Bulgarian Journal of Agricultural Science, 28 (No 4) 2022, 738–742

Using root and leaf meal of cassava to partially replace maize in broiler diet

Tran Thi Hoan and Tu Quang Hien*

Thai Nguyen University of Agriculture and Forestry, Division of Animal Science, Faculty of Animal Science and Veterinary Medicine, Quyet Thang Ward, Thai Nguyen City, Thai Nguyen province, Vietnam
**Corresponding author:* tqhien.dhtn@moet.edu.vn

Abstract

Hoan, T. T. & Hien, T. Q. (2022). Using root and leaf meal of cassava to partially replace maize in broiler diet. *Bulg. J. Agric. Sci., 28 (4)*, 738–742

Cassava root meal is rich in energy but poor in protein content, whereas cassava leaf meal is vice versa. The mixture would balance between energy and protein. That's the reason for the experiment using a mixture of cassava root – leaf meal (CRLM) to partially replace maize in broiler diets. The ratio of root and leaf meal of cassava in the mixture was 65 and 35%. The experiment was conducted with 450 unsexed Luong Phuong broilers, from 15 to 70 days of age, allotted into 5 formulas (NT), each consisted of 10 birds, repetition of 9 times. All formulas were abbreviated to as NT1, NT2a, NT2b, NT3a and NT3b. Where NT1 was served as control, its diet did not replace grounded maize by CRLM and the metabolic energy (ME) of the diet met the feed ME standards of Luong Phuong broiler chickens. NT2a and NT2b diets were replaced 20%, NT3a and NT3b diets were replaced 30% grounded maize by CRLM, but vegetable oils were added to NT2b and NT3b diets more than NT2a and NT3a in order to achieve ME value similar to that of control (NT1). The results showed that the weight gain and FCR of NT2b were better than that of NT1, which of NT2a and NT3b were similar to NT1, which of NT3a were lower than NT1. The slaughtering parameters and meat chemical composition were not significantly different among treatments. It is concluded that the replacement of grounded maize by CRLM in broiler chicken diet as NT2b is optimal.

Keywords: Cassava root meal; Cassava leaf meal; grounded maize; broiler, replacement

Introduction

The cassava root meal is rich in energy content (3260 Kcal ME/kg) but low in protein content (2.58%) (NIAS, 2001), in contrast, cassava leaf meal is low in energy content (1978 Kcal ME/kg) but rich in protein content (21.64%) (Hien et al., 2017a). The majority of amino acids contents of cassava leaf meal protein is higher than that of maize (NIAS, 2001). On the other hand, cassava leaf meal is rich in carotenoids content (876 mg/ kg DM), (Hoan et al., 2018), which was proved to have a positive effect on growth of the broiler chickens (Trung, 2016; Hien et al., 2017b). Therefore, the inclusion of the mixture (root and leaf meals of cassava) in order to partially replace grounded maize in broiler diet is feasible; it would contribute to the domestic availability of animal feed ingredients and less dependency on the importation of feed materials.

Materials and Methods

Broiler chickens of Luong Phuong breed were used in this experiment. Cassava root meal and cassava leaf meal were obtained from the KM94 variety. Cassava roots were peeled, sliced, dried and grounded into powder. Cassava leaves were dried and grounded into powder. The root meal and leaf meal of cassava were mixed at the ratio of 65% and 35%; hereinafter refers to as CRLM (cassava root - leaf meal). The above ratio was selected because with this ratio the mixture had the

Fig. 1. Cassava root and C. root meal

Fig. 2. Cassava leaves and C. leaf meal

similar protein ratio as grounded maize.The trial was conducted at Thai Nguyen University of Agriculture and Forestry, Vietnam in 2020.

The feeding trials were conducted by employing 450 unsexed birds, from 15 to 70 days of age, allotted into 5 different formulas (NT), each treatment consisted of 10 birds, 9 repetition each (10 x 9 =90/NT). All treatments were coded as NT1, NT2a, NT2b, NT3a and NT3b. Where NT1 was served as control, its diet did not replace maize by CRLM and the metabolic energy (ME) of the diet met the feed ME standards for Luong Phuong broiler chickens. NT2a and NT2b diets were replaced 20%, NT3a and NT3b diets were replaced 30% maize by CRLM, but vegetable oils were added to NT2b and NT3b diets more than NT2a and NT3a in order to achieve ME value similar to that of control (NT1). The ME content in 1 kg of feed of NT2a and NT3a was 56 and 84 kcal lower than that of NT1 at 15 – 42 days of age, and 64 and 92 kcal at 43 – 70 days of age, respectively.

The experimental diets were formulated from maize, rice bran, soybean meal, fish meal, vegetable oils, CRLM and other additives; all ingredients were chemically analysed prior to diets mixing. The ingredient and chemical composition of all diets is showed in Table 1 and Table 2.

Birds were accessed to feed and water *ad libitum*, other bird management program were performed similarly in all treatments.

Monitoring parameters include live ability rate, bird performance traits, feed intake, feed conversion ratio, slaughter criteria, meat chemical composition and Economic Number.

Monitoring procedure: Bird performance was performed after Doan et al. (2011) and EN index was calculated after Van et al. (2015). The dissection was performed after Tien (1993); 3 males and 3 females/ treatment were selected for dissection. Meat chemical composition was analyzed after AOAC (1990); each parameter was performed 5 times. The skin yellowness colour was estimated by colour fan from Roche (1988). Statistical analysis was performed after Dzung et al. (2018) using Minitab software version 18.1.

Results and Discussion

Survivability

Birds in all feeding trials survived at the rate of 97.8 to 100%, which proved that the partial replacement of grounded maize by CRLM in broiler diet did not affect the survivability of the broilers.

Table 1. Ingredient and chemical composition of all diet treatments (15 – 42 days)

Categories	unit	NT1	NT2a	NT2b	NT3a	NT3b
Maize	%	55.00	44.00	44.00	38.50	38.50
CRLM (1)	%	–	11.00	11.00	16.50	16.50
Rice bran	%	12.60	12.60	11.60	12.60	11.20
Fish meal	%	6.00	6.00	6.00	6.00	6.00
Soybean meal	%	22.80	22.80	22.80	22.80	22.80
Vegetable oil	%	0.50	0.50	1.50	0.50	1.90
Additives (2)	%	3.10	3.10	3.10	3.10	3.10
ME(3)	kcal	3007	2951	3013	2923	3010
CP	%	20.15	20.19	20.02	20.21	20.04
EE	%	5.03	4.95	5.82	4.91	6.13
CF	%	3.99	4.31	4.22	4.47	4.34
Lysine	%	1.15	1.17	1.16	1.18	1.17
Methionine	%	0.46	0.46	0.46	0.47	0.47
Ca	%	1.16	1.17	1.17	1.19	119
P_{av}	%	0.52	0.53	0.52	0.53	0.52
CPF(4)	%	100	98.1	102..1	97.1	102.7

Table 2. Ingredient and chemical composition of all diet treatments (43 – 70 days)

Categories	unit	NT1	NT2a	NT2b	NT3a	NT3b
Maize	%	60.00	48.00	48.00	42.00	42.00
CRLM [(1)]	%	–	12.00	12.00	18.00	18.00
Rice bran	%	11.50	11.50	10.60	11.50	10.00
Fish meal	%	3.00	3.00	3.00	3.00	3.00
Soybean meal	%	21.40	21.40	21.40	21.40	21.40
Vegetable oil	%	1.00	1.00	1.90	1.00	2.50
Additives [(2)]	%	3.10	3.10	3.10	3.10	3.10
ME[(3)]	kcal	3057	2993	3053	2965	3058
CP	%	18.04	18.08	18.00	18.10	17.95
EE	%	5.37	5.29	6.07	5.24	6.55
CF	%	3.83	4.18	4.16	4.36	4.28
Lysine	%	1.00	1.03	1.03	1.05	1.05
Methionine	%	0.40	0.41	0.40	0.41	0.40
Ca	%	1.00	1.03	1.03	1.05	1.05
P_{av}	%	0.44	0.45	0.44	0.46	0.45
CPF[(4)]	%	100	97.7	101.7	96.6	103.1

Note: (1) CRLM.: Cassava Root – Leaf Meal; (2) Additives: 0.1% methionine, 1.4% $CaCO_3$ 0.3% DCP, 0.3% NaCl, 0.5% Vitamine premix, 0.5% Mineral premix for each treatment; (3) 238,8 kcal = 1 Mj; (4) CPF: Compare the Price of 1 kg of mixed Feed.

Bird growth

The livebody weight (LBW) of birds at 15, 42, 70 days of age, the body weight gain (BWG) during the period of 15 – 42; 42 – 70 and 15 – 70 days of age are showed in Table 3.

The LBW of birds at 42 and 70 days of NT2b was the highest and significantly differed compare to that of the other treatments ($p<0.001$), LBW of birds in NT1, NT2a and NT3b was similar ($p>0.05$), bird LBW in NT3a was the lowest and sigificantly differed to that of the other treatments ($p<0.001$). The BWG during 42 – 70 and 15 – 70 days in all treatments was progressed as NT2b > NT3b, NT1, NT2a> NT3a, in which, the BWG of birds in NT2b was higher and that of NT3a was lower than that of the other treatments significantly ($p<0.001$)

With the replacement of 20 - 30% maize by CRLM, the ratio of cassava leaf meal in the diet was 3.9 – 5.8% at the statge of 15 – 42 and 4.2 – 6.3% at the stage of 43 – 70 days old. Hoan (2012), Trung (2016) and Hien et al. (2017b) reported that birds fed with diet containing an appropriate proportion of cassava leaf meal (3 - 6%) in the broiler diet showed the higher BWG compare to those fed without inclusion of cassava leaf meal in the diet. This was due cassava leaf meal containing a remarkable amount of carotenoids and that carotenoids had the positive effect on animal growth. On the other hand CRLM has a higher content of amino acids than maize and it also makes amino acids of maize become more balanced. Therefore, with the replacement of 20% maize by CRLM, NT2a diet had less metabolic energy than control (NT1) but similar BWG to that of NT1; and NT2b diet had the same metabolic energy as NT1, but was significantly higher BWG than that of the Control.

However, with the replacement of 30% maize by CRLM, NT3a diet had a significant shortage of energy content in comparison to that of the Control thus BWG of birds was significantly lower but NT3b diet contained the same metabolic energy as NT1, the BWG showed similarity to that of the Control.

The reason why treatment NT3b had similar ME and carotenoids contents to that of NT2b but LBW and BWG were lower than that of NT2b and just similar to that of NT1 is that

Table 3. Livebody weight and bodyweight gain of experimental birds

Categories	NT1	NT2a	NT2b	NT3a	NT3b	SEM	P
Livebody weight, g/ bird							
1 day	39	39	39	39	39	0.837	1.000
15 days	195	195	195	195	195	1.160	1.000
42 days	1039^b	1025^b	1069^a	995^c	1043^b	12.770	0.000
70 days	1979^b	1964^b	2056^a	1897^c	1985^b	16.699	0.000
Bodyweight gain, g/ bird/ day							
15 - 42 days	30.14^{bc}	29.64^c	31.21^a	28.57^d	30.29^b	0.418	0.000
43 - 70 days	33.57^b	33.54^b	35.25^a	32.21^c	33.64^b	0.234	0.000
15 - 70 days	31.86^b	31.59^b	33.23^a	30.39^c	31.96^b	0.280	0.000

Note: Number with different subscription letter in the same row are significant different ($p < 0.001$)

the increase of the CRLM replacement rate had resulted in the increase of cyanhydric acid (HCN) content, this toxic substant had a negative effect on bird's performance. Hien et al. (2012) had reported HCN content in cassava root meal was 0.95 mg/kg, and this content in cassava leaf meal was 30.9 mg/kg DM (Hoan et al., 2018). Moreover, the increase of CRLM level had also resulted in the increase of fibre content in the diet, thus negatively affect the nutrient digestion and absoption of the birds.

Feed intake and feed conversion ratio

Feed intake (FI) and feed conversion ratio (FCR) of tested birds are presented in Table 4.

The average FI per bird during the period of 15 – 42 days was similar among treatments (p>0.05). Feed intake of birds during 43 – 70 days and 15 – 70 days of all treatments had the similar trend, that was NT2b, NT2a, NT3a > NT1, NT3b with P<0.001.

Birds fed with NT2a and NT3a diets consumed more feed than birds in other treatments because these diets were lower in energy than other diet treatments; birds consumed more feed in order to compensate the energy shortage. Diet of NT2b had similar energy content with NT1 however birds in this treatment consumed more feed than birds in NT1 did, this was because they had heavier LBW thus more feed required. Diet treatment NT3b had similar energy content to that of the NT1, bird LBW was also similar to that of NT1, and feed intake was also similar to that of NT1.

The FCR of birds in all diet treatments was ranked from the lowest to the highest as following: NT2b, NT3b, NT1, NT2a, NT3a. Thus, with the replacement of 20% maize by CRLM, NT2b had achieved the optimal feed conversion ratio. It was because diet NT2b had the equal energy level compare to NT1 and carotenoids content in cassava leaf meal had positively affected animal's nutrients utilization efficiency.

Diet of NT3b despite having similar energy content compare to that of NT1 and containing carotenoids similar to that of NT2b but showed the poorer FCR compare to that of NT2b, that was because the fibre content of the diet increased with increase in maize substitution with CRLM in the diet, it also increased the HCN content, this led to the decrease of feed utilization efficiency.

Diets of NT2a and NT3a were lower in energy than that of other diet treatments, therefore, their FCR was higher.

The Economic Number (EN) was ranked from the highest to the lowest as following: NT2b, NT1, NT3b, NT2a, NT3a. Thus, with the replacement of maize by CRLM, the diets with the same metabo lic energy as control had achieved the higher economic efficiency in comparation to diets with less metabolic energy than control.

Slaughter parameters

The results of dissection parameters of birds at the 70th days of age showed that the carcass percentage compare to LBW and the breast, thigh meats/ carcass were not significant different among diet treatments (p>0.05). This proved that partial replacement of maize by 20 or 30% CRLM had no effect on carcass characteristics. Adomimal fat/ carcass rate of NT1, NT2a, NT2b, NT3a and NT3b was 1.65^{a}, 1.36^{b}, 1.62^{a}, 1.31^{b} and 1.63^{a} %, respectively. Birds of NT2a and NT3a had lower adomimal fat/ carcass rate compare to that of birds in other treatments (p<0.001) because the diets had lower in energy content than that of the other treatments. Diarra et al. (2015) tested on broiler chickens fed commercial finisher and cassava copra meal – based diets and reported that thigh meat percentage was not different among treatments, but that of breast meat and carcass percentage and adominal fat were lower compare to that of birds fed control diet. Etalem et al. (2013) tested on replacement of maize by cassava root chips and revealed that birds fed with diets containing high level cassava root chips content showed the lower slaughtering parameters compare to birds in control.

Meat chemical composition

Meat chemical composition of experimental birds were showed in Table 5.

The results showed that replacement of maize by CRLM in the diet did not have effect on the DM, protein contents of

Table 4. Feed intake, feed utilization efficiency, EN index

Categories	NT1	NT2a	NT2b	NT3a	NT3b	SEM	P
Feed intake, g/bird/day							
15 - 42 days	66.09	66.18	66.17	66.12	66.05	0.676	0.269
43 - 70 days	111.45^{b}	113.78^{a}	114.33^{a}	113.45^{a}	111.32^{b}	1.172	0.000
15 - 70 days	88.77^{b}	89.98^{a}	90.25^{a}	89.76^{a}	88.69^{b}	0.924	0.000
FCR, kg Feed/ kg bodyweight gain							
15 - 42 days	2.19^{bc}	2.23^{ab}	2.12^{cd}	2.31^{a}	2.18^{bc}	0.012	0.000
43 - 70 days	3.32^{bc}	3.39^{ab}	3.24^{cd}	3.52^{a}	3.31^{bc}	0.017	0.000
15 - 70 days	2.79^{bc}	2.85^{ab}	2.72^{cd}	2.95^{a}	2.77^{bc}	0.013	0.000
EN index	4.04^{b}	3.97^{b}	4.36^{a}	3.51^{c}	4.02^{b}	0.215	0.000

Note: Numbers with different subsciption letters in the same row are significant different (p < 0.001).

Table 5. Meat chemical composition of experimental birds

Categories	Unit	NT1	NT2a	NT2b	NT3a	NT3b	SEM	P
a) B & T muscles								
Dry matter	%	24.36	24.29	24.34	24.23	24.35	0.139	0.475
Protein	% DM	21.45	21.53	21.48	21.54	21.46	0.128	0.660
Lipid	% DM	1.82^a	1.73^b	1.80^a	1.69^b	1.83^a	0.040	0.000
b) LC	mg %	0.54^c	1.25^b	1.22^b	1.65^a	1.68^a	0.124	0.000
c) SY	Score	1.62^c	3.26^b	3.24^b	4.30^a	4.35^a	0.408	0.000

Note: B & T: Breast and thigh; LC: Liver Carotenoids; SY: Skin Yellowness; Numbers in the same row with different subscription letters are different significant (p<0.001).

broiler meat. The lipid content in the meat birds fed diets with replacement of maize by CRLM, which had lower in ME content (p<0.001), was lower. The carotenoids content in the liver and the skin yellowness showed that the higher level of replacement was, the higher results of these parameters were obtained significantly (p<0.001).

Latscha (1990), reported that carotenoids had increased the skin yellowness and improved meat flavor. Other reports from Hoan (2012), Trung (2016), Hien et al. (2016) and Hien et al. (2017_b) showed that addition of leaf meals with high carotenoids content into chicken diets had increased skin yellowness and darkened the egg yolk.

Conclusion

A feeding trial utilized the mixture of 65% cassava root meal and 35% cassava leaf meal to replace grounded maize in broiler diet at the replacement rate of 20% and 30%. It is concluded that the replacement of 20% grounded maize by CRLM with addition of vegetable oil in order to achieve metabolic energy value similar to that of control resulted in the optimal broiler performance.

References

AOAC (1990). Official Methods of Analysis. 15th adition, *AOAC* Inc. Arlington, Virginia, USA, 746.

Diarra, S. S., Sandakabatu, D., Perera, D., Tabuaciri, P. & Mohammed, U. (2015). Growth performance and carcass yield of broiler chickens fed commercial finisher and cassava copra meal-based diets. *J. of Applied Animal Research, 43(3),* 352–356, http://dx.doi.org/10.1080/09712119.2014.978

Doan, B. H., Mai, N. T., Son, N. T. & Dat, N. H. (2011). Parameters used in poultry research. *Agriculture Publishing House,* Hanoi, 60 (Viet.).

Dzung, T. H., Tham, P. D. & Thang, T. V. (2018). Research methodology in animal science and vieterinary. *Agriculture Publishing House*, Hanoi, 153 (Viet.).

Etalem, T., Animut, G., Urge, M. & Dessie, T. (2013). Cassava Root Chips as an Alternative Energy Feed Ingredient in Broiler Ration. *Inter. J. Poul. Sci., 12 (5),* 298-306.

Hien, T. Q., Hao, D. N., Diep, L. T. N. & Kien, T. T. (2012). Toxins in Animal Feed. *Agricultural Publishing House*, 111(Viet.).

Hien, T. Q., Hoan, N. D., Hoan, T. T. & Trung, T. Q. (2016). Relation between carotenoids content in egg yolk and hatching egg quality according to the time laying hens fed diet containing leaf meal. *Bulg. J. Agric. Sci., 22 (1),* 92 – 98.

Hien, T. Q., Hoan, T. T., Khoa, M. A., Kien, T. T., Nhung, H. T. H. & Huong, **P. T.** (2017a). Determination of metabolic energy value of some leaf meal kinds on Luong Phuong broiler chickens. Sci. confer. "Animal Science - Challenges and Innovation", Sofia 1 - 3, Nov. 2017. Proceedings, 120 -128.

Hien, T. Q., Hoan, T. T., Khoa, M. A., Kien, T. T. & Trung, T. Q. (2017b).The effect of some leaf meal kinds as a supplement in the basal diet on Luong Phuong broiler perfomance. *Bulg. J. Agric. Sci., 23 (4),* 617 - 624.

Hoan, T. T. (2012). Cassava for foliage production and utilization of cassava leaf meal in Luong Phuong broiler and layer parent stocks. PhD thesis, TNU (Viet.).

Hoan, T. T., Kien, T. T., Trung, T. Q., Khoa, M. A. & Hien, T. Q. (2018). Study on cultivation of cassava, leucaena and stylosanthes grass for leaf meal production for chicken diet supplement. *Bulg. J. Agric. Sci., 24 (5),* 836–843.

Latscha, T. (1990). Carotenoids in animal nutrition. F. Hoffmann La Roche, Basel, Switzerland.

National Institute of Animal Husbandry (NIAS) (2001). Composition and Nutritive Value of Animal Feed in Vietnam. *Agri. Publishing House,* Hanoi. 391(Viet.).

Roche (1988). Vitamin and Fine Chemicals, Egg Yolk Pigmentation with Carophyll. 3rd ed., Hoffmann-La Roche Ltd., Basel, Switzerland, 1218.

Tien, B. Q. (1993). Poultry dissection methods. *Journal of Agriculture and Food Industry, 2,* 72 - 78 (Viet.).

Trung, T. Q. (2016). Utilization of cassava, leucaena, stylosanthes meals as Luong Phuong broilers and layer parent stock diets in small farm households of northern moutain Vietnam. PhD thesis, Thai Nguyen University (Viet.).

Van, T. T., Hoan, N. D. & My, N. T. T. (2015). Poultry breeding curriculum. *Hanoi Agricultural Publishing House*, 360 (Viet.).

Received:**April, 25, 2022**; *Accepted*: **May, 3,2022**; *Published*: **August, 2022**