Journal homepage
www.ajas.uoanbar.edu.iq
Anbar Journal of Agricultural Sciences
(University of Anbar – College of Agriculture)

EFFECT OF SUBSTITUTING RICE BRAN TREATED WITH A MIX OF ENZYMES AND PROBIOTICS FOR YELLOW CORN (ZEA MAYS) ON THE PERFORMANCE OF ROSS 308 BROILERS

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Article info

Received: 2024-10-15
Accepted: 2024-12-04
Published: 2025-06-30

DOI-Crossref:
10.32649/ajas.2025.186679

Cite as:
Areaaer, A. H., Hammod, A. J., and Almrsomi, T. S. (2025). Effect of substituting rice bran treated with a mix of enzymes and probiotics for yellow corn (zea mays) on the performance of ross 308 broilers. Anbar Journal of Agricultural Sciences, 23(1): 432-443.

Abstract

This experiment aimed at improving the quality of rice bran using multi-enzymes and probiotics (MEP) as a feed additive for broilers. The treatments comprised a control (PO with 45% yellow corn without MEP), and P1, P2 and P3 replacd with 10% rice bran treated with 0.500, 0.750, 1.000g multi-enzymes/kg in the diet, respectively. Meanwhile, groups P4, P5, and P6 replaced 10% of the yellow corn with rice bran treated with similar amounts of MEP/kg in the diet, respectively. The 10% rice bran treated with 0.750g/kg enzymes (P2) at $P \leq 0.05$ produced the best outcomes in body weight (BW), growth, production index, and economic aspects, similar to the control (corn diet). In general, the studied parameters fluctuated for all treatments during 8-35 days of the broilers' ages.

Keywords: Broiler, Enzyme, Performance, Rice bran.

تأثير إحلال سحالة الرز المعاملة بمخلوط الانزيمات او البروبايوتك محل الذرة الصفراء في الأداء الإنتاجي لفروج اللحم روز 308

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الخلاصة

أجريت التجربة لتحسين القيمة الغذائية لسحالة الرز باستخدام مخلوط من الانزيمات المختلفة ومخلوط من البروبايوتك كمضافات غذائية في عليقة فروج اللحم. وكانت المعاملات كما يلي: معاملة المقارنة P0 (تحتوي على 45% ذرة صفراء وبدون إضافة مخلوط الانزيمات او البروبايوتك)، المعاملات P1, P2 وP3 تم استخدام سحالة الرز بنسبة 10% بالعليقة محل الذرة الصفراء مع إضافة مخلوط الانزيمات بمقدار 0,500 و0,750 و1,000 غم لكل 1 كغم على التوالي من العليقة محل الذرة الصفراء، بينما المعاملات P4, P5 وP6 تم استخدام سحالة الرز بنسبة 10% بالعليقة محل الذرة الصفراء مع إضافة مخلوط الانزيمات والبروبايوتك بمقدار 0,500 و0,750 و1,000 غم لكل 1 كغم على التوالي من العليقة محل الذرة الصفراء. تباين أداء المعاملات التجريبية مقارنة مع معاملة المقارنة في الأداء الإنتاجي في صفتي وزن الجسم الحي عند التسويق ومعدل الزيادة الوزنية والدليل الانتاجي والمؤشر الاقتصادي وكانت الافضل هي معاملة P2 معنويا (P≤0.05) عند إضافة مخلوط الانزيمات بمقدار 0,750 غم لكل 1 كغم علف حيث لم تختلف معنويا مقارنة مع معاملة السيطرة P0 وخلال الفترة (8–35 يوما من العمر) في صفات النمو والدليل الإنتاجي والمؤشر الاقتصادي.

كلمات مفتاحية: فروج اللحم، الانزيم، الأداء الإنتاجي، سحالة الرز.

Introduction

Poultry projects have been focusing on the use of local by-products to reduce feed costs. Rice is an essential food in Iraq and its bran is one of the cheapest and most readily available feed ingredient. It contains approximately 9-13% protein, 13% lipids and 2980 kcal of metabolism energy per kg (12 and 22). The crude protein digestibility in rice bran is 73% which also contains threonine (4.2%), cysteine (5.4%) and lysine (4.8%) which can be an active source of amino acid supplementation as compared to yellow corn (14, 18 and 20). However, the use of rice bran in poultry diets is limited due to its high fibrous contents (cellulose and hemicelluloses) and lack of cellulase enzyme in the broiler gut which reduces the digestibility of fibers in bird diets (32). This anti-nutritional factor reduces the availability of nutrients in feed containing rice bran (27) thus negatively impacting the growth performance and feed consumption of broilers (3, 4, 5, 14, 24 and 26) and their economic performance (10).

Various techniques have been applied to mitigate these inhibition factors and improve nutritional values such as treatment with enzymes and probiotics to improve broiler health and performance (6, 7, 9, 11 and 17), especially in regard to weight gain (25), and to enhance nutrient preservation (11 and 23). This is one of the best solutions to enrich the nutritive value of feedsstuffs. Enzymes and probiotics can improve the balance of gastric microbiota, leading to improved gut health (14, 15 and 17). Probiotics such as *Lactobacillus acidophilus* and *Bifidobacterium bifidum* have been employed to decrease pathogens in the small intestine (9 and 22) as a means to increase livestock productivity. Much research has been conducted on various differentiated feed products after enhancing the nutritious value of rice bran using different methods.

In this study, a combination of probiotics and enzymes was used to improve Iraqi rice bran quality for easy inclusion in broiler diets. Protease, amylase, and cellulase as enzyme mixtures and *L. acidophilus, B. Subtilis* and *S. faecium* were used to enhance the solubility of the crude fibers (13 and 19). The use of probiotics has been known to promote broiler growth (26).

Objective of the Study: The aim of this research was to evaluate the impact of substituting 10% of yellow corn with rice bran that included a combination of multi-enzymes and probiotics (MEP) as a feed additive in enhancing the growth performance, production index, and economic viability of broilers.

Materials and Methods

The experiment was conducted at the fowl farm of the Faculty of Agriculture, Kufa University over 5 weeks from February 1 to March 7, 2022. Rice bran from Iraqi amber rice was obtained from the local market in Kufa governorate. Its bran content comprised 12.8% crude protein, 16% ether extract, 6.9% crude fiber and 2980 kcal\kg of metabolism energy. The experimental flock consisted of 315 day-old chicks weighing 42g initial weight were purchased from the Al-Anwar Hatchery) a reliable hatchery in Babylon.

The study was based on the following experimental treatments:

Control (P0): 45% yellow corn in the diet without additives (baseline or reference treatment).

For each of the following treatment groups 10% of yellow corn was replaced with rice bran treated with different concentrations of enzymes and/or probiotics, as follows:

P1: 0.500g of multi-enzymes/kg diet.

P2: 0.750g of multi-enzymes/kg diet.

P3: 1.000g of multi-enzymes/kg diet.

P4: 0.500g of multi-probiotics and enzymes/kg diet.

P5: 0.750g of multi-probiotics and enzymes/kg diet.

P6: 1.000g of multi-probiotics and enzymes/kg diet.

Each treatment had three replicates of 45 broiler birds. The chicks were kept in floor cages in a closed house and split into pens as experimental units and provided with artificial lighting (23 hours/day), feed and drinking water. All necessary routine managements were followed, and the recommended vaccinations were administered throughout the 35-day study period.

The following key parameters were measured:

Growth;

Body weight (BW);

Feed intake and feed conversion ratio (FCR);

Average daily gain (ADG);

Production Index (PI): comprising a composite of growth rates, feeding efficiency, and other productivity factors; and

Economic Figures (EF): cost-effectiveness of each treatment, including feed cost per unit of weight gain or production output, according to (8).

Management and Diets: Four isocaloric and isonitrogenous diets were provided in mashed form (from day one to 21-days of age), namely starter (23% crude protein and about 3000 kcal/kg metabolizable energy) and finisher (day 22 to 35 days of age), according to the standard nutrient requirements of Ross 308 broilers (27). Diet P0 (yellow corn-based diet) served as control while P1, P2 and P3 were fed 10% rice bran treated with 0.500, 0.750 and 1.000g of multi-enzymes (protease above 2.750CFU, amylase more than 5.500 SLU and cellulase more than 275 FPU)\ 1 kg of diet respectively. Similarly, P4, P5 and P6 were fed 10% rice bran treated with the same amounts of multi enzymes and probiotics\1kg of diet, respectively. The designated experimental treatments are shown in Table 1. Labazyme is manufactured by New Pharm Company (Korea) and contains the multi-probiotics *L. acidophilus* (above 2.75*10CFU), *S. faecium* (above 8.25*10CFU), *B. Subtilis* (above 1.1*10CFU), and multiple enzymes, namely protease (more than 2.750CFU), amylase (more than 5.500 SLU), and cellulase (more than 275 FPU). The data were analyzed using one-way (ANOVA) by GLM processes of SAS (29) while Duncan multiple range at (P≤0.05) significance (33) was used for means.

Table 1: Composition of the experimental broiler basal diet and calculated chemical analysis (%).

Ingredients (%)	Starter (one-21 days)		Finisher (22-marketing day)	
	P0	P1,P2,P3	P0	P1,P2,P3
		P4,P5,P6		P4,P5,P6
Yellow corn	45	35	45	35
Rice bran	-	10	-	10
Wheat	16.60	17.10	23.10	23.80
Soybean meal (48%)	32.70	31.70	24.70	23.70
Premix[a]	2.50	2.50	2.50	2.50
Salt	0.20	0.20	0.20	0.20
Limestone	0.50	0.50	0.50	0.50
Dicalcium phosphate	1.5	1.5	1.5	1.5
Vegetable oil	1	1.5	2.5	2.8
Protein %	22.8	22.8	20	20
Metabolizable Energy (kcal/kg)	2969	2957	3120	3096
Calcium % (Total)	1. 26	0.120	0.100	0.100
Phosphorus % (available)	0.40	0.45	0.41	0.40
Total cysteine and methionine %	0.69	0.67	0.60	0.60
Fiber % (Total)	2.8	4.31	3.57	4
***Chemical analysis according to (23).**				

P1, P2, and P3 supplemented with 500, 750, and 1000 mg/kg diets of multi-enzymes, while P4, P5, and

P6 included similar amounts of enzymes and probiotics, respectively.

a: One kilogram of premix containing: 2200 kcal/kg Met.En., protein 45%, fat 8%, fiber 3%, calcium 6%, phosphorus (av) 0.12%, cys.+ meth. 2.5%, meth. 2%, lys. 3%. A 30.000 IU, D3 30.000 IU, E 500mg, K 40mg, B1 30mg, B2 75mg, B6 60mg, pantothenic acid 120mg, folic acid 15mg, biotin 1500mg, Niacin 400mg, choline 1.7%, Na 1.5%, Cu 70%, Zn 600mg, potassium iodine 5mg, Fe 450mg, cob 1mg, and Se 1mg.

Results and Discussion

Growth Parameters: P2 (0.750g/kg enzymes) showed the best performance in terms of growth, closely matching the control group (P0), which contained only yellow corn and no feed additives. The treatment groups exhibited fluctuations in growth parameters between 8-35 days of age, suggesting that performance could vary over time, especially with different enzyme or probiotic treatments.

The body weight of the chicks (Table 2) showed no significant differences between the control and experimental groups at 7 and 14 days of age, while at 21 days P0 recorded the maximum BW while the other groups recorded lesser weights ($P \leq 0.05$). No significant difference was found between experimental treatments and P0 at 28 days of age, except for the P3 snd P4 groups which were significantly ($P \leq 0.05$) lower than P0. At marketing age (35 days), no significant difference was foud in the BW of P2 and control, while the other groups were significantly ($P \leq 0.05$) lower compared to the control. Data for the entire study period shows that adding multi enzymes at about 0.750 mg/kg in the diets enhanced the feed conversion ratio, an important indicator of profitability as well as a critical factor in supporting body growth (Table 3).

Enzyme activity provides essential nutrients and reduces the cost of production processes. Improved FCR was clearly considerable for all experimental groups. This study provides new insights into the use of enzymes compared with probiotics, and its activity on growth parameters where FCR increased at similar amounts of enzyme additions although there were high levels of fiber in the diets especially during the finisher period (29-35 days). It also enhanced marketing body weights (P2 treatment) due to the improved palatability of feed stuff, which strengthen the PI and EF parameters.

Table 2: Effect of substituting rice bran treated with a mix of enzymes and probiotics for Zea mays on broiler body weight (mean value ± SD).

Treatment	Body weight at age (days)				
	7	14	21	28	35
P0	132±3.51ab	309±2.61ab	662±5.66a	1062±7.86ab	1546±10.04a
P1	135±2.30a	317±0.88a	626±11.2b	972±11.2b	1411±6.64bcd
P2	133±1.15ab	321±0.88a	612±10.3b	1066±9.52a	1483±2.02ab
P3	129±1.45ab	315±1.45a	539±1.15c	993±23.96c	1343±2.02d
P4	127±2.02b	291±12.1b	611±0.57b	981±9.23c	1368±17.29cd
P5	131±0.33ab	319±0.33a	527±2.88c	1013±19.05bc	1396±25.11cd
P6	132±0.88ab	325±2.88a	607±5.48b	1029±23.09abc	1430±50.56bc
***Sig. level**	*	*	*	*	*

* $P \leq 0.05$: significant difference for different letters in the same column. P1, P2, P3: addition of 500, 750, 1000 mg/kg of enzymes in diets; P4, P5, P6 addition similar amounts of enzymes and probiotics/kg, respectively.

As seen in Table 3, there was no significant differences in BWG during the first experimental period (8-14 days), though there was a significant ($P \leq 0.05$) decrease in the experimental treatments compared to the control during 15-21 days except for P1 and P4.

At 22-28 days, there was no significant difference between the control and experimental treatments except for P5 which had higher BWG than the control ($P \leq 0.05$). In the last stage of the experiment (29-35 days), a significant ($P \leq 0.05$) decrease in BWG was recorded for the experimental groups P1, P3, P5, and P6, while there was no significant difference between the control and P2 and P4 groups. There was no BWG difference between P2 and the control at 1-35 days, both having reached their highest BWG, while a significant drop ($P \leq 0.05$) in all other treatments in contrast to the control was recorded. As Table 4 shows, FCR decreased significantly ($P \leq 0.05$) in all treatments compared to the control, except P4 which recorded no significant difference during 8-14 days of age.

There was no significant difference in FCR at 15-21 days between the control and experimental groups. At 22-28 days, a significant decrease ($P \leq 0.05$) occurred for P2 and P5 while that for other experimental groups was similar to the control. In the final period (29-35 days), there was a significant ($P \leq 0.05$) decrease in feed consumption for P1, while the other treatment groups matched the control. At 1-35 days, a significant decrease ($P \leq 0.05$) in feed consumption was recorded for P1, P3 and P6 over the control, while P2, P4 and P5 were similar to the control.

The analysis in Table 5 show FCR being significantly higher ($P \leq 0.05$) for all treatments in contrast to the control at 8-14 days, except for P4. At 15-21 days, P2, P3, and P5 decreased significantly ($P \leq 0.05$) while the other treatments (P1, P4, and P6) matched the control. A similar response was recorded for 22-28 days. For the 29-35 days stage, all treatments significantly improved ($P \leq 0.05$) over the control except P3 which had a marked decrease. Over the total study period (1-35) days all treatments significantly improved ($P \leq 0.05$) over the control. FCR improved when rice bran mixed with 10% labazyme was fed to the chicks compared to the P0.

Production Index: P2 (0.750g of enzymes/kg diet) also had the highest production index, indicating that this treatment supported optimal broiler productivity, similar to the control group as seen in Table 6.

Economic Viability: The economic figures (in regard to feed conversion, feed costs, and weight gain) showed that the P2 group benefited not only in terms of growth but also in cost-effectiveness, similar to the control. This suggests that the 0.750g/kg enzyme treatment is a cost-efficient alternative to the control diet. At the project's conclusion, both the production index (PI) with economic figure (EF) data (Table 6) showed significant improvements ($P \leq 0.05$) for the P1, P2, and P6 groups over the P0, while P3, P4, and P5 decreased significantly ($P \leq 0.05$).

Table 3: Effect of substituting rice bran treated with a mix of enzymes and probiotics for Zea mays on broiler body weight gain (g) (mean value± SD).

Treatment	Body weight gain				
	8-14 days	15-21days	22-28 days	29-35 days	1-35 days
P0	178±2.07ab	344±5.77a	409±4.94bc	484±16.18a	1505±10.03a
P1	183±9.52a	310±23.1abc	392±21.36c	392±3.46b	1370±6.64cd
P2	189±0.03a	291±9.52bc	455±0.89ab	417±7.78ab	1442±2.03ab
P3	186±2.88a	224±2.31d	454±25.11ab	351±21.9b	1302±2.03d
P4	163±10.11b	320±12.7ab	369±8.37c	404±13.86ab	1343±4.61cd
P5	188±0.09 a	207±2.60d	486±16.17a	384±5.78b	1354±25.11cd
P6	192±2.02a	282±8.37c	421±28.86bc	401±58.62b	1388±50.56bc
*Sig. level	*	*	*	*	*

* P≤0.05: significant difference for different letters in the same column. P1, P2, P3: addition of 500, 750, 1000 mg/kg of enzymes in diets; P4, P5, P6 addition similar amounts of enzymes and probiotics/kg, respectively.

Table 4: Effect of substituting rice bran treated with a mix of enzymes and probiotics for Zea mays on broiler feed consumption (g) (mean value± SD).

Treatment	Feed consumption at age (days)				
	8-14	15-21	22-28	29-35	1-35
P0	241±5.86a	415±6.27	648±26.86a	861±27.63a	2165±54.71a
P1	157±17.32c	425±39.26	586±9.52ab	745±4.61b	1913±42.43b
P2	176±13.56bc	557±8.38	558±40.70b	833±46.48ab	2162±36.50a
P3	191±0.88b	417±8.37	602±10.39ab	831±47.04ab	2016±44.16b
P4	223±5.77a	478±43.87	578±0.33ab	773±3.76ab	2053±53.98ab
P5	176±2.02bc	455±14.43	558±6.64b	861±45.32a	2051±35.51ab
P6	185±2.88bc	399±14.43	603±42.43ab	773±7.79ab	1960±38.68b
*Sig. level	*	NS	*	*	*

* P≤0.05: significant difference for different letters in the same column. P1, P2, P3: addition of 500, 750, 1000 mg/kg of enzymes in diets; P4, P5, P6 addition similar amounts of enzymes and probiotics/kg, respectively.

Enzymes and probiotics are commonly used as feed additives in commercial Iraqi farms because of their positive effects in promoting broiler growth by degrading inhibiter structures and fiber (24). Improvements in both growth parameters and broiler performance to a variable extent using enzymes and probiotics (optimized percentage) have been confirmed by numerous studies (17, 26, 28, 29, 30 and 32). In this study, all the treatments (3 only with enzymes, and 3 others with enzymes and probiotics) affected the growth parameters, production index, and economic figure of the broilers in different ways. The best outcome for all the treatments, which was similar to the control (fed only a corn diet), in terms of the above parameters was obtained by using 0% rice bran treated with 0.750g/kg of enzymes as seen in P2.

Table 5: Effect of substituting rice bran treated with a mix of enzymes and probiotics for Zea mays on broiler feed conversion ratios (mean value± SD.

Treatment	Feed conversion ratios at age (days)				
	8-14	15-21	22-28	29-35	1-35
P0	1.37±0.2a	1.21±0.02c	1.59±0.06a	1.79±0.08b	1.44±0.03abc
P1	0.85±0.06c	1.41±0.23c	1.51±0.10a	1.91±0.06ab	1.39±0.02c
P2	0.95±0.06bc	2.04±0.04a	1.23±0.09bc	2.01±0.04ab	1.50±0.02abc
P3	1.03±0.02b	1.87±0.05ab	1.28±0.09bc	2.40±0.28a	1.54±0.03a
P4	1.37±0.05a	1.51±20bc	1.57±0.03a	1.91±0.06ab	1.53±0.03a
P5	0.94±0.01bc	2.19±0.09a	1.15±0.02c	2.24±0.08ab	1.51±0.01ab
P6	0.96±0.01bc	1.41±0.01c	1.44±0.01ab	2.02±0.31ab	1.41±0.06bc
*Sig. level	*	*	*	*	*

* P≤0.05: significant difference for different letters in the same column. P1, P2, P3: addition of 500, 750, 1000 mg/kg of enzymes in diets; P4, P5, P6 addition similar amounts of enzymes and probiotics/kg, respectively.

Table 6: Effect of substituting rice bran treated with mix of enzymes and probiotics for Zea mays on the production index and economic figures of broilers (mean value± SD).

Treatment	Production Index	Economic Figure
P0	307±7.52a	307.57±7.52a
P1	288±3.58ab	288.9±3.58ab
P2	282±3.92ab	282.73±3.92ab
P3	248±4.67c	248.00±4,67c
P4	259±4.99bc	259.03±4.99bc
P5	263±5.02bc	263.50±5.02bc
P6	290±22.38ab	290.40±22.38ab
*Sig. level	*	*

*** P≤0.05: significant difference for different letters in the same column. P1, P2, P3: addition of 500, 750, 1000 mg/kg of enzymes in diets; P4, P5, P6 addition similar amounts of enzymes and probiotics/kg, respectively.**

Corn is a fairly expensive feed compared to the rice bran byproduct which is not used in broiler diets. Substituting corn with 10% rice bran will reduce broiler feed costs as well as promote the use of renewable resource towards a more sustainable environment. Diet costs will also be reduced when using enzymes only as the cost of priobiotics will not need to be factored in.

This finding points to significant savings in broiler feed costs while maintaining its nutritional value and protecting the environment. This study strongly recommends substituting yellow corn in rice bran diets treated with 0.750g/kg of enzymes.

Conclusions

The diet containing 10% rice bran treated with 0.750g/kg enzymes (P2) produced results that were similar to the control group in terms of growth performance, production index, and economic efficiency. This treatment was identified as the most effective for broiler growth and economic performance among all experimental groups. While fluctuations were observed in performance across all the groups, the P2 group consistently showed a balance in growth and cost outcomes, indicating that a moderate level of enzyme supplementation might be optimal for improving rice bran quality without compromising performance.

This study showed that the optimal inputs for the alternative treatment involved 10% rice bran treated with 0.750g of enzymes/kg diet, which recorded similar outcomes as the control group for the growth, production index, and economic viability indicators. In terms of fluctuations, the performaces of the treatments varied over the experiment period although the P2 group provided consistent and reliable result, and the enzyme-only treatment was cost-effective, making it a viable economic alternative to conventional corn-based feeds.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

Authors 1: methodology, writing—original draft preparation. All authors were involved in writing and editing the review. The authors have read and agreed to the published version of the manuscript.

Funding:

This research was funded by the College of Education for Pure Sciences, University of Mosul which provided the research materials, laboratories, and used research equipment.

Institutional Review Board Statement:

This study was conducted according to authorized protocols of the Ministry of Higher Education and Scientific Research, Kufa University, Kufa Central Ethics Commission, Republic of Iraq.

Informed Consent Statement:

No Informed Consent Statement.

Data Availability Statement:

No Data Availability Statement.

Conflicts of Interest:

The authors declare no conflicts of interest associated with the publication of this research.

Acknowledgments:

The authors are gratedul for all the assistance provided in the conduct of this research.

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