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Effect of replacing soya bean meal with Indigofera zollingeriana leaf meal on the performance and carcass characteristics of growing rabbits

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Abstract
The current experiment was carried out to evaluate the effect of replacing soya bean meal with Indigofera zollingerian leaf meal (IZML) on the performance and carcass characteristics of growing rabbits. Fifty (50) 7-8 weeks bucks cross breed rabbits (Chinchilla × New Zealand White) with an average weight of 553.7g and 560.5g were allotted to five treatments with ten rabbits per treatment in a completely randomized design. IZML was used to replace soya meal at 0%, 10%, 20%, 30% and 40% for T1, T2, T3, T4 and T5 respectively. Feed and water was provided *ad libitum* throughout the experiment which lasted for 10 weeks. Results obtained revealed that final live weight, average weight gain, total feed intake, feed conversion ratio and daily water intake showed no significant ($p>0.05$) difference among the treatments. Dressing percentage, weights of liver, kidney, heart, lungs, spleen and testis were not significantly ($p>0.05$) affected. From the results obtained it was concluded that IZML can replace soya meal up to 40% for optimum performance in the diet of growing rabbits.

Keywords: Indigofera zollingerian leaf meal, Soya meal, Performance, Carcass characteristics

Introduction
Feed cost accounts for about 60-70 per cent total cost of production and it is one of the key areas of management. Therefore, the growth of animals is directly proportional to the demand of feed (Ravi, 2000). The increase in human population in the tropics has given rise to increased demand of livestock products to satisfy protein need of the people. In order to reduce feed cost and increase livestock production, series of research and production strategies have been adopted using feed materials ranging from conventional feedstuffs to unconventional feedstuffs and their bye products have been used in animal feed formulations to enhance growth rate and improve feed efficiency and utilization (Raeesi *et al.,* 2010; Garba *et al.,* 2010).
It has been reported that some plants provides animals with necessary vitamins, minerals, oxycarotenoids and protein (Opara, 1996; Fayemi *et al.,* 2011) and can add value to feed when used in formulation. Indigofera zollingeriana is among the most promising species based on their high protein, minerals and antioxidant activity.
Indigofera zollingeriana is a legume which belongs to the family Fabaceae. The family fabaceae is divided into three sub families (Caesalpiniodeae, Mimosoidae and Faboideae). It is found in the tropics and some Asian countries such as India and Pakistan. The plant can grow up to 2.5m tall and has been reported to contain about 25 – 31% crude protein (Abdullah and Suharlina, 2010; Abdullah, 2010) [5, 2] and vitamins such as xantofil and carotenoids which makes it play a significant role as antioxidant (Prakash *et al.,* 2007; Akbarillah *et al.,* 2010) [16, 1]. It has also been reported that Indigofera zollingeriana contains several bioactive chemical which makes them perform medicinal purposes (Chakrabarti *et al.*, 2006; Hamayun *et al.*, 2003).
Santi *et al.* (2015) observed that Indigofera zollingeriana leaf meal (IZML) can be included up to 17.74% in the diets of broiler chickenwithout negative effect on performance, Suharlina *et al.* (2016) [23] also reported that IZML can be incorporated up to 80% in the diets of dairy goats and can replace soya meal at 15.6% (Palupi *et al.,* 2014) [21]. However, limited information is available on replacing soya bean meal with Indigofera zollingeriana leaf meal in rabbits. Therefore, the objective of this study is to evaluate the effect of replacing soya bean meal with Indigofera zollingeriana leaf meal on the performance and carcass characteristics of growing rabbits.
Materials and Methods

Experimental site
The experiment was carried out at Division of Animal Nutrition, Sumitra Research Farm, Gujarat, India during the month of January to March, 2018.

Collection and processing of Indigofera zollingeriana leaf meal
Fresh healthy Indigofera zollingeriana leaves were harvested; the leaves were air dried on a concrete floor under shed for 2 weeks. The dried leaves are then hammer milled to produce Indigofera zollingeriana leaf meal (IZML). The processed IZML was later subjected stored in a clean air tight container for proximate analysis as expressed in Table 1.

Animals and their management
A total of fifty (50), 7-8 weeks bucks cross breed rabbits (Chinchilla × New Zealand White) with an average weight

of 553.7g and 560.5g were used for this experiment. Two rabbits each were housed in an all wire cages measuring 1.0m×0.50m×0.70m (width×length×height) and equipped with feeding and watering troughs. The cages were cleaned and disinfected before the arrival of the animals. The rabbits were allowed two week adjustment period during which they were fed with control diet and given prophylactic treatment of Oralmectin against endo and ecto- parasites before they were placed on the experimental diets.

Experimental diets

Five experimental diets were formulated for the experiment as presented on Table 1. IZML was used as a replacement for soy meal at 0%, 10.0%, 20.0%, 30.0% and 40.0% for T1, T2, T3, T4 and T5 respectively.

Data collection

The record of weekly body weight, feed intake and feed efficiency ratio were taken. Mortality was also recorded as they occur.

Carcass evaluation

At the end of the experiment, three rabbits were randomly selected from each treatment for carcass evaluation. Prior to slaughter the animal were starved over night to reduce their gut contents only water was given to the animals before their live weights were taken. The rabbits were stunned and slaughtered by severing the veins. After evisceration, the organs were removed and weighed. The dressing percentage (%) was calculated using the formula:

Dressing percentage = dressed weight of the carcass/live weight × 100.

Cost benefit analysis

Cost analysis of each diet fed to the experimental animals was calculated. The cost of per kg of ingredient was used to multiply the total feed intake per rabbit to obtain the total cost of feed consumed during the experimental period.

Laboratory Analysis

The proximate composition of experimental diets and IZML were analysed according to AOAC (2000).

Statistical analysis

Completely randomized design (CRD) was used for the experiment. All data collected were subjected to one way analysis of variance (ANOVA) using SAS (2000) [15]. Significant means were separated using Duncan Multiple Range Test (Duncan, 1955) [10].

Table 1. Proximate analysis of IZML

Parameter	% Composition
Moisture	12.80
Dry matter	87.20
Crude protein	25.77
Crude fibre	12.40
Ether extract	3.40
Ash	5.90

Table 2: Percentage composition (%) of experimental diets.

Ingredients			Treatments		
	1	2	3	4	5
Maize	35.0	35.0	35.0	35.0	35.0
Wheat offal	20.0	20.0	20.0	20.0	20.0
Soya meal	16.25	14.62	13.00	11.37	9.75
Groundnut cake	5.00	5.00	5.00	5.00	5.00
Palm kernel meal	20.0	20.0	20.0	20.0	20.0
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
[1]Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
IZML	0	1.63	3.25	4.88	6.50
100	100	100	100	100	
Determined Analysis					
Dry matter	87.11	87.34	87.44	87.58	87.81
Crude protein (%)	17.78	16.91	16.46	16.22	16.08
Crude fibre (%)	13.33	13.43	13.46	13.51	13.53
Ether extract (%)	3.08	3.01	3.00	3.00	2.98
Ash (%)	9.04	9.10	9.12	9.13	9.15
Energy (MEkcal/kg)	2560.5	2560.8	2560.7	2650.0	2650.9
Cost/kg (N)	98.11	81.06	81.56	81.89	80.97

[1]Premix supplied per kg diet :- Vit A, 8,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg; Vit B12, 16mg; Choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu, 2.6g; Folic acid, 2mg; Fe, 5g; Pantothenic acid, 10mg; Biotin, 30.5g; Antioxidant, 56mg

Table 3: Growth Performance of rabbit's fed varying levels of IZML

Parameters	1	2	3	4	5	SEM
Number of rabbits	10	10	10	10	10	-
Initial body weight (g)	571.3	560.1	559.7	560.5	553.7	0.44^{ns}
Final body weight (g)	1322.1	1301.2	1333.9	1301.1	1300.9	5.11^{ns}
Average weight gain (g)	750.8	741.1	774.2	740.6	747.2	4.02^{ns}
Average weekly wgt gain (g)	75.08	74.11	77.42	74.06	74.72	0.38^{ns}
Total feed intake (g)	5240.1	5120.7	5120.3	5119.8	5100.1	4.31^{ns}

Feed conversion ratio	6.98	6.91	6.61	6.91	6.83	0.33^{ns}
Daily water intake (ml/day)	905.7	905.1	905.4	905.1	905.4	0.69^{ns}
Mortality	0/0	0/0	0/0	0/0	0/0	

Ns: No significant difference (P>0.05)

Table 4. Carcass characteristics and relative organ weights of rabbits fed varying levels of IZML

Parameters	Treatments					SEM
	1	2	3	4	5	
Dressing percentage (%)	50.83	50.04	51.27	50.04	50.03	1.33 ^{ns}
Liver (g)	6.48	6.51	6.43	6.40	5.97	0.41^{ns}
Kidney (g)	1.59	1.57	1.52	1.61	1.60	0.03^{ns}
Heart (g)	0.59	0.61	0.64	0.60	0.59	0.01^{ns}
Lungs (g)	1.09	1.08	1.07	1.06	1.07	0.29^{ns}
Spleen (g)	0.35	0.33	0.34	0.33	0.34	0.02^{ns}
Testis (g)	0.26	0.25	0.25	0.23	0.24	0.18 ^{ns}

Ns: No significant difference (P>0.05)

Results and Discussion

Table 1 reveals the proximate composition of IZML. The proximate components had dry matter (87.20 %), crude protein (25.77%), crude fibre (12.40%), ether extract (3.40 %) and ash (5.90 %). The crude protein level of IZML in this study was comparable to report of Abdullah and Suharlina (2011) and Abdullah *et al.* (2014) [6] but contrary to the reports of Ali *et al.* (2014) [3] who reported a protein level of 23.10 %. The differences in the proximate composition might be attributed to the differences in soil type, environmental condition and processing methods (Newman *et al.*, 2009) [13]. The experimental diet of rabbits fed varying levels of IZML is presented in Table 2, the dry matter increased as the inclusion of IZML increased in the diets.The crude protein and ether extract level decreased as IZML increased in the diet. CP level in the diet is highest in 0% IZML (17.78%) followed by 10% IZML (16.91%), 20% IZML (16.22%), 30% IZML (16.22%) and 40% (16.08%) respectively. The crude fibre values increased as the inclusion level of IZML increased with the highest level in rabbits fed T5 (13.53%) followed by T4 (13.51%), T3 (13.46%), T2 (13.43%) and the least value in animals fed T1 (13.33%)., this agrees with the recommendation of Spreadbury and Davidson (1978) [14] who reported that rabbits require a minimum of 9% crude fibre. Ash content was highest in rabbits fed 40% IZML (9.13%) followed by 30 % IZML (9.10%), 30% IZML (9.12%), 20% IZML (9.10%) and 0% IZML (9.04%). The metabolizable energy ranged between 2560.5 – 2650.9 MEkcal/kg, it's within the range reported by Unigwe *et al.* (2016) [25]; Omale *et al.* (2011). Hon*et al.* (2009) reported a higher digestible energy of 2613 - 2734 MEkcal/kg. However, all values are within the range recommended byAduku and Olukosi (1990) [8].

The crude protein contents in the experimental diets decreases as the inclusion of IZML increases, however, it did not significantly (P>0.05) affect the final live weight, total feed intake, feed conversion ratio and daily water consumption of the rabbits in all the treatment groups (Table 3). The non-significant differences (P>0.05) in the values obtained for the final live weight across the treatment group is in agreement to reports of Ojabo *et al.* (2012) [19]; Olorunsanya *et al.* (2007) [18] on the effects of replacing maize with sun-dried cassava waste meal on growth performance and carcass characteristics of meat type rabbit. This is a clear indication that IZML is good unconventional feedstuff that can contribute to the growth of an animal because it can be compared with the control diet. The daily water consumption was not significantly different among the treatment which is in agreement with the findings of Oluremi *et al.* (2005) [20] on the response of growing rabbits to the dietary replacement of maize with sweet orange (Citrus cinensis) rind. According to Omole *et al.* (2012) [17] the quantity of feed consumed by animals depends on their age, quality of feed, environmental condition, genetic factor and health status.

The feed cost per kg were significantly different (P>0.05), diet 1 cost N 98.11 per kg to yield a final live weight of 1322.1 kg, total feed intake of 5240.1 kg and weekly average weight gain of 75.08 kg compared animals fed diet 3 with a final live weight of 1333.9 kg, total feed intake of 5120.3 kg and N 81.56 per kg. Economically, using diet 3 will reduce the total cost of production and will give a good final weight. According to Etim and Oguike (2010), feed is an important aspect of animal production, increase in meat production can be achieved through proper nutrition and good management. No mortality was recorded throughout the experimental period.

Table 4 shows the carcass characteristics and relative organ weights of rabbits fed varying levels of IZML. The dressing weight of the rabbits ranged from 50.03-50.83%, there was no significant differences (P>0.05) among the treatments in terms of the dressing percentage. This was similar with the finding of Shittu *et al.* (2013) [24] who noted that addition of processed mango seed kernel meal at 20% as replacement for maize in the diet of rabbits does not have any significant differences on the dressing percentage of the animals. Similarly, Alagbe, J.O (2017) [7] reported that the supplementation of Polyalthia longifolia leaf meal in the diets of grass cutters did not significantly influence their dressing percentage. On the contrary, Salisu Bakura Abdu *et al.* (2012) [22] reported that the inclusion of Carrot leaf meal up to 15% in the diet of growing rabbits significantly affected (P<0.05) the dressing percentage of the animals.

The relative weights liver, kidney, heart, lungs, spleen and testis fed IZML were not significantly (P>0.05) different from the control diets.In the same way, Al-Dabagh and Abdulla (1963) [4] observed that diet, age and body weight are significant factors that could affect the internal organs of an animals.

Conclusion and Recommendation

It could be concluded that replacing of Soya bean meal by IZML at 20%dietary level improved the final live weight, feed conversion ratio, dressing percentage of the animal,

cost of feed is also reduced when compared to the control diet (0% IZML). Therefore IZML can be included up to 40% without any deleterious effect on growth and carcass characteristics of growing rabbits.

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