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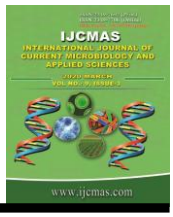

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Effect of Inclusion of Rice DDGS on the Performance in Crossbred Pigs

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A B S T R A C T

Four dietary treatments were evaluated for their effect on growth performance of crossbred (LWY x Desi) male pigs during grower and finisher phases in a Completely Randomized Block Design. A Basal ration (T1) + 100g of Probiotic (*Bacillus*) + 500 g of enzyme cocktail per ton of feed, T1 + DDGS to contribute 20% of the total protein (9% & 7.5% of diet during grower and finisher phases, respectively (T2); T1 + DDGS to contribute 30% of the total protein (12.5% & 11% of diets during grower and finisher phases, respectively(T3); T1 + DDGS to contribute 40% of the total protein (16.5% & 15% of diets during grower and finisher phases, respectively(T4). During grower phase, the pigs fed T1 have taken less (P<0.05) number of days than those fed T4. ADG (g) was higher (P<0.05) in T1 (440) or T2 (432) fed pigs than in T3 (413) and T4 (382) fed pigs and during finisher phase, initial, final and total weight gain (kg) were not significantly different among treatments. Number of days taken was T1 (90), T2 (92), T3 (88), T4 (96) and were not significant. ADG (g) in T1 to T4 diets fed pigs was 400, 392, 405 and 370, respectively. The ADFI (kg), the feed per kg gain and the cost of feed per kg gain (Rs) were not significantly different among treatments. During overall growth performance, ADG (g) was higher (P<0.05) in T1 (423) followed by T2 (412), T3 (409) and lowest in T4 (372) fed pigs. The ADFI (kg) and the feed per kg gain were not significantly different among treatments. The cost of feed per kg gain (Rs) was higher (P<0.05) in T1 (98.8) or T2 (93.8) fed pigs than in T3 (92.2) and T4 (84.3) fed pigs. It was concluded that contributing (%) 20 and 30 of the CP through DDGS improved ADG and reduced the cost of feed gain per kg gain in growers and finishers, respectively.

Introduction

Pig as compared to other livestock species has a great potential to contribute to faster economic return to the farmers, because of certain inherent traits like high fecundity, better-feed conversion efficiency, early maturity and short generation interval. The dressing percentage is also higher (Jaishankar *et al.*, 2015). Over decades, Corn and Soybean have been the major components of conventional feed for pigs and satisfy the needs for energy and protein. But owing to an increased cost of production, use of other non-edible human protein and energy sources have come into picture

Distillers dried grains with solubles (DDGS) is a by-product of the beverage and fuel alcohol industries (Stein and De Lange, 2007). It has a relatively high concentration of energy and digestible phosphorus, and a

moderate concentration of protein and it can partially replace The relatively high abundance, low price, and high nutritional value of DDGS make it a popular cost-effective alternative feed ingredient for swine producers. Including DDGS in swine diets concurrently minimized cost of production (De Matteisa *et al.*, 2018).

DDGS product obtained from Rice Distillery is called Rice Distillers Dried Grains with Solubles (RDDGS). India is one of the largest producers of rice in world producing approximately 111.52 MT of rice in 2017-18 (IBEF, 2018). It is a good source of phosphorus and maximum of it is present as non phytate form which is readily available to animal.

Rice-based DDG has been reported to have higher contents of protein (47.5%) and fiber (15.8%) (Chatterjee *et al.,* 2016) when compared with those of corn-based DDGS (Liu, 2011).Hence the present work was planned by including the Rice DDGS in the pig diets to study the productive performance.

Materials and Methods

In a Completely Randomized Design four dietary treatments were evaluated for their effect on growth performance of crossbred (LWY x Desi) male pigs during grower and finisher phases. Four isonitrogenous experimental diets were formulated as per NRC (2012) and fed during grower (15 -35 kg body weight) and finisher (35-70 kg body weight) phases. The dietary treatments were as shown below:

Control diet (T1) - Basal ration + 100g of Probiotic (*Bacillus*) + 500g of enzyme cocktail per ton of feed.

Experimental diet 2 (T2) - T1 + DDGS to contribute 20% of the total protein (9% & 7.5% of diet during grower and finisher phases, respectively)

Experimental diet 3 (T3) - T1 + DDGS to contribute 30% of the total protein (12.5% & 11% of diet during grower and finisher phases, respectively)

Experimental diet 4 (T4) - T1 + DDGS to contribute 40% of the total protein (16.5% of & 15% of diet during grower and finisher phases, respectively).

The experiment was carried out on 24 crossbred (Large White Yorkshire) male pigs and distributed randomly into four groups with six animals in each group. Dietary treatments consisted of corn, soybean meal control (T1) or Rice Distillers Dried Grain Solubles to contribute 20 (T2), 30(T3) and 40% (T4) of the total protein of T1. At the beginning of experiment, animals were weighed for two consecutive days in the morning before feeding and watering.

Then animals were weighed individually at 14 days interval during experimental period before feeding and watering to record the body weight change. The chemical composition of Maize, Soybean meal, Rice DDGS and De-oiled rice bran used in the experimental diets is- the percent DM, CP, EE, CF, TA, NFE, NDF, ADF and Hemi cellulose were 88.9, 10.6, 4.1, 2.7, 6.9, 75.7, 14.5, 9.7 and 4.8 (Maize); 90.9, 42.9, 1.0, 7.2, 10.0, 40.0, 39.7, 22.4 and 17.3 (Soybean meal); 88.5, 39.0, 2.3, 11.2, 6.5, 41.3, 37.0, 22.0 and 15.0 (Rice DDGS) and 88.9, 15, 1.5, 17.8, 15.9, 51.8, 47.2, 34.3 and 12.9 (De-oiled rice bran), respectively.

The ingredient and chemical composition (%) of the experimental grower and finisher diets fed to pigs from15 to 35 kg and 35 kg to 70 kg body weight are presented in Tables 1 & 2, respectively. Synerzyme-P-FS (a combination

of Amylase, Hemi-cellulase, Xylanase, Galactosidase, Cellulase, Protease, β-glucanse and Phytase) as Enzyme cocktail and *Bacillus* probiotic added uniformly to T1, T2, T3, and T4 @ 50g and 10g / 100 kg of feed respectively.

Results and Discussion

The growth performance of the pigs fed during grower phase is presented in Table 3. The initial and final weights (kg) were not significantly different among treatments. Similarly the weight gain (kg) was also not significantly different among treatments and the pigs fed T1 have taken less (P<0.05) number of days (Fig.2) than those fed T4. ADG (g) was higher (P<0.05) in T1 (440) or T2 (432) fed pigs than (Fig.1) in T3 (413) and T4 (382) fed pigs. The ADFI (kg) and the feed per kg gain (Fig.3) were not significantly different among treatments.

The cost of feed per kg gain (Rs) was significantly (P<0.05) higher in T1 than in other treatments. During finisher phase, initial, final and total weightgain (kg) were not (Table 4) significantly different among treatments. Number of days taken was T1 (90), T2 (92), T3 (88), T4 (96) and were not significant. ADG (g) in T1 to T4 diets (Fig.4) fed pigs was 400, 392, 405 and 370, respectively. The ADFI (kg), the feed per kg gain (Fig.5) and the cost of feed (Fig.6) per kg gain (Rs) were not significantly different among treatments

During overall growth performance, (15-70 kg).initial and final weights (kg), weight gain (kg) and (Table 5) the number of days taken to reach the target weight were comparable among treatments. However, the ADG (g) was higher (P<0.05) in T1 (423) followed by T2 (412), T3 (409) and lowest in T4 (372) fed pigs. The ADFI (kg) and the feed per kg gain were not significantly different among treatments and the values were 1.80 and 4.3 for T1, 1.78 and 4.4 for T2, 1.80 and 4.4 for T3 and 1.73 and 4.7 for T4 fed pigs. The cost of feed per kg gain (Rs) was higher (P<0.05) in T1 (98.8) or T2 (93.8) fed pigs than in T3 (92.2) and T4 (84.3) fed pigs.

As seen from the table it is evident that the initial and final weight showed similar values and was non- significant. The number of days taken to achieve the target weight increased (P<0.05) from T1 to T4 with a corresponding decrease in ADG (g) and ADFI (kg).

The results of present study were partially in agreement with previous studies of Thacker (2006), Feoli (2008), Linneen *et al.,* (2008) where they have observed growth inhibition when either nursery or growing-finishing pigs were fed diets containing of up 30% of corn, wheat or sorghum DDGS. Results from some studies have shown that feeding diets containing 20 or 30% DDGS can did not affect growth performance (Cook *et al.,* 2005; DeDecker *et al.,* 2005; Gaines *et al.,* 2007), whereas other studies (Whitney *et al.,* 2006; Linneen *et al.,* 2008) have shown a negative effect on ADG and ADFI when pigs were fed diets containing DDGS levels 20% and above as compared with control diet (corn-soybean meal diets).

It was reported that DDGS contains a higher digestible energy and AA content than cereal grain from which it was prepared (Widyaratne and Zijlstra, 2007), but following pre-characterization and incorporation of the digestible nutrient content information in diet formulation, DDGS caused a reduction in voluntary feed intake, ADG and final body weight. The same trend would have been implied in present study also. The other reason for a reduced ADFI could be attributed to an increase in the dietary inclusion levels of DDGS would have affected the palatability negatively (Whitney *et al.,* 2006).

During overall growth performance, the total weight gain was not significant among treatments. Whereas there was a distinct increase in number of days taken to reach target weight due to rice DDGS inclusion, which was more pronounced in T4. However, the feed per kg gain was not significantly different across treatments. On the positive side, there was a decrease in feed cost/kg gain by Rs.5.0, 6.6 and 14.5 in T2, T3 and T4 fed pigs than in T1 fed pigs, which was significantly different (P<0.05).

Table.1 Ingredient and chemical composition (%) of experimental grower diets

Ingredient	T1	T2	T3	T4
Maize	60	59	59	59
Soybean meal	20	12	9.5	5.5
Rice DDGS	-	9	12.5	16.5
Deioled Rice bran	18	18	17	17
Mineral mixture #	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
	100	**100**	**100**	**100**
Lysine (%)	0.47	0.63	0.70	0.81
Methionine (%)	0.05	0.05	0.05	0.05
Bacillus (gm/100kg)	10	10	10	10
Multi enzyme(gm/100kg)	50	50	50	50
Cost per 100kg (Rs.)	2355	2238	2209	2154
Proximate composition (%)[a]				
DM	91	91.2	91.1	91.1
OM	89.1	89.5	89.4	89.5
CP	16.4	16.2	16.1	16.4
TA	10.9	10.5	10.6	10.5
EE	1.7	1.9	1.8	1.8
CF	9.2	9.6	9.9	10.7
NFE	61.8	61.8	61.6	60.6
Calcium	0.67	0.62	0.66	0.70
Phosphorus	0.30	0.30	0.31	0.32
GE (kcal/g)	3591	3747	3856	3919
Cell wall composition (%) [a]				
NDF	27.53	28.60	28.80	29.20
ADF	17.10	17.30	17.60	18.10
Hemicellulose	10.43	11.30	11.20	11.10

[a] on Dry Matter basis except for DM

[#] per kg contained - Ca 25.5%; P 12.75%; S 0.72%; Zn 9600mg; Mn 1500mg; Na 5.9mg; K 100 mg; Mg 6000mg; Fe 1500mg; Iodine325mg; Cu 12000mg; Co 150 mg

Table.2 Ingredient and chemical composition (%) of experimental finisher diets

Ingredient	T1	T2	T3	T4
Maize	59	59	59	59
Soybean meal	15	9	6	2
Rice DDGS	-	7.5	11	15
Deioled Rice bran	24	22.5	22	22
Mineral mixture #	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5
	100	**100**	**100**	**100**
Lysine (%)	0.41	0.57	0.65	0.76
Methionine (%)	0.04	0.04	0.04	0.04
Bacillus (gm/100kg)	10	10	10	10
Multi enzyme(gm/100kg)	50	50	50	50
Cost per 100kg (Rs.)	2205	2133	2094	1939
Proximate composition (%)				
DM	91.6	92	91.5	91.3
OM	88.2	88.9	89.2	89.2
CP	14.5	14.3	14.4	14.2
TA	11.8	11.1	10.8	10.8
EE	1.7	1.6	1.9	1.6
CF	14.5	14.8	15.2	15.9
NFE	57.5	58.2	57.7	57.5
Calcium	0.73	0.69	0.72	0.69
Phosphorus	0.31	0.32	0.31	0.35
GE (kcal/g)	3500	3625	3714	3792
Cell wall composition (%)				
NDF	29.7	30.1	30.4	30.5
ADF	19.4	19.1	19.0	19.2
Hemicellulose	10.30	11.00	11.40	11.30

[a] on Dry Matter basis except for DM
[#] per kg contained - Ca 25.5%; P 12.75%; S 0.72%; Zn 9600mg; Mn 1500mg; Na 5.9mg; K 100 mg; Mg 6000mg; Fe 1500mg; Iodine325mg; Cu 12000mg; Co 150 mg

Table.3 Growth performance of growers

Parameter	T1	T2	T3	T4	P- value
Initial wt. (kg)	15.21 ± 0.21	15.35 ± 0.34	15.23 ± 0.23	15.18 ± 0.07	0.968
Final wt. (kg)	35.65 ± 0.17	35.08 ± 0.24	35.32 ± 0.23	35.23 ± 0.23	1.000
Weight gain (kg)	20.43 ± 0.22	19.73 ± 0.36	20.08 ± 0.25	20.05 ± 0.22	0.815
No. of days*	45.51^{a} ± 2.21	46.2^{a} ± 3.06	48.8^{ab} ±1.81	52.7^{b} ± 0.83	0.039
ADG (g)*	440^{b} ± 16	432^{b} ±19	413^{ab} ±10	382^{a} ± 9	0.047
ADFI (kg)	1.4 ± 0.05	1.3 ± 0.05	1.3 ± 0.03	1.12 ± 0.01	0.105
Feed /kg gain	3.2 ± 0.11	3.0 ± 0.23	3.2 ± 0.18	3.4 ± 0.14	0.563
Cost of feed/kg gain (Rs)*	75.9 ± 3.05^{b}	64.3 ± 3.32^{a}	64.7 ± 3.10^{a}	66.7 ± 2.43^{a}	0.043
^{abc} values in a row not sharing common superscripts differ significantly * (P<0.05) **(P<0.01)					

Table.4 Growth performance of finishers

Parameter	T1	T2	T3	T4	P- value
Initial wt. (kg)	35.65 ± 0.17	35.08 ± 0.24	35.32 ± 0.23	35.23 ± 0.23	1.000
Final wt. (kg)	70.4 ± 0.17	70.3 ± 0.24	70.4 ± 0.23	70.2 ± 0.23	0.469
Weight gain (kg)	35.2 ± 0.22	35.3 ± 0.36	35.2 ± 0.25	35.0 ± 0.22	0.893
No. of days	89.5 ± 2.21	92.3 ± 3.06	87.7 ±1.81	95.8 ± 0.83	0.736
ADG (g)	400 ± 16	392 ±19	405 ±10	370± 91	0.776
ADFI (kg)	2.2 ± 0.05	2.3± 0.05	2.3± 0.03	2.1 ± 0.01	0.090
Feed /kg gain	5.6 ± 0.11	5.9 ± 0.23	5.7 ± 0.18	5.9 ± 0.14	0.812
Cost of feed /kg gain (Rs)	123± 5.98	118.2± 6.7	112.7± 5.9	113.3± 6.01	0.613

Table.5 Overall growth performance

Parameter	T1	T2	T3	T4	P- value
Initial wt. (kg)	15.21 ± 0.21	15.35 ± 0.34	15.23 ± 0.23	15.18 ± 0.07	0.968
Final wt. (kg)	70.4 ± 0.17	70.3 ± 0.24	70.4 ± 0.23	70.2 ± 0.23	0.469
Weight gain (kg)	55.08 ± 0.56	54.91 ± 0.56	55.11 ± 0.45	54.9 ± 0.84	0.915
No. of days	134.7 ± 1.12	138.5± 0.95	136.7 ± 0.95	148.5 ±1.54	0.366
ADG (g)*	423^{b} ±15.09	412^{ab} ±7.16	409^{ab} ± 7.76	372^{a} ±12.75	0.048
ADFI (kg)	1.80 ± 0.008	1.78 ± 0.002	1.80 ± 0.014	1.73 ±0.023	0.126
Feed /kg gain	4.3 ± 0.008	4.4 ± 0.11	4.4 ± 5.69	4.7 ± 0.18	0.280
Cost of feed /kg gain(Rs) *	98.8 ± 4.04^{b}	93.8 ± 3.09^{b}	92.2 ± 2.02^{ab}	84.3 ± 2.45^{a}	0.020

^{abc} values in a row not sharing common superscripts differ significantly * (P<0.05) **(P<0.01)

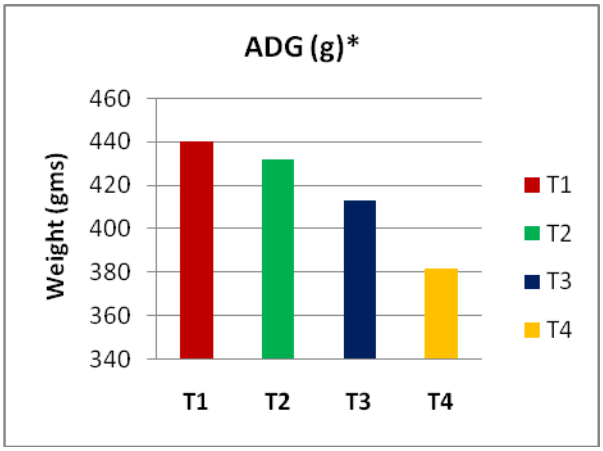

Fig.1

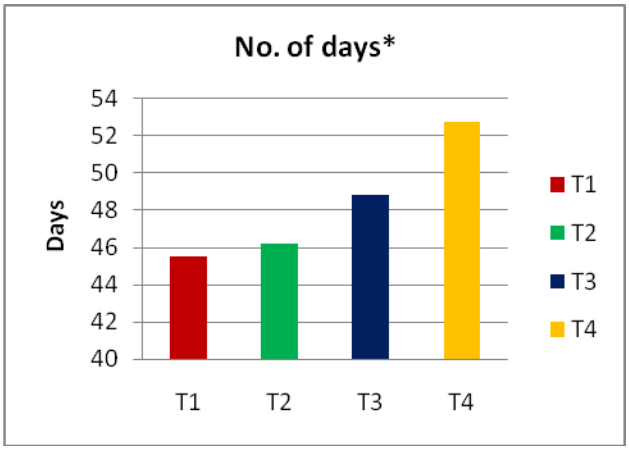

Fig.2

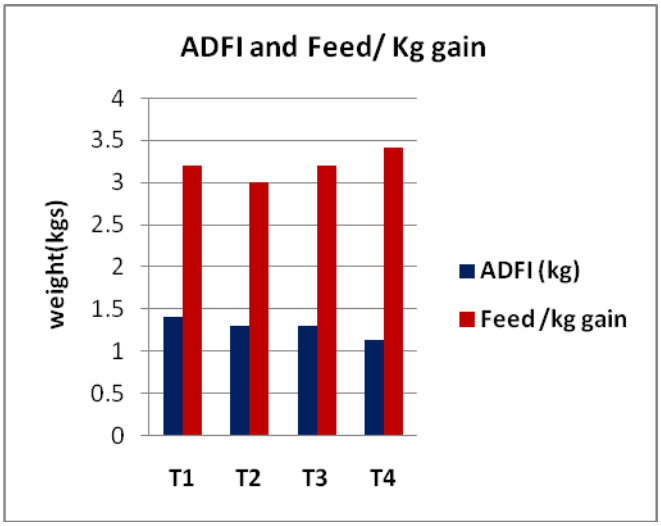

Fig.3

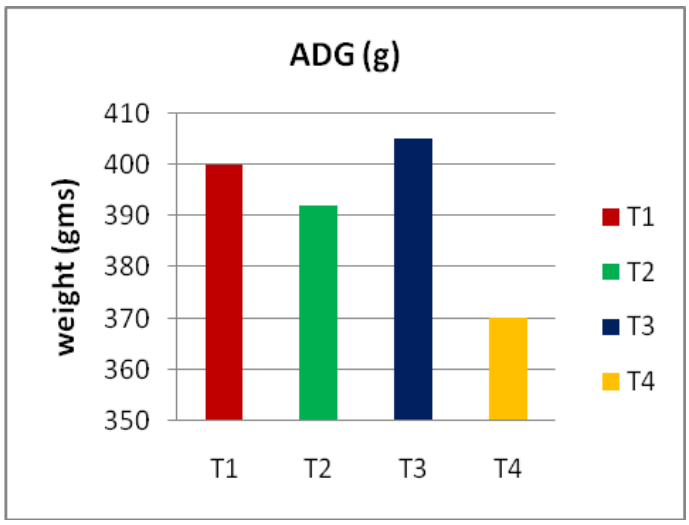

Fig.4

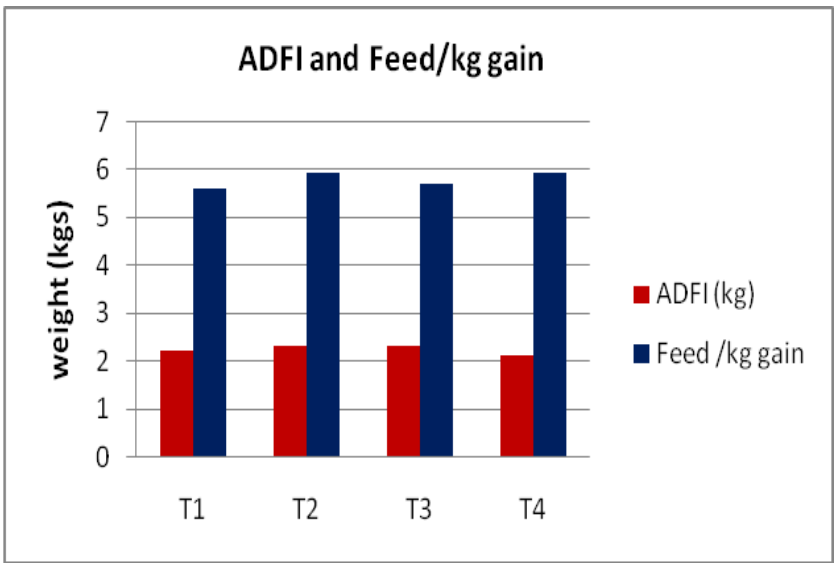

Fig.5

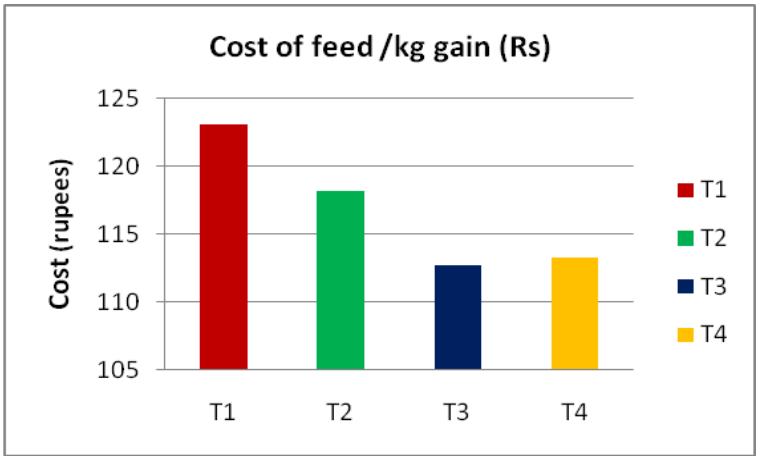

Fig.6

A continuous effort is needed to lower the cost of pig production as an economic measure. Use of rice DDGS as protein source in the diets of pig diets was found to be effective. It was concluded that contributing (%) 20 and 30 of the CP through DDGS improved ADG and reduced the cost of feed gain per kg gain in growers and finishers, respectively. However, long term trials need to be studied to record the ill effects.

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