

*Original Research***Effect of Jaggery Filter Cake Supplementation on Growth Performance of Large White Yorkshire Grower Pigs****B. H. M. Patel^{1*}, Sanjay Kumar², S. B. Prasanna³ and Ravindra Kumar⁴**¹Isolation Unit, Indian Veterinary Research Institute, Hebbal, Bengaluru, Karnataka, INDIA²LPM Department, Veterinary College, G. B. Pant Univ. of Agric. Tech., Pantnagar, Uttarakhand, INDIA³ILFC Department, Veterinary College, KVAFSU, Bengaluru 24, Karnataka, INDIA⁴LPM Department, Faculty of Veterinary science and Animal Husbandry, BAU, Ranchi, Jharkhand, INDIA***Corresponding author:** mpatellpm@gmail.com

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Abstract

Jaggery filter cake (JFC) is byproduct obtained while making jaggery. Keeping the importance of Jaggery filter cake as unconventional feed in economic pig feeding, the study was conducted on growth performance of grower Large White Yorkshire pigs fed on different levels of Jaggery filter cake. Thirty piglets (3 ½ month old) were divided into 5 dietary treatment groups, viz. group I: concentrate only, group II: concentrate +250 g JFC, group III: concentrate +500 g JFC, group IV: concentrate +750 g JFC and group V: ad lib. JFC only. Jaggery filter cake supplementation was increased in the ratio of 50:100:150 g in group II, III, IV respectively every fortnight during growing stage. There was no significant difference in overall DM intake between groups. During 1st week the daily DM intake in all the groups irrespective of treatments was almost similar (non-significant). However, from 2nd week onwards up to 4th week the daily DM intake was found to be significantly ($P<0.01$) highest in group V. The overall concentrate intake did not differ significantly between groups. Body weight of group IV showed highest followed by group II, III and I whereas group V showed lowest body weight gain. Body weight from 4th week onwards till end of the experiment group V showed a highly significant ($P<0.01$) difference from rest of the groups. Whereas, group I, II, III and IV did not revealed any significant difference except for 8th week during which group IV showed a significant ($P<0.01$) difference in body weight from group I and group V. During growing stage supplementation of JFC along with concentrate increased the weight gain, whereas, sole feeding of JFC greatly reduced it. During entire growing stage group V revealed a significantly ($P<0.01$) lowest weight gain than all other groups except for 2nd week when there was no significant difference between treatment groups. Supplementation of JFC along with concentrate decreased the FCR, whereas sole feeding of JFC greatly increased it. However, FCR was not much different between different treatment groups during entire experiment except 3rd week, where there was a significant ($P<0.01$) decrease in FCR in group II and group IV from group I. Decreased FCR in JFC supplemented group indicates efficient utilization of nutrients. Moreover, in group V, the FCR was found to be significantly ($P<0.01$) highest with respect to all other treatment's groups. Thus, jaggery filter cake can be supplemented with concentrate as an ideal unconventional feed without any deleterious effects in the sugarcane belt.

Key words: Body Weight, Growth, Grower Pig, Jaggery Filter Cake

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Introduction

Feed is the major cost in the pork industry. Maize grain is the one of main energy source and most commonly used feed ingredient in pig and poultry ration. In the recent past, demand of maize warrants for the alternative feed resources which are cheap, easily available and suitable for pig feeding. Many researchers (Sikka, 2007 and Campos *et al.*, 2006) have tried to replace the maize with molasses also. The most unconventional feed sources are food wastes, leftovers of bakery, and tea factory, brewery, sugar industry, dairy industry, agriculture wastes of culled potatoes, unmarketable fruits and vegetables. Farmers often feed jaggery filter cake (scum) to pigs during winter season. Jaggery filter cake (JFC) is obtained from jaggery preparation units. In the rural areas, Jaggery (Jaggery is an indigenous sugar) manufacture is one of the most important cottage industries in India. Jaggery filter cake is nothing but scum obtained while making Jaggery (Patel *et al.*, 2009; Patel *et al.*, 2019). Scum is removed from the boiling juice by a simple perforated scoop on a long handle. Scum is being collected in a cloth and hanged in an elevated area till all the extract comes out. Then solid material remained in the cloth is called as JFC and locally also referred as *maili*. Feeding such high energy source will not only help in growing fast but also reduce the cost of production. Feeding of sugarcane filter cake/press mud in different livestock have been noted in some studies (Suma *et al.*, 2007; Suresh *et al.*, 2012; Sahu *et al.*, 2016; Kumar *et al.*, 2017). However, no literature or any scientific study is available on this traditional practice. Therefore, keeping in view the importance of jaggery filter cake in economic pig farming in developing countries, this study was conducted on the performance of Large White Yorkshire grower fed on different level of jaggery filter cake along with balanced diet.

Material and Methods

The present investigation was conducted at Swine Production Unit, Department of Livestock Production & Management, College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand. The place is located in the foothills of Himalayas at 29.5°N latitude, 79.3°E longitude and an altitude of 243.84 m above mean sea level. Thirty Large White Yorkshire growers of nearly 3-3½ months age were selected and were randomly divided into five groups maintaining similar male: female ratio.

Table 1: Quantify of jaggery filter cake offered in different groups at beginning of experiment

	Group I	Group II	Group III	Group IV	Group V
Jaggery filter cake	No JFC	250g*	500*	750*	Ad lib [#]
Standard balanced ration*	Ad lib	Ad lib	Ad lib	Ad lib	No feed

*the quantity of jaggery filter cake was increased in the ratio of 50:100:150 g in II, III, IV groups, respectively every fortnight interval; # Vitablend @ 0.25g/kg feed, salt 0.5%, Mineral mixture 2% were added daily to the feed on DM basis.

Animals were housed in individual well-ventilated shed under corrugated asbestos sheeting roof on cement concrete floor with a floor space allowance of 2×3 m² per individual. Pen was cleaned and washed with water twice daily. Proper hygienic conditions including healthy surroundings were maintained in the shed throughout the experimental trial. All the piglets were de-wormed 15 days before the start of the experiment with Albendazole. All animals were vaccinated against swine fever (BP Division, IVRI). Ration was prepared at the experimental site. The percentage of maize, soybean meal, wheat bran, fish meal, mineral mixture, common salt and vitamin (AB2D3) & vitamin B complex in grower ration was 52, 15, 24.5, 6, 2, 0.5% and 25 g/kg, respectively. The grower ration was continued for 9 weeks (nearly upto 35 kg body weight). The fresh jaggery filter cake was procured from local area on daily basis. However, required portion of fresh jaggery filter cake was fed before feeding the concentrate.

The parameters like feed intake and gain were recorded. Daily voluntary feed intakes of each animal were noted. Weighed quantity of feed was offered daily twice (once in the morning at 10:00 AM and also in the evening 4:00 PM). The residues were collected and weighed at 2:00 PM same day and 9:30 AM on next day in all the groups, respectively. The dry matter of jaggery filter cake and concentrate was clubbed. Body weight changes of animals in each treatment group were recorded in the morning before feeding at weekly intervals. Recording of body weights of weaners were made on a platform balance of 300 kg capacity with a least count of 50 g.

Statistical Analysis

The data were analyzed using Analysis of Variance (ANOVA) and the Critical Difference (CD) was calculated to determine any significant difference among the treatment means (Snedecor and Cochran, 1994).

Results and Discussion

Table 2 represents the mean ± S.E. of daily dry matter intake (kg) of growers. The overall daily DM intake (kg) during growing stage was 1.06 ± 0.10, 1.08 ± 0.10, 1.13 ± 0.11, 1.19 ± 0.12 and 1.25 ± 0.11 respectively. During growing stage, there was no significant difference in overall DM intake between different treatment groups.

Table 2: Average daily dry matter intake (kg) of grower pigs fed ration containing jaggery filter cake during weekly intervals

Weeks	I	II	III	IV	V	Significance
1 st	0.69±0.02	0.70±0.04	0.72±0.05	0.76±0.02	0.67±0.01	ns
2 nd	0.64 ^a ±0.03	0.69 ^a ±0.06	0.71 ^a ±0.06	0.73 ^a ±0.02	1.24 ^b ±0.01	**
3 rd	0.87 ^a ±0.01	0.87 ^a ±0.05	0.92 ^a ±0.04	0.92 ^a ±0.04	1.19 ^b ±0.01	**
4 th	0.88 ^a ±0.04	0.91 ^a ±0.04	0.94 ^{ab} ±0.04	1.01 ^b ±0.03	1.37 ^c ±0.00	**
5 th	1.13 ^a ±0.03	1.13 ^a ±0.0	1.19 ^a ±0.04	1.20 ^a ±0.04	0.95 ^b ±0.00	**
6 th	1.18±0.03	1.19±0.04	1.22±0.05	1.26±0.05	1.19±0.01	ns
7 th	1.27 ^a ±0.04	1.29 ^a ±0.06	1.35 ^a ±0.08	1.50 ^b ±0.05	1.36 ^{ab} ±0.00	*
8 th	1.35 ^a ±0.04	1.41 ^{ab} ±0.05	1.52 ^{bc} ±0.08	1.60 ^c ±0.03	1.54 ^{bc} ±0.00	*
9 th	1.50 ^a ±0.04	1.55 ^a ±0.06	1.59 ^a ±0.05	1.75 ^b ±0.02	1.77 ^b ±0.018	**
Ovrall Mean	1.06±0.10	1.08±0.10	1.13±0.19	1.19±0.12	1.25±0.11	ns

^{a, b, c}Means bearing different superscripts in a row differ significantly from each other (**P<0.01; *P<0.05)

During 1st week of the growing stage the daily DM intake in all the groups irrespective of treatments was almost similar (non-significant). However, from 2nd week onwards up to 4th week the daily DM intake was found to be significantly (P<0.01) highest in group V from rest of the treatment groups. This is in agreement with Suresh *et al.* (2012), who reported that feed consumption was moderately affected by incorporation of Sugarcane Press Residue (SPR) as feed ingredient at 5% and substantially at 10% level. During 5th week onwards, daily DM was highest in group IV followed by III, II, I and V. Group V showed significantly (P<0.05) lowest DM intake from 5th week onwards except 6th week when DM intake was non-significantly different between different treatment groups. More DM intake in group V in the beginning of the experiment (up to 4th week) might be because of no crude fibre in the diet which led to no satisfaction and low DM intake during last phase might be due to small stomach capacity due to poor growth rate and quick hunger satisfaction because of high energy content in JFC.

A preliminary trial on magnitude of utilization of SPR in broiler birds (up to 4%) showed that SPR can be valuable non-conventional feedstuffs for poultry (Budeppa *et al.*, 2008). Another trial conducted in laying hens also revealed that there is a potential for use of SPR upto 10% as a source of both organic and inorganic nutrients excepting energy (because of unavailable data) in layer rations (Suma *et al.*, 2007). In growing sheep, Suresh *et al.* (2012) demonstrated that SPR can serve as a valuable ingredient in the concentrate for stall fed sheep up to 3%.

The mean ± S.E. of weekly concentrate balanced ration intake (kg) of growers has been presented in Table 3. During 1st week of experiment concentrate intake ranged from 4.03 to 4.80 kg. The daily concentrate intake was found to be highest in group I followed by group II, III and IV, whereas, Group V was maintained without any concentrate feed. Same trend was followed during whole experimental period. Table 3 revealed that the daily concentrate intake was increased gradually with advancement of age in all the treatment groups, except for 2nd week, where daily concentrate intake was reduced than the previous week. This might

be due to due to low ambient temperature during 2nd week of December and relatively higher ambient temperature during last week of March. Group IV showed a highly significant (P<0.01) difference in daily concentrate intake from group I during whole experiment except during 1st and 8th week where the concentrate intake was non-significant.

Table 3: Average weekly concentrate intake (Kg) of grower pigs fed ration containing jaggery filter cake

Weeks	I	II	III	IV	V	Significance
1 st	0.69± 0.02	0.63± 0.04	0.59± 0.05	0.58± 0.04	-	ns
2 nd	0.64± 0.03	0.61± 0.06	0.57± 0.06	0.51± 0.02	-	ns
3 rd	0.87 ^a ± 0.01	0.78 ^{ab} ± 0.05	0.72 ^{bc} ± 0.04	0.66 ^c ± 0.04	-	**
4 th	0.88± 0.04	0.82± 0.04	0.76± 0.04	0.74± 0.03	-	ns
5 th	1.13 ^a ± 0.03	1.02 ^b ± 0.02	0.98 ^{bc} ± 0.04	0.89 ^c ± 0.04	-	**
6 th	1.18 ^a ± 0.03	1.09 ^{ab} ± 0.04	1.01 ^{bc} ± 0.05	0.95 ^c ± 0.05	-	*
7 th	1.27± 0.04	1.18± 0.06	1.11± 0.08	1.15± 0.05	-	ns
8 th	1.35± 0.04	1.29± 0.05	1.28± 0.08	1.24± 0.03	-	ns
9 th	1.50 ^a ± 0.04	1.42 ^{ab} ± 0.06	1.30 ^b ± 0.05	1.35 ^b ± 0.02	-	*
Overall Mean	1.06 ± 0.10	0.98± 0.10	0.92± 0.09	0.89 ± 0.10	-	ns

^{a, b, c}Means bearing different superscripts in a row differ significantly from each other (**P<0.01; *P<0.05)

Table 4 represents the mean ± S.E. of weekly change in body weight (kg) of growers during experimental trial. During 0 day of the experiment, the mean ± S.E. of body weight of different treatment groups was almost similar (ranging from 11.00 ± 0.66 kg to 12.75 ± 0.30 kg). At the end of growing stage, group IV showed highest body weight followed by group II, III and I, whereas group V showed lowest body weight gain.

Table 4: Average weekly body weight changes (kg) of grower pigs fed ration containing jaggery filter cake

Weeks	I	II	III	IV	V	Significance
0	12.00± 0.22	12.75± 0.30	11.00± 0.66	12.17± 0.68	12.00± 0.66	ns
1 st	13.71± 0.18	14.67± 0.36	12.96± 0.67	13.58± 0.58	13.00± 0.66	ns
2 nd	15.38± 0.23	16.38± 0.29	14.88± 0.65	15.67± 0.60	14.92± 0.67	ns
3 rd	17.50± 0.27	18.83± 0.27	17.38± 0.65	18.38± 0.68	16.67± 0.67	ns
4 th	19.79 ^{ab} ± 0.41	21.42 ^a ± 0.36	20.13 ^{ab} ± 0.65	21.13 ^a ± 0.69	18.75 ^b ± 0.71	**
5 th	22.83 ^a ± 0.50	24.58 ^a ± 0.29	23.29 ^a ± 0.65	24.38 ^a ± 0.79	20.17 ^b ± 0.74	**
6 th	26.00 ^a ± 0.70	27.83 ^a ± 0.31	26.71 ^a ± 0.69	27.88 ^a ± 0.91	21.88 ^b ± 0.75	**
7 th	29.71 ^a ± 0.88	31.63 ^a ± 0.47	30.54 ^a ± 0.73	31.83 ^a ± 1.04	24.33 ^b ± 0.70	**
8 th	33.38 ^a ± 1.08	35.54 ^{ab} ± 0.63	34.67 ^{ab} ± 0.83	36.17 ^b ± 1.17	26.92 ^c ± 0.67	**
9 th	37.63 ^a ± 1.13	39.83 ^a ± 0.74	39.13 ^a ± 0.83	40.38 ^a ± 1.55	29.50 ^b ± 0.71	**

^{a, b, c}Means bearing different superscripts in a row differ significantly from each other (**P<0.01; *P<0.05)

During first 3 weeks of the experiment, there was no significant difference between different treatment groups. However, from 4th week onwards till end of the experiment group V showed a highly significant (P<0.01) difference from rest of the groups. Whereas, group I, II, III and IV did not revealed any significant

difference except for 8th week during which group IV showed a significant ($P < 0.01$) difference in body weight from group I and group V.

Table 5 represents mean \pm S.E. of daily weight gain (kg) of growers during entire experimental period. The overall daily weight gain (kg) in group I, II, III, IV and V was 406.75 ± 44.68 , 429.89 ± 43.04 , 446.43 ± 43.64 , 466.93 ± 45.33 and 276.45 ± 25.78 , respectively during growing stage. It can be inferred that during growing stage supplementation of JFC along with concentrate increased the weight gain, whereas, sole feeding of JFC greatly reduced it. During entire growing stage, group V revealed a significantly ($P < 0.01$) lowest weight gain from all other groups except for 2nd week when there was no significant difference between treatment groups. This is in agreement with the results of Straub and Darne (1965), who, conducted experiment on groups of 12 cows using either scums, scums/molasses/fish meal (50/35/15) or a standard cow feed and found that scum feeding gave average results, while the second feed type gave better results than the standard feed from the point of view of milk productivity and cost.

Table 5: Average daily weight gain (g) of grower fed ration containing jaggery filter cake

Weeks	I	II	III	IV	V	Significance
1 st	244.05 ^a \pm 17.05	273.81 ^{ab} \pm 19.92	279.76 ^{ab} \pm 5.95	297.62 ^b \pm 7.53	142.86 ^c \pm 0.0	**
2 nd	238.10 \pm 27.15	244.05 \pm 10.98	273.81 \pm 7.53	297.62 \pm 27.15	273.81 \pm 7.53	ns
3 rd	303.57 ^a \pm 15.29	351.19 ^b \pm 10.98	357.14 ^b \pm 0.0	386.90 ^b \pm 31.16	250.00 ^c \pm 0.0	**
4 th	327.38 ^a \pm 21.46	369.05 ^{ab} \pm 27.15	392.86 ^b \pm 20.62	392.86 ^b \pm 9.22	297.62 ^c \pm 15.06	**
5 th	434.52 ^a \pm 14.34	452.38 ^a \pm 11.90	452.38 ^a \pm 21.95	464.29 ^a \pm 15.97	202.38 ^b \pm 7.53	**
6 th	452.38 ^a \pm 30.12	464.29 ^a \pm 15.97	488.10 ^a \pm 23.81	500.00 ^a \pm 22.59	238.10 ^b \pm 7.53	**
7 th	529.76 ^a \pm 33.78	541.67 ^a \pm 29.76	547.62 ^a \pm 17.66	565.48 ^a \pm 21.46	369.05 ^b \pm 31.50	**
8 th	523.81 ^a \pm 36.50	559.52 ^{ab} \pm 25.53	589.29 ^{ab} \pm 22.11	619.05 ^b \pm 19.92	345.24 ^c \pm 7.53	**
9 th	607.14 ^a \pm 22.59	613.10 ^a \pm 21.46	636.90 ^{ab} \pm 29.76	678.57 ^b \pm 18.44	369.05 ^c \pm 15.06	**
Overall Mean	406.75 ^a \pm 44.68	429.89 ^a \pm 43.04	446.43 ^a \pm 43.64	466.93 ^a \pm 45.33	276.45 ^b \pm 25.78	*

^{a b c} Means bearing different superscripts in a row differ significantly from each other (** $P < 0.01$; * $P < 0.05$)

Weekly FCR (mean \pm S.E.) of pigs during growing and finishing stage is presented in Table 6. The overall FCR during growing stage was 2.70 ± 0.06 , 2.55 ± 0.04 , 0.56 ± 0.02 , 0.574 ± 0.02 and 4.61 ± 0.11 in group I, II, III, IV and V respectively. From table it can be concluded that during growing stage supplementation of JFC along with concentrate decreased the FCR, whereas sole feeding of JFC greatly increased it. However, FCR was not much different between different treatment groups during entire experiment except 3rd week, where there was a significantly ($P < 0.01$) decrease in FCR in group II and group IV from group I. Decreased FCR in JFC supplemented group indicates good utilization of nutrients. Suresh *et al.* (2012) conducted a trial, where SPR was evaluated at 1, 2 and 3% of concentrate mixtures which were offered to meet 50% dry matter requirement of lambs, demonstrated that the feed conversion ratio was uniform among different treatment groups including that of the control (0% SPR) group. Moreover, in group V, the FCR was found to be significantly ($P < 0.01$) highest with respect to all other treatments groups, which revealed

relatively poor nutrients in the ration. Inclusion of JFC affects the FCR, is well supported by Budeppa *et al.* (2008) in poultry.

Table 6: Average weekly FCR of grower and finisher pigs fed ration containing jaggery filter cake

Week	I	II	III	IV	V	Significance
1 st	2.87 ^a ± 0.18	2.56 ^a ± 0.08	2.56 ^a ± 0.15	2.57 ^a ± 0.08	4.70 ^b ± 0.06	**
2 nd	2.90 ^a ± 0.37	2.87 ^a ± 0.29	2.64 ^a ± 0.31	2.60 ^a ± 0.32	4.53 ^b ± 0.14	**
3 rd	2.91 ^a ± 0.14	2.49 ^b ± 0.16	2.57 ^{ab} ± 0.11	2.45 ^b ± 0.205	4.74 ^c ± 0.04	**
4 th	2.74 ^a ± 0.22	2.48 ^a ± 0.07	2.45 ^a ± 0.21	2.59 ^a ± 0.12	4.673 ^b ± 0.26	**
5 th	2.62 ^a ± 0.14	2.51 ^a ± 0.09	2.67 ^a ± 0.21	2.59 ^a ± 0.07	4.75 ^b ± 0.19	**
6 th	2.67 ^a ± 0.21	2.59 ^a ± 0.13	2.55 ^a ± 0.21	2.55 ^a ± 0.15	5.00 ^b ± 0.13	**
7 th	2.47 ^a ± 0.22	2.40 ^a ± 0.06	2.49 ^a ± 0.20	2.66 ^a ± 0.08	3.81 ^b ± 0.27	**
8 th	2.65 ^a ± 0.22	2.53 ^a ± 0.07	2.59 ^a ± 0.17	2.59 ^a ± 0.08	4.48 ^b ± 0.10	**
9 th	2.48 ^a ± 0.05	2.53 ^a ± 0.08	2.51 ^a ± 0.11	2.58 ^a ± 0.08	4.83 ^b ± 0.16	**
Overall Mean	2.70^a± 0.06	2.55^a± 0.04	2.56^a± 0.02	2.57^a± 0.02	4.61^b± 0.11	**

^{a, b, c}Means bearing different superscripts in a row differ significantly from each other (**P<0.01;)

Conclusion

Jaggery filter cake can be an ideal unconventional feed without any deleterious effects in sugarcane producing belts. It can be concluded that jaggery filter cake can be fed to weaners at the rate of 500 g and increment of 100g in the subsequent fortnights for optimal growth rates.

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