EFFECT OF VARIOUS FIBER SOURCES ON THE GROWTH OF WEANED RABBIT

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Effect of Various Fiber Sources on the Growth of Weaned Rabbit

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ABSTRACT

Four fiber sources (cane-top, rice straw, saw dust and rice hull) were observed in this study. Digestibility trial was carried out using 12 male satin rabbit (3 replicates, each of 4 rabbits). Each of test fiber source was mixed with a basal diet at 1:1 ratio and then were pelleted. Three days adaption period was applied and followed with 7 days feeding and fecal collection. Protein digestibility was 30.78% (basal+canetop) and 57.22% for basal diet. Energy digestibily showed positive value, however NDF, ADF and lignin digestibilities showed negative values for basal and basal + canetop, rice straw and saw dust. The result showed that rice hull gave positive values for all digestibility subjects. Feeding trial was conducted to 100 weaned rabbit (6 week-old) with 5 treatments (1)Control, 2) Basal+canetop, 3) Basal+ rice straw, 4) Basal+ saw dust and 5) Basal+ rice hull. The crude protein content was between 17.6 % and 18.27% and gross energy was between 3834 and 4499 kcal/ kg. Feed consumption, weight gain, feed consumption ratio was measured. The average of total mortality in the 6th week reached 27% with the highest for basal+canetop treatment (45%) and followed with saw dust (30%), for rice straw and rice hull (both 25%). Average daily feed consumption of each rabbit for control basal (B), basal+canetop (BCT), basal+rice straw (BRS), basal+saw dust (BSD) and basal+rice hull (BRH) treatments were 100.02; 72.65; 69.54; 65.76 dan 63.95 g respectively. The average of feed consumption ratio for B, BCT, BRS, BSD and BRH were 4.68, 6.87; 6.15; 6.88 and 7.40 respectively and average of daily weight gain for B, BCT, BRH, BRS and BSD were 17.2; 11.11; 5.62; 14.34 and 8.19 g respectively. Rice straw could be a promising fiber source that can be used for rabbit diet.

Key Words: Fiber Sources, Rice Hull, Cane Tops, Saw Dust, Rice Straw

INTRODUCTION

Fiber is an important component in a rabbit ration and it is recommended that 12-16% of rabbit feed should be crude fiber (de Blas 2004). While fiber is not considered to be an "essential" nutrient, however it is certainly important to the rabbit to maintain a healthy gut function, motility and transit of feed ingested (Belenguer et al. 2002; Garcia et al. 1993). Low fiber intake has been reported to decrease the volatile fatty acid (VFA), increase pH and ammonia levels in the caecum (Gidenne et al. 2004). Indonesia is one of the intensive agriculture countries in South East Asia with rice as the most priority crop. Byproduct from agriculture is abundant in Indonesia such as of rice (rice bran, straw, hull /husk), sugarcane (sugarcane top, bagasse, molasses) and wood (sawdust).

Rice straw is usually used as alternative feedstuffs for the animals in most rice-based farm areas in Indonesia, especially during dry season. Rice straw has low content of essential nutrients like protein, energy, minerals and vitamins as well as poor palatability and digestibility. The main components of rice straw are fibrous cell wall substances consisting of cellulose, hemicellulose, lignin and silica. With the proportion of 20% husk and 50% straw in rice weight (Lim et al. 2012), the production of rice husk and straw may reach 14 million and 34.5 million ton per year, respectively (Ministry of Agriculture 2013). Rice straw is commonly used for cattle feed by farmers, while rice hull was rarely used as animal feed.

Sugar cane top is a major side-product of the sugar industry and obtained after the harvesting of the sugarcane plant. Indonesian sugarcane area had reached 418,000 hectares in 2010 with sugarcane production was 34 million tons and approximately produced 16.7 million tons of waste products as cane top and bagasse (Directorate General of Crops Plantations 2011). Cane top and bagasse are familiar to farmers and used as feed for cattle or other ruminant animals.

Meanwhile saw dust as a waste from wood industry although is abundant but is not used as animal feed. Those agricultural wastes are rich in crude fiber component and since fiber is essential in rabbit feed, their digestibility, chemical composition and their effect on rabbit growth rate were evaluated and reported.

MATERIALS AND METHODS

Digestibility trial was performed using 12 weaned rabbit. Tested ingredients were cane top (CT), rice hull (RH), rice straw (RS) and saw dust (SD), each was mixed (1 : 1w/w) with basal diet (Table 1). Feeding was conducted for 3 days adaptation period and 7 days collection periods. Intake, feed refusal, fecal produced were recorded. Proximate analysis (crude protein, CP; Crude fiber, CF; fiber fractions (NDF, neutral detergent fiber and ADF, acid detergent fiber) and energy was measured. Crude protein, CF, NDF. ADF and lignin digestibility were calculated.

Feeding trial was conducted using 100 weaned rabbit for 6 weeks. Basal diets consist of fish meal, soybean meal, coconut kernel cake, rice bran, corn, elephant grass, vegetable oil, premix (Table 1).

Feeding was performed in five treatments as follows: (1) Control: basal diet (B, Table 1); (2) Basal diet containing cane top (BCT); (3) Basal diet containing rice hull (BRH); (4)Basal diet containing rice straw (BRS); (5) Basal diet containing saw dust (BSD).

Table 1. Basal diet composition

Feed Ingredient	%
Corn	27.0
Elephant grass	25.0
Soybean meal	16.2
Rice bran	15.3
Coconut kernel cake	7.5
Fish meal	3.0
CPO	2.0
Molases	2.0
$CaCO_3$	1.0
DCP	0.5
Topmix	0.3
Salt	0.2

When fiber material was added, elephant grass was omitted. All fiber feed materials were added to basal diet to meet the minimum fiber content for rabbit (12%). Feed offered, feed refusal, weekly body weight were recorded.

RESULTS AND DISCUSSION

Digestibility

Proximate analysis of fiber feed material, basal diet, and faecal samples were shown in Table 2. Basal diet (B) contained 17.66% protein and protein content in basal + fiber feed ingredient was between 11 and 15%. The dietary protein requirement of growing rabbits has been set at 15.5 to 16% (NRC 1977; De Blas & Wiseman 2010). However, Cheeke (1987) reported that 11% protein in the rabbit diet will support growth when casein was used as protein source.

Fiber content in basal diet was 13% and in the basal + fiber feed ingredient (1 : 1) between 15 and 32%. Fiber content of cane top (CT) was higher than rice straw (RS) but much lower when compared with saw dust (SD) and rice hull (RH) that reached up to 52%. Fiber component in CT mostly is cellulose and the crude protein content of CT was the lowest than the three other fiber materials. In the shortage of elephant grass, CT was used as grass replacer to fulfill fiber need for rabbit feed. Typical nutritive value of sugarcane top had been reported wit CP content and digestibility was 5.5 and 27.5% (NSW Department of Primary Industries 2007).

The most general method for determining digestibility involves the collection of all feedd eaten and all excreta produced (total collection method). The apparent digestibility of basal diet, CT, RS, RH and SD is presented in Table 3. Crude protein, crude fiber, NDF, ADF and lignin digestibility were significantly different ($P<0.05$) among treatments. Basal and basal-rice straw were similar for CP digestibility (51 and 59%) while for other treatments were between 31 to 35%. It was reported that apparent digestibility of urea treated RS were between 64.42 and 73.62% (Hossain et al. 2010).

Table 2. Proximate analysis of basal diet, fiber sources feed ingredients and faecal samples for digestibility measurement of fiber sources feed ingredients

Sample	%CP	%C Fiber	Gross energy	%NDF	%ADF	%Lignin
Cane top (CT)	4.54	38.15	4157	45.50	40.75	16.65
Rice hull (RH)	12.28	52.23	5039	74.20	62.30	20.18
Rice straw (RS)	5.74	28.11	4153	37.15	16.50	12.48
Saw dust (SD)	9.70	52.15	6439	72.83	43.17	24.22
Basal diet (B)	17.66	12.71	2653	22.89	13.59	2.22
BCT (Basal+cane top)	11.10	15.43	3405	43.99	27.55	3.92
BRH (Basal+rice hull)	14.97	32.47	3846	40.83	39.98	10.00
BRS (Basal+rice straw)	11.70	20.41	3403	47.79	34.24	4.53
BSD (Basal+straw dust)	13.68	32.43	4546	53,17	38.47	9.18
Fecal composition						
FBCT (Basal+cane top)	11.53	25.32	3027	64.29	39.44	5.95
FBRH (Basal+rice hull)	14.42	24.39	3704	52.66	41.30	7.79
FBRS (Basal+rice straw)	8.64	35.01	3207	73.98	54.19	8.02
FBSD (Basal+straw dust)	7.83	53.60	3899	77.71	61.62	15.12

Table 3. Crude Protein, Crude Fiber, Neutral and acid detergent fiber and lignin Digestibility ofbasal diet and canetop, rice straw, rice hull and saw dust

Digestibility (%) of	B	BCT	BRS	BRH	BSD
CP	58.72 ± 3.87	30.78 ± 3.11	50.72 ± 3.77	34.38 ± 2.56	35.13 ± 2.40
CF	34.91 ± 7.97	34.91 ± 7.07	(4.02) ± 5.37	48.71 ± 1.72	(9.61) ± 2.66
NDF	21.11 ± 3.69	2.22 ± 1.14	(3.26) ± 1.92	11.37 ± 11.89	17.11 ± 3.65
ADF	14.58 ± 4.71	4.58 ± 14.71	(5.57) ± 1.97	29.11 ± 7.87	6.22 ± 2.48
Lignin	9.90 ± 4.06	10.90 ± 4.96	(8.09) ± 9.50	46.66 ± 3.95	(8.21) ± 4.02

Treatment BRS showed a negative digestibility value for CF, NDF, ADF and lignin (value shows in brackets) and BSD diets showed negative value for CF and lignin.

Lignin is commonly derived from woody plants and being an integral part of the cell wall of plants. Negative value on lignin digestibility such as in BRS and BSD diets could be caused by the formation of artifact lignin either in the gastrointestinal digestion and released through feces and triggered by drying method of faecal sample. Artifact lignin could alter on lignin determination and could result to higher value of lignin in feces than in intake. The digestibility of cane top in this experiment was lower than *in vitro* digestibility that had been reported (35.2%, Mohammadabadi & Chaji 2010).

Rabbit performance

Feeding trial was conducted for 6 weeks and basal diet as shown in Table 1. Chemical composition of treatment diets was presented in Table 4. Crude fiber content of diet which contained fiber materials tested were lower than 12% except for BSD (13.24%), while basal diet contained 12.71% of CF (Table 2). Crude protein content was similar among treatments, between 17.41 and 18.27%. The highest value of fiber fraction in the form of NDF and ADF was found in BRS diet (31.04 and 20.96% respectively) followed by BSD, BCT and BRH diets. The NDF fraction represents a cell wall content of feed forage, gives a close estimate of fiber constituents of feedstuffs as it measures cellulose, hemi-cellulose, lignin, silica, tannins and cutins.

Table 4. Proximate Analysis of treatment diets

Chemical composition		Fiber source			
		BCT (cane top)	BRH (rice hull)	BRS (rice straw)	BSD (saw dust)
DM	(%)	90.65	90.70	91.16	90.24
CP	(%)	17.90	18.27	17.60	17.41
Fat	(%)	8.10	9.73	9.52	6.74
CF	(%)	9.17	8.05	10.38	13.24
NDF	(%)	22.89	20.08	31.04	25.80
ADF	(%)	13.59	14.19	20.96	17.13
Lignin	(%)	2.22	4.00	2.69	4.50
Ash	(%)	8.40	9.05	13.32	6.48
Ca	(%)	0.89	0.86	0.89	0.94
P	(%)	0.77	0.78	0.61	0.79
Energy	(kcal/kg)	3979	4499	3834	4235

Fiber level in rabbit diet was recommended as between 33 and 40% NDF and approximately 17% ADF (De Blas & Mateus 1998) and a daily intake of 6 g lignin (Dalle Zotte 2002). In this experiment NDF and ADF content of BRS diet was almost similar to the recommended NDF and ADF content.

Average of daily feed consumption for basal diet (control) between 67 and 121 g/head/day, was significantly higher ($P<0.05$) with other treatments, while other treatments were similar in daily intake which was between 44 and 77 g/head/day (Figure 1). It was significant difference in feed consumption ($P<0.05$) between control and other treatments. Average daily feed intake for rabbit fed with different levels of protein was reported between 75 and 85 g/h/day (Wang et al. 2012).

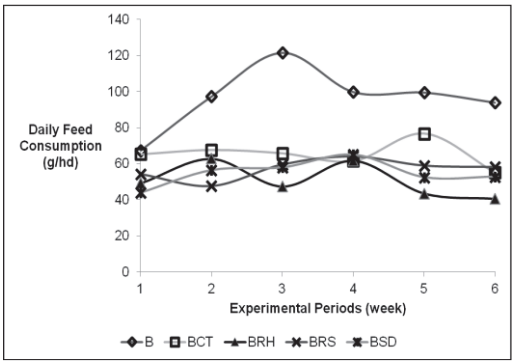

Figure 1. Daily feed consumption during 6 weeks experimental period

Average daily weight gain of rabbit during experimental period is presented in Figure 2. Control (B) and BRS treatments showed a similar pattern of weight gained with the highest weight was at the 3rd week of experiment period and then showed a reduction until the end of experiment. Other treatments showed a steady weighed gain.

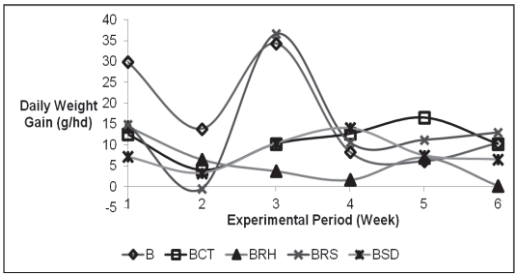

Figure 2. Daily weight gain of rabbit during 6 weeks period

Some of feed conversion ratio (FCR) of treatment feed was giving a negative value. It showed that some of the rabbits had a lower gain during experiment than in the initial period. Feed conversion ratio for control diet (B) was 2.34 to 7.72; BCT -5.96 to 7.13; BRH 3.65 to 12.06; BRS 3.83 to 10.54; BSD -1.98 to 8.12. Overall mortality reached up to 27% with the highest percentage of mortality (45%) was by BCT treatment (Table 4). Mostly the mortality of rabbit was due to reduction in weight gain. It was probably the palatability of

the feed shared the reason in low intake and then low weight gain of animal.

Table 4. Percentage of Mortality of rabbit during experiment

Treatment	Dead	Percentage
B	2.0	10
BCT	9.0	45
BRH	5.0	25
BRS	5.0	25
BSD	6.0	30
Total	27.0	27
Average	5.4	27

CONCLUSION

The result from this study showed that rice straw could be a promising fiber source that can be used for rabbit diet. It gave a similar feed intake and average daily gain to control diet.

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EFFECT OF VARIOUS FIBER SOURCES ON GROWTH OF WEANED RABBIT

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Introduction

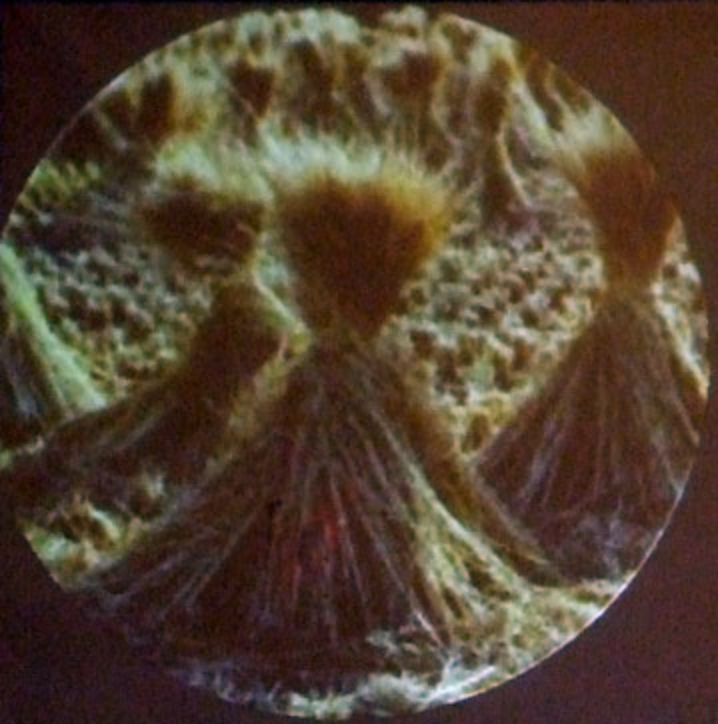
- Fiber is an important component of a ration for a rabbit and it is recommended that 12%-16% of rabbit feed should be crude fiber
- Important for maintain a healthy gut function, motility and transit of feed ingested
- Low fiber intake has been reported to decrease the volatile fatty acid (VFA), increase pH and ammonia levels in the caecum

Agricultural waste product as fiber sources.

Sugarcane waste:
Cane top

Cane top and baggase is familiar by Indonesian farmers .

Used as feed for cattle or other ruminant animals.



Rice straw

Rice husk

- Rice straw and husk are abundant in Indonesia.
- used for cattle feed
- rice hull was rarely used as animal feed.

Saw dust

- waste from wood industry
- used as animal feed

- To evaluate the digestibility, chemical composition and their effect on rabbit growth rate

Methodology

- Digestibility trial
  - 12 weaned rabbit.
  - Tested ingredients: cane top (CT), rice hull (RH), rice straw (RS) and saw dust (SD
  - mixed (1:1) with basal diet.
  - Feeding was conducted for 3 days adaptation period and 7 days collection periods.
  - Intake, feed refusal, fecal production were recorded.
  - Proximate analysis (crude protein, CP; Crude fiber, CF; fiber fractions (NDF, neutral detergent fiber and ADF, acid detergent neutral) and energy was measured.
  - Crude protein, CF, NDF. ADF and lignin digestibility were calculated.

Basal diet composition (%)

Corn	27
Elephant Grass	25
Soybean meal	16,2
Rice bran	15,3
Coconut kernel cake	7,5
Fish Meal	3

CPO	2
Mollases	2
CaCO3	1
DCP	0,5
Topmix	0,3
Salt	0,2

Feeding trial

- 100 weaned rabbit for 6 weeks.
- 5 treatments as follows:
  - Control: basal diet (B, Table 1)
  - Basal diet containing cane top (BCT)
  - Basal diet containg rice hull (BRH)
  - Basal diet containing rice straw (BRS)
  - Basal diet containing saw dust (BSD)
- fiber feed materials were added to basal diet to meet the minimum fiber content for rabbit (12%)
- Feed offered, feed refusal, weekly body weight were recorded.

Proximate analysis of fiber sources and basal diet

Sample	%CP	%CF	E (kkal/ kg)	%NDF	%ADF	%Lignin
Cane top (CT)	4.54	38.15	4157	45.50	40.75	16.65
Rice hull (RH)	12.28	52.23	5039	74.20	62.30	20.18
Rice straw (RS)	5.74	28.11	4153	37.15	16.50	12.48
Saw dust (SD)	9.70	52.15	6439	72.83	43.17	24.22
Basal diet (B)	17.66	12.71	2653	22.89	13.59	2.22

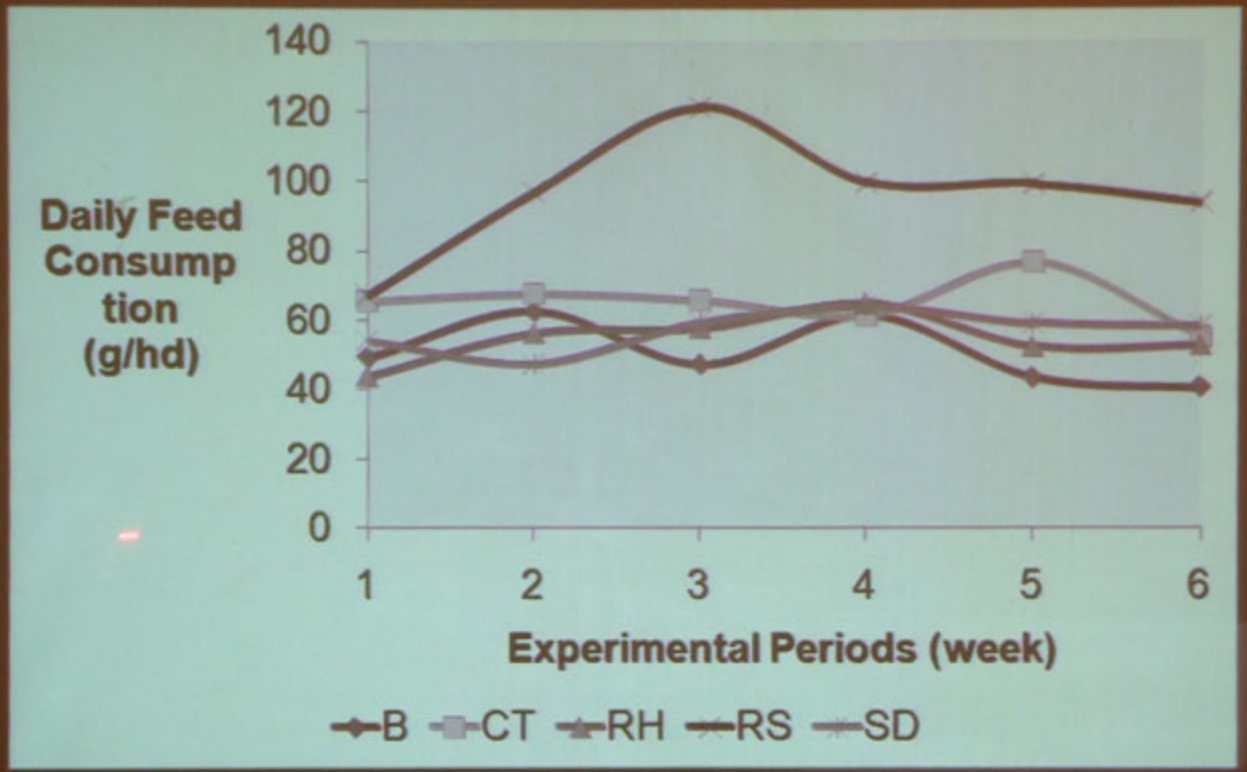
CP, CF, NDF, ADF and lignin Digestibility of fiber sources

	B	BCT	B RS	BRH	BSD
CP	58,72 ± 3,87	30,78 ± 3,11	50,72 ± 3,77	34,38 ± 2,56	35,13 ± 2,40
CF	34,91 ± 7,97	34,91 ± 7,07	(4,02)±5,37	48,71 ± 1,72	(9,61)± 2,66
NDF	21,11± 3,69	2,22 ± 1,14	(3,26) ± 1,92	11,37±11,89	17,11 ± 3,65
ADF	14,58 ± 4,71	4,58 ±14,71	(5,57) ± 1,97	29,11± 7,87	6,22 ± 2,48
Lignin	9,90 ± 4,06	10,90 ± 4,96	(8,09)±9,50	46,66 ± 3,95	(8,21) ± 4,02

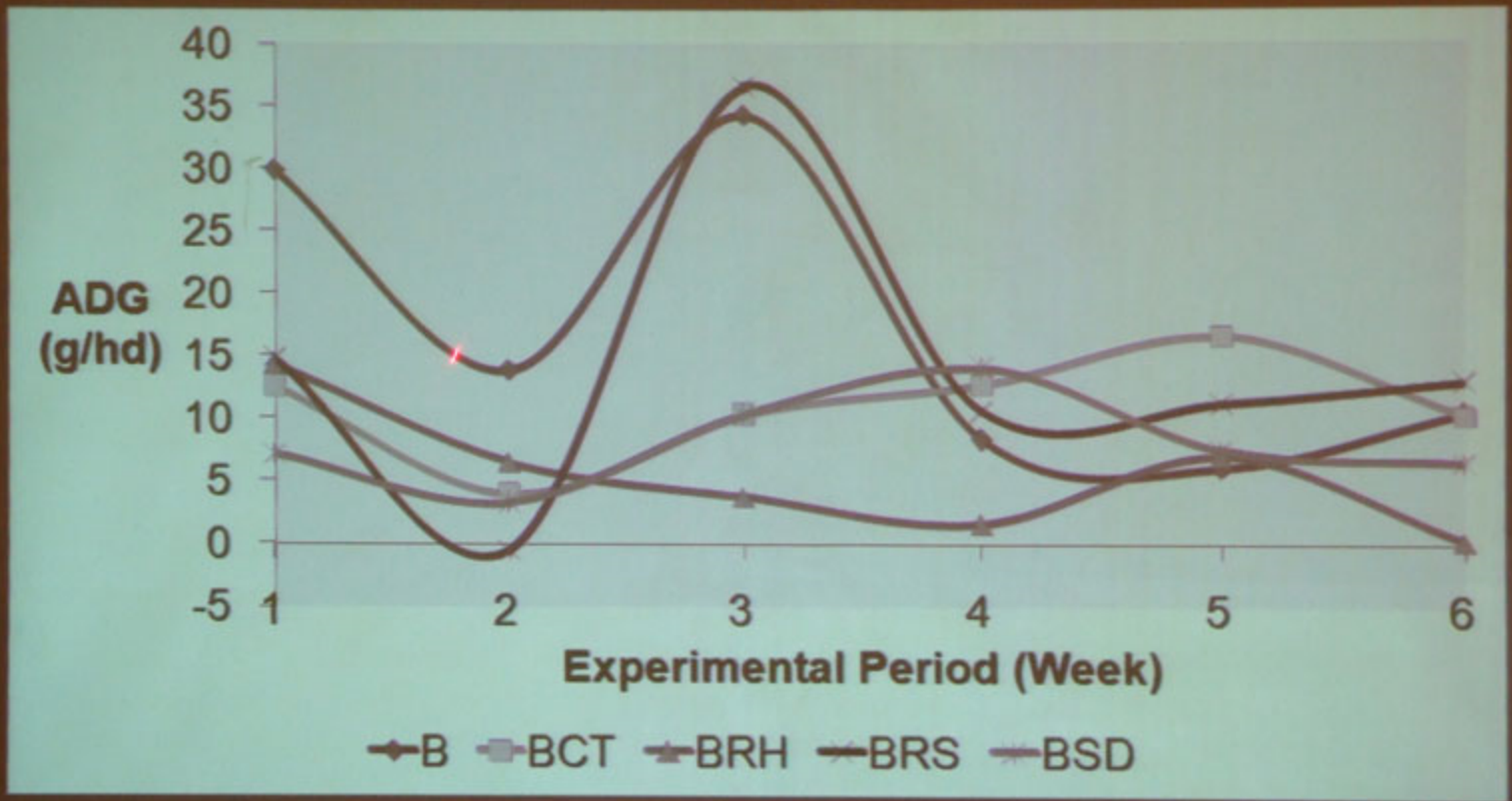
Proximate analysis of treatment diets

		Treatments			
Chemical Composition		BCT	BRH	BRS	BSD
Water	(g/100g)	9.35	9.70	8.84	9.76
CF	(g/100g)	17.90	18.27	17.60	17.41
Fat	(g/100g)	8.10	9.73	9.52	6.74
Energy	(kkal/Kg)	3979	4499	3834	4235
CF	(g/100g)	9.17	8.05	10.38	13.24
NDF	(g/100g)	22.89	20.08	31.04	25.80
ADF	(g/100g)	13.59	14.19	20.96	17.13
Lignin	(g/100g)	2.22	4.00	2.69	4.50
Ash	(g/100g)	8.40	9.05	13.32	6.48
Ca	(g/100g)	0.89	0.86	0.89	0.94
P	(g/100g)	0.77	0.78	0.61	0.79

Feed consumption during 6 weeks experimental period



Average daily gain (ADG)



Feed conversion and mortality

Treatments	FCR	Mortality
B	5,03	10
BCT	6,55	45
BRH	7,59	25
BRS	14,37	25
BSD	10,10	30
Average		27

Conclusion

- Rice straw can be used as fiber source in rabbit diet and gave similar average daily gain with basal diet contain elephant grass. However the FCR value was higher than elephant grass.