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Research Article

EFFECT OF HERBAL RESIDUES ON SERUM LIPID, FATTY ACID PROFILES AND CARCASS CHARACTERISTICS OF CROSS-BRED FINISHER PIGS

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ABSTRACT
Five dietary treatments, standard (T1), economic diet (T2) supplemented with exogenous enzymes, T2+turmeric residue (T3), T2+amla residue (T4) and T2+ginger residue (T5) were evaluated for their effect on serum lipid and fatty acid profile and carcass characteristics in a completely randomized design. Carcass traits like hot carcass weight carcass length, loin eye area; average back fat thickness, primal cuts and dressing percentage were not significantly different among treatments. T2 to T5 recorded lower ($P<0.01$) serum triglycerides, total cholesterol, LDL cholesterol and higher ($P<0.01$) HDL cholesterol (mg/dl). Saturated fatty acids, C14, C16 and C18 in minced pork fed T1 to T5 were not significantly different among treatments. Unsaturated fatty acid C16:1 in T3, C18:1 in T4 were higher ($P<0.01$) than in others. Other unsaturated fatty acids, C18:2, C18:3 and C20:4 were comparable among treatments. EPA was higher ($P<0.05$) in T1 or T2 fed pigs than other treatments while DHA was comparable among treatments. Higher ($P<0.05$) LCFA and lower ($P<0.05$) MCFA was observed in T3 fed group. It was concluded herbal residues had a considerable influence on the serum lipid profile and fatty acid profile.

***Key Words**: Herbal Residues, Minced Pork, Serum Lipid Profile, Fatty Acid Profile*

INTRODUCTION
A successful feeding programme is achieved only when it optimizes product yield, produce desirable components in the product and maximize profit. Owing to the disease control, nutrient sparing action, toxin inhibition, improving nutrient utilization and other properties, antibiotic growth promoters are being used as feed additives.

The ban of some AGP by European Union and the public concern over the usage of antibiotic feed additives has led to research on alternate substances with anti microbial properties. Phytobiotics or phytogenic feed additives is a term used to describe plant derived natural bio-active compounds which affects animal growth and health and is often applied to essential oils, botanicals, extracts and residues derived from herbal plants.

In recent years the analysis of fatty acids and serum lipid profile has gained importance because of their nutritional and health implications. Hence in the present study an attempt was made to study the fatty acid and lipid profiles in pork on feeding herbal residues.

MATERIALS AND METHODS
Five experimental diets (Table. 1) from T1 to T5 were formulated (NRC, 1998) such that T1 is a standard diet without enzyme cocktail (xylanase + β- glucanase + cellulase + phytase) and herbal residues (turmeric, amla and ginger), T2 is an economic diet with enzyme cocktail but without herbal residues, T2 with *turmeric* residue is T3, T2 with *amla* residue is T4 and T2 with *ginger* residue is T5.

Thirty entire male cross-bred (LWY X desi) pigs (35 ± 1.3 kg) were selected and made into five groups of 6 each. Groups 1 to 5 were fed with treatments T1 to T5, respectively.

Table 1: Ingredient composition (%) of experimental finisher diets

Ingredient	T1	T2	T3	T4	T5
Maize	42.00	20.00	20.00	20.00	20.00
Soybean meal	14.00	8.00	8.00	8.00	8.00
Sunflower Cake	-	12.00	12.00	12.00	12.00
Deoiled Rice bran	41.50	57.50	55.50	55.50	55.50
Mineral mixture #	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Turmeric residue	0.00	0.00	2.00	0.00	0.00
Amla residue	0.00	0.00	0.00	2.00	0.00
Ginger residue	0.00	0.00	0.00	0.00	2.00
	100	**100**	**100**	**100**	**100**
Lysine (%)	0.41	0.44	0.44	0.44	0.44
Methionine (%)	0.01	0.60	0.60	0.60	0.60
AB_2D_3	0.02	0.02	0.02	0.02	0.02
Biovital	0.02	0.02	0.02	0.02	0.02
Enzyme cocktail (xylanase 3500, β-glucanase 2500, cellulase 1250 and phytase 3000 Units / Kg)	-	+	+	+	+
Cost per 100 Kg (Rs.)	1320	1266	1266	1266	1266

 # contained, Ca 32%; P 6%; Mn 0.27%; Zn 0.26%; Cu 100 ppm; Fe 1000 ppm, Iodine 0.01%; Fluorine (max.) 0.03%

Carcass Characteristics

At about 70 kg, the pigs were slaughtered (USDA, 1970) after a 16 h fasting period but had *ad lib* access to water. The dressing percentage was calculated from half carcass weight with intact kidneys and also with head and feet on. Loin area was traced on acetate paper by keeping it between 10^{th} and 11^{th} ribs. The traced area was measured in square centimeters. The average back fat thickness was measured at three locations i.e., first rib, last rib and the last lumbar vertebra.

At the time of slaughter, 25 cm of large intestine between caecum & colon was ligated on both sides and it was cut by a sterilized knife and the same was collected in a sterilized potato tube by following all the aseptic precautions and it was brought to the laboratory for microbiological analysis.

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Estimation of Serum Lipid Profile

The HDL, total cholesterol and the triglycerides in the serum samples were estimated using kits (ERBA diagnostic Mannheim, GmbH, Germany). HDL (Burstein *et al.*, 1970), total cholesterol (Allain *et al.*, 1974) and triglycerides (Fossati, 1969) were estimated by phosphotungstic Acid method, CHOD-PAP method and GPO-TRINDER method respectively. The LDL cholesterol is calculated by the difference between total cholesterol and HDL cholesterol.

Fatty Acid Analysis in Pork with Gas-Liquid Chromatography

The fatty acid profile in pork (C_4 to C_{22}) was estimated using CERES 800 plus series gas chromatography. Exactly 4 grams of pork was taken and minced well with pestle and mortar and the minced sample was taken into large sized test tubes. 10 ml of Folch's solution (Chloroform and methanol mixed in the ratio of 2:1). 25 µl of butylated hydroxyl anisole (1 g of butylated hydroxyl anisole in 10 ml of ethanol) was added to the test tube to prevent the oxidation of unsaturated fatty acid and the sample was allowed to stay overnight. Then this solution was filtered through Whatmann filter no.1 paper into another test tube.10 ml of 0.89 % NaCl solution was added to this filtrate and after one hour standing the layers was allowed to separate. The supernant layer was discarded off. The remaining contents in the test tube were transferred into amber coloured air tight bottles and the chloroform layer was evaporated by placing the bottles on hot plate at $40\text{-}50^0$ C. The bottles were cooled and 3 ml of freshly prepared 10% methanolic hydrochloride (anhydrous methanol and acetyl chloride mixed in the ratio of 4:1) was added and the bottles were again made air tight. (Caution is to be taken while adding acetyl chloride to anhydrous methanol drop wise to avoid spurting). Then the amber coloured bottles were placed in hot water bath at 70^0C for 2 hours, cooled and 5 ml of 6% potassium carbonate was added followed by 2 ml of hexane. After thorough mixing of the two solutions, they were transferred to centrifuge test tubes and centrifuged for the separation of the two solutions (layers) at 3000 rpm for 10 minutes. The top hexane layer was collected and stored for the estimation of fatty acids by gas chromatography.

Statistical Analysis

The data were subjected to one –way analysis of variance (Snedecor and Cochran, 1989) and the means were tested by least significant difference.

RESULTS AND DISCUSSION

Four animals per each treatment were slaughtered and the carcass characteristics (Table 2) were studied. No significant differences were found in any of the carcass characteristics among the treatments and these results are in agreement with those of Grandhi (2001) who reported no differences in carcass quality of cross-bred pigs supplemented with a combination of carbohydrases along with xylanase and β-glucanase. The results also tally with those of Grandhi (2001) and O'Quinn (1997) who reported no response to phytase supplementation in pigs fed barley-SBM based diets. A trend to a lower average back fat thickness was observed in pigs fed T2 to T5 than in T1, probably due to higher fibre content in these diets. The effect of herbal residues and cocktail enzymes on serum triglycerides, (Table.3) total cholesterol, HDL and LDL cholesterol in finisher pigs can be compared with the studies of Lanjewar *et al.*, (2008) where in they reported that addition of Tulsi (*Ocimum sanctum*) leaf powder at 0.5 and 1.0% in broiler diets decreased the total cholesterol, serum triglyceries, LDL cholesterol and increased HDL cholesterol levels in serum. In the present study, in treatments T3 to T5, containing herbal residues, there was a decrease ($P<0.01$) in serum triglycerides, total cholesterol, LDL cholesterol with an increase ($P<0.01$) in HDL cholesterol, suggesting that herbs or herbal extracts alter the serum lipid profile by either decreasing ($P<0.01$) the bad cholesterol (LDL), total cholesterol or serum triglycerides or by increasing the good cholesterol (HDL).

Table 2: Effect of dietary treatments on carcass characteristics of cross-bred pigs

Treatment	Weight at slaughter (Kg)	Hot carcass weight (Kg)	Carcass length (cm)	Loin eye area (sq. cm)	Average back fat thickness (cm)	Primal cuts			Dressing percentage
						Weight of ham (Kg)	Weight of Loin (Kg)	Weight of shoulder (Kg)	
T1	70.43±0.45	56.19±1.36	72.17±3.11	28.33±1.12	2.62±0.33	14.57±0.17	11.65±0.30	9.88±0.76	75.55±1.24
T2	69.42±0.44	61.01±0.75	74.33±1.78	28.00±1.18	2.22±0.14	16.10±0.38	12.10±0.38	10.63±0.47	80.03±1.46
T3	70.45±1.19	56.42±1.31	77.83±1.3	26.83±0.49	2.26±0.07	14.81±0.39	11.02±0.8	10.99±1.24	74.87±1.65
T4	69.63±0.44	53.96±2.8	73.83±1.62	28.00±0.86	2.08±0.08	14.44±0.81	11.95±0.81	9.54±0.65	75.65±1.19
T5	70.65±1.2	55.72±1.63	75.00±0.73	26.83±0.48	2.15±0.11	14.03±0.61	10.97±0.68	9.85±0.22	76.50±1.03

Table 3: Effect of dietary treatments on serum lipid profile (mg/dl) of cross-bred pigs

Treatments	Triglycerides * *	Total Cholesterol * *	HDL Cholesterol * *	LDL Cholesterol * *
T1	67.10 ^{ab} ± 10.10	82.92 ^{a} ± 1.14	50.19 ^{b} ± 1.97	32.73 ^{a} ± 1.94
T2	70.08 ^{a} ± 1.53	72.19 ^{b} ± 1.32	60.11^{a} ± 0.93	12.07 ^{b} ±1.89
T3	61.11^{c} ± 1.11	68.94 ^{b} ± 0.67	57.50 ^{a} ± 1.02	11.43 ^{b} ± 0.86
T4	63.15 ^{b} ± 1.75	70.26 ^{b} ± 2.54	60.15 ^{a} ± 2.05	10.11 ^{b} ± 1.50
T5	66.82 ^{b} ± 1.18	69.06 ^{b} ± 1.49	58.03 ^{a} ± 1.21	11.02 ^{b} ±2.20

^{abc} *values in a column not sharing common superscripts differ significantly **(P<0.01)*

As seen from (Table 4) the saturated and unsaturated fatty acid profile (%) of minced pork, as the level of Myristic acid (C14) and Palmitic acid (C16) increased (P<0.05) in pork of pigs fed (T1, T2, T4 & T5), the levels of blood cholesterol also showed an increasing trend in these treatments. These results are in line with Jakobsen (1999). However Stearic acid did not show any effect on total cholesterol (Jakobsen, 1999). The increase in Oleic acid (C18:1) in the pork of pigs fed T1,T2,T3 and T5 showed a positive correlation with the concentration (%) of cholesterol in the serum and these results are in agreement with Yu *et al.,* (1995). In the present study increase in α-Linoleic acid in the pork of pigs fed T1 showed a positive response for higher blood cholesterol levels.

Table 4: Effect of dietary treatments on fatty acid profile (%) in minced pork

Treatments	C 14:0 Myristic acid	C 16:0 * Palmitic acid	C 16:1 * * Palmioleic acid	C 18:0 Stearic acid	C 18:1 Oleic acid	C 18:2 Linoleic acid	C 18:3 α-Linoleic acid	C 20:4 Arachidonic acid	C 20:5 * EPA	C 22:6 DHA	LCFA *	MCFA *
T1	3.63 ± 0.34	23.61[a] ± 0.52	1.02[c] ± 6.15	12.51 ± 0.28	26.13[b] ± 0.59	24.21 ± 0.31	0.63 ± 0.38	0.85 ± 0.63	6.54[a] ± 0.23	0.91 ± 0.09	73.22[b] ± 0.74	26.77 a ± 0.73
T2	3.42 ± 0.19	23.69[a] ± 0.53	1.63[b] ± 0.26	16.15 ± 0.83	28.05[b] ± 1.13	18.88 ± 1.22	0.53 ± 0.10	0.83 ± 0.22	5.55[a] ± 0.42	0.86 ± 0.22	70.34[b] ± 0.68	29.66[a] ± 0.69
T3	2.76 ± 0.57	19.21[b] ± 2.58	2.42[a] ± 0.12	15.26 ± 1.49	26.60[b] ± 0.94	27.86 ± 2.38	0.56 ± 0.18	0.53 ± 0.22	4.31[bc] ± 0.73	0.89 ± 0.25	82.95[a] ± 5.35	17.05[b] ± 5.35
T4	2.78 ± 0.78	25.06[a] ± 0.82	2.16[ab] ± 0.34	15.48 ± 4.39	23.13[b] ± 3.11	27.79 ± 8.52	0.54 ± 0.15	0.67 ± 0.37	3.44[c] ± 1.02	1.05 ± 0.20	73.08[b] ± 7.17	26.92[a] ± 7.17
T5	2.68 ± 0.23	23.23[a] ± 0.55	2.13[ab] ± 0.30	13.33 ± 0.52	31.77[a] ± 0.94	20.53 ± 2.54	0.55 ± 0.42	0.61 ± 0.19	4.31[b] ± 0.41	0.87 ± 0.06	71.87[b] ± 0.95	28.13[a] ± 0.95

[abc] Values in a column not sharing common superscripts differ significantly ** (P<0.01) * (P<0.05)

Conclusion

It was concluded that inclusion of herbal residues in pig diets can significantly affect the fatty acid and lipid profiles without influencing carcass traits

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