International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 4, No. 5, p. 195-201, 2014

INNSPUB

RESEARCH PAPER OPEN ACCESS

Evaluation of nutritive values of papua foxtail millet (*Setaria italica* sp) and its substitutive effect for yellow corn on broiler performances

Siska Tirajoh[1,4], Achmanu[2], Osfar Sjofjan[3], Eko Widodo[3*]

[1] *Post Graduate Student, Faculty of Animal Husbandry, University of Brawijaya , Malang, East Java, Indonesia*

[2] *Animal Production Department, Faculty of Animal Husbandry, University of Brawijaya , Malang, East Java, Indonesia*

[3] *Animal Nutrition Department, Faculty of Animal Husbandry, University of Brawijaya , Malang, East Java, Indonesia*

[4] *The Assessment Institute of Agricultural Technology (AIAT), Jayapura, Papua, Indonesia*

Article published on April 29, 2014

Key words: Papua Foxtail millet, Nutritive values, Substitution, Broiler Performances

Abstract

Yellow corn is still an expensive and one of imported feedstuffs used by feed manufacturing in Indonesia. Research on the use of inconventional feed for broiler is currently elaborated in particular interest on Papua foxtail millet (*Setaria italica* sp) of yellow variety. The aims were to analyze proximate, fibre, calcium, phosphorus, β-carotene, tannin, phytic acid and amino acids contents, and examine the possibility of partly substitution of yellow corn with Papua Foxtail millet. The results showed that Papua foxtail millet contained higher protein than yellow corn (12.07 vs 8.7%) and high estimated metabolizable energy 2941 kcal/kg. it also rich in methionine and lysine with reasonable amount of other essential amino acids. The biological experiment was designed to evaluate substitutive effect Papua foxtail millet to yellow corn. Two hundred and fifty day old chicks of Lohmann broiler were used. They were allotted to 5 dietary treatments, namely P0 = basal feed (without Papua foxtail millet), P1 = basal feed in which 2.5% of yellow corn was substituted by Papua foxtail millet, P2 = basal feed in which 5.0% of yellow corn was substituted by Papua foxtail millet, P3 = basal feed in which 7.5% of yellow corn was substituted by Papua foxtail millet, P4 = basal feed in which 10.0% of yellow corn was substituted by Papua foxtail millet. Feed and water were provided *ad libitum*. The results showed that beside contain high phytic acid Papua foxtail millet shows a potential use for poultry feedstuffs and utilization of 10% Papua foxtail Millet as substitute of corn showed no adverse effect on broiler performances, even increase carcass percentage.

* **Corresponding Author:** Eko Widodo ✉ eko.widodo@ub.ac.id

Introduction

Slow development of poultry population in the most east province of Indonesia, West and Papua provinces, is due predominantly lack of locally available feedstuffs and low of human resources. While increasing income and education of Papua people require an increase in poultry production to support the needs of animal protein, efforts should be made to both educate people on knowledge of raising poultry and, as much as possible, encorage development of local crops for poultry feedstuffs.

Papua is the largest island in Indonesia, but development of agricultural sector is not as fast as other islands. Some of agricultural products like sugar, corn, rice and palm oil, are still have to be transported from Java, which is very far and costly. In the areas of mainland Papua is characterised as dryland, where Foxtail millet have long been traditionally cultivated by Papua people.

Papua foxtail millet (*Setaria italica* sp) is one of the main food crops, beside rice, corn, sago or sweet potato, that has long been cultivated by Papua people. To note that Papua province which has a dryland area of 4 million ha, about 10% has been used to cultivate Papua foxtail millet. Due to dryland is the most suitable site and people have already have skill and knowledge for generations, local government has started an extentification program of Papua foxtail millet cultivation.

Anticipating an increase in production of Papua foxtail millet, diversification uses of Papua foxtail millet not only for human consumption, but also for livestock, especially poultry is also potential. Based on nutrition consideration, it was reported by Budi (2003) that Papua foxtail millet contained fat (2.69 %), carbohydrate (74.17 %), crude protein (11.36 %), crude fiber (1.36 %), vitamin A (600 iu/g), Vitamin C (6.01 mg/kg), Vitamin D (5.40 mg/kg) and some mineral (Ca, Mg,K, Fe, Zn, Cu and Mn). However, antinutrition factors in Papua Foxtail millet included phytic acid and tannin. Therefore, current experiment was conducted to elaborate chemical composition of Papua Foxtail millet and examine its application on broiler performances and internal organ weights.

Material and methods

Material and chemical analysis of Papua foxtail millet Papua foxtail millet use in this experiment was of yellow variety cultivated in Kameri village, East Numfor, Biak Numfor district of Papua, Indonesia. Chemical analysis was carried out, namely proximate, fibre, calcium and phosphorus, beta carotene, amino acid, tannin and phytic acid analysis of standard procedures of AOAC (1996).

In vivo biological test of substitution of yellow corn with Papua foxtail millet. Two hundred and fifty day old chick of Lohmann broilers were used. The unsex chicks were divided into 25 units, and each unit of 10 chicks was raised in a litter floor pen of 1.25x1.00x1.00 m. Each pen was equipped by feeder and drinker facilities, lamp and brooder to maintain room temperature to meet the requirement. The chicks were subjected to 5 dietary treatments, namely

P0 = basal feed (without Papua foxtail millet),

P1 = basal feed in which 2.5% of yellow corn was substituted by Papua foxtail millet

P2 = basal feed in which 5.0% of yellow corn was substituted by Papua foxtail millet

P3 = basal feed in which 7.5% of yellow corn was substituted by Papua foxtail millet

P4= basal feed in which 10.0% of yellow corn was substituted by Papua foxtail millet. Because the length of experiment was 5 weeks, 2 kinds of basal feeds were used, for starter and finisher periods, respectively. The composition of basal feeds and treatments for starter and finisher period presented in Table 1 and 2.

Feed and water were provided *ad libitum*. The variables measured included feed consumption, body weight gain, feed conversion, and production index.

At 5 weeks of age, 1 bird representative of each replication unit was also selected, and then slaughtered. Carcass weight and percentage and internal organ (liver, spleen, gizzard, pancreas, kidney and heart) weight data were then measured. Finally, abdominal fat was also be weighted. Newcastle Disease vaccines were administered at 4 and 21 days of age, respectively.

Table 1. Composition of experimental feeds at 0-3 weeks of age (starter period)

Ingredients Composition	P0	P1	P2	P3	P4
			-%-		
Yellow Corn	60	57.5	55	52.5	50
Papua Foxtail Millet	**0**	**2.5**	**5**	**7.5**	**10**
Soybean Meal	19	19	19	19	19
Meat and Bone Meal	5	5	5	5	5
Fish Meal	8	8	8	8	8
Copra Meal	5	5	5	5	5
DL-Methionine	0.2	0.2	0.2	0.2	0.2
Palm oil	2	2	2	2	2
Bone Meal	0.3	0.3	0.3	0.3	0.3
Salt	0.2	0.2	0.2	0.2	0.2
Premix*	0.3	0.3	0.3	0.3	0.3
Total	100	100	100	100	100
Nutrient Contents :					
Dry Matter (%)**	88.77	88.94	88.77	89.21	87.81
Metablizable energy (Kcal/kg)***	3,056	3,050	3,044	3,039	3,033
Crude Protein (%)**	22.87	23.16	23.33	23.51	24.69
Crude Fat (%)**	6.64	6.58	6.11	6.76	6.88
Crude Fiber (%)**	3.82	3.70	4.06	3.90	3.91
Ash (%)**	8.04	7.83	7.51	7.64	7.15
Ca (%)****	1.75	1.25	1.15	1.45	1.59
P (%)****	0.91	0.85	1.15	0.92	0.92

**per kg contained vit. A: 2,000,000 IU, vit.D3: 400,000 IU, vit.E: 2,000 mg, vit.K3: 300 mg, vit. B1: 200 mg, vit. B2: 1,200 mg, vit.B6: 100 mg, vit.B12: 2 mg, Ca-d-pantothenat: 1,500 mg, Nicotinic acid: 3,000 mg, Choline chloride: 5,000 mg, dl-methionine: 50,000 mg, Iron: 6,400 mg, Copper: 1,600 mg, Magnesium: 10,000 mg, Manganese: 6,000 mg, Zinc: 8,000 mg; Cobalt: 20 mg, Iodine: 20 mg, and Antioxydant*
***A standard proximate analysis was performed based on AOAC(1996)*
****metabolizable energy was taken from Tirajoh (2013)*

*****calculated value*

Table 2. Composition of experimental feeds at 4-5 weeks of age (finisher period)

Ingredients Composition	P0	P1	P2	P3	P4
			--%--		
Yellow Corn	60	57.5	55	52.5	50
Papua Foxtail Millet	**0**	**2.5**	**5**	**7.5**	**10**
Rice Bran	10	10	10	10	10
Soybean Meal	14	14	14	14	14
Meat and Bone Meal	5	5	5	5	5
Fish Meal	8	8	8	8	8
Copra Meal	0	0	0	0	0
DL-Methionine	0.2	0.2	0.2	0.2	0.2
Palm oil	2	2	2	2	2
Bone Meal	0.35	0.35	0.35	0.35	0.35
Salt	0.15	0.15	0.15	0.15	0.15
Premix*	0.3	0.3	0.3	0.3	0.3
Total	100	100	100	100	100
Nutrient content Dry Matter (%)**	86.32	86.49	86.43	85.86	85.55
Metabolizable energy (Kcal/kg)***	3,120	3,112	3,106	3,100	3,094
Crude Protein (%)**	19.95	19.86	21.63	21.46	21.74
Crude Fat (%)**	6.51	6.60	6.11	7.10	5.89
Crude Fiber (%)**	5.13	4.30	5.30	4.49	4.35
Ash (%)**	8.46	7.51	8.61	7.59	7.68
Ca (%)****	1.21	1.21	1.27	1.53	1.34
P (%)****	0.91	0.85	1.15	0.92	0.92

**per kg contained vit. A: 2,000,000 IU, vit.D3: 400,000 IU, vit.E: 2,000 mg, vit.K3: 300 mg, vit. B1: 200 mg, vit. B2: 1,200 mg, vit.B6: 100 mg, vit.B12: 2 mg, Ca-d-pantothenat: 1,500 mg, Nicotinic acid: 3,000 mg, Choline chloride: 5,000 mg, dl-methionine: 50,000 mg, Iron: 6,400 mg, Copper: 1,600 mg, Magnesium: 10,000 mg, Manganese: 6,000 mg, Zinc: 8,000 mg; Cobalt: 20 mg, Iodine: 20 mg, and Antioxydant*
***A standard proximate analysis was performed based on AOAC(1996)*
****metabolizable energy was taken from Tirajoh (2013)*

*****calculated value*

While gumburo vaccine was employed at 14 days of age. Data were subjected to analysis of variance and if the significant effect among the treatments existed then being tested by using Duncan Multiple Range Test.

Results and discussion

Description of Papua Foxtail millet (Setaria italica sp)

Papua foxtail millet is a commonly cultivated crop specific to dryland of Biak Numfor, Papua, Indonesia. Although Rumbrawer (2003) reported that there are 5 virieties namely Papua foxtail millet *vesyek* (brown color), Papua foxtail millet *verik* (red color), Papua foxtail millet *vepyoper* (white color), Papua foxtail millet *vepaisem* (black color) and Papua foxtail millet *venanyar* (yellow color), only Papua foxtail millet *venayar* is the most common and, therefore, chepest in price. The photo of Papua foxtail millet *venayar* is presented in Figure 1.

Figure 1. Papua foxtail millet *venayar*

Evaluation of Nutritional Values of Papua Foxtail Millet (Setaria italica sp)

Results of analysis of chemical composition including amino acids contents of Papua foxtail millet as presented in Tabel 3.

The results indicated that Papua foxtail millet might be classified as energy source due to high content of its carbohydrate 83.99 %, closely similar to rice, wheat, sorghum and corn and in accordance with previous report (84.20 %) of Suherman *et al* (2009).

Table 3. Chemical contents of Papua foxtail millet (*Setaria italica* sp)*

Proximate contents	amount	Amino acids	Amount (%)
Dry Matter (%)	88.37	L-Aspartic Acid	0.78
Ash (%)	0.86	L-Serine	0.57
Crude Protein (%)	12.07	L-Glutamic Acid	2.33
Crude Fiber (%)	1.93	L-Glycine	0.26
Crude Fat (%)	2.76	L-Histidine	0.13
Metabolizable energy (Kcal/kg)**	3,139	L-Arginine	0.38
Nitrogen Free Extract (%)	85.09	L-Threonine	0.44
ADF (%)	5.02	L-Alanine	1.01
NDF (%)	27.24	L-Proline	0.81
Carbohydrate (%)	83.99	L-Cystine	4.12
Ca (%)	1.25	L-Tyrosine	0.16
P (%)	0.18	L-Valine	0.61
Tannin (%)	0.01	L-Metheonine	0.21
Phytic Acid (%)	3.07	L-Lysine	0.63
β-carotene (ppb)	54.1	L-Isoleucine	0.51
		L-Leucine	1.50
		L-Phenylalanine	0.62

**cited from Tirajoh et al, (2012) except for Ca, P, Tannin, Phytic acid and β-carotene*

*** cited from Tirajoh et al, (2013)*

Current result showed a similar result than those reported by Coulibaly dan Chen (2011) that foxtail millet contained carbohydrate 75.51 %, protein 11.90 % and fat 4.10 %. Some similar reports of protein, fat and ash contents of foxtail millet have been reported by Abate dan Gomez (1984) ; Zheng-li *et al,* (2006) and Bangoura *et al*, (2011), but its contents on calcium and phosphorus were higher as reported by Abate and Gomez (1984). On the basis of amino acids, methionine and lysine contents of Papua Foxtail Millet are similar to those reported by Boroojeni *et al* (2011). Davis *et al* (2003) mentioned that variation of protein content of foxtail millet is highly influenced by soil condition and implementation of fertilizer.

Antinutrition analysis showed that comparison between literatures and current research showed that tannin and phytic acid contents of Papua foxtail millet as low as 0.06 % vs 0.01 and 3.30 vs 3.07 %, respectively (Amadou *et al,* 2013) and (Herodian, 2011). While β-carotene of Papua foxtail millet was 54.1 ppb or 5.41 ug/100g, much lower than those of Choi *et al* (2007)(80 ug/100g) and Asharani *et al* (2010) 78 - 366 ug/100g. The different might be attributed to strain of Papua foxtail millet and analysis method.

Effect of Papua foxtail millet (Setaria italica sp) on broiler performances

Table 4 summarizes the results of utilization of Papua foxtail millet on broiler performances.

The results indicated that none of the treatments were significantly affected (P>0,05) broiler performances. On the basis of feed consumption, current results indicated that substitution of corn with Papua foxtail millet might not change palatability because metabolizable energy values only slightly changed. While no significant effect of Papua Foxtail Millet on body weight gain and final body weight might be due to no significant effect on feed consumption and hence it was though that digestion and absorption of nutrients were similar. Davis *et al.,* (2003) and Boroojeni *et al.,* (2011) reported no significant effect on body weight of broilers fed diet contained pearl millet as compared to those fed control diet. In Indonesia, production index indicates how good management program implemented in the broiler farm. Even the production indexes of current research were much better than those indexes reported by Timmerman *et al*., (2006) but they were not as high as those of Nollet *et al*., (2008).

Effect of Papua Foxtail Millet (Setaria italica sp) on carcass quality and internal organ weights

Effect of Papua Foxtail Millet (*Setaria italica* sp) on carcass and internal organ weights were not statistically significant, except for carcass percentage.

Table 4. Effect of Papua Foxtail Millet on Broiler Performances

Variables	Feeding Treatment					Pvalue
	P0	P1	P2	P3	P4	
Feed Consumption (g/bird)	3,180±84	3,101±144	3,259±176	3,138±152	3,240±181	P>0.445
Final Body Weight (g/bird)	1,803±93	1,808±55	1,855±31	1,816±99	1,885±59	P>0.333
Body Weight Gain (g/bird)	1,765±93	1,769±55	1,817±31	1,777±99	1,847±59	P>0.340
Feed Conversion	1.80±0.09	1.75±0.05	1.79±0.08	1.77±0.07	1.75±0.07	P>0.728
Production index[1]	286±28	296±12	296±12	294±24	307±16	P>0.577

[1]*production number was calculated according to* Nollet *et al*., (2008) *as follows:*
[(body weight (kg) x liveability (%))/(FCR x age (days)]x100

Table 5. Effect of Papua Foxtail Millet (*Setaria italica* sp) on carcass and internal organ weights

Variables	Feeding Treatment					P value
	P0	P1	P2	P3	P4	
	g/bird					
Carcass weight	1,536 ± 154.47	1,571 ± 88.46	1,647 ± 49.59	1,607 ± 193.19	1,714 ± 135.17	P>0.29
	Percentage of live weight					
Carcass*)	67.45 ± 4.89 [a]	70.81 ± 1.32 [ab]	71.63 ± 1.18 [b]	70.14 ± 1.15 [ab]	72.35 ± 1.29 [b]	P<0.04
Liver	2.37 ± 0.10	2.33 ± 0.18	2.33 ± 0.42	2.44 ± 0.27	2.45 ± 0.22	P>0.91
Spleen	0.04 ± 0.00	0.09 ± 0.03	0.07 ± 0.04	0.08 ± 0.03	0.08 ± 0.03	P>0.23
Gizzard	1.43 ± 0.29	1.33 ± 0.16	1.24 ± 0.06	1.40 ± 0.23	1.19 ± 0.16	P>0.29
Pancreas	0.22 ± 0.06	0.22 ± 0.07	0.19 ± 0.05	0.23 ± 0.04	0.26 ± 0.03	P>0.35
Kidney	0.16 ± 0.03	0.18 ± 0.04	0.19 ± 0.07	0.22 ± 0.04	0.19 ± 0.04	P>0.40
Heart	0.45 ± 0.03	0.45 ± 0.05	0.43 ± 0.07	0.45 ± 0.06	0.38 ± 0.04	P>0.22
Abdominal Fat	1.15 ± 0.10	1.25 ± 0.22	1.42 ± 0.35	1.19 ± 0.47	1.45 ± 0.54	P>0.63

**) means with different superscript in the same column differ significantly (P<0.05)*

The significant effect on carcass percentage found in this experiment was not related to internal organ weights (Table 5.). Iji et al., (2001) reported that non-starch polysaccharides content of chicken diet induced an increase in small intestinal weight. The reason of decreasing carcass percentage for P3 might be partly attributed to intestinal organ weight which was not measured in this experiment. But the reason of significant effect with highest level of Papua Foxtail Millet having significantly higher percentage of carcass is difficult to explain.

Conclusion

1. The proximate, mineral and amino acid analysis of Papua Foxtail Millet has been carried out. Since it has higher protein and lower metabolizable energy, but with comparable amino acid contents, Papua Foxtail Millet is potential poultry ingredient to substitute corn. Moreover, it also contains high phytat so it may not be able to replace the whole amount of corn in the diet.
2. Utilization of 10% Papua Foxtail Millet (*Setaria italica* sp) as substitute of corn showed no adverse effect on broiler performances, even increase carcass percentage.

References

Abate AN, Gomez M. 1984. Substitution of finger millet (*Eleusine coracana*) and bulrush millet (*Pennisetum typhoides*) for maize in broiler feeds. Animal Feed Science and Technology **10**(4), 291-299.

Amadou I, Gounga ME, Le GW. 2013. Millets: Nutritional composition, some health benefits and processing – A Review. Emirates Journal of Food and Agriculture **25** (7), 501-508.

Association of Official of Analytical Chemist. AOAC. 1996. Methods of Analysis. 13th Ed. Washington DC, USA.

Asharani VT, Jayadeep A, Malleshi NG. 2010. Natural antioxidants in edible flours of selected small millets. International Journal of Food Properties **13** (1), 41 - 50.

Bangoura ML, Ming ZH, Nsor-Atindana J, Xue ZK, Tolno MB, Wei. 2011. Extraction and fractionation of insoluble fibers from foxtail millet (*Setaria italica* (L.) P. Beauv). American Journal of Food Technology **6**(12), 1034 – 1044.

Boroojeni FG, Samie AH, Edriss MA, Khorvash M, Sadeghi G, Van Kessel A, Zentek J. 2011. Replacement of corn in the diet of broiler chickens using foxtail millet produced by 2 different cultivation strategies. Poultry Science **90**, 2817 – 2827.

Budi IM. 2003. Pemanfaatan gandum Papua (pokem) sebagai sumber pangan alternatif untuk menunjang ketahanan pangan masyarakat Papua. Prosiding Lokakarya Pangan Spesifik Papua. Kerjasama Pemerintah Provinsi Papua dengan Universitas Negeri Papua.

Choi Y, Jeong H-S, Lee J. 2007. Antioxidant activity of methanolic extracts from some grains consumed in Korea. Food Chemistry **103**, 130-138.

Coulibaly A, Chen J. 2011. Evolution of energetic compound, antioxidant capacity, some vitamins and minerals, phytase and amylase activity during the germination of foxtail millet. American Journal of Food Technology **6**(1), 40-51.

Davis AJ, Dale NM, Ferreira FJ. 2003. Pearl millet as an alternative feed ingredient in broiler diets. Journal of Applied Poultry Research **12**, 137-144.

Herodian S. 2011. Pengembangan buru hotong (*Setaria italica* (L.) Beauv. sebagai sumber pangan pokok alternatif. Institut Pertanian Bogor.

Iji, PA, Saki AA, Tivey, DR. 2001. Intestinal development and body growth of broiler chick on diet supplemented with Non-Starch Polysaccharides. AnimalFeed Science and Technology **89** (3-4): 175-188.

Nollet L, Huyghebaert G, Spring P. 2008. Effect of different levelsof dietary organic (bioplex) trace minerals on live performance of broiler chickens by growth phases. 17, 109-115.

Rumbrawer F. 2003. Pokem terigu unggul masa depan. Jurnal Antropologi Papua **25** (2), 18-41.

Suherman O, Zairin M, Awaluddin. 2011. Keberadaan dan pemanfaatan plasma nutfah jewawut di kawasan lahan kering pulau Lombok. http://ntb.litbang.deptan.go.id.

Timmerman HM, Veldman A, Van den Elsen E, Rombouts FM, Beynen MC. 2006. Mortality and Growth Performance of Broilers Given Drinking Water Supplemented with Chicken-Specific Probiotics. Poultry Science **85**: 1383-1388.

Tirajoh S, Achmanu, Sjofjan S, Widodo E. 2012. Nutrient Composition of 2 Different Varieties of Foxtail Millet (*Setaria italica* sp) and Their Potential for Poultry Feed Ingredient. Proceedings International Conference on Livestock and Veterinary Technology. Bogor Indonesia.

Tirajoh S, Achmanu, Sjofjan S, Widodo E. 2013. Digestibility and Metabolizable Energy of Papua Foxtail Millet (Setaria italica sp) when Included at High Level in the Broiler Diet. Proceedings the 2nd Animal Production International Seminar. Malang. Indonesia.

Zheng-li L, Shi-xian S, Ru-hong C, Wen-Sheng H, Jun-Xin L, Zhu-Feng Q, Xue-Yan X, Zhi-Gang S. 2006. Development of a New Foxtail Millet Germplasm with Super Early Maturity and High Iron Content. Agricultural Sciences In China **5**(7), 558-562.