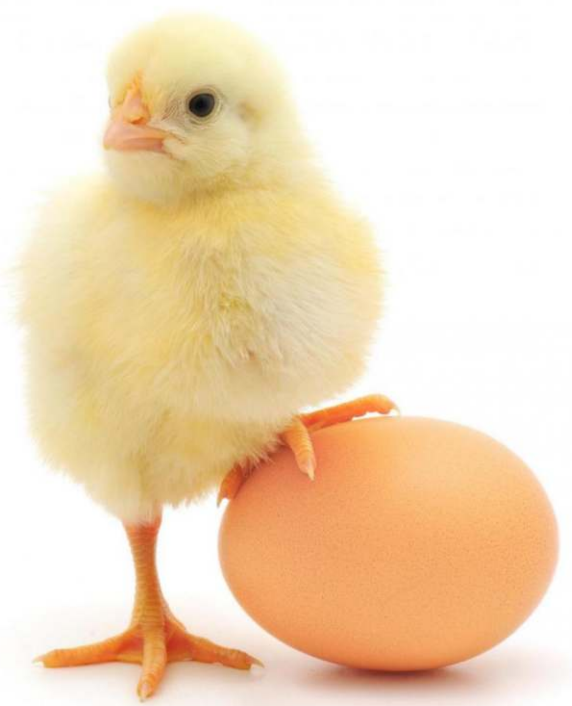
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 8 (7): 671-676, 2009
ISSN 1682-8356

Carcass Characteristics of Broilers Fed Sugarcane Press Residue with Biotechnological Agents

B.N. Suresh[1], B.S.V. Reddy[1], Manjunatha Prabhu B.H.[2] and N. Jaishankar[1]
[1]Department of Animal Nutrition, Veterinary College, KVAFSU, Hebbal, Bangalore-560 024, India
[2]Human Molecular Genetics Lab, Molecular Biology and Genetics Unit,
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore 560 064, India

Abstract: An experiment was carried out to study the effect of inclusion of sun-dried Sugarcane Press Residue (SPR) as a feed ingredient with some biotechnological interventions on the carcass characteristics and gut development of broilers. Experimental diets were prepared by incorporating SPR at 0, 5 and 10 per cent and further such diets were supplemented with or without lipid utilizing agents (lipase and lecithin) or NSP degrading enzymes or together to result in a set of 12 diets. Each diet prepared for starter (0-14 days), grower (15-28 days) and finisher (29-42 days) phases was offered to triplicate groups of 10 broiler chicks each. At the termination of the experiment (42nd day), no significant ($p>0.05$) differences in dressing percentage, meat to bone ratio, abdominal fat and relative weights of different organs viz., liver, heart, gizzard, proventriculus and spleen excepting bursa ($p<0.01$) among different treatments. The main factor SPR showed significant ($p<0.01$) differences in abdominal fat (27.79, 22.60 and 19.13 g/bird or 1.81, 1.47 and 1.33% of live weight in 0, 5 and 10% SPR based groups) while the main factor biotechnological agents in relative weight of spleen, but not for other parameters. The relative length of different segments of small intestine viz., duodenum, jejunum and ileum of birds under different treatments and main factors were remained statistically ($p>0.05$) similar. Thus it was implied that the carcass characteristic of broilers remained unaffected by SPR inclusion up to 10% except abdominal fat, gizzard and proventriculus and by supplementation of some biotechnological agents except spleen.

Key words: Broilers, sugarcane press residue, carcass characteristics, vital organs, gut length

INTRODUCTION

The ever-increasing cost and scarcity of conventional feed ingredients in developing countries like India has compelled to search alternative feed ingredients for poultry feeding (Panda *et al.*, 2006). Sugarcane Press Residue (SPR), a byproduct of sugarcane industry is one such potential feed ingredient. It was included up to 4% in broiler rations without any adverse effect on bird performance (Budeppa *et al.*, 2008). The use of such alternate feed ingredients is limited due to the presence of certain anti-nutritional factors. Many recent studies have confirmed that the use of exogenous feed enzymes derived form biotechnological innovation can result in improved performance (Zanella *et al.*, 1999; Kocher *et al.*, 2003). Further, Mandal *et al.* (2006) reported that the addition of enzymes in un-decorticated sunflower meal based diets improved eviscerated yield of broilers and the yield of giblets also increased due to increased yield of gizzard and liver. In recent years, trend towards formulating high-energy diets for broiler chickens make it necessary for inclusion of fats and oils in broiler diets. However, due to insufficient secretion of endogenous lipase the utilization of fat is limited in young birds which can be improved by the dietary supplementation of bacterial lipase (Meng *et al.*, 2004). Further, lecithin, an excellent source of phospholipids has the ability to promote fat absorption in the digestive system as the birds' cannot synthesize this component (Meng *et al.*, 2004). Hence, in the present study, an attempt was made to evaluate carcass characteristics of broilers at higher levels of SPR with some potential biotechnological interventions was taken up.

MATERIALS AND METHODS

Three experimental diets with similar energy, protein and mineral status were prepared by incorporating sun dried SPR at 0, 5 and 10%. Further, the diets were supplemented with either lipid utilizing agents either lipid utilizing agents (lipase @ 0.2 g and lecithin 2 g/kg diet) or NSP degrading enzyme preparation @ 0.5 g/kg diet or their combination to result in another set of none diets. The diets were prepared separately for starter (0-14 days), grower (15-28 days) and finisher (29-42 days) phases. The ingredient and calculated nutrient composition of all diets is detailed in Tables 1 and 2, respectively.

A total of 360 one-day-old straight-run commercial chicks (Hubbard strain) were wing banded, weighed and distributed randomly into 36 groups of 10 chicks each. The birds were housed in raised wire floor battery brooders of single tier system. Each of the 12 diets was offered randomly to triplicate groups of 10 chicks each.

Table 1: Ingredient composition of experimental diets[2] compounded for different phases

	Starter phase			Grower phase			Finisher phase		
Ingredients, Kg	0% SPR	5% SPR	10% SPR	0% SPR	5% SPR	10% SPR	0% SPR	5% SPR	10% SPR
Maize	528.5	513.4	494.6	554.5	523.0	484.0	621.0	584.0	536.0
Soybean meal	311.5	336.0	359.0	311.0	323.2	331.7	275.0	285.0	288.0
Sunflower extractions	112.0	55.0	2.0	78.0	46.0	23.0	44.3	18.4	7.9
Soya oil	10.0	15.0	21.1	18.0	27.0	38.0	21.6	32.4	45.6
Di-Ca phosphate	20.2	19.3	18.2	20.2	18.8	17	20	18	16
Calcite powder	14.5	8.3	2.2	14.5	8.5	2.8	14	8.5	2.8
Salt	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Sugarcane press residue	0.0	50.0	100.0	0.0	50.0	100.0	0.0	50.0	100.0
$FeSO_4$, g	274.0	0.0	0.0	274.0	0.0	0.0	274.0	0.0	0.0
$ZnSO_4$, g	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0
$CuSO_4$, g	18.0	13.5	8.9	19.0	13.5	8.9	22.0	16.0	10.0
$CoSO_4$, g	9.5	7.9	6.4	9.8	7.9	6.4	9.8	8.3	6.8
KI, g	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Na_2SeO_3, g	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
$MnSO_4$, g	220.0	190.0	159.0	223.0	191.0	158.0	223.0	191.0	158.0
DL-Methionine, g	2000	2010	2020	2000	2050	2100	1800	1940	2000
L-Lysine, g	1000	1000	1000	1000	950	900	1200	1100	1000
Additives[1]	+	+	+	+	+	+	+	+	+
Total	1004.8	1004.8	1004.9	1004.3	1004.3	1004.3	1004.0	1004.1	1004.1

[1]Additives contained Brovit plus-0.5kg (each 500 g contained vit A-12.5 MIU, vit D_3-2.8 MIU, vit E-30 g, vit K-2 g, vit B_1-2 g, vit B_2-5 g, vit B_6-3 g, vit B_{12}-0.015 g, niacin-40 g, Cal-d-panthothenate-15 g, folic acid-1 g, biotin-0.08 g, organic nutritive carrier.-q.s), Tylosine phosphate-0.5 kg; Hepatocare-1.0 kg; Choline chloride-0.5 kg; Curotox-0.5 kg, [2]Parallely, another set of 9 diets with SPR at 0, 5 and 10% were also prepared using either lipase and lecithin or NSP degrading enzymes or their combination

Table 2: Calculated nutrient composition of experimental diets[1] compounded for different phases

	Starter phase			Grower phase			Finisher phase		
Nutrients	0% SPR	5% SPR	10% SPR	0% SPR	5% SPR	10% SPR	0% SPR	5% SPR	10% SPR
ME kcal/kg	2822	2822	2822	2909	2910	2910	3000	3004	3004
CP, %	22.22	22.23	22.24	21.48	21.47	21.48	19.48	19.49	19.51
EE, %	3.19	3.88	4.67	4.02	5.06	6.27	4.54	5.73	7.14
CF, %	6.12	5.59	5.13	5.36	5.30	5.41	4.44	4.49	4.84
Ca, %	1.16	1.16	1.16	1.15	1.14	1.15	1.10	1.10	1.10
TP, %	0.86	0.88	0.89	0.85	0.88	0.90	0.82	0.84	0.87
Pav, %	0.53	0.53	0.53	0.54	0.54	0.54	0.53	0.53	0.53
Na, %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.14
Cl, %	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
K, %	1.08	1.09	1.10	1.06	1.06	1.06	0.96	0.97	0.96
Mg, %	0.21	0.25	0.29	0.20	0.24	0.29	0.17	0.22	0.28
Fe, ppm	120.08	277.30	486.72	117.67	275.57	485.85	113.21	271.43	482.05
Cu, ppm	25.53	25.55	25.59	25.10	25.16	25.54	25.25	25.24	25.40
Co, ppm	2.00	1.98	1.98	2.06	1.98	1.98	2.06	2.06	2.07
Mn, ppm	90.67	90.83	90.76	90.64	90.62	90.53	88.84	89.08	89.20
Zn, ppm	60.56	60.48	60.65	57.52	58.93	60.90	52.92	54.72	57.46
Se, ppm	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.31
Lys, %	1.20	1.20	1.21	1.09	1.10	1.10	1.00	1.00	1.00
Arg, %	1.41	1.36	1.31	1.34	1.31	1.28	1.20	1.16	1.14
Met, %	2.32	2.32	2.32	0.51	0.51	0.51	0.46	0.47	0.48
Cys, %	0.28	0.26	0.25	0.26	0.25	0.24	0.24	0.23	0.22
Met+Cyst, %	2.59	2.58	2.57	0.77	0.76	0.75	0.70	0.70	0.70
Try, %	0.29	0.29	0.28	0.28	0.27	0.27	0.25	0.24	0.24
Thr %	0.83	0.83	0.83	0.80	0.80	0.80	0.73	0.73	0.74

[1]Similar nutrient composition prevailed in rest of the each of the 3 types of the nine diets as the basic dietary variation was due to addition of biotechnological product

The rest of the managemental practices including brooding and vaccination were applied uniformly to all the birds during the 42-day period.

At the end of the trial (42[nd] day), two birds (1 male and 1 female) from each replicate were randomly selected, starved for 12 h with the provision of water *ad lib* and then weighed and sacrificed by cervical dislocation. The slaughtered birds were defeathered, denecked and eviscerated along with two legs beneath the hock joint to observe the effect of various experimental diets on the dressing percentage. The dressing percentage was calculated as the percent of the carcass weight obtained after removing the feathers, neck, legs and internal viscera, to its live body weight.

A specific portion of the carcass viz., thigh from all the 72 carcasses were separated, weighed and preserved under frozen conditions. Later, the thigh portions were thawed and the bone and muscles were separated manually from each other and their individual weights were recorded to arrive at meat: bone ratio (Weight of the meat (g) to weight of bone (g)).

The weight of the giblet organs viz., heart without pericardium, liver with out gall bladder and gizzard with out the food contents and internal lining membrane, lymphoid organs viz., bursa and spleen from each sacrificed bird were recorded and expressed as the per cent of pre-slaughter bird weight (g/100g). The weight of the fat present in abdomen including the fat surrounding gizzard, bursa, cloaca and adjacent muscles of each bird was recovered and expressed as percent of concerned pre-slaughter bird weight.

Along with the organometry study, the digestive tract of the all sacrificed birds were carefully removed and the length of different segments of intestine viz., duodenum (the length of pancreatic loop), jejunum (from pancreatic loop to Meckel's diverticulum) and ileum (from Meckel's diverticulum to ileocaecal junction) and expressed in terms of percentage of pre-slaughter body weight (cm/100 g)

The data were subjected for analysis of variance (Snedecor and Cochran, 1989) and the comparison among means were made by Duncan's multiple range test (Duncan, 1955)

RESULTS AND DISCUSSION

Composition of SPR and biotechnological agents: The sun-dried SPR employed in the present study contained 92.83, 23.95, 11.80, 13.73, 11.95, 38.57 and 4.93 percent of DM, TA, CP, CF, EE, NFE and AIA, respectively, besides 4.90, 1.25 and 1.35 percent of Ca, total P and Mg. The ME content was 1105 kcal/kg (Suresh, 2007). Each g of NSP degrading enzyme preparation used contained 2500, 1000, 500 and 250 units of xylanase, beta-glucanase, cellulase and pectinase, respectively and the experimental lipase contained lipase-500 units/g.

Carcass characteristics: The treatment wise and main factor wise average dressing percentage, meat to bone ratio and abdominal fat content of broilers are presented in Table 3. Among different treatments, the dressing percentage value was highest in T_7 (79.61) and lowest in T_5 (75.58). However, no significant differences were observed among different treatments. As regards the SPR and biotechnological tools as the main factors, the dressing percentage values were statistically similar for both the main factors.

The meat to bone ratio among different treatments ranged from 2.98 (T_2) to 3.98 (T_{11}) and the values were statistically similar ($p>0.05$). With regard to SPR and biotechnological supplements, the meat to bone ratio was statistically similar ($p>0.05$) among different groups. However, numerically better meat to bone ratios were observed in groups supplemented with biotechnologically derived feed supplements (3.50-3.73) compared to unsupplemented groups (3.34).

The abdominal fat content of birds fed different diets were significantly significant ($p<0.05$) and that the values ranged from as low as 15.20 (T_{12}) to 36.00 g/bird (T_4). However, when the abdominal fat content values expressed in terms of per cent post-fast body weight, the differences among different treatments became statistically non-significant ($p>0.05$) with the values ranging from 1.54 (T_{12}) to 2.41 % (T_4). With regard to SPR as the main factor, the abdominal fat content (g/bird) were 27.79, 22.60 and 19.13 g for birds fed diets formulated with 0, 5 and 10% SPR, respectively and the values were statistically different ($p<0.05$). The corresponding values when expressed as per cent pos-fast body weight were 1.81, 1.47 and 1.33% and were also significantly different ($p<0.05$). With regard to biotechnological tool as the main factor, the abdominal fat content values ranged non-significantly ($p>0.05$) from 21.56-24.15 g/bird and correspondingly from 1.40-1.61% on the basis of post-fast body weight.

The inclusion of SPR up to 10% in broiler diets has no influence on dressing percentage and meat to bone ratio, which were in conformation with the findings of Budeppa *et al.* (2008) who reported no significant ($p>0.05$) differences in dressing percentage among the broiler birds fed diets containing SPR up to 4%. However, the abdominal fat pad of broilers was affected by the SPR inclusion in their diets. Higher the level of SPR in the diet, lesser was the abdominal fat deposition in broilers. The lower amount of abdominal fat accumulation in birds fed SPR based diets implied that the energy available in such diets was poorer as reflected by lower body weight gain in such groups or that the SPR has the ability to decrease abdominal fat accretion. The former statement is in conformation with the recent findings that the lesser fat deposition in birds on low energy (Lesson *et al.*, 1996) and/or protein/amino acid diets (Jaishankar, 2006).

Organometry: The relative weight of giblet organs (liver, heart and gizzard) and lymphoid organs (spleen and bursa) as well as proventriculus under different treatments and main factors are presented in Table 4. The relative weights of liver among different treatments were found to be statistically ($p>0.05$) similar with values ranging from 2.41 (T_5) to 3.07 g/100 g post-fast body weight (T_4). Similarly, the relative liver weight values also differed non-significantly ($p>0.05$) for the main factors, SPR and biotechnological tool.

Table 3: Carcass characteristic of broiler birds as influenced by different treatments and main factors

SPR %	Treatment Description: Biotechnological Tool	Tr. No.	Dressing percentage	Meat to bone ratio	Abdominal fat g/bird	Abdominal fat % of live weight
0	No supplement	T_1	78.06	3.61	27.50	1.79
	Lipase+Lecithin	T_2	79.39	2.98	24.33	1.50
	NSPases	T_3	78.20	3.83	23.33	1.54
	Lipase+Lecithin+NSPases	T_4	77.68	3.57	36.00	2.41
5	No supplement	T_5	75.91	3.32	21.33	1.31
	Lipase+Lecithin	T_6	78.99	3.84	19.83	1.29
	NSPases	T_7	79.61	3.36	28.00	1.89
	Lipase+Lecithin+NSPases	T_8	79.23	3.86	21.25	1.38
10	No supplement	T_9	76.44	3.08	21.67	1.50
	Lipase+Lecithin	T_{10}	78.44	3.68	20.50	1.41
	NSPases	T_{11}	75.58	3.98	19.17	1.37
	Lipase+Lecithin+NSPases	T_{12}	76.95	3.42	15.20	1.05
	SEM		1.67	0.14	5.67	0.39
	P-Value[1]		0.214	0.082	0.077	0.119
Effect of SPR						
	0%		78.33	3.50	27.79[a]	1.81[a]
	5%		78.44	3.60	22.60[ab]	1.47[ab]
	10%		76.86	3.54	19.13[b]	1.33[b]
	SEM		0.84	0.07	2.84	0.20
	P-Value[1]		0.114	0.852	0.012	0.049
Effect of Biotechnological Tool						
	No supplement		76.80	3.34	23.50	1.53
	Lipase+Lecithin		78.84	3.50	21.56	1.40
	NSPases		77.80	3.73	23.50	1.60
	Lipase+Lecithin+NSPases		77.96	3.62	24.15	1.61
	SEM		0.96	0.08	3.27	0.23
	P-Value[1]		0.188	0.240	0.871	0.769

[1]An effect with a probability of less than 0.05 is considered significant, [a,b]Means with different superscripts in a column differ significantly

In case of gizzard, the relative weights under different treatments were statistically ($p>0.05$) similar with values ranging from 2.22 (T_1) to 2.79 % (T_{12}). With regard to SPR as the main factor, the relative gizzard weight was statistically ($p<0.05$) higher in 10% SPR based group (2.58%) compared to 5% SPR group (2.41%) which in turn higher than that of control (2.35%). Nir *et al*. (1995) observed that weight of gizzard and its contents are positively related to the size of the feed particle, which is contrary to the present findings since more fines in SPR based diets. Panda *et al*. (2006) reported that the relative weight of gizzard was significantly higher in the birds fed low-density diets. Where as the biotechnological to as the main factor showed non-significant ($p>0.05$) variation ranging from 2.37 (unsupplemented group) to 2.53% (lipid utilizing agents).

As far as the proventriculus was concerned, the relative organ weight ranged non-significantly ($p>0.05$) from 0.45 (T_8) to 0.57% (T_3 and T_{10}). Even when data was arranged as per the main factors SPR and biotechnological tool, the differences were non-significant ($p>0.05$). However, the relative proventriculus weight was higher in 10% SPR based groups when compared to that of control and 5% SPR groups. With the increasing inclusion level of SPR, the relative proventriculus weight was also linearly increased ($p<0.05$) and was accompanied by a linear decrease in the relative abdominal fat weight ($p<0.05$).

In case of spleen, the relative weights under different treatments were statistically ($p>0.05$) similar with values ranging from 0.16 (T_7) to 0.28% (T_4). With regard to the main factor SPR, the values were 0.23, 0.20 and 0.22% for 0, 5 and 10% SPR, respectively and they were statistically similar ($p>0.05$). However, with regards the main factor biotechnological tool, the relative weight of spleen was significantly ($p<0.05$) higher in groups supplemented with both lipid utilizing agents and NSP degrading enzymes when compared to the groups supplemented with or with out lipid utilizing agents and NSP degrading enzymes separately.

With respect to Bursa, the relative weights among different treatments varied significantly ($p<0.01$) ranged from 0.16 (T_7) to 0.32 % (T_8) without any noticeable definite trend. Such a variation was nullified when data was arranged as per the main factors, SPR and biotechnological tool ($p>0.05$).

In the present study, weight of the organs viz., liver, heart and gizzard was not influenced by either various treatments or the main factors excepting the main factor SPR on gizzard weight. The results confirmed the earlier

Table 4: Relative weight of vital organs of broiler birds as influenced by different treatments and main factors

	Treatment Description		g/100g body weight					
SPR %	Biotechnological Tool	Tr. No.	Liver	Heart	Gizzard	Provent-riculus	Spleen	Bursa
0	No supplement	T_1	2.81	0.59	2.22	0.49	0.24	0.23[abc]
	Lipase+Lecithin	T_2	2.89	0.60	2.54	0.54	0.20	0.24[abc]
	NSPases	T_3	2.69	0.62	2.34	0.57	0.19	0.22[abc]
	Lipase+Lecithin+NSPases	T_4	3.07	0.66	2.30	0.50	0.28	0.16[c]
5	No supplement	T_5	2.41	0.55	2.34	0.52	0.18	0.21[abc]
	Lipase+Lecithin	T_6	2.89	0.60	2.52	0.56	0.19	0.16[c]
	NSPases	T_7	2.32	0.65	2.54	0.55	0.16	0.18[c]
	Lipase+Lecithin+NSPases	T_8	2.29	0.62	2.31	0.45	0.27	0.32[a]
10	No supplement	T_9	2.70	0.63	2.55	0.55	0.23	0.30[ab]
	Lipase+Lecithin	T_{10}	2.83	0.68	2.54	0.57	0.18	0.20[bc]
	NSPases	T_{11}	2.91	0.64	2.45	0.52	0.22	0.21[bc]
	Lipase+Lecithin+NSPases	T_{12}	2.44	0.58	2.79	0.52	0.27	0.27[abc]
	SEM		0.32	0.05	0.17	0.06	0.05	0.04
	P-Value[1]		0.240	0.483	0.118	0.757	0.170	0.009
Effect of SPR								
	0%		2.87	0.62	2.35[b]	0.52	0.23	0.21
	5%		2.48	0.61	2.43[ab]	0.52	0.20	0.22
	10%		2.72	0.63	2.58[a]	0.54	0.22	0.24
	SEM		0.16	0.03	0.09	0.03	0.02	0.02
	P-Value[1]		0.058	0.594	0.032	0.767	0.460	0.316
Effect of Biotechnological Tool								
	No supplement		2.64	0.59	2.37	0.52	0.21[b]	0.24
	Lipase+Lecithin		2.87	0.63	2.53	0.55	0.19[b]	0.20
	NSPases		2.64	0.64	2.45	0.55	0.19[b]	0.20
	Lipase+Lecithin+NSPases		2.60	0.62	2.46	0.49	0.27[a]	0.25
	SEM		0.19	0.03	0.10	0.04	0.03	0.02
P-Value[1]			0.452	0.433	0.471	0.258	0.011	0.104

[1]An effect with a probability of less than 0.05 is considered significant, [a-c]Means with different superscripts in a column differ significantly

findings of Budeppa *et al*. (2008) who reported that the weight of liver, heart and gizzard remains statistically similar (p>0.05) among the broiler birds fed with 0, 1, 2, 3 and 4% SPR included diets. The results also indicated that the weight of the lymphoid organs spleen and bursa were not influenced by inclusion of SPR and no literature is available to confirm the same. Thus it was implied that the development of gizzard and proventriculus were slightly affected by SPR inclusion at 5 and 10%. However, several vital organs remained unaffected by SPR inclusion up to 10%.

Digestive tract measurements: The treatment and main factor wise relative length of different segments of small intestine of birds under different dietary groups is presented in Table 4. In case of duodenum, the relative length under different treatments were statistically (p>0.05) similar with values ranging from 1.20 (T_{10}) to 1.89 (T_9) cm/100 g body weight. Similarly, the relative length of duodenum also differed non-significantly (p>0.05) for main factors, SPR and biotechnological tool. Pertaining to the jejunum, the relative length of jejunum under different treatments varied significantly (p<0.05) and the values ranged from 3.86 (T_7) to 4.72 cm/100 g (T_{11}). With regard to the SPR as the main factor, the relative jejunal length was significantly (p>0.05) different between 5% SPR (4.09) and 10% SPR included groups (4.50 cm/100 g). For the main factor biotechnological tools, the measurements were non-significant (p>0.05). As regards the ileum, its relative length under different treatments was statistically (p<0.05) different with the values ranging from 4.10 (T_2) to 4.82 cm/100 g (T_{12}). As regard to the main factors, the SPR inclusion showed significant (p<0.05) differences in relative length of ileum among different groups whereas non-significant differences were observed for the main factor biotechnological tool. Like jejunum the longest ileal segment was found in birds fed 10% SPR based diets (4.57 cm/100 g) when compared to the shortest in 5% SPR based diets (4.26 cm/100 g).

The total relative length of small intestine of birds under different treatments was found to be statistically significant (p<0.05) with the values ranging from 9.64 (T_8) to 11.13 cm/100 g (T_{12}). When data was arranged as per main factors, the SPR inclusion showed highly significant (p<0.01) differences in relative lengths of small intestine (9.86 in 5% SPR to 10.78 cm/100 g in 10% SPR) but not for the main factor biotechnological tool.

The length of different segments of small intestine viz., jejunum and ileum excluding duodenum of birds was found to be influenced by the SPR inclusion at 10% level

Table 5: Relative length of intestinal segments of broiler birds as influenced by different treatments and main factors

	Treatment Description		cm/100g body weight			
SPR %	Biotechnological Tool	Tr. No.	Duodenum	Jejunum	Ileum	Small intestine
0	No supplement	T_1	1.64	4.69^{ab}	4.73^{ab}	11.06^{a}
	Lipase+Lecithin	T_2	1.53	4.08^{de}	4.10^{c}	9.71^{b}
	NSPases	T_3	1.54	4.33^{de}	4.22^{c}	10.09^{ab}
	Lipase+Lecithin+NSPases	T_4	1.62	4.11^{de}	4.45^{abc}	10.18^{ab}
5	No supplement	T_5	1.51	4.06^{de}	4.19^{c}	10.35^{b}
	Lipase+Lecithin	T_6	1.70	4.34^{de}	4.31^{b}	9.89^{ab}
	NSPases	T_7	1.54	4.09^{de}	4.26^{c}	9.79^{b}
	Lipase+Lecithin+NSPases	T_8	1.67	3.86^{e}	4.26^{c}	10.61^{b}
10	No supplement	T_9	1.89	4.21^{de}	4.51^{abc}	10.21^{ab}
	Lipase+Lecithin	T_{10}	1.50	4.46^{cd}	4.25^{c}	10.21^{ab}
	NSPases	T_{11}	1.52	4.72^{a}	4.71^{ab}	10.95^{a}
	Lipase+Lecithin+NSPases	T_{12}	1.62	4.59^{bc}	4.82^{a}	11.03^{a}
	SEM		0.19	0.26	0.22	0.55
	P-Value[1]		0.75	0.03	0.02	0.04
Effect of SPR						
	0%		1.58	4.30^{ab}	4.37	10.27^{ab}
	5%		1.60	4.09^{b}	4.26	9.86^{b}
	10%		1.63	4.50^{a}	4.57	10.78^{a}
	SEM		0.10	0.13	0.11	0.28
	P-Value[1]		0.86	0.01	0.021	0.006
Effect of Biotechnological Tool						
	No supplement		1.68	4.32	4.48	10.33
	Lipase+Lecithin		1.58	4.29	4.22	10.19
	NSPases		1.56	4.38	4.40	10.41
	Lipase+Lecithin+NSPases		1.61	4.19	4.51	10.28
	SEM		0.11	0.15	0.13	0.32
	P-Value[1]		0.71	0.65	0.12	0.92

[1]An effect with a probability of less than 0.05 is considered significant, Means with different superscripts in a column differ significantly

but however such an effect was not evident at 5% SPR level when compared to control for which no explanation can be given.

From the study, it was inferred that the inclusion of SPR up to 10% in broiler diets has no influence on carcass characteristic parameters namely dressing percentage and meat to bone ratio besides substantially decreasing the abdominal fat pad deposition.

REFERENCES

Budeppa, H.B., B.S.V. Reddy, K.C. Singh and R.G. Doss, 2008. Influence of sugarcane press mud on serum and plasma inorganic P in broilers. Ind. J. Anim. Nutr., 25: 93-96.

Duncan, D.B., 1955. Multiple range and multiple F test. Biometrics, 11: 1-42.

Jaishankar, N., 2006. Influence of lysine producing probiotics vis-à-vis type of protein source on performance of broilers. M.V.Sc. Thesis submitted to KVAFSU, Bidar, India.

Kocher , A., M. Choct, G. Ross, J. Broz, and T.K. Chung, 2003. Effect of enzyme combinations on apparent metabolizable energy of corn-soybean meal-based diets in broilers. J. Appl. Poult. Res., 12: 275-283.

Lesson, S., L.J. Caston and J.D. Summers, 1996. Broiler response to diet energy. Poult. Sci., 75: 529-535.

Mandal, A.B., A.V. Elangovan, P.K. Tyagi, S. Kaur and A.K. Johri, 2006. Utilization of un-decorticated sunflower seed meal in different cereal based diets with or without addition of mixed enzymes in broilers. Ind. J. Anim. Sci., 76: 255-259.

Meng, X., B.A. Slominski and W. Guenter, 2004. The effect of fat type, carbohydrase and lipase addition on growth performance and nutrient utilization of young broilers fed wheat-based diets. Poult. Sci., 83: 1718-1727.

Nir, I., R. Hillel, I. Ptichi and G. Shefet, 1995. Effect of particle size on the performance 1. grinding pelleting interaction. Poult. Sci., 74: 771-783.

Panda, A.K., V.R.B. Sastry, A.B. Mandal and S.K. Saha, 2006. Physico-chemical carcass characteristics of broiler chickens meat fed alkali processed karanj cake with methionine. Ind. J. Anim. Sci., 76: 92-94.

Snedecor, G.W. and W.G. Cochran, 1989. Statistical Methods. 9th Edn., The Iowa State University Press, Ames, Iowa.

Suresh, B.N., B.S.V. Reddy, T.M. Prabhu, R.G. Gloridoss and B. Jagadish, 2006. Nutritional evaluation of sugarcane pressmud in lambs. Ind. J. Anim. Nutr., 23: 47-49.

Suresh, B.N., 2007. Evaluation of sugarcane press residue in terms of its metabolizable energy and other nutrients in broilers and layers. Ph.D. Thesis, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, India.

Zanella, I., N.K. Sakomura, F.G. Silversides, A. Fiqueirdo, and M. Pack, 1999. Effect of enzyme supplementation of broiler diets based on corn and soybeans. Poult. Sci., 78: 561-568.