Effect of home-made cooked feed vs. balanced feed on growth performance and benefit-cost ratio of Ghungroo and Large White Yorkshire piglets reared under intensive system in Sundarban area of West Bengal, India

ABSTRACT

Aims: The present study was carried out to analyze the growth performance and benefit-cost ratio (BCR) of Ghungroo and Large White Yorkshire (LWY) piglets reared under intensive housing by providing home-made cooked feeds and balanced feed.

Place and Duration of Study: The study was conducted for a period of four months in Sundarban area of West Bengal, India.

Methodology: A total of 12 (six males and six females) piglets of each grower weaned Ghungroo and LWY piglets were randomly selected. For control group, commercially available grower pig ration were offered and for treatment group, locally available cooked feed were offered. The body weight (kg) measurements of both the groups were taken every month from 2 to 6 months of age. Benefit-cost ratio (BCR) was calculated.

Results: The body weights obtained in groups fed with locally available cooked feeds and that of balanced ration are significantly different (P<0.05) to each other. The body weight of both Ghungroo and Large White Yorkshire (LWY) piglets in treatment group was significantly (P<0.05) less than that of the control group from 3 to 6 months of age. LWY piglets had significantly (P<0.05) higher body weight than Ghungroo piglets in both control and treatment groups. The BCR of LWY pigs was more when compared to that of Ghungroo pigs in both control and treatment groups. It was also observed that BCR for both Ghungroo and LWY piglets was more in control groups in comparison with treatment groups.

Conclusion: Thus, it can be concluded that attainment of feasible body weight was not possible by only feeding locally available cooked feeds to Ghungroo and LWY piglets and so, piglets should be offered balanced ration for a profitable pig farming.

Keywords: Growth, Benefit-cost ratio, cooked feed, Ghungroo, Large White Yorkshire, Intensive rearing

1. INTRODUCTION

Pig bears substantial ability to provide a quick remunerative yield to the farmers in comparison to other livestock species, since it carries definite innate attributes namely high fecundity, early maturity, better feed conversion efficiency and short generation interval. Rearing of pig requires minimum capital investment and labour. Pig converts grain, pasture and other feeds into pork and hence serves as a biological machine. Through consumption of by-products, surfeit and dumps emerging from production, processing and consumption of various types of human foods, pig plays a pivotal role acting as a scavenger [1]. The rearing of pigs is mainly done under backyard production systems in rural areas which require less input. Pigs possess better feed conversion ratio. Woefully, the expense on feeds attribute to 70% of the total expenses of pig rearing hence, non-economical at farmer's level. Therefore, through a precise feeding plan formulation involving low expense and nutritive feed resources, cost-effective and profitable pig rearing can be made possible [2]. About 1.7% of the total livestock is contributed by pigs but the total pig population in India has decreased by 12.03% from 10.29 Million during 2012 [3] to 9.06 Million during 2019 [4] and in West Bengal, it has declined by 16.63% over previous Livestock Census [3].

As pigs are effectual transformer of agricultural by-products and scraps into high grade meat or protein, precise formulation of low-cost rations as per locally available feed ingredients, coherent utilization of by-products of agriculture and scraps of food waste can provide the prime prospect of lessening the expenses of production to a large dimension [5]. Considering the gradual increase in expenses spent on concentrates, farmers are into agreements with restaurants, hostels and hotels to proffer scraps and refusals or kitchen waste for feeding the pigs. Incorporation of pig production with other agricultural venture is gaining popularity as it furnishes low-cost input for each of the activities [6]. One portion of several ingredients that is generally feed to the pigs by smallholders is forage, which involves by-products of agriculture from nearby food-processing units, naturally grown weeds in the jungles and nearby the river banks, aquatic plants and plants of previous crops on barren lands [7,8]. Several insights describe why small holders incorporate notable quantities of forage in the feed provided to their animals; their low wages in comparison with high cost of imported grains or oil-seed cakes [9,10]; the segregation and inaccessibility of their farms inflate the cost on protein and energy concentrate at the farm entrance [1]; and the shortage of reachable market [11]. This perpetuates mass small holdings in resource-efficient farming systems with midget space for mid- or long-term deposit as boost in the genetics and the systems of feeding would need. Furthermore, Considering feed with high nutritive value, little attempt is made to ameliorate the growth performances of animal when the pursuit is handled by socio-cultural motivations and is more directed on the way to self-consumption in comparison to that of market [7,12]. In addition, feeding of forage is often utilized in case of native breed of pigs, which are the choiceful breed of smallholding farmers in rural areas [11,13].

The pigs are reared in a traditional way generation to generations. Conventionally, the pigs are provided locally accessible rice bear waste, rice bran, local grass, herbs etc. This is solely a zero gain pig production system. Nevertheless, there is a paucity of knowledge on chemical composition of such kind of

feed ingredients and the consequence of the traditional feeding system on pig performances [14]. Majority of swine fed primarily on food scraps achieve utmost gains of almost one pound per day, but to attain this, pig should ingest food scraps and remnants i.e. waste in bulk quantities (as fed-basis) compared to that of consuming commercial swine feed [15]. Compared to the animals fed with imported or local compound feeds, the rate of growth witnessed in animals fed with local diet were slower to a certain extent. Nevertheless, this was reimbursed for the cheap cost of the local available feed which in accordance permitted the economical production of pig meat [16]. Formerly, it was noticed that a pig was fed with 1 kg of locally available plants in addition to rice and kitchen wastes in Mizoram once a day customarily [1].

Ghungroo has been recognized recently as breed at its native tract in Duars valley along with its surrounding of West Bengal state of India [17]. Ghungroo pigs have key traits such as rapid multiplication, increased growth rate, and feed conversion potential. Despite the dwindling populations of these indigenous pigs, the Ghungroo pig remains a vital component of local genetic resources. Ghungroo pigs are well suited to the low-input production strategy for livelihood and sustainable farming. The evaluation of both the productive and reproductive aspects of these pigs will be beneficial in the selection of breeding stock for future generations [18]. Under the traditional feeding regime, indigenous pigs have been reported to be more prevalent than exotic breeds. When exotic breeds like Large White Yorkshire, Landrace, Duroc etc. having high inputs and high genetic merit were introduced, local pigs were not given the attention and consideration they deserved [19].

There are several feed constituents that can be accessible for pigs. The cost on diet can be reduced through locally available feed ingredients along with increasing lucrative efficiency by lessening the strain on employing imported constituents [20,21]. The locally available feed ingredients which we ponder unusable can smoothly be utilized by the grower piglets. Feed ingredients which are locally available i.e. green plants can be utilized to ameliorate the nutritional stature of local pigs at cheap cost [22]. Cereal grains are frequently fed to the pigs as principle source of energy, and at definite phases of growth such that almost entirely 90% of their diet may constitute of cereals and cereal by-products [23]. Therefore, the necessity for incorporation of locally available feed ingredients is the need of the hour and this paper has the objective to check if locally available cooked feeds can provide better growth and benefit cost ratio than commercially available feeds in Ghungroo and Large White Yorkshire piglets.

2. MATERIALS AND METHODS

The present study was carried out at Pig Farm of Tagore Society for Rural Development, Sundarban, West Bengal, India, over a period of 4 months i.e., from November 2020 to February 2021. Sundarban is the largest delta, located between 21◦32′ and 22◦40′N latitude and 88◦30′N and 89◦00′E longitude. The Sundarbans' floor varies from 0.9 to 2.11 m (3.0 to 6.9 ft) above sea level.

2.1 Details of Experimental Animals

For the purpose of present investigation, a total of 24 number of pigs i.e., two batches of each 12 (n = 6 males and 6 females) grower weaned healthy Ghungroo piglets and 12 (n = 6 males and 6 females) grower weaned Large White Yorkshire (LWY) piglets were randomly selected. The selected animals were kept in intensive housing. Managements related to feeding, watering and housing for all 2 different grower weaned breeds were followed as per the routine guidelines of the farm. Six (n = 3 males and 3 females) grower piglets each of Ghungroo and LWY breeds were included under control group and another six (n = 3 males and 3 females) grower piglets each of Ghungroo and LWY breeds were included under treatment group. For control group, commercially available grower pig ration was offered and for treatment group, locally available cooked feed was offered (Table 1).

Table 1. Quantity of feeds offered to the growing piglets

Particulars / Age (in months)	Control (C) Balanced Ration (kg/day/pig)		Treatment (T) Cooked-feed (kg/day/pig)	
	Ghungroo	Large White Yorkshire	Ghungroo	Large White Yorkshire
2-3	1.00	1.25	1.50	1.75
3-4	1.25	1.50	1.75	2.00
4-5	1.50	2.00	2.00	2.25
5-6	2.00	2.50	2.50	2.75

2.2 Feeding of Experimental Animals

2.2.1 Time and types of feedings offered to different groups of piglets

During the feeding trial period, balanced feeds and cooked feeds were offered twice in a day, at morning (6.30 - 7.00 am) and at afternoon (4.30 - 5.00 pm) to respective groups. About 60% of the feed was offered to the groups in the morning and another 40% in the afternoon. Feed ingredients collected from the local places (Table 2) were mixed, boiled and cooked before offering to the piglets.

Table 2. Composition of home-made cooked feed for grower piglets

Ingredients	Quantity (Kg)	Percentage (%)

Rice	2.0	20
Taro Root	2.0	20
Wheat flour	0.45	4.5
De Oiled Rice Bran (DORB)	3.5	35
Molasses	1.0	10
Til Cake	1.0	10
Salt	0.05	0.5

2.2.2 Proximate analysis of ingredients of cooked feeds for piglets

The cooked feed samples (n = 3) were analyzed for moisture, crude protein (CP), crude fiber (CF), ether extract (EE), and total ash (TA) and nitrogen free extract (NFE) according to AOAC (2011) [24] in Animal Nutrition Laboratory, West Bengal University of Animal and Fishery Sciences, Kolkata -700037, West Bengal, India.

2.3 Measurement of growth traits

Body weight of each pig was recorded every month from 2 to 6 months at the morning before providing feed and water. Average body weight of total pigs in each group (n = 3 males and 3 females) was calculated. Average body weight of pigs of each breed (n = 12) irrespective of the offered feed treatment was also estimated to observe if there is any significant change breed wise.

2.4 Profitability

Benefit Cost Ratio analysis was done to calculate the profitability of feeding home-made cooked feed to pigs reared under intensive system at Sundarban area of West Bengal. The viability of the pig farming business can be understood from the benefit-cost ratio analysis [25].

2.5 Statistical analysis

The data were analyzed for descriptive statistics, one way ANOVA using multivariate general linear model. SPSS (21 version) was used for data analysis [26].

3. RESULTS AND DISCUSSION

3.1 Proximate analysis of feeds offered to piglets

Table 3 represents the proximate analysis of ingredients of cooked feeds and balanced ration offered to piglets during the experimental period. The crude protein (CP) percentage was highest for Til-cake (27.64%) compared to the least value of 1.53% for Taro Root. CP content in ghani / til cake used by Yasothai ranged from 35-39.10% which was lower than solvent extraction cake (41–45%) and expeller cake (39.10–47.10%) [27] but higher than til-cake used in the present study. The protein % of cooked taro used by Lucio et al. was 2.10% [28]. Crude fiber content was highest for DORB (18.17%) while the lowest value of 1.06% was recorded for rice as white rice is a rich and digestible carbohydrate with low fiber contents and high digestible nutrients than corn [29]. Acid detergent fiber (%) of white rice was 1.85% and brown rice was 1.31% as reported by Kim et al. [30]. Digestibility of rice was increased compared with that of other grains when rice was heat-treated (gelatinous form) before feeding to pigs [31-33]. Previous studies have shown that partial or complete replacement of corn with brown rice in pig diets didn't have any adverse impact on growth performance and nutrient digestibility [34-36]. The ether extract (EE) was highest for til-cake (4.16%) and lowest for taro root (0.21%) which was similar to the lipid % of cooked taro (0.18%) used by Lucio et al. [28]. Total ash content was highest for til-cake (8.16%) and lowest for rice (0.91%) while the results for nitrogen free extract (NFE) revealed that taro root recorded the least, with value of 24.84% and rice recording the highest (89.74%). Kumaresan et al. observed that on an average a pig can be fed with 1 kg of local plants per day along with rice and kitchen wastes in Mizoram [1]. The average CP content of locally available cooked feed was only 9.63%, which was less than the recommended level @ 12-18% [14]. Concentrate pig mash feed used in the study was 15.41% which was similar to the basic diet containing commercially available concentrate pig feed mash with 17.83% CP, which was used by Halder et al. [14].

Table 3. Proximate analysis (on % DM) of ingredients of cooked feed and balanced feed (Mean±SD) offered to piglets

Ingredients	Crude Protein (%)	Crude Fiber (%)	Ether Extract (%)	Total Ash (%)	Moisture (%)	Nitrogen Free Extract (%)
Cooked Feed						
Rice	7.16±0.41	1.06±0.23	1.13±0.11	0.91±0.17	8.91±1.01	89.74±2.32
Wheat flour	8.00±0.38	6.54±0.16	2.23±0.27	2.12±0.23	9.67±0.51	81.11±1.08
De Oiled Rice Bran (DORB)	13.62±0.26	18.17±0.21	0.83±0.07	4.13±0.52	9.12±0.35	63.25±1.41

Taro Root	1.53±0.17	4.17±0.35	0.21±0.31	1.88±0.21	67.37±0.27	24.84±1.37
Til-cake	27.64±0.31	16.48±1.21	4.16±0.25	8.16±0.18	9.91±0.39	33.65±0.48
Whole cooked feed	9.63±0.52	9.35±0.34	1.07±0.19	2.91±0.46	19.87±0.22	52.07±1.57
Balanced Feed						
Concentrate Mash feed	15.41±0.37	10.68±0.28	3.12±0.67	5.17±0.25	11.32±0.37	65.62±1.47

3.2 Body weight of grower piglets

Table 4 shows the respective body weights of both control and treatment groups of both weaned grower Ghungroo and Large White Yorkshire (LWY) piglets from 2 to 6 months of age. It was revealed that from 3 to 6 months of age, the body weight (in kg) of both Ghungroo and Large White Yorkshire (LWY) piglets in treatment group (feeding of cooked feeds) was significantly (P<0.05) less than that of the control group (feeding of balanced ration). This can be due to the varying nutrient composition of the control and experimental pig diets [37]. Fast growing breeds like LWY, Landrace, Duroc require more protein in their diet than the breeds that do not grow as fast such as Berkshire, Hampshire [38,39] but in the study the experimental cooked feed had less CP% than the control feed and this could have led to lesser body weight of LWY pigs in treatment group than that of control group. The group of pigs fed with locally available cooked feed also didn't receive any kind of vitamin and mineral supplement during the experimental period, which might be the reason of their lower body weight than pigs fed with balanced ration which contain adequate amount of nutrients for optimal growth. Vitamins and minerals account for a minor portion of the nourishment, but they are essential for animal health, well-being, and efficiency; each serves a well-established function in metabolism, and their requirements vary depending on the physiological state of the animal [40]. In the meantime, the deficiency of certain vitamins and minerals in the diet of animals could impede muscle and bone development [41]. Most commercially available feeds contain vitamins and trace elements that meet the nutritional requirements set by National Research Council [42] and animal feeding standards [43].

It was also observed that LWY piglets had significantly (P<0.05) higher body weight than Ghungroo piglets in both control and treatment groups and also when average of both the groups was taken into consideration. Similar result was observed by Kumaresan et al. that when kitchen waste (1.53 kg), locally available grasses (1 kg) and concentrate (200 g) were offered per pig per day, Hampshire and LWY pigs had significantly (P<0.05) higher body weight than Mizo local pigs and there was no significant difference in the body weight between male and female pigs [44]. According to a study by Saikia et al., the overall weekly body weight of Ghungroo pigs at the end of 8th week (5.93±2.67 kg) for both the sexes was

comparatively less than that of current finding at the end of 2 months (7.69±0.39 kg) [45]. Patra et al. reported that the postnatal growth rate of Ghungroo and Large Black piglet was similar at first and last fortnight of pre-weaning period whereas, during 2nd fortnight (15-30 day), the average daily weight gain was significantly (P<0.05) higher in Large Black (201.93 g) than Ghungroo (146.22 g) [46]. The birth weight of piglet is an essential trait for survival and postnatal growth and get influenced by several factors such as genotype, follicular development, parity and placental size [47]. Reduction in growth rate and performance of pigs due to unconventional feeding has also been reported by Sharda et al. [48] and Kennedy and Aherne [49]. Halder et al. reported that there was significant (P<0.05) difference in BW of male Ghungroo and male LWY pigs at 2 months and females of both the breeds at 6 months of age [14].

Table 4. Mean±SD of Body Weights (in kg) of pigs from 2 to 6 months

Age (in months)	Type	Body weight of Ghungroo piglets (kg)	Body weight of Large White Yorkshire piglets (kg)
2	Control	7.55^{y}±0.41	10.43^{x}±0.72
	Treatment	7.83^{y}±0.33	10.55^{x}±0.51
	Average	7.69^{y}±0.39	10.49^{x}±0.60
3	Control	15.22^{ay}±0.48	17.73^{ax}±0.71
	Treatment	11.52^{by}±0.81	13.82^{bx}±0.68
	Average	13.37^{y}±2.03	15.77^{x}±2.15
4	Control	35.60^{ay}±0.71	38.50^{ax}±0.88
	Treatment	27.22^{by}±1.20	29.27^{bx}±1.14
	Average	31.41^{y}±4.48	33.88^{x}±4.92
5	Control	45.65^{ay}±1.01	49.20^{ax}±1.19
	Treatment	37.20^{by}±1.09	39.72^{b}±1.66
	Average	41.42^{y}±4.52	44.46^{x}±5.14

6	**Control**	61.55^{ay}±0.73	67.15^{ax}±1.04
	Treatment	49.18^{by}±1.16	52.05^{bx}±1.23
	Average	55.37^{y}±6.52	59.60^{x}±7.96

Means with different superscript ($^{a, b}$ in a column and $^{x, y}$ in a row) differ significantly (P<0.05)

3.3 Benefit Cost Ratio

Table 5 shows the amount of feed and cost involved in different groups of growing piglets. The Benefit-Cost Ratio (BCR) (Table 6) was more in case of Large White Yorkshire (LWY) piglets compared to Ghungroo piglets in both control and treatment groups. It was also observed that BCR for both Ghungroo and LWY piglets was more in control groups in comparison with treatment groups. Hence, the benefit/profit obtained was less in the treatment group in contrast with the control group. Das et al. found that the net income of the farmers of Terai region of West Bengal, India was more in case of LWY pig farming (Rs. 63,000-75,000) than Ghungroo pig farming (Rs. 40,000 - 43,000) and the BCR was more in case of LWY farming (3.73 - 3.92) than Ghungroo pig farming (3.15 - 3.22) [50]. Raja et al. reported that the overall BCR of pigs from North-eastern zone of Tamil Nadu, India was 1.46, which was profitable for swine farming [25]. Hence, it would be economical to feed concentrate mash pig feed to pigs than home-made cooked feed from locally available ingredients. However, rearing LWY pigs on concentrate mash pig feed would be more profitable for swine farmers than rearing Ghungroo pigs.

Table 5. Amount of feed and cost involved in different groups of growing piglets

Particulars	**Amount of feed required (kg)**				**Total amount of feed consumed per piglet (Kg)**	**Cost (Rs.) of feed/ kg**	**Total expenditure of feed per piglet (Rs.)**
Age (in months) / Piglets	**2-3**	**3-4**	**4-5**	**5-6**			
Control							
Large White Yorkshire Male	1.25	1.50	2.00	2.50	216	35	7560
Large White Yorkshire Female	1.25	1.50	2.00	2.50	216	35	7560

Ghungroo Male	1.00	1.25	1.5	2	171.25	35	5994
Ghungroo Female	1.00	1.25	1.5	2	171.25	35	5994
Treatment							
Large White Yorkshire Male	1.75	2.00	2.25	2.75	261.25	20	5225
Large White Yorkshire Female	1.75	2.00	2.25	2.75	261.25	20	5225
Ghungroo Male	1.50	1.75	2.00	2.50	231.25	20	4625
Ghungroo Female	1.50	1.75	2.00	2.50	231.25	20	4625

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217 **Table 6. Calculation of Expenditure, Income and Benefit-Cost Ratio (BCR) for grower piglets**

Expenditure (Rs.)	**Control**		**Treatment**	
	Ghungroo (n=6)	**Large White Yorkshire (n=6)**	**Ghungroo (n=6)**	**Large White Yorkshire (n=6)**
Cost of 2 month old piglet (Rs.1500/Ghungroo and Rs. 2500/LWY)	9000	15000	9000	15000
Cost of feed (Rs. 35/kg balanced ration and Rs. 20/kg of total ingredients of cooked feed)	5994	7560	4625	5225
Medicines and Vaccines (Rs.15/pig/month)	360	360	360	360
Electricity cost (Rs.300/month)	300	300	300	300
Manpower (Rs. 6000 x 2	12000	12000	12000	12000

nos. x 4 months)				
Miscellaneous cost (Rs. 400)	400	400	400	400
Total expenditure (Rs.)	28054	35620	26685	33285
Income				
Selling of pigs (Rs. 150/kg for Ghungroo & Rs.200/kg for LWY)	55395	80580	44262	62406
Selling cost of manure (Rs.1/kg)	1800	1800	1800	1800
Selling of gunny bags(Rs.10/bag)	410	520	_	_
Total income (Rs.)	57605	82900	46062	64206
Net Profit (Rs.)	29551	47280	19377	30921
Benefit-Cost Ratio*	2.05	2.33	1.73	1.93

**Benefit-Cost Ratio (BCR) = Gross Income/Total Cost*

4. CONCLUSION

Since the body weights obtained in the group of piglets fed with locally available cooked feed was significantly less as compared to that of the groups fed with balanced ration, it can be concluded that the attainment of feasible body weight of pigs was not possible by only feeding locally available home-made cooked feeds. The benefit-cost ratio was also less in the group of piglets fed with cooked feeds compared to the groups fed with balanced concentrate pig mash feed. Hence, for a profitable pig farming, feeding of piglets using balanced ration should be recommended.

Ethical Approval

Animal Ethic committee approval has been collected and preserved by the author(s)

COMPETING INTERESTS

Authors have declared that no competing interest exists.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all the authors. Amit Roy and Santanu Bera designed the study and wrote the protocol. Amit Roy and Sudhanya Nath wrote the first draft of the manuscript. Sudhanya Nath and Manik Pakhira managed the analyses of the study and literature searches. Uttam Sarkar performed the statistical analysis. All the authors have read and approved the final manuscript.

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