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Effect of gradual inclusion of papua foxtail millet (*Setaria italica* sp) to substitute yellow corn on breast meat quality and blood profiles in broilers

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Abstract

An experiment was carried out to examine effect of gradual inclusion of Papua foxtail millet (Setaria italica sp) to substitute yellow corn on breast meat quality and blood profiles in broilers. Two hundred and fifty day old chicks were used and alloted to 25 experimental units of 10 chicks. Five different dietary treatments were set, namely (i) T0 = basal feed, (ii) T1 = basal feed of which 2.5 % of yellow corn was substituted by Papua foxtail millet, (iii) T2 = basal feed of which 5.0 % of yellow corn was substituted by Papua foxtail millet, (iv) T3 = basal feed of which 7.5 % of yellow corn was substituted by Papua foxtail millet, (v) T4 = basal feed of which 10.0 % of yellow corn was substituted by Papua foxtail millet. All dietary treatments were set as iso-protein and iso-energy. At the end of experiment 2 birds in each experimental unit was selected, 25 birds were slaughtered and breast meats were sampled. Blood samples were taken from another 25 birds. On the basis of meat quality, water content, water holding capacity, colour and tenderness were analyzed. While for blood profiles, the measured variables included concentrations of serum haemoglobin, erythrocite, glukose and triglyceride. The results showed that level of Papua foxtail millet (Setaria italica sp) did dose dependently improve ($P>0.05$) tenderness of broiler meat, on the other hand redness of broiler meat did significantly change ($P<0.01$) with tendency less redness colour appear when Papua foxtail millet added more than 5% in the diet. No changes in lightness and yellowness of breast meat were reported. All blood profiles measurements of broiler showed that no physiologycal changes due to inclusion of Papua foxtail millet to replace corn. Based on this research, it is concluded that Papua foxtail millet might be used 10% in the diet to improve tenderness and redness of broiler meat.

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Introduction

Among common livestock, broiler industry is recognised as the most developed in Indonesia. The broiler meat provides nutritious food at reasonable cheap price helping enhancement of protein consumption. At early age of slaughter, broiler meat has high quality in term of softness or tenderness, flavour and colour make it possible to be further cook for a variety of cuisines. According to Kim *et al.*, (2009) preferency of consumers toward broiler meat is predominantly due to tenderness, low fat and cholesterol contents.

Meat quality of broiler varied among farms, usually is influenced by genetic, environment, nutrition and condition before and during slaughtering (Qiao *et al.*,2002; Soeparno, 2009, Resnawati, 2005). Since nutrition affects the meat quality, and utilization of unconventional feedstuffs is encouraged, the use of Papua foxtail millet (*Setaria italica* sp) as substitute of yellow corn might influence broiler meat quality.

Papua foxtail millet is one of local Papua plant which commonly cultivated by local farmers. Due to improvement of productivity and availability of seed for cultivation, the government has a policy to extensively promote cultivation of Papua foxtail millet for the purposes of human consumptionas well as for livestock. In the previous experiment, Tirajoh *et al.*, (2014) reported that substitution of 10% yellow corn with Papua foxtail millet did not affect performance of broilers. It was also reported that Papua foxtail millet contained 12% protein (higher than yellow corn), 3139 kcal/kg metabolizable energy, 1.93% crude fibre and rich in amino acids particularly cystine and lysine. Current experiment was designed to examine effect of gradual inclusion of Papua foxtail millet to substitute yellow corn on breast meat quality and blood profiles of broiler.

Material and methods

Bird management

Two hundred and fifty day old chick of Lohmann broilers was obtained from local hatchery. They were alloted to 5 dietary treatments, each treatment was repeated 5 times, and each replication consisted of 10 chicks. The chicks were raised in a litter floor pen of 1.25x1.00x1.00 m. Each pen was equipped by feeder and drinker facilities and lamp. Brooder facilities were provide till 10 days to maintain room temperature to meet the small chicks requirement. Newcastle Disease vaccines were administered at 4 and 21 days of age, respectively. While gumburo vaccine was employed at 14 days of age.

Dietary treatments

Papua Foxtail millet of yellow variety used in this experiment was cultivated in Biak numfor district of Papua Indonesia. The dietary treatments consisted of:

T0 = basal diet (without Papua foxtail millet),

T1 = basal diet of which 2.5% of yellow corn was substituted by Papua foxtail millet

T2 = basal diet of which 5.0% of yellow corn was substituted by Papua foxtail millet

T3 = basal diet of which 7.5% of yellow corn was substituted by Papua foxtail millet

T4= basal diet of which 10.0% of yellow corn was substituted by Papua foxtail millet

Feed and water were provided *ad libitum*. Because the length of experiment was 5 weeks, 2 kinds of basal diets were used, namely basal for starter and finisher periods, respectively. Basal diet for starter consisted of 60 % yellow corn, 19% soybean meal, 5% meat and bone meal, 8% fish meal, 5% copra meal, 0.2% DL-methionine, 2% palm oil, 0.3% bone meal, 0.2% salt, and 0.3% premix. While basal for finisher period consisted of 60 % yellow corn, 10 % rice polishing, 14% soybean meal, 5% meat and bone meal, 8% fish meal, 0.2% DL-methionine, 2% palm oil, 0.35% bone meal, 0.15% salt and 0.3% premix. Nutrients composition of basal diets and Papua foxtail millet is presented in Table 1.

At the end of experiment, 2 representative birds of each replication unit (total 50 birds) were selected, half for the purpose of meat quality measurements and rest for blood profiles. Breast meat of each representative sample was sampled for meat quality measurement. The meat quality analysis consisted of water content, water holding capacity (WHC), colour and tenderness of broiler meat. While blood was taken by using 3 ml spuit connecting to vacuum tube containing EDTA (Ethylene Diamine Tetra Acetic) from the wing vein. The blood serum was obtained after centrifusing 3000 rpm for 15 minutes. The blood analysis for haemoglobin, erythrocite, glucose and triglyceride as well as water content of breast meat were done according to AOAC (1990). While the breast meat water holding capacity/WHC was measured following the method of Soeparno (2009), and colours were measured by using Colour Reader of MINOLTA CR-10 based on the lightness(L*), redness(a*) dan yellowness(b*) (Yuwono dan Susanto, 2001). Meat tenderness was measured by using Tensile Strength Instrument (TSI) of IMADA/ZP - 200N.

Table 1. Composition of basal diets at starter and finisher periods as compare to Papua foxtail millet.

Composition	*Basal diet*		*Papua foxtail millet*
	Starter	Finisher	
Metablizable energy (Kcal/kg)	3,056	3,112	3,139
Crude Protein (%)	22.87	19.86	12.07
Crude Fat (%)	6.64	6.51	2.76
Crude Fiber (%)	3.82	5.13	1.93
Ash (%)	8.04	8.46	0.86
Ca (%)	1.75	1.21	1.25
P (%)	0.91	0.91	0.18

Statistical anaysis

The data obtained were expressed as mean ± SD. Data were then subjected to analysis of variance of Completely Randomized Design, and if the significant effect among the treatments existed then being tested by using Duncan Multiple Range Test (Steel and Torrie, 1993).

Results and discussion

Effect of Papua foxtail millet (Setaria italica sp) on breast meat quality

Gradual inclusion of Papua foxtail millet (*Setaria italica* sp) to replace yellow corn on meat quality is presented in Table 2.

Table 2. Breast meat quality of broiler fed gradual inclusion of Papua foxtail millet.

Variables	*Feeding Treatment*				
	T0	T1	T2	T3	T4
Water content (%)	75.61±1.23	75.46±0.94	75.19±1.53	75.28±0.90	74.56±2.03
WHC (%)	54.72±9.98	63.43±3.07	67.81±9.25	63.70±9.27	68.72±2.45
Meat colour :					
L*	55.08±1.11	54.58±3.41	55.54±2.30	53.84±3.65	54.82±1.60
a* [1)]	$2.02±0.70^{ab}$	$2.96±1.82^{b}$	$3.06±0.68^{b}$	$1.70±0.69^{ab}$	$1.18±0.38^{a}$
b*	10.00±0.94	9.66±0.69	8.92±2.08	9.02±1.07	10.22±1.59
Tenderness (Newton) [2)]	$18.26±2.08^{b}$	$18.50±2.67^{b}$	$16.38±4.10^{b}$	$16.50±2.87^{b}$	$9.12±1.68^{a}$

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

means with different superscript in the same column differ significantly (P<0.01)

meaning that L as lightness level; a* as redness level and b* as yellowness level*

Water content

Statistical analysis indicated that gradual inclusion of Papua foxtail millet (*Setaria italica* sp) did not change (P>0.05) the water content of breast meat. Water content resulted from this experiment is still in a normal range of 74.56 % - 75.61 %. Riette and Van Laack (1999) ; Huff-Lonergan and Lonergan (2005) and USDA (2011) noted that normal water content of meat is 75%. Hidajati (2005) and Parakkasi (1990) said that meat should has a normal water content because at higher water content is easily spoilage due to the growth of unexpected microorganisms (Soeparno, 2009).

Water Holding Capacity

Statistical analysis indicated that gradual inclusion of Papua foxtail millet (*Setaria italica* sp) did not change (P>0.05) water holding capacity (WHC) of breast meat. WHC obtained from current experiment was in the range of 54.72 % - 68.72 %. These WHC values were in accordance with those reported by Ao *et al.*, (2011) and Jung *et al.*, (2010). Lawrie (2003) reported that improvement of WHC was somewhat influenced by meat protein content. Huff-Lonergan and Lonergan (2005) said that increasing meat protein content would increase its water holding capacity. Mechanism by which protein of meat is able to bind water is particularly through protein myofibril.

Breast meat colour

Statistical analysis indicated that gradual inclusion of Papua foxtail millet (*Setaria italica* sp) did not change (P>0.05) the lightness and yellowness (*L** and *b**) of breast meat colour, but it significantly improved (P<0.05) the redness (a*) of breast meat colour. Corzo *et al.*, (2009) reported that broilers fed DDGS containing diets produced L* value of 54-55 and b* value of 4.90 to 5.40 for control and 8 % DDGS containing diets. In addition, the current experiment found more yellowness of breast meat colour ranging from 8.92 – 10.22 might be attributed to the ingredients used in the formulated diets. The significant different effect of redness in breast meat colour due to gradual inclusion of Papua foxtail millet in broiler diets in particular for T4 could be attributed to Papua foxtail millet richer β-carotene. Other factors that might influence breast meat colour are concentration of myoglobine, Mg and Fe contents. Soeparno (2009) said that colour of meat is influenced by diet, age, sex, stress, type of muscle, pH and oxygen. Chemical status and myoglobin type together with chemical condition of meat play important role in determining meat color. In term of redness, founding of this experiment on redness value was higher than those of Corzo *et al.*, (2009) (1.50 – 1.60).

Tenderness

Statistical analysis indicated that gradual inclusion of Papua foxtail millet (*Setaria italica* sp) did significantly change (P<0.01) tenderness of breast meat. A tendency of increasing WHC and presumably at higher protein consumed (due to increasing level of Papua foxtail millet) might influence tenderness of breast meat. Rosyidi *et al.*, (2009) reported that the higher tenderness of meat the higher forces to push the meat. Gaman and Sherrington (1992) said that animal activities could influence the number of connective tissues resulted in decresing tenderness of meat. Soeparno (2009) said that tenderness is one of the most important factor determine meat quality, and tenderness varies between breed, carcass cut method and of different muscles.

Effect of Papua foxtail millet (Setaria italica sp) on blood profiles

Gradual inclusion of Papua foxtail millet (*Setaria italica* sp) to replace yellow corn on blood profiles is presented in Table 3.

Statistical analysis indicated that gradual inclusion of Papua foxtail millet (*Setaria italica* sp) did not change (P>0.05) all the blood profile variables. The results indicated that no harmful or negative effect of gradual inclusion of Papua foxtail millet to replace yellow corn in the diet toward physiological aspects of broilers. Schalms *et al* (1986) reported that normal erytrocite and haemoglobin concentrations in chicken blood were 2.50 – 3.50 million/mm^3 and 7.00 – 13.00 g/dl. While normal glukose concentration in chicken is from 130 – 290 mg/dl (Pond *et al.*, 1995), Hernawan *et al* (2012) reported that blood triglyceride is between 77.45 – 87.26 mg/dL with a tendency that male chicken has higher triglyceride level in the blood than female one. This indicated that inclusion of Papua foxtail millet did not change physiologically the chicken. This fact was somehow differ from broiler given high tannin containing sorghum (Medugu, *et al.*,2010[a] ; Medugu, *et al.*, 2010[b)] reduced erythrosite number to 1.82 million/mm^3.

Table 3. Blood profiles of broiler fed gradual inclusion of Papua foxtail millet.

Variables	*Feeding Treatment*				
	T0	T1	T2	T3	T4
Hemoglobin (mg/dl)	12.22±0.58	11.88±1.19	11.78±0.73	11.18±1.73	11.60±0.71
Erythrosite (million/mm^3)	2.57±0.06	2.52±0.37	2.43±0.16	2.29±0.42	2.41±0.21
Glukose (mg/dl)	251.60±4.45	266.00±33.11	276.40±17.44	284.20±20.96	260.40±30.68
Triglyceride (mg/dl)	52.60±10.90	55.40±12.22	65.60±21.27	66.00±28.30	63.80±14.01

Conclusion

It is concluded that inclusion of gradual level of Papua foxtail millet (*Setaria italica* sp) as substitute of yellow corn improves redness (a*) and tenderness of breast meat in broiler, but did not change the blood profiles indicated no physiological changes resulted from the use of Papua foxtail millet. It is suggested, therefore, to use up to 10% Papua foxtail millet in broiler diet.

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