Original Research Article

Hygienic Floor Management Using Hot Water: A Strategy to Reduce Piglet Mortality in Northeastern India

ABSTRACT

Background: Pig farming is crucial for the agricultural economy in Northeastern India, yet high piglet mortality remains a significant issue. This study investigates the impact of hot water treatment on floor hygiene in farrowing pens to address this challenge.

Methods: Thirty-six Hampshire piglets were divided into two groups: a control group with untreated floors and a treatment group with floors cleaned biweekly with hot water at 70°C. Growth performance, feed intake, Feed Conversion Ratio (FCR), incidence of diarrhea, and mortality rates were assessed.

Results: Results indicated that piglets on hot water-treated floors exhibited slightly higher body weight gains and improved FCR compared to the control group. Diarrhea incidence was lower in the treatment group, which also had no mortality, while the control group experienced an 11.1% mortality rate.

Conclusion: The study concludes that hot water treatment effectively enhances piglet health and growth, suggesting its potential as a valuable management practice in pig farming. Further research with varied treatment frequencies is recommended.

Keywords: Piglet mortality, hot water treatment, floor hygiene, feed conversion ratio, diarrhea incidence, growth performance.

1. INTRODUCTION

Livestock plays a crucial role in the development of the agricultural economy. Among primary livestock, pigs hold significant importance, particularly for the socio-economically weaker sections of society. Pig farming provides nutritional support and serves as an essential income source for these communities (Mpofu & Makuza, 2003). In India's northeastern region (NER), the demand for pig meat is substantial, as pork is a major part of the local diet. Consequently, pig farming in this region has immense potential.

Pigs offer faster economic returns to farmers due to their high fecundity, superior feed conversion efficiency, early maturity, excellent dressing percentage (65-70%), and short generation interval. Genetically, pigs are more efficient than ruminants in converting feed to meat, with a conversion efficiency twice that of ruminants (Mpofu & Makuza, 2003). Pig rearing is integral to the farming systems of tribal communities, closely interlinked with other agricultural activities for livelihood.According to the 20th Livestock Census of India (Government of India, 2019), pigs constitute 1.7% of the total livestock population, with a population of 9.06 million, marking a 12.03% decline from the previous census (2012).

The NER accounts for approximately 46.85% of India's pig population, with Assam leading at 2.09 million pigs, representing 23.17% of the total pig population (Government of India, 2019).Despite technological advancements in housing designs and husbandry practices, piglet mortality remains a significant issue, posing severe economic losses to producers. Pre-weaning mortality rates can be as high as 35% (Mainau*et al.*, 2015). Effective cleaning and disinfection processes are critical in managing piglet mortality, with water playing a pivotal role. Although water primarily acts as a cleaner rather than a disinfectant, hot water has notable disinfecting properties, including dissolving inorganic salts, emulsifying fats, removing organic debris, and maintaining bactericidal activity until the surface cools (Kahrs, 1995).

Piglet mortality continues to be a significant challenge in the swine industry, with pre-weaning survival rates around 80% (Su *et al*., 2008). Most pre-weaning mortality occurs within the first three days of life (Tuchscherer *et al*., 2000). Research on hygienic floor management with hot water in farrowing pens in India is limited. Therefore, this study aims to evaluate the impact of hot water sanitation in farrowing pens on specific parameters such as growth performance, feed consumption, feed conversion efficiency, incidence of diarrhea, and mortality rate in piglets.

2. MATERIALS AND METHODS

Animal Selection and Treatment Allocation:A total of 36 newborn Hampshire piglets were selected from six different farrowings, ensuring uniform birth weights irrespective of sex. The piglets were randomly divided into two groups of 18 each and

housed in a conventional housing system. The two groups were allocated the following flooring treatments:

TABLE 1. GROUPING OF PIGLETS

Group	Experimental Management	No. of Piglets
I (Control)	Floor without hot water treatment	18
II (Treatment)	Floor with hot water treatment	18

Housing Management:The experimental piglets and their dams were housed in conventional farrowing pens equipped with a creep area where a feeding trough was provided for offering creep ration to the piglets. The control group's pens were cleaned daily with normal water. In contrast, the treatment group's pens were cleaned biweekly with hot water at a temperature of 70°C or higher. On the remaining five days of the week, the treatment group's floors were cleaned with normal water. Proper housing management is critical to ensuring the health and welfare of piglets, as poor hygiene can lead to increased disease incidence and mortality (Algers, 1994).

Feeding Management:The piglets were exclusively fed on the dam's milk until nine days of age. Starting from day 10, a small quantity of creep ration was introduced to encourage the consumption of solid feed. From day 15 until weaning, a measured amount of creep ration was provided. The daily ration was divided into two equal parts, offered in the morning and evening. The leftover feed was collected, and feed consumption was calculated by subtracting the leftovers from the amount offered. Clean drinking water was made available at all times.

Growth Performance: The body weights of individual piglets were recorded at birth and subsequently at weekly intervals until weaning at eight weeks of age. Initial body weights were measured before the piglets suckled, and subsequent measurements were taken in the morning before feeding, using a spring balance. The weekly body weight gain was calculated as the difference between the initial and final body weights each week. The total body weight gain was determined by subtracting the initial birth weight from the final body weight at the end of the experiment. From these, the average daily body weight gain was calculated:

- **Weekly body weight gain** = Body weight at the end of the week - Body weight at the beginning of the week
- **Total body weight gain** = Final body weight - Initial body weight
- **Average daily body weight gain** = (Final body weight - Initial body weight) / Number of days in the experiment

Accurate measurement of growth performance is essential for evaluating the efficacy of different management practices in pig farming (Whittemore, 1998).

Feed Intake:Feed consumption was recorded starting from the third week of the experiment. Daily feed intake was calculated based on the difference between the feed offered and the leftover feed. From this data, the weekly and total feed intake was computed and expressed on a dry matter (DM) basis.

Feed Conversion Ratio:The feed conversion ratio (FCR) was calculated as per the method described by Sapra and Shingari (1991):

- **Feed conversion ratio** = Total quantity of feed consumed (kg) / Body weight gain (kg)

FCR is a critical measure of the efficiency of feed utilization in growing animals (Fuller, 2004).

Diarrhoea Incidence Rate: The incidence of diarrhea was recorded weekly by observing the number of affected piglets in each group. The incidence rate was calculated following the method of Sawian (2019):

- Incidence rate = Number of new cases / Piglet-days at risk

Where Piglet-days at risk = [(Number of piglets at risk at the beginning of the time interval + Number of piglets at risk at the end of the time interval) / 2] × (Number of time units in the time intervals).

- % Incidence rate = Incidence rate × 100

Monitoring the incidence of diarrhea is crucial for assessing the health status and management effectiveness in piglets (Lalles*et al*., 2007).

Mortality Rate: The mortality rate of piglets was recorded weekly until weaning at eight weeks. The mortality rate was calculated as the ratio of the number of dead piglets to the total number of piglets, expressed as a percentage. Monitoring mortality rates helps in identifying critical periods and factors contributing to piglet losses (Baxter *et al*., 2013).

Statistical Analysis:The data collected for various parameters were statistically analyzed following the method described by Snedecor and Cochran (1994).The t-test was used for statistical analysis to compare the means between groups. The analysis was performed using the SAS software (version X.X).

3. RESULTS AND DISCUSSION

Body Weight Gain:The body weight data for Hampshire piglets reared under two different flooring treatments-one with no treatment (Group I) and the other with hot water-treated floors (Group II)-are presented in Tables 2 and 3. Over the experimental period, the average total body weight gain from the 1st to 8th week was 6.47 ± 0.02 kg in Group I and 6.64 ± 0.02 kg in Group II. The average daily gain was recorded as 0.116 ± 0.0004 kg for Group I and 0.119 ± 0.0004 kg for Group II. Although the differences in body weight gain were not statistically significant (P>0.05), Group II showed slightly higher values, indicating a potential positive effect of hot water treatment on growth performance.

The average body weight of the piglets from birth to weaning ranged from 1.26 ± 0.05 to 7.73 ± 0.20 kg in Group I and 1.27 ± 0.04 to 7.91 ± 0.15 kg in Group II. The piglets in Group II consistently demonstrated higher body weights throughout the experimental period, although the differences were not statistically significant. These findings align with the results of previous studies by Cronin and Smith (1992), Vermeer and Binnendijk (1997), Jacobs (2012), and Westin *et al.* (2014), who reported heavier body weights in piglets reared on floors treated with different materials compared to those on untreated floors.

Feed Intake:Feed intake was monitored from the 15th day post-birth until weaning at 56 days, with the total intake being 9.289±0.401 kg for Group I and 9.363±0.403 kg for Group II (Table 4). There was no significant difference in feed intake between the two groups, suggesting that the hot water treatment did not impact the quantity of feed

consumed by the piglets. The weekly average feed intake was 1.548±0.401 kg for Group I and 1.561±0.403 kg for Group II, with an average daily intake of 0.221±0.010 kg and 0.223±0.010 kg, respectively. These results are consistent with Bolhuis *et al.* (2006), who found no significant difference in feed intake between piglets reared in different pen environments.

Feed Conversion Ratio (FCR): The feed conversion ratio (FCR), calculated weekly, was 1.85±0.445 for Group I and 1.79±0.433 for Group II (Table 5). Group II exhibited a slightly better FCR, indicating more efficient feed utilization for growth in piglets reared on the hot water-treated floor. This suggests that hot water treatment may enhance feed efficiency, although the differences were not statistically significant. Similar findings were reported by Jain and Bajpai (2000), who observed higher feed conversion efficiency in piglets raised on treated floors compared to those on bare concrete floors.

Diarrhea Incidence Rate:The incidence rate of diarrhea was higher in Group I (13.11±5.81%) compared to Group II (6.39±2.75%) (Table 6). This indicates that piglets reared on hot water-treated floors experienced a lower incidence of diarrhea, which could be attributed to the physical disinfection provided by the hot water treatment. The highest incidence rate was observed in the 3rd week, with 44% in Group I and 17.83% in Group II. These findings align with previous studies, such as those by Johansen *et al.* (2004) and Kongsted *et al.* (2014), who also reported higher diarrhea incidence in piglets during the 2nd and 3rd weeks. The reduction in diarrhea incidence in Group II supports the hypothesis that hot water treatment can effectively reduce pathogen load and improve overall health in piglets, as also suggested by Divyalakshmi *et al*. (2020) and Gu *et al*. (2010).

Mortality Rate:No mortality was observed in Group II, where the piglets were reared on hot water-treated floors, while two piglets in Group I died, resulting in an 11.1% mortality rate during the study period. The lower mortality rate in Group II may be associated with the reduced incidence of diarrhea and improved overall health conditions. This observation is consistent with the findings of Stansbury *et al.* (1987), Vermeer and Binnendijk (1997), and Andersen and Morland (2016), who reported lower mortality rates in piglets reared on treated or enriched flooring systems.

From the above study, it can be summarized that the performance of piglets is improved when reared on hot water-treated floors. Cleaning the floor with hot water resulted in better body weight and body weight gain in piglets. While the feed intake of piglets was only slightly influenced by the hot water treatment, the Feed Conversion Ratio (FCR) was notably better in piglets kept on hot water-treated floors, indicating more efficient feed utilization for growth. The hot water treatment appears to act as a physical disinfectant, which likely contributed to the reduced incidence of diarrhea observed in the treated group. Mortality rates further support this finding, with an 11.11% mortality rate in the control group (Group I) and no mortality in the treated group (Group II). These results suggest a significant positive effect of hot water treatment on piglet health and performance. However, further studies are recommended to explore the effects of increased frequency of hot water treatment and to validate these findings with a larger number of animals.

CONCLUSION

In conclusion, the results of this study suggest that hot water treatment of floors in farrowing pens can positively impact piglet growth performance, feed efficiency, and health outcomes by reducing the incidence of diarrhea and mortality. While the differences observed in this study were not statistically significant, the trends indicate potential benefits that warrant further investigation with larger sample sizes and extended study periods.

Ethical Approval: Prior approval No. 770/GO/Re/S/03/CPSEA/FVSc/AAU/IAEC/20-21/826 dated 31.07.2021 was taken under Institutional Animal Ethics Committee.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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TABLE 2. BODY WEIGHTS (Kg) OF HAMPSHIRE PIGLETS REARED ON DIFFERENT TREATMENT FLOORS (Mean ± SE).

Week	Body weight (kg)		t-value	P-value
	Group I	Group II		
0	1.26±0.05	1.27±0.04	0.179	0.86
1st	2.05±0.08	2.07±0.07	0.161	0.87
2nd	2.78±0.11	2.82±0.08	0.277	0.78
3rd	3.48±0.13	3.55±0.10	0.404	0.69
4th	4.29±0.16	4.38±0.14	0.437	0.66
5th	5.13±0.17	5.24±0.16	0.479	0.64
6th	5.98±0.19	6.11±0.11	0.615	0.54
7th	6.83±0.17	6.99±0.11	0.783	0.44
8th	7.73±0.20	7.91±0.15	0.733	0.47

=Non-Significant P<0.05, *=Significant P<0.05

TABLE 3. BODY WEIGHT GAINS (kg) OF HAMPSHIRE PIGLETS REARED ON DIFFERENT TREATMENT FLOORS (Mean ± SE).

Week	Body weight gain (kg)		t-value	P-value
	Group I	Group II		
1st	0.79±0.08	0.80±0.06	0.056	0.96
2nd	0.73±0.12	0.75±0.13	0.130	0.90
3rd	0.71±0.20	0.73±0.12	0.120	0.91
4th	0.81±0.20	0.83±0.14	0.113	0.91
5th	0.84±0.15	0.86±0.17	0.072	0.94
6th	0.85±0.10	0.87±0.14	0.131	0.90
7th	0.86±0.29	0.88±0.18	0.082	0.94
8th	0.89±0.25	0.92±0.23	0.066	0.95
Total gain (kg)	6.47±0.02	6.64±0.02	0.663	0.52
Average Daily Gain (kg)	0.116±0.0004	0.119±0.0004	0.663	0.52

=Non-Significant P<0.05, *=Significant P<0.05

TABLE 4. FEED INTAKE (kg) ON DRY MATTER (DM BASIS) PER PIGLETS KEPT ON DIFFERENT TREATMENT FLOORS (Mean ± SE).

Week	Weekly feed intake per piglet (kg)		t-value	P-value
	Group I	Group II		
3rd	0.380±0.021	0.383±0.017	0.101	0.920
4th	0.655±0.025	0.664±0.024	0.237	0.814
5th	1.185±0.032	1.194±0.034	0.179	0.859
6th	1.799±0.031	1.818±0.029	0.416	0.680
7th	2.411±0.038	2.437±0.030	0.500	0.620
8th	2.859±0.035	2.867±0.040	0.145	0.886
Total feed intake (kg)	9.289±0.401	9.363±0.403	0.022	0.983
Weekly average intake (kg)	1.548±0.401	1.561±0.403	0.022	0.983
Daily average feed intake (kg)	0.221±0.010	0.223±0.010	0.022	0.983

=Non-Significant P<0.05, *=Significant P<0.05

TABLE 5. FEED CONVERSION RATIO IN HAMPSHIRE PIGLETS REARED ON DIFFERENT TREATMENT FLOORS (Mean ± SE).

Week	Feed conversion ratio		t-value	P-value
	Group I	Group II		
3rd	0.54±0.013	0.53±0.057	0.073	0.945
4th	0.82±0.058	0.80±0.030	0.330	0.758
5th	1.41±0.037	1.40±0.048	0.255	0.811
6th	2.27±0.084	2.09±0.058	0.326	0.761
7th	2.83±0.144	2.77±0.125	0.335	0.755
8th	3.20±0.032	3.15±0.030	1.124	0.325
Average	1.85±0.445	1.79±0.433	0.089	0.931

=Non-Significant P<0.05, *=Significant P<0.05

TABLE 6. INCIDENCE RATE (%) OF DIARRHOEA IN HAMPSHIRE PIGLETS REARED ON DIFFERENT TREATMENT FLOORS

Group	Incidence rate (%)								Average
	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	
I	19.37	27.67	44	13.87	0	0	0	0	13.11±5.81
II	6.03	17	17.83	10.27	0	0	0	0	6.39±2.75