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Original Article

Adding fish meal into fermented moringa plus yellow corn in the diet does not affect performances but can recover breast yield of broiler

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Abstract

Objective: This study aimed to investigate the use of fermented domesticated-type *Moringa oleifera* leaves (FDMOL) + yellow corn (YC) + rice bran (RB) + top mix (TM) with the provision of fish meal (FM) in replacement of partial commercial diet (CD) to broiler performances and carcass yields.
Methods: The study used 100 broiler chicks, unsex, MB 90 performed into Completely Randomized Design (CRD) consisting of 5 treatments and 4 replicates. The trial diets were: MCR= 84.5% CD + 5% FDMOL + 5% YC + 5% RB + 0.5% TM (moringa+), MCF= 84.5% CD + 5% FDMOL + 5% YC + 5% FM + 0.5% TM (moringa++), C_1= 100% CD, C_2= 84.5% CD + 7.5% YC + 7.5% RB + 0.5% TM, and C_3 = 84.5% CD + 5% YC + 5% RB + 5% FM + 0.5% TM.
Results: Better adding fish meal into the FDMOL + YC rather than no fish meal in replacement of partial commercial diet to feed on the broilers. Most parameter performances and yields seemed not affected on broilers fed the FDMOL + YC base replacement diet, but the breast tended to reduce, then adding FM into FDMOL + YC relatively recovered this valuable part of cuts-up similar to the control.
Conclusion: Adding fish meal into fermented domesticated *Moringa oleifera* plus yellow corn in the diet did not affect performances but could recover the breast yield of broiler compared to those fed the moringa-based diet without adding fish meal.

Keywords: Breast; Broiler; Corn; Fishmeal; Moringa; Performances; Yields

INTRODUCTION

Moringa oleifera is a nutritious plant and is often named the miracle tree, the drumstick tree, and the horseradish tree. These plant leaves contain high protein (22.99–29.36%) and phytonutrients, proposing a prospective extra of food ingredients either for human or animal diets [1]. In addition, moringa leaves are rich in vitamin C, calcium, potassium [2], carotenoids [3], and other essential phytochemicals [4]. Moringa leaves are proper for animal feed since they contain high amounts of nutrients and low amounts of anti-nutrients [5].

The weaknesses of the moringa leaves to formulate in the poultry diet are associated with their low palatability due to active compounds such as *glucosoonjnain* [6]. High crude fiber content is another difficulty for these leaves to feed on the birds. The fermentation treatment can expand both. The study reported by [7] showed that fermentation reduced crude fiber in moringa. Another problem with administering the moringa leaves was their lack of energy. The energy might be supported by adding yellow corn to the moringa. Therefore, to employ the moringa in the poultry ration, the moringa leaves should be fermented and combined with yellow corn.

A previous study reported by [8,9] found that using fermented wild-type *Moringa oleifera* (FWMOL) mixed with yellow corn (YC) to replace a few commercial diets caused the decline in final body weight (FBW) and carcass yield of broilers. These were the impact of the decreased feed intake of birds fed the diet containing FWMOL. Fermentation could enhance the flavor, but the birds might still feel a bitter savor, causing lower feed consumption. Protein and other nutrients entering the gastrointestinal tract diminished when the birds reduced feed intake. The dietary nutrients at a level lower than a bird's requirements could aggravate protein deficiency. It can occur when the commercial diet is replaced with a single feed ingredient such as the only moringa. Corn could anticipate the energy, but the expected results might not be achieved successfully. Some possible other nutrients were assumed not to exist in proper amount in the moringa-based-diet supposed methionine.

Moringa is a good source of essential amino acids (EAA) except for methionine [10]. An inadequate amount of sulfur amino acids can severely upset the synthesis of enzymes [5]. EAA deficiency can be directed by supplementing fish meal or soybean meal. In this way, the total amount of amino acids can increase and improve feed palatability [5]. In a recent study, adding fish meal will serve more methionine and lysine to the moringa. Not all types of moringa have a lower taste. As reported by [6], *glucosoonjnain* is highly found in the wild type rather than in the domesticated moringa. Concerning this problem, the cultivated moringa was utilized in the recent study instead of the wild type.

Although moringa leaves are rich in nutrition and the plant grows easily in most areas of Indonesia, in some regions, the leaves of this plant are not so highly consumed by humans. Therefore, the broiler farmers in these places should explore these abundant leave sources to feed their broilers. The result of this study was expected to provide newer information about utilizing moringa in the poultry diet to substitute partially commercial diet. The plant types, the level of usage, the treatment on the leaves such as fermentation, and the combination of feeds for the moringa or adding a supplement for dietary adjustments may still take continuous study concerning the moringa. Then, the characteristics, people's acceptance, and the meat quality of carcass may be suggested to be further exposed and some of these have been discussed in [11]. This study aimed to examine the effect of using fermented domesticated moringa leaves mingled with yellow corn and fish meal to substitute a part of a commercial diet for broiler performances and carcass yields.

MATERIALS AND METHODS

Materials and equipment

A total of hundred broiler chicks, unsex, MB 90 produced by PT Expravet Nasuba (Mabar Group), Medan were used in the recent study. A CP511 Bravo, a broiler commercial feed produced by PT Charoen Pokhphand, North Sumatera was chosen to be replaced fractionally with the mixture feed composed of domesticated moringa leaves, yellow corn, commercial local fish meal, and top mix. Molasses and EM4 were provided to ferment the moringa leaves. The ND and IBD vaccines were purchased to immune the birds from possible infected diseases and then Vita Stress to prevent bird stress. The cages were constructed into 20 pens (1 × 1 m per pen) completed by feeders, drinkers, and heating bulbs. A disk mill was used for milling the moringa leaves.

Fermentation procedures

The leaves of moringa were harvested from the cultivated crops in Desa Lambhuk, Banda Aceh. The stems and other unexpected materials were removed from the leaves, and then the leaves were dried in the room for seven days. Then, the dry leaves were pounded by operating a disk mill.

The moringa leaf powder was fermented as follows: EM4 and molasses in the same amount of 3 ml each were diluted into 3 liters of fresh water, then blended within a bucket, and subsequently transferred into a sprayer. The dilution was scattered and mixed homogenized into 6 kg of the powder. The wet leave powder was filled densely into a plastic bag and then firmly fastened to reach a circumstance close to the anaerobe. The plastic bag containing the feed was stored in a dark chamber. After a week of incubation, the plastic bag was untied, and its content was spelled out and exposed to room temperature for drying.

Diets

The present study was developed regarding the unsatisfied results observed from the previous finding of feeding the broilers on FWMOL + YC. There were two experimental diets involved the FDMOL: The MCR diet was the mixture feed composed of 5% FDMOL + 5% yellow corn + 5% rice bran + 0.5% top mix without a fish meal, and then into this composition was added 5% fish meal in replacement of rice bran to constitute the MCF diet. Three control diets were presented in the absence of the FDMOL: The C_1 diet was 100% commercial diet CP511 Bravo, then 15.5% of this was replaced with the mixture feed composed of 7.5% yellow corn + 7.5% rice bran + 0.5% top mix to perform the C_2 diet, and subsequently, 5% fish meal was added into this composition with reducing an equal amount of 2.5% of yellow corn and rice bran each to obtain 15.5% in replacement to the CD diet to perform the C_3 diet. The nutrient contents of the experimental diets were set up according to NRC (1994) recommendation [12], and their compositions and calculated nutrient contents were given in Table 1. The experimental diets were presented as follows:

MCR = 84.5% commercial diet + 5% FDMOL + 5% yellow corn + 5% rice bran+ 0.5% top mix (moringa+)

MCF = 84.5% commercial diet + 5% FDMOL + 5% yellow corn + 0.5% top mix + 5% fish meal (moringa ++)

C1 = 100% commercial diet (control 1)

C2 = 84.5% commercial diet + 7.5% yellow corn + 7.5% rice bran + 0.5% top mix (control 2)

C3 = 84.5% commercial diet + 5% yellow corn + 5% rice bran + 5% fish meal + 0.5% top mix (control 3)

Table 1. The composition and nutrient contents of experimental diets (%)

Ingredients	Moringa based-diets		Control diets		
	MCR	MCF	C_1	C_2	C_3
			(%)		
CP511 Bravo[1]	84.5	84.5	100	84.5	84.5
FDMOL[2]	5.0	5.0	0	0	0
Yellow corn[3]	5.0	5.0	0	7.5	5.0
Fish meal[3]	0	5.0	0	0	5.0
Rice bran[3]	5.0	0	0	7.5	5.0
Top mix	0.5	0.5	0	0.5	0.5
Total	100	100	100	100	100
Calculated nutrient content					
Crude protein (%)	20.25–21.94	21.93–23.62	21.00–23.00	19.55–21.24	21.32–23.01
EM (kcal/kg)	2,874	2,906	2,950	2,945	2,920
Crude fiber (%) (max.)	5.20	5.18	5.00	5.28	5.50
Crude fat (%) (max.)	5.56	5.54	5.00	5.56	5.75
Ca (%)					
P (%)					
Methionine (%)	0.51	0.57	0.55	0.51	0.57
Lysine (%)	0.96	1.16	1.00	0.91	1.12

Nutrient contents refer to: [1] The marked label of CP511 Bravo, PT Charoen Pokphand: CP min. 21.0–23.0%, crude fat 5.0%, CF 5.0%, EM 2.900–3.000 kcal/kg, Ca min. 0.9%, P min. 0.6%, Met 0.55%, and Lys 1.00%, [2] Laboratory of Baristan, Banda Aceh, 2021: CP 25.96%, fat 8.80%, CF 5.35%; Laboratory Nutrition and Animal Feed, Brawijaya University, Malang, 2007: EM 1.380 kcal/kg= approximately 70% of the GE [13], [3] [14]= CP 47%, fat 9,54%, CF 2,98%, Ca 2,46%, and P 4,60%; [16]= Met 1.51%, Lys 4.62%, [4] [15].

Feeding the broilers

All chicks consumed a complete CP507 diet during the first week, then fed on the experimental diets from the first day of the second week till the last day of the fifth week. The broilers were permitted to get the diet and drinking water *ad libitum.* A supplement of Vita Stress, a commercial product by Medion, was delivered via drinking water for 0–4 weeks.

Experimental design

The study was performed in Completely Randomized Design (CRD) with five treatments and four replicates. Replication was an experimental unit consisting of 5 birds per unit. The mathematical model for studying bird performances was $Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$ where μ = overall mean, α_i = effects to the experimental diets i^{th}, and ε_{ij}= error to the experimental diets j^{th}. Two birds from every pen were sampled with a decisive factor of the average body weights close to those in their unit to collect carcass and cut-up data. Here, sub-sampling was applied into CRD, causing an additional error that might occur in sub-samplings, and then the linear model for studying bird yield should be: $Y_{ijk} = \mu + \alpha_i + \varepsilon_{ij} + d_{ijk}$ where d_{ijk}= a sub-sampling error [16].

Variables

The variables of bird performances were characterized by the average final body weight (FBW), the average body weight gain (BWG), daily feed intake (DFI), daily methionine intake (DMI), daily lysine intake (DLI), feed conversion ratio (FCR), and weights and percentages of whole and parts of the carcass. The FBW was recorded by weighing the broilers on the last day of the 5th week. Total feed intake (TFI) was counted by subtracting the delivered and the residual feed for five weeks. The percentage of the whole carcass was defined by dividing carcass weight by body weight (BW), while the percentage of cuts-up was computed by dividing the weight of each part by carcass weight. The rest variables were calculated as follows:

$$\text{Daily BWG} = \frac{\text{BW 5 wks} - \text{BW DOC}}{\text{35 days}} \quad \ldots(1)$$

$$\text{DFI} = \frac{\text{TFI 5 wks}}{\text{35 days}} \quad \ldots(2)$$

$$\text{DPI} = \text{DFI} \times \text{DPC} \quad \ldots(3)$$

Note: DPC = dietary protein content

$$\text{DMI} = \text{DFI} \times \text{DMC} \quad \ldots(4)$$

Note: DMC = dietary methionine content

$$\text{DLI} = \text{DFI x DLC} \quad \ldots(5)$$

Note: DLC = dietary lysine content

$$\text{FCR} = \frac{\text{DFI}}{\text{daily BWG}} \quad \ldots(6)$$

Data analysis

The data were analyzed using Analysis of Variance (ANOVA). A Duncan's Multiple Range Test (DMRT) was applied when there were significant differences among the groups.

RESULTS

The performances of broilers fed the diets incorporating fermented domesticated *Moringa oleifera* leaf meal (FDMOL) + yellow corn (YC) + fish meal (FM) + top mix (TM) in replacement of partial CP diets are given in Table 2.

Daily feed intake

The experimental diets did not significantly (P>0.05) affect daily feed intake (DFI). There was no tendency to include 5% FDMOL + 5% yellow corn + 5% rice bran + 0.5% top mix in replacement of the commercial diet (MCR diet) declined DFI. This was not predictable that a previous study by [8] reported broilers fed diets containing FWMOL + yellow corn (MC) had a slight tendency to lower DFI. However, the result of the present study supported different types of moringas that can lead to differing DFI. The moringa leaves exploited in the first study were collected from different sources than those used in the present study. The latter was a wild type that the unknown-old trees grew massively over 5 m in uncultivated lands and their leaves were less consumed by the people due to a pronounced taste. The former is a domesticated type cultivated in the backyards of which the trees grow not more than 3 m tall,

Table 2. Performances of the broilers fed the moringa based-diets and control diets

Parameters	Moringa based-diets		Control diets			*p-value*
	MCR	MCF	C_1	C_2	C_3	
FBW (g/bird)	2,041±89	2,063±43	2,043±103	2,031±138	2,123±121	0.7374
Weekly BWG (g/bird/week)	393±14.26	397±14.70	394±30.25	391±26.36	409±12.06	0.7476
BWG (g/bird/day)	56.19±2.04	56.75±2.10	56.23±4.32	55.91±3.77	58.49±1.72	0.7476
TFI (g/bird)	3,311±69	3,254 ±66	3,314±195	3,166±221	3,317±124	0.5647
DFI (g/bird/day)	94.60±1.98	92.96±1.87	94.68±5.56	90.44±6.31	94.78±3.55	0.5647
FCR	1.69±0.08	1.64±0.09	1.69±0.20	1.62±0.06	1.62±0.04	0.7923
DPI min. (g/bird/day)	19.16±0.40^{ab}	20.39±0.41^{a}	19.88±1.17^{a}	17.68±1.23^{b}	20.21±0.76^{a}	0.0033
DPI max.(g/bird/day)	20.76±0.43^{ab}	21.96±0.44^{a}	21.78±1.28^{a}	19.21±1.34^{b}	21.81±0.82^{a}	0.0043
DMI (g/bird/day)	0.48±0.01^{bc}	0.53±0.01^{ab}	0.52±0.03^{ab}	0.46±0.03^{c}	0.54±0.02^{a}	0.0008
DLI (g/bird/day)	0.91±0.02^{c}	1.49±0.03^{a}	0.95±0.06^{c}	0.82±0.06^{d}	1.14±0.04^{b}	0.0000

$^{a, b}$ Different superscripts in the same row indicated very significant differences (P<0.01), FBW= final body weight; BWG= body weight gain, TFI= total feed intake; DFI= daily feed intake; FCR= feed conversion ratio; DPI= daily protein intake; DMI= daily Met intake; and DLI= daily Lys intake.

and their leaves are served as vegetables. This agreed with [6], moringa comprising either domesticated or wild types *differs in taste subjecting to their glucosoonjnain* presence. The latter contains this compound significantly lower than the former (1.16 *vs* 33.79 μmol/g).

Daily protein intake

Daily protein intake (DPI) is defined based on the amount of daily feed intake (DFI) and the amount of protein contained in the diet (dietary protein content). Since the protein in the commercial diet (C_1) has been in the range of 21–23%, it should be advised as the minimum and maximum constraints of the available protein. The experimental diets, therefore, were computed for at least and the greatest possible provided protein as given in Table 2. ANOVA detected a very significant effect (P<0.01) on the DPI. The birds from the C_2 diet eat protein (17.68–19.21 g/day) highly significantly lower than the other groups did because of their slightly declined DFI. This amount of DPI was still at the considered level for broilers for satisfying growth, as presented in Table 2, in which the BWG did not show any significant difference among the others. According to [17], protein is a pivotal constituent of the biologically active compounds in the body, and it assists in the synthesis of body tissue for the renovation and growth of the body.

FBW and BWG

The experimental diets did not significantly (P>0.05) influence final body weight (FBW) and body weight gain (BWG). Adding fish meal into the MCR diet to constitute the MCF diet did not enhance the FBW and BWG of broilers. This was caused by the birds fed this diet having the FBW similar to those fed the C_1 or the C_2 diet. The fish meal introduced into the MCR diet could not enhance the FBW of the groups over those fed these control diets. No suggestion fish meal used in this study had low quality since the broilers fed the C_3 diet i.e. the control diet for commercial local fish meal (CFM), had FBW and BWG comparable to those fed the C_1 diet. It meant the inclusion of approximately 5% of domesticated moringa in the diet might not require a fish meal to only maintain FBW and BWG but probably consented to a wild one.

Daily Met and Lys intake

Methionine (Met) and lysine (Lys) are the most important essential amino acids (EAA) for birds. ANOVA detected highly significant differences (P<0.01) in both daily Met and Lys intake (DMI and DLI). Lack Met and Lys sources of mixture feed (7.5% rice bran + 7.5 yellow corn + 0.5% top mix) formulated to substitute partial commercial diet to perform the C_2 diet had been aggravated by the declining DFI causing highly significantly lower DMI and DLI compared to the C_1. In contrast, fish meal is rich in Met (1.51%) and Lys (4.62%) refers to [15]. According to [12], the broiler requirements for Met and Lys are 0.5% and 0.90%, respectively. Incorporating as much as 5% of that into the mixture of 5% yellow corn + 5% rice bran increased the dietary Met and Lys. When DFI did not alter, the DMI and DLI increased in the C_3. Agree to [18], an extra Met intake in the diet connects with significantly higher FBW and BWG. The dietary Met and Lys presented based on calculation, while Met and Lys contents of the moringa referred to the laboratory analyses. Fig. 1 shows the Met and Lys intakes.

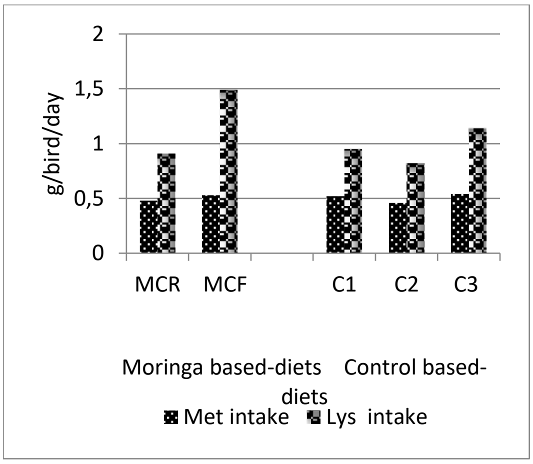

Figure 1. Met and Lys intake

Whole carcass and cuts up

The yield of broilers fed the diets incorporating FDMOL + yellow corn (YC) + fish meal (FM) + top mix (TM) in replacement of partial commercial diets is given in Table 3. The trial diets did not significantly (P>0.05) influence the whole carcass and all parts of the observed carcass. Nevertheless, the weight of the whole carcass and its cuts-up seem relatively lower in the C_2 and the MCR diet but slightly higher in the C_3 diet compared to the C_1. The absence of fish meal in the moringa base diet (MCR) might cause the declined breast weight of the broiler (from 572 g in the C_1 to 536 g in the MCR), and then by incorporating fish meal into the moringa base diet (MCF), breast weight increased again to 573 g in the MCF close to the C_1. This linked to Met and Lys intakes that the birds fed the C_2 and the MCR diet even though efficaciously retained LW, the Met and Lys did not enter in the proper amount to produce the edible yields, causing the increase in the non-carcass percentages. It meant that a feed mixture composed of 7.5% yellow corn + 7.5% rice bran + 0.5% top mix (C_2) was not qualified to replace the 15.5% commercial diet to generate the right yield target because this mixture feed was low in protein sources. Only a right moringa should be incorporated up to 5% into this without adversely declining yield but

Table 3. Weights and percentages of whole carcass and cuts-up

Parameters		Moringa based-diets		Control diets			*p-value*
		MCR	MCF	C_1	C_2	C_3	
Sampling LW	(g)	1,991±103	2,036±163	1,995±112	1,949±171	2,090±139	0.3737
Whole carcass	(g)	1,432±94	1,492±125	1,466±72	1,395±161	1,531±102	0.2913
	(%)	71.90±2.05	73.32±233	73.62±4.05	71.71±2.09	73.28±1.54	0.5002
Non-carcass	(g)	559±44	544±65	529±102	554±35	559±52	0.8599
	(%)	28.10±2.05	26.68±2.33	26.38±4.05	28.29±2.09	26.72±1.54	0.5165
Breast	(g)	536±46	573±72	572±36	538±76	582±46	0.4145
	(%)	37.39±1.99	38.33±2.48	39.02±2.02	38.49±1.84	38.04±1.22	0.6361
Thighs	(g)	428±34	431±36	414±16	402±53	439±36	0.3209
	(%)	29.93±1.86	28.89±1.11	28.26±0.62	28.79±1.21	28.67±1.21	0.1195
Wings	(g)	151±5	156±13	155±11	150±13	161±13	0.3877
	(%)	10.58±0.73	10.46±0.21	10.54±0.49	10.83±0.73	10.51±0.51	0.7467
Back	(g)	317±42	332±43	325±38	305±27	349±25	0.3399
	(%)	22.10±1.97	22.32±2.64	22.18±1.95	21.89±1.93	22.78±1.10	0.9340

considering produced breast. Fig. 2 shows the breast weights of broilers from all treatments.

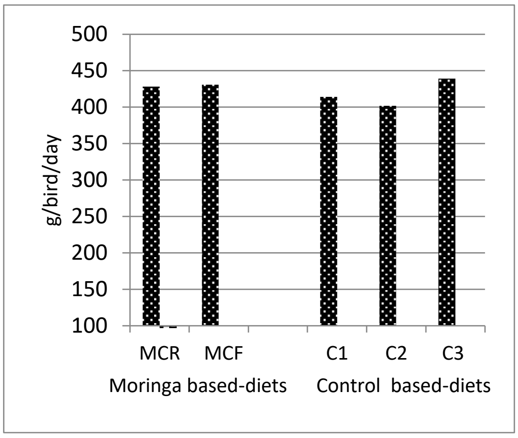

Figure 2. Breast weights of broilers (C_2= the control diet with no adding moringa and fish meal)

DISCUSSION

The anti-nutrient contents in moringas vary depending on their genetic sources, such as the cultivar and growing environment [5]. This may involve tannin existing from 12.0 to 20.6 mg/g. Tannin is a phenolic compound that interacts with trypsin and amylase or the substrates of these enzymes to build complexes that are not easily digestible, causing decreased acceptability and reduced feed intake. Another composite within the moringa leaves responsible for the flavor is saponins. Adding moringa leaves may increase the bitter taste and unpleasant odor caused by saponin [19]. A high concentration of this phytochemical donates to poor taste and then depresses feed consumption. Despite this, the DFI of broilers recorded in the present study not affected was supposed to those composites awarding in low amounts in the current moringa rather than in the earlier one. According to [5], the amounts of saponins in moringa in the dry matter are only 4.7–5 g/kg, and this amount cannot trigger any detrimental effects on the animal.

The anti-nutritional substances are not the only factor responsible for feed intake but should also involve the crude fiber (CF) content. The different ages of the harvested moringa could carry out various CF presence. As age increases, the CF increases, and this may affect feed intake [5]. The present study used the young age of the moringa, a fermentation treatment on dried leaves minimized CF down to 5.35%, and this did not enormously increase the dietary CF over the permissible limit within the broiler diet (Table 1). Agree to [7], fermented moringa reduces CF and increases feed digestibility.

Introducing fish meal into the MCR (moringa+) to form the MCF diet (moringa++) could not result in higher DFI, so this was unexpected. It did not mean the fish meal used in this study was inferior because it was unexpressed in the C_3 diet, the control diet with the inclusion of fish meal without FDMOL. Fish meal is well-known as palatable feed and can increase feed intake. Hence, a satisfactory amount of DFI by the birds for their energy requirement from the MCF diet might not highly stimulate the birds to increase their feed consumption even though feed has been more favorable since their crop was in restricted volume. The size of the gastrointestinal tract (GIT) in broilers is close to its biological borders, and as such, so is the volume for maximum DFI [20]. Therefore, an acceptable reason why DFI on the MCF diet did not appear higher than that on the MC diet was that the latter did not result in lower feed intake than the C_1 diet, as recorded in the previous study. The less anti-nutritional and crude fiber content in the recent moringa may not support the decline in feed intake.

In contrast to the C_1 diet, the protein was somewhat lower eaten by the birds fed the MCR diet but higher in the MCF diet. However, DMRT could not detect any significant difference in DPI in the FDMOL diets. It meant birds consuming the diets containing moringa with the absence of fish meal (MCR diet) had swallowed an amount of protein equal to those eating the fully commercial diet (the C_1 diet), thus bringing into similar FBW of those. It was unpredictable since, in the previous study, feeding broilers with the FWMOL + yellow corn reduced DPI as the impact of lowering DFI caused significantly depressed BWG and FBW, then led to a decline in income over feed cost (IOFC).

Including fish meal into the FDMOL + yellow corn to form the MCF diet in the present study was reasoned to upraise the FBW of the birds fed the MCF diet at least close to the control

(C_1). The improved the MC diet, supposedly failed but FBW equal to the control C_1 was successfully achieved by a mission of fish meal. Therefore, a domesticated moringa used in this study did not hardly depress DFI → DPI → FBW then seems as if punishing fish meal. Including fish meal into the FDMOL + yellow corn improved DFI. Nevertheless, a heightened DPI was undetected in statistical differences. It should not be able to significantly increase FBW and BWG of the birds fed the MCF diet over those fed the MCR diet.

All experimental diets (the MCR and the MCF diet) and the control diets for fish meal (C_3) and the absence of fish meal and moringa (C_2) brought FBW and BWG equal to the C_1. Proper DFI resulted in an acceptable amount of protein and energy intake to sustain FBW and BWG. According to [21], feed intake is the main factor that affects BWG in meat-type poultry. It also was found in the C_2, the control diet with yellow corn + the rice bran + top mix without FDMOL and fish meal in substitution to the commercial diet, the formulated diet not presumed to counterpart to a fully adopted commercial diet. Despite this, there was no guarantee that BWG would yield linearly to carcass even though both related to each other. The types of ingested feeds could predominantly contribute to producing the proportion of edible or valued parts. This was associated with nutrient digestibility, which refers to the conception of bioavailability. Feed digestibility indicates the amount of nutrients used by the body. Ingested feeds are not absorbed totally by the body, but some of the ingestas are indigestible, pass through the digestive tract, and are excreted in feces [22].

Moringa contains low Met and moderate Lys. Because both rice bran and corn were also low in Met and Lys to constitute the MCR diet, causing the dietary Met and Lys to decline too. Due to the DFI at the MCF diet was sustained very close to the C_1, both DMI and DLI reduced insignificantly in confrontation with the C_1. Therefore, the consumed Met and Lys were still in an adequate amount to produce properly the whole carcass but might be insufficient for breast formation.

Although containing high protein and nutritious, moringa leaves have a low caloric value and Met, also found in domesticated moringa [4], causing lower breasts. This finding matched with [9] that replacing the CD diet with the moringa-corn (MC) significantly reduced breast weight. In the current study, introducing corn into the moringa to perform the MC diet maintained the energy-protein ratio (EPR), and then adding fish meal into this diet to establish the MCF diet seemed able to preserve breast yield supported by the correct amount of the absorbed Met and Lys. It was under [23] where the broilers fed on the diet containing 7.5% moringa without Met and Lys have significantly lower body weight and weight gain than those having the diet containing 7.5% moringa with Met and Lys. Another study reported by [24] found that the increased breast muscle yield results from high Met diets only uncovered in the fast-growing broilers rather than in the slow-growing broilers even though insulin-like growth factor-I (IGF-I) concentration increases in both strains of broilers. In a study reported by [25], there is a quadratic relationship ($p \leq 0.05$) between dietary lysine levels and breast meat weight. When supplementation of Met and Lys such as L or DL-methionine and lysine were not included, the fish meal might be a better choice for a moringa-corn-based diet. In suggestion, better using *leubim* fish waste meal (LFWM) to replace commercial fish meal because the LFWM is cheaper and positively effects on broiler carcasses [26].

CONCLUSION

This study concluded that it would be better to add fish meal into the fermented moringa + yellow corn rather than no fish meal in replacement partially commercial diets to feed the broiler. Most parameter performances and yields did not change on broilers fed the fermented domesticated moringa + yellow corn-based replacement diet. However, the breast tended to reduce, then adding fish meal into this fermented moringa + yellow corn could recover this valuable part of cuts-up similar to the control.

CONFLICT OF INTEREST

There was no conflict of interest with any party to the materials discussed in this paper.

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