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Feeding Impact of Yellow Maize Variety "Pool 8A" On Egg Production in Layers

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Abstract: **An experiment was carried out at Rubirizi farm in the College of Agriculture Animal Science and veterinary Medicine (CAVM) of the University of Rwanda, to evaluate the effects of feeding a yellow maize variety pool 8A based- diet on egg production in layers. A total number of 60 pullets were randomly divided into two lots of 30 pullets, and each lot was made of three sub-groups of ten pullets arranged in a complete randomized design and data were collected during ten weeks from July to October 2013. The parameters studied were the laying rate, feed conversion ratio, feed intake, rate of broken eggs, and weight of eggs, and egg yolk colour index. The inclusion ratio of both types of maize (white and yellow) was the same (47%) and all other ingredients were similar in two ration formulation. A proximate analysis of both maize based-diets and eggs produced was carried out in laboratory of CAVM-Busogo campus. Data were analyzed using GenStat with a one-way ANOVA. The proximate analysis revealed that yellow maize recorded high protein content (9.18%) than white maize (7.48%). Pullets fed with yellow maize based- diet recorded an average weekly laying rate of 89.7% while those fed on white maize recorded 87% but the difference were not significant (P>0.05). There was no significant difference (P>0.05) between the average daily feed intake of 110.7g/day/hen for white maize based-diet while it was 110.2g/day/hen. The feed conversion ratio tended to be the same, 2.2 for pullets fed on yellow maize based-diet and 2.3 for those fed on white maize based-diet. Eggs from layers fed with a yellow maize based-diet had a higher yolk colour score (8= yellow) than those from white maize based-diet (11= pale yellow) index evaluated using colour charts comparison.**

Keywords : **Yellow maize, egg production, layers.**

1. INTRODUCTION

White Maize has been used for many decades and now in combination with other feedstuffs, to formulate compounded poultry feed. White maize is used as energy source because of its high starch content (90%), low fiber, better palatability, presence of some pigments and essential fatty acids in an animal's diet (Dado, 1999). However, the normal maize variety (white maize) in the diets of livestock has some significant limitations, namely it has a low protein (7-10%) content and is deficient in yellow pigment(carotene or Vitamin A precursor) and some essential amino acids especially lysine and tryptophan (Okai *et al.*, 2005, Vasal, 2006).

Therefore, while formulating the diets, maize is combined with protein-rich ingredients such as fishmeal, and soybean meal which are expensive and are not always available. Many crop scientists have attempted to improve maize varieties so as to obtain a variety that can have a balanced nutrient content such as essential amino acids and can reduce the dietary inclusion of protein-rich feed ingredients thereby reducing cost of feeding and production. Moreover, it has been noticed that many egg consumers prefer eggs with a yellow egg yolk instead of eggs with a white egg yolk. Therefore, utilization of quality protein maize (QPM) can correct this deficiency and may be advantageous in the diets of poultry, especially layers (Mertz *et al.*, 1964). Nutritional evaluation of QPM in various locations has proved the superiority of QPM over Normal Maize in the feeding of various animals (Bai, 2002; Gao, 2002; Zhai, 2002.)

The objective of this study was to assess the feeding impact of yellow maize variety "pool 8A" on Egg production in layers" in terms of egg production and egg quality in layers.

2. METHODOLOGY

The experiment was conducted in the farm of CAVM Rubirizi campus, located in Kanombe sector, Kicukiro District in Kigali city from July to October 2013. This site is located in the peri-urban side of Kigali city located in an area having four seasons namely short rainy season, long rainy season, short sunny season and long sunny season. The minimum mean annual temperature varies between 18 and 22^{o}C. The maximum mean temperatures are about 25 to 28^{0}C, whereas annual rainfall is approximately 1177mm/ year, altitude of 1191m and the relative humidity varies between 71% and 87% (Monograph of Kicukiro District, 2006).

Experimental pullets:

A flock of 60 pullets aged of 16 weeks all from I SA BROWN strain were bought from a poultry farm in Rulindo District and were transported to CAVM farm, Rubirizi campus. Pullets were raised in open-sided deep litter house partitioned into rectangular pens measuring 2 m by 3 m and 1.75 m of height giving a floor space of 0.6 m^2 per pullet. The pens were thoroughly cleaned and disinfected. Wood shavings were spread on the floor about 5 cm depth to provide litter for the birds. Feed trough, water trough, and laying nest were placed at vantage points for the chicken to have easy access.

Experimental diets :

Normal maize (white maize) and Yellow maize (Variety pool 8 A) used in feed formulation were provided by Rwanda Agriculture Board (RAB) from one of its experimental stations located at Musanze district. Other ingredients including maize bran, fishmeal, soybean meal, cotton seed cake, snail shell, salt and vitamin premix were purchased from Zamura feed company in Kigali city. Each maize type was dried to have a Dry matter content of 12% and was ground in a hammer mill with a sieve mesh of 70 mm and mixed with other ingredients ground before. The proximate analysis was carried out to analyze the nutrient content and allow us to formulate diets of layers. The nutrients analyzed were Crude protein (CP), Ether extract (EE), Crude Fiber (CF), Ash, Starch, and sugar content. The white maize based diet was used as control and a yellow maize based-diet was used as experimental diet.

Both diets (white maize and yellow maize based-diets) were formulated to meet the nutrient requirements of the pullets as recommended by the national Research Council (NRC, 1988) and the pullets were around the period of starting laying eggs. The following table illustrates the composition of diets

Table 1. Dietary composition of layer diets

Ingredients	White maize Based-diet (%)	Yellow maize based-diet (%)
Maize	47	47
Maize bran	15	15
Soybean meal	10	10
Cotton seed cakes	8	8
Fish meal	9	9
Snail shells	10	10
Layer premix	0.5	0.5
Common salt	0.5	0.5
Total	**100**	**100**

Experimental design:

The 60 pullets were randomly assigned to two lots of 30 pullets for two diets and each lot was divided into three sub-groups of ten pullets in a Completely Randomized Design and the parameters studied were laying rate, feed conversion ratio, feed intake, rate of broken eggs, and weight of eggs, and egg yolk colour index. A white maize based-diet was fed to one lot of pullets and a yellow maize based-diet was fed to another lot of pullets.

Feeding procedure and data collection:

At the beginning of the study, the first two weeks were used to initialize the chicken on the two diets and chicken were fed twice daily (7 am and 1 pm). After this period, data on important parameters to be measured were recorded. Each time of feeding, troughs were filled with the diet and at the end of every day, the feeding trough was emptied and the leftover feed was weighed. At the end of every week, the weight of the leftovers was then subtracted from total feed offered to get the weekly feed intake. Daily feed intake per sub-group was determined by dividing the weekly intake by seven. Daily feed intake per pullet was also determined by dividing the total daily feed intake per lot by the number of pullets in each lot.

When pullets started laying, eggs were collected twice daily, morning (10 am) and in the evening (3 pm). The eggs were weighed and stored according to the two treatments. Broken eggs were also recorded as they occurred.

The feed conversion ratio (FCR) was measured by taking the average weekly feed intake divided by the weight of laid eggs and it varies from 2.08 to 2.8 (R. A. Singh, 1990).

Egg yolk colour index:

To determine the colour of egg yolk, a flat color chart, coloured with an arrangement of standardized colour samples, used for color comparisons and measurements such as checking the color reproduction of an imaging system was used. Eggs were cracked and opened at the centre onto a plate dish placed against plain background. The chart of the colour was brought near the plate and the yolk colour was scored by visual comparison with the various colours of the chart and choose particular colour which corresponded with the yolk colour for each lot.

3. DATA ANALYSIS

Data collected were subjected to statistical analysis using analysis of variance (ANOVA) for a complete randomized design using general linear model procedure of GenStat, 2011.

4. RESULTS AND DISCUSSION

The results of the proximate analysis of the white and yellow maize and the two diets are listed in the table below.

Table 2: Proximate analysis of yellow maize (pool 8 A) and white normal maize

Parameters (%)	White maize	Yellow maize
CP	7.48	9.18
EE	4.20	4.9
CF	1.06	1.03
DM	88.9	89.9
TN	1.20	1.47
Ca	0.30	0.72
P	0.30	0.55

Index: CP: Crude Protein, EE: Ether Extract, CF: Crude Fiber, DM: Dry Matter, TN: Total Nitrogen

Table 3: Proximate analysis of layer diets (yellow and white maize based-diet)

Parameters (%)	White maize based-diet	Yellow maize based-diet
Crude protein	17.5	17.9
Dry matter	88.3	89.7
Ether extract	6.00	2.63
Crude Fiber	2.66	2.60
Ash	0.5	0.6
Ca	3.61	6.24
P	0.115	0.116

The proximate analysis of both white and yellow showed no significant difference among nutrient (EE, CF, DM, Ca, Tn and P) but there was a significant difference between CP content ($P<0.02$). The yellow maize showed higher content of

Calcium, and Phosphorous. The higher content of CP for yellow maize results from the higher content of essential amino acids such lysine and tryptophan as revealed by Ortega *et al*., (1986), Sproule *et al.* (1988), Osei *et al*., (1999), and Zhai (2002).

Effect of yellow and white maize based-diet on technical parameters:

The table 4 shows the effect of yellow and white maize base-diet on the technical parameters**.**

Table 4: Effect of both maize base- diets on technical parameters

Parameters	Feed1(white maize based- diet)	Feed2(yellow maize based- diet)	P-value
Average Daily feed intake(g/day)	110.7	110.2	0.911
Feed conversion ratio	2.3	2.2	0.968
Average laying rate (%)	87	89.7	0.640
Feed per egg(g/egg)	127.13	122.8	-
Average egg weight (g)	54.6	55.1	0.681
Total egg laid	1828	1991	-

From table 4, the daily feed intake did not differ among two lots (P>0.05). This was due to the long dry season in which laying hens limited their intake to reduce the heat increament.

Feed conversion ratio for two pullets' lots showed no significant difference between the two dietary treatments. However, numerically, pullets fed yellow maize recorded better feed conversion value of 2.2 compared with those fed white maize which recorded values of 2.3.The inclusion of maize grain in the poultry feed as source of energy increases feed utilization compared to the use of maize by-product. These values were higher than what was reported by Osei *et al.*, (1999) who reported values between 1.99 and 2.09 for Quality Protein Maize (QPM) and Normal Maize (NM) respectively. Laying hens consuming yellow maize based diet consumed less feed to produce egg than those fed with white maize base-diet.

From table 4 the analysis of variance showed no significant difference (P>0.05) between the laying rate made by pullets fed with yellow and white maize based-diet. However the total eggs laid by the chickens on the two dietary treatments over the ten week period of the experiment was not significantly different (P>0.05). Pullets fed with yellow maize laid 1991 eggs compared with 1828 eggs laid by those fed with white maize based- diets (table 4). This was due to the high protein content in yellow maize grain (9.18%) than (7.48%) as shown the table 11 and many researchers on yellow maize or QPM reported a higher impact of yellow maize over white maize on egg production. Zhai (2002), reported that replacing NM by QPM significantly (P<0.10) enhanced egg production.

The rate of broken eggs (table not shown) was 2.35% for white maize based-diet and 1.24% respectively for yellow maize based-diet. Yellow maize diet contained high Calcium (0.72%) than white maize (0.55%) as presented in table 3, and this may be the reason why eggs from yellow maize based-diet had a rigid egg shell which protects them from cracking.

The colour index was yellow (Y-8) for egg from yellow maize based-diet and pale yellow (Y-11) for white maize based-diet as shown in table 5.

Effect of yellow maize on egg yolk colour :

A total of 10 eggs per treatment were analyzed. The value recorded using colour charts are presented in table 5.

Table 5: Egg yolk colour index using colour chart

Treatment	**(white maize diet)**	**(yellow maize diet)**
Recorded value	Y-11	Y-8

Index: Y-11: Pale yellow, Y-8: yellow

In addition, eggs from pullets fed Yellow maize variety pool 8A based-diet contained higher beta-Carotene as shown the table 6, the substance responsible for yellow colour of egg yolk. Those findings agree with Kodjogan kivi (2007), who reported values 8 (very intense yellow egg yolk) of yellow maize diet and 4(light yellow) respectively for white maize

based-diet. The results of this study, therefore, convinced us to conclude that yellow maize QPM when used in the ration of layers could improve egg yolk colour and this can meet the consumer's preference.

The results obtained for nutrient composition of eggs produced from two lots are presented in the table 6.

Table 6: Nutrient composition of eggs from both maize based-diets

Parameters (%)	Eggs from white maize based-diet	Egg from yellow maize based-diet
Crude protein	1.12	1.14
Fat	0.6	0.8
Ash	0.2	0.3
B-carotene	0.91	1.69
Ca	0.37	0.74
P	0.15	0.14

The table above shows that eggs from yellow maize based-diet have high B-carotene content (1.69%), high fat content (0.8%) and a higher protein content (1.14%) than that of white maize based-diet which recorded a B- carotene, fat and protein content of 0.91%, 0.6%, 1.12% respectively.

5. CONCLUSION

Cereal grains are the main source of energy in poultry diet and maize is a popular cereal used in combination with other feedstuffs to formulate compound poultry feeds. Yellow egg yolk is enhanced by feeding carotene -containing feeds from plants which some time have higher indigestible fiber content to non ruminants such as poultry. It is thought that yellow maize can overcome this challenge and increase egg production in layers. The results of this study are really interesting in terms of feeding yellow maize based-diet in layers.

Considering the egg production, the results of this experiment state that pullets fed a yellow maize based-diet layed more eggs than the other groups but with little difference in the laying rate. Regarding the feed intake and feed conversion ratio, little difference was observed between two groups. The rate of broken eggs was quite small for the group fed a yellow maize based-diet and a bit higher for the other group. The egg yolk colour index results showed more intense yellow egg colour in the group fed a yellow maize based-diet than the group fed a white maize based diet.

Making reference to the results of this experiment, we can conclude that feeding a yellow maize based -diet to layers is effective to provide protein and minerals such as Ca and P and therefore improve egg production . The results of this experiment also shows the importance of including yellow maize based- diet to enhance the yellow colour of eggs produced and this may attract more consumers. It was also revealed that using a yellow maize based diet will definitely increase egg production which could impact higher returns to poultry farmers.

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