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The Impact of Fermented Local Feed on Turkey Production Performance in the Grower Period

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ABSTRACT

The rising demand for turkey meat in Indonesia is driving an expansion in turkey farming businesses. However, many farmers ignore the nutritional requirements of their poultry and frequently incorporate unprocessed water hyacinth into their feed, which provides low nutritional value. The present study aimed to improve the nutritional value of feed through fermentation to enhance feed quality on smallholder farms. The present study involved 180 heads of eight-week-old turkeys divided into three groups, including basic feed as a control, local feed, and fermented feed. Body weight, daily body weight gain, feed conversion, and mortality rates were measured during the study. The current results indicated that turkeys fed fermented water hyacinth had improved growth performance, as evidenced by increased body weight and daily weight gain and reduced mortality. The turkeys fed local feed did not indicate improvements in growth performance due to the use of poor-quality local feed. The fermentation method could improve the quality of feed ingredients, thereby enhancing turkey growth performance. Fermented feed given to turkeys could improve production performance by increasing body weight and daily weight gain, also decreasing feed convertion, and mortality rates during the grower period.

Keywords: Fermented feed, Fermentation, Local feed, Performance, Turkey

INTRODUCTION

Small-scale poultry farming serves as a source of income for farmers by selling protein-rich products (Selaledi et al., 2021). Farmers have started raising turkeys because of their popular meat and sustained demand (Yasmin et al., 2021). Turkeys are valued for their lean, high-protein meat, high market price, and ability to utilize forage (Utama et al., 2025). However, turkey feeding management is still carried out solely at the smallholder farm scale, without prioritizing the quality and effectiveness of feed nutrition (Dotché et al., 2024). The traditional maintenance process leads to nutrient deficiency, resulting in suboptimal growth (Moustapha et al., 2022).

Small-scale poultry farmers in Indonesia often use locally available feed components in their feed formulations, including water hyacinth (*Eichhornia crassipes*), rice bran, and tofu dregs. The mentioned ingredients are popular because they are accessible, affordable, and available throughout the year (Pangeran et al., 2021). However, when used, these ingredients, without processing, the nutritional potential of these feed ingredients remains suboptimal (van der Poel et al., 2020). Improving the skills of small farmers in Kudus, Central Java, Indonesia, particularly in feed processing, requires targeted strategies to transition from no-input scavenging to poultry keeping, and profit-driven egg and meat production (Kim et al., 2016). Strengthening these skills has been shown to notably improve production efficiency and increase farmers' income (Njoku and Chibundu, 2022; Birhanu et al., 2023). The nutritional requirements of turkeys, which consist of high-protein, low-fiber feed, can be met by using feed processing methods that improve nutrient quality, increase digestibility, enhance feed functionality, and adapt the feed to the physiological needs of livestock. Turkey can consume up to 9% fiber at 26-48 days of age (grower phase; Dorigam et al., 2016; Utama et al., 2025). Transforming raw ingredients into more digestible, nutrient-enriched forms ensures that turkeys

receive the essential nutrients required for optimal growth and overall health. Locally available feed ingredients such as water hyacinth (*Eichhornia crassipes*; Dumaup and Ampode, 2020; Rajan et al., 2023), rice bran (Yamin et al., 2020; Attia et al., 2023), and tofu dregs (Anggraeni et al., 2013; Nguyen et al., 2020) exhibited promising nutritional potential as alternative feed resources, although their utilization remains limited by challenges in processing and nutrient bioavailability. One method to increase utility is through fermentation (Shamim et al., 2017; Johnson et al., 2024). Fermentation is a bioconversion process in which microorganisms, particularly lactic acid bacteria (LAB), transform substrates into more nutritionally valuable compounds. Lactic acid bacteria play crucial roles in enhancing the nutritional profile of feed ingredients and generating several bioactive compounds, including enzymes, vitamins, linoleic acid, exopolysaccharides, and gamma-aminobutyric acid (GABA), all of which possess functional and nutraceutical properties (Kondrotiene et al., 2023). The inoculum of LAB in feed has also been shown to effectively reduce crude fiber content, thereby improving feed digestibility (Wu et al., 2025). One innovative approach in feed fermentation technology involves using a vegetable fermented extract (VFE) as a microbial starter. The VFE-2019, as a non-commercial functional starter from research results, has been shown to contain lactic and allicin bacteria, has been proven to improve the quality and utility of the ingredients, and the fermented product contains LABs up to 10^8 CFU/g (Sulistiyanto et al., 2019; Sulistiyanto and Utama, 2020). The present study aimed to examine the effects of fermented local ingredients, such as water hyacinth, rice bran, and tofu dregs, on improving the quality and utility of local feed during the grower period in turkeys on small-scale farms.

MATERIALS AND METHODS

Ethical approval

All procedures involving animals were approved by the Faculty of Animal and Agricultural Science, Diponegoro University, Semarang, Indonesia, under approval number 62-01/A-01/KEP-FPP.

Ingredients

Dietary ingredients included pollard, distiller's dried grains with solubles (DDGS), broiler-1 (BR 1), corn gluten feed (CGF), soybean meal, rice bran, molasses, mineral mix from local market, cassava pulp and tofu dregs from tapioca flour local industry in Kudus, water hyacinth, from Kudus, Indonesia, and VFE-2019 starter, prepared in accordance with the method of Sulistiyanto et al. (2019). Equipment used included cages to keep turkeys, feed mats, drinking water tanks, barrels as fermentation silos, and digital scales to weigh turkeys and feed.

Study design and animals

The current study involved 180 unsexed local turkeys, aged eight weeks and weighing 1600 g ± 140 g, employing a completely randomized design with three treatments and five replicates, with each replicate consisting of 12 turkeys. Turkeys were kept in communal cages with a capacity of three turkeys per square meter. The cages maintained a temperature range of 23°C to 30°C and a humidity level of 80% to 90% (Nangoy et al., 2022). To maintain cleanliness and prevent disease transmission, litter was changed twice a week. Any turkeys that appeared unhealthy were separated from the group and placed into a quarantine cage. The turkeys were kept for two weeks for adaptation and then fed for four weeks. Feed and drinking water were given *ad libitum*. Feed was given three times a day, and the remaining feed was measured before the first feeding on the next day. The total duration of the research, from preparation to maintenance, is 6 weeks.

Experimental treatments

The treatments consisted of basic feed, local feed, and fermented feed. The composition of the local feed was adopted from traditional turkey farms in Kudus Regency, Indonesia. The basic feed was formulated for 8-16 week-old turkeys in the grower period based on minimum requirements, using non-fermented ingredients. In contrast, the fermented feed was formulated from the basic feed using fermented ingredients (Utama et al., 2025). The composition of the treatment feed is presented in Table 1.

The fermentation process was based on the study of Mulyasari et al. (2022), which was conducted by adding 6% VFE-2019 starter (W/W) to a mixture of water hyacinth (WH), tofu pulp (TP), and rice bran (RB; Ratio of WH: TP: RB = 20:50:30). Water hyacinth was cut into small pieces measuring approximately 1 cm and mixed evenly with the starter. Meanwhile, the tofu pulp was mixed evenly with the rice bran. The two mixtures were then combined and stored in a silo for five days under anaerobic fermentation conditions. The final fermented feed had an acidic pH and contained probiotics, specifically lactic acid bacteria, with a population of 5.44 × 10^8 CFU/g.

Table 1. Composition of local, basic, and fermented diets for unsexed 8-16 weeks grower-phase turkeys

Composition of diet	Basic feed (%)	Local feed (%)	Fermented feed (%)
Corn	-	10	-
Rice bran	-	20	8
Tofu dregs	-	20	-
Pollard	20	-	-
Cassava pulp	3	-	1.2
Water hyacinth	-	40	-
Mineral mixed	2	5	0,8
Soybean meal	10	-	4
Broiler-1	20	5	8
Distiller's dried grains with soluble	25	-	10
Corn gluten feed	20	-	8
Basic diet	-	-	-
Fermented local feed	-	-	60
Total	100	100	100
Chemical analysis	**Basic feed**	**Local feed**	**Fermented feed**
Crude protein (%)	22.98	17.79	21.72
Fat (%)	3.9	2.82	3.19
Crude fiber (%)	3.8	5.37	13.12
Metabolizable energy (Kcal/kg)	2871	2593	2351.8
Ash (%)	5.25	1.54	4.3
Moisture content (%)	6.52	11.47	10.42
Calcium (%)	1.05	3.25	0.42
Phosphor (%)	1.2	2.02	0.48

The composition of the mineral mixed (produced by PT. Medion from the Indonesian factory) is calcium, phosphorus, iron, manganese, iodine, copper, and zinc. The diet was balanced according to the study by Sunarti et al. (2016).

Data collection

Body weight was measured every two weeks starting from the beginning of the study until the end of the treatment (10, 12, and 14 weeks of age; Utama et al., 2025). Body weight, daily weight gain, feed conversion, and mortality rates were observed during the study. The mortality rate was calculated by dividing the number of turkeys that died during the rearing period, then multiplying by 100%. The average daily weight gain (ADG) was calculated according to the following formula (van der Sluis et al., 2022).

$$\text{ADG} = \frac{(body\ weight_{end} - body\ weight_{start})}{(age\ in\ days_{end} - age\ in\ days_{start})}$$

Statistical analysis

Current data was analyzed using SPSS, version 23.0. After testing for normality and homogeneity of variance, the effect of treatment was assessed via ANOVA (Steel and Torrie, 1980). Where ANOVA indicated a significant difference ($p \leq 0.05$), means were compared using Duncan's multiple range test.

RESULTS

The present results indicated that body weight in turkeys was significantly affected by the diet ($p \leq 0.05$). The turkeys fed fermented feed (3345.2 ± 260.9 g) had the highest body weight compared to turkeys fed non-fermented basic feed (3058.8 ± 147.4 g) and local feed (2535.2 ± 157.6 g; $p \leq 0.05$; Table 2). The body weight in turkeys fed local feed was significantly lower than the body weight in turkeys fed fermented ingredients ($p \leq 0.05$). The fermented ingredients indicated that fermentation with VFE-2019 starters can enhance feed quality and utility.

The current results indicated that ADG increased in turkeys fed fermented ingredients ($p \leq 0.05$) compared to those fed basal feed and local feed. The turkeys fed fermented ingredients had the highest ADG (40.4 ± 7.9 g) compared to those fed basic feed (34.5 ± 3.1 g) or local feed (21.4 ± 4.4 g; Table 2). The growth rate of turkeys fed the local diet was significantly lower than that of turkeys fed the basic and fermented diet ($p \leq 0.05$). The presented result indicated that fermented feed was

completely utilized by livestock and increased their weight.

Feed conversion indicates how efficiently feed nutrients are converted into livestock products, expressed as a final weight. The current results indicated that feed conversion was significantly affected by differences in the rations given ($p \leq 0.05$). Among the treatments, the best feed conversion rate was observed in turkeys fed basic feed (1.22 ± 0.44%) and fermented feed (1.29 ± 0.11%), compared to those fed local feed (2.14 ± 0.45%; $p \leq 0.05$; Table 2). The low feed conversion rate indicated that the animals fully utilized the feed nutrients.

Fermented feed significantly affected turkeys' mortality rates compared to the basic feed and local feed ($p \leq 0.05$). Turkeys fed fermented feed exhibited the lowest mortality rate (1.67%), which was significantly lower ($p \leq 0.05$) than those fed basic (3.33%) or local feed (8.33%). The study indicated that deaths happen at the beginning of the rearing period. These deaths may have been caused by low adaptability to the environment and the feed.

Table 2. Production performance of unsexed 8-16 weeks grower-phase fed basic, local, and fermented diets

Treatment	Body weight (g)	Average daily gain (g)	Feed consumption (g)	Feed conversion (%)	Mortality rates (%)
Basic feed	3058.8 ± 147.4 ^{b}	34.5 ± 3.1 ^{b}	218.87 ± 34.53	1.22 ± 0.44 ^{b}	3.33 %
Local feed	2535.2 ± 157.6 ^{c}	21.4 ± 4.4 ^{c}	335.03 ± 71.21	2.14 ± 0.45 ^{a}	8.33 %
Fermented feed	3345.2 ± 260.9 ^{a}	40.4 ± 7.9 ^{a}	245.73 ± 80.31	1.29 ± 0.11 ^{b}	1.67 %

$^{a, b, \text{and } c}$ Different superscript letters in the same column indicate significant differences among the treatments ($p \leq 0.05$).

DISCUSSION

The body weight of turkeys fed with basal and fermented ingredients aligned with local turkey growth standards, whereas those fed the local diet fell below the weight range of 2500-3500 g set by turkey growers (Sunarti et al., 2016). Turkeys fed the local diet exhibited lower production performance due to low-quality ingredients and an imbalanced energy-to-protein ratio, which failed to meet physiological requirements. In the grower period, turkeys require protein and energy in the range of 21-23% and 3000-3500 kcal/kg, respectively. Besides the balance of nutrients, the local feed contains highly fiber ingredients (Shamim et al., 2017). Although turkeys can digest high-fiber rations, providing a fibrous diet without appropriate treatments may lead to reduced weight gain (Chachaj et al., 2019; Drażbo et al., 2020; Qui and Linh, 2023).

In the present study, fermentation was used to improve the quality of local feed, as supported by the study of Utama et al. (2025), who demonstrated that the quality of water hyacinth can be improved with starters, including LABs. Providing animals with feed enriched with LABs as probiotics can enhance their health, as indicated by Mansilla et al. (2022). Consequently, healthy animals exhibit improved growth rates and more robust development (Cameron and McAllister, 2019). The advantages of feed fermentation not only enhance the feed's nutritional profile but also increase livestock productivity (Katu et al., 2025).

The inclusion of fermented feed improves feed conversion efficiency, thereby stimulating growth (Shamim et al., 2017). The most notable improvements in animal health and function were observed in the poorest conditions, with unhealthy animals housed in filthy environments (Chervonova, 2021; Johnson et al., 2024). Consistent with the findings of Sulistiyanto et al. (2024), the current results indicated that the VFE-2019 starter provided satisfactory outcomes in processing local ingredients such as water hyacinth, tofu dregs, and rice bran, and had a positive impact on the turkeys that consumed them (Shamim et al., 2017; Pratiwi and Pratiwy, 2021; Johnson et al., 2024). Some studies have noted the beneficial effects of administering LAB probiotics, including improved nutritional utility, modulating the intestinal microbiota, inhibiting pathogens, improving intestinal integrity, immunomodulation, and enhancing microbiological and sensory characteristics of the broiler's meal (Alagawany et al., 2021; Johnson et al., 2024; Qui et al., 2024). The LABs in fermented products have been demonstrated to serve a functional role as probiotics. Multiple studies have indicated that administering probiotic LAB can enhance intestinal performance in chickens, augment immune responses, and improve feed efficiency, thereby supporting animal growth (Wajda et al., 2010; Alagawany et al., 2021).

In addition, fermented feed has a low pH and a high organic acid content. Dietary fermented feed can improve growth performance, immune organ development, and organ function capacity, which may be related to the regulation of microbial composition. As turkeys reach maturity and develop disease immunity, their mortality rate decreases, resulting in a lower death rate (Mukandungutse et al., 2020; Zhu et al., 2023).

CONCLUSION

Fermented feed given to turkeys could improve production performance by increasing body weight and daily weight gain, also decreasing feed conversion and mortality rates during the grower period. The present study has limitations because it was conducted over a relatively short period and did not consider economic aspects, so further studies should assess the cost-effectiveness of using fermentation technology before smallholder farmers adopt it.

DECLARATIONS

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Author's contributions

Bambang Sulistiyanto, Cahya Utama, and Sri Sumarsih conducted the study, collected, and analyzed data. Bambang Sulistiyanto, Cahya Utama, Sri Sumarsih, and Nadya Marcelina Cinderawati drafted, reviewed, and edited the manuscript. All authors have read and approved the final edition of the manuscript.

Competing interests

The authors have declared that no conflict of interest.

Ethical considerations

Plagiarism, consent to publish, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been checked by all the authors. The authors did not use any artificial intelligence (AI) tools in preparing this manuscript.

Availability of data and materials

All generated and analyzed data during this study are included in the present study; additional information is available upon reasonable request from the corresponding author.

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