Effects of Yeast Culture Supplementation in Barley-Sorghum-Based Diets on Growth Performance and Meat Quality of Finishing Pigs (Postprint)

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Abstract

This experiment was conducted to investigate the effects of yeast culture supplementation in barley-sorghum based diets on growth performance and meat quality of finishing pigs. A total of 120 healthy Duroc × Landrace × Yorkshire (DLY) three-way crossbred finishing pigs with similar body weight and age were randomly allocated into 3 groups, with 4 replicates per group and 10 pigs per replicate. The groups were fed corn-soybean meal based diet, barley-sorghum based diet, and experimental diet supplemented with 0.8% yeast culture in the barley-sorghum based diet, respectively. The experimental period lasted 60 days. The results showed: 1) Compared with the corn-soybean meal group, the barley-sorghum group exhibited an 8.62% reduction in average daily gain ($P > 0.05$) and a 9.78% increase in feed conversion ratio ($P < 0.05$), while the barley-sorghum + yeast culture group showed no significant changes in average daily gain and feed conversion ratio ($P < 0.05$). 2) Compared with the corn-soybean meal group, the barley-sorghum group had significantly decreased lightness (L*) value ($P < 0.05$) and significantly increased redness (a*) value ($P < 0.05$) in the longissimus dorsi muscle, while the barley-sorghum + yeast culture group showed no significant differences in L* and a* values ($P > 0.05$). No significant differences were observed among groups in pH45min, drip loss, intramuscular fat, crude protein, and moisture content of the longissimus dorsi muscle ($P > 0.05$). 3) Compared with the corn-soybean meal and barley-sorghum groups, the barley-sorghum + yeast culture group had significantly higher saturated fatty acid content in the longissimus dorsi muscle ($P < 0.05$), while monounsaturated fatty acid (MUFA) content was significantly lower ($P < 0.05$); MUFA content in subcutaneous adipose tissue was also significantly lower ($P < 0.05$). 4) Compared with the corn-soybean meal group, the barley-sorghum + yeast

culture group had significantly lower total volatile basic nitrogen content ($P < 0.05$). This study indicates that supplementation of 0.8% yeast culture in barley-sorghum based diets can effectively improve growth performance and meat quality of finishing pigs.

Full Text

Effects of Yeast Culture on Growth Performance and Meat Quality of Finishing Pigs Fed a Barley-Sorghum Diet

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Abstract: This experiment investigated the effects of yeast culture supplementation on growth performance and meat quality in finishing pigs fed a barley-sorghum diet. One hundred and twenty healthy "Duroc × Landrace × Yorkshire" crossbred finishing pigs with similar body weight and age were randomly allocated into three groups, each consisting of four replicates of ten pigs. The three groups were fed a corn-soybean meal diet, a barley-sorghum diet, or a barley-sorghum diet supplemented with 0.8% yeast culture for a 60-day experimental period. The results showed: (1) Compared with the corn-soybean group, the barley-sorghum group exhibited an 8.62% reduction in average daily gain (ADG) ($P > 0.05$) and a 9.78% increase in feed-to-gain ratio (F/G) ($P < 0.05$), whereas the barley-sorghum + yeast culture group showed no significant differences in ADG or F/G compared to the corn-soybean group ($P > 0.05$). (2) The barley-sorghum group had significantly lower lightness (L*) values ($P < 0.05$) and significantly higher redness (a*) values ($P < 0.05$) in the longissimus dorsi muscle compared to the corn-soybean group, while the barley-sorghum + yeast culture group showed no significant differences in L* or a* values ($P > 0.05$). No significant differences were observed among groups in pH at 45 minutes postmortem, drip loss, intramuscular fat, crude protein, or moisture content ($P > 0.05$). (3) The barley-sorghum + yeast culture group exhibited significantly higher saturated fatty acid (SFA) content ($P < 0.05$) and significantly lower monounsaturated fatty acid (MUFA) content ($P < 0.05$) in the longissimus dorsi muscle compared to both the corn-soybean and barley-sorghum groups; MUFA content in subcutaneous adipose tissue was also significantly reduced ($P < 0.05$). (4) The barley-sorghum + yeast culture group showed significantly lower total volatile base nitrogen (TVB-N) content compared to the corn-soybean group ($P < 0.05$). These findings suggest that supplementation of a barley-sorghum diet with 0.8% yeast culture can effectively improve growth performance and meat quality in finishing pigs.

Keywords: yeast culture; growth performance; meat quality; finishing pigs

Introduction

China' s swine industry predominantly relies on corn-soybean meal diets, while unconventional feed ingredients such as barley and sorghum, along with agricultural by-products, remain underutilized. This limited utilization contributes to persistently high feed costs. Furthermore, the excessive emphasis on improving growth performance has resulted in inferior pork quality. Currently, "Duroc × Landrace × Yorkshire" crossbred pigs are widely used in domestic production; however, their low intramuscular fat content negatively affects meat flavor and leads to high drip loss and pale meat color. Yeast culture, a green, non-toxic, and harmless microecological preparation, is receiving increasing attention. It is a microecological product formed through the full fermentation of yeast in a culture medium under specific conditions, containing abundant metabolites such as proteins, small peptides, amino acids, nucleotides, organic acids, oligosaccharides, enzymes, and various unknown growth factors. While yeast culture has been extensively applied in ruminant production, including dairy cattle, beef cattle, and goats, research on its application in piglets is also growing. Studies have demonstrated that yeast culture can increase feed intake, maintain intestinal microecological balance, improve nutrient digestibility, and enhance immune function in piglets. However, research on yeast culture in finishing pigs remains limited and has primarily focused on corn-soybean meal diets. Therefore, this study investigated the effects of yeast culture supplementation in a barley-sorghum diet on growth performance and meat quality in finishing pigs, providing a theoretical basis for the efficient application of yeast culture with unconventional feed ingredients.

1.1 Experimental Design

One hundred and twenty healthy "Duroc × Landrace × Yorkshire" crossbred finishing pigs with an initial weight of approximately 68 kg, similar genetic background, and consistent age were randomly divided into three groups with four replicates each, containing ten pigs per replicate. The three dietary treatments were: (1) corn-soybean meal diet (corn-soybean group), (2) barley-sorghum diet (barley-sorghum group), and (3) barley-sorghum diet supplemented with 0.8% yeast culture (barley-sorghum + yeast culture group). Diets were formulated according to the nutrient requirements for growing-finishing pigs recommended in the Chinese Feeding Standard (NY/T 65-2004). The composition and nutrient levels of the experimental diets are presented in . The experimental period lasted 60 days. The yeast culture (trade name: Yikang XP) was provided by Diamond V China.

1.2 Feeding Management

Prior to the experiment, pig houses were disinfected. During the trial, pigs were fed three times daily at 06:00, 11:00, and 17:00. Feed amounts were adjusted according to consumption, allowing ad libitum intake with free access to water.

Pens were cleaned daily, and feed consumption and health status were recorded. Immunization and disinfection were conducted according to farm protocols.

1.3.1 Growth Performance Measurement

Body weight was measured on days 1 and 60 after 16 hours of fasting with free access to water. Feed consumption was recorded for each replicate to calculate average daily feed intake (ADFI), average daily gain (ADG), and feed-to-gain ratio (F/G).

1.3.2 Meat Quality Measurement

At the end of the experiment, two pigs were randomly selected from each replicate (eight pigs per group, 24 pigs total) for slaughter. The left carcass longissimus dorsi muscle at the last rib and dorsal subcutaneous fat were collected for meat quality analysis. Muscle pH at 45 min and 24 h postmortem, drip loss, intramuscular fat, crude protein, and moisture content were determined according to the Technical Specification for Pork Quality Measurement (NY/T 821-2004). Meat color parameters (L, *a*, and b* values) were measured using a colorimeter. Inosinic acid content was determined by high-performance liquid chromatography. Muscle tenderness was measured according to the Method for Determination of Meat Tenderness—Shear Force Measurement (NY/T 1180-2006). Fatty acid composition and iron, copper, and zinc contents were analyzed according to Meat and Meat Products (GB/T 9695-2009). Total volatile base nitrogen (TVB-N) content was determined according to the Method for Analysis of Hygienic Standard of Meat and Meat Products (GB/T 5009.44-2003). Total bacterial count was measured according to Microbiological Examination of Food—Determination of Aerobic Plate Count (GB 4789.2-2010).

1.4 Statistical Analysis

Data were analyzed using one-way ANOVA with the ANOVA model in SPSS 19.0 software. Duncan' s multiple range test was used for post-hoc comparisons. Differences were considered significant at $P < 0.05$. Results are expressed as means ± standard error.

Results

2.1 Effects of Yeast Culture on Growth Performance of Finishing Pigs

As shown in , the barley-sorghum group exhibited an 8.62% reduction in ADG ($P > 0.05$) and a 9.78% increase in F/G ($P < 0.05$) compared to the corn-soybean group, indicating that the barley-sorghum diet negatively affected growth performance. In contrast, the barley-sorghum + yeast culture group showed an improved ADG trend ($P > 0.05$) and significantly reduced F/G ($P < 0.05$) compared to the barley-sorghum group, with no significant differences from the

corn-soybean group ($P > 0.05$). These results demonstrate that yeast culture alleviated the adverse effects of the barley-sorghum diet on ADG and F/G.

2.2 Effects of Yeast Culture on Meat Quality of Finishing Pigs

As presented in , the barley-sorghum group had significantly higher pH24h values than both the corn-soybean and barley-sorghum + yeast culture groups ($P < 0.05$). Compared to the corn-soybean group, the barley-sorghum group showed significantly lower L* values ($P < 0.05$) and significantly higher a* values ($P < 0.05$) in the longissimus dorsi muscle, while the barley-sorghum + yeast culture group tended to mitigate these changes in L* and a* values ($P > 0.05$). Additionally, barley and sorghum reduced muscle inosinic acid content, with the barley-sorghum group showing significantly lower values than the corn-soybean group ($P < 0.05$), while the barley-sorghum + yeast culture group tended to alleviate this reduction. No significant differences were observed among groups in pH45min, drip loss, intramuscular fat, crude protein, or moisture content ($P > 0.05$).

2.3 Effects of Yeast Culture on Fatty Acid Composition of Pork

As shown in , regarding fatty acid composition in the longissimus dorsi muscle, the barley-sorghum + yeast culture group exhibited significantly higher saturated fatty acid (SFA) content ($P < 0.05$) and significantly lower monounsaturated fatty acid (MUFA) content ($P < 0.05$) compared to both the corn-soybean and barley-sorghum groups. The polyunsaturated fatty acid (PUFA) content in the barley-sorghum + yeast culture group was significantly higher than in the barley-sorghum group ($P < 0.05$) but did not differ from the corn-soybean group ($P > 0.05$). In subcutaneous adipose tissue, both the barley-sorghum and barley-sorghum + yeast culture groups showed significantly lower SFA content ($P < 0.05$) and significantly higher MUFA content ($P < 0.05$) compared to the corn-soybean group, while PUFA content remained unchanged ($P > 0.05$).

2.4 Effects of Yeast Culture on Hygienic Index and Microelement Content of Pork

Total bacterial count and TVB-N content are important indicators for evaluating pork freshness, with fresh pork typically having bacterial counts <10 CFU/g and TVB-N content <15 mg/100g. As shown in , the barley-sorghum + yeast culture group showed no significant difference in total bacterial count in the longissimus dorsi muscle compared to the corn-soybean group ($P > 0.05$), but TVB-N content was significantly reduced ($P < 0.05$). Lower TVB-N content indicates longer shelf life. No significant differences were observed among groups in copper, zinc, or iron content ($P > 0.05$).

Discussion

3.1 Effects of Yeast Culture on Growth Performance of Finishing Pigs

Previous studies have shown that yeast culture supplementation in weaned piglet diets can reduce weaning stress, decrease diarrhea incidence, increase feed intake and daily gain, and improve survival rate. However, research on yeast culture in finishing pigs is limited. Tian et al. reported that adding 0.4% yeast culture to corn-soybean meal diets for growing-finishing pigs during summer significantly reduced ileal lactobacilli count and lactic acid concentration while increasing colonic butyric acid concentration, providing more energy for intestinal epithelial cells. Liu et al. found that supplementing corn-soybean meal diets for 35 kg growing pigs with 0.15% yeast culture significantly improved ADG and increased intestinal microbial populations, thereby enhancing crude fiber utilization. Huang et al. reported that adding 10% yeast culture to soybean meal-corn diets improved growth performance and digestibility in finishing pigs, though their yeast culture was actually a dried distillers grains with solubles (DDGS) product processed by microbial fermentation. The present study found that feeding a barley-sorghum diet significantly reduced growth performance compared to a corn-soybean meal diet, likely due to antinutritional factors such as xylan and -glucan in barley and tannins in sorghum. Yeast culture, rich in bioactive substances including small peptides, amino acids, nucleotides, organic acids, and enzymes, can regulate intestinal microflora balance and improve nutrient utilization, thereby alleviating the negative effects of barley-sorghum diets on ADG and F/G. These findings provide a feasible approach for reducing feed costs in finishing pigs through the use of unconventional feed ingredients.

3.2 Effects of Yeast Culture on Meat Quality of Finishing Pigs

Pork quality is influenced by genetics, nutrition, environment, transportation, and slaughter processing. Key indicators for meat quality evaluation include meat color, pH, tenderness, drip loss, intramuscular fat, fatty acid composition, and flavor compounds. Postmortem pH reflects the rate of muscle glycogen glycolysis, with normal pH45min values of 6.1–6.4, while pale, soft, exudative (PSE) meat typically shows pH45min values of 5.1–5.5. Meat color, represented by L*, a*, and b* values, is a critical appearance trait and pricing determinant, with ideal fresh red color characterized by lower L* values, higher a* values, and lower b* values. Muscle tenderness, reflected by shear force values, decreases with lower values. Water-holding capacity directly affects meat palatability, juiciness, nutrient loss, tenderness, and color, with greater drip loss indicating poorer water-holding capacity and greater economic losses. Studies in broilers have shown that 0.5% yeast culture supplementation significantly reduced shear force and drip loss while improving tenderness and water-holding capacity. Research in growing-finishing pigs indicated that yeast culture had no significant effects on longissimus dorsi muscle pH, drip loss, or meat color, though the 0.2% supplementation group showed the lowest shear force values. In the present study, 0.8% yeast culture supplementation in the barley-sorghum diet

significantly reduced pH24h in the longissimus dorsi muscle without affecting pH45min. Additionally, the combination of unconventional ingredients (barley, sorghum) with 0.8% yeast culture reduced L* values and increased a* values, possibly due to enhanced glutathione peroxidase (GSH-Px) and superoxide dismutase (SOD) activities.

Intramuscular fat is a decisive factor for meat quality, strongly correlated with water-holding capacity, tenderness, and flavor compounds. Appropriate intramuscular fat levels can improve meat quality. Inosinic acid is the primary compound contributing to meat umami flavor. Previous research reported that feeding barley instead of corn reduced crude fat content in the longissimus dorsi muscle of finishing pigs. In contrast, the present study found no significant effects of barley-sorghum diets or yeast culture on intramuscular fat content, with values of 2.2%–2.5% across groups, approaching the ideal range of 2.5%–3.5%. However, the barley-sorghum diet significantly reduced inosinic acid content, while 0.8% yeast culture supplementation alleviated this reduction and improved meat quality, likely attributable to the rich content of small peptides, amino acids, and nucleotides in yeast culture.

3.3 Effects of Yeast Culture on Fatty Acid Composition of Pork

Fatty acid content, type, and ratio are important indicators for pork quality evaluation, influencing meat flavor to some extent, though research findings remain inconsistent. Migdal et al. reported that high PUFA content in carcass fat could improve meat flavor and edible value but may cause excessive fat softening and oxidation. Conversely, Cameron et al. found that higher SFA and MUFA content in pork was associated with better tenderness, juiciness, and flavor. Compared to corn, sorghum has lower fat content and a smaller proportion of unsaturated fatty acids, particularly much lower linoleic acid content. Studies have shown that pigs fed sorghum have lower linoleic acid content in meat and lower PUFA/SFA ratios in backfat and mandibular fat. In the present study, yeast culture supplementation in the barley-sorghum diet significantly increased SFA and PUFA content in the longissimus dorsi muscle while significantly reducing SFA content and increasing MUFA content in subcutaneous adipose tissue.

Conclusion

Compared with conventional corn-soybean meal diets, feeding a barley-sorghum diet negatively affected growth performance in finishing pigs, while supplementation with 0.8% yeast culture alleviated this decline. The use of unconventional ingredients such as barley and sorghum affected muscle L* values and increased a* values, while combined yeast culture supplementation increased muscle inosinic acid content and improved meat quality.

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Note: Figure translations are in progress. See original paper for figures.