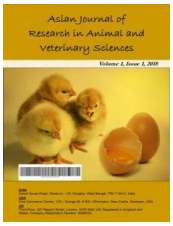

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Performances of Rabbit Fed Diets with Graded Levels of Bean Offal (*Phaseolus vulgaris* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MKH and FLB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author NF managed the analyses of the study. Author TA managed the literature searches and read the final draft. All authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

Aims: The aim of the study was to increase rabbit production by evaluating the effects of bean offal on the growth performance of the New Zealand rabbits breed and to reduce the economic costs of feed.
Study Design: Study was conducted in a completely randomized design.
Methodology: For this purpose, forty-eight (48) rabbits of 50 days old were divided into four equal groups each containing 12 rabbits and into sub-groups of 3 rabbits per cage, depending on the rate of incorporation of bean offal (0, 15, 22.5, and 30% respectively for T0, T15, T22.5 and T30) in a completely randomized design. The diets were iso caloric and iso nitrogenous.
Results: The results obtained showed that there was no significance (p> 0.05) different among treatment means in final live weight, weekly live weight and feed conversion ratio (FCR), however,

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feed intake was significantly higher in the control diet T0 (3251±554.96 g) as compared to T22.5 (31412±554.96 g). Weight gain of rabbit fed dietT22.5 was higher (3173±284.93 g) as compared to those fed on control diet T0 that recorded the lowest values (2986.67±284.93 g). Cost of production per kg of live weight was significantly higher ($p<0.05$) with rabbit fed on control diet T0 (7835.79±278.62 FCFA) whereas the lowest value was recorded with rabbit under diet T30 (7232.06±278.62 FCFA).

Conclusion: It is concluded that up to 22% of bean offal could be included in rabbit diet to reduce cost of feed and improve performances.

Keywords: Bean offal; diets; growth and rabbit.

1. INTRODUCTION

There is limited access to protein sources in most countries of the sub-Saharan Africa and Cameroon in particular. In Cameroon, animal protein intake is approximately 17 kg/caput/year [1] which is less than the 42 kg/caput/year recommended by the Food and Agricultural Organisation (FAO) and the World Health Organisation (WHO). To cover the gap, there is an urgent need to increase livestock in the country. This necessitated the continuous research into more cost-effective systems for meat production [2] and rabbit production appear as one of the most suitable way. In fact, rabbit have good attributes which include high efficiency in converting forage to meat, short gestation period, high prolificacy, relatively low cost of production, high nutritional quality. Moreover, rabbit possess the ability to digest large amount of fibrous feed in the diet which can be used properly to reduce the cost of production [3]. Despite these advantages, rabbit production in Cameroon is still critically low because of unsuitable production technique, unavailability of parent stock and high feed cost. In rabbit intensive farming, feed accounts for 60 to 70% of production costs [4]. The use of unconventional foodstuffs is one of the alternatives that can be adopted to reduce production costs [5]. Economically, it would provide the poorer strata of the population with cheap access to animal proteins. In fact, previous research reveals that the utilization of agricultural by product in rabbit diet lead to a reduction in production cost without impairing growth performances [3,6]. Furthermore, as reported by Hamed et al. [7] the used of pea offal and hay in rabbit diet reduce the production cost of the ration and improve the feed conversion ratio. In Cameroon, leguminous plant such as bean is abundantly produced (51×103 tons/year) (INS, 2015), the offal is generally abandoned in fields or sometimes are burn after the harvest. Feedipedia [8], reported that bean offal contains 7.1% of crude proteins, 41.0% of crude fiber, 8.9% of ash. Bean offal properly used, can be a good source fiber which will reduce production cost. This study was aimed to investigate the effect of bean offal on growth performances and cost of production of rabbit.

2. MATERIALS AND METHODS

The study was conducted using forty-eight (48) healthy, New Zealand rabbit breed of 50 (fifty) days old and weighing between 1.1 and 1.2 Kg. Before the arrival of the animals the breeding house, the metabolic cages and all equipment such as drinkers, feeders, and buckets were thoroughly cleaned, washed and disinfected with Cresyl®. These rabbits were randomly allocated to 4 groups of 12 animals each. Bean offal was purchase in Badjoun rural organization farm directly after harvest. Four rations were formulated containing 0% (control feed), 15%, 22.5%, and 30% bean offal representing T0, T15, T22.5 and T30 respectively.

The composition of the various diets fed to the rabbits is shown in Table 1.

The rabbits were allowed to access water and feed *ad libitum*. The experiment was a complete randomized design. Eighteen weaned rabbits, of average weight 536 g were allotted to four treatments, with six rabbits per treatment diet.

The animals were weighed weekly and feed intake was measured daily. Feed conversion ratio was then calculated from the data obtained.

2.1 Economic Analysis

Economic analysis consisted of estimating the economic benefit of incorporating bean offal in rabbit diet. Only the direct variable costs are thus taken into account here. The characteristics evaluated were price of kg of diet, price of feed consumption and prize of kg of live weight.

Table 1. Composition of experimental diet

Ingredients	T_0	T_{15}	$T_{22.5}$	T_{30}
Maize	30	28.5	28.5	29
Wheat bran	5	7	6.6	8
Pennisetum purpurum	30	15	7.5	0
Bean offal	0	15	22.5	30
Soya bean cake	5	7	7	7
Cotton cake	6.5	6	6	7
Palm cake	11	10	10	6
Fish meal	3	3	3	4.5
Lime stone	0.5	1	1	1.5
Premix	5	5	5	5
Oil	4	2.5	2	2
Total	**100**	**100**	**100**	**100**
Chemical composition				
Metabolisableenergy	2586	2587	2580	2610
Digestible energy	3150	3154	3200	3200
Crudeprotein	17.4	17.4	17.3	17.7
Cellulose	15 .00	15.30	15.8	15.7
Prize/kg(FCFA)	241	231	230	227

2.2 Statistical Analysis

At the end of the experiment, the different results were processed using the Microsoft Excel spreadsheet. The statistical analysis and comparison of averages between the different dietary schemes (control and those based on bean offal) were conducted by means of one-way analysis of variance (ANOVA) test using the Statistical Package for the Social Sciences software (SPSS version 21). Duncan test were performed if the ANOVA test displayed a significant difference from the error risk of 5% ($p<0.05$). Pearson test was used to determine the relation between growth parameter and incorporation level of offal bean.

2.3 Ethical Approval

The present study was conducted after approval of Institutional Animal Ethics Committee of Dschang University, Cameroon.

3. RESULTS AND DISCUSSION

The mean feed intake, body weight, total weight gain and feed conversion ratio (FCR) as affected by bean offal are presented in Table 2. Generally, it appears that apart from feed intake, all other characteristics were not significantly affected ($p>0.05$) with the bean offal levels in the diet.

Rabbit fed on the control diet recorded the highest feed intake ($p>0.05$) as compared to rabbit fed on diet containing bean offal. This decreased in trend is confirmed by the regression curve presented in Fig. 1. This curve reveals that, 60% of variation recorded in feed intake can be attributed to bean offal level in the diet (R^2=0.61). This feed intake reduction can be attributed to the high concentration of tannin and lignin present in bean offal. In fact, tannin and lignin are antinutritional factors in agricultural by products which deprived intake [9,3]. This result corroborated with those of El-Gendy et al. [10] and Mennani et al. [3] that recorded a decrease in feed intake in rabbits when fed with graded level of sorghum offal and apricot kernel respectively. In contrary, Fatma et al. [11] and Omer et al. [12] recorded no significant difference between control diet and those containing hay in rabbit. This difference may be attributed to the high incorporation level and type of agricultural by product used.

The inclusion of *bean offal* in the diet did not significantly affected body weight, body weight gain and feed conversion ratio. Similar results have also been reported by other authors [13,3]. However, it tends to increase body weight and body weight gain as compared to the control diet (Table 2). This trend is illustrated in Fig. 2. The parabolic shape shows that from 0 to 22.5%, body weight increases with the level of bean offal in the diet up to 30% it tends to decrease weight. This result is in line with those of [13] which obtained an improved in rabbit weight when fed diet containing Bersem offal as compared to the control diet.

Table 2. Growth performances of growing rabbit graded levels of bean offal

Characteristics	Diets				SEM	p
	T_0	T_{15}	$T_{22.5}$	T_{30}		
Feedintake (g)	32513.67[b]	32184.67[ab]	31412[a]	31859.33[ab]	554.96	0.004
Body weight (g)	7812.5[a]	7783.33[a]	7791.67[a]	7820.83[a]	227.88	0.998
Body weight gain (g)	2986.67[a]	3080.00[a]	3173.33[a]	3010.00[a]	284.93	0.891
Dailly weight gain (g)	53.33[a]	55.00[a]	56.67[a]	53.75[a]	5.09	0.891
Feed conversion ratio	10.95[a]	10.45[a]	9.95[a]	10.81[a]	1.14	0.770

a,b: mean with the same superscript are not significantly different at 0.05 significant level; SEM: standard errors of mean; p: p-value

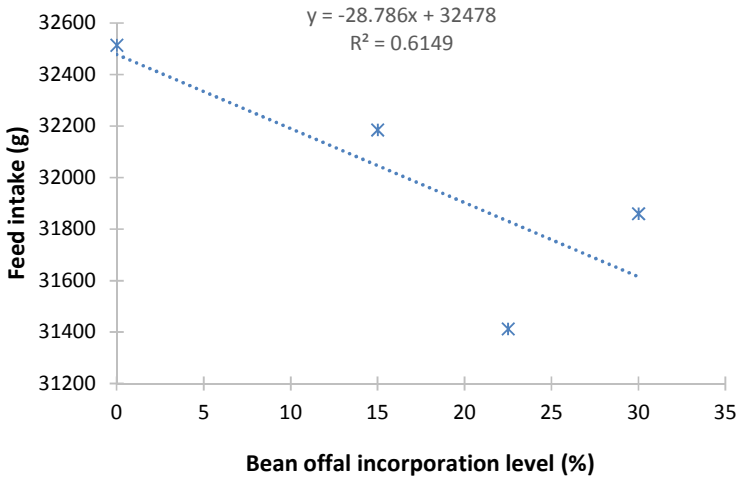

Fig. 1. Relationships feed intake in rabbit and level of incorporation of bean offal

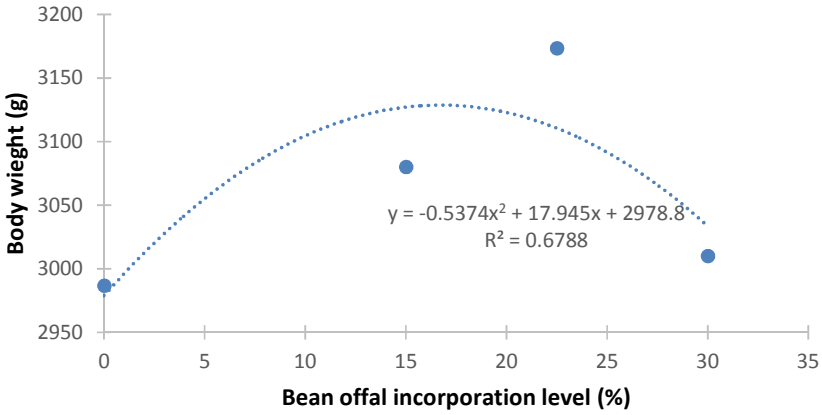

Fig. 2. Correlation between final body weight and bean offal incorporation level in rabbit diet

Feed conversion was not significantly affected ($p>0.05$) by bean offal incorporation in the diet. However, it tends to decrease with the level of offal in the diet. The illustration of this trend is presented in Fig. 3 showing that from 0 to 22.5% bean offal decreased FCR but above this level, FCR increases instead.

Feeding rabbits with bean offal at 22.5% in the diet reduced FCR by 10% when bean offal was as compared to control. We can therefore suggest that, feed efficiency is improved by bean offal as source of fiber. This finding is in line with those of Safwat et al. [14] who reported that leguminous offal (bean and groundnut) in rabbit

diet reduced feed conversion ratio. This can be explained by the reduction in digestive transit time and increase in caeca microbiota as reported by Bennegadi et al. [15] and Fatma et al. [11].

3.1 Economics Analysis

Effects of bean offal on feed cost of production of rabbit are presented in Table 3. Feed consumption decreases significantly ($p<0.05$) with the incorporation of bean offal in the diet.

The lowest feed consumption cost was recorded with diet T22.5 and T30 containing 22.5 and 30% bean offal respectively as compared to the rest of the treatment. In contrary, cost of production was not significantly affected ($p>0.05$) by the level of bean offal in the diet although a slit decrease was recorded in production cost when the rate of incorporation of bean offal increased (Fig. 4). Diet T22.5 decreased feed production cost by 13% as compared to the control diet. Moreover, the relation between bean offal ratio and cost of production was very high. As presented in Fig. 4, the correlation coefficient between these two variables was R2=0.97 meaning that 97% of variation observed in feed cost of production are related to bean offal.

The utilization of agricultural by product lead to the reduction in the cost of production off rabbit meat. Similar results were reported by El-Medany et al. [16] and later Hamed et al. [7]. These authors recorded that, incorporation of red bean and peanut offal in the diet resulted to a decrease in production cost and were therefore more economically efficient (increase breeder net return). This improvement is due to the combined effect of this ingredient on the low cost of the diet and the benefit on digestion via the caeca microbiota [17].

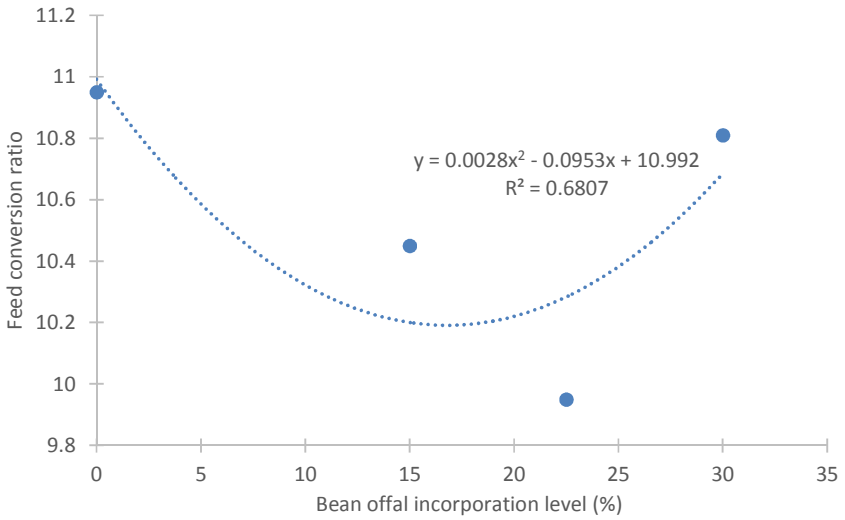

Fig. 3. Correlation between feed conversion ratio and bean offal incorporation level in rabbit diet

Table 3. Economic analysis of rabbit production as affected by incorporation of bean offal in the diet

Characteristics	Rations				SEM	p
	T_0	T_{15}	$T_{22.5}$	T_{30}		
Price of feed (FCFA/kg)	241	231	230	227	/	
Feed consumption cost	7835.79^{c}	7434.66^{b}	7224.76^{a}	7232.07^{a}	278.62	0.000
Feed cost for production of Kg of live weight (FCFA)	2639.36^{a}	2414.26^{a}	2289.19^{a}	2454.62^{a}	271.41	0.548

a,b: mean with the same superscript are not significantly different at 0.05 significant level SEM: standard errors of mean; p: p-value

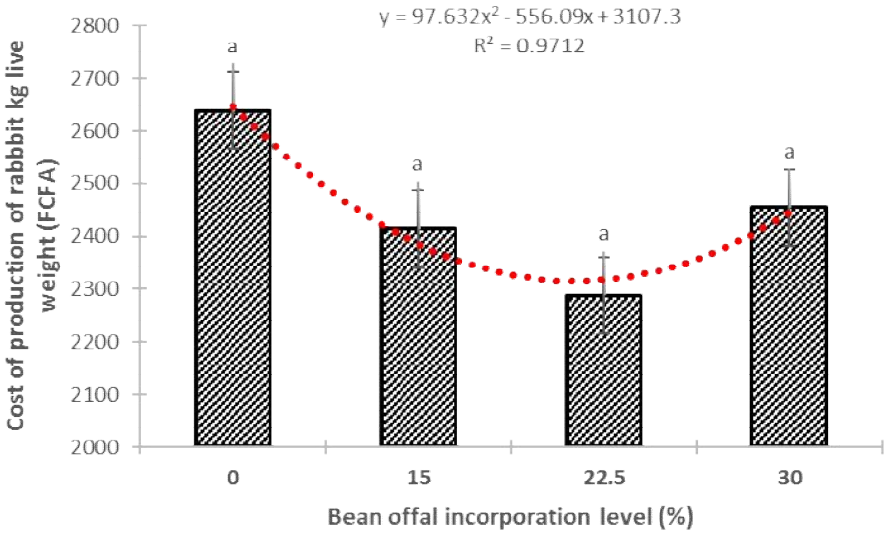

Fig. 4. Correlation between feed cost of production per kg of live weight and bean offal incorporation level in rabbit diet

4. CONCLUSION

The result of the study indicated that 22.5% of bean offal could be included in the diet of weaned rabbits without adverse effects on performance.

Rabbits fed on bean offal inclusion level of 22.5% recorded the highest weight gain and cheapest cost of production.

Farmers should therefore take advantage of the availability of bean offal to lower the cost of feed and also increase their profit margin.

ETHICAL APPROVAL

The present study was conducted after approval of Institutional Animal Ethics Committee of Dschang University, Cameroon.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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