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EVALUATION OF SEABUCKTHORN (*HIPPOPHAE L.*) CAKE AND LEAVES FED AS MASH AND PELLETED FEED ON BIOLOGICAL PERFORMANCE OF POULTRY BROILERS

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ABSTRACT

The study was conducted to compare the feeding value of seabuckthorn (SBT) leaves and cake as the protein replacer as mash and pelleted forms in the poultry birds in two different experiments. Feed processing likely to have a great influence on nutrient utilization and broilers performance. The present study was envisaged to see the effect of replacement of CP of conventional feed of poultry broilers with SBT leaves and cake as mash and pelleted forms of feed on biological performances and nutrient digestibility. The two experiments were conducted on 189 vancobb strain each, on one day-old chicks dividing into 4 groups and 7 subgroups with 3 replications having 9 chicks in each replication for each experiment. The CP of control group (TL0) was replaced with the CP of SBT leaves at 6, 9 and 12 per cent levels in TL1, TL2 and TL3 treatment groups and each group divided into two subgroups, where broilers chicks were fed with mash feed and represented as TLm, TLm-1, TLm-2 and TLm-3, and pelleted feed represented as TLp, TLp-1, TLp-2 and TLp-3 respectively. Similarly, in another experiment the CP of control group (TC0) was replaced with CP of SBT cake at 20, 30 and 40 per cent level in TC1, TC2 and TC3 treatment groups. Each group divided into two sub groups where broilers chicks fed with mash feed and represented as TCm, TCm-1, TCm-2 and TCm-3 and pellet feed and represented as TCp, TCp-1, TCp-2 and TCp-4. As both the experiments conducted simultaneously and hence control group composition was kept common in both the experiments. Broilers performance and nutrient digestibility increased with the increase in CP replacement with SBT leaves at 12 level with pelleted feed as compared to mash feed fed groups. Similar results were found with CP replacement with

SBT cake at 40 per cent levels with pelleted feed. Like wise numerically better overall performance FCR was found in all leaves and cake pellet fed groups as compared to their corresponding mash fed groups. In overall, the best FCR was found in treatment groups, where 12 and 40 per cent CP of basal diet was replaced with CP of SBT leaves and cake in pellet form of feed. The inclusion of SBT leaves and cake in the diet as well as feed physical form (mash or pellet) have no effects on broilers mortality rates. Based on the findings it was concluded that 12 and 40 per cent CP of the broilers traditional diet can be replaced with the CP of SBT leaves and cake respectively without any adverse effect and better results found in pelleted form of the feed as compared to mash fed form of the SBT leaves or cake.

KEYWORDS: Seabuckthorn (SBT), Poultry, Broiler, Gain in weight, FCR, Blood parameters.

INTRODUCTION

In recent years the poultry production sector has increased tremendously. Poultry broiler consumption grew faster as compared to consumption of other types of animal meats and products, including milk and eggs (Landes *et al.* 2004). Poultry farming has various advantages like low initial investment and faster returns from the investment. Thus sustained availability of low-priced, high-quality feeds in India is imperative, if poultry production is to remain competitive and to meet the increasing consumer demand for eggs and meat. Thus poultry nutritionist's world over are exploiting the use of various un-conventional feed ingredients in poultry feeding to enhance the growth performance of broilers.

One of such plant which can be used as NFCR is "Seabuckthorn" (*Hippophae sp*. Family *Elelagnacea*), the "golden bush" with deciduous, thorny and nitrogen fixing plant with (2-4 cm) height generally naturally growing in temperate Himalaya regions. Thus from the proximate analysis of different parts of seabuckthorn (SBT) plant parts like leaves and fruit residues,etc it was concluded that it can be used as source of animal feeds (Sharma *et al*. 2014). Seabuckthorn (*Hippophage.L.*) is a rich source of vitamins and other bioactive substances. Due to industrial processing, appreciable quantity of wastes in the form of leaf meal, fruit pulp and seed waste remains un-utilized, which have enormous potential as a livestock feed as having high content of proteins, amino acids, fat, vitamin A, C, D, E, carotenoids, flavonoids and micro minerals. Keeping in view the usefulness of seabuckthorn leaves and cake, it will be of great importance to evaluate its nutrient utilization in commercial broilers birds.

Feed processing operation such as grinding, mixing and pelleting are have a great influence on feed quality and broiler performance (Behnak and Beyer, 2012). For better broiler growth and efficient nutrient utilization, it is therefore vital that efficient and improved feed technology is used. As per the suggestion of Agah and Norollahi (2008), feed intake can be significantly affected by the form and method of processing. The physical form of feed (mash, pellet and crumble) is a crucial factor in broiler meat production. Pellet system of feeding is a modification of the mash system. It involves of mechanically pressing of the mash into pellets or artificial grains.

According to Gadzirayi *et al.* (2006), each physical form of feed has some of its own characteristics and aspects. Mash diet gives greater unification of growth, less death loss and is more economical. However, ground mash feed is not so palatable and does not retain their nutritive value. But for better performance, nutrient uniformity in a complete diet is important to maximize nutrient utilization. One of the most important quality aspects of pelleted feed is uniformity (Beumer, 1991 and Mandal *et al.* 2006). As per (Patrick and Philip, 1980) consideration, now a day's most of the poultry feed (approximately 60 per cent) fed as pelleted or crumble feed to the poultry in the world.

Therefore the present experiment was planned to study the effects of replacement of crude protein of conventional feed of broiler with crude protein of SBT leaves and cake and carry out the comparative study of mash as well as pelleted feed for evaluating the broiler production.

MATERIAL AND METHODS

The research work was conducted in the Metabolic Stall of the Department of Animal Nutrition, DGCN, College of Veterinary and Animal Sciences, CSK HPKV, Palampur (H.P). Two experiments were conducted on 378 each, on one day-old broiler chicks of Vancobb strains which were divided into 4 main groups and 8 sub groups with 3 replications having 9 chicks in each replication. The CP of control treatment group (TL0) was replaced with the CP of Seabuckthorn (SBT) leaves at 6, 9 and 12 per cent levels in TL1, TL2 and TL3 treatment groups respectively. Each treatment group was fed as mash feed and represented as TLm, TLm-1, TLm-2 and TLm-3, whereas as pelleted fed groups represented as TLp, TLp-1, TLp-2 and TLp-3 respectively. Similarly, the CP of control group (TC0) was replaced with CP of SBT cake at 20, 30 and 40 per cent level in TC1, TC2 and TC3 treatment groups respectively. Each cake SBT treatment groups fed as mash feed and represented as TCm, TCm-1, TCm-2 and TCm-3 respectively, whereas as pelleted fed groups represented as TCp, TCp-1, TCp-2 and TCp-3, respectively (Table 1, 2).

The seabuckthorn leaves were purchased from Shansha village in the Lahoul & Spiti region of Himachal Pradesh and seabuckthorn cake was purchased from M/S Mantra Ayurveda, Plot no. 6, Gurukul Industrial Area, Sarai Khwaja, Faridabad (Haryana). The SBT leaves were dried and passed through 2 mm sieve with the help of grinding mill.

The pelleted feed was prepared with the help of electrically operated mini pellet making machine having 2 mm die and pellet diameter of 2mm (Anonyms 2009) was mixed to obtain the good quality and textured pellets (Parsons, 2004). Standard methods as reported in AOAC (1985) were followed for determination of proximate composition as well as feed samples. The metabolizable energy (ME) contents of different test diets used under different experiments were calculated as per the equation proposed by Lodhi *et al*. (1976). Composition of experimental ration and nutrient profile has been depicted in Table 3and 4.

Experimental Plan

Table 1: Experimental design (Experiment 1).

Sr. No.	Treatment	Sub-group	CP% of basal diet replaced by CP of SBT leaves	Supplementation level of SBT leaves per quintal of control feed used	
				Starter phase	Finisher phase
1	TL0	TLm	Nil	Nil	Nil
2		TLp			
3	TL1	TLm-1	6 % leaves	7.712 Kg Leaves	6.80 Kg Leaves
4		TLp -1			
5	TL2	TLm -2	9 % leaves	11.57 Kg Leaves	10.20 Kg Leaves
6		TLp-2			
7	TL3	TLm -3	12 % leaves	15.425 Kg Leaves	13.60 Kg Leaves
8		TLp-3			

Table 2: Experimental design (Experiment 2).

Sr. No.	Treatment	Sub-group	CP% of basal diet replaced by CP of SBT cake	Supplementation level of SBT cake per quintal of control feed used	
				Starter phase	Finisher phase
1	TC0	TCm	Nil	Nil	Nil
2		TCp			
3	TC1	TCm-1	20 % cake	17.3 Kg Cake	15.25 Kg Cake
4		TCp-1			
5	TC2	TCm-2	30 % cake	25.956 Kg Cake	22.88 Kg Cake

6		TCp-2			
7	TC3	TCm-3	40 % cake	34.608 Kg Cake	30.51 Kg Cake
8		TCp- 3			

After procuring the Vacobb strain broiler chicks from Uttam Hatcheries, Kangra, H.P. The chicks were kept only on water for first 24 hours and then fed on starter diet as mentioned above. They were wing banded, weighed and divided into seven treatment groups and 2 sub-groups each having 3 replications, with 9 chicks in each replication with almost having same average body weight in each treatment. They were kept in a 42 compartments poultry brooder, which were thermostatically controlled. The standard management practices were followed for rearing the chicks in battery brooders for 4 weeks of age (Starter phase) and thereafter they were shifted to poultry cages to rear up to 6 weeks of age (finisher phase). Clean drinking water and the respective experimental feeds were always available to the chicks during the entire course of study.

The digestibility of various nutrients was studied from day 29^{th} to 33^{rd} of the age of chicks. The amount of feed consumed, feed refused and faeces voided during this period were recorded. Fresh samples of faecal matter were taken for nitrogen and dry matter estimation. $1/100^{th}$ of the total faeces were taken for nitrogen estimation while another $1/10^{th}$ portion of faecal sample was.

Table 3: Physical and chemical composition of broiler starter feeds (% DMB).

Particulates	Physical composition							Treatment Nutrient	Chemical composition						
	Common Control	Experiment-1			Experiment-2				Common Control	Experiment-1			Experiment-2		
		TL1	TL2	TL3	TC1	TC2	TC3			TL1	TL2	TL3	TC1	TC2	TC3
Maize	44.00	40.60	38.90	37.21	36.38	32.58	28.77	Dry matter	90.94	90.19	90.62	90.28	90.94	90.39	90.80
Soya flakes	33.00	30.45	29.02	27.91	27.29	24.43	21.58	Crude Protein	23.10	22.44	22.55	22.79	22.37	22.44	23.05
Fishmeal	3.00	2.76	2.65	2.53	2.48	2.22	1.96	Ether extract	3.95	5.06	5.16	5.09	4.45	4.63	4.99
Rice polish	9.75	8.99	8.62	8.25	8.06	7.21	6.37	Crude fiber	5.92	6.04	6.54	6.25	5.85	5.96	6.76
Mustard cake	3.00	2.76	2.65	2.53	2.48	2.22	1.96	Total ash	5.14	5.30	5.21	5.31	5.27	5.12	6.20
Sun Flower Cake	5.00	4.61	4.42	4.42	4.13	3.70	3.26	NFE	61.89	61.16	60.54	60.56	62.02	61.85	61.00
Seabuckthorn leaves	-	7.71	11.57	15.43	-	-	-	Acid insoluble ash	1.06	1.06	1.30	1.03	1.28	1.08	1.34
Seabuckthorn cake	-	-	-	-	17.30	25.95	34.61	Ca	2.35	2.12	2.25	2.33	2.25	2.08	2.23
Lime Powder	1.00	0.92	0.88	0.84	0.83	0.74	0.65	P	0.80	0.92	1.12	1.22	1.19	0.98	1.08
Di Calcium Phosphate	1.00	0.92	0.88	0.84	0.83	0.74	0.65	ME(Kcal/kg)	2786.35	2816.86	2829.56	2852.86	2829.07	2850.80	2872.37
Minerals mixture*	0.25	0.23	0.22	0.21	0.20	0.19	0.16								

Table 4: Physical and chemical composition of broiler finisher feed (% DMB)

Particulates	Physical composition							Treatment Nutrient	Chemical composition						
	Common Control	Experiment-1			Experiment-2				Commo n Control	Experiment-1			Experiment-2		
		TL1	TL2	TL3	TC1	TC2	TC3			TL1	TL2	TL3	TC1	TC2	TC3
Maize	52.00	48.34	46.70	44.93	44.07	40.10	36.13	**Dry matter**	90.05	89.45	89.87	90.65	91.05	90.07	88.78
Soya flakes	25.00	23.35	22.45	21.6	21.18	19.28	17.37	**Crude Protein**	19.87	19.75	20.05	20.18	19.63	19.67	19.84
Fishmeal	3.00	2.81	2.69	2.59	2.54	2.31	2.08	**Ether extract**	3.50	4.25	4.87	5.72	5.03	5.78	5.64
Rice polish	10.00	9.73	8.98	8.64	8.47	7.71	6.94	**Crude fiber**	6.16	6.00	6.64	6.54	6.66	6.75	5.77
Mustard cake	3.00	2.81	2.69	2.59	2.54	2.31	2.08	**Total ash**	5.45	5.18	4.87	5.25	5.12	5.34	4.78
Sun Flower Cake	5.00	4.69	4.49	4.32	4.23	3.85	3.47	**NFE**	65.02	64.82	63.57	62.31	63.56	62.46	63.97
Seabuckthorn leaves	-	6.80	10.20	13.60	-	-	-	**Acid insolube ash**	1.00	1.07	1.05	1.04	1.25	1.28	1.04
Seabuckthorn cake	-	-	-	-	15.25	22.88	30.51	**Calcium**	2.15	2.32	2.34	2.53	2.05	2.23	2.43
Lime Powder	1.00	0.93	0.89	0.86	0.84	0.77	0.69	**P**	1.20	1.08	1.10	1.21	0.98	0.92	1.08
Di Calcium Phosphate	1.00	0.93	0.89	0.86	0.84	0.77	0.69	**ME (Kcal/kg)**	2877.80	2911.27	2910.30	2921.18	2901.39	2913.66	2925.37
Minerals mixture*	0.25	0.23	0.22	0.21	0.21	0.19	0.17								

(*)

1. Merivite AB_2D_3: 25 mg (Vit A-82, 500 IU, Vit B_2-52 mg, Vit D_3-12000 IU, Vit K-10 mg, PO_4-395 mg /gm)
2. Nicomix BE: 25mg (Vit B_1-4 mg, Vit B_{12} 40 µg, Niacin-60 mg, Calcium Pentothenate-40 mg, Vit E-40 mg / gm)
3. Trace Minerals: 100 gm (Ferric Oxide-2 gm, Copper sulphate-2 gm, Ferrous sulphate-10 gm, Zn sulphate-0.6 gm Di calcium phosphate-53 gm, Manganese sulphate-5.5 gm, Pottasium iodide-2.5 gm, Sodium thiosulphate-0.75 gm Zinc oxide-1 gm)
4. Choline chloride: 100 gm

taken for dry matter estimation. The sample of feed, refusals and faeces were analyzed for crude protein, ether extract, total ash, crude fibre and NFE as per methods given in AOAC (1985) to assess the digestibility of different nutrients. The physical and chemical composition of the feed ingredients and diets has been given in the table 2, 3 and 4 during the starter and finisher phase of broiler production.

The data generated out from the experiment was analyzed using Software Graphpad InStat™ 1990-1994, by applying One Way Analysis of Variance.

RESULTS AND DISCUSSION

Overall biological performance at the end of finisher phase of the poultry broilers has been presented in table 5.

The overall GIW under experiment 1 in leaves mash fed group ranged from 1437.60±32.18 to 1624.00±32.03 gm being lowest in TLm and significantly (P<0.05) highest in TLm-3 as compared to all other treatment groups. In pellet fed group the overall GIW ranged from 1441.63±27.05 to 1668.48±45.73 gm and was lowest in TLp and highest in TLp-3 treatment group and was significant (P<0.05) as compared to TLp and TLp-1 treatment groups. The GIW showed linear increase with increase in level of CP inclusion from SBT leaves. The overall feed intake in leaves mash fed group was ranged from 3398.03± 57.46 to 3629.20±132.20 gm being minimum in TLm-3 and maximum in TLm-2, where it was significantly (P<0.05) highest among all other treatment groups. The FI in pellet fed group varied from 3423.23±76.77 to 3788.29±128.62 gm being the lowest in TLp and significantly (P<0.05) highest in TLp-2 as compared to all other treatment groups. The overall FCR in leaves mash fed group was ranged from 2.47± 0.06 in TLm to 2.09±0.03 in TLm-3 treatment group. It was observed that the FCR in TLm-3 treatment group was significantly (P<0.05) lowest among all the other treatments of mash fed group. In pellet fed group, it ranged from 2.37±0.05 in TLp to 2.08±0.05 in TLp-3 treatment group being significantly (P<0.05) lowest in TLp-3 as compared to all other treatments of pellet fed group. It was observed that with increase in CP level from SBT leaves, the FCR was having linear decreasing trend and all pellet fed groups had numerically better FCR as compared to mash fed group

The overall GIW under experiment 2 in cake mash fed group was found to be varied from 1437.60 ± 32.18 to 1902.90±47.84 gm, was the lowest in TCm and significantly (P<0.05) highest in TCm-3 treatment group. Similarly, in pellet fed group it ranged from 1441.63 ±

27.048 to 2042.87±41.06 gm being the lowest in TCp and significantly ($P<0.05$) highest in TCp-3 treatment group. The GIW showed linear increase with increase in level of CP inclusion from SBT cake. Similarly, it was significantly ($P<0.05$) higher in all pellet fed treatment groups as compared to their corresponding mash fed groups except of TCp-3 *viz* TLm-3. The overall FI in cake mash fed group ranged from 3557.58±91.84 to 4166.40±101.09 gm being lowest in TCm and highest in TCm-3 treatment group where it was significantly ($P<0.05$) highest among all other treatment groups. The FI in pellet fed group varied from 3423.23±76.77 to 4392.27±67.13 gm being lowest in TCp and significantly ($P<0.05$) highest in TCp-3 treatment group among all other treatment groups. It was observed that with increase in CP level from SBT leaves as well as cake, the FI was having linear increasing trend and all pellet fed treatment groups had significantly ($P<0.05$) higher FI as compared to mash fed group except TCm-3 viz TCp2. The overall FCR cake mash fed group ranged from 2.47±0.06 to 2.19±0.05 being maximum in TCm and minimum in TCm-3 treatment group respectively. The FCR in TCm-2 and TCm-3 was observed to be significantly ($P<0.05$) better as compared to Tm and TCm-1 treatment groups. In pellet fed group, the FCR ranged from 2.37± 0.05 to 2.15± 0.03 being maximum in TCp and minimum in TCp-3 which was significantly ($P<0.05$) lowest as compared to TCp-1 and TCp-2 treatment groups. It was observed that with increase in CP level from SBT cake, the FCR was having linear decreasing trend and all pellet fed groups had numerically better FCR as compared to mash fed group.

These results are in agreement with Ambatkar (2009), but our findings were higher than the finding of Sharma (2010), who concluded that CP from SBT leaves up to 6 per cent can be used in broiler diet successfully. Melesse *et al.* (2011) also concluded that the CP of control diet of grower chicks can be replaced by *Moringa stenopetal* leaf meal (MSLM) up to 8.8 per cent. Similarly, the results were supported by Esonu *et al.* (*2012),* who concluded that *Microdesmis puberula* leaf meal can be used successfully in broiler feeding up to 10 per cent inclusion level. Similarly, Juniar *et al*. (2008) *also* concluded that addition of 10 per cent *Moringa* oleifera leaf meal in feed did not show negative effects on broiler production performance. These results are also supported by *Wyllie and Chamanga, (1979),* who concluded that broilers showed improved performance at the level of 10 per cent inclusion of cassava leaves. However, it were in contrast with Teguia *et al.* (1997), who replaced maize of broiler control diet with leaves of sweet potato (*Ipomoea batatas*) and perennial peanuts (*Arachis glabrata Benth*) and reported that their use was not justified.

In case of cake fed group, on the basis of overall studies, it was found that CP in broiler starter and broiler finisher phases diets from SBT cake at all inclusion levels had positive effects on broiler performance. Similarly, it had better effects in pellet form of feed as compared to mash. So, it could be concluded that SBT cake could be used in broiler starter and broiler finisher phase diets to have up to 40 per cent of total CP. These results were higher than the finding of Sharma (2010), Guleria (2010) and Hasanuzzaman (2011). The results were corroborated by Tadelle *et al.* (2003), who reported that 28 per cent rapeseed cake can be included in broiler feed as protein source. But the finding were lower than the finding of Adeyemo and Longe (2007), who had concluded that in broiler ration, soyabean cake could be replaced up to 75 per cent level with cotton seed cake.

From the above studies it was observed that comparatively better broiler performance was found in birds fed pellet form as compared to mash form of feed.

Therefore, it could be suggested that both cake and leaves, if used in the form of pellets, it can improve the performance of the broilers. This might be due to the energy sparing action of pelleted form due to less time spent on feed consumption. The similar role of feed formulation has also been reported by Lesson and Johan (1993), Sawant (2010), Cerrate *et al.* (2009) and Winowiski (2012).

Physical form of feed plays an important role in feed intake which could be reciprocated in the form of better broiler performance (Lesson and Johan, 1993). The pellet form of feed has uniform structure which contains all the required nutrients (Mandal *et al.* 2004). However, these results were in contrast to the finding of Gadzirayi *et al.* (2006), where they reported that up to 32 days no significant ($P<0.05$) difference was found in bird fed with mash and birds fed with pellet form of feed, but after 32 days, better growth was observed in birds fed with pellet form of feed. Similarly, these results were also in contrast with the finding of Kaudia (1999). These findings of the present study were in agreement with Cerrate *et al*. (2009), where they found that bird fed with 1.59 and 3.17 mm dies in starter phase (0 to 13 days), had better BW as compared to bird fed with mash form of feed. Similarly, Dozier *et.al* (2012) also has reported that bird fed with good quality pellet exhibit better growth as compared to birds fed with poor quality pellet or mash form of feed.

Table: 5 Overall biological performance of broilers offered diets up to 6th week of age

Leaves fed groups (Experiment-1)								
Mash sub groups					Pellet sub groups			
PARTICULARS	**TLm**	**TLm-1**	**TLm-2**	**TLm-3**	**TLp**	**TLp-1**	**TLp-2**	**TLp-3**
Initial Wt at 5th day (gm)	72.08 ± 0.40	72.33 ± 018	72.07 ± 0.49	72.30 ± 0.29	72.37 ± 0.12	72.30 ± 0.27	72.07 ± 0.51	72.32 ± 0.08
Final Wt at 7th week	1509.60^{a} ± 34.97	1547.00^{b} ± 32.68	1614.80^{c} ± 33.20	1696.30^{d} ± 32.06	1514.30^{a} ± 27.11	1593.70^{c} ± 30.95	1722.13^{d} ± 29.76	1740.80^{d} ± 45.70
GIW (gm)	1437.60^{a} ± 32.18	1472.67^{b} ± 35.01	1542.73^{c} ± 33.20	1624.00^{d} ± 32.03	1441.63^{a} ± 27.05	1521.40^{c} ± 30.10	1650.50^{de} ± 30.03	1668.48^{d} ± 45.73
FI (gm)	3557.58^{a} ± 91.84	3400.78^{a} ± 85.58	3629.20^{b} ± 132.20	3398.03^{a} ± 57.46	3423.23^{a} ± 76.77	3488.96^{c} ± 62.76	3788.29^{d} ± 128.62	3475.59^{a} ± 86.83
FCR	2.47^{a} ± 0.06	2.30^{b} ± 0.05	2.35^{cb} ± 0.08	2.09^{d} ± 0.03	2.37^{c} ± 0.05	2.29^{b} ± 0.04	2.29^{b} ± 0.07	2.08^{d} ± 0.05
Cake fed groups (Experiment-2)								
Mash sub groups					**Pellet sub groups**			
PARTICULARS	**TCm**	**TCm-1**	**TCm-2**	**TCm-3**	**TCp**	**TCp-1**	**TCp-2**	**TCp-3**
Initial Wt at 5th day (gm)	72.08 ± 0.40	71.19 ± 0.80	70.85 ± 0.85	72.70 ±0.64	72.07 ± 0.92	71.96 ± 0.95	72.42 ± 0.71	72.33 ± 0.73
Final Wt at 7th week	1509.60^{a} ± 34.97	1772.20^{b} ± 39.02	1846.70^{c} ± 36.95	1975.60^{d} ± 47.60	1514.30^{a} ± 27.11	1831.90^{c} ± 32.06	1958.50^{d} ± 40.28	2115.20^{e} ± 40.95
GIW (gm)	1437.60^{a} ± 32.18	1701.00^{b} ± 39.13	1775.85^{c} ± 36.97	1902.90^{d} ± 47.84	1441.63^{a} ± 27.048	1758.94^{c} ± 32.15	1886.08^{e} ± 40.34	2042.87^{f} ± 41.06
FI (gm)	3557.58^{a} ± 91.84	3880.13^{b} ± 87.50	3841.38^{b} ± 65.83	4166.40^{c} ± 101.09	3423.23^{d} ± 76.77	4017.35^{e} ± 63.96	4158.93^{c} ±103.18	4392.27^{f} ± 67.13
FCR	2.47^{a} ± 0.06	2.28^{b} ± 0.05	2.16^{c} ± 0.04	2.19^{c} ± 0.05	2.37^{d} ± 0.05	2.28^{b} ± 0.03	2.20^{c} ± 0.05	2.15^{c} ± 0.03

The figures bearing different superscripts within a row differ significantly ($P<0.05$)

Digestibility coefficient of different nutrients (% DMB)

The metabolism trial was conducted during the day of 26th to 29th of age. The digestibility coefficients of dry matter, crude protein, crude fiber, ether extract, nitrogen free extract and organic matter have been presented in Table 6.

From the overall studies it was revealed that with increase CP inclusion level of SBT leaves and cake, the digestibility coefficients of DM, CP, CF, NFE and OM were also increased. The SBT cake inclusion had slightly negative effect on EE digestibility. The results of digestibility coefficient of leaves fed group in respect of DM, CP, EE and CF were corroborated to the finding of Ambatkar (2009), where in respect of OM, these findings were higher than the findings of Ambatkar (2009). In cake fed group, similar values of digestibility coefficients of DM, NFE and OM was reported by Hasanuzzaman (2011), where our finding in respect of CP and EE digestibility were lower, and of CF was higher than the findings of

Hasanuzzaman (2011). Our findings of digestibility coefficients in respect of DM, CP, EE, CF and NFE were in agreement with the findings reported by Sharma (2010).

In overall, the digestibility coefficients of DM, CP, EE, CF, NFE and OM were higher in pellet fed group as compared to corresponding mash fed groups. The similar difference in respect of digestibility of OM, CP, CF and EE was reported by Zelenka (2003) which was higher in pelleted as compared to mash feed. The positive effect of pellet form of feed on apparent digestibility has also been reported by Ganzer *et al.* (2007).

Table 6: Digestibility coefficient of different nutrients (% DMB).

Leaves fed groups (Experiment-1)									
Mash sub groups					**Pellet sub groups**				
PARTICULARS	**TLm**	**TLm-1**	**TLm-2**	**TLm-3**		**TLp**	**TLp-1**	**TLp-2**	**TLp-3**
DM	62.19^{a} ± 2.40	63.10^{ab} ± 1.37	62.49^{a} ±1.78	65.37^{b} ± 2.66		63.29^{ab} ± 2.07	64.09^{ab} ± 2.19	64.52^{ab} ± 2.76	65.95^{b} ± 1.29
CP	52.12^{ab} ± 2.26	53.57^{ab} ± 1.24	$52.85^{a,b}$ ± 3.23	54.48^{b} ± 2.53		53.48^{ab} ± 1.20	53.27^{ab} ± 2.09	53.18^{b} ± 0.62	54.68^{b} ± 2.13
CF	74.32^{a} ± 0.32	73.46^{a} ± 0.52	75.69^{b} ± 1.02	76.15^{b} ± 2.09		72.74^{a} ± 2.10	73.36^{a} ± 1.11	76.86^{b} ± 0.26	75.66^{b} ± 2.25
EE	46.63^{a} ± 3.13	48.37^{a} ± 1.05	52.92^{b} ± 2.17	54.49^{bc} ± 2.11		48.24^{a} ± 0.33	48.01^{a} ± 2.01	53.26^{b} ± 2.05	56.30^{c} ± 1.10
NFE	59.86^{a} ± 1.62	62.79^{b} ± 0.77	63.16^{bc} ± 2.52	65.98^{d} ± 0.55		60.54^{a} ± 2.06	62.86^{b} ± 0.26	64.07^{c} ± 1.12	66.42^{d} ± 2.33
OM	60.05^{a} ± 0.88	62.85^{bc} ± 1.49	61.92^{b} ± 2.34	64.55^{dc} ± 0.44		60.79^{a} ± 1.31	62.05^{b} ± 1.48	62.25^{bc} ± 0.91	65.15^{c} ±2.16
Cake fed groups (Experiment-2)									
Mash sub groups					**Pellet sub groups**				
PARTICULARS	**TCm**	**TCm-1**	**TCm-2**	**TCm-3**		**TCp**	**TCp-1**	**TCp-2**	**TCp-3**
DM	62.19^{a} ± 2.40	64.15^{ab} ± 2.13	65.76^{b} ± 2.17	65.27^{b} ± 1.45		63.29^{a} ± 2.07	64.32^{ab} ± 1.22	65.36^{b} ± 1.29	66.73^{b} ± 2.13
CP	52.12^{a} ± 2.26	54.33^{ab} ± 1.13	55.63^{b} ± 1.38	55.13^{b} ± 1.33		53.48^{ab} ± 1.20	54.69^{b} ± 3.21	55.10^{b} ± 2.23	55.88^{b} ± 2.21
CF	74.32^{ab} ± 1.32	73.17^{a} ± 2.05	73.32^{a} ± 2.02	75.60^{b} ± 2.16		72.74^{a} ± 2.10	72.21^{a} ± 2.37	76.64^{b} ± 2.23	76.40^{b} ±1.15
EE	46.63^{abd} ± 3.13	45.63^{abc} ± 2.17	44.62^{abc} ± 1.23	46.48^{abd} ± 0.65		48.24^{ae} ± 2.33	46.79^{abd} ± 1.27	45.32^{abc} ± 1.31	46.17^{abd} ± 1.30
NFE	59.86^{a} ± 1.62	62.23^{b} ± 1.10	63.37^{cde} ± 1.11	63.22^{bcde} ± 0.67		60.54^{a} ± 2.06	62.81^{bcde} ± 1.12	62.77^{bcde} ± 1.01	64.51^{e} ± 2.13
OM	60.05^{a} ± 0.88	63.17^{b} ± 2.18	64.01^{b} ± 1.23	63.92^{b} ± 1.15		60.79^{a} ± 1.31	63.63^{b} ± 1.23	63.95^{b} ± 1.14	64.48^{b} ± 2.19

CONCLUSION

From the overall performance of the broiler it can be concluded that.

The body weight gain of the broilers was found to be higher at all the inclusion levels of SBT leaves up to 12 and cake protein upto 40 per cent levels respectively in the pelleted form as compared to the mash form of feed.

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