestive process, so it is recommended to use in the formulation of ADF and ADF-lignin (Xiccato et al. 2006). Among a variety of herbs commonly used to treat diarhea is turmeric/curcuma (*Curcuma longa*). In addition to improving the performance of livestock, curcuma may also prevent or reduce the incidence of diarhea. On the other hand, reported that the herbal ingredients such as turmeric (*C. longa* or *C. domestica*), ginger (*C. xantorrhiza* Roxb) and garlic (*Allium sativum* Linn) is known to be antibacterial and immune-boosting (Setiawan 1998; Thakare 2004; Murdiati 2006) has long been used to treat diarhea in humans. Result of exploratory experiment in Balitnak showed that 2% fresh curcuma give the body weight gain a better and lower mortality compared with the xanthoriza and garlic (Table 2). Sinurat et al. (2009) also showed growth and a better FCR and lower mortality in broiler chickens with add curcuma in the rations.

The combination of fiber and curcuma level appropriate to provide optimal growth performance in weaning rabbits.

METHODOLOGY

Three levels of fiber (12; 14 and 16%) and 3 levels of curcuma (1; 2 and 3% wet or equal to 0.1; 0.2 and 0.3% dry air weight). Fiber source used was a mixture of mostly rice hulls and sugarcane shoots. Entire ration treatment had higher levels of fiber (13%), protein (17%) and energy (2550 kcal/kg) of the same. Other nutrients to meet the needs of the rabbit in accordance to NRC (1977). Five replicates, each consisting of 5 weaning rabbits with a body weight 650 + 50 g, were used for each treatment. Feed and water provided ad lib. The study was conducted from weaning ages 6 weeks to 7 weeks of the study. Measurements were made on the growth performance (feed intake, body weight, body weight gain, feed conversion) and weekly mortality, as well as the dry matter digestibility (DMD).

Table 1. Composition and digestibility of fiber from various sources of fiber (%)

Nutrient	Sawdust		Cane shoots		Rice hull		Rice straw	
	Composition	Digestibility	Composition	Digestibility	Composition	Digestibility	Composition	Digestibility
CF	59.80	-9.61	27.00	-9.39	10.43	48.71	20.00	-14.41
ADF	66.10	-6.22	37.90	4.58	19.20	29.11	50.30	-5.57
NDF	79.20	3.08	60.60	2.59	27.60	11.37	61.30	-3.26
Lignin	7.38	-9.23	3.20	-1.11	2.80	46.66	4.70	-18.09

Table 2. Effects of garlic, Curcuma, and *C. xanthorriza* for 5 weeks in rabbits after weaning

Treatment	BWG (g)	Consumption (g/d)	FCR	Mortality (%)
Control	19	82	4.51	33
Garlic	17	75	4.97	33
Curcuma	22	84	3.86	0
C. xanthorriza	20	81	4.23	17

RESULTS AND DISCUSSION

The chemical composition of the ration and the results of this experiment are shown in Table 1. Result of composition analysis is different from calculated. Protein content, which is calculated rations had higher levels of 17% (dry air), while the results of the analysis were 21.5 to 22.4% (dry), or 19.14 to 19.94 (dry air) which mean 2% higher than expected. In contrast to crude fiber, calculated levels were 12, 14 and 16%, while the results of the analysis showed 9.9, 10.8 and 12.9%, much lower than that prepared rations. This may because of few fish meal have a higher protein content, while the fiber content of cane shoots were lower than usual composition. It can also occur when the cane shoots were taken from young leaves of sugarcane, with a low fiber content and high protein.

Animal response to the treatment are shown in Table and Figure below. There is no significant interaction between the level of fiber with the level of curcuma on any parameter. Table 2 shows the feed intake of rabbits for 7 weeks, while the Figure 1 and Figure 2 shows the effect of fiber content and levels of turmeric on feed consumption. Increased fiber causes a decrease in feed intake from 88 grams to 72 g/h/d, while at 0.2 curcuma and 0.3% levels in the diet led to a significant decrease in consumption (92 vs 77 g/h/d). The increase in fiber content, which is voluminous and resulting in consumption decreased, this may be related to the development of the capacity of the stomach, which is increasingly limited to accommodate the volume of high-fiber feed. However poorly understood, why the increase in curcuma caused a decrease in consumption, whereas in humans it stimulates appetite.

Table 3. Composition of ration

Fiber	Curcuma	Counted			Analysis		
		DE	CP	CF	CP	GE	CF
12	0.0	2518	17.0	12.2	22.4	4022	9.6
	0.1				22.1	3999	9.7
	0.2				22.1	4189	9.4
	0.3				21.5	4330	10.9
14	0.0	2517	17.1	14.0	22.0	5323	10.7
	0.1				21.9	4597	10.0
	0.2				22.5	4255	11.2
	0.3				22.4	4349	11.2
16	0.0	2505	17.1	16.0	23.4	4414	12.8
	0.1				22.0	4384	13.2
	0.2				22.7	4129	12.9
	0.3				22.3	2282	12.7

Effect of fiber level and turmeric to the weekly feed consumption shown in Figure 1 and Figure 2. In the early weeks, (weeks 1 to 4), although not significantly, higher fiber content (16%) showed higher consumption, while at the end of the week, the high fiber content of feed consumption will be lower. This may related to the development of the capacity of the stomach, which is increasingly limited to accommodate the volume of high fiber feed.

In Figure 2 it appears that the weekly feed intake of various diet containing curcuma does not vary in the first 5 weeks, but slightly higher in rations with low levels of Curcuma. Cumulatively increased levels of Curcuma lowered feed intake.

The response of growth performance in weight of crude fiber and curcuma level in the diet are shown in Table 5. The results showed that 14% of crude fiber in the ration gave the highest body weight, although not significantly different with 12% fiber, but significantly higher than the 16% crude fiber. It is associated with low feed intake (Table 2) and a lower digestibility (Table 6) on high crude fiber ration.

Tabel 4. The effect of various levels of fiber and curcuma on feed consumption (g/h/d)

Curcuma (%)	Fiber (%)			
	12	14	16	Rataan
0	100	100	75	92
0.1		107	55	81
0.2	83	43	78	68
0.3	81	71	79	77
Average	88	80	72	79

Rabbits in the treatment of 12% fiber and 0.1% curcuma death occurs entirely, so there is no data

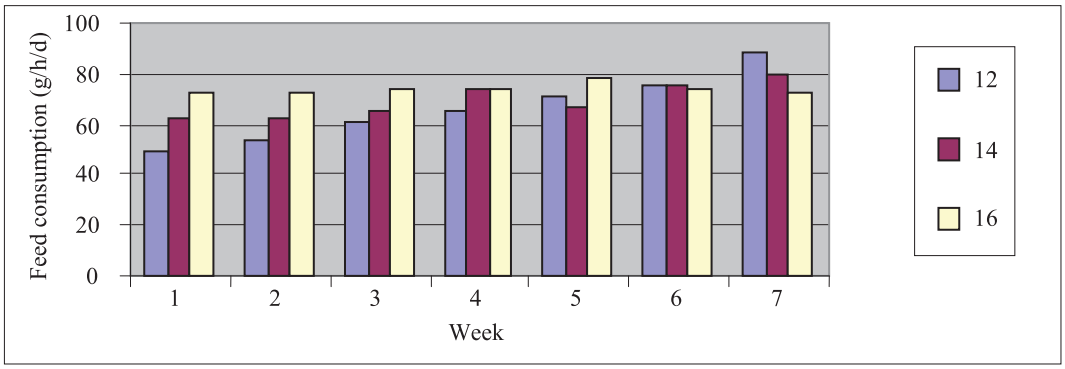

Figure 1. Feed consumption of various crude fibre content (g/h/d)

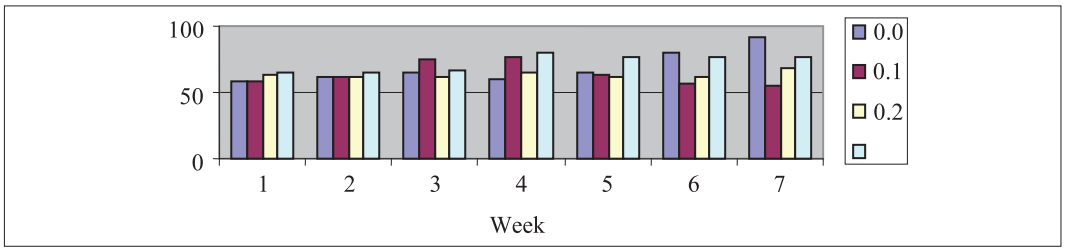

Figure 2. The effect of curcuma levels to feed consumption (g/h/d)

Figure 3 and 4, respectively show the rabbit body weight growth curve is influenced by the fiber and curcuma level from week 6 to week 12. In Figure 3 it appears that the curves of the body weight of rabbits fed diet with 14% crude fiber content was consistently higher than the other two feed treatments. On the other hand, although at week 4 to week 6 trial occurred considerable variation in body weight to the level of curcuma, but at week -7, the difference is very small (Figure 4).

The results indicate that 14% of fiber and 0.1% of curcumin the diet gave the best results of body weight than other treatments. However at 0.1% of curcuma and 12% fiber occurs very high incidence of mortality, so that all animal experiments on the treatment are died. The whole dead animals showed of diarrhea and/or bloating symptoms. The response of body weight gain (BWG) rabbit on the level of fiber and curcuma are presented in Table 4. The highest body weight gain produced by a rabbit ration with fiber content 14 and 16% (24 g//h /d). This value is comparable to or even better than some of the results of previous studies (27 g/h/d). The highest body weight gain generated from rabbits 0.0 and 0.1% curcuma. These results are consistent with the response to body weight (Table 3).

Table 5. The Effect of fiber and curcuma level on body weight in week 7th (g/h)

Curcuma (%)	Fiber(%)			
	12	14	16	Average
0.0	1978	2030	1366	1791
0.1	death	2224	1533	1879
0.2	1748	1657	1520	1642
0.3	1881	1679	1590	1717
Average	1869	1898	1502	1757

Tabel 6. Body weight gain (g/h/d) of rabbit that fed with different level of fiber and curcuma

Curcuma (%)	Fiber(%)			
	12	14	16	Average
0.0	28	29	16	24
0.1		28	20	24
0.2	21	20	18	20
0.3	22	19	18	20
Average	24	24	18	

Weekly body weight gain response to the level of the fiber (Figure 5) and the level of turmeric (Figure 6), although it seems slightly vary each week, but did not significantly different (18 to 24 g/h/d). In the last 2 weeks, the addition of 0.1% curcuma produce the lowest body weight gain.

For crude fiber, in the last 3 weeks, rabbits were given with high crude fiber (16%) consistently produced the lowest body weight gain. It is associated with a lower feed quality, which is indicated by the lower digestibility of dry matter in the high-fiber feed (Table 6)

Effect of fiber level and curcuma in the diet on feed conversion are shown in Table 5.Tabel shows that lever of fiber effected to feed conversion (fibers 12; 14 and 16% yield conversion of 3.17; 3.71 and 4.16), which means the less efficient use of feed. The higher the fiber the higher amount of feed needed to produce the same amount of body weight. It is common in all animals, both monogastric and ruminant, because fiber is generally not digestible and less contribution to the formation of cell-cell growth.

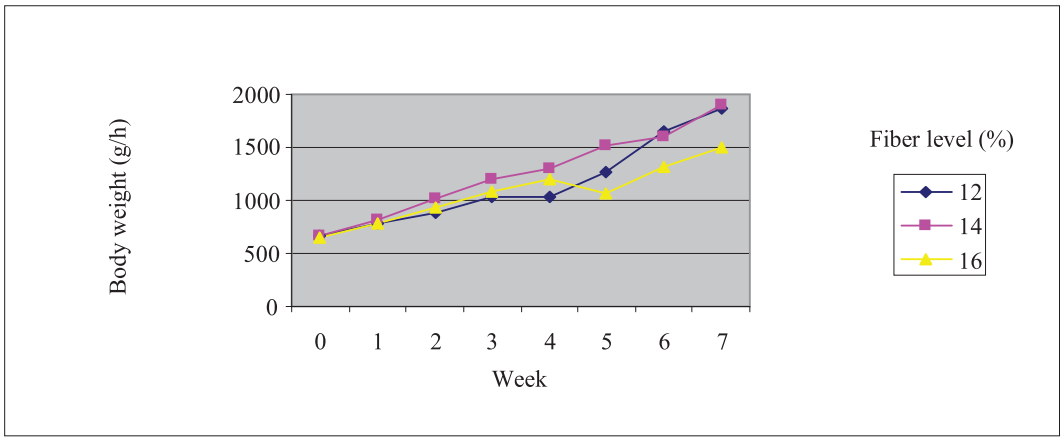

Figure 3. Effect of fiber level on body weight (g)

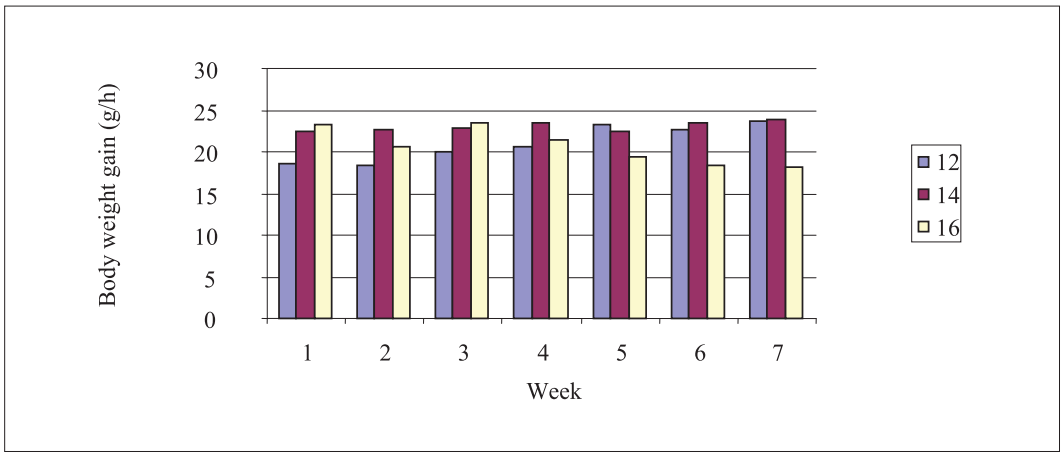

Figure 4. Effect of fiber level on weekly body gain (g)

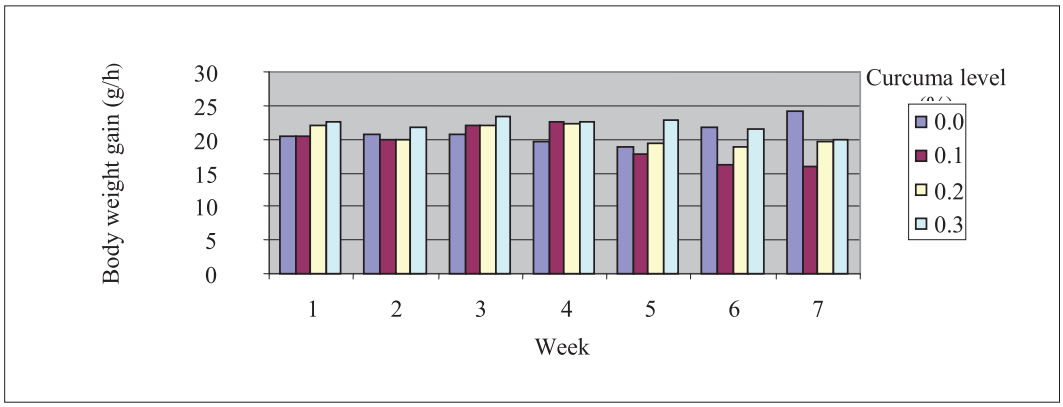

Figure 5. Effect of curcuma level on weekly body gain (g)

On the other hand, increasing of curcuma level in the diet led to an improves of FCR, eventhough not significantly (3.74 to 3.92). This is in contrast to that produced in chickens (Sinurat et al. 2009), which reported that the addition of curcuma gives better FCR.

Figure 7 shows the weekly FCR response of the crude fiber level in rations. The Figure shows a consistent pattern that almost every week, increased levels of crude fiber of the will improves FCR in rabbits. In Figure 10, first week to the fourth week of the study showed that the difference in the level of fiber does not affect the FCR, but in the last three weeks, 0.1% curcuma gives the lowest FCR, which means it provides the most efficient use of the high ration. In situations of low mortality, the addition of 0.1% curcuma in the diet may be the best choice (see also Table 2, 3 and 4).

Table 6 shows the response of dry matter digestibility of fiber and turmeric level in the ration. Fiber levels significantly affect the dry matter digestibility of the ration.The higher the fiber content, the lower the dry matter digestibility ration (72 vs 64 vs 58%). At the level of 16% crude fiber in the ration with 58% dry matter digestibility shows that the ration is very inefficient for use as feed. With the exception of very low prices sources of fiber, the use of 16% with 58% fiber digestibility potentially economically loss. Curcuma levels, by contrast, did not significantly affect dry matter digestibility. The whole ration with different levels of curcuma have dry matter digestibility not differ significantly (63-68%).

Table 7. Effect of fiber and curcuma level on feed conversion

Curcuma(%)	Fiber (%)			
	12	14	16	Average
0.0	3.60	3.45	4.15	3.74
0.1	n.a.	3.76	3.70	3.73
0.2	3.41	3.86	4.17	3.81
0.3	3.39	3.76	4.60	3.92
Average	3.47	3.71	4.16	

n.a.: not available data

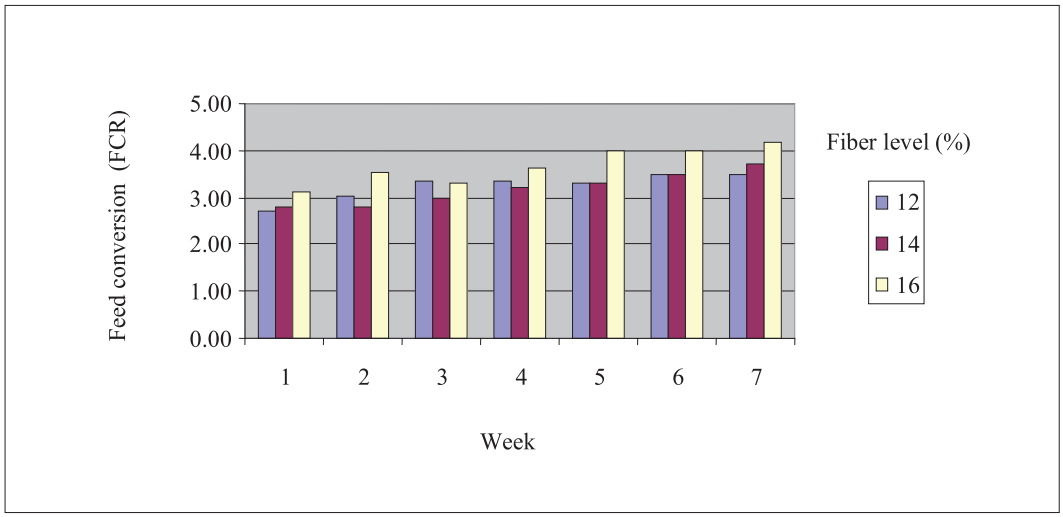

Figure 6. Effect of fiber level on feed conversion

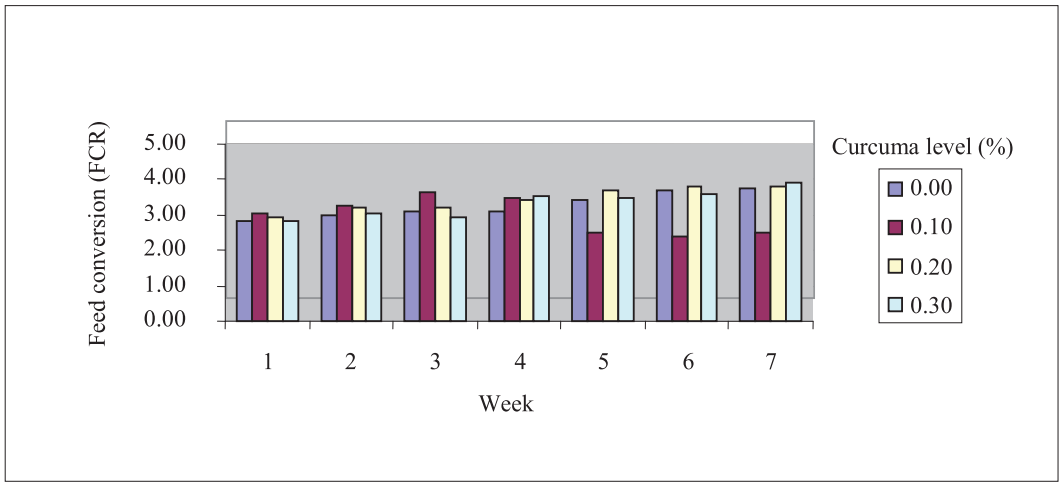

Figure 7. Effect of curcuma level on feed conversion

Tabel 8. Effect of fiber and turmeric levels on feed dry matter digestibility

Curcuma(%)	Fiber (%)			
	12	14	16	Average
0.0	71.64	64.85	58.02	64.84
0.1	76.27	64.53	58.53	66.44
0.2	71.19	64.84	57.81	64.61
0.3	69.17	63.73	57.01	63.30
Average	72.07	64.49	57.84	64.80

Effect of fiber level and curcuma on mortality rabbits are shown in Table 7. The mortality rate of rabbits (Figure 8) in this study were very high in any combination of treatments, ranging from 25 (14 and 16% fiber at 0.2% curcuma) - 100% (12% fiber at 0.1% curcuma). There is a significant interaction between levels of curcuma with the level of fiber in the diet on rabbit mortality.

Except at level 0%, increasing levels of curcuma and fiber significantly lower of mortality in rabbits. However, the effect is not always consistent. at level 0.1 and 0.2% curcuma, mortality decreased with increasing crude fiber content, but at the level of 0.3% curcuma, increasing crude fiber is not consistent decline, which at 16% fiber mortality increased again. While at every level of crude fiber, mortality is very fluctuating with increased levels of curcuma. Lowest mortality occurs in the ration with 14 and 16% fiber at 0.2% of curcuma. Sinurat et al. (2009) reported that 0.2% Curcuma resulted best production performance of broiler chickens.

Figure 8. Mortality of rabbits during experiment

Tabel 9. Effect of fiber and curcuma level on mortality rabbits for 7 weeks (%)

Curcuma (%)	Fiber (%)			
	12	14	16	Average
0	58.33	50.00	50.00	52.78
0.1	100.00	58.33	41.67	66.67
0.2	58.33	25.00	25.00	36.11
0.3	50.00	33.33	41.67	41.67
Average	66.66	41.67	39.58	49.31

The high mortality rate is very unusual case, although mortality at the level of farmers in Lembang, Magelang and Karo were also higher at the same time, so it takes a very serious effort to mitigate them. More than 90% mortality was recorded showing symptoms of enteritis, either bloating (Figure 9) and diarhea (Figure 10).

Figure 9. Bloating in rabbits (enlargement of caecum due to gas formation)

Figure 8 shows the percentage mortality of rabbits from the first week until the seventh week due to the influence of crude fiber content in the ration. It seems clear that the low crude fiber content (12%) led to higher mortality. This is consistent with some results that showing the 'indigestible fiber' (undigested fiber) can reduce the incidence of diarrhea (Cheeke 1983; Cheeke & Patton 1980, Gidenne & Garcia 2006).

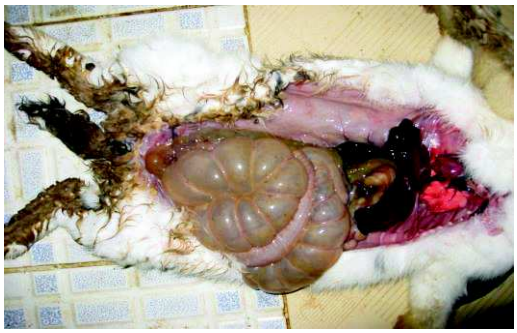

Figure 10. Diarrhea and bloating (note the black part of the wet/liquid faeces and enlarged caecum without content), as well as complications with the green-black liver on the side lobus)

Effect of fiber level and turmeric to the percentage of carcasses are presented in Table 8. There was no significant difference between treatments, though there is a tendency that increased fiber content causes a decrease in the percentage of carcasses. However this is more due to the low growth achieved (Table 2. Pattern carcass percentage appears to correlate linearly with body weight. High body weight gives a higher percentage of carcass , and vice versa. This happens at small rabbits, the percentage of the head, feet, skin become greater than the total body weight of carcass percentage consequently be lower.

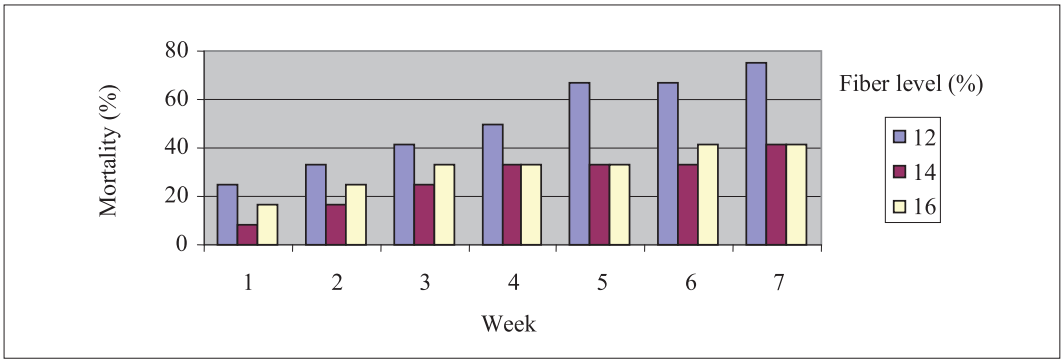

Figure 11. Rabbit mortality (%) from various fiber levels for 7 weeks

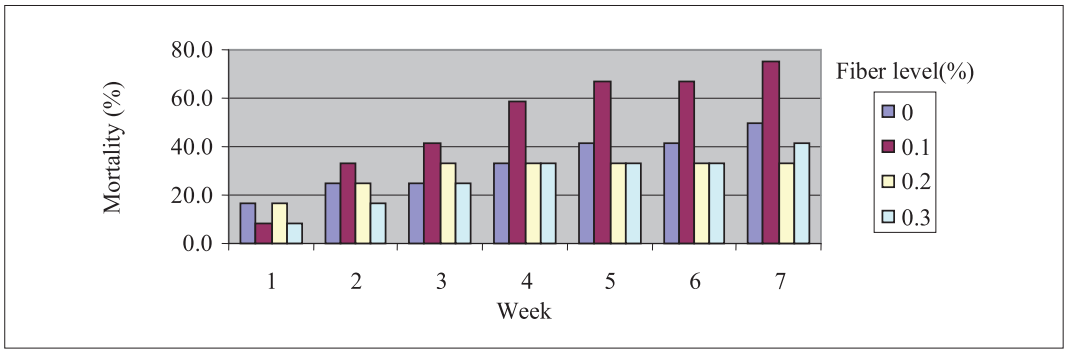

Figure 12. Rabbit mortality (%) from various curcuma levels for 7 weeks

Tabel 10. Effect of fiber and turmeric level in the diet on rabbit carcass percentage at week 7

Curcuma (%)	Fiber (%)			
	12	14	16	average
0.0	49.78	50.30	45.66	48.58
0.1	death	51.24	46.13	48.68
0.2	47.48	47.57	46.20	47.08
0.3	48.81	47.79	47.90	48.16
Average	48.69	49.22	46.47	

On the other hand, the level of 0.1% curcuma in the diet apparently caused the highest mortality (Figure 9). But other than that, an increase in curcuma lowers mortality, yet unknown mechanism of 'stimulation' or 'inhibition' curcuma on mortality rabbits

Percentage rabbit carcass that only 46-50% is considered low, due to the commercial rabbit, carcass percentage can reach 56%. Carcass percentage less than 50% carry a potential reduction in profits or even losses.

CONCLUSION

The results of this study indicate that the level of crude fiber significantly affect feed consumption, body weight, body weight gain, and digestibility of the ration. Also the reduction in mortality rabbits. Effect of crude fiber more real and more consistent than the effect of curcuma level. Crude fiber level of 14% and 0.2% curcuma is the best combination of performance in delivering growth and

lowest mortality. However, the mortality that occurred in this study was very high. The rate of mortality such as this, can not be obtained an economic benefits to be gained. Therefore, it is suggested that attention to mortality reduction is a higher priority compared to other efforts.

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