*International Journal of Bio-resource and Stress Management* https://ojs.pphouse.org/index.php/IJBSM

Crossref

*IJBSM October* 2025, 16(10): 01-07 **Article** AR6275

**Research Article** *Natural Resource Management*

DOI: HTTPS://DOI.ORG/10.23910/1.2025.6275

# Traditional Feeding Practices with Brewer's Cake (*Xaj pitha*) on Growth Performance of Crossbred Pigs

**A. Kalita[1], J. Saharia[1], R. J. Deka[1], J. R. Bora[1], A. Haque[1], K. Saikia[1], G. Saikia[2], S. D. Deka[1] and M. Talukdar[3]**

[1]Dept. of Livestock Production and Management, [2]Dept. of Animal Nutrition, [3]Dept. of Veterinary Anatomy, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam (781 022), India

Open Access

**Corresponding** rajsird09@gmail.com

0000-0002-0999-2857

## ABSTRACT

The present investigation was conducted for a period of 6 months from April, 2022 to September, 2022 under the Department of Livestock Production and Management, at institutional pig farm (30- Sow Teaching Unit), College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam, India to evaluate the effect of feed prepared by using *Xaj pitha* on crossbred Hampshire pigs. The experiment was conducted to study the impact of feeding indigenously fermented feed on growth performance of crossbred Hampshire pigs under farm condition. A total of 18 weaned Crossbred Hampshire pigs irrespective of sex with an average age of around 8 weeks were randomly selected for the study. Thereafter, the piglets were divided into three experimental treatment groups viz., Standard Conventional feed ($T_0$), Indigenously fermented feed by using traditional Brewer's Cake (*Xaj pitha*) ($T_1$) and boiled feed ($T_2$). Findings revealed a significant effect ($p$<0.01) on final body weight of pigs fed with indigenously fermented feed when compared to boiled feed and conventional feed. No significant difference was found in average final daily body weight gain, feed consumption and feed conversion efficiency of the crossbred Hampshire pigs in different experimental groups. The digestibility co-efficient of crude protein and ether extract were significantly higher ($p$<0.01) in group fed with fermented feed as compared to groups given boiled feed and conventional feed. From the present study it can be concluded that pigs fed with fermented feed by using traditional brewer's cake (*Xaj pitha*) had better results in comparison to pigs given conventional feed and boiled feed.

**KEYWORDS:** Brewer's cake, body weight, feed intake, digestibility, pigs

***Citation* (VANCOUVER):** Kalita et al., Traditional Feeding Practices with Brewer's Cake (*Xaj pitha*) on Growth Performance of Crossbred Pigs. *International Journal of Bio-resource and Stress Management,* 2025; 16(10), 01-07. HTTPS://DOI.ORG/10.23910/1.2025.6275.



***Data Availability Statement:*** Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

***Conflict of interests:*** The authors have declared that no conflict of interest exists.

RECEIVED on 07th April 2025 RECEIVED in revised form on 15th September 2025 ACCEPTED in final form on 02nd October 2025 PUBLISHED on 11th October 2025

## 1. INTRODUCTION

Livestock industry produces a variety of foods for human use, including meat, milk and eggs. Approximately 10.25 mt of meat are produced during 2023–24 in India (Anonymous, 2024). Among livestock options, piggery emerges as a potent force for uplifting the socio-economic status of resource-poor farmers. As per the 20th livestock census (Anonymous, 2019 the total pig population in India is 9.06 million, which is 1.26% of the total livestock population. Improving feed efficiency is essential for profitable pig production because feeding costs account for about two thirds of all production costs in the swine industry (Liao and Nyachoti, 2017). For thousands of years, fermented foods and beverages have played a vital role in human and animal diets. Several scientists have reported the beneficial effects of fermented medicinal plants on growth performance, immune system and meat quality of broilers and pigs (Kim et al., 2012; Jeong and Kim, 2015; Zhou et al., 2015). Feeding fermented feed to weaned pigs may improve nutrient digestibility and gut health and thereby reduce diarrhea incidence (Le et al., 2016). Fermented feed additives promoted growth at all stages. The improvement in pig growth performance with FF supplementation is attributed to enhanced feed efficiency, which results from improved nutritional value and nutrient availability rather than increased feed intake (Mukherjee et al., 2016; Zhang et al., 2018; Xu et al., 2020). Feeding of Fermented liquid feed (FLF) either with *Lactobacillus acidophilus* or *Enterococcus faecium* to grower-finisher pigs enhance growth performance and improve economic returns for pig farmers (Buragohain et al., 2022). The high cost of oil cakes and cereals prevents farmers from funding the expensive feeding programs. Therefore, in order to create an affordable feeding program for pigs and other livestock, animal nutritionists used to look for novel feed supplies, particularly unconventional feeds (Abd El-Hack et al., 2017a; 2017b). One such unconventional feed resource that farmers is brewer's rice byproduct; use to lower feed costs for swine (Barman et al., 2020), as well as other livestock such as Rabbit (Adeniji and Adewole, 2015), lamb (Radzik et al., 2018), broiler chicken (Abd El-Hack et al., 2019) and beef cattle (Stefanello et al., 2019). A brewer's rice product locally referred as 'Mewa' or 'Juguli', is sometimes used as feed for pigs in tribal and rural areas of North Eastern states of India (Barman et al., 2020). In Northeast India, particularly in the state of Assam, various tribes have a rich tradition of preparing fermented rice beers. These beers, known by different names like *Apong* (Mising tribe), *Xaj-Pani* (Ahom tribe), *Sujenfero* (Deori tribe), and *Jou-Bishi* (Boro tribe), are not just beverages but hold cultural and religious significance. Amongst these *Xaj-pani* or *Xaj* is intricately associated with the social and religious belief system of the *Ahoms* or *Tai-Ahoms*, an ethnic community of Assam (Saikia et al., 2007). The traditional fermentation process of *Xaj* involves mixing of parboiling rice with the ethnic starter culture called *Xaj pitha.* The starter culture *(Xaj pitha)* contains a diverse community of microorganisms viz. starch degrading moulds (fungi), alcohol-producing yeasts and lactic acid bacteria maintained on substrates like rice powder supplemented with various herbs specifically adapted to control and safe fermentation of rice (Keot et al., 2020). These organic starter cultures traditionally employed in preparing rice beers hold immense potential for preparation of fermented feed for sustainable pig production. Therefore this study was conducted to know the effect of feeding indigenously fermented feed prepared by using *Xaj pitha* on growth performance crossbred Hampshire pigs.

## 2. MATERIALS AND METHODS

The present study was conducted for a period of 6 months from April, 2022 to September, 2022 in the institutional pig farm (30- Sow Teaching Unit) College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22. The study was conducted after being approved by the Institutional Animal Ethics Committee.

Eighteen (18) weaned Crossbred Hampshire pigs irrespective of sex with an average age around 8 weeks were randomly selected for the study. Thereafter, the piglets were divided into three experimental treatments groups ($T_0$, $T_1$ and $T_2$) depending upon nearness of body weight and age in such a manner that each treatment consisted of six pigs. The $T_0$ group was provided with standard non-fermented feed, while the $T_1$ group received indigenously fermented feed starting at 8 weeks of age. The $T_2$ group was fed standard conventional feed that was boiled, cooled, and then given to the animals.

The ingredient of the concentrate mixture included Maize, Wheat bran, Rice polish, Ground nut cake (DO), Fish meal, Mineral mixture and common Salt. The experimental rations were prepared as per BIS (Anonymous, 2005b). The ration was provided in two halves i.e. morning at 9 am and afternoon 3 pm.

Fermented feed was prepared with locally available brewer's cake *Xaj pitha* which is used for preparation of rice beer with standard conventional feed. The brewer's cake was thoroughly mixed and moistened with the standard conventional feed at the rate of 1:1 i.e. 1 number of *Xaj pitha* in 1 kg of feed. This mixed feed was kept in airtight polythene bags to ferment for 72 hours at 35–37°C temperature and a sweat fermented smell indicated good fermentation of feed which may take 7 to 10 days (Amadou et al., 2009). This indigenously fermented feed was offered

to $T_1$ group of pigs.

The fortnightly body weight, average daily gain, average daily feed intake, feed conversion efficiency and digestibility trial were recorded during the experimental period. The protein content of grower ration was 20.29, 22.23 and 19.95 in $T_0$, $T_1$ and $T_2$ group, respectively and for finisher ration was 18.74, 19.16 and 17.38 in $T_0$, $T_1$ and $T_2$ group, respectively. The proximate composition was done as per AOAC (Anonymous, 2005a).

The experimental data were analyzed by using one way ANOVA, two way ANOVA and Post-Hoc test were carried out based on Tukey's Honestly Significant Difference method. Statistical software package used for the analysis was SYSTAT 13.2.

## 3. RESULTS AND DISCUSSION

### *3.1. Growth performance*

The average initial body weights of crossbred pigs were 9.33±0.43, 9.45±0.41 and 9.38±0.23 kg in Group $T_0$, $T_1$ and $T_2$, respectively and were not significant ($p$>0.05) among each other. Thereafter, a gradual increase in the fortnightly body weight was recorded with a highly significant difference ($p$<0.01) in between the groups. The final body weight at 13th fortnight was recorded as 85.98±0.43, 95.01±0.70 and 89.84±0.92 kg in Group $T_0$, $T_1$ and $T_2$, respectively (Table 1). Similar findings were reported by Rahman et al. (2015), Balasubramaniam et al.(2016), Buragohain et al. (2022), Haldar et al. (2017) andVazquez and Brenner (2020) while Chu et al. (2012) and Ahmed et al. (2018) reported that

Table 1: Fortnightly average body weight (kg) of experimental animals

| Fortnight | Experimental group | | | $p$ value |
|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | |
| Initial | 9.33±0.43 | 9.45±0.41 | 9.38±0.23 | 0.975 |
| 1st | 10.75$^{b}$±0.27 | 12.32$^{a}$±0.30 | 11.17$^{b}$±0.30 | 0.004 |
| 2nd | 14.98$^{b}$±0.19 | 17.34$^{a}$±0.26 | 15.54$^{b}$±0.53 | 0.001 |
| 3rd | 20.11$^{b}$±0.20 | 22.84$^{a}$±0.41 | 20.19$^{b}$±0.64 | 0.001 |
| 4th | 25.51$^{b}$±0.24 | 28.44$^{a}$±0.74 | 25.39$^{b}$±0.80 | 0.007 |
| 5th | 31.11$^{b}$±0.29 | 34.14$^{a}$±0.52 | 31.71$^{b}$±0.54 | 0.001 |
| 6th | 37.01$^{b}$±0.15 | 39.89$^{a}$±0.64 | 38.04$^{b}$±0.65 | 0.005 |
| 7th | 43.24$^{b}$±0.26 | 46.29$^{a}$±1.06 | 44.82$^{b}$±0.58 | 0.028 |
| 8th | 49.51$^{b}$±0.33 | 53.47$^{a}$±0.57 | 51.62$^{c}$±0.53 | 0.000 |
| 9th | 56.24$^{b}$±0.93 | 60.82$^{a}$±0.90 | 58.44$^{ab}$±0.71 | 0.006 |
| 10th | 63.14$^{b}$±1.89 | 68.65$^{a}$±0.59 | 65.41$^{ab}$±0.77 | 0.021 |
| 11th | 70.26$^{b}$±0.45 | 76.57$^{a}$±0.57 | 72.76$^{c}$±0.87 | 0.000 |
| 12th | 77.53$^{b}$±0.59 | 85.49$^{a}$±1.57 | 80.39$^{c}$±0.81 | 0.000 |
| 13th | 85.98$^{b}$±0.43 | 95.01$^{a}$±0.70 | 89.84$^{c}$±0.92 | 0.000 |

*Means in columns with different superscript differs significantly

there was no significant difference among the groups when given fermented mushroom by-product and fermented bamboo vinegar liquid, respectively.

The average final daily body weight gain of the crossbred Hampshire pigs in different experimental groups were 0.39±0.03, 0.44±0.03 and 0.41±0.03 kg in group $T_0$, $T_1$ and $T_2$, respectively and no significant difference was found (Table 2). Similar findings were observed by Lan et al. (2016), Ahmed et al. (2018), Dowarah et al. (2018), Buragohain et al. (2022) and Roy (2022). The reports on average daily gain found to be lower than the present findings as reported by Chu et al. (2012) and Le et al. (2016).

From the present study, it has been observed that the pigs given fermented feed ($T_1$) achieved higher weight gain which might be due to high protein content of fermented feed.

### *3.2. Feed consumption and feed conversion efficiency*

The average daily feed intake was recorded as 1.46±0.14, 1.32±0.14 and 1.40±0.14 kg, in $T_0$, $T_1$ and $T_2$ respectively where no significant difference was recorded among the groups (Table 3). Similar findings were reported by Dung et al. (2005), Giang et al. (2011), Chu et al. (2012), Missotten et al. (2015) and Le et al. (2016). Higher average daily feed intake than the present study were reported by Buragohain et al. (2022) in large white Yorkshire pigs.In the feeding trial carried out by Cheng et al. (2017), the pigs' diet containing

Table 2: Average daily gain (kg) in body weight of experimental animals

| Fortnight | Experimental group | | | *p* value |
|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | |
| 1st | 0.09[b]±0.02 | 0.19[a]±0.02 | 0.12[b]±0.03 | 0.022 |
| 2nd | 0.28±0.03 | 0.33±0.02 | 0.29±0.05 | 0.481 |
| 3rd | 0.34±0.02 | 0.37±0.02 | 0.31±0.05 | 0.526 |
| 4th | 0.36±0.02 | 0.37±0.07 | 0.35±0.06 | 0.938 |
| 5th | 0.37±0.03 | 0.38±0.06 | 0.42±0.06 | 0.773 |
| 6th | 0.39±0.01 | 0.38±0.06 | 0.42±0.07 | 0.871 |
| 7th | 0.42±0.02 | 0.43±0.04 | 0.45±0.06 | 0.826 |
| 8th | 0.42±0.02 | 0.48±0.11 | 0.45±0.05 | 0.831 |
| 9th | 0.45±0.08 | 0.49±0.05 | 0.45±0.07 | 0.894 |
| 10th | 0.46±0.07 | 0.52±0.05 | 0.46±0.04 | 0.666 |
| 11th | 0.47±0.11 | 0.53±0.05 | 0.49±0.02 | 0.868 |
| 12th | 0.48±0.05 | 0.59±0.10 | 0.51±0.09 | 0.623 |
| 13th | 0.56±0.05 | 0.63±0.13 | 0.63±0.06 | 0.809 |
| Overall | 0.39±0.03 | 0.44±0.03 | 0.41±0.03 | 0.624 |

*Means in columns with different superscript differs significantly

Table 3: Average daily feed intake (kg) of experimental animals

| Fortnight | Experimental group | | | *p* value |
|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | |
| Initial | 0.61±0.04 | 0.55±0.02 | 0.60±0.04 | 0.452 |
| 1st | 0.75±0.06 | 0.66±0.01 | 0.70±0.03 | 0.282 |
| 2nd | 0.82±0.07 | 0.76±0.03 | 0.77±0.05 | 0.643 |
| 3rd | 0.95±0.06 | 0.86±0.05 | 0.90±0.04 | 0.468 |
| 4th | 1.16[a]±0.07 | 0.97[b]±0.02 | 1.09[a]±0.01 | 0.046 |
| 5th | 1.32±0.05 | 1.16±0.05 | 1.24±0.03 | 0.073 |
| 6th | 1.49±0.07 | 1.30±0.04 | 1.43±0.02 | 0.054 |
| 7th | 1.65[a]±0.02 | 1.45[b]±0.03 | 1.58[a]±0.04 | 0.002 |
| 8th | 1.79±0.05 | 1.66±0.01 | 1.76±0.04 | 0.078 |
| 9th | 1.92±0.05 | 1.83±0.05 | 1.88±0.04 | 0.437 |
| 10th | 1.95±0.03 | 1.92±0.02 | 1.96±0.03 | 0.503 |
| 11th | 1.96±0.05 | 1.93±0.02 | 1.98±0.02 | 0.532 |
| 12th | 1.98[a]±0.03 | 1.74[b]±0.06 | 1.83[b]±0.03 | 0.015 |
| 13th | 2.03[a]±0.06 | 1.76[b]±0.03 | 1.86[b]±0.04 | 0.007 |
| Average | 1.46±0.14 | 1.32±0.14 | 1.40±0.14 | 0.790 |

*Means in columns with different superscript differs significantly

fermented soyabean meal had higher average daily feed intake as compared to the control group. The differences in findings might be due to different breeds and environmental conditions at the time of experiment.

Feed conversion efficiency of an animal is defined as unit of feed consumed per unit gain in body weight. The feed conversion efficiency was calculated as 3.99±0.35, 3.25±0.14 and 3.65±0.24, respectively in $T_0$, $T_1$ and $T_2$ groups. The feed

conversion efficiency did not show any significant difference in between the groups (Table 4). More or less similar trend on feed conversion efficiency was reported by Aguilera-Soto et al. (2009) in pigs given wet brewers grain, Lan et al. (2016) on feeding *Lactobacillus acidophilus* on weaned pigs and Roy (2022) in Hampshire pigs. A lower feed conversion efficiency than the present study was found by Ahmed et al.(2018), Dowarah et al. (2018), and Buragohain et al. (2022). The differences in feed conversion efficiency might be due to differences methodology in experiment, breeds and ago-climatic conditions.

Table 4: Feed conversion efficiency of experimental animals

| Fortnight | Experimental group | | | *p* value |
|---|---|---|---|---|
| | $T_0$ | $T_1$ | $T_2$ | |
| 1st | 7.93 | 3.44 | 5.91 | |
| 2nd | 2.92 | 2.26 | 2.66 | |
| 3rd | 2.78 | 2.34 | 2.90 | |
| 4th | 3.21 | 2.59 | 3.15 | |
| 5th | 3.55 | 3.05 | 2.95 | |
| 6th | 3.78 | 3.38 | 3.39 | |
| 7th | 3.97 | 3.40 | 3.49 | |
| 8th | 4.28 | 3.47 | 3.88 | |
| 9th | 4.28 | 3.74 | 4.15 | |
| 10th | 4.24 | 3.67 | 4.22 | |
| 11th | 4.13 | 3.66 | 4.04 | |
| 12th | 4.08 | 2.93 | 3.59 | |
| 13th | 3.60 | 2.77 | 2.96 | |
| Overall | 3.99±0.35 | 3.25±0.14 | 3.65±0.24 | 0.051 |

*Means in columns with different superscript differs significantly

### *3.3. Digestibility trial*

The digestibility co-efficient of the group fed fermented feed ($T_1$) had better results than pigs fed with boiled feed ($T_2$) and conventional feed ($T_0$) in crossbred Hampshire pigs. The digestibility co-efficient of crude protein and ether extract were significantly higher ($p<0.01$) in $T_1$ group than $T_0$ and $T_2$ groups (Table 5). Similar findings were recorded by Yu et al. (2008), Giang et al. (2010), Dowarah et al. (2018), Lee et al. (2018), Barman et al. (2020) and Buragohain et al. (2022). The reports on digestibility co-efficient were in contrary with Balasubramaniam et al.(2016) and Shi et al.(2016).According to Yu et al. (2008), weaned pigs fed a diet supplemented with *Lactobacillus fermentum* and Lactobacilli complex showed increased apparent crude protein digestibility ($p<0.05$). They spaculated that this could be due to the production of lactic acid and proteolytic enzymes, which improved nutrient digestion in the gastrointestinal tract.

Table 5: Digestibility co-efficient of pigs under different experimental groups

| Group | $T_0$ | $T_1$ | $T_2$ | *p* value |
|---|---|---|---|---|
| DM | 81.51±1.36 | 82.21±0.55 | 81.22±0.97 | 0.783 |
| CP | $79.84^{b}$±0.66 | $82.68^{a}$±0.39 | $80.75^{b}$±0.32 | 0.007 |
| EE | $51.32^{b}$±0.67 | $53.95^{a}$±0.49 | $51.67^{b}$±0.43 | 0.014 |
| CF | 45.24±0.68 | 47.50±0.46 | 46.96±0.65 | 0.061 |
| NFE | 87.85±0.16 | 88.95±0.24 | 88.12±0.38 | 0.051 |

## 4. CONCLUSION

Feeding of fermented feed to growing-finishing pigs resulted in significant improvement in the growth performance of the crossbred pigs than the conventional and boiled feed. Feed intake did not show any significant difference in the crossbred pigs, however the feed conversion efficiency was better in the animals fed with fermented feed compared to the conventional feed and boiled feed. The nutrient digestibility was better in the animals fed with fermented feed.

## 5. FURTHER RESEARCH

Further study with larger sample size might be very beneficial to understand and exploit the benefit of the present study for the pig production.

## 6. ACKNOWLEDGEMENT

The authors are thankful to Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara-781022 to carry out the research work.

## 7. REFERENCES

Abd El-Hack, M.E., Alagawany, M., El-Sayed, S.A.A., Fowler, J., 2017a. Influence of dietary inclusion of untreated or heat-treated Jatropha meal on productive and reproductive performances and biochemical blood parameters of laying Japanese quail. Poultry Science 96, 2761–2767.

Abd El-Hack, M.E., El-Hindawy, M.M., Attia, A.I., Mahrose, K.M., 2017b. Does the use of distiller's dried grains with solubles (DDGS) in layer diets affect the nutrients digestibility and manure pollution by nitrogen and phosphorous? Environmental Science and Pollution Research 24, 13335–13343.

Abd El-Hack, M.E., Alagawany, M., Patra, A., Latif, M.A., Ashour, E.A., Arif, M., Farag, M.R., Dhama, K., 2019. Use of brewers dried grains as an unconventional feed

ingredient in the diets of broiler chickens: A review. Advances in Animal and Veterinary Sciences 7(3), 218–224.

Adeniji, A.A., Adewole, O.A., 2015. Effects of feeding graded levels of brewers dried grains with or without probiotics supplementation in replacing groundnut cake in the diet of weaned rabbits. Journal of Natural Science Research 5(7), 155–163.

Ahmed, S.T., Mun, H.S., Son, S.B., Yang, C.J., 2018. Effects of fermented bamboo vinegar liquid on growth performance, nutrient digestibility, faecal Escherichia coli concentration and ammonia emissions in growing pigs. South African Journal of Animal Science 48(4), 621–626.

Aguilera-Soto, J.I., Ramirezb, R.G., Arechiga, C.F., Gutibrrez-Baiiuelos, H., Mendez-Llorente, F., Lopez-Carlos, M.A., Pifia-Flores, J.A., Rodriguez-Frausto, H., Rodriguez-Tenorio, D., 2009. Effect of fermentable liquid diets based on wet brewers grains on performance of growing pigs. Himalayan Journal of Applied Medical Sciences and Research 36, 271–274.

Amadou, I., Jin, S., Kamara, M.T., Shi, Y.H.,Gbadamosi, O.S., Wei, L.G., 2009. Characterization *in vitro* trypsin digestibility and antioxidant activity of fermented soybean protein meal with Lactobacillus plantarum Lp6. American Journal of Food Technology 4, 268–276.

Anonymous, 2024. Basic animal husbandry statistics (BAHS), Govt. of India, Ministry of Fisheries, Animal Husbandry and Dairying, Department of Animal husbandry and dairying, Krishi Bhavan, New Delhi. Available from : https://dahd.gov.in/schemes/programmes/animal-husbandry-statistics. Accessed on: 02 February 2025.

Anonymous, 2019. 20th Livestock Census, Govt. of India, Ministry of Fisheries, Animal Husbandry and Dairying, Department of Animal husbandry and dairying, Krishi Bhavan, New Delhi. Available from: https://dahd.gov.in/schemes/programmes/animal-husbandry-statistics. Accessed on: 05 December 2024.

Anonymous, 2005a. AOAC (2005a) Association of Official Analytical Chemist, Official Methods of Analysis, 18th Edition, AOAC International, Suite 500, 481 North Frederick Avenue, Gaithersburg, Maryland 20877-2417, USA. Available from: https://www.researchgate.net/publication/292783651_AOAC_2005. Accessed on: 20th August 2022.

Anonymous, 2005b. BIS (7472:1986. Reaffirmed 2005). Bureau of Indian Standard for swine feed. Manikbhawan, 9 Bahadur Shah Zafar Marg, New Delhi. Available from: gov.in.is.7472.1986. Accessed on: 20th August 2022.

Balasubramaniam, B., Li, T., Kim, I.H., 2016. Effects of supplementing growing-finishing pig diets with Bacillus spp. probiotic on growth performance and meat-carcass grade quality traits. Revista Brasileira de Zootecnia 45(3), 93–100.

Barman, K., Banik, S., Thomas, R., Das, G., Kaushik, P., Kumar, S., Das, B.C., Das, A.K., Konwar, D., Rajkhowa, S., 2020. Effects of replacing conventional diets with Brewer's rice byproducts on performance of crossbred (hampshire×ghungroo) grower pigs. Indian Journal of Animal Health 59(1), 62–66.

Buragohain, R., Saikia, B.N., 2022. Effect of fermented liquid feed (FLF) on performance and feed efficiency of large white yorkshire (LWY) pigs under tropical climate of North-East India. Asian Journal of Dairy and Food Research 41(2), 205–212. doi: 10.18805/ajdfr.DR-1791.

Cheng, S., Li, Y., Geng, S., Hu, L., Fu, X., Han, X., 2017. Effects of dietary fresh fermented soyabean meal on growth performance, ammonia and particulate matter emissions, and nitrogen excretion in nursery piglets. Journal of Zhejiang University- SCIENCE B (Biomedicine and Biotechnology) 18(12), 1083–1092.

Chu, G.M., Yang, J.M., Kim, H.Y., Kim, C.H., Song, Y.M., 2012. Effects of fermented mushroom (*Flammulina velutipes*) by-product diets on growth performance and carcass traits in growing-fattening Berkshire pigs. Animal Science Journal 83, 55–62.

Dowarah, R., Verma, A.K., Agarwal, N., Singh, P., Singh, B.R., 2018. Selection and characterization of probiotic lactic acid bacteria and its impact on growth, nutrient digestibility, health and antioxidant status in weaned piglets. PLOS ONE 13(3), e0192978.

Dung, N.N.X., Manh, L.H., Ogle, B., 2005. Effects of fermented liquid feeds on the performance, digestibility, nitrogen retention and plasma urea nitrogen (PUN) of growing-finishing pigs. Livestock Research for Rural Development 17, 1–8.

Giang, H.H., Viet, T.Q., Ogle, B., Lindberg, J.E., 2010. Growth performance digestibility, gut environment and health status in weaned piglets fed a diet supplemented with potentially probiotic complexes of lactic acid bacteria. Livestock Science 129, 95–103.

Giang, H.H., Viet, T.Q., Ogle, B., Lindberg, J.E., 2011. Effects of supplementation of probiotics on the performance nutrient digestibility and faecal microflora in growing-finishing pigs. Asian-Australian Journal of Animal Science 24(5), 655–661.

Haldar, A., Das, D., Santra, A., Pal, P., Dey, S., Das, A., Rajkhowa, D., Hazarika, S., Datta, M., 2017. Traditional feeding system for pigs in northeast India. International Journal of Livestock Research 7(8), 122–132.

Jeong, J.S., Kim, I.H., 2015. Effect of probiotic bacteria-

fermented medicinal plants (*Gynura procumbens*, *Rehmannia glutinosa*, *Scutellaria baicalensis*) as performance enhancers in growing pigs. Animal Science Journal 86(6), 603–609.

Keot, J., Bora, S.S., Kangabam, R.D., Barooah, M., 2020. Assessment of microbial quality and health risks associated with traditional rice wine starter *Xaj pitha* of Assam, India: a step towards defined and controlled fermentation. 3 Biotech 10, 64. doi.org/10.1007/s13205-020-2059-z.

Kim, C.H., Kim, G.B., Chang, M.B., Bae, G.S., Paik, I.K., Kil, D.Y., 2012. Effect of dietary supplementation of Lactobacillus-fermented Artemisia princeps on growth performance, meat lipid peroxidation, and intestinal microflora in Hy-line brown male chickens. Poultry Science 91, 2845–2851.

Lan, R., Koo, J., Kim, I., 2016. Effects of Lactobacillus acidophilus supplementation on growth performance, nutrient digestibility, faecal microbial and noxious gas emission in weaning pigs. Journal of Science of Food and Agriculture 97, 1310–1315.

Le, M.H.A., Yang, Y., Galle, S., Landero, J.L., Beltranena, E., Ganzle, M.G., Zijlstra, R.T., 2016. Effects of feeding fermented wheat with *Lactobacillus reuteri* on nutrient digestibility, growth performance and, intestinal fermentation in weaned pigs. Journal of Animal Science 94(11), 4677–4687.

Lee, C.H., Kim, H.B., Ahn, J.H., Jung, H.J., Yun, W., Lee, J.H., Kwak, W.G., Oh, H.J., Liu, S.D., An, J.S., Song, T.H., Park, T.I., Kim, D.W., Yu, D.J., Song, M.H., Cho, J.H., 2018. Effects of restricted feeding with fermented whole crop barley and wheat on the growth performance, nutrient digestibility, blood characteristic, and faecal microbiota in finishing pigs. Korean Journal of Agricultural Science 45(4), 665–675.

Liao, S.F., Nyachoti, M., 2017. Using probiotics to improve swine gut health and nutrient utilization. Animal Nutrition 3, 331–343.

Missotten, J.A.M., Michiels, J., Ovyn, A., Smet, De S., Dierick, N.A., 2015. Fermented liquid feed for weaned piglets: impact of sedimentation in the feed slurry on performance and gut parameters. Czech Journal of Animal Science 60(5), 195–207.

Mukherjee, R., Chakraborty, R., Dutta, A., 2016. Role of fermentation in improving nutritional quality of soybean meal - a review. Asian-Australian Journal of Animal Science 29, 1523–1529.

Radzik, R.A., Rant, W., Niznikowski, R., Swiatek, M., Szymanska, Z., Slezak, M., Niemiec, T., 2018. The effect of the addition of wet brewers grain to the diet of lambs on body weight gain, slaughter value and meat quality. Archives Animal Breeding 61, 245–251.

Rahman, M., Bora, J.K., Sarma, A.K., Roychoudhury, R., Borgohain, A., 2015. Effect of deep litter housing and fermented feed on carcass characteristics and meat quality of crossbred Hampshire pigs. Veterinary World 8(7), 881–887.

Roy, N.K., 2022. Performance of crossbred Hampshire pig fed on poultry by-products. PhD. Thesis, Assam Agricultural University, Khanapara, Guwahati (781 022) India. https://krishikosh.egranth.ac.in/handle/1/5810203950.

Saikia, B., Tag, H., Das, A.K., 2007. Ethnobotany of foods and beverages among the rural farmers of Tai Ahom of North Lakhimpur district, Asom. Indian Journal Traditional Knowledge 6, 126–132.

Shi, C., He, J., Wang, J., Yu, J., Yu, B., Mao, X., Chen, D., 2016. Effects of *Aspergillus niger* fermented rapeseed meal on nutrient digestibility, growth performance and serum parameters in growing pigs. Animal Science Journal 87, 557–563.

Stefanello, F.S., Fruet, A.P.B., Trombetta, F., da Fonseca, P.A.F., Dos Santos da Silva, M., Stefanello, S., Nornberg, J.L., 2019. Stability of vacuum-packed meat from finishing steers fed different inclusion levels of brewer's spent grain. Meat Science147, 155–161.

Vazquez, N.A., Brenner, E.G., 2020. Effect of wet versus dry feeding on digestibility, growing performance, carcass composition, and meat eating quality of finishing pigs. Journal of Animal Science 97(Suppl3), 474–475. doi: 10.1093/jas/skz258.931.

Xu, B., Li, Z., Wang, C., Fu, J., Zhang, Y., Wang, Y., Lu, Z., 2020. Effects of fermented feed supplementation on pig growth performance: A meta-analysis. Animal Feed Science and Technology 259, 114135. DOI:10.1016/j.anifeedsci.2019.114315.

Yu, H.F., Wang, A.N., Li, X.J., Qiao, S.Y., 2008. Effect of viable Lactobacillus fermentum on the growth performance, nutrient digestibility and immunity of weaned pigs. Journal of Animal and Feed Sciences 17, 61–69.

Zhang, Y., Shi, C., Wang, C., Lu, Z., Wang, F., Feng, J., Wang, Y., 2018. Effect of soybean meal fermented with Bacillus subtilis BS12 on growth performance and small intestinal immune status of piglets. Food and Agricultural Immunology 29, 133–146.

Zhou, H., Wang, C., Ye, J., Chen, H., Tao, R., 2015. Effects of dietary supplementation of fermented *Ginkgo biloba* L. residues on growth performance, nutrient digestibility, serum biochemical parameters and immune function in weaned piglets. Animal Science Journal 86(8), 790–799. https://doi.org/10.1111/asj.12361.