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Effect of Addition Level of Turmeric Powder (*Curcuma domestica*) in Diet on Growth Performance of Crossbred Rabbit

Yusti Pujiawati*, Ni Luh Gede Budiari, and I Made Rai Yasa

Bali Assessment Institute of Agriculture Technology Denpasar Selatan, 80222

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* Corresponding author:
Telp. +62 838 1230 9706
E-mail: yustipwiradinata@gmail.com

ABSTRACT

The use of feed additive of turmeric powder aimed to improve the growth performances of rabbits. Conducted this research in the Riang Gede Village, Penebel District, Bali Province, in July-October 2018. The rabbit used were 20 aged 8-week-old male crossbred rabbits (New Zealand White and Local Rabbits). The design experimental used was a completely randomized design with four treatments and five replications with details of treatment, namely ration without turmeric powder (P0), ration with 0.5% turmeric powder (P1), ration with 1% turmeric powder (P2), ration with 1.5% turmeric powder (P3). The parameters observed were daily weight gain, final body weight, feed intake, and feed conversion ratio (FCR). Turmeric powder has a positive impact on feed intake, daily body weight gain, FCR, and final body weight of rabbits. The addition of 1.5% turmeric powder had the highest feed intake at first and third-month research 72.98 g/head/day and 106.26 g/head/day. The turmeric powder of 1.5% in ration had the greatest feed conversion ratio of 3.85 with a final body weight of 1902.2 g/head.

Keywords: Crossbred rabbit, Curcumin, Daily body weight gain, FCR, Feed intake, Turmeric powder

Introduction

Rabbit is an alternative source of animal protein besides cow, goat, sheep, buffalo, and chicken. One of type the superior broiler rabbits is the New Zealand White rabbit. The daily body weight gain of New Zealand White rabbits with a crude protein content of 18% feed ranges from 9.69-19.83 g/head/day (Marhaeniyanto and Susanti, 2017). New Zealand White Rabbit has the lowest mortality, shortest gestation length in days was recorded for Havana Black. Also, New Zealand White and Havana Black had better reproductive performance than other breeds like Palomino brown and California breed (Fadare and Fatoba, 2018). The reproductive ability of rabbits is very high, giving birth to 10 times per year with ± 6 children per birth and weighing 2-3 kg at the age of 4.5-6 months. However, a rabbits are prone to diarrhea and cause mortality of 20% (Raharjo, 2005). Nevertheless, several efforts can be made to overcome diarrhea and improve the growth performance of rabbits, such as the use of turmeric as a natural antibiotic.

Turmeric has long been used as a kitchen spice and coloring agent. Besides that, the chemical content in turmeric acts as an anticoagulant, lowers blood pressure, anthelmintic, asthma medication, treats stomach ache, liver disease, carminative, itching, bites insects, diarrhea, and rheumatism (Keihanian *et al*., 2017; Yao *et al*., 2016; Cheraghipour *et al*., 2018; Abidi *et al*., 2014; Dulbecco and Savarino, 2013; Sikha *et al*., 2015; Umar *et al*., 2020; Yang *et al*., 2019). The curcumin content in turmeric ranges from 1.37-3.38% (Wirasuta *et al*., 2018). Many studies on turmeric to improve livestock production performance has been carried out. Nawab *et al*. (2020) laying hens supplemented with curcumin in diet have a better immunity level than control diets at high or normal temperature conditions. Supplementation of dietary curcumin enhanced growth performance and antioxidant biomarkers of heat-stressed broiler (Salah *et al*., 2019). The use of curcumin as an additional feed for nursing lambs can improve growth performance as an effect of antioxidant activity (Molosse *et al*., 2019). Budiari *et al*. (2020) stated that the provision of 1.5% turmeric powder could increase Bali Cattle production's performance and benefit farmers.

While in rabbits, supplementation with 150-300 mg/100 g turmeric in diet is known not to affect the weekly mean body weight gain, feed conversion ratio, and digestibility of rabbits under summer stress (Basavaraj *et al*., 2010). Information on the optimal level of use of turmeric powder to improve the growth performance of

rabbits has not been determined. In this study, the level of use of turmeric powder needs to be increased to achieve optimal growth performance. Based on this, it is necessary to further study the function of turmeric at various levels on the growth performance of rabbits. Therefore, the purpose of this study was to assess the optimal level of use of turmeric powder in the diet in crossbred rabbits between female New Zealand White and male local rabbits.

Materials and Methods

Experimental Location

This study was conducted in The Riang Gede Village, Penebel District Tabanan Regency, from July to October 2018. The preliminary period was done one week before parameters measurement.

Experimental Animal, Cage, and Feeding

This study used twenty male rabbits crossbred New Zealand White x Local Rabbit aged two months with an initial body weight of about 374-375 g/head. Rabbits were housed in a single cage per head equipped with a container for feed and drinking water. Other tools used are feed scales, body weight scales, and stationery.

The ration was composed of corn, fish meal, pollard, coconut oil cake, soybean powder, Napier grass, tapioca flour, turmeric powder, coconut oil, and premix.

Table 1. Composition of ration treatments

Feed Ingredients (%)	Treatments			
	P0	P1	P2	P3
Corn	20	20	20	20
Coconut oil cake	17	17	16.5	16
Fish Meal	6	6	6	6
Tapioca flour	10	10	10	10
Soybean powder	7.5	7.5	7.5	7.5
Pollard	21.5	20	20	20
Napier grass	15	15	15	15
Coconut oil	2	2	2	2
Bone meal	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Turmeric powder	0	0.5	1.0	1.5
Total	100	100	100	100

The feed is given in the form of a total mix ration dry. The turmeric powder is made by washing the turmeric clean, cutting it into smaller sizes, and drying it in an oven at 60ºC. The dried turmeric is crushed into powder. The experimental feed was given for three months of rearing rabbits by one week for a preliminary period. The composition of the treatment ration is presented in Table 1; meanwhile, the nutrient content is presented in Table 2. The Ration is given twice a day, i.e., in the morning (at 7 a.m) and afternoon (at 4 p.m) with an equal portion.

Experimental design

The experimental design used was a completely randomized design with four treatments and five replications. The treatments tested are P0: ration without turmeric powder (control), P1: control+0.5% turmeric powder, P2: control+1% turmeric powder, P3: control+1.5% turmeric powder. The level of use of turmeric flour is determined based on the study of Al-Kassie *et al*., (2011) stated that the use level of turmeric 0.75-1% in ration. The observed variables included daily body weight gain, final body weight, feed intake, water intake, and feed conversion ratio (FCR). The data obtained were analyzed by analysis of variance; if between treatments, there were significant differences ($P<0.05$), then continued the analysis with polynomial orthogonal test (Steel and Torrie, 1980).

The dietary intake is calculated every day, while the nutrient intake is measured by the number of nutrients given minus the remaining nutrient. In addition, weighing body weight is carried out every month for three months of raising rabbits. The feed conversion ratio (FCR) was calculated by dividing the amount of ration intake by the bodyweight gain during the study.

Results and Discussion

Effect of Turmeric Powder to Feed and Nutrient Intake

Feed intake was affected by treatment ($P<0.05$; $y = -67.953x3 + 150.7x2 – 54.372x + 244.01$ $R=0.7791$). In general, the rabbit's feed intake with turmeric powder was higher than the control (Table 3). In this study, the addition of turmeric powder in ration did not decrease palatability, although turmeric has a bitter taste (Forsyth *et al*., 2019). According to Al-Kassie *et al*. (2011), supplementation up to 2% in ration's broiler did not affect feed intake, but increasing supplementation to 4% resulted in a significant decrease in feed intake. In this study, at 9 weeks of age, rabbits, adding 1.0% and 1.5% turmeric powder in the ration, have the highest feed intake than other treatments ($P<0.05$). The daily feed intake for both treatments was 69.90 and 72.98 g/day; this figure was higher than the Pratiwi *et al*. (2017) study, which obtained feed intake for male rex rabbits 67.36 g/head/day. The curcumin in turmeric can affect appetite due to increased enzymes and bile acid production to accelerate the digestive process (Indrawati *et al*., 2018). Based on Figure 1, there is an indication that the optimal level of turmeric powder for a rabbit's feed intake is between 1-1.5%. The feed intake certainly determines the amount of nutrient intake, and also influenced by the supplementation of turmeric powder (Table 3; $P<0.05$).

The highest digestible energy (DE) intake is in giving 1.0% and 1.5% turmeric powder. In this study, DE intake ranged between 144.06-179.22 kcal/head/day. In this study, the range of DE intake is still following the NRC (1977) standard, which stated that the daily DE intake for growth rabbits is 150 kcal/head/day. However, higher than the study by Pratiwi *et al*. (2017) daily DE intake in male rex rabbits ranged from

Table 2. Nutrient content of ration treatments

Nutrient	Treatments			
	P0	P1	P2	P3
DE (Kcal/kg)*	2486.40	2478.70	2479.00	2455.71
Crude Protein %	17.49	17.71	18.02	17.79
Ether Extract %	4.94	4.44	4.02	4.84
Crude Fiber %	10.28	10.21	10.13	10.26
Calcium %	0.33	0.33	0.32	0.41
Phosporus %	0.62	0.59	0.55	0.64
Lysine %	0.62	0.59	0.55	0.55
Methionine + cysteine %	0.40	0.38	0.35	0.35
Isoleucine %	0.61	0.58	0.55	0.54
Leucine %	1.99	0.93	0.87	0.89
Phenylalanine + Tyrosine %	1.99	0.88	0.81	0.84
Threonine %	0.48	0.45	0.41	0.42
Tryptophan%	0.12	0.11	0.10	0.10
Valine %	0.63	0.59	0.54	0.55

*DE: Digestible energy

Table 3. Effect level of turmeric powder to daily nutrient and water Intake

Nutrient*	Treatments2)			
	P0	P1	P2	P3
Month I				
Feed Intake (g/head/day)	57.94±2.99^{a}	59.04±5.02^{a}	69.90±2.07^{b}	72.98±8.22^{b}
DE (kcal/head/day)	144.06±7.44^{a}	146.33±12.43^{a}	173.28±5.13^{b}	179.22±20.20^{b}
CP (g/head/day)	10.13±0.52^{a}	10.46±0.89^{a}	12.60±0.38^{b}	12.99±1.46^{b}
EE (g/head/day)	2.86±0.15^{a}	2.62±0.22^{a}	2.81±0.08^{a}	3.54±0.40^{b}
CF (g/head/day)	5.96±0.31^{a}	6.03±0.51^{a}	7.08±0.21^{b}	7.49±0.84^{b}
Ca (g/head/day)	0.19±0.01^{a}	0.19±0.02^{a}	0.22±0.01^{b}	0.30±0.04^{c}
P (g/head/day)	0.36±0.02^{a}	0.35±0.03^{a}	0.35±0.01^{a}	0.46±0.05^{b}
Month II				
Feed Intake (g/head/day)	86.95±3.62^{a}	93.71±6.85^{b}	100.02±1.08^{c}	92.95±4.08^{b}
DE (kcal/head/day)	216.18±8.99^{a}	232.28±16.97^{b}	247.94±2.66^{c}	228.26±10.03^{ab}
CP (g/head/day)	15.21±0.63^{a}	16.59±1.21^{b}	18.02±0.19^{c}	16.54±0.73^{b}
EE (g/head/day)	4.29±0.18^{ab}	4.16±0.30^{a}	4.02±0.05^{a}	4.50±0.20^{b}
CF (g/head/day)	8.94±0.37^{a}	9.57±0.70^{ab}	10.13±0.11^{b}	9.54±0.42^{ab}
Ca (g/head/day)	0.29±0.01^{a}	0.31±0.02^{a}	0.32±0.01^{a}	0.36±0.05^{b}
P (g/head/day)	0.54±0.02^{a}	0.55±0.04^{a}	0.55±0.01^{a}	0.60±0.02^{b}
Month III				
Feed Intake (g/head/day)	99.12±6.75^{b}	93.25±3.31^{a}	102.47±3.81^{bc}	106.26±1.52^{c}
DE (kcal/head/day)	246.46±16.79^{b}	231.15±8.20^{a}	254.02±9.45^{b}	260.94±3.74^{b}
CP (g/head/day)	17.34±1.18^{a}	16.62±0.76^{a}	18.46±0.68^{b}	18.90±0.27^{b}
EE (g/head/day)	4.98±0.25^{b}	4.23±0.21^{a}	4.12±0.15^{a}	5.14±0.07^{b}
CF (g/head/day)	10.19±0.69^{b}	9.52±0.34^{a}	10.38±0.39^{bc}	10.90±0.15^{c}
Ca (g/head/day)	0.33±0.02^{a}	0.31±0.13^{a}	0.33±0.01^{a}	0.43±0.01^{b}
P (g/head/day)	0.62±0.04^{b}	0.54±0.23^{a}	0.56±0.02^{a}	0.68±0.01^{c}
Total Feed Intake (g/head/day)	244.01±6.11^{a}	246.00±13.00^{a}	272.38±4.13^{b}	272.19±6.41^{b}

*DE: Digestible energy, CP: Crude Protein, EE: Ether extract, CF: Crude fiber, Ca: Calcium, P: Phosphor; **Values with different superscript in the same rows show a significant difference (P<0.05).

105.09-131.36 kcal/head/day. The high DE intake is expected to support the better productive performance of the rabbits.

The different levels of turmeric powder did affect crude protein (CP) intake (Table 3; P<0.05). This is because the feed intake has also increased, as is the case with DE intake. The treatments of adding 1% and 1.5% turmeric powder obtained the highest CP intake than other treatments. Crude protein intake for P2 and P3 treatments, respectively 12.60 and 12.99 g/head/day. Crude protein intake in this study lower than Safwat *et al*. (2015), which has a CP intake of 17.95 g/head/day, but higher than the study Pratiwi *et al*. (2017), which has a CP intake of 10.44 g/head/day. NRC (1977) stated that the daily requirement of crude protein for growth rabbits was 9.6 g/head/day. Therefore, adequate crude protein intake is expected to be able to support increased growth performance. Rabbits are more efficient at digesting protein in plants than other simple-stomached animals, such as swine and poultry (NRC, 1977).

Likewise, the intake of extract ether, crude fiber, Ca, and P is influenced by the level of turmeric powder supplementation (Table 3; P<0.05). In line with level feed intake, P3 treatment obtained more nutrient intake than other treatments. In the same study, Pratiwi *et al*. (2017) stated that ether extract intake for ration with ether extract content of 4%, namely 2.98 g/head/day. Ether extract intake for 1.5% turmeric powder supplementation is 3.54 g/head/day (Table 3); this value is higher than the daily ether extract intake requirement, namely 1.2 g/head/day (NRC, 1977). Fat or fatty acid in a diet that plays a role as a hormone precursor also functions as high energy density in diet (Pujiawati *et al*., 2018). Therefore, several studies state that high dietary fat content can reduce feed intake but, on the other hand, can increase daily gain in rabbits (Eiben *et al*., 2010; Pratiwi *et al*., 2017). In this study, although the ether extract intake is higher than the standard NRC (1977), it has not impacted reducing feed intake at 1 to 3 months of the experiment.

Intake of crude fiber (CF), Ca dan P was also influenced by turmeric powder

supplementation (P<0.05; Table 3). The highest intake of CF, Ca and P was in the P3 treatment (1.5% turmeric powder). Crude fiber intake in this study following the NRC (1977), which states that crude fiber intake should be between 10-12%. This also applies to the intake of Ca dan P, which is still following the standard daily require for growing rabbits (NRC, 1977).

Effect of Turmeric Powder on Growth Performance

Effect of turmeric powder on growth performance presented in Table 4. The treatment of turmeric powder supplementation at various levels affects daily body weight gain. Feed conversion ration and final body weight of rabbits. The supplementation of 1% turmeric powder produced the highest daily body weight gain compared to control and other levels of turmeric powder (P<0.05; y = -10.747x3 + 16.756x2 – 0.0393x + 16.81; R=0.9459) . Daily body weight gain in P2 treatment is 22.78 gs/head/day (Table 4). Turmeric powder has a positive effect on body weight gain indicated because of its curcumin content.

The curcumin content in turmeric can improve production performance in various ways. Xun *et al*. (2015) stated that curcumin might have properties as a digestive enhancer. And thus improve growth performance. The curcumin content had been able to improve antioxidant activity and animal health, resulting in better production performance (Molosse *et al*., 2019). According to Földešiová *et al*. (2015) which stated that supplementation of *Curcuma longa* powder to the commercial diet for rabbits positively affected weight gain in rabbits does. The benefits of turmeric powder for body weight gain and growth performance are also found in broiler chickens (Al-Kassie *et al*., 2011). Laying hens (Park *et al*., 2012) and dairy sheep (Jaguezeski *et al*., 2018).

In this study, the daily body weight gains higher in P2 treatment than P3 treatment (Table 4). Figure 2 shows a decrease in daily body weight gain when the level of turmeric powder is added. According to Földešiová *et al*. (2015) who found the addition of turmeric powder level of 5 g/100 kg feed mixture resulted in a better body weight gain than the level of 20 g/100 kg. This case is possible because high levels of turmeric powder possibly decreased dry matter digestibility (Pujianti *et al*., 2013). Therefore, the optimal level of turmeric powder for rabbits' daily weight gain is likely to be in the 1-1.05% range (Y= -10.747x3+16.756x2-0.0393x+16.81).

The feed conversion ratio is also affected by turmeric powder supplementation (P<0.05; y=-3.3867x3 + 7.292x2 – 4.2113x + 5.186; R=0.8391). In contrast with daily body weight gain. P2 treatment (1% turmeric powder) showed that the feed efficiency was worse than other treatments or the same as the treatment without the addition of turmeric powder (Table 4; P<0.05). This means that the feed intake is not proportional to the weight gain of the rabbit. This condition is also found in the study of Riasi *et al*. (2012), which found that supplementation of 1.5 g/kg turmeric rhizome in laying hens diet produces the highest FCR compared to 2 g/kg and control group. This shows that the positive impact of turmeric powder needs to be supported by the right level. Figure 2 shows the optimal level for FCR is at 1.5% turmeric powder in the diet. The positive impact of turmeric powder on FCR and daily weight gain rabbits needs to be further evaluated. It can indicate that turmeric powder has a positive impact on the activity of pancreatic enzyme

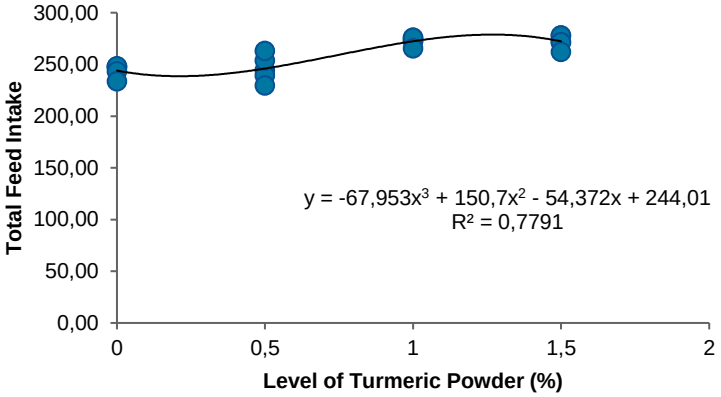

Figure 1. Polynomial curve of the effect of turmeric powder level on feed intake.

Table 4. The Data of Production Performance

Parameters	Treatments			
	P0	P1	P2	P3
Initial Body Weight (g/head)	374.2±8.87	374.8±17.54	374.8±22.49	375±28.50
Daily Body Weight Gain (g/head/day)	16.81±0.32[a]	19.64±0.66[c]	22.78±0.62[d]	18.18±0.69[b]
Feed Conversion Ratio	5.19±0.19[c]	4.48±0.31[b]	4.88±0.18[c]	3.85±0.28[a]
Final Body Weight (g/head)	1786.20±19.49[a]	2024.2±47.74[c]	2288.4±66.44[d]	1902.2±36.29[b]

[a, b]Values with different superscript in the same row show a significant difference (P<0.05)

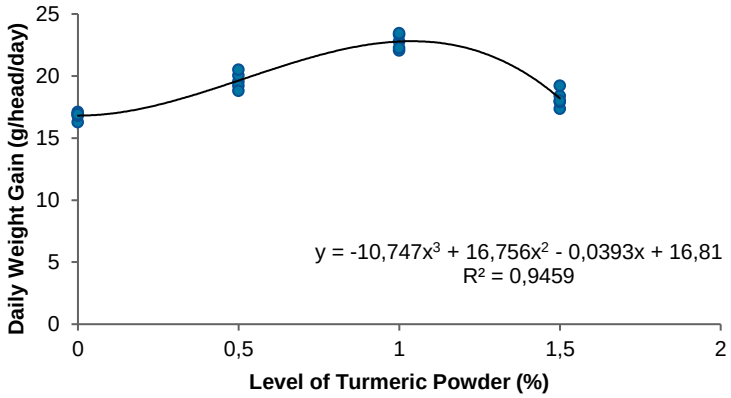

Figure 2. Polynomial curve effect of turmeric powder level on daily weight gain.

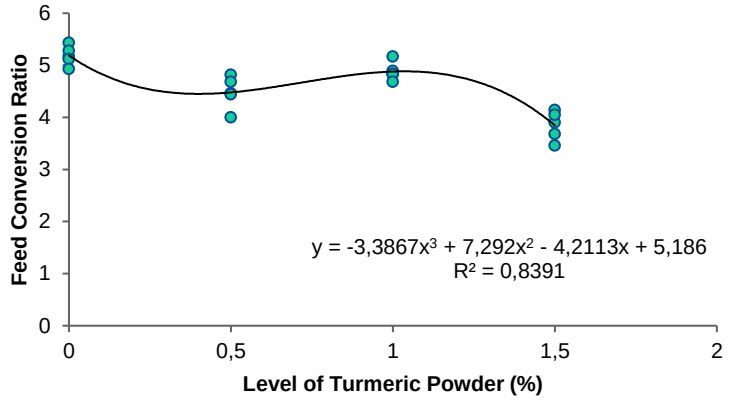

Figure 3. Polynomial curve of the effect of turmeric powder level on feed conversion ratio.

activity (Purwanti *et al*., 2015), or turmeric powder has a positive impact on antioxidant activity to improve growth performance (Riasi *et al*., 2012).

Table 4 presents the 1% turmeric powder supplementation with the greatest final weight compared to other treatments. This consistent with daily body weight gain even though the FCR value is higher (P<0.05). Following Földešiová *et al*. (2015) showed that the addition of turmeric resulted in better body weight in rabbits. This condition is also found in broiler chicks (Rajput *et al*., 2012), rats (Gyu Kim *et al*., 2014) and goat (Oderinwale *et al*., 2019).

Conclusions

Turmeric powder has a positive impact on feed intake. daily body weight gain. FCR and final body weight of rabbits. The addition of 1.5% turmeric powder in diet produces the most optimal growth performance.

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