Research Article

Effect of Fermented Feed Addition and Crude Protein Level on Performance of Local Chickens in the South of Vietnam

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Abstract | A study was conducted to evaluate the effect of fermented feed addition and crude protein level on the performance of local chickens in the south of Vietnam. It was (3*2*3 factorial) with 2 factors. **Factor fermentation:** Yeast-fermented maize (YM), Yeast-fermented broken rice (YR), Probiotic fermented maize (PM). **Factor protein level:** 20% (CP20) and 16% (CP16). One hundred and eighty Noi chickens at 6 weeks of age (334±9.5 g/bird), and 10 birds per unit (balanced sex) were in the treatment. All treatments were added 4% (DM) of fermented feed to the basal diet. The trial lasted 9 weeks with Noi chickens from 6 to 14 weeks of age. The results showed when adding yeast feed at 4% (DM) to the diet of Noi chickens, there is an increase the weight and decrease in FCR of Noi chickens. Especially the PM treatments had the best results. At crude protein level, the CP20 treatments was better than the CP16 treatments. Microorganisms of chicken manure, especially the PM treatments was the highest Lactobacilli and the PM treatments was the best results (*E. coli* and *Clostridium* the lowest). It was concluded that in Noi chickens from 6 to 14 weeks of age, the treatment probiotic fermented maize (PM) supplement at 4% (DM) and diet with 20% crude protein had the most positive outcomes.

Keywords | Noi chickens, Fermented, Lactobacilli, *E. coli, Clostridium*

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INTRODUCTION

In many Vietnamese provinces, particularly in the south, Noi chickens are raised, which helps farmers increase their income. Raising domestic chickens has several advantages, including good resistance, simplicity in rearing, and good climatic and breeding circumstances adaption. This type of bird, raised in a small-scale project in Vietnam, has good genetic potential as they can eat and digest different types of feed. Therefore, domestic chicken production will play an important role in the sustainable development of the poultry industry in Vietnam.

Fermented maize or broken rice has helped the birds eat more, digest the feed better, Therefrom, helping the birds grow faster, the feed conversion ratio is reduced and the birds are less sick, especially reducing gastrointestinal diseases such as dysentery, typhoid and coccidiosis (Nha, 2020).

Maize and broken rice are very popular source of feed for poultry today. They are widely grown and popular in the southern provinces of Vietnam, so they are inexpensive food that is always available locally. The study's objectives include using more frequently locally produced feed, lowering the cost of raising animals, preventing poultry diseases, and being environmentally sustainable.

MATERIALS AND METHODS

Location and climate of the study area

The experiment was carried out on a private farm in Binh Minh Town, Vinh Long Province. The experimental period was from April to August 2022. The chemical analysis of feeds was done at the laboratory of the Department of Animal sciences, Faculty of Agriculture of Can Tho University.

Experimental animals

One day old Noi chickens were purchased from a farm in Long An Province. During the period of raising and preparing for the experiment, Noi chickens were fed with concentrate for chicks (20% CP). Noi chickens were trained to eat experimental diets 2 weeks before the experiment. Noi chickens were put into the experiment at 43 days old. These chickens were injected with vaccine H5N1, Newcastle and some other diseases before being put into the experiment.

Experimental design and treatments

Experiments (3*2*3 factorial) with 2 factors. **Factor fermentation:** Yeast-fermented maize (YM), Yeast-fermented broken rice (YR), Probiotic fermented maize (PM). **Factor protein level:** 20% (CP20) and 16% % (CP16). One hundred and eighty Noi chickens at 6 weeks of age (334±9.5 g/bird) were put to the test, and 10 birds per experimental unit (balanced sex). The treatments were: YM20, YR20, PM20, YM16, YR16 and PM16. All treatments were added 4% (DM) of fermented feed to the basal diet. The trial lasted 9 weeks with Noi chickens from 6 to 14 weeks of age. Feed ingredients of basal diet was presented in Table 1.

Table 1: Feed ingredient composition of concentrate basal diet in the experiment

	Feed	(%)		Feed	(%)
1	Rice bran	5.9	6	Premix vitamin	0.40
2	Maize	29.0	7	Premix mineral	0.50
3	Fish meal	9.3	8	$CaCO_3$	0.49
4	Broken rice	41.2	9	DCP	0.51
5	Soybean extraction	12.7			

Feeds and fermented maize

How to incubate cornstarch with active probiotics: Mix 1kg of active probiotics with 10kg of maize starch, then add about 5-6 liters of water and mix well until the corn is sticky. Then put it in a plastic bag or barrel and tie it tightly or cover the box (anaerobic). Keep the batch incubated in a dry, dark and warm place (about 32-35 Celsius degrees), can be used after 4-5 days. When taking maize to incubate for Noi chicken to eat, it will have a slight aroma and slightly sour taste, should only be used for 7-10 days (Niem and Nha, 2018) (Table 2).

Table 2: Active ingredients of probiotics used in the study

Ingredient	Units	Value
Bacillus subtilis	CFU	10^{10}
Saccharomyces boulardii	CFU	10^{10}-10^{14}
Lactobacillus acidophilus	CFU	10^{10}
Amylase	UI	280
Lipase	UI	80
β Glucanase	UI	180
Limestone, Rice Hulls	Gram	1000
(Microbiology Laboratory- University of Can Tho)		

Figure 1: Noi chicken in the experiment

Basal diet was formulated and contained 12.9 MJ ME/kgDM, 20% CP and 16% CP. Fermented feed was finely mixed with the concentrate following experimental design before feeding. Chemical compositions of feed basal diet were presented in Table 3.

Table 3: Chemical compositions of feed ingredients and basal diet (% DM)

Ingredient, %	Concentrated 20%CP	Concentrated 16%CP
DM	89.8	89.9
OM	92.1	92.0
CP	20.1	16.03
EE	7.49	7.51
CF	4.58	4.67
NDF	23.7	23.4
Ash	7.9	8.0
ME (MJ/kg DM)	12.94	12.98
ME (Kcal/kg)	3091	3098
B - Glucanase	18 UI/kgDM	18 UI/kgDM

DM: dry matter, OM: organic matter, CP: crude protein, EE: ether extraction, CF: crude fibre, NDF: neutral detergent fibre, ME: metablolizable ernergy (Janssen et al., 1989)

Housing and management

House for birds was made by bamboo and leaves. Experimental chickens live in an area of 2.5 m2 / 10 chickens

which was surrounded by wood, plastic net. The floor was covered with a layer of sand and 20cm thick of rice husk on its surface to make litter. Feeding and drinking troughs were placed in each cage. Birds were fed at 7.00, 13.00 and 17.00 hours (3 times/day) and bird feed was adjusted weekly by increasing from 5 to 10% according to actual feed intake. Noi chickens were freely to access water.

Measurements

Daily intakes of feed: feed and refusals were collected and weighed daily morning.

Weekly weight gains and feed conversion ratio: the birds were weighed weekly and at the end of experiment.

Fecal samples were collected at the 14th week of age (End of the experiment), the content of *Lactobacillus*, *Salmonella* spp., *E. coli* and *Clostridium perfringens* in stool samples were determined by colony counting method. Stool samples were collected directly at the barn for 10 Noi chickens/treatment (about 100g of manure/bag) and stored in cold storage. Then, these stool samples were homogenized and transferred to the Biology Laboratory of the Center for Analytical Services of Can Tho City for colony counting.
Carcass values: after finishing 4 chickens (2 males and 2 female) per each experimental unit were slaughtered for the evaluation of carcass traits. Body measurements of birds were described by Salomon (1996).

Chemical analyses

Feeds offered were analyzed for chemical compositions: DM, OM, CP, EE, CF and Ash. They were analyzed following procedures of AOAC (1990). NDF analysis was followed the Van Soest et al. (1991) and ME was calculated by Janssen (1989).

Statistical analysis

Data were analyzed by using General Linear Model (GLM) of Minitab program 16.1.0 (Minitab, 2016) and the comparison of significant difference between two treatments was done by Tukey method of Minitab (2016).

RESULTS AND DISCUSSION

Daily intakes of feed and nutrients of growing Noi chickens

Daily intakes of DM, OM, CP, EE and NDF were significantly lower (P<0.05) for the Noi chickens giving CP16 treatments than CP20 treatments at CP level factor. At the additional factor of fermented feed: Daily intakes of DM, OM, EE and NDF were significantly higher (P<0.05) for the Noi chickens giving PM treatments than for other treatments (Table 4).

The DM and CP intakes in the present trial are lower than those of a previous study on Tau Vang chickens (61.6-63.4 gDM/day; 11.1-11.5 gCP/day, respectively) reported by Nha and Dong (2021). The ME intake was significantly lower for the Noi chickens in the PM treatments (P<0.05) than for the Noi chickens in other treatments at the additional factor of fermented feed. At the CP level factor: Daily intakes of CP and ME were significantly higher for the Noi chickens in the CP20 treatments (P<0.05) than for the Noi chickens in CP16 treatments.

Effects of factor fermentation and factor protein level on the growth performance of growing Noi chicken

Table 5 shows that daily weight gain (DWG) were lower for the Noi chickens with YM and YP treatment than PM treatments at the additional factor of fermented feed. At the CP level factor, DWG was higher for Noi chickens with CP20 treatment than CP16 treatments. FCR was best used to PM treatments in fermented feed supplements. At the CP level factor, FCR of CP20 treatments was bester than CP16 treatments (3.1 and 3.3; respectively). FCR of this trial were consistent with the values of 3.1-3.5 reported by Pham Tan Nha (2020). The final live weights in this trial were in a range of 1405-1529g of a previous experiment (Nha and Dong, 2021). Results of CP consumption/weight gain was significantly lower for the chickens in the CP16 treatment (P<0.05) at the CP level factor (530 and 611 g/kg).

FCR tends to decrease when fermented feed is added. The PM treatments was the lowest FCR of chicken in the fermentation factor. At the CP level factor, the CP20 treatments was lower FCR of chicken than the CP16 treatments.

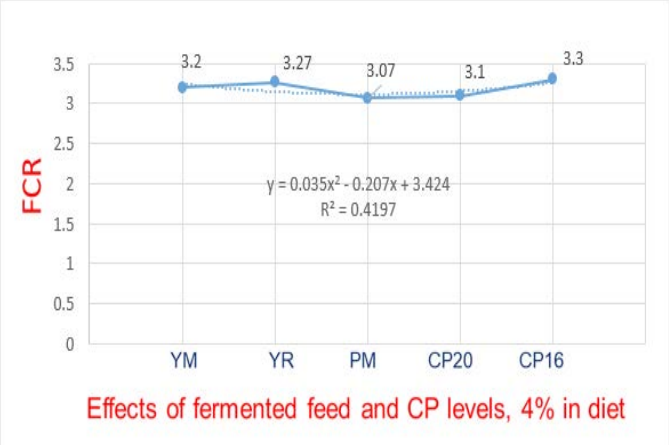

Figure 2: The effect of fermented feed and crude protein levels on FCR

Table 4: Daily intakes of feed and nutrient of Noi chicken (g/bird)

Item	Factor					SE	P
	YM	YR	PM	CP20	CP16		
DM	57.2	57.0	57.1	58.0	56.1	2.35	0.07/0.04
OM	51.9[b]	50.7[b]	54.3[a]	55.4	49.3	2.22	0.05/0.03
CP	10.3[a]	9.75[b]	10.3[a]	11.3	8.89	0.32	0.01/0.01
EE	2.30[b]	2.29[b]	2.86[a]	2.71	2.23	0.23	0.01/0.01
CF	2.95[ab]	2.50[c]	3.40[a]	3.53	2.37	0.30	0.01/0.01
NDF	7.81[b]	7.55[c]	8.0[a]	8.11	7.47	1.24	0.01/0.01
Ash	2.3[b]	2.25[b]	2.3[b]	2.46	2.13	0.04	0.06/0.01
ME (MJ/kg/DM)	0.74[a]	0.74[a]	0.70[b]	0.75	0.73	0.03	0.01/0.01

Table 5: Daily weight gain, final live weight and feed conversion ratio (FCR) of Noi chichens (g/bird)

Item	Factor					SE	P
	YM	YR	PM	CP20	CP16		
Initial live weight	329	333	336	331	334	9.5	0.97/0.95
Final live weight	1,458[b]	1,434[b]	1,509[a]	1,529	1,405	24.5	0.03/0.01
Daily weight gain	17.9[b]	17.5[b]	18.6[a]	19.0	17.0	0.38	0.01/0.01
FCR	3.2[a]	3.27[a]	3.07[b]	3.1	3.3	0.18	0.03/0.01
CP/ weight gain (g/kg)	574[a]	586[a]	552[b]	611	530	2.34	0.01/0.01
ME/weight gain (MJ/kg)	41.5[b]	42.4[a]	39.9[c]	39.6	42.9	1.97	0.01/0.01

Effects of dietary different fermented maize supplement on carcass quality of guineafowl

Slaughter weights of Noi chicken were correspondent to the final live weights. Carcass weight were not significantly higher in the YM, PM and CP20 treatments (P>0.05) (Table 6). Percentage of carcass was closed among the treatments (P>0.05), these results are in a range of 71.3-72.2%, published by Nha anh Dong (2022). Breast meat and thigh meat weights were significantly highest in YM, PM and CP20 treatments. Percentages of breast meat and thigh meat were resembled among the treatments (P>0.05). All internal organs were not significantly different among the treatments (P>0.05).

Intestinal microflora

Salmonella spp. is almost undetectable in noi chicken manure at week 14 (Table 7) in PM treatments. However, *Lactobacillus*, *E. coli* and *Clostridium* perfringens are quite high in noi chicken manure. In fermented feed supplements, the PM treatments with *Lactobacillus* bacteria was the highest, *E. coli* and *clostridium perfringens* bacteria were the lowest.

Table 6: Carcass values and internal organs of Noi chicken supplemented fermented feed in diets (g/bird)

Item	Factor					SE	P
	YM	YR	PM	CP20	CP16		
Slaughter live weight	1,439[b]	1,420[b]	1,519[a]	1,467	1,451	12.4	0.01/0.08
Carcass weight	1,036[b]	1,004[c]	1,096[a]	1,056	1,034	11.7	0.04/0.09
% Carcass	72.0	70.7	72.2	72.0	71.3	0.81	0.23/0.24
Thigh meat weight	192[b]	181[c]	207[a]	198	188	5.75	0.04/0.05
%Thigh meat	18.6	18.1	18.9	18.8	18.2	1.16	0.89/0.86
Breast meat weight	162[a]	151[b]	164[a]	165	154	4.07	0.03/0.04
% Breast meat	15.7	15.0	15.0	15.6	14.9	0.34	0.94/0.87
Heart weight	10.1	10.0	10.9	10.3	10.3	0.85	0.08/0.9
Liver weight	22.0	22.9	22.0	22.8	21.8	4.22	0.67/0.85
Cecal length, cm	14.2	13.6	14.0	13.5	14.3	1.34	0.83/0.76

[a, b, c] Mean values with different superscripts within the same row are different at P<0 05.

Table 7: Bacteria density in guineafowl at 14 th weeks age of the experimental

Variables	Factor					SEM	p
	YM	YR	PM	CP20	CP16		
Lactobacillus (10 CFU/g)	0.94[b]	0.92[b]	7.65[a]	3.25	3.09	0.67	0.01/0.15
Salmonella spp./25g (+/-)	Positive	Positive	Non detected	-	-	-	-
E. coli (10^5 CFU/g)	5.00[a]	4.66[a]	3.12[b]	4.07	4.44	0.06	0.02/0.27
Clostridium perfringens (10^4 CFU/g)	7.44[a]	7.29[a]	4.72[b]	5.98	6.98	0.02	0.03/0.13

[a, b, c] Means within a row with different superscripts are significantly different (P<0.05)

Such was very good for the health of chickens. Among these bacteria, *Lactobacillus* is a beneficial bacterium but *Salmonella spp.*, *E. coli* and *Clostridium perfringens* are potentially pathogenic bacteria.

Adding fermented feed to the Noi chicken diet at 4%(DM) in the diet, the content of lactobacilli in the stool also increased. The PM treatments was the highest Lactobacilli.

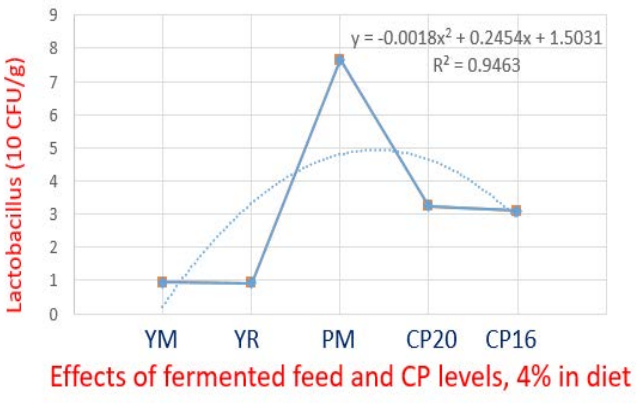

Figure 3: The effect of fermented feed on *Lactobacillus*

In contrast, mixing fermented feed with a diet reduced *E. coli* and *Clostridium* in the gastrointestinal tract of Noi chickens after 14 weeks. This can be explained when probiotics increase, causing pathogenic bacteria such as *E. coli* and *Clostridium* (P<0.05) to decrease compared to not adding fermented feed. Especially the PM treatments was the best results (*E. coli* and *Clostridium* the lowest).

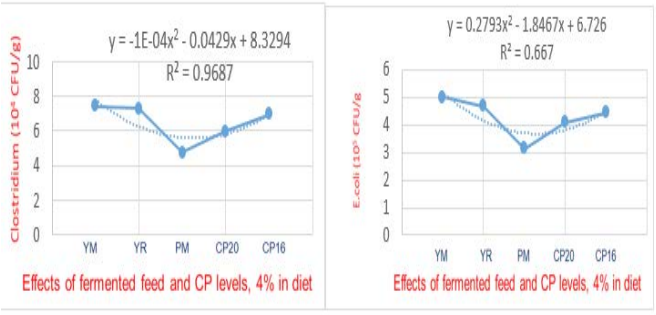

Figure 4: The effect of fermented feed on *E. coli* and *Clostridium*

This result is also consistent with the study of Niem and Nha (2018). When adding fermented fine bran to the diet of Hoa Lan ducks, it also increased *Lactobacillus* yeast and reduced *E. coli* bacteria in duck feces.

CONCLUSIONS

It was concluded that in Noi chickens from 6 to 14 weeks of age, the treatment probiotic fermented maize (PM) supplement at 4% (DM) and diet with 20% crude protein had the most positive outcomes.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

NOVELTY STATEMENT

Adding 4%(DM) of probiotic-fermented feed to the diet of local chickens improved chicken productivity and increased probiotics in the gut of local chickens.

AUTHORS CONTIRBUTION

The authors came up with ideas, designed experiments, conducted experiments, and wrote articles.

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