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Research Article

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ABSTRACT

Thirty weaned crossbred (Large White York Shire × Desi) piglets were randomly allotted to five dietary treatments (T1, T2, T3, T4 and T5), each consisted of 12 animals (6 barrows and 6 gilts). First treatment (T1) served as control and others were experimental groups. Diet 1 (T1) was formulated with maize (54%), wheat bran (10%), groundnut cake (17%), DORP (10%), fish meal (6%), mineral mixture and vitamin supplements. Diets 2 (T2), 3 (T3), 4 (T4) and 5 (T5) were formulated using paddy instead of maize at 25, 50, 75 and 100 percent. Age at 1st estrous was found significantly higher (P<0.05) in group T5 as compared to T1 group. Age at 1st service was found significantly higher (P<0.05) in gilts maintained on T4 and T5 diets than control. In barrows there was no significant (P>0.05) difference in fasting weight, weight after bleeding and evisceration weight between T1, T2 and T3 groups, however these parameters were significantly lower in T4 and T5 groups as compared to control. Statistically there was no significant (P>0.05) difference in fasting weight, weight after bleeding and evisceration weight of gilts of T1, T2, T3 and T4 groups, however it was significantly (P<0.05) lower in T5 group as compared to control. The dressing percentage of boars and dressing percentage, carcass length, backfat thickness and loin eye area in gilts was significantly (P<0.05) lower in T3, T4 and T5 groups as compared to T1 group, however it did not differ significantly between T1 and T2 groups. In both barrows and gilts, statistically there was no significant (P>0.05) difference in average percent weight of shoulder between T2 and T3 groups, however it was significantly (P<0.05) higher in T4 and T5 group as compared to control. In barrows, average percent weight of bacon and ham was significantly (P<0.05) lower in T4 and T5 groups as compared to control, however showing no significant difference in T1, T2 and T3 groups. Average percent weight of loin shows no significant (P>0.05) difference in T1 and T2 group; however is significantly (P<0.05) higher T3, T4, and T5 groups as compared to control. There was no significant difference in the average percent weight of rib chop and undercut among control and treatment groups. In gilts the percent weight of bacon and ham was significantly (P<0.05) lower in T2, T3, T4, and T5 groups as compared to control. There was no significant difference in the percent weight of rib chop and undercut between T1 and T2 groups, however it is significantly lower in T3, T4 and T5 groups as compared to control. Total cost of production was higher at higher level of replacement of maize with paddy in pigs.

Keywords: Carcass traits, Maize, Paddy, Pig, Production cost, Gilts, Reproductive Performance.

INTRODUCTION

Pigs play a crucial role in the rural economy in many tropical countries. These are recognised as one of the most effective livestock for promoting health and economy of poor people in the developing countries of the world. Feed at 55-65% of the total production costs is the largest cost associated with pig production (Sikka, 1990). The tropical developing countries with limited feed resources have to economize feeding of pigs by avoiding their wasteful feeding. Selection of a combination of feed ingredients responsible for a diet giving optimum animal production at least cost, is a priority for maximising profitability. Maize as a source of energy is most common ingredient in animal diet. But steeply increasing price of maize, its less production and less availability to livestock feed has created increased interest in alternate feedstuffs for swine feeding. Paddy seed (*Oryza sativa*) is available in rice growing areas in huge quantities at economical rates and could be alternate to maize. Paddy seed on it contains a rough, hard and woody outer covering (husk), which make, paddy, as such, inedible. Paddy, on an average, contains 7- 8 per cent crude protein, 12-14 per cent crude fibre, 2-3 per cent ether extract, 74-75 per cent nitrogen free extract, 36-38 per cent available carbohydrates and is a good source of energy for pigs (Sikka, 1990). In this experiment paddy as a replacement of maize in the pig grower and finisher rations has been tested.

MATERIALS AND METHODS

Animals and their management

Sixty weaned piglets of about three month age (Large White York Shire × Desi) were randomly allotted to five dietary treatments. Each dietary group consisted 12 piglets (6 male and six female) of comparable body weight. Five experimental diets were formulated (Table 1) and fed as per the requirements specified in ICAR (1998) bulletin. Standard farm practice was followed for rearing the piglets. Body weight of piglets was taken at monthly intervals. Group feeding was done and individual average feed consumption was calculated based on the total quantity of feed consumed by number of animals in that group. The experiment lasted for 110 days and slaughter of animals was done at the end of experiment for study of carcass parameters.

Table 1: Composition of experimental diets

Ingredients	Diets (%)				
	T1 (Control)	T2 (25% paddy)	T3 (50% paddy)	T4 (75% paddy)	T5 (100% paddy)
Maize	54	40.5	27	13.5	-
Paddy	-	13.5	27	40.5	54
Wheat bran	10	10	10	10	10
GNC	17	17	17	17	17
DORP	10	10	10	10	10
Fish meal	6	6	6	6	6
MM+ Vitamins	3	3	3	3	3
Percent composition of nutrients in diet.					
Crude protein	17	17	17	17	17
Metabolizing Energy(kcal kg–1)	2900	2750	2625	2550	2450
Ether Extract	5.0	5.02	5.04	5.07	5.12
Crude Fiber	5.3	6.4	6.9	7.3	7.8
Nitrogen free extract	64.43	61.32	57.23	54.32	52.69
Total ash	6.16	6.23	6.64	6.87	7.12
Ca	0.48	0.52	0.53	0.56	0.57
P	0.79	0.82	0.86	0.87	0.89

* Biomix Grower Premix used contained VitA 3.2×10^{6} IU, Vit D3 6×10^{6} IU, VitE 2800mg, Niacin 6×10^{3} mg, Biotin 100mg, VitB 1000mg, VitB6 800mg, VitB12 4mg, VitK3 60mg, Pantathinic acid 2,200mg, folic acid 200mg, choline chloride 7×10^{4} mg, cobalt 80mg, copper 1,200mg, iodine 400mg, iron 8400mg, manganese 16×10^{3} mg, Selenium 80mg, Zinc 12,400mg and antioxidant 500mg.

Analysis

Samples of feed and feaces were analysed for proximate composition by AOAC (2000). Data on body weight gain, Carcass Traits and Cost of production were analysed statistically (Snedecor and Cochran, 1994). Economics of production influenced due to use of paddy instead of maize was calculated based on the feed consumed, its cost and returns from the sale of carcass.

RESULT AND DISCUSSION

Reproductive performance

Reproductive performance of gilts was recorded during the experiment and data gathered has been presented in Table 2. Age at 1st estrous was found significantly higher ($P<0.05$) in group T5 as compared to T1, T2, T3 and T4 groups. Age at 1st service was found significantly higher ($P<0.05$) in gilts maintained on T4 and T5 diets while among gilts offered T1, T2 and T3 diets difference were non significant. The increase in age at 1st estrous in the T5 group and age at 1st service in the T4 and T5 group was probably due to decrease in the energy level of their diet responsible to poor energy balance. It would also be correlated to hormonal status of these gilts with lower energy balance. Smits *et al.* (2008) found increasing energy content in diet optimize the reproductive performance of sows. Holt *et al.* (2006) found increased crude fibre in diet has adverse effect on reproductive performance of sows. Klindt *et al.* (2003) and Armstrong *et al.* (1986) found subjecting gilts to dietary energy restriction had no measurable impact on reproductive performance.

Table 2: Effect of paddy instead of maize on age at 1st estrous and 1st service of gilts

Groups	Age at 1st estrous (days)	Age at 1st service (days)
T1 **(Control)**	170±2.12^{b}	193±2.08^{b}
T2 (25% paddy)	170±1.87^{b}	193±1.08^{b}
T3 (50% paddy)	170±3.46^{b}	195±2.00^{b}
T4 (75% paddy)	175±2.04^{ab}	200±1.47^{a}
T5 (100% paddy)	180±2.16^{a}	206±0.71^{a}

a, b Values bearing similar superscripts in the same column does not differ significantly (P>0.05)

Carcass Parameters

The data regarding final body weight, gain in body weight, fasting weight, weight after bleeding, eviscerated weight and dressing percentage is presented in Tables 3. In both barrows and gilts, statistically there was no significant (P>0.05) difference in final body weight, gain in body weight, fasting weight, weight after bleeding and eviscerated weight among animals of T1, T2 and T3 groups, however these parameters were significantly lower in T4 and T5 groups as compared to control. The dressing percentage was significantly (P<0.05) lower in T3, T4 and T5 groups as compared to control, however it did not differ significantly between T1 and T2 groups. This decrease in the body weight gain and carcass parameters of animals with the increase in the level of paddy in their diet is probably attributed to decreased growth rate in these groups, because of higher crude fibre and lower energy content of their diets. The studies of various workers also presented the more or less similar dressing percentages of carcasses raised on different feeds. Kuan *et al.* (2008) found that pigs given high-energy diets grew faster, than those given low-energy diets. Gupta and Bujarbarua (2007) also found that pigs attained significantly (P<0.01) higher growth rate on maize- soy based ration than deoiled rice polish based ration. Sikka (2007) reported that replacement of maize and rice bran by paddy during finishing phase lead to decrease in growth rate of pigs (P<0.05) significantly.

Table 3: Effect of paddy instead of maize on carcass parameters of growing and finishing pigs

Traits	Groups									
	T1		T2		T3		T4		T5	
	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts
Initial weight (kg)	26.66 ±4.60	27.00 ±3.89	26.33 ±4.11	27.00 ±2.55	27.68 ±2.96	27.50 ±3.88	27.16 ±2.80	27.70 ±1.76	26.83 ±2.75	28.50 ±2.02
Final weight (kg)	75.21 ± 5.96^{a}	72.94 ±4.65	73.09 ±5.86^{ab}	71.93 ±5.50	73.00 ±3.56^{ab}	71.90 ±8.30	70.51 ±5.82^{c}	71.63 ±1.46	69.81 ±5.01^{c}	69.95 ±0.49
Gain in weight (kg)	48.55 ±2.12^{a}	45.94 ±4.48^{a}	46.76 ±2.88^{ab}	44.93 ±3.38^{a}	45.32 ±0.94^{ab}	44.40 ±7.45^{a}	43.35 ±3.16^{bc}	43.93 ±2.99^{ab}	42.98 ±2.36^{c}	41.45 ±1.74^{b}
Fasting weight (kg)	74.13 ±1.48^{a}	71.60 ±0.73^{a}	72.31 ± 1.20^{ab}	71.19 ±0.31^{a}	72.14 ±0.34^{ab}	71.00 ±0.54^{a}	70.06 ±0.33^{bc}	70.88 ±0.43^{a}	68.24 ±0.34^{c}	69.00 ±0.97^{b}
Weight after bleeding (kg)	72.05 ±1.59^{a}	70.63 ±0.69^{a}	70.51 ± 1.28^{ab}	70.35 ±0.13^{a}	69.88 ±0.43^{ab}	69.85 ±0.41^{a}	67.97 ±0.20^{bc}	69.83 ±0.33^{a}	66.16 ±0.32^{c}	68.00 ±1.13^{b}
Evisceration weight (kg)	43.48 ±0.89^{a}	42.18 ±0.46^{a}	41.88 ± 0.43^{ab}	42.00 ±0.40^{a}	41.04 ±0.41^{ab}	41.69 ±0.31^{a}	40.50 ±0.50^{bc}	41.43 ±0.64^{a}	39.39 ±0.17^{c}	39.58 ±0.54^{b}
Dressing percentage without head (%)	60.87 ± 0.39^{a}	60.52 ±0.35^{a}	60.78 ±0.24^{a}	60.41 ±0.28^{a}	59.58 ±0.36^{b}	59.16 ±0.19^{b}	59.29 ±0.49^{b}	58.90 ±0.45^{b}	59.28 ±0.14^{b}	58.84 ±0.56^{b}
Carcass length (inch)	28.23 ±0.30^{a}	28.33 ±0.08^{a}	28.21 ±0.11^{a}	28.09 ±0.14^{a}	27.63 ±0.06^{a}	27.64 ±0.13^{b}	27.20 ±0.11^{b}	27.73 ±0.09^{b}	26.68 ±0.04^{c}	26.67 ±0.11^{c}
Backfat thickness (inch)	1.78 ± 0.07^{a}	1.96 ±0.02^{a}	1.76 ±0.06^{a}	1.85 ±0.04^{a}	1.74 ±0.09^{a}	1.89 ±0.04^{ab}	1.47 ±0.04^{b}	1.66 ±0.02^{c}	1.31 ±0.03^{b}	1.21 ±0.03^{d}
Loin eye area (sq.cm)	44.98 ±0.12^{a}	45.69 ±0.31^{a}	44.38 ±0.72^{a}	45.12 ±1.00^{a}	43.88 ±0.14^{a}	44.32 ±0.79^{b}	44.32 ±0.28^{a}	43.15 ±1.83^{bc}	41.13 ±0.48^{b}	42.29 ±0.42^{c}

a, b, c Values bearing similar superscripts in the same row does not differ significantly (P>0.05)

Samoo *et al.* (2004) found that by replacing maize with deoiled rice polish, the dressing percentage was decreased linearly with increased level of replacement. Mitra and Samanta (1990) found that by replacing maize with de-oiled mustard cake decreases carcass characteristics. Gupta (1989) found barrows raised on maize diet had higher carcass dressing percentage in comparison to deoiled rice polish fed barrows.

In barrows, statistically there was no significant (P>0.05) difference in carcass length and backfat thickness of animals pertaining to T2 and T3 groups, however carcass length and backfat thickness were significantly (P<0.05) lower in T4 and T5 groups as compared to control. The loin eye area was significantly (P< 0.05) lower in T5; however it did not differ significantly in T2, T3 and T4 groups as compared to control. In gilts, the dressing percentage, carcass length, backfat thickness and loin eye area was significantly (P<0.05) lower in T3, T4 and T5 groups as compared to T1 group, however it did not differ significantly between T1 and T2 groups. The decrease in the carcass length, backfat thickness and loin eye area of treatment groups, getting diet containing higher proportion of paddy as compared to control T1 group was correlated with energy content of these diets which result in reduced growth and production of lean pork. Priya *et al.* (2000) found that different levels of amaranthus whole plant meal as replacement of maize in the ration of pigs in finisher phase causes linear decrease in backfat thickness. Rao *et al.* (1989) found replacing maize grain with groundnut haulms reduces average backfat thickness significantly. Sikka (2007) found average backfat thickness and loin eye area reduced linearly with the increase in the level of paddy in the diet.

Retail cuts of carcass

The data regarding their weights and percent weight of retail cuts have been given in Tables 4. In both barrows and gilts, statistically there was no significant (P>0.05) difference in average percent weight of shoulder between T2 and T3 groups, however it was significantly (P<0.05) higher in T4 and T5 group as compared to control. In barrows, average percent weight of bacon and ham was significantly (P<0.05) lower in T4 and T5 groups as compared to control, however showing no significant difference in T1, T2 and T3 groups. In gilts, percent weight of bacon and ham was significantly (P<0.05) lower in T2, T3, T4, and T5 groups as compared to control. In barrow, average percent weight of loin shows no significant (P>0.05) difference in T1 and T2 group; however is significantly (P<0.05) higher T3, T4, and T5 groups as compared to control. There was no significant difference in the average percent weight of rib chop and under cut among control and treatment groups. In case of gilts, there was no significant difference in the percent weight of rib chop and undercut between T1 and T2 groups, however it is significantly lower in T3, T4 and T5 groups as compared to control.

Table 4: Effect of paddy instead of maize on average percent weight of retail cuts of pig carcass

Average percent weight (%)	Groups									
	T1		**T2**		**T3**		**T4**		**T5**	
	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts
Shoulder	21.73 ±0.12^{c}	21.94 ±0.05^{c}	22.15 ±0.03^{bc}	22.40 ±0.11^{bc}	22.39 ±0.12^{bc}	22.59 ±0.05^{b}	22.87 ±0.24^{ab}	23.76 ±0.08^{a}	23.30 ±0.47^{a}	24.21 ±0.33^{a}
Bacon	6.30 ±0.24^{a}	6.48 ±0.22^{a}	6.12 ±0.22^{a}	6.20 ±0.15^{b}	5.84 ±0.14^{ab}	6.16 ±0.23^{b}	5.69 ±0.04^{b}	5.86 ±0.23^{c}	5.36 ±0.02^{b}	5.42 ±0.02^{d}
Ham	15.99 ±0.35^{a}	17.20 ±0.24^{a}	15.50 ±0.48^{a}	15.45 ±0.08^{c}	15.82 ±0.19^{a}	16.18 ±0.28^{b}	12.29 ±0.04^{b}	11.62 ±0.14^{d}	11.85 ±0.14^{b}	16.53 ±0.04^{b}
Loin	9.12 ±0.11^{c}	9.42 ±0.10^{d}	9.39 ±0.28^{c}	9.62 ±0.03^{cd}	10.35 ±0.24^{b}	9.74 ±0.02^{bc}	11.16 ±0.20^{a}	9.92 ±0.05^{ab}	11.49 ±0.17^{a}	9.99 ±0.13^{a}
Rib chop	3.13 ±0.14	3.78 ±0.32^{a}	3.11 ±0.13	3.23 ±0.05^{a}	3.10 ±0.13	2.88 ±0.02^{b}	3.06 ±0.19	2.76 ±0.19^{b}	2.94 ±0.17	2.74 ±0.00^{b}
Under cut	1.45 ±0.08	1.52 ±0.04^{a}	1.48 ±0.10	1.55 ±0.21^{a}	1.46 ±0.04	1.11 ±0.06^{b}	1.49 ±0.04	0.80 ±0.03^{c}	1.48 ±0.38	0.87 ±0.03^{bc}

a, b, c, d Values bearing similar superscripts in the same row does not differ significantly (P>0.05)

The increase in average percent weight of shoulder and loin and decrease in the average percent weight of bacon and ham with the increase of paddy in the diet may be correlated with the decrease in the energy content of these diets, which results in production of more muscular and lean pork. Gupta (1989) found barrows raised on maize diet had higher portions of ham and bacon as compared to deoiled rice polish raised barrows and pork of this group was lean than those of maize feed barrows. Sikka (2007) found average increased in loin, belly and shoulder weights by incorporation of paddy in the diet as a replacement of maize. Similar findings where reported by Sikka and Chawla (1986). Liao (1985) found increased crude fibre content diet improves carcass quality.

Other edible parts of carcass

Besides the retail cuts of carcasses, other parts are also consumed by a section of people and these parts are head, kidney and lean fat and it is also better to study about these edible parts. The data of average percent of these parts have been tabulated in Table 5. In both barrows and gilts, statistically there was no significant (P>0.05) difference in average percent weight of kidney and head among the groups, however percent weight of lean fat was significantly (P< 0.05) lower in T2, T3, T4 and T5 groups as compared to control. The decrease in the lean fat of T2, T3, T4 and T5 groups as compared to control T1 group is probably due to decrease in the energy content of these diets which result in production of lean pork. Gupta (1989) found barrows raised on deoiled rice polish produces lean pork than those of maize feed barrows. Sharda *et al.* (1975) and Sharda and Singh (1981) also reported similar trends in regarding to these edible part percentage.

Table 5: Effect of paddy instead of maize on percent weight of head, kidney, lean fat and cost of production of pigs

Average percent weight (%)	Groups									
	T1		T2		T3		T4		T5	
	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts	Boars	Gilts
Head	10.51 ±0.29	10.33 ±0.08	10.45 ±0.02	10.52 ±0.15	10.36 ±0.07	10.26 ±0.16	7.63 ±0.02	9.83 ±0.02	10.35 ±0.31	10.31 ±0.04
Kidneys	0.24 ±0.00	0.24 ±0.00	0.23 ±0.01	0.22 ±0.01	0.23 ±0.01	0.25 ±0.01	0.52 ±0.01	0.23 ±0.01	0.22 ±0.00	0.26 ±0.01
Lean fat	2.70 ±0.02^{a}	1.74 ±0.06^{a}	1.90 ±0.16^{b}	1.72 ±0.06^{a}	1.47 ±0.04^{c}	1.52 ±0.06^{b}	1.37 ±0.02^{c}	1.29 ±0.03^{c}	1.27 ±0.03^{c}	1.16 ±0.01^{c}
Cost of Production										
Cost of production/ Kg live weight gain (Rs.)	57.25	55.76	55.98	54.63	56.87	53.39	57.32	50.35	58.68	54.77

a, b, c Values bearing similar superscripts in the same row does not differ significantly (P>0.05)

Cost of Production

The effect of paddy instead of maize on average cost of raising pigss for entire period of 110 days was worked out and have been presented Table 5. In both barrows and gilts, there was decrease in the cost of production till 50% replacement of maize with paddy, but at higher level of replacement, the cost of production increased than control. The decrease in the total expenditure per kg live weight gain by the replacement of paddy with maize was due to decrease in the portion of maize in these diets which is costlier cereal grain as compared to paddy, however at higher level of replacement the cost of production increased due to decrease in feed efficiency ratio. Kumari *et al*. (2007) found the replacement of maize with marua causes significantly lowest cost for one kg gain. Gupta (1989), Yadav *et al*. (2005) and Yadav and Gupta (1995) found the replacement of maize with deoiled rice polish based ration causes significantly lowest cost for one kg gain.

CONCLUSION

The results suggest that at 25% and 50% replacement of maize of control with paddy, there was no adverse effect on carcass traits in finishing pigs. Proportion of Lean meat was significantly higher in pigs which were fed on higher paddy based diet than pigs fed on maize based diet. Replacing maize with paddy in the diet of growing and finishing pigs at 25% and 50% reduced cost of production.

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