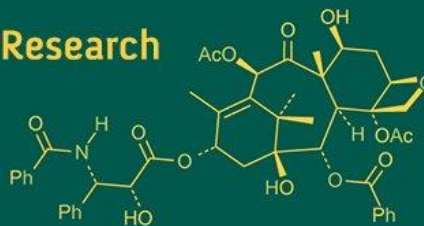


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(5): 405-409
www.biochemjournal.com
Received: 21-02-2026
Accepted: 26-03-2026

Akhilesh S
M.V.Sc. Scholar, Department
of Poultry Science, Madras
Veterinary College, Tamil
Nadu Veterinary and Animal
Sciences University, Chennai,
Tamil Nadu, India

Ashok A
Professor, Department of
Poultry Science, Madras
Veterinary College, Tamil
Nadu Veterinary and Animal
Sciences University, Chennai,
Tamil Nadu, India

Raj Manohar G
Professor, CPPM, Tamil Nadu
Veterinary and Animal
Sciences University, Hosur,
Tamil Nadu, India

Bandeswaran C
Professor, LRS, Tamil Nadu
Veterinary and Animal
Sciences University,
Kattupakkam, Tamil Nadu,
India

Corresponding Author:
Ashok A
Professor, Department of
Poultry Science, Madras
Veterinary College, Tamil
Nadu Veterinary and Animal
Sciences University, Chennai,
Tamil Nadu, India

Evaluation of whole paddy grain on carcass traits, chemical composition, and fatty acid profile in commercial broiler chicken

Akhilesh S, Ashok A, Raj Manohar G and Bandeswaran C

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i5e.8400>

Abstract

The increasing volatility in maize availability and price, driven by its competing demand across food, industrial, and biofuel sectors, has intensified the search for alternative feed ingredients in poultry production systems. Whole paddy grain represents a regionally abundant yet underutilized energy source, particularly in rice-dominant agro-ecological zones. The present study was undertaken to evaluate the effects of graded inclusion levels of whole paddy grain as a partial replacement for maize on carcass traits, proximate composition, and fatty acid profile of meat in commercial broiler chickens. A total of 144 day-old Ven Cobb 430 Y broiler chicks were randomly allocated to four dietary treatments under a completely randomized design, with three replicates of twelve birds each. The experimental treatments consisted of diets containing 0% (T₁), 5% (T₂), 10% (T₃), and 15% (T₄) whole paddy grain inclusion levels, formulated to be nearly isocaloric and isonitrogenous in accordance with BIS (2007) standards. Birds were reared under standard management conditions for a period of 42 days. At the end of the experimental period, significantly higher ($P < 0.05$) pre-slaughter live weight, eviscerated carcass weight, New York dressed weight, and ready-to-cook weight were observed in T₂, T₃, and T₄ compared to T₁. Giblet weight did not differ significantly ($P > 0.05$) among treatments. Among cut-up parts, significant improvements ($P < 0.05$) were observed in back, thigh, drumstick, wing, and neck weights in paddy-fed groups, whereas breast weight remained unaffected ($P > 0.05$). Proximate composition analysis revealed no significant differences ($P > 0.05$) in moisture, crude protein, and total ash content; however, ether extract was significantly higher ($P < 0.05$) in the control group. Fatty acid analysis demonstrated no significant alterations in MUFA and PUFA fractions, although specific saturated fatty acids such as capric and behenic acids exhibited treatment-dependent variation. The findings demonstrate that inclusion of whole paddy grain up to 15% can improve carcass yield without compromising meat quality, indicating its potential as a viable alternative energy source in broiler nutrition. These results have implications for feed cost optimization, regional feed resource utilization, and sustainable poultry production systems.

Keywords: Whole paddy grain, broiler chicken, carcass traits, fatty acid profile, alternative feed resources, poultry nutrition

Introduction

Global Feed Resource Constraints and the Maize Dependency Problem

The poultry sector is among the fastest-growing segments of animal agriculture, driven by rising global demand for affordable animal protein. However, this growth is increasingly constrained by feed cost volatility, particularly due to dependence on maize as the principal energy source. Maize typically constitutes 50-65% of broiler diets and contributes significantly to overall feed cost, which accounts for nearly 70% of total production expenses. In recent decades, maize markets have experienced substantial fluctuations due to competing demands from human consumption, industrial uses (including starch and ethanol production), and livestock feeding. These pressures are particularly pronounced in developing countries such as India, where the poultry sector is expanding rapidly but remains sensitive to feed cost shocks. Consequently, the identification of alternative energy sources that are locally available, cost-effective, and nutritionally adequate has become a critical priority.

Whole Paddy Grain as an Alternative Energy Source

Whole paddy grain (unprocessed rice with husk) represents a potential substitute for maize, particularly in rice-producing regions. India, being one of the largest producers of rice globally, generates substantial quantities of paddy, including lower-grade grains unsuitable for human consumption. The utilization of such grains in poultry diets offers a pathway for improving feed resource efficiency and reducing dependence on maize. From a nutritional perspective, paddy grain contains comparable levels of gross energy and crude protein to maize. However, its composition differs in key aspects, including higher fiber content and the presence of non-starch polysaccharides (NSPs), which may influence digestibility. The husk component contributes to increased structural fiber, which can affect nutrient availability but may also stimulate gizzard development and improve digestive efficiency.

Physiological Basis for Whole Grain Utilization in Poultry

Unlike many monogastric species, chickens possess a highly developed gizzard capable of mechanically grinding coarse feed particles. The inclusion of whole grains in poultry diets has been associated with enhanced gizzard function, improved gut motility, and better nutrient utilization. Banfield and Forbes (2001)^[1] demonstrated that whole grain feeding can influence gastrointestinal physiology and microbial dynamics, potentially improving feed efficiency. The mechanical action of the gizzard facilitates the breakdown of fibrous components and enhances enzymatic access to nutrients. This suggests that moderate inclusion of whole paddy grain may not only be tolerated but may also confer physiological benefits.

Previous Research and Knowledge Gaps

Several studies have investigated the use of paddy rice in poultry diets. Nanto *et al.* (2012)^[6] and Sittiya and Yamauchi (2014)^[11] reported that partial replacement of conventional feed ingredients with paddy grain did not adversely affect growth performance. However, results have been inconsistent, particularly at higher inclusion levels, where reduced performance has been observed due to increased fiber content.

While growth performance has been relatively well studied, there is limited information on the effects of whole paddy grain on carcass composition and meat quality parameters, particularly fatty acid profile. These parameters are critical for consumer acceptance and nutritional evaluation of poultry meat.

Objectives of the Study

The present study was designed to address these gaps by systematically evaluating the effects of graded levels of whole paddy grain inclusion on:

- Carcass traits and yield parameters
- Cut-up part distribution
- Proximate composition of meat
- Fatty acid profile

The study aims to provide a comprehensive assessment of the suitability of whole paddy grain as an alternative energy source in broiler diets.

Materials and Methods

The present experiment was conducted at the Department of Poultry Science, Madras Veterinary College, Chennai,

following approval from the Institutional Animal Ethics Committee (IAEC No: 04/SA/IAEC/2024). A total of 144 day-old straight-run commercial broiler chicks (Ven Cobb 430 Y) were procured and randomly allotted to four dietary treatments under a completely randomized design. Each treatment consisted of three replicates with twelve birds per replicate, ensuring uniform distribution of body weight across treatments at the start of the experiment.

The experimental diets were formulated to include whole paddy grain at graded levels of 0% (T₁), 5% (T₂), 10% (T₃), and 15% (T₄), replacing maize proportionately. All diets were designed to be nearly isocaloric and isonitrogenous, conforming to the nutrient specifications prescribed by the Bureau of Indian Standards (BIS, 2007). Birds were reared under standard deep litter management conditions with ad libitum access to feed and water throughout the 42-day experimental period. The feeding regimen was divided into three phases: pre-starter (0-7 days), starter (8-21 days), and finisher (22-42 days).

Table 1: Experimental Design

Experimental group	Treatment
T ₁	Basal diet with 0% whole paddy grain
T ₂	Basal diet with 5% whole paddy grain
T ₃	Basal diet with 10% whole paddy grain
T ₄	Basal diet with 15% whole paddy grain

At the end of the experimental period, six birds from each treatment group (three males and three females) were randomly selected for carcass evaluation. Birds were fasted for six hours prior to slaughter, after which pre-slaughter live weight was recorded. Slaughter was carried out by severing the jugular vein following standard humane procedures. Carcass parameters, including eviscerated carcass weight, New York dressed weight, ready-to-cook weight, and giblet weight, were recorded. Subsequently, carcasses were dissected into standard cut-up parts, namely breast, back, thigh, drumstick, wings, and neck, and individual weights were recorded.

For chemical composition analysis, two birds from each replicate (total n = 24) were randomly selected, and breast muscle samples were collected. The samples were analyzed for moisture, crude protein, ether extract, and total ash content using standard AOAC procedures at the Animal Feed Analytical and Quality Assurance Laboratory (AFAQAL), Namakkal. The percentage data were subjected to arcsine transformation prior to statistical analysis to stabilize variance associated with proportional data.

Fatty acid profiling of the meat samples was performed using established lipid extraction and analytical procedures as described by Palmquist and Jenkins (2003)^[8]. The fatty acid composition was expressed as percentage of total fatty acids.

All experimental data were analyzed using Analysis of Variance (ANOVA) employing IBM SPSS software (version 25.0). The statistical model included treatment as a fixed effect under a completely randomized design framework. When significant differences were detected, means were compared using Duncan's Multiple Range Test (Kramer, 1956)^[5]. Statistical significance was declared at $P < 0.05$.

Results

The effect of dietary inclusion of whole paddy grain on carcass characteristics is presented in Table 2. The results

indicated that pre-slaughter live weight, eviscerated carcass weight, New York dressed weight, and ready-to-cook weight were significantly higher ($P<0.05$) in birds fed diets containing 5%, 10%, and 15% whole paddy grain (T_2 , T_3 , and T_4) compared to the control group (T_1). Among these treatments, the highest values were consistently observed in T_4 , although T_2 and T_3 also showed comparable improvements. In contrast, giblet weight did not differ significantly ($P>0.05$) among the treatment groups, indicating that internal organ development remained unaffected by dietary inclusion of paddy grain.

The influence of dietary treatments on cut-up parts is summarized in Table 3. No significant difference ($P>0.05$) was observed in breast weight across treatments, suggesting that the deposition of breast muscle was not influenced by paddy grain inclusion. However, significant increases ($P<0.05$) were observed in the weights of back, thigh, drumstick, wings, and neck in T_2 , T_3 , and T_4 compared to T_1 . The magnitude of improvement was generally higher in T_4 , followed by T_3 and T_2 , indicating a dose-dependent response to increasing levels of paddy grain inclusion.

The chemical composition of broiler meat is presented in Table 4. The results showed that moisture, crude protein, and total ash content did not differ significantly ($P>0.05$) among the treatment groups. However, ether extract content was significantly higher ($P<0.05$) in the control group (T_1) compared to the paddy-fed groups, particularly T_3 and T_4 . This indicates a reduction in fat deposition in birds receiving higher levels of paddy grain.

The fatty acid profile of broiler meat is presented in Table 5. The results revealed that there were no significant differences ($P>0.05$) in the proportions of monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) among treatments. However, certain saturated fatty acids exhibited significant variation. Capric acid content was significantly higher ($P<0.05$) in T_4 compared to T_2 , while behenic acid was significantly higher ($P<0.05$) in T_4 compared to T_1 . Conversely, arachidic acid content was significantly higher ($P<0.05$) in T_1 compared to T_4 . These findings indicate selective modulation of specific saturated fatty acids without affecting the overall fatty acid profile.

Discussion

The significant improvement observed in carcass traits, particularly pre-slaughter live weight and carcass yield parameters, suggests that partial replacement of maize with whole paddy grain up to 15% does not adversely affect growth performance and may enhance nutrient utilization efficiency. These findings are in agreement with Sharma *et al.* (2018) [10], who reported improved dressed weight and carcass yield in broilers fed diets containing paddy grain supplemented with enzymes. The enhanced performance observed in the present study may be attributed to improved

gizzard activity associated with whole grain feeding, which facilitates mechanical breakdown of feed particles and enhances digestive efficiency (Banfield and Forbes, 2001) [1].

The absence of significant differences in giblet weight across treatments indicates that dietary inclusion of paddy grain does not affect internal organ development, suggesting that the diets were nutritionally adequate and did not impose physiological stress on the birds. Similar findings have been reported by Gen (2007) [3] and Yu Lu *et al.* (2007) [14], who observed no significant changes in carcass characteristics at moderate levels of paddy inclusion.

The observed increase in weights of cut-up parts such as thigh, drumstick, and wings in paddy-fed groups suggests improved muscle deposition in these regions. The lack of significant difference in breast weight indicates that muscle growth remained proportionally distributed, rather than preferentially enhanced in specific regions. This pattern of response is consistent with the findings of Nanto *et al.* (2012) [6], who reported uniform growth across muscle groups in broilers fed whole grain diets.

The reduction in ether extract content in paddy-fed groups is indicative of lower fat deposition, which may be attributed to the higher fiber content of paddy grain. Dietary fiber is known to influence lipid metabolism by reducing energy availability and altering nutrient partitioning, leading to leaner carcasses. Similar observations have been reported by Kita and Okuten (2013) [4], who found no significant changes in protein content but observed variations in lipid deposition with alternative grain feeding.

The stability of moisture, crude protein, and ash content across treatments indicates that inclusion of paddy grain does not compromise the basic nutritional composition of meat. This is consistent with the findings of Yu *et al.* (2022) [13], who reported no significant differences in proximate composition in poultry fed varying levels of paddy rice.

The fatty acid profile results suggest that inclusion of paddy grain does not significantly affect the overall balance of MUFA and PUFA, which are critical determinants of meat quality and nutritional value. However, the observed variation in specific saturated fatty acids such as capric, arachidic, and behenic acids indicates that dietary composition can influence lipid metabolism at a more nuanced level. Nishikawa *et al.* (2024) [7] reported similar variations in fatty acid composition with rice-based diets, suggesting that grain type can modulate fatty acid synthesis pathways.

Overall, the findings of the present study demonstrate that whole paddy grain can be effectively utilized as a partial replacement for maize in broiler diets without compromising performance or meat quality. The improved carcass traits and reduced fat deposition further enhance its value as a feed ingredient.

Table 2: Mean $\pm$ SE of carcass characteristics of broiler meat at 6th week of age in different groups of broiler chicken by feeding different levels of whole paddy grain

Parameters	T ₁ (control)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)
Preslaughter live weight (g)	2403.00 ^b $\pm$ 123.96	2706.00 ^a $\pm$ 74.98	2696.66 ^a $\pm$ 74.44	2750.16 ^a $\pm$ 76.44
New York dressed weight (g)	2240.66 ^b $\pm$ 116.13	2518.33 ^a $\pm$ 72.92	2508.50 ^a $\pm$ 71.26	2560.16 ^a $\pm$ 74.35
Eviscerated carcass weight (g)	1783.83 ^b $\pm$ 110.59	2005.33 ^{ab} $\pm$ 49.30	2040.33 ^a $\pm$ 44.26	2098.16 ^a $\pm$ 94.03
Ready to cook weight (g)	1875.16 ^b $\pm$ 115.85	2105.00 ^{ab} $\pm$ 52.83	2134.66 ^{ab} $\pm$ 48.49	2187.83 ^a $\pm$ 98.33
Giblet weight (g)	91.33 $\pm$ 5.62	99.66 $\pm$ 5.32	94.33 $\pm$ 4.96	89.66 $\pm$ 6.00

Means bearing different superscripts within a row differ significantly ($P<0.05$)

*Significant ($P<0.05$), NS - Not Significant

Table 3: Mean $\pm$ SE of cut up parts of broiler meat at 6th week of age in different groups of broiler chicken by feeding different levels of whole paddy grain

Parameters	T ₁ (control)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)
Breast Weight (g)	595.50 $\pm$ 57.27	642.00 $\pm$ 20.11	633.33 $\pm$ 6.46	665.00 $\pm$ 18.05
Back Weight (g)	320.66 ^b $\pm$ 24.36	348.83 ^{ab} $\pm$ 17.52	409.00 ^a $\pm$ 26.38	355.66 ^{ab} $\pm$ 15.99
Thigh Weight (g)	259.83 ^b $\pm$ 16.31	306.33 ^a $\pm$ 9.84	281.33 ^{ab} $\pm$ 11.21	312.83 ^a $\pm$ 17.79
Drumstick weight (g)	240.16 ^b $\pm$ 14.02	287.33 ^a $\pm$ 9.58	285.33 ^a $\pm$ 12.79	317.83 ^a $\pm$ 21.11
Wing weight (g)	198.00 ^b $\pm$ 12.83	217.00 ^{ab} $\pm$ 4.34	234.66 ^a $\pm$ 7.20	237.83 ^a $\pm$ 16.48
Neck Weight (g)	153.83 ^b $\pm$ 8.27	181.33 ^a $\pm$ 4.60	166.66 ^{ab} $\pm$ 3.08	182.33 ^a $\pm$ 10.11

Means bearing different superscripts within a row differ significantly ($P < 0.05$)

*Significant ($P < 0.05$), NS - Not Significant

Table 4: Mean $\pm$ SE of chemical composition of broiler meat at 6th week of age in different groups of broiler chicken by feeding different levels of whole paddy grain

Parameters	T ₁ (control)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)
Moisture (%)	74.56 $\pm$ 0.51	74.56 $\pm$ 1.10	74.92 $\pm$ 0.27	75.43 $\pm$ 0.32
Crude Protein (%)	20.10 $\pm$ 0.36	19.59 $\pm$ 1.18	20.51 $\pm$ 0.64	20.22 $\pm$ 0.35
Ether Extract (%)	3.06 ^a $\pm$ 0.47	2.65 ^{ab} $\pm$ 0.42	1.82 ^b $\pm$ 0.29	1.91 ^b $\pm$ 0.02
Total Ash (%)	1.28 $\pm$ 0.01	1.12 $\pm$ 0.01	1.28 $\pm$ 0.07	1.39 $\pm$ 0.10

Means bearing different superscripts within a row differ significantly ($P < 0.05$)

*Significant ($P < 0.05$), NS - Not Significant

Table 5: Mean $\pm$ SE of fatty acid profile of broiler meat at 6th week of age in different groups of broiler chicken by feeding different levels of whole paddy grain

Fatty acid (%)	T ₁ (Control)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)
Capric Acid	0.55 ^{ab} $\pm$ 0.20	0.21 ^b $\pm$ 0.08	0.36 ^{ab} $\pm$ 0.07	0.78 ^a $\pm$ 0.25
Lauric Acid	0.15 $\pm$ 0.02	0.15 $\pm$ 0.03	0.17 $\pm$ 0.01	0.12 $\pm$ 0.12
Myristic Acid	0.86 $\pm$ 0.11	0.85 $\pm$ 0.04	0.76 $\pm$ 0.03	0.96 $\pm$ 0.20
Palmitic Acid	27.40 $\pm$ 0.88	27.63 $\pm$ 0.11	26.73 $\pm$ 0.43	26.98 $\pm$ 0.80
Palmitoleic Acid	3.29 $\pm$ 0.38	3.27 $\pm$ 0.29	3.47 $\pm$ 0.32	2.57 $\pm$ 0.13
Stearic Acid	5.73 $\pm$ 0.67	5.89 $\pm$ 0.14	5.63 $\pm$ 0.12	7.16 $\pm$ 0.80
Oleic Acid	41.9 $\pm$ 1.29	42.31 $\pm$ 1.47	42.27 $\pm$ 0.34	38.95 $\pm$ 1.99
Linoleic Acid	17.52 $\pm$ 0.67	17.50 $\pm$ 0.63	16.89 $\pm$ 0.21	16.88 $\pm$ 0.52
Arachidic Acid	0.14 ^a $\pm$ 0.04	0.09 ^{ab} $\pm$ 0.02	0.08 ^{ab} $\pm$ 0.01	0.02 ^b $\pm$ 0.02
Linolenic Acid	0.67 $\pm$ 0.11	0.66 $\pm$ 0.24	0.78 $\pm$ 0.17	1.00 $\pm$ 0.45
Behenic Acid	1.24 ^b $\pm$ 0.40	0.87 ^b $\pm$ 0.18	1.61 ^{ab} $\pm$ 0.15	3.29 $\pm$ 0.90
Eicosapentaenoic Acid	0.01 $\pm$ 0.01	0.08 $\pm$ 0.08	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
Docosahexaenoic Acid	0.30 $\pm$ 0.17	0.15 $\pm$ 0.06	0.15 $\pm$ 0.08	0.43 $\pm$ 0.12
Others	0.37 $\pm$ 0.12	0.24 $\pm$ 0.05	1.00 $\pm$ 0.65	0.75 $\pm$ 0.33
MUFA: PUFA	2.44 $\pm$ 0.13	2.50 $\pm$ 0.20	2.56 $\pm$ 0.05	2.27 $\pm$ 0.07
MUFA: SFA	1.26 $\pm$ 0.09	1.27 $\pm$ 0.05	1.29 $\pm$ 0.02	1.07 $\pm$ 0.11
PUFA: SFA	0.51 $\pm$ 0.04	0.51 $\pm$ 0.01	0.50 $\pm$ 0.01	0.47 $\pm$ 0.04

Means bearing different superscripts within a row differ significantly ($P < 0.05$)

*Significant ($P < 0.05$), NS - Not Significant

Conclusion

The results of the present study clearly demonstrate that whole paddy grain can be included in broiler diets up to a level of 15% as a partial replacement for maize without adverse effects on carcass traits, chemical composition, or fatty acid profile of meat. The inclusion of paddy grain resulted in significant improvements in carcass yield parameters and reduced fat deposition, indicating a favorable effect on production efficiency and meat quality. The absence of negative effects on protein content and fatty acid composition further supports its suitability as an alternative energy source in poultry nutrition. From a practical standpoint, the use of whole paddy grain offers a cost-effective and regionally sustainable feed resource, particularly in rice-producing areas. These findings provide a

strong basis for the incorporation of whole paddy grain into commercial broiler feeding programs and contribute to the development of more resilient and economically viable poultry production systems.

Acknowledgement

This research was funded by Department of Poultry Science, Madras Veterinary College, Tamil Nadu Veterinary and Animal Science University, Chennai - 600 007, Tamil Nadu, India.

References

- Banfield MJ, Forbes JM. Effects of whole wheat dilution vs. substitution on coccidiosis in broiler chickens. *British Journal of Nutrition*. 2001;86(1):89-95.
- Bureau of Indian Standards (BIS). Indian Standard: Poultry feed specification (5th Revision). 2007.
- Gen G. Studies on the application effects of paddy grain in broiler chicken diets [Master's thesis]. Yangzhou University; 2007.
- Kita K, Okuten A. Influence of dietary rice grain replaced from corn on serum concentrations of amino acids in young chickens. *Journal of Poultry Science*. 2013;50(2):114-119.
- Kramer CY. Extension of multiple range tests to group means with unequal numbers of replications. *Biometrics*. 1956;12(3):307-310.
- Nanto F, Kikusato M, Ito C, Sudo S, Toyomizu M. Effects of dehulled, crushed and untreated whole-grain paddy rice on growth performance in broiler chickens. *Journal of Poultry Science*. 2012;49(4):291-299.
- Nishikawa K, Miyazaki K, Hirai T, Saneyasu T, Honda K. Effects of dietary brown rice and sake lees on the growth performance and color of meat in broiler chicks. *Journal of Poultry Science*. 2024;61:2024007.
- Palmquist DL, Jenkins TC. Challenges with fats and fatty acid methods. *Journal of Animal Science*. 2003;81(12):3250-3254.
- Ridgman WJ. Statistical Methods, 8th edn, by G. W. Snedecor and W. G. Cochran. *Journal of Agricultural Science*. 1990;115(1):153-153.
- Sharma R, Baghel RPS, Sharma RK, Mishra S, Nayak S, Yadav AS. Effect of varying levels of enzyme supplementation with high levels of paddy replacing maize on the performance and economics of broiler production. *Journal of Entomology and Zoology Studies*. 2018;6(4):05-09.
- Sittiya J, Yamauchi KE. Growth performance and histological intestinal alterations of Sanuki Cochin chickens fed diets diluted with untreated whole-grain paddy rice. *Journal of Poultry Science*. 2014;51(1):52-57.

12. Wang M, Xu QR, Sun JY, Kim BG. Effects of enzyme supplementation on growth, intestinal content viscosity and digestive enzyme activities in growing pigs fed rough rice-based diet. *Journal of Animal Science*. 2008;21:270-276.
13. Yu JH, Zhang HM, Yang HM, Wang ZY. Effects of dietary paddy rice on growth performance, carcass traits, bare skin color and nutrient digestibility in geese. *Poultry Science*. 2022;101(6):101865.
14. Yu J, Lu J, Xing-Yong C, Run-Shen J. Effect of replacing corn with paddy grain on broiler growth and slaughter performance. *Journal of Anhui Agricultural University*. 2007;18:27-31.