Original Research

Effect of Feeding Cauliflower (*Brassica oleracea*) Leaves on the Growth Performances and Carcass Characters of Crossbred Barrows (*Landrace* X *Desi*)

Carolina Potshangham[1*], Mukesh Singh[2], Sarada Prasanna Sahoo[3], G. K. Gaur[2], B. H. M. Patel[4], S. E. Jadhav[5] and Anup Kumar Singh[1]

[1]Livestock Production Management Section, National Dairy Research Institute, Karnal-132001 Haryana, INDIA
[2]Division of Livestock Production Management, Indian Veterinary Research Institute, Izatnagar, Bareilly-243122, Uttar Pradesh, INDIA
[3]Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Government of India, INDIA
[4]Division of Livestock Production Management, Indian Veterinary Research Institute, Bengaluru Campus-560024, Karnataka, INDIA
[5]Division of Animal Nutrition, Indian Veterinary Research Institute, Izatnagar, Bareilly-243122, Uttar Pradesh, INDIA

***Corresponding author:** carolchengleicha@gmail.com

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Abstract

The present study was designed to analyse the effect of in locally available culled cauliflower leaves with standard conventional ration growth, carcass quality and behaviour along with its economical utility in pig rearing. So, 18 crossbred of 5 to 6 months of age (Landrace x desi) barrows were selected randomly and divided into three groups T_0 (control) fed control diet without cauliflower leaves, T_1 (treatment 1) cauliflower leaves fed @ 10% of DM with ad lib concentrate and T_2 (treatment 2)15% of DM of cauliflower leaves with ad lib concentrate were offered. Each group consists of six animals and each group consists of three unit, in each unit two animal are kept as group for the experiment trial. The parameters with respective to growth, carcass, and economy were recorded as per standard procedures. Results revealed that the mean average daily weight gain (ADG) in the 1st, 2nd and 3rd fortnight was significantly (P<0.05) varied between groups. Fortnightly body measurements of various attributes viz. body length, body height, heart girth and flank to flank length were statistically non-significant (P<0.05) among all the treatment groups throughout the observational period. Carcass weight (without head) was non-significant (P<0.05) among the groups. A non-significant (P<0.05) difference was observed in dressing % between the groups. Carcass length did not show any significant difference (P<0.05) among treatments. Basing on these findings we can conclude that locally available cost effective and abundant available cauliflower leaves can be fed for replacing the concentrate @ 15% DM of the concentrate, which reduced the rearing cost without causing any adverse effect on growth rate and carcass traits.

Key words: Carcass, Cauliflower, Growth Performance, Pig Rearing

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Introduction

Feeding of pig cost nearly 70% of the total recurring cost and there is competition between pig with humans and other livestock for cereal grains so there is shortage of feed & problem of demand and supply. The global price of feed ingredients such as maize, wheat, fish meal and soybean meal has increased by 160, 118, 186 and 108 percent, respectively in the last decade, while the price rise in livestock products such as poultry meat, pork and lamb was only 59, 32 and -37 percent respectively, while that of beef was 142 percent (Index Mundi, 2013). So, there is scarcity of the conventional feeds and also the commercial feeds are very costly. On the other hand, in India a shortage of 25, 159 and 117 million tonnes of concentrates, green forages and crop residues, constituting respectively a shortage of 32, 20 and 25 percent of the requirement has been estimated (Ravi Kiran *et al*., 2012). The area under fodder production cannot be increased due to increasing human population and urbanization. Thus, cheaper ingredients sources like feeding un-conventional feeds and fodders which are easily available in the local area pays attention of time. Under these conditions, to meet the nutrient requirements of livestock and to sustain their productivity and profitability seem only possible if non-conventional, alternate feed resources are explored. It is therefore, imperative to examine for cheaper non-conventional feed resources that can improve intake and digestibility of low quality forages. One must increase the use of non-conventional feed resources to fill the gap of demand and supply. Earlier many researchers have attempted to feed greens and vegetable waste (Ravindra *et al.*, 2014).

Generally cauliflowers (*Brassica oleracea*) are transported to market by retaining the few (10-12) leaves to avoid damage to flower. But same leaves are removed and thrown before they sell them to the customers. These are available in large quantities in the vegetable market in the morning time. Further, this culled cauliflower leave contains 70%TDN, 9% DM and 30% CP and also are low in Fat, rich in Carbohydrate and Vitamin-C. They have high dietary fiber, folate, water and contains several phytochemicals (USDA 2003). So considering the low cost and availability of cauliflower leaves the present experiment was designed to study the effect of cauliflower leaves on growth performance of Landrace crossbred growers.

Materials and Methods

Ethical Approval

The institutional animal ethical committee approved the proposed design of the study ensuring that no potential harm toward animal welfare was done and without causing any discomfort to the animals.

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Animals, Housing and Management

A total of 18 cross bred (Landrace × *Desi*) growing barrows around 5 months of age were selected from the main flock available at IVRI swine production farm. All the growers were de-wormed 15 days before the start of the experiment with Albendazole. All animals were also vaccinated against swine fever. Animal were marked with silver nitrate solution for identification.

Experimental Design

A total of 18 animals were equally divided into 3 treatment groups viz.T_0 (**T_0:** the barrows fed with concentrate without cauliflower leaves), T_1 (T_1: cauliflower leaves fed @ 10% of DM with *ad lib* concentrate) and T_2 (T_2: cauliflower leaves fed @ 15% of DM with *ad lib* concentrate). In each group, there were three units and in each unit, two animals of closely similar weight were kept together for the duration of the experiment was 90 days i.e. 3 months. The composition of concentrate offered during feeding trial is given on Table 1.

Table 1: The composition of concentrate mixture

Ingredients	Percent %
Maize	40
Wheat bran	43
Soya cake	10
Fish meal	5
Mineral mixture	1.5
Salt	0.5

Procurement of Cauliflower Leaves

The cauliflower leaves were procured from different vendors of vegetable Mandi near IVRI, Delapir, Bareilly. Vendors generally remove these cauliflower leaves before sale. Such fresh leaves were collected from the different vendors. These cauliflower leaves were offered without any chopping to the animals. The ration was offered only after consumption of cauliflower by the pigs.

Daily Feed Intake and Body Weight

Throughout the experimental period (90 days), *ad libitum* feed and water were provided under uniform management and hygienic conditions. Weighed quantity of feed was offered daily twice at 9:30 AM and 4:00 PM. Daily voluntary feed intake was noted during the entire experimental feeding period. The left over residues were weighed after 24 hours of offering and records were maintained daily. Body weights of each animal in each group were recorded at fortnightly intervals for the entire experiment in the morning before feeding and watering.

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Feed Conversion Efficiency (FCE)

FCE was calculated from average feed intake during a fortnight (kg) per body weight gain during that period (kg).

Total Dry Matter of Concentrate and Cauliflower Leaves

Dry matter of both offered concentrate and cauliflower leaves were evaluate every fortnightly intervals during the whole feeding trial of the experiment.The dry matter (DM) were determined by drying a known weight of sample in moisture cup overnight at 100 ± 2ºC in a hot air oven.

Composition of Feed

A total of six samples were collected from different vendors for cauliflower leaves and they were analysed at fortnightly during the feeding trial. Similarly the composition for concentrate mixture also analysed at fortnightly during the feeding trial (AOAC, 2000).

Body Measurements

The body measurement viz. body length, height, heart girth and flank to flank length or punch girth were measured (cm) using measuring tape. Body measurements of individual animal were recorded at the time of weighing in weighing chamber.

Body Length

It was measured, with the animal in a normal position, as the length from the base of the neck to the base of the tail.

Height at Withers

It was measured as the distance from the surface of a platform to the withers.

Heart Girth

It represented the circumference of the heart region (Machebe and Ezekwe, 2010).

Flank to Flank

It was taken from the base of one flank over and across the hip bone down to the next flank on the other side of the pig.

Carcass Characteristics

At day the end of the experiment, three animals represented as heavy, medium and light from each group were selected to study the carcass traits. These animals were slaughtered at LPT, Division, IVRI. They were slaughtered, dressed, eviscerated and halved as per the procedure recommended by Ziegler (1968). Carcass length was measured from the front of aitchbone to the middle of the front of first rib using a metal scale.

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Back fat thickness was measured at first rib, last rib and last lumbar using plastic measuring scale. Similarly the Loin eye area was measured by the depth of the longissimus dorsi (loin eye) muscle was measured immediately posterior to the last rib. The width of loin eye was measured at a right angle to the depth measurement. The product of these two measurements was referred as the loin eye cross section area (mm^2). Dressing percent was calculated by dividing the chilled carcass weight by the live weight and multiplying by 100.

Economics

Relative economics were calculated between different levels of cauliflower feeding being common in both the groups, the general inputs and outputs during the whole study were not considered for economical analysis. Cost of feed was calculated as a sum of the products of the price of different ingredients and their proportionate amount used in the feed. Feeding cost was calculated by the average amount of feed consumed in each treatment on phase basis.

Statistical Analysis

The collected data was subjected to statistical analysis using Software Package for Social Sciences (SPSS Version 16.0) available in the Central library, IVRI, Bareilly. The recorded data were subjected to one-way analysis of variance (Snedecor and Cochran, 1994) with comparison among means was made by Duncan's multiple range test (Duncan, 1955) with significance level of $P \leq 0.05$.

Results

Composition of Feed

The composition of cauliflower and concentrate feed mixture are presented in Table 2.

Table 2: Chemical composition of concentrates and cauliflower leaves (% DM basis) during feeding trial

Attributes		Fortnights						
		1	2	3	4	5	6	Mean ± SE
DM	Concentrates	92.01	91.4	91.57	92.62	91.02	91.3	91.65±0.23
%	Cauliflower leaves	10.07	11.27	13.65	12.17	10	11.01	11.36±0.56
CP	Concentrates	19.81	19.44	19.04	19.74	18.6	19.03	19.28±0.19
%	Cauliflower leaves	17.41	17.12	16.61	17.91	16.36	17.01	17.07±0.22
CF	Concentrates	4.11	4.27	4.15	4.04	4.13	4.07	4.13±0.03
%	Cauliflower leaves	6.53	7.13	6.55	7.64	6.02	5.99	6.64±0.26
EE	Concentrates	2.32	2.37	3.06	2.2	3	2.78	2.62±0.15
%	Cauliflower leaves	3.57	4.21	3.74	5.71	3.4	4.06	4.11±0.34
TA	Concentrates	8.36	8.78	7.8	8.41	8.03	7.65	8.17±0.17
%	Cauliflower leaves	13.64	10.12	11.1	11.23	13.07	10.1	11.54±0.60
OM	Concentrates	91.64	91.22	92.2	91.59	91.97	92.35	91.83±0.17
%	Cauliflower leaves	86.36	89.88	88.9	88.77	86.93	89.9	88.45±0.60
NFE	Concentrates	65.4	65.14	65.95	65.6	66.24	66.47	65.80±0.20
%	Cauliflower leaves	58.84	61.41	62	57.51	61.15	62.84	60.62±0.82

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Results revealed that cauliflower leaves contained mean value of DM%, CP%, CF%, EE% & TA% were 11.36 ± 0.56, 17.07± 0.22, 6.64±0.26, 4.11±0.34 and 11.54±0.60 respectively. The concentrate mixture given during feeding trial have same ingredient for all groups. The DM%, CP%, CF%, EE%, TA%, OM% and NFE% were 91.65±0.23, 19.28±0.19, 4.13±0.03, 2.62±0.15, 8.17±0.17, 91.83±0.17 & 65.80±0.20 respectively.

Dry Matter Intake (DMI)

The DMI at fortnightly intervals during the feeding trial of the treatment groups is given in Table 3. The overall mean quantity of cauliflower leaves consumed by each pig of treatment groups during the entire experiment were 2.24±0.1 kg for T_1 and 3.29±0.2 for T_2. During 1st fortnight of the trial, the mean DM intake of the animals in different groups were almost similar ranging from 1.908±0.01 in control, 1.934±0.02 in T_1 group and T_2 is 1.973±0.01. At 2nd, 3rd, 4th& 6th the mean DMI were gradually increased in all the three groups.

Table 3: Average DMI (kg) at fortnightly intervals

Fortnights	T_0	T_1	T_2	SEM	F	Sig.
1st	1.90±0.01	1.93±0.02	1.97±0.01	1.93±0.01	1.77	0.204
2nd	2.42±0.04	2.47±0.01	2.47±0.01	2.45±0.01	1.539	0.247
3rd	2.67±.050	2.69±0.01	2.71±0.01	2.69±0.02	0.379	0.691
4th	2.99±0.06	2.85±0.15	3.04±0.02	2.96±0.06	1.092	0.361
5th	3.11^{a}±0.05	3.27^{b}±0.01	3.27^{b}±0.02	3.22±0.02	11.185	0.001
6th	3.37±0.05	3.42±0.01	3.42±0.01	3.40±0.02	0.803	0.466
7th	3.55^{a}±0.07	3.69^{a}±0.04	3.90^{b}±0.01	3.72±0.04	12.768	0.001
Mean	2.86±0.21	2.90±0.22	2.97±0.24	2.91±0.12	0.058	0.943

The mean value of DM intake of T_2 were higher as compared to the control and T_1 at 2nd, 3rd and 4th fortnight but they showed no significant difference ($P<0.05$) between the groups. However, at the 5th fortnight DMI values of control differed significantly ($P<0.01$) among control, T_1& T_2 groups. DMI in T_2 and T_1group values showed highly significant compare to control group. Further, at the 7th fortnight i.e. finisher stage, the mean DM of T_2 intake showed highly significant ($P<0.01$) from control and T_1.

Body Weight

The mean fortnight body weight changes from grower to finisher pigs are presented on Table 4. The initial body weight of T_0, T_1 and T_2 was 62.66 ± 2.20 kg, 58.00±1.36 kg 59.83 ± 0.60 kg respectively. The mean body weight of animals in different treatment groups was almost similar. Body weight from the 2nd fortnight to 7th, there were gradually increased in every intervals. Though the mean value of T_2 group showed higher value compared to T_1 and control groups at all fortnights but values did not differ significantly ($P<0.05$) between groups. At the end of the first fortnight mean body weight was lowest in T_1 (66.10±1.37kg)

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followed by T_2 group (68.51±0.76kg) and was highest at control group (69.68±2.37kg) but statistically non-significant (P<0.05).

Table 4: Body weight (BW) and Average Daily Gain (ADG) (in kg) changes at fortnightly interval

Fortnights		T_0	T_1	T_2	SEM	F	Sig.
0	BW	62.66±2.20	58.00±1.36	59.83±0.60	60.16±0.95	2.345	0.13
1st	BW	69.68±2.37	66.10±1.37	68.51±0.76	68.10±0.96	1.232	0.319
	ADG	0.501^{a}±0.04	0.578^{ab}±0.02	0.620^{b}±0.02	0.566±0.02	4.823	0.024
2nd	BW	77.60±2.41	75.43±1.50	78.41±0.84	77.15±0.97	0.809	0.464
	ADG	0.565^{a}±0.04	0.666^{b}±0.02	0.707^{b}±0.02	0.646±0.02	17.219	<0.00
3rd	BW	86.30±2.26	85.36±1.65	88.68±0.99	86.78±0.99	0.989	0.395
	ADG	0.621^{b}±0.03	0.709^{b}±0.03	0.733^{b}±0.02	0.688±0.02	5.994	0.012
4th	BW	95.55±2.26	95.41±1.65	98.75±0.99	96.57±0.99	1.027	0.382
	ADG	0.660±0.01	0.718±0.03	0.719±0.02	0.699±0.02	1.534	0.248
5th	BW	104.68±2.44	105.26±1.88	108.70±0.85	106.21±1.19	1.107	0.356
	ADG	0.652±0.02	0.703±0.04	0.710±0.04	0.688±0.01	0.958	0.406
6th	BW	113.45±2.63	114.46±2.24	117.96±0.78	115.29±1.20	1.336	0.293
	ADG	0.626±0.04	0.657±0.02	0.661±0.01	0.648±0.02	0.516	0.607
7th	BW	121.31±2.97	122.10±2.60	126.11±0.800	123.17±1.36	1.221	0.323
	ADG	0.561±0.03	0.545±0.03	0.582±0.01	0.563±0.02	0.38	0.69

ADG from Grower to Finisher

The average daily body weight gain on fortnight basis from grower to finisher is presented on Table 4. The mean average daily weight gain (kg) in the 1st, 2nd and 3rd fortnight showed significant between groups. During 1st fortnight, there is significant (P<0.05) increased in ADG in T2 compare to control and T1. The value of T_2 group (0.620 ± 0.02) is significantly higher compared to T_1 (0.578 ± 0.02) and control (0.501 ± 0.04) as T_1. The similar trend was observed at 2nd and 3rd fortnights intervals showed highly significant (P<0.01) between control and treatment groups. The values of T_2 group (0.707^{b} ± 0.02 kg) at 2nd fortnight and (0.733^{b} ± 0.02 kg) at 3rd fortnight is highly significant compared to 2nd fortnight values of T_1 and control (0.666^{b} ± 0.02 & 0.565^{a} ± 0.04) and 3rd fortnight values of T_1 and control (0.709^{b} ± 0.03 & 0.621^{b} ± 0.03) respectively. Conversely from 4th to 7th fortnight, the mean value of ADG is slightly lower than previous fortnights. But the values of T_2 showed relatively higher value as compared to T_1 and control groups and they showed non-significant between the groups. The overall mean ADG in control, T_1 group and T_2 was 0.598 ±0.02 kg, 0.653 ± 0.03 kg 0.676 ± 0.02 kg respectively.

Fortnight Feed Conversion Efficiency (FCE)

Average fortnight FCE of grower to finisher pig up to 7th fortnight is presented at Table 5. From the beginning to the last fortnight, the mean value of FCE of T_2 showed slightly lower as compared to T_1 and control groups, control got the highest FCE among the groups. The mean values showed non- significant (P<0.05) among the groups throughout the experiment except at 2ndand 3rd fortnights. The overall mean FCE in control was 4.82±0.32 kg, 4.55±0.46 kg in T_1 group and T_2 was 4.46±0.46 kg.

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Table 5: Average fortnight FCE of pigs

Fortnights	T_0	T_1	T_2	SEM	F	Sig.
1st	3.92±0.31	3.37±0.15	3.19±0.09	3.49±0.13	3.388	0.061
2nd	4.28[b]±0.59	3.73[a]±0.13	3.51[a]±0.86	3.84±0.09	17.681	<0.00
3rd	4.35[b]±0.24	3.83[a]±0.13	3.71[a]±0.09	3.96±0.12	4.064	0.039
4th	4.53±0.09	4.06±0.35	4.25±0.14	4.28±0.13	1.095	0.36
5th	4.79±0.14	4.74±0.31	4.66±0.23	4.73±0.13	0.078	0.926
6th	5.50±0.37	5.23±0.13	5.19±0.16	5.30±0.14	0.469	0.635
7th	6.42±0.31	6.91±0.48	6.74±0.19	6.69±0.19	0.508	0.612
Overall mean	4.82±0.32	4.55±0.46	4.46±0.46	4.61±0.23	0.203	0.818

Body Measurement

Mean value of fortnight body length (cm), body height (cm) changes, punch girth or flank to flank measurement (cm), heart girth (cm) from grower to finisher are presented at Table 6.

Table 6: Average fortnight body length (BL), body height (BH), punch girth or flank to flank (PG), heart girth (HG) of pigs in cm in different treatment groups

Fortnights		T_0	T_1	T_2	SEM	F	Sig.
1st	BL	56.08±0.33	56.96±0.43	57.05±0.40	56.70±0.23	1.892	0.185
	BH	43.20±0.28	43.33±0.43	44.05±0.14	43.53±0.19	2.127	0.154
	PG	55.01±0.96	55.85±0.98	55.98±1.14	55.61±0.57	0.257	0.776
	HG	66.86±0.66	66.83±0.59	67.60±0.72	67.10±037	0.424	0.662
2nd	BL	61.55±0.31	62.20±0.55	62.73±0.58	62.16±0.29	1.422	0.272
	BH	46.60±0.35	46.64±0.32	46.97±0.29	46.73±0.18	0.388	0.685
	PG	62.51±0.99	62.78±0.98	62.89±0.98	62.73±0.53	0.038	0.963
	HG	70.26±0.69	70.93±0.54	71.76±0.88	70.98±0.41	1.088	0.362
3rd	BL	68.94±0.34	69.26±0.46	69.86±0.35	69.36±0.23	1.422	0.272
	BH	50.45±0.25	50.50±0.38	50.83±0.29	50.59±0.17	0.42	0.665
	PG	70.47±0.62	70.31±0.87	70.46±0.95	70.42±0.45	0.012	0.988
	HG	77.10±0.51	77.43±0.54	77.81±0.65	77.45±0.31	0.391	0.683
4th	BL	75.86±0.46	76.25±0.46	76.55±0.37	76.22±0.24	0.618	0.552
	BH	54.20±0.32	54.50±0.31	54.91±0.31	54.54±0.18	1.268	0.31
	PG	77.03±0.52	78.00±0.64	78.76±1.39	77.93±0.53	0.853	0.446
	HG	83.95±0.71	84.22±0.74	85.50±0.52	84.55±0.39	1.535	0.248
5th	BL	81.71±0.51	82.15±0.44	82.76±0.33	82.21±0.25	1.459	0.264
	BH	58.30±0.27	58.71±0.32	58.88±0.31	58.63±0.17	0.963	0.404
	PG	84.13±0.60	84.5±1.20	84.59±1.20	84.41±0.56	0.055	0.947
	HG	90.41±0.81	91.20±0.72	91.90±0.56	91.17±0.41	1.101	0.358
6th	BL	87.23±0.42	88.00±0.60	88.36±0.33	87.86±0.27	1.525	0.25
	BH	61.98±0.39	62.28±0.35c	62.75±0.18	62.33±0.19	1.403	0.276
	PG	91.93±0.39	92.41±1.03	92.8±1.49	92.38±0.58	0.164	0.85
	HG	97.40±0.70	98.53±0.56	98.90±0.46	98.28±0.35	1.806	0.198
7th	BL	92.55±0.63	93.75±0.97	94.06±0.27	93.45±0.40	1.342	0.291
	BH	65.78±0.44	66.33±0.40	66.95±0.16	66.35±0.22	2.603	0.107
	PG	98.00±0.65	98.38±0.63	98.61±1.01	98.33±0.43	0.156	0.857
	HG	102.16±0.65	103.00±0.57	103.52±0.52	102.89±0.34	1.356	0.288
Over all mean	BL	71.90±5.28	72.56±5.30	72.91±5.34	72.46±2.93	0.009	0.991
	BH	52.60±3.20	52.83±3.26	53.31±3.23	52.91±1.78	0.013	0.987
	PG	80.19±6.01	80.66±6.01	80.97±6.04	80.60±3.32	0.004	0.996
	HG	86.92±5.26	87.55±5.37	88.23±5.34	87.56±2.94	0.015	0.985

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Towards the end of the experiment T_2 show marginal more value in body length in comparison to T_1 and T_0, but were statistically non-significant (P<0.05). Towards the end of the experiment the mean value of T_2 showed slightly more value in body height as compared to T_1 and T_0. But the value were statistically non-significant (P<0.05) throughout the observation period. The body height was found to be non-significant between control and treatment groups. During observational period showed non- significant (P<0.05) between the treatments and the control groups which indicated that feeding of cauliflower leaves improved the punch girth in a similar way as like that of control group. Similar to the finding of flank to flank, no significant difference (P>0.05) was observed in mean value of heart girth. Body measurements did not differ significantly during successive weeks of experiment. All the body measurements increased as age advanced.

Carcass Characteristics

The mean values of different carcass traits after slaughter at the end of the experiment are given on Table 7.

Table 7: Effects of feeding cauliflower leaves on carcass traits

Parameters	T_0	T_1	T_2	F	Sig.
Live wt.(kg)	111.50 ± 5.22	112 ± 7.93	118.66 ±1.33	0.521	0.618
Carcass wt. (kg)	81.52 ± 5.76	85.06 ± 5.47	91.56 ± 1.18	1.206	0.362
Dressing (%)	73.15 ± 1.57	76.02 ± 1.58	77.16 ± 1.57	1.709	0.258
Carcass lenght(cm)	82.33 ± 2.18	83.36 ± 2.00	85.60 ± 0.70	0.902	0.454
Back fat thickness (cm)	3.39 ± 0.11	3.22 ± 0.14	3.18 ± 0.30	0.279	0.765
10th rib fat thickness (cm)	2.80 ± 0.52	3.19 ± 0.22	2.90 ± 0.22	0.331	0.73
Loin eye area (sq cm)	42.35 ± 2.32	45.68 ± 2.89	46.16 ± 1.92	0.741	0.515

The data revealed that the live weight 12 h prior to slaughter was comparable (P<0.05) between different treatments and the value ranged between 111.50 ± 5.22 to 118.66 ±1.33 kg and found to be non-significant between the treatments. Carcass weight (without head) was non-significant (P<0.05) among the groups. Highest carcass weight (without head) was observed in T_2 (91.56±1.18 kg) followed by T_1 (85.06±5.47) and control group got the lowest value of carcass weight (81.52±5.76). The similar trend was also observed for dressing % without head. The value for dressing % without head varies between 73.15 ± 1.57 in T_0 and 77.16 ± 1.57 in T_2. A non-significant (P<0.05) was observed in dressing % between the groups. Also value for carcass length was ranged from 82.33 ± 2.18 cm in $T_0$to 85.60 ± 0.70cm in T_2. Carcass length did not show any significant difference (P<0.05) among treatments. Results regarding back fat thickness was comparable between different treatments and control group. Though the value was relatively higher for T_0 (3.39 ± 0.11cm) than the other groups but followed a marginal decreasing trend from T_1 to control. But BFT did not show any significant difference (P<0.05) between the groups. Loin eye area (cm^2) results showed 46.16 ± 1.92cm^2in T_2 which was highest compared to T_1 (45.68 ± 2.89cm^2) and T_0 (42.35 ±

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2.32cm^2). Value obtained was comparable among all the groups and no significant difference (P<0.05) was obtained. Similarly 10th rib back fat thickness (cm) value also comparable among all the groups and no different in significant (P<0.05) was obtained. However, T_1 (3.19±0.22cm) had higher value compared to T_2 (2.90±0.22cm) followed by control (2.8±0.52cm) group.

Economics

Relative economics including cauliflower leaves for pigs from grower to finisher stage is presented on Table 8. The total expenditure on feed inclusive of cauliflower T_0, T_1 & T_2 was Rs.5689.11, Rs.6085 and Rs.5987.51respectively. Further, the total income from sale of animals was Rs.5865 for T_0, Rs.6400 for T_1 and Rs.6700 for T_2. The net was T_0, T_1 & T_2 was Rs.175.89, Rs315 and Rs.712.49 respectively. On supplementation of cauliflower increased the net profit by and Rs 139.11 in T_1 and Rs.536.6 in T_2.

Table 8: Effects of feeding cauliflower leaves on economics

Particulars	T_0	T_1	T_2
Total weight gain (kg)	58.65	64	67
Quantity of cauliflower (kg)	0	204.54	280.56
Cost of cauliflower (Rs)	0	102.27	140.28
Quantity of concentrate (kg)	270.91	261.09	254.63
Cost of concentrate (Rs)	5689.11	5482.89	5347.23
Total cost of feed (Rs)	5689.11	6085	5987.51
Income from body gain (Rs)	5865	6400	6700
Total profit (Rs)	175.89	315	712.49

Discussion

Dry Matter Intake

The value of DMI of T_2 were higher than T_1 and T_0 groups with no significant difference (P<0.05) between the groups except on the finisher stage. Similar to this study Saikia and Bhar (2010) reported that on supplementation of vegetables along with kitchen increased DM intake during 9th week showed highly significant (P<0.01) among the treatment groups. In accordance to this study Patel *et al*. (2009) concluded that on supplementation of JFC 75% reported that a significantly (P<0.01) higher DM intake during entire finishing stage of pigs between the groups fed with 75% JFC increased DM in finisher stage. The sun dried, ground tomato promace could replace the concentrate mixture completely in the diet of male buffaloes without affecting DM intake, digestibility of nutrients (Bakshi *et al.*, 2012).

Body Weight

The mean body weight of animals in different groups was almost similar though the mean value of T_2 group showed higher value compared to $T_1$and control groups at all fortnights but the values did not differ significantly (P<0.05) between groups. This showed that feeding of cauliflower leaves up to 15% DM of

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concentrate does not affect the average body weight changes. Similar to our study, dried ripe banana peels can be fed to growing pigs up to 20% in the diet without depressing growth was validated (Rios *et al.*, 1975). Silage containing 17% carrots (with fodder beets, sugar beets and potatoes) fed to replacement sows had a positive effect on live weight gain, reproductive parameters and on litter performance. Similar results were tained on lactating and gestating sows fed silage containing 12% carrots with pumpkins and potatoes (Yushkova and Kertieva, 2010) however at the end of growing stage no significant difference were observed in final body weight gain among groups of pigs fed on different levels of green berseem in a basal diet of kitchen waste (Ravindra *et al.*, 2014).

ADG from Grower to Finisher

The mean average daily weight gain (kg) in the 1st, 2nd and 3rd fortnight varied significantly ($P<0.05$) between the groups. Conversely from 4th to 7th fortnight, value of ADG is slightly lower than previous fortnights. But the values of T_2 was relatively higher as compared to T_1 and control groups with a non significant ($P<0.05$) difference between the groups. Similarly, Ravindra *et al.* (2014) reported that at the end of growing stage no significant difference were observed in daily weight gain among groups of pigs fed on different levels of green Berseem (up to 25%) in a basal diet of kitchen waste however a significant ($P<0.05$) difference between treatment groups during 1st fortnight average body gain of pigs fed on sugarcane press mud (Sahu, 2014).

Body Measurement

All the body measurement parameters showed non- significant ($P<0.05$) throughout the entire experiment period. Although, there are no direct reference and literature available to compare the findings, Sahu (2014) reported that the mean values of all the body measurement parameters viz. body length, height, punch girth and heart girth showed non-significant ($P<0.05$) throughout the entire experiment period between the treatment groups of pig feeding on SPM as a partial replacement of conventional feed.

Carcass Characteristics

Carcass weight (without head) was varied non-significantly ($P<0.05$) among the groups. Similar findings on dressed carcass weight was found on the treatment groups fed with JFC along with concentrate was validated (Patel *et al.*, 2009). However, back fat thickness was less in pigs maintained on hotel wastes and concentrate than those maintained on concentrate alone was found by Jha *et al.* (1999).

Economics

The net income was T_0, T_1 and T_2 was Rs.175.89, Rs. 315 and Rs.712.49 respectively. On supplementation of cauliflower increased the net profit by and Rs 139.11 in T1 and Rs.536.6 in T2 respectively. It can be

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said that feeding of cauliflower leaves as non- conventional feed @ 15% DM of the concentrate has potential to reduce the cost of pig and utilized the cheaper and locally available culled cauliflower leaves with standard conventional ration without affecting the production. Similarly, Ravindran (1995) reported that the cost of produce a dozen eggs was decreased by feeding layers with diet containing several non-conventional feed stuffs such as dried poultry manure, rice polishing, cassava leaf meal, *ipilipil leaf* meal, rubber seed cake and *ragi* and attributed the benefit to the price structure of such feed stuffs.

Conclusion

It can be concluded that locally available cost effective and abundant available cauliflower leaves can be fed for replacing the concentrate @ 15% DM of the concentrate, which reduced the rearing cost without causing any adverse effect on growth rate and carcass traits. So, cauliflower leaves can be safely used in pig rearing for higher economical return without any adversity.

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Competing Interests

Authors declare that they have no competing interests.

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