AKENTEN APPIAH-MENKAH UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

EFFECTS OF REGULAR MAIZE AND DIFFERENT CERTIFIED MAIZE VARIETIES ON THE GROWTH PERFORMANCE AND CARCASS TRAITS OF BROILER CHICKENS.

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A thesis in the Department of Animal Science Education, Faculty of Agriculture Education, submitted to the School of Graduate Studies in partial fulfilment of the requirements for the award of the degree of
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DECLARATION

STUDENT'S DECLARATION

I, AMANKRAH, JOSEPH declare that this thesis, except for quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work and it has not been submitted, either in part or whole for another degree elsewhere.

SIGNATURE: ……………………

DATE: …………………………….

SUPERVISOR'S DECLARATION

I hereby declare that; the preparation and presentation of this work were supervised by the guidelines for supervision of the thesis as laid down by the Akenten Appiah - Menkah University of Skills Training and Entrepreneurial Development

DR. HOLY KWABLA ZANU (Supervisor)

SIGNATURE: ………….....................

DATE: ………………………………..

DEDICATION

I dedicate this work to my lovely wife Mrs Lillian Appiah- Mensah and my Children (Aseda Amankrah, Fiifi Ayeyi Amankrah and Nhyira Amankrah).

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LIST OF ABBREVIATIONS AND MEANING

CSIR	Center for scientific and Industrial Research
MOFA	Ministry of Food and Agriculture
QPM	Quality Protein Maize
USDA	United State Development for Agriculture
FAO	Food and Agriculture Organization
ME	Metabolizable Energy
IFBC	International Food Biotechnology Council
CRI	Crop Research Institute
SARI	Savannah Agriculture Research Institute
OPV	Open Pollinated Variety
WG	Weight Gain
FCR	Feed Convention Ratio
NM	Normal Maize / Silo Maize
OBM	Obatanpa Maize
OPM	Opeaburoo Maize
HM	Honampa Maize
ASM	Aseda Maize
TT	Tintim Maize
OW	Owanwa Maize
ODM	Odomfo Maize
DWG	Daily Weight Gain
TFI	Total Feed Intake
MDFI	Mean Daily Feed Intake
MWG	Mean Weight Gain

GJM	Golden Jubilee Maize
ETM	Etubi Maize
LNM	Local Normal Maize
INYM	Imported Normal Yellow Maize
LYS	Lysine.
ABM	Abontem Maize
OAH	Obatanpa + Abontem + Honampa
NFE	Nitrogen Free Extract
MSD	Meteorological Service Department
ANOVA	Analysis Of Variance
LSD	Least Significant Difference
C. P	Crude Protein
CF	Crude Fat
T.A	Total Fat
SEM	Standard Error of Measurement

ABSTRACT

This 6-week study was conducted to compare the effects of different varieties of maize (Obatanpa, Abontem, Honampa or their mixture) and regular maize on the growth performances of broiler chickens. A total of one 180-day-old chick were randomly allotted to 5 treatments with 4 replications with 9 birds in a Completely Randomized Design (CRD). All the dietary treatments were formulated to iso-caloric and iso-nitrogenous. The energy, crude protein and crude fat content of the Obatanpa, Abontem, and Honampa was higher than the regular maize. The production performances did not significantly influence ($P > 0.05$) for day 0 – 7 by the maize varieties and regular maize. No significant ($P> 0.05$) difference was observed for the parameters used among the dietary treatments from day 0 – 21. However, weight gain (WG) from day 0 – 42 recorded an increase showing a significant ($P< 0.05$) effect. Feed intake also increased from day 0-42. Again, feed intake did not show any significant effect ($P> 0.05$) on the birds for day 21 – 42. Also FCR of birds for day 21– 35 did not show any significant effects ($P> 0.05$). Moreover, day 21 – 28 recorded a significant difference in Weight gain (WG), body weight (BW) and Livability (LV) for all dietary treatments. B.W, WG, FCR and intake recorded no difference ($P> 0.05$) for day 28 - 35. Birds fed the Abontem diet recorded the lowest Liveability. However, from day 0 – 42, BW, WG and FCR differed significantly ($P<0.05$) but birds fed regular maize recorded a higher FCR. The weights (% of live weight) of the breast, thigh, heart, liver, duodenum, jejenum, gizzard, Ileum and caeca of the birds were not significantly influenced ($P>0.05$) by the dietary treatments. Birds fed the regular maize, Abontem and Honampa recorded a higher ($P < 0.05$) weight in the breast and proventriculus. Feeding Obatanpa decreased ($P>0.05$) the weight of the liver and gizzard. Overall, It was concluded from the results that the growth performance parameters were similar for all the dietary treatments, farmers can utilize any of these new varieties in their feeding operations but where carcass colour is desired HM and AM could be the varieties to use.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to The Study

In poultry production, specifically broilers, tissue growth, activities and maintenance rest upon the energy requirement of the broiler chickens. The energy requirement of the broiler chickens is mainly gotten from cereals and grains and it is the main source of carbohydrates. In Ghana and other parts of the world, the domestic fowl (chicken) is the most popular reared bird because of the value of protein it gives to humans through its meat and the additional income it provides to poultry farmers. claimed that, poultry production ensures quick returns within weeks in the case of broilers and months in terms of layers ((Dolberg, 2007; Yaw Kusi et al., 2015; Rajendran and Mohanty, 2003).

Feed ingredients such as maize have been competed for by man and the poultry sector and this raises the production cost status. The ingredient most competed for is maize (Zea Mays) (Bidi et al., 2019). In Ghana, maize is the major feed ingredient used by animal producers especially poultry farmers when formulating or preparing feed for the chickens from the starter-finisher phase when they are ready to be sold out. Maize provides calories and it is used as the major energy source for broilers chickens. (MOFA, 2012).

Maize produces a lot of by-products such as distiller’s dried grains, soluble and bran which is used by poultry farmers to feed broiler chickens. However, different maize varieties (QPM) such as “Mama ba”, “Dada ba”, Obatanpa Honampa, “Golden Jubilee”, Aziga and others have been developed. The QPM have good nutritional qualities which are good for broiler feed formulation and increased growth rates of broiler chickens. Another QPM has high pro-vitamin A content and carotene which causes the beaks, shanks and egg yolks to be yellow.(Ewool et al., 2016; Okai et al., 2015).

The lignin content in Brown midrib maize helps increase digestion in livestock. Also, low phytate, high amylose, high oil, high tryptophan and high lysine have been seen in new varieties of maize as a nutritional improvement which helps livestock production in terms of feeding. (Shiferaw et al, 2011)

1.2 Problem Statement

In Ghana, poultry farmers are unable to tell which maize variety they use in feed formulation and mixing. It is most probable that the maize purchased from the market in feeding poultry is a mixture of difference varieties. But it is important to investigate the potential of each maize variety in the production of broiler chickens. For instance, though a diet could be formulated using different maize varieties to meet the nutrient requirements of an animal regardless of their nutrient profile, factors such as texture, fibre (non-starch polysaccharide), ß- carotene levels etc. which are not normally considered in feed formulation could make a difference. Thus, in this study, it was hypothesized that broiler feed diets based on different maize varieties would have better growth performance and carcase traits than their counterpart on diets with only one variety.

1.3 Objectives of The Study.

1.3.1 Main Objective

The main objective of this study was to compare the effects of different varieties of maize (Obatanpa, Abontem, Honampa or their mixture) and regular maize on the growth performances of broiler chickens.

1.3.2 Specific Objectives

The specific objectives of this study were:

1. To determine the proximate composition of Obatanpa, Honampa and Abontem maize or their mixture and regular maize.
2. To determine the effects of Obatanpa, Honampa and Abontem maize or their mixture and regular maize on the growth performance of broiler chickens.
3. To investigate the influence of the inclusion of Obatanpa, Honampa and Abontem maize or their mixture and regular maize on the Carcass qualities of broiler chicken.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Maize as A Feed Ingredient

2.1.1 Maize as an energy source

Cereal such as Maize is very important in poultry production. It is used by both animals as feed or feed ingredients and human beings as food. Maize is a major source of energy for both animals and human beings when formulating and compounding feed for animals. It was revealed that there has been an acceptance of maize as the main energy feed ingredient when formulating poultry diets. A major challenge of normal maize in terms of its nutrient is the limited proportion of protein content and poor protein quality in the assessment of maize as a feed resource for poultry (Dei, 2017).

Akinbobola, (2019), asserted that animals need good and normal body functioning and this can be achieved through the high energy the animals get through maize when fed wholly or as a feed ingredient. Normal maize is mostly white and does not contain any carotenoid pigmentation. The metabolizable energy (ME) of maize has been compared with other energy sources because it is the standard value generally accepted.

Also, maize as an energy source is starch and is good for poultry because it's highly digestible (Ravindran, poultry feed availability and nutrition in developing countries). According to Okai et al., (2015), in the diet of monogastric farm animals, maize is a very essential cereal grain which constitutes about 50%-60% of the diet. The fibre content of maize is very low compared to other feed ingredients.

2.1.2 Maize as an energy source

The low protein contents as revealed by (Dei, 2017) and also confirmed by Okai et al. (2015) have a percentage of 9% - 10%. The lysine and tryptophan contents are 0.23% and 0.06% respectively. Lysine and tryptophan are essential amino acids which are very low in the normal maize varieties used in Ghana. The low contents of proteins and amino acids are the major limitations in the use of normal maize. The table below summarizes the protein fractions in the endosperm of normal maize.

Table 1: Protein fractions in the endosperm of normal maize

Protein Fraction	Normal Maize (%)
Albumins	3.2
Globulins	1.5
Prolamine (Zein)	49.2
Glutelin	35.1

Source: Vasal, 2000

The limiting amino acids such as lysine and tryptophan which are unfavourable and cannot be synthesized by monogastric animals and humans reduce the protein value of the normal maize (Vasal, 2000).

2.2 Biology of Maize

2.2.1 Nutritive value of normal hybrid maize grain

The maize grain on a dry matter basis is made up of 82.9% endosperm, 11.1% germ, 5.2% Pericarp and 0.8% tip cap (Kling 1991). From the work done by (Bathla et al., 2019; Raninen et al., 2011), conventional maize provides an energy content of 1400kcal /100g approximately on a dry basis. This is sufficient to maintain body equilibrium and helps in performing different types of physiological tasks. Maize is also considered a booster of nutrients like carbohydrates, fats, proteins and insoluble fibres that helps in providing sufficient energy to meet the human daily dietary requirements. Maize contains an appreciable amount of fat content that helps in the carrier of fat-soluble vitamins A, D, E and K. There is subcutaneous fat (fat content) and is an insulating material for the body that prevents heat loss. It is found beneath the skin of the maize. The fat content acts as a body reservoir for energy conservation purposes. There is a significant quantity of insoluble fibre found in the cell wall of the constituent.

The dietary fibre found in maize is resistant to digestion by the elementary enzyme system in human beings and making it an important component in the maze. Maize contains 8-11% of protein from different components like albumins, globulin, non-nitrogen substances and prolamin. Good agronomic practices and genotype help to give the maize a quality protein. The regulation of water balance, maintenance of appropriate p^H, defence and detoxification, growth and maintenance of tissues, transport of nutrients and formation of essential body compounds are done with the help of protein content in maize. The maize contains vitamin B-complex which also helps in growth, healthy, skin, heart, digestion and nail growth (Bathla et al., 2019; *Kataria* (2014))

Table 2: Percent chemical composition of the maize grain and grain fractions. In general, maize grain is low in protein content (9.1%), oil (4.4%) and ash (1.4%), but very high in starch content (73.4%) when considered on a dry matter basis.

Starch	Protein	Oil	Sugar	Ash	Minerals
Whole grain	73.	9.1	4.4	1.9	1.4
Endosperm	87.6	8.0	0.8	0.6	0.3
Germ	8.3	18.4	33.2	10.8	0.8
Pericarp	7.3	3.7	1.0	0.3	0.8
Tip cap	5.3	9.1	3.8	1.6	1.6

Chemical composition of normal maize grain and grain fractions (%DM) (Watson et al., 1987)

2. 3 Improved Maize Varieties in Ghana

2. 3. 1 Quality protein maize (QPM)

According to (Amofa, 2015), there are high levels of lysine and tryptophan which are two essential amino acids as compared to normal maize varieties. The presence of the opaque-2-gene in a homozygous recessive state increases the maize's biological value. This has caused higher levels of tryptophan and lysine (Bressani 1992).

Osborne (1897) asserted that there are four fractions of maize endosperm protein and these are; water-soluble albumins (3%), salt-soluble globulins (3%), alcohol-soluble zein or Prolamine (60%) and alkali-soluble glutelin (34%). The lysine content has different protein fractions but the lysine content (>2g/100g) of Albumin, Glubulins and Glutelin is high (Osborne and Mendel 1914).

The quality protein maize is a variety in which the nutritional content is high and is developed by researchers from the crop production sector. The Center for Scientific and Industrial Research – Crops Research Institute also reported that there are other benefits to the use of improved maize seeds and these are; high yields, disease and pest resistance, high nutritive values, increased farmer incomes and improved livelihood. In terms of human consumption of QPM, Zinc (Zn) and Iron (Fe) absorption in the human digestive system is improved due to the high lysine content (Apraku et al., 2006).

Table 3: Maize varieties developed in Ghana

Name of Variety	Year of *formal* release	Origin (institute)	Maturity period (days)	Potential (tons/hectare)	Selected characteristics
Mex 17 Early	1961	CIMMYT	90–105		Earliness, resistance to lodging
Comp 4	1972	CIMMYT	120		High yield, lodging resistant
Comp W	1972	CRI/CIMMYT	120		Yield, kernel type, tolerance to pests/diseases (blight, rust, streak, and stem borers), lodging resistance
Golden Crystal	1972	CRI/CIMMYT	105–110	4.6	Yield, suitable for poultry
Laposta	1972	CIMMYT	120		High yield, lodging resistant
Aburotia	1983	CRI/CIMMYT	105–110	3.5	High yield
Dobidi	1984	CIMMYT	120	5.5	High yield, lodging resistant
Kawanzie	1984	CIMMYT	90–95	4.6	Earliness
Safita – 2	1984	CIMMYT	90–95	3.5	Earliness
Okomasa	1988	IITA/CIMMYT	120	5.5	High yield, streak resistance
Abeleehi	1990	IITA/CIMMYT	105–110	4.6	Yield, streak resistance
Dorke SR	1992	IITA/CIMMYT	95	3.8	Yield, kernel type, tolerance to pests/diseases (blight, rust, streak, and stem borers), lodging resistance
Obatanpa	1992	IITA/CIMMYT	105	4.6	Yield, quality protein maize, kernel type, tolerance to pests and diseases (blight, rust, streak, stem borer), lodging resistant
Mamaba (hybrid)	1996	CIMMYT	105	6.0–7.0	High yield, drought tolerant (hybrid), lodges heavily in certain conditions.
Cida-ba (hybrid)	1997	CIMMYT	110	6.0–7.0	High yield, protein content (hybrid)
Dada-ba (hybrid)	1997	CIMMYT	110	6.0–7.0	High yield, protein content (hybrid)
Dodzi	1997	IITA	80–85	3.5	Extra early, open-pollinated
Aziga (yellow)	2007	CIMMYT	110	4.7	High yield, QPM, good for poultry and livestock industry, contains carotene which imparts a yellow colour to egg yolk, similar to Golden Jubilee except that it is more flint/dent type (better for storage and more resistant to weevil attack)

Name of Variety	**Year of *formal* release**	**Origin (institute)**	**Maturity period (days)**	**Potential(tons/hectare)**	**Selected characteristics**
Akposoe	2007	CIMMYT/IITA	80–85	3.5	Extra early, QPM, DT, excellent taste when boiled or roasted
Etubi (hybrid)	2007	CIMMYT	105–110	6.5–7.0	QPM hybrid, DT, lodging tolerance (an advantage for Mamaba)
Golden Jubilee (yellow)	2007	CIMMYT	105–110	5.0	High yield, QPM, the cross of white Obatanpa and a yellow QPM, good for the poultry and livestock industry, contains carotene which imparts a yellow colour to egg yolk
Aburohemaa	2010	IITA	90	5.0	DT, *Striga*tolerant, QPM; all 2010 varieties are drought resistant and mature early, were suitable for the forest and coastal zones, as well as that of Northern and Sudan savannah zones.
Enibi (hybrid)	2010	CIMMYT/IITA	110	6.5	QPM hybrid, DT, lodging resistant
Abontem	2010	IITA	75–80	5.0	DT, *Striga*tolerant, QPM
Omankwa	2010	IITA	90	4.7	DT, *Striga*tolerant; QPM
Aseda	2012	110–115	6.7		Hybrid white, DT, very good for domestic Purposes
Opeaburoo	2012	110–115	7.5		Hybrid white, DT
Tintim	2012	110–115	7.9		Hybrid white, DT
Nwanwa	2012	110–115	7.9		Hybrid yellow, suitable for human, poultry, and livestock consumption
Odomfo	2012	110–115	6.5		Hybrid yellow, suitable for humans,poultry, livestock consumption
Honampa	2012	110–115	5.2		Open-pollinated variety, yellow, source of provitamin A

Source: Compiled from DIVA project raw data; MOFA/CRI/SARI (2005); and personal communication with scientists in the Council of Scientific and Industrial Research. CIMMYT = International Maize and Wheat Improvement Center; CRI = Crops Research Institute; SARI = Savannah Agricultural Research Institute; IITA = International Institute of Tropical Agriculture; QPM = quality protein maize; DT = drought tolerant.

2.3.2 Obatanpa Maize

Obatanpa maize was released in the year 1992. It is a white dent open-pollinated quantity protein maize (QPM) variety. According to CSIR, Obatanpa has a potential yield of 5.5 tons/ha with a maturity day of 110 days. It is suitable for poultry and livestock production, that is, it increases the growth of the animal. In human nutrition, CSIR-CRI has recorded that, it enhances nutrition and health excellently. Obatanpa is the most cultivated seed and because is white, it does not have any carotenoid pigment which is responsible for yellowness. From the website of CSIR-CRI, Obatanpa maize being QPM improves the absorption of Zinc (Zn) and Iron (Fe) in the human digestive system due to the high lysine content in QPM. Out of this cultivar, are other Quality Protein Maize (QPM) hybrid varieties gotten from. That is, as a source of inbred lines. A white dent QPM called population 63 SR was Obatanpa where GH was derived (Apraku et al., 2006).

Research about the use of Obatanpa maize as a feed ingredient for piglets and chicken showed that Obatanpa maize had a higher value in nutrition and can replace normal maize for economic advantage (Osei et al., 1994; Okai et al., 1994). Obatanpa maize has a maturity period ranging from 105-110 days as researched and stated by Crop Research Institute.

2.3.3 Honampa Maize

The CSIR-CRI released the Honampa maize in the year 2012. It is an open-pollinated variety (OPV) and has a maturity day of 110 with a potential yield of 5.2 tons/ha. The Honampa maize variety is good for humans, poultry and livestock. It is suitable for all Agroecological zones in Ghana and has a flint seed which is tolerant to streak.

Honampa maize is yellow indicating the presence of high carotenoid pigment which causes the beak; egg York, meat, and legs to be yellow when fed to animals as feed. The vitamin A content in Honampa maize is very high and helps strengthen the immune system of both animals and human beings. A deficiency in Vitamin A may cause blindness, poor metabolism, retard growth and weakness of the immune system. Manfred Ewool revealed that 17200 deaths occur annually in children due to the deficiency of Vitamin A in Ghana (www.myjoyonline.com, 2015).

2.3.4 Abontem Maize

Abontem was released by CSIR in the year 2010. It is suitable for the Guinea and Sudan, savanna agroecological zones in Ghana with a potential yield of 4.7 tons/hectare. It can tolerate drought and Striga and has maturity days of 75-80 days. Abontem is an open-pollinated variety (OPV). It is also quality protein-productive yellow maize (vitamin A: < 3 micrograms/g). It is good for humans, poultry and livestock due to its rich beta-carotene (Oppong et al., 2017). A spacing of 75 cm by 25 cm 1 seed / hill or 80cm by 30 cm 2 seeds / hill. It is favourable for all weather patterns and grows very well in deep and well-drained loamy soils (Mas-Ud et al., 2021).

2.4 Quality Protein Maize on The General Growth Or Production Performance of Broiler Chickens.

Growth performance is the primary factor for determining the productivity of broiler chickens. It measures how well an animal grows. Feed conversion ratio (FCR) as an indicator of growth performance is important for overall efficiency and thus is the contributing factor to sustainable poultry production. In addition, it is of great economic importance to the producer (farmer). Onimisi et al. (2009), reported that when Quality

Protein Maize (QPM) (Obatanpa) was used to replace normal maize in broiler diets, weight gain (WG) increased during the starter phase as QPM also increased from 0% to 25%, 50%, 75% and 100%. But 100% had the greatest weight gain as compared to birds fed the control diet, 0% QPM to 75% QPM (Obatanpa variety). Again, Onimisi et al. (2009), observed that the feed consumption for birds fed 0% - 100% diet also performed better significantly but the Feed/gain ratio of the broiler birds improved ($P<0.05$) as QPM was increased in the diet.

The above authors also observed that birds put on control diets (regular maize) had a greater or highest body weight gain, Feed consumption and Feed/gain ratio as compared to 0% to 25%, 50%, 75% and 100%. At the finisher stage, (Onimisi et al., 2009) concluded that (0%) -(50%) recorded no difference significantly. The same trend was seen in (75) - (regular maize) but (75%), (100%) and (regular maize) recorded a significantly better performance than 0% - 50%). In all, birds fed a regular maize diet had the greatest weight gain.

Feed consumption of the birds for all treatments 0, 25, 50, 75, 100%QPM and regular maize was significantly different ($P<0.05$) with regular maize having the highest feed consumption followed by (0%), (25%), (75%) and (100%) with (50%) recording the lowest feed consumption (FC). There was no significant difference between (0%), (25%), (75%) and (100%). The authors reviewed recorded significant differences amongst Treatments (T) for feed/gain ratio. Birds fed 25% QPM and 100% QPM had a lower feed conversion ratio (FCR) as compared to 50% QPM and 75% QPM. Birds fed with normal maize had a linearly increase in FCR than T5 (100% QPM) but resulted in non-significant weight gains for 100% QPMT5 and regular maize.

Also, the non-significant differences observed from T2-T4 for FCR resulted in a significant difference between T4 and T2, T3. The increase as seen in birds fed normal maize (NM) was due to the lysine added to their feed. This is because lysine helps in protein synthesis for the growth of tissues. It helps again in the absorption of calcium.

Tryptophan and lysine were seen to be increased when QPM also increased in levels. This helped the weight gain also increase.

In the work of (Okai et al., 2015), the authors observed that when albino rats were fed seven (7) different new maize varieties; Obatanpa (OB), Opeaburo (OP), Honampa (HO), Aseda (AS), Tintim (TT), Owanwa (OW) and Odomfo (OD), they showed a similar trend for mean daily feed intake and weight gains. The FCR also showed no significant difference in the weight gain (WG) of the albino rats. Albino rat-fed Obatanpa (OB) maize variety saw an improvement in FCR, Daily weight gain (DWG), total feed intake (TFI), and Daily feed intake (DFI). Though (Okai et al., 2015) and (Onimisi et al., 2009) used different animals that are broiler chicks and albino rats respectively but both showed an improvement in growth indicators when fed with Obatanpa maize. Another observation was that Honampa (HO) diet fed to the albino rats recorded a slight difference as compared to OB.

Also, TFI, DWG, TWG, and DFI of the Honampa diet were higher than albino rats fed AS, TT, OD and OW for total feed intake and total weight gain. In all the Maize varieties used to prepare the diet, the results showed some inconsistencies though there was a great improvement in production performance and this could be attributed to the nutrient composition among the QPM cultivars.

In contrast to the findings of (Onimisi et al., 2009), where the performance of broiler starters in terms of feed consumption did not show any significant difference but broilers fed QPM showed a significant difference for feed consumption (Amonelo, 2008).

Also, the results (Amonelo, 2008), again agree with the performance of broilers at the finisher stage where there was a significant difference in feed consumption. The reason being is that tryptophan and lysine increased as the QPM also increased thereby the better performance result observed was due to the reduced leucine and isoleucine in QPM.

In the work of (Salifu et al., 2012) where local Ghanaian maize, imported normal yellow maize and two new quality protein maize (QPM) varieties (Etubi and Golden Jubilee) were used to ascertain the effects on growth performance and carcass characteristics of pigs, it was observed that total feed intake (TFI), Mean daily feed intake (MDFI), Mean weight gain (MWG), did not show any significant difference. The QPM varieties, Golden Jubilee (GJ) and Etubi (ET) figures for MWG were higher than local normal maize (LNM) and imported normal yellow maize (INM). FCR values for GJ and ET were higher than the NM value. The ADW values of GJ and ET were lower than LN and INYM though there was a significant difference among the treatment means were LNM, INYM and ET with closed values but GJ recorded the least value among the means.

According to (Panda et al., 2010), normal maize was replaced with QPM and body weight gain, and FCR improved significantly at 50% QPM as compared to the Normal maize (NM). The weight gain of birds fed QPM (50%) was comparable to the NM diet which included a synthetic lysine (NM + Lys). Also, diets containing 75% QPM values were significantly different and can also be compared to the (NM + Lys) diet. The reason for the improved performance of birds fed diet six (6) (NM + Lys) was due to the synthetic lysine added to their feed which helps to synthesize protein. The FCR improved from Diet 5-3 (100%-50%).

2.5 Quality Protein Maize on Carcass Characteristics of Broiler Chickens.

According to the work of (Panda et al., 2010), the 50% QPM significantly improved the breast yield. The 100% QPM replacement also improved breast meat yield and was higher than the QPM replacement of 75% but in all 100%, the NM diet was lower than the diet that contains QPM. Again, there was no significant difference for dressed yield, Giblet and spleen but a diet containing QPM from 25% to 100% (difference of 25%) improved significantly with higher values as compared to birds fed with Normal maize (NM) diet. Among the above-mentioned carcass part in terms of dressed yield, 50% QPM diet replacement had the lowest value (72.1) and this can also be compared to Diet 1 (NM 100%) getting 72.1 for dressed yield. Abdominal fat and Bursa also had a significant difference in their values. Diet 1 (NM) had a slightly higher value for abdominal fat.

Again, the values for the QPM diet for Dressed yield, Breast meat yield, Giblet, Abdominal fat, spleen and Bursa can be related to the values for birds fed normal maize with lysine (NM + Lys.). This improvement for QPM and (NM + Lys.) can be attributed to the lysine content in maize. There have been numerous reports by researchers that lysine in its low content in the diets of farm animals decreases the yield of breast muscle and also reduces performance (Bastianelli et al., 2007, Kidd et al., 1998). Based upon findings of (Renden et al., 1994) concluded that, breast muscle yield performance improvement was due to the high concentration of lysine in the diet when the researchers researched into the lack of interactions between dietary lysine or strain cross and photo schedule for male broiler performance and carcass yield.

The findings of (Nartey et al., 2018), asserted that breast and back muscles differed significantly among dietary treatments when an assessment of performance and Carcass Characteristics in broiler chickens fed diets based on quality protein maize varieties (Abontem and Etubi) developed in Ghana were done.

The difference occurred between the Etubi maize variety and the traditional maize for both breast and back but Etubi (ETM) and Abontem maize (ABM) values were higher than the Traditional maize (TM). No significant differences occurred for Thigh, Drumstick, Neck, Liver, Heart, Crop and Gizzard. There was a slight difference in values between TM and ABM for Drumstick, Wing, Liver and Crop with TM values causing the differences (marginal). Concerning crop, its value for ETM and ABM was lesser than TM.

Again, another revelation was that the full intestine recorded a significant difference among dietary treatments. ABM recorded the highest value (204) followed by TM (192) and the least is ETM (109). The performance of the regular maize (TM) was better than Etubi (ET).

Table 4: Dietary Treatment Effect on Some Carcass and Organ Weights in Broiler Chickens.

Parameters (g)	NM	ETM	ABM	SED	Sig.
Mean warm carcass wgt (g)	1854	2092	1983	105.5	NS
Mean dressing % (g)	74.2	71.8	80.9	4.17	NS
Mean chilled carcass wgt	1696	1957	1879	129.1	NS
Thigh (g)	322.3	361.8	330.6	22.63	NS
Drumstick (g)	276.7	309.2	270.4	21.04	NS
Wing (g)	244.8	258.5	240.3	13.52	NS
Breast (g)	597^{b}	742^{a}	648^{ab}	62.9	*
Back (g)	272^{b}	375^{a}	357^{ab}	43.0	*
Neck (g)	115.4	127.3	124.0	12.61	Ns
Liver (g)	60.7	65.0	45.8	12.86	Ns
Heart (g)	8.44	9.05	10.54	1.198	NS
Crop (g)	26.9	25.7	23.9	2.62	NS
Gizzard (g)	50.6	57.8	53.4	3.46	NS
Full intestine (g)	192^{a}	109^{b}	204^{a}	24.8	*

Source Nartey et al. (2018). Means in a row with similar superscripts are not significantly different (P>0.05). NM=Normal maize, ETM=Etubi maize, ABM= Abontem maize, SED=Standard Error of Difference

Assessment of Performance and Carcass Characteristics of Broiler Chickens Fed Diets Based On. According to Boateng et al. (2012) based upon a comparative study of two Normal Maize and two Quality Protein maize varieties-effects on growth performance and carcass characteristics of Albino rats, it was revealed at the end of their study that, the mean (empty stomach, kidney weight, liver weight) values resulted in a significant difference among the dietary treatments. The mean (full GIT, empty GIT, heart weight, respiratory tract weight, spleen weight, and viscera weight) did not record any difference among the dietary treatment. This means that the dietary treatment; local normal maize, imported normal yellow maize (INY), Golden Jubilee (GJ) and Etubi (ET) maize did not have any influence on the later carcass parameters mentioned. Again, amongst the parameters which had a significant difference with higher values under imported normal yellow maize was mean empty stomach (1.10) as compared to LN (1.02), GJ (1.03) and ET (0.93). The Golden Jubilee maize also recorded slightly higher values for significant different parameters when compared to the imported normal yellow maize. The mean (full GIT, empty GIT, spleen weight and Viscera weight recorded higher values for imported normal yellow maize though there was no difference in their dietary treatment. The Golden Jubilee and Etubi maize varieties (QPM) improved the organ characteristics but the imported normal yellow maize overall performance was higher among the dietary treatments.

However, the differences observed were attributed to the growth rates. From the research conducted by (Ibe et al., 2014), it was concluded that there was an influence of dietary treatment on the carcass characteristics significantly except for dressing percentage, and thigh and back weight. Heart, kidney, gizzard weight and intestinal length did not have any significant difference. Ibe et al. (2014) assessed the production performance and Carcass characteristics of broiler chicken when two varieties of Guinea corn and millet were replaced for dietary maize.

They (authors) observed that two varieties of Guinea corn (white and yellow colour) performed better but the pear and finger millet performed best with high values as compared to normal dietary maize for both Carcass characteristics and organ weight of the Broiler chickens.

From the findings of (Onimisi et al., 2009), the results of their Carcass study show that the percentage inclusion level of QPM at 25%, 50%, 70% and 100% did not influence (P>0.05) the following part; Dressing %, Thigh, Breast, Back, Liver, Lungs and Kidney. Thou QPM (Obatanpa) resulted in higher weight gains as compared to normal maize. Observations from the findings of (Salifu et al., 2012) revealed that Carcass length, dressing %, shoulder, loin, belly, thigh and back fat thickness were not statistically different. This was when the authors use Etubi and Golden Jubilee (QPM) against Local maize and imported yellow maize fed to pigs.

2. 6. Nutritional Profile of Feed Containing Certified Obatanpa, Honampa And Abontem Maize Varieties.

Salifu et al., (2012) results of the proximate composition showed that all four (4) maize varieties under dry matter recorded high values for Local Normal Maize (LN), Imported Normal Yellow Maize (INY) Golden Jubilee (GJ) and Etubi (ET) as 85.0, 88.0, 85.0 and 86.0% respectively. The ET value was slightly higher than the normal maize but among them is the Imported Normal Yellow Maize which recorded the highest value.

De Oliveira et al., (2011) and O'Quinn et al., (2000) record similar values for dry matter. The moisture content for the Local Normal Maize and the Golden Jubilee Maize variety was 15% and the Etubi Maize was 14% but Imported Normal Yellow Maize was 12% and it was the lowest among all the maize varieties. It could be seen that; the moisture content was very high in both QPM and the Normal Maize.

Ibe, (2014) recorded the following values 94.10, 8.60, 3.82, 3.20, 1.81, and 80.60 for Dry matter, Crude protein, Ether Extract, Crude fibre, Ash and Nitrogen free extract (NFE) respectively. When the chemical composition of maize (yellow) was determined against white and yellow Guinea corn and pearl and Finger millet were used to determine the growth performance and carcass characteristics of boilers. The dry matter, Ether extract and NFE were higher than the other accompanied feed ingredients. The crude protein and crude fibre chemical composition were low as compared to the Guinea corn and the millet.

Nweke, (2010) reported an 8.0 – 13% value for moisture content whiles crude protein was in the range of 7.00 – 8.75% Crude Fat, Ash and Carbohydrate were between 0.5 – 1.0%, 69 – 76% and 2.5 – 8.0% respectively.

Bello et al., (2014) reported 8.20 for moisture, 2.05 (Ash), 72.32 (Carbohydrate), 8.30 (Crude protein), 6.31 (Crude fat), 3.92 (Crude fibre), 70.37 (NFE) for Obatanpa maize against other quality protein maize (QPM) in 2009 and 2010 when the researchers researched into the Agro-Nutritional variations of quality protein maize in Nigeria.

Ahmed et al., (2013) researched the effect of substituting yellow maize for sorghum on broiler performance and reported on the proximate composition of QPM (yellow maize) is 11.7 (Crude printing), 5.3 (Crude fibre), 4.2 (Ether extract), 94.0 (Dry matter), 2.2 (Ash), 70.60 (NFE). These values were slightly different and higher than what (IBE, 2014)recorded from quality protein yellow maize.

Table 5 proximate composition (%) of Normal maize (NM) and Quality Protein Maize.

Maize varieties	Protein	Fat	Ash	Moisture	Carbohydrate
Obatanpa	9.7	4.2	2.2	11.1	72.8
Okomasa	9.9	4.3	2.0	11.4	72.7

Source: (Ahenkora et al., 1999).

From (Table 5), the energy level of the two maize varieties was high but Obatanpa recorded a higher value with a slight difference of 0.1.

Boateng *et al.*, (2012) also analyzed the content of four (4) maize varieties, that is two (2) normal and two (2) QPM and their findings are presented in Table 6.

Table 6: Proximate composition (%) of normal maize (NM) and QPM

PARAMETER	LN	INY	GJ	ET
Crude Protein	10.0	7.9	9.1	8.1
Ether extract	5.5	3.0	7.0	5.5
Crude Fiber	1.56	2.06	1.63	1.04
Ash	1.0	0.5	0.5	0.5
Moisture	15.0	12.0	15.0	14.0
Nitrogen Free Extract	66.94	74.54	66.77	70.86
Dry Matter	85	88	85	86

Source: (Boateng et al., 2012)

The Etubi (ET) and Imported Normal Yellow Maize (INY) had a close figure for Crude protein (8.10 vs. 7.9%) respectively but Golden Jubilee (GJ) maize recorded a higher valued (9.10%). The differences observed in all the proximate analyses could be due to varieties of maize and the environment in which the maize was cultivated. The finding from (Boateng et al., 2012) is similar to those of (Salifu et al., 2012).

2. 7. Crude Protein / Amino Acid Content of The Different Varieties Of Maize

Proteins which are complex organic compounds are formed as a result of the polymerization of simple monomers of amino acids bound together by peptide bonds to form complex compounds of high molecular weight (McDonald et al, 1996). According to (Maertens & Villanide, 1998) animals require amino acids from which body proteins are synthesized. This means that animals have no specific requirements for crude protein.

In the study of Ranjhan where he compared body weight and feed intake on broiler cockerels to know the effects, he stated that protein molecules of the diet are hydrolyzed or digested to their component acids before being absorbed.

It was also revealed by NRC that Nutrient requirements are mostly found in tables meant for temperate animals. Thus, farm animals raised in sub‑Saharan Africa protein requirements are not known (Ranjhan 1993; NRC, 1994).

There is an inadequate supply of plant protein sources. Maize is an important feed ingredient used in the formulation of a lot of feedstuffs for animals. It is seen as an energy food source with (3930 kcal of GE / kg) with a high percentage of starch (63%). The crude protein (C.P) content of maize is 8.0%. Saldivar and Rooney also asserted that new varieties and hybrids of corn developed with genetic improvement and manipulation with molecular biology have a high level of lysine of 0.35% as compared to 0.24% for normal maize (Lara & Rostagno, 2013; *Rostagno et al., 2005*; Serna-Saldivar et al., 1994).

De Oliveira et al., (2011) revealed that the crude protein (% C. P) for high lysine corn used for the research had a higher C.P % of 11.23% for Dry matter basis (DM) and 9.87% for as‑fed basis (AB). These figures are higher than the C. P % for common corn used as the comparison against the QPM. The CP % were 8.66% and 7.70% for DM and AB respectively. Arginine, Phenylalanine, Histidine, Isoleucine, Leucine, Valine, Lysine, Threonine, and Methionine was some of the amino acid composition for common corn and high-hygiene corn, The DM and AB essential amino acids (EAA) for high - lysine corn were higher than the DM and AB amino acids for common corn.

Below is the result obtained by (De Oliveira et al., 2011) presented in table 7

Table 7. Amino acid composition[1] of the corns with different nutritional profiles was used in the experiments during the growing and finishing phases.

Amino acid (%)	Common corn		High-lysine corn		High-oil corn	
	DM [a]	AB [b]	DM [a]	AB [b]	DM [a]	AB [b]
	------------------------- Essential amino acids (EAA) ------------					
Arginine	0.52	0.46	0.81	0.71	0.44	0.38
Phenylalanine	0.48	0.43	0.57	0.50	0.43	0.37
Histidine	0.24	0.21	0.41	0.36	0.28	0.24
Isoleucine	0.35	0.31	0.43	0.38	0.31	0.27
Leucine	1.00	0.89	0.99	0.87	0.94	0.82
Valine	0.46	0.41	0.61	0.54	0.45	0.39
Lysine	0.28	0.25	0.44	0.39	0.25	0.22
Threonine	0.32	0.28	0.42	0.37	0.29	0.25
Methionine	0.27	0.24	0.22	0.19	0.21	0.18
Methionine+cystine	0.37	0.33	0.33	0.29	0.29	0.25
	------------------- Non-essential amino acids (NEAA) -------------					
Aspartic acid	0.60	0.53	0.83	0.73	0.53	0.46
Alanine	0.68	0.60	0.69	0.61	0.61	0.53
Glutamic acid	1.67	1.48	1.89	1.66	1.59	1.38
Cystine	0.10	0.09	0.11	0.10	0.08	0.07
Glycine	0.34	0.30	0.49	0.43	0.31	0.27
Serine	0.39	0.35	0.47	0.41	0.37	0.32
Tyrosine	0.36	0.32	0.40	0.35	0.32	0.28

Source; De Oliveira et al., (2011). Analysis carried out in Laboratory of Analyses CBO - Campinas, São Paulo, Brazil; [a] Dry-matter. [b] As-fed basis.

Sumbo H & Victor, (2014) confirmed that the total amino acids, essential amino acid, non－essential amino acid and amino acid index of QPM were higher than common maize (CM). QPM 63.50, 36.96, 26.54, 88.35 and common maize 50.20, 26.37, 23.83 and 63.04 respectively. The amino acid composition of QPM and common maize (CM) were significant differences in which QPM was higher than CM. Threonine (3.20g / 2.00g), Lysine (2.64g /1.80g), Arginine (4.10g / 3.82g), Aspartic acid (6.76g / 6.21g), Glutamic acid (7.50g / 5.70g), Glycine (3.45g/2.50g), Tyrosine (2.73g / 2.07g), Valine (3.60g / 3.00g), Methionine (1.2g / 0.90g). This result was achieved when 100g of the maize meal for both was subjected to proximate analysis.

Akuamoa-Boateng (2002) also did similar research where quality protein maize was used in an infant feeding trial in Ghana and realized that the amino acids were higher than the other maize used. *Akuamoa-Boateng A (2002*) and *Nuss and Tanumihardjo(2011*) also revealed that QPM C. P % was low as compared to CM C. P% but better in terms of amino acid composition.

From the research results from (*Ikujenlola (2010*; Prasanna et al., 2001) where the researchers researched QPM and later worked on the effects of malting and fermentation on the nutritional qualities of complementary foods produced from maize varieties and soya beans grains. It was concluded at the end of their findings that QPM contains a higher level of lysine because lysine and tryptophan are the major limiting amino acids found in maize or other cereals. The crude protein of common maize and QPM was found to be 9.72% and 9.80% respectively, depicting that CM CP% was higher than QPM.

Panda et al., (2013) held that the QPM Crude Protein % (97.1%) was higher than the CP % of NM (89.4%) when the efficacy of quality protein maize in meeting energy and essential amino acid requirements in boiler chicken production. The amino acid essays of NM for Methionine, Phenylalanine, Leucine, Isoleucine, and Arginine were slightly higher than QPM but Cystine, Methionine + Cystine, Lysine, Threonine, Tryptophan, Valine, Histidine amino acids in crude protein were also higher in QPM than NM.

The crude protein of QPM was slightly higher than NM with 91.1%: and 89.2% respectively. This means the proximate composition of QPM was similar to that of normal maize (NM). From the results of the amino acids essays done, six of the critical amino acids profiles (Arginine, Glycine, Lysine, Cystine, Threonine, Tryptophan and Valine) for QPM had higher levels as compared to NM. But the levels of the other acid profiles (Leucine, Methionine, Phenylalanine, and Isoleucine) were less than in QPM (Osei et al., 1999a).

When (Eshetie, 2017), reviewed QPM as food and feed: in alleviating protein deficiency in developing countries, it was found that the amino acid profile especially Lysine and Tryptophan was 2-3-fold higher than normal maize.

Table 8 The Amino acid Profiles of QPM and NM

Feed source	Amino acid Profiles of QPM and NM on DM bases (%)									References
	Threonine	Tryptophan	Leucine	Valine	Methionine	Isoleucine	Cysteine	Lysine	Arginine	
QPM	0.27	0.07	0.82	0.43	0.16	0.27	0.22	0.28	0.44	Osei et.al., 1999
NM	0.22	0.05	1.04	0.40	0.17	0.30	0.17	0.21	0.35	Osei et.al., 1999
QPM	0.36	0.08	0.87	0.51	0.18	0.30	0.27	0.36	0.63	Panda et.al., 2011
NM	0.29	0.06	1.06	0.37	0.17	0.28	0.18	0.25	0.39	Panda et.al., 2011
QPM	0.45	0.10	0.96	0.57	0.21	0.36	-	0.43	0.75	Ortega et.al., 1986
NM	0.38	0.06	1.34	0.50	0.22	0.36	-	0.27	0.42	Ortega et.al., 1986
QPM	0.34	0.10	0.88	0.48	0.15	0.30	0.26	0.36	0.56	Osei et.al., 1998
NM	0.24	0.06	0.77	0.33	0.17	0.23	0.19	0.23	0.35	Osei et.al., 1998

QPM = Quality Protein Maize; RM = Regular Maize; DM = Dry Matter

According to (Adefris et al., 2017), the Lysine and Tryptophan in protein were higher in QPM than in common maize. The result of their findings was 2.7-4.5 and 1.6 - 2.6, 0.5 - 1.1 and 0.2 -0.6 respectively. The protein content for QPM was (>8) with common maize (CM) recording the same (>8). In addition to the above information from the literature, (Panda et al, 2010) also concluded that the amino acids profile for QPM was higher than NM except for phenylalanine and leucine which had a higher value for NM than QPM. The crude protein for QPM was slightly higher than NM.

Khan et al., (2020) also asserted results that, the crude protein (C. P) for two QPM hybrids (QPM 200 and 300) was higher than the conventional maize (CM). The amino acids profile percentages of these two hybrids' QPM were higher than CM percentages (%) gotten except for Leucine, and Valine which had higher values for CM than the hybrids QPM. Quality protein maize such as Obatanpa (Ob), Mamaba (Mb) Dadaba (Db) and CIDA - ba (Cb) was chosen for research by (Ahenkora et al., 1999) against normal maize (NM), Okomasa (Ok) and Abeleehi (Ab). The C.P of the NM and QPM did not show any difference though the percentage of NM was slightly up than the QPM. There were also differences between the QPM and the NM used for the research in terms of amino acid profile conduct.

Table 9. Essential amino acid contents (g/100 g protein) of tropical Ghanaian quality protein maize (QPM) and normal maize varieties

	QPM[a]			Normal maize			Amino acid requirements	
Amino acid	Obatanpa	Mamaba	Dadaba	CIDA-ba	Okomasa	Abeleehi	1-yr-old	Pre-school or adult[c]
Threonine	3.50	3.69	3.67	3.74	2.47	2.78	4.3	2.5
Cysteine + methionine	4.21	12.5	10.90	5.54	3.70	5.02	4.2	2.5
Valine	4.93	3.16	3.30	4.99	3.39	5.25	5.5	3.5
Isoleucine	3.08	3.06	2.95	2.95	2.36	3.42	4.6	3.5
Leucine	9.05	9.39	8.52	9.08	7.92	11.43	9.3	6.5
Tyrosine + phenylalanine	7.40	7.06	7.09	6.69	6.59	5.61	7.2	6.5
Histidine	3.60	4.00	4.01	4.09	2.26	3.66	2.6	–
Lysine	3.70	4.00	4.12	4.20	2.36	3.10	6.6	5.0
Tryptophan	1.03	1.01	1.21	1.01	0.62	0.61	1.7	1.0
Leucine/isoleucine ratio	2.93	3.06	2.89	3.07	3.35	3.34		
Protein (%)	9.73	9.48	9.46	9.81	9.86	9.87		

The results of the proximate composition percentages from (Salifu et al., 2012) of three QPM, Golden jubilee (GJ), imported normal yellow maize (INY), Etubi (ET) against local normal maize (LN) concerning crude protein (CP) was similar to what Ahenkora et.al reported. LN recorded higher values of 10.0% against INY (7.9), GJ (9.1) and ET (8.1). QPM is considered a bio-fortified food because its nutritional profile has been improved using conventional breeding techniques. The QPM possess double the levels of Lysine and Tryptophan which are essential amino acid for monogastric animals (Prasanna et al., 2001).

2.8. The Energy Content of The Different Varieties of Maize

Maize as a feed ingredient in animal production forms the highest percentage of energy in the national diet. It is known to be high in carbohydrates and a good source of calories (*Nuss and Tanumihardjo, 2011*).

Sumbo H & Victor, (2014) alleged that the energy (kcal/100g) of QPM was 378.50 and common maize was 375.00. Though the farmer was a little higher than the latter but did not show any significant effect. It was concluded by (Osei et al., 1999a) that the gross energy, Mj / kg for quality protein maize was 16.76 and normal maize 14.71. The levels of the gross energy of QPM were similar to that of normal maize through QPM tended to have higher levels.

Data from the United States department of Agriculture National Nutrient Data (USDA NND, 2016) shows that normal maize had an energy content of 3650 kcal/kg. They also found that an energy content of 86 kcal/kg was found in sweet corn. The apparent metabolizable energy (AME) content of QPM was 3,382 kcal/kg and NM also was 3,352 kcal/kg. The AME of QPM was similar to NM. QPM recorded the highest figure. This finding was achieved when NM was replaced with QPM on the performance, immune response and carcass characteristics of broiler chickens. (Panda et al., 2010).

The chemical composition percentage for the energy content of two QPM (200 and 300) and common maize is 13.7 MJ/kg, 13.9 Mj / kg and 13.6 MJ / kg respectively. The energy content for CM was similar to the two QPM 200 and 300 though QPM 200 recorded a slim margin of (0.2) followed by CM (0.1) and finally QPM 300 had the lowest energy content. This result from ((Khan et al., 2020) is similar to what (Osei et al., 1999a) recorded.

The ME (kcal/ kg) content of yellow maize, White Guinea Corn and Yellow Guinea Corn as reported by (IBE, 2014) are as follows 3451.68, 3379.79 and 3403.13 respectively. This result was recorded when the performance and carcass characteristics of boiler chickens were fed two varieties each of Guinea Corn and Millet as replacements for dietary maize. Yellow

Maize recorded the highest ME content followed by Yellow Guinea Corn and White Guinea Corn. The results recorded were similar for all three (3) different maize used.

Panda et al., (2014) asserted that the NM and QPM Cultivars used when they determined the efficacy of QPM in meeting energy and essential amino acid requirements in broiler chicken production recorded 13.91 MJ / kg and 140.5 Mj /kg respectively for the maize cultivators used. The margin between QPM and NM was minimal though QPM recorded the higher energy content. However, (MAFF, 1975) asserted that the gross energy (MJ/kg DM) for cereals such as maize is 19.0. The metabolizable energy (MJ/kg DM for the same maize is 14.2).

2.9. The Mineral Content of The Different Varieties of Maize.

Maize is used to preparing food and feed for both humans and animals respectively. Food such as porridge, popcorn, barbecues and as forage and silage for animals. (Mburu et al., 2012.; Zhang et al., 2010). Maize is also a good source of products such as starch, vitamins, fibre and oil. (Warman and Harvard, 1998; Pandya and Srinivasan 2012; Common et al 2012).

According to (Sumbo H & Victor, 2014)) when they compared the chemical composition, functional properties and amino acids composition of QPM and common maize, they concluded that, the sodium (Na), Magnesium (Mg), Potassium (K), Calcium (Ca), Zinc (Zn), Iron (Fe) and Phytate recorded values of (61.65; 43.88 mg/100g), (141.30: 137.10 mg/100g), (77.23:79.24 mg/100g), (64.70:85.61 mg/100g), (11.48:14.45mg/100g), (1.10:0.82 mg/100g) and (1.22:1.17 mg/100g) respectively. When these minerals were determined in normal maize and QPM respectively. Calcium, Zinc and potassium mineral concentrations were higher in QPM than in normal maize. While sodium, magnesium, iron and phytate concentrations were also higher in normal maize than in QM. Phytate in maize is reported to prevent the availability of calcium to the consumer of maize and maize products (FAO, 1992; *Hotz & Gibson, 2001*) The phytate concentration determined for NM (1.22mg/100g) and QPM (1.17mg/100g) and QPM (1.17mg/100g) did not show any significance (P>0.05).

The report by (De Oliveira et al., 2011)asserted that, the concentration of Calcium, total Phosphorus and available Phosphorus as determined in common corn (CC), High Lysine corn (HLC) and High - oil Corn (HOC) under dry matter (DM) and as feed basis (AB) as follows, Calcium, CC (DM 0.01: AB 0.01), HLC (DM 0.01: AB 0.01), HOC (0.02: AB 0.02). Though there was no difference in their concentration percentages HOC recorded a slightly high percentage.

Total phosphorus percentage in DM and AB for CC (0.24% :0.21%), HLC (0.28% :0.25) and HOC (0.21%: 0.18%) did not show any differences. But HLC mineral (phosphorus) concentration was high as compared to common maize. The HLC concentration of available phosphorus percentage was increased (DM 0.07: AB 0.08) whiles CC (DM 0.08: 0.07 AB) was low but HOC recorded the lowest available phosphorus percentage.

Panda et al., (2010) also did similar work and analyzed calcium and phosphorus percentage concentration during the proximate composition of feed ingredients. They found out that, the QPM percentage of phosphorus was increased (0.33%) as compared to normal maize (0.28%). Meanwhile, the calcium percentage concentration for normal maize (0.22%) was high as QPM (0.19%).

Also, (Badau et al., 2013) determined the following mineral components from conventional maize; Calcium, Iron, Manganese, Magnesium, Phosphorus, Potassium, Zinc and Copper. Their results for the mineral component are 11mg / 1000g, 24 mg / 1000g, 4.8 mg / 1000g, 780 mg / 1000g, 2310 mg / 1000g, 3280 mg / 1000g, 18 mg / 1000g, 2.9 mg / 1000g respectively. The ash component (mineral concentration) of normal maize comprises less than 2% of this, 75% is found in the germ. Phosphorus and potassium are mostly abundant in normal maize.

However, calcium and some trace minerals except iron are deficient in normal maize. Monogastric animals are however not able to digest phosphorus because much of them are in the phytic phosphorus state. The calcium in its minute form forms complexes with the phytic phosphorus because of its low bioavailability. The concentration (mg/100g) of minerals content in normal maize for Calcium Phosphorus, Magnesium, Sodium, Potassium, Chlorine, Sulphur, Iron, Manganese and Copper are 6.0, 300.0, 160.0, 50.0, 400.0, 70.0, 140.0, 2.50, 6.80, and 4.50 respectively (*Kling, 1991,* IITA, 1982; Maner, 1983).

The main factors affecting the mineral composition of grains are species, variety, stage of maturity, soil and environmental factors, morphological fraction and the use of fertilizers (Vaswani et al., 2016).

Hussaini et al., (2008) asserted that the increased in Nitrogen, Phosphorus, Calcium and Magnesium in maize grain was due to the nitrogen fertilizer application of up to 60kg/ha. Variations are a result of the effects of genotype and environment (Azim et al., 1989; Zhang et al., 2010). It was also characterized by (Peterson et al., 1983) that the genotype effect on the variation in mineral concentration was much larger than environment factors. The deficiency of one or more of these mineral elements may constitute nutritional disorders in humans.

2. 10. The Carotene Content of The Different Varieties of Maize

Carotenoids are categorized as non – pro – vitamin A carotenoids and pro-vitamin A carotenoids having bioactivity other than vitamin A activity. Maize is the only cereal with different types of bioactive carotenoids in higher amounts (Jennings et al., 2015; Kandla Kunta et al 2008; Kean et al., 2007; Namitha and Negi, 2010).

The B – Carotene is well-documented in maize (Berardo et al, 2004). Non – Pro – vitamin A carotenoids, Lutein and Zeaxanthin are the major carotenoids found in maize and it is categorized as xanthophylls. These xanthophylls possess anticancer and antitumor activities (Berardo et al, 2004; Kean et al, 2008; Bolhassani et al 2014). The total carotenoids for three (3) different maize varieties Big Flint Maize, (BFM), Popcorn (PC), and Red Maize (RM) are 1008 µg/100g), 602.4µg, and 970µg /100g respectively. Also, B-carotene for the same varieties when determined was BFM 10.21µg/ 100g, PC 14.35µg/100g and RM 20.05µg/100g.

The RM recorded the highest B – carotene among the three (3) QPM but for total carotenoids, QPM, and BFM recorded the highest value followed by RM and PC (Hossain & Jayadeep, 2018). Both the yellow grains types of QPM and normal maize contain similar levels of carotenoids. The carotenoid content of normal maize is 4.6g/kg. The carotene's presence in yellow maize grains primarily gives results in vitamin A potency. The yellow maize grain carotene content is 0.46mg/100g(MacDonald et al, 1988).

It was revealed that the total carotenoid contents of the 16 improved maize varieties showed Significant differences among the varieties. The total carotenoid content varied from 143 to 278 µg/g, with an overall mean of 200 µg/g. The results of (Maziya-Dixon et al., 2000) are in agreement with those of (Carballido et al. 1971), who reported a range of 82 to 280 µg/g for total carotenoids in hybrid corn grown in different regions. The table below summarizes the results revealed by Maziya-Dixon et al.

Table 10. Total carotenoid and fat contents of 16 adapted improved maize varieties

Genotype	Fat (%)	Carotenoid's content (µg/g)
IK 91 TZL COMP3-Y-C1	5.2	143
TZB-SR-SGY	4.1	159
TZSR-Y-1 C4	4.8	164
TZESR-Y-1	3.6	172
TZUTSR-W-SGY	4.3	173
TZEE-Y	3.7	179
AK 9331-DMR-SR	3.9	186
SUWAN-2-SR	3.8	194
EV 8728-SR	3.1	204
ACR 91 SUWAN-1-SR	5.2	210
MAKA-SR	5.2	212
POOL 26 SEGUA	3.8	216
AK94-DMR-ESR-Y	5.6	222
AK 9528-DMR	4.6	228
DMR-LSRY	4.1	266
STR-SYN-Y	7.1	278
Mean	4.55	200
LSD	0.33	3.41

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Location of the Study and Time

The research was carried out at the poultry section of the research farm of the Department of Animal Science, under the Faculty of Agriculture Education of the Akenten Appiah-Menkah University of Science, Technology and Entrepreneurial Development, (Mampong-Ashanti Campus).

According to records of the Meteorological Service Department (MSD, Mampong Agency), Ashanti Mampong is located in the forest transitional zone of Ghana between latitude 07° 04°N and longitude 01° 24°W with an altitude (Green Which Meridian) of 457.1m above sea level. Also, the research area is found in the north-west of the transitional zone of the forest and the Savannah region of Ghana. It has a wet semi-equatorial type with a bi-modal rainfall pattern with maximum and minimum temperatures of 30.5 and 21.2^0 respectively (MSD, 2017).

Rainfall occurs between April to July (major season) and August to November (minor season), with about 1224mm per annum. The research area experiences an annual harmattan season from December to March. Timsina and Agreements (2016) find out that, the area is a transitional savanna wood land, which is good for proper poultry keeping. The research lasted 42 days.

3. 2. Housing and Equipment

There were twenty (20) pens each measuring $(1m \times 0.8m)$ and made up of a concrete floor with an aluminium roofing sheet serving as the roofing; a wire mesh net with wood was used for the partition. Within the poultry house was a source of light of which energy-saving bulbs were used to help provide light for ad-libitum feeding during the night. In addition, was a touching light which was powered by battery cells and used during light failure. Wood shavings serving as litter were provided in each pen. Omnicide was also used to disinfect the shavings to prevent any infection. The shed was made air-tight by covering it with a polythene sheet. Each pen had a 3.0-litre plastic watering trough and a feeder.

3.3 Experimental Birds, Treatments, Design and Diets

3.3.1 Research birds

A total of one hundred- and eighty-day-old chicks were used for the research which was brought on 2nd March 2021. The broilers (Cobb 500) were obtained from Chick and Chicken services limited at Kumasi. The stocking rate for each pen was nine (9) for each replicate and done randomly. The area of each pen was measured at length 1m × 0.8m.

3.3.2 Experimental design

There were five (5) dietary treatments during the research and these are Each treatment had a different maize variety. Below are the treatments in each diet (D). The experimental unit was homogeneous therefore a completely randomized design was used for the research. Each treatment and its replications were pasted on each pen. Every treatment (T) had four (4) replicates with nine (9) birds each resulting in twenty (20) replications.

Table 11: Dietary treatment Maize Variety

Dietary Treatments	Maize Variety
1	Obatanpa variety-based diets
2	Obatanpa variety-based diets
3	Abontem variety-based diets
4	Honampa variety-based diets
5	Mixture of varieties (OB+AB+H)

3.4 Sources and Preparation of Dietary Treatment.

Dietary treatments 2, 3 and 4 were bought from Kwadaso Agriculture College-Kumasi. Fish meal, Soya bean meal, Wheat bran, Tuna fish meal, Oyster shells, Vitamins, Minerals, Premise, Di-calcium phosphate and Salt were bought at Asante Mampong from a commercial feed seller.

3.5 Management.

Ad-libitum feed and water were given to the birds. Water troughs were cleaned every morning. The day-old chicks were housed in pens of an area of 1m x 0.8m. Before the birds were brought in; the pen had been previously disinfected thoroughly against potential pathogenic micro-organisms. Wood shavings were spread to cover the floor.

The brooder house had energy-saving bulbs that provided heat for the birds as well as light for ad-libitum feeding. Empty tomato tins which contain a source of heat, providing heat to the birds were done on daily basis (Morning and Evening) and the daily routine of the program was observed. The litter was frequently stirred with a rake to enhance the absorption of water from faecal materials. The experiment started from this stage. Good and proper hygienic conditions were followed from day one to the end. Birds were observed on daily basis to identify unhealthy ones if any. Birds suffering from splay legs, paralysis and closed eyes were given Antibact 3x and vitaminolyte and they were healed from such disorders.

3.5.1 Medication and vaccination

Recommended and acceptable regular medication and vaccination were followed throughout the entire research period. This was supervised by the farm technicians. This was practised

to prevent diseases and also to cure affected birds with the disease.

3.6. Table 12. Ingredients and nutrient composition of broiler diet (%) as-fed

RM=Regular Maize, OBM=Obatanpa Maize, ABM=Abontem Maize, HM=Honampa Maize,

	STARTER DIET					FINISHER DIET				
INGREDIENTS	CM	O	AB	HO	O+A+H	CM	OB	AB	HM	OM+AM+HM
Regular. maize	58	-	-	-	-	60	-	-	-	-
Obatanpa maize	-	58	-	-	20	-	60	-	-	20
Abontem maize	-	-	58	-	20	-	-	60	-	20
Honampa maize	-	-	-	58	19.5	-	-	-	60	20
Wheat bran	12.5	13	14	12.5	13	18	16	17	16	16
Soya bean meal	16	15.5	15	16	14	11	13	12	13	12
Fish meal	11	11	11	11	11	9	9	9	9	10
Premix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Oyster shell	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
DCP	1	1	1	1	1	0.5	0.5	0.5	0.5	0.5
Calculated nutrient compositions										
Protein, %	23	23	23	23	23	18	18	18	18	18
Energy, Kcal kg^{-1}	3000	3000	3000	3000	3000	3200	3200	3200	3200	3200
Calcium	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.9
Av Phosphorus	0.45	0.45	0.45	0.45	0.45	0.35	0.35	0.35	0.35	0.35

DCP=Dicalcium phosphate, Regular maize: the maize normally sold out in the market and used for feeding chickens.

Vitamin mineral premix provided the following per kg of diet: vitamin A, 10,000IU: D, 400,000IU, E, 3,000IU: K, 2,000IU: B1 200mg B2, 900mg: B12, 2400mg: niacin, 5,000mg: Fe, 9,000mg: Cu, 500mg: Mn, 12,000mg: Co, 1000mg: Zn, 10,000mg: Se, 4.

3.7 Data Collection

3.7.1 Feed Consumption

The weight of the feed consumed for each treatment was calculated by subtracting the left-over feed weighed from the total feed served at the end of each week. The weekly feed consumed was also determined.

3.7.2 Feed Intake

Feed intake at weekly intervals was determined by multiplying the weight gain (WG) by the Feed Conversion Ratio (FCR) of each pen. The weekly feed intake was measured with the use of a digital scale. The feed intake per bird was also calculated by dividing the feed consumed per week by the number of birds per pen.

3.7.3 Weight gained

The initial weight of birds per pen was determined using a digital balance. Each pen had nine (9) birds. Thereafter, the weight of birds per pen was weighed weekly till the end of the research. The live weight gained as it is the rate of growth was calculated by dividing the pen weight per week by the number of birds and subtracting from pen weight zero divided by the number of birds on day zero.

3.7.4 Feed Conversion Ratio (FCR)

The weekly FCR was calculated by feed consumed for the week divided by pen weight of the week minus pen initial weight plus dead body weight.

3.7.5 Body Weight

The body weights of the birds were taken weekly per pen. It was calculated by dividing the pen weight per week by the number of birds.

3.7.6 livability (LV)

Weekly pen count was done after the pen weight is done. The livability of the birds was calculated by dividing the number of birds alive by the initial stocking rate or the number of birds multiplied by 100.

3.7.7 Carcass traits

At the end of the experiment, two (2) birds were selected from each pen at a random base without any bias. A total of forty (40) birds were euthanized. Before rapid head dislocation was done, their live weights were taken. Breast, liver and gall bladder, thigh, empty gizzard, heart, empty proventriculus, duodenum, jejunum, ileum and caeca weights were taken and weighed for recording. It was expressed as a percentage of live body weight.

3.8 Statistical Analysis

Data collected on growth performance and carcass traits were subjected to Analysis using the General Linear Modules (GLM) procedure of Minitab version 17.0 statistical software The means of different treatments were compared with Tukey Pairwise Comparison tests. Significance was considered at $P< 0.05$ level.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1. Nutrient Composition of Regular maize, Obatanpa, Abontem, and Honampa.

Regular maize contains some trace amounts of lysine and tryptophan which also contribute to the low amount of protein and trace amount of B vitamins. But hybrid and QPM maize contain a high amount of protein content due to the high content of tryptophan and lysine (USDA, 2012). Obatanpa is a quality protein maize with higher protein contents, fat, ash and an acceptable acidity level (Obiri-Danso et.al., 1998). Maize also contains a high amount of macronutrients such as fibre, starch, protein and fat whiles the micronutrient found in maize is the vitamin B-complex, B-carotene and essential minerals such as magnesium, zinc, copper and phosphorus (Bathla et.al., 2019).

Table 13: Proximate composition (%) of Regular maize, Obatanpa, Abontem, and Honampa maize (as-fed basis).

PARAMETERS	RM	OBM	ABM	HM
Moisture	11.1	9.3	10.5	9.4
Ash	0.9	1.1	0.7	0.78
Crude protein	11.38	12.92	13.13	12.04
Crude fat	1.15	1.0	2.05	1.5
Crude fibre	1.95	1.91	1.75	1.45
NFE	73.52	74.07	71.87	74.84
M/E[1], Kcal/kg	3088.33	3160.47	3168.95	3187.23

RM=Regular Maize, OBM=Obatanpa Maize, ABM=Abontem Maize, HM=Honampa Maize, [1]predicted.

In terms of moisture content, regular Maize recorded the highest value (11.1) followed by Abontem maize (10.5). Obatanpa and Honampa recorded a slight difference between their values. A difference of 0.1% between 9.3% and 9.4% respectively. These values were lower than what was recorded by (Boateng et al., 2012). There was a significant difference between the values recorded for Ash, Crude protein and Crude fat. Obatanpa recorded the highest value for Ash followed by conventional Maize (CM). Abontem maize variety had the highest values for crude protein and crude fat.

Bello et al., (2014) reported that the proximate composition of Obatanpa maize concerning moisture, Ash, Carbohydrate, Crude protein, crude fat, crude fibre and nitrogen-free extract (NFE) is 8.20, 2.05, 72.32, 8.30, 6.31, 3.92, 70.37 respectively. The moisture content, crude protein and NFE values were different (higher) than those recorded by (Bello et al., 2014) in 2009 and 2010.

Also, from the proximate composition of (Ahenkora et al., 1999). The values recorded from Ash, Fat and Moisture were higher than what the current studies showed. The Crude protein value (12.92) was higher (9.7) than what was recorded by (Ahenkora et al., 1999) for Obatanpa maize when they researched protein nutritional quality and consumer acceptability of tropical Ghanaian quality protein maize.

Again, regular maize recorded 10.0, 1.56, 1.0, 15.0 and 66.94 for Crude protein, Crude fibre, Ash, Moisture and NFE respectively (Boateng et al., 2012). The recordings of Moisture and Ash had a slight difference in the current study. Crude fibre, NFE and Crude protein values were higher than what was recorded by (Boateng et al., 2012). The NFE for the Honampa maize variety was slightly different from Obatanpa, Silo and Abontem maize respectively.

The value (819.2) recorded by (Panda et al., 2014) was higher than what was recorded in this present study as shown in (Table 13) for Conventional maize. Crude protein (C.P), Crude fibre (CF), and Total ash (T.A) values were also higher than the proximate analysis from this present study. The QPM used by (Panda et al., 2014) when researching the efficacy of QPM in meeting energy and essential amino acid requirements in broiler chicken production values recorded for C.P, C.F, T.A and NFE were higher than the proximate analysis done for the current study, Crude Protein (19.1), Crude Fibre (30.3), total ash (10.2) and NFE (813.7).

Eshetie, (2017), also did a similar work where he reviewed quality protein Maize (QPM) as food and feed in alleviating protein Deficiency in developing countries. Four different QPM and Conventional maize (CM) were analyzed for their nutritional composition. The results showed a significant difference among QPM and NM varieties with higher values as compared to this current study in Crude protein, Ether extract, Crude fibre and Total Ash.

The total Ash, crude protein, and crude fibre for normal and QPM varieties are 2.03, 9.0, 2.34 and 2.38, 9.0, and 6.26 respectively (Tiwari et al., 2013). These chemical composition values were a little higher than the recording from this present study except for crude protein which recorded low (9.0%) for both QPM and NM as compared to what was recorded for silo maize and the various QPM varieties used under this present study.

A similar study was also conducted by (Osei et al., 1999b) and had higher values for two QPM and NM in terms of Moisture, E.E, C. F, T.A and NFE. The current study values recorded for its parameters during the chemical composition are lower than what (Osei et al., 1999b) recorded. In all, the proximate composition of QPM varieties was similar to Silo maize, although QPM tended to have higher levels of NFE, C.P. C. Fat and Metabolizable energy. The standard moisture content of maize from proximate analysis by NRC is 15.5%, which the recorded value from the present study is far lower but the C.P falls within the NRC recommended Value of 12.5%.

Also from the study by (Vivek et al., 2008) the C.P of maize and C. fat range from 8 – 13% and 2 – 5% respectively. Both the QPM and Silo maize values recorded for C.P and Crude fat fall within the above range. The changes in the values could be attributed to the differences in Production methods, Climate, Stage of maturity, Soils, Variety of maize, harvesting time, Cultivar and the drying methods employed.

4.2 General growth or production performance of Cobb -500 Broiler Chickens fed the maize varieties.

Table 14: The effect of Regular maize, Obatanpa, Abontem, and Honampa maize on the growth performance per bird from day 0 to day 7.

Parameters	(CM)	**OBM**	**ABM**	**HM**	**(O+A+H)**	**P-VALUE**	**SEM**
Liv	97.22^{a}	91.67^{a}	91.67^{a}	100.0^{a}	97.22^{a}	0.455	1.69
B.W	117.701^{a}	125.26^{a}	127.13^{a}	125.72^{a}	117.24^{a}	0.312	1.91
Wt. Gain	76.67^{a}	84.71^{a}	87.57^{a}	86.89^{a}	76.00^{a}	0.247	1.82
FCRc	0.8309^{a}	1.195^{a}	0.8021^{a}	1.077^{a}	0.9240^{a}	0.437	0.0784
Intake	66.32^{a}	101.1a	71.0^{a}	93.3^{a}	70.82^{a}	0.436	6.96

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences ($p<0.05$). Mean values with the same superscript in the same row are not significantly different ($P>0.05$). RM=Regular Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCRc= Feed Conversion Ratio corrected and it was corrected for mortality.

Table 15: Performance of experimental broilers from day 0 to day 14

Parameters	**RM**	**OBM**	**ABM**	**HM**	**(O+A+H)**	**P - VALUE**	**SEM**
Liv.	91.67^{a}	91.67^{a}	86.89^{a}	97.22^{a}	97.22^{a}	0.723	2.19
B. Wt	236.37^{a}	256.8^{a}	264.6^{a}	264.01^{a}	243.2^{a}	0.322	5.16
Wt. Gain	198.35^{a}	216.2^{a}	225.1^{a}	225.18^{a}	202.6^{a}	0.292	4.97
FCRc	1.4730^{a}	1.5818^{a}	1.3884^{a}	1.474^{a}	1.5051^{a}	0.456	0.031
Intake	291.92^{a}	341.3^{a}	313.6^{a}	333.2^{a}	304.5^{a}	0.559	10.1

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences ($p<0.05$). Mean values with the same superscript in the same row are not significantly different ($P>0.05$). RM=Regular Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCRc= Feed Conversion Ratio corrected and it was corrected for mortality.

Table 16: Performance of experimental broilers from day 0 to day 21

PARAMETER	RM	OBM	ABM	HM	O+A+H	P-VALUE	SEM
LIV (g)	91.67^{a}	88.89^{a}	86.11^{a}	97.22^{a}	94.44^{a}	0.525	2.11
B.W (g)	403.90^{a}	437.3^{a}	469.30^{a}	448.20^{a}	431.80^{a}	0.207	8.83
Wt Gain (g)	365.8^{a}	396.8a	429.80^{a}	409.40^{a}	391.20^{a}	0.210	8.72
FCR (g)	1.700^{a}	1.640a	1.5825^{a}	1.5486^{a}	1.525^{a}	0.836	0.049
INTAKE (g)	616.5^{a}	645.4^{a}	679.8^{a}	632.5^{a}	586.6^{a}	0.405	15.0

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences (p<0.05). Mean values with the same superscript in the same row are not significantly different (P>0.05). RM=Rgular Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCRc= Feed Conversion Ratio corrected and it was corrected for mortality.

Table 17: Performance of experimental broilers from day 0 to day 28.

PARAMETER	RM	OBM	ABM	HM	O+A+H	P-VALUE	SEM
LIV (g)	86.11^{ab}	77.8^{ab}	58.33^{b}	94.44^{a}	88.89^{a}	0.022	4.04
B.W (g)	585.1^{b}	706.3^{ab}	779.2^{a}	686.8^{ab}	667.5^{ab}	0.068	22.1
Wt Gain (g)	547.0^{b}	665.7^{ab}	739.6^{a}	648.0^{ab}	626.9^{ab}	0.069	22.00
FCRc (g)	1.869^{a}	1.6599^{a}	1.603^{a}	1.6736^{a}	1.6885^{a}	0.358	0.042
INTAKE (g)	1014.8^{a}	1099.3^{a}	1165.3^{a}	1080.6^{a}	1056.1^{a}	0.305	22.4

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences (p<0.05). Mean values with the same superscript in the same row are not significantly different (P>0.05). RM=Regular Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCRc= Feed Conversion Ratio corrected and it was corrected for mortality.

Table 18: Performance of experimental broilers from day 28 to day 35.

PARAMETER	RM	OBM	ABM	HM	O+A+H	P-VALUE	SEM
LIV (g)	72.22[ab]	72.2[ab]	52.78[b]	91.67[a]	86.11[ab]	0.029	4.41
B.W (g)	689.4[a]	780.2[a]	900.8[a]	845.8[a]	812.8[a]	0.092	25.8
Wt. Gain (g)	651.3[a]	739.7[a]	861.3[a]	807.0[a]	772.2[a]	0.092	25.7
FCRc (g)	2.369[a]	1.939[a]	1.7738[a]	1.9298[a]	1.950[a]	0.100	0.073
INTAKE (g)	1490.9[a]	1423.6[a]	1523.2[a]	1555.6[a]	1490.4[a]	0.547	24.0

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences (p<0.05). Mean values with the same superscript in the same row are not significantly different (P>0.05). RM=Regular Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCR= Feed Conversion Ratio corrected and it was corrected for mortality.

Table 19: Performance of experimental broilers from day 0 to day 42

Parameters	RM	OM	ABM	HM	O+A+H	P - VALUE	SEM
Liv(g)	58.3[a]	61.1[a]	52.78[a]	80.56[a]	80.56[a]	0.183	4.70
B.wt(g)	804.4[b]	947.1[ab]	1130[a]	1002.6[ab]	1054[ab]	0.050	37.5
Wt. Gain(g)	776.3[b]	906.5[ab]	1090.4[a]	963.7[ab]	1014[ab]	0.050	37.3
FCRc (g)	3.497[a]	2.680[ab]	2.4006[b]	2.6672[ab]	2.436[ab]	0.046	0.135
Intake (g)	2625[a]	2415[a]	2605[a]	2569[a]	2410.5[a]	0.787	67.0

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences (p<0.05). Mean values with the same superscript in the same row are not significantly different (P>0.05). RM=Silo Maize, OBM=Obatanpa maize, ABM=Abontem maize, HM=Honampa maize. Liv=Liveability, BW= Body Weight, FCR= Feed Conversion Ratio corrected and it was corrected for mortality.

4.3 Carcass Characteristics of Cobb -500 Broiler Chickens fed the maize varieties.

From Table 20, The experimental diets had no significant (P>0.05) effects on all the parameters taken except percentage Proventriculus weight.

Table 20 Carcass Characteristics of Cobb -500 Broiler Chickens fed the maize varieties

PARAMETERS (%)	RM	OBM	ABM	HM	OAH	PVALUE	SEM
Mean live wgt	875[b]	1104[b]	1750[a]	1572[ab]	1653[a]	0.006	101.00
Breast wgt (BW)	5.232[a]	5.731[a]	6.838[a]	6.938[a]	6.875[a]	0140	0.273
Thigh wgt (TW)	9.5605[a]	9.451[a]	10.244[a]	9.993[a]	9.795[a]	0.374	0.137
Heart wgt (HW)	0.5926[a]	0.5689[a]	0.4595[a]	0.5286[a]	0.4305[a]	0.052	0.021
Duodenum wgt	1.359[a]	1.258[a]	0.9523[a]	0.9959[a]	0.908[a]	0.262	0.077
Liver wgt (LW)	2.880[a]	2.759[a]	2.309[a]	2.2178[a]	2.400[a]	0.075	0.092
Proventriculus wgt	0.6587[a]	0.6666[a]	0.4513[b]	0.5039[ab]	0.4601[b]	0.002	0.027
Gizzard weight (GW)	2.481[a]	2.313[a]	2.167[a]	2.1238[a]	2.257[a]	0.367	0.059
Jejunum weight (JW)	2.072[a]	1.805[a]	1.561[a]	1.632[a]	1.740[a]	0.256	0.076
Ileum weight (IW)	1.4365[a]	1.267[a]	1.0691[a]	1.191[a]	1.117[a]	0.191	0.052
Caeca (CW)	0.632[a]	0.666[a]	0.3858[a]	0.4632[a]	0.4340[a]	0.057	0.038

SEM: Standard Error of Means; a, b, c: Means with different superscripts on the same row are Significant differences ($p<0.05$). Mean values with the same superscript in the same row are not significantly different ($P>0.05$).

From Table 14, none of the parameters measured for growth performance: Body Weight (IBW), Gain(G), corrected Feed Conversion Ratio (FCR), Intake (I) and Livability (L) was significantly influenced ($P>0.05$) by the use of the QPM varieties and CM. This indicates that there was an improvement in the performance of birds. Birds fed Honampa had the highest values for livability. Birds fed regular maize (RM) diet and a diet containing a mixture of Obatanpa, Abontem and Honampa had the same values. Birds fed a diet containing Obatanpa maize only (0BM) and Abontem maize only (ABM) also recorded the same values and the least for livability.

The body weight of birds fed normal maize (NM) diet and a diet containing a mixture of Obatanpa (0), Abontem (A) and Honampa (H) (O+A+H) recorded no significance ($P>0.05$) and this can be compared to the recordings from (Onimisi et al., 2009) when they replaced normal maize with QPM (Obatanpa varieties) and had no significance (P>0.05) difference for the initial weight of birds at the starter and finisher phase. From (Tables 15 and 16), No significant (P>0.05) differences were observed for the parameters used and among the dietary treatments. Birds from all the treatments increased their feed intake as compared to days 0 – 7 presented in (Table 14) and FCR birds fed Obatanpa maize recorded a higher feed intake followed by birds fed Honampa maize diets, Abontem maize diet, O+A+H maize diets and birds fed Conventional maize diet recording the lowest respectively.

The higher feed intake by birds may be due to the palatability of the diet coupled with good environmental conditions. The weight gain (W.G) of the birds across the weeks, and days (0 – 42) increased with significant effects. Hence, Intake also increased for all the weeks (0 – 42 days) though there was no significant effect (P>0.05). This could be attributed to the higher crude protein content in the QPM varieties. Higher lysine content in the QPM varieties affected the high intake of feed.

The results from this study (Table 14 to 19) are similar to those of (Boateng et al., 2012) when they also recorded no significant effects (P>0.05) for mean initial weight, mean total feed intake and mean daily feed intake where two normal maize and two QPM varieties were compared on Albino Rats.

From the findings of (Nartey et al., 2018) on the Assessment of Performance and Carcass characteristics in Broiler chicken fed diet based on QPM varieties (Abontem and Etubi) developed in Ghana. The mean initial weight of the birds used did not show any significant (P>0.05) effects. This result also affirms what was gotten from the current study and the other authors mentioned above findings though their results are based upon the entire months used for the research work. Again from (Table 16 to 19), that is days 21 – 42, feed intake did not show a significant effect (P>0.05) on the birds. FCR for days 21 – 35 (Tables 16 to 18) also did not show any significant effects (P>0.05) but Birds fed Conventional maize (CM) recorded the least value for body weight gain (B.W).

From Table 17, days 21 – 28 recorded a significant difference in weight gain (WG), initial body weight (IBW) and Livability (LV) across all treatments. For WG, birds fed the Abontem diet recorded the highest value followed by birds fed Obatanpa, Honampa, (OBM+HOM+ABM) and the least were birds fed the regular maize (RM) diet. Livability (LV) and BW also had significant differences (P<0.05) in their values.

A report by (Okai et al., 2015) asserted that there was no effect (P>0.05) on Average Daily Weight Gain (ADWG) for the entire period, the feeding trial took place when Obatanpa, Opeaburoo, Honampa, Aseda, Tintim, Owanwa and Odomfo were tried on the growth and Carcass performance of Albino rats. Their result differs from what was recorded for the current study.

A similar feeding trial but with different results was tabled out by (Boateng et al., 2012) where FCR, Mean gain weight and Daily gain were affected significantly (P<0.05). This result affirms or supports this current study. From the current study, it could be observed from (Table 18) days 28-35 that, apart from Liveability, which resulted in a significant difference (P<0.05), IBW, WG, FCR, and Intake recorded no difference (P>0.05). The difference in livability occurred between birds fed the Abontem maize diet, birds from the Honampa maize diet against birds fed Conventional maize, birds fed Obatanpa maize and birds fed O+A+H maize diets. From (Table 14 to 19), day 0 – 42 birds fed the Abontem maize diet recorded the least values for Livability.

The reasons for the significant difference ($P<0.05$) observation for Liveability could be due to the size of birds in their pens as they grow and not being able to get enough space for movement within their pens. This situation caused some of the birds to be dull and not active leading to death. Gumboro, coccidiosis, bacterial septicemia, pneumonia and other environmental conditions are some of the factors that affected Livability.

From (Tables 18 to 19) on days 35 – 42, BW, W.G, and FCR differed ($P<0.05$) significantly. The highest FCR was for birds fed with Conventional maize (CM). A high FCR means birds need more feed to put on one unit of body weight and vice versa. A lower FCR is said to be an indication of better absorption and utilization of feed. FCR of birds feeding on the Abontem diet can be said to be better than those fed Conventional maize, Obatanpa maize, Honampa maize and a diet containing a mixture of QPM.

Also, birds fed with QPM had better FCR than those fed with CM. This could be seen in day 14 – 21, day 21 – 28, day 28 – 35 and day 35 – 42. The high levels of FCR could be attributed to the fact that the birds did less utilization potential of the nutrients, due to an increase in the bulkiness of the feed. Aderinola et al., (2013) also suggested that birds not able to utilize feed for a better FCR could be increased the bulkiness of feed.

Onimisi et al., (2009) also observed a similar trend as (Ahmed et al., 2013; Boateng et al., 2012; Nartey et al., 2018) reported. Their findings were from; two NM and two QPM were tried on the growth performance and Carcass characteristics of Albino Rats, the effect of substituting Yellow Maize for sorghum on broiler performance and the use of QPM (Abontem and Etubi) developed in Ghana to assess performance and characteristics in boiler chickens respectively. Though their results were tabulated on a monthly base as compared to the current study, which was done weekly. It could be seen that, if their results were presented on a weekly base, the trend of their results as compared to the present study, would have been the same. This is because of the values or figures noted for the various parameters concerned.

The results for FCR in the present study contradict the findings from (Ahmed et al., 2013; Panda et al., 2014; Tiwari et al., 2013) for feed conversion ratio. In addition, the days used for the research by the authors were days 0 – 21, 0 – 21 and 60 respectively unlike the present study took 42 days. Their findings were on the efficacy of QPM in meeting energy and essential amino acid requirement in broiler chicken production (Panda et al., 2014) and the evaluation of QPM and NM for the growth performance of crossbred piglets in the wester hills of Nepal (Tiwari et al., 2013). The inconsistencies in the current study findings could be attributed to the variations in nutrient composition between QPM cultivars and conventional maize varieties used in different feeding trails. The improvement of the WG for birds fed QPM from day 0-42 can be attributed to the high levels of lysine in the QPM as compared to conventional maize. Though amino acid essays were not done to ascertain their levels, from literature QPM is noted to contain high levels of lysine and tryptophan as against Conventional maize.

Krivanek (2007) find out that, the QPM cultivar had a lysine content of (0.48%) with tryptophan (0.11%) but normally maize has 0.23% and 0.05% respectively. Another reason for the improved performance could be attributed to how well the body of the birds utilized a specific type of protein found in their feed. This reason confirms what (Onimisi et al., 2009) reported that better performance of birds fed QPM could only not be the high amino acids content present in the feed but a higher bioavailability resulting in higher protein synthesis. The superiority of QPM over Conventional maize has been well established as seen in the table for the current study.

The Mean live weight of the birds recorded a significant ($P<0.05$) difference among dietary treatments. Birds fed Abontem (ABM) meal recorded the highest value of 1750g followed by (O+A+H) 1653g, Obatanpa meal birds (OBM) 1104g and Conventional maize diet birds (CM) 875g being the lowest as shown in (Table 20). The BW, TW, HW, LW, DW, JW, GW, IW and CW all recorded a non-significant ($P>0.05$) difference when birds were fed the research treatments meal. Proventriculus weight (PW) had a significant difference ($P<0.05$) with birds fed Abontem maize recording a lower value of 0.4513g followed by birds fed O+A+H, Honampa, Conventional maize and Obatanpa maize being the highest value.

The values of breast weight of birds increased from birds fed the regular maize diet to the Honampa maize diet but decrease with a non-significant ($P>0.05$) value of 0.063g from Honampa maize diet to birds fed a mixture of the QPM (T5).

Also, liver weight (LW) decreased from birds fed the Obatanpa maize diet to birds fed a mixture of QPM diet as compared to regular maize birds recording the highest weight. Gizzard weight (GW) also decreased from birds given an Obatanpa maize diet to Birds fed a mixture of the QPM as compared to birds from a regular maize diet been the control birds during the research.

The function of the gizzard is to grind feed and if the feed contains more fibre, the gizzard due to its extra work will expand and become bigger. This suggests why birds fed Normal maize have higher gizzard than those fed QPM varieties.

The results of this study are supported by that of (Azmal et al., 2007; Boateng et al., 2012; Okai et al., 2015; Onimisi et al., 2009; Salifu et al., 2012) where no significant difference (P>0.05) was recorded for heart weight, Liver weight, Breast weight and Thigh weight when feeding trial between normal maize and various QPM varieties were used on rats, Ross Broilers, Pigs, Starbro broiler chicks and Albino rat respectively. Although their findings were recorded on a monthly base as compared to the current study, which was weekly.

According to (Okai et al., 2015), a non-significant effect was reflected for both the absolute weights and relative weights for Heart and liver when Aseda, Opeaburoo, Tintim, Owanwa, Odumfo, Honampa and Obatanpa maize varieties were used for the study. However, the findings of the current study for Liver, Heart And Breast weights were not affected (P>0.05) and contradict the findings of (Azmal et al., 2007; Boateng et al., 2012) as it recorded a significant (P<0.05) effect for values for liver, Breast and heart weight.

From this study, it can be seen that QPM varieties used in this study, did not have any effects on the Breast, Thigh, Heart, Duodenum, Liver, Gizzard, Jejunum, Ileum and Caeca over the Conventional maize though values of QPM varieties increased as compared to Conventional maize. The improvement in the weight of the carcass parameters could be attributed to higher levels of lysine QPM varieties diet. The QPM that was used in this experiment does not only contain high protein content, but also high lysine and tryptophan concentration as compared to Conventional maize. It has been found that a low lysine diet does not only lead to a reduction in breast muscle yield but also poor performance (Bastianelli et al., 2007; Kidd et al., 1997). Another reason for these current results could also be due to the higher bioavailability resulting in higher protein synthesis (Onimisi et al., 2009).

An observation seen during the period of the research was that birds fed with yellow QPM varieties (Abontem, Honampa) had their Shanks, Legs, Beak, Skin, Thigh, Breast meat and Adipose fat tissue yellow. This change in colour intensity is attributed to the presence of xanthophyll and carotenoid pigment in the maze. Birds fed a mixture of the QPM varieties also had such changes.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From this study, the maize varieties used (Obatanpa, Honampa, Abontem or their mixture had no negative effects on growth and carcass performance. The carotenoid content (yellow colour) of Abontem, Honampa and the mixture of the maize varieties used affected the yellow colour intensity of Thigh and Breast meat and others which can increase the acceptability of consumers.

The varieties of maize used for the feeding trial has an appreciable amount of crude protein and energy content and hence can be used as a diet ingredient. The maize varieties (Obatanpa, Honampa and Abontem) used did not have any adverse effects on the Carcass characteristics of the broilers.

5. 2 Recommendations

Further and detailed research should be done into the biochemistry, lipids profile and amino acids essays since it was not done in this trial because of logistical challenges.

A follow-up experiment can be done to validate the findings in this work as well as OBM, ABM, HM and their mixture on digestibility. I, therefore, recommend to poultry farmers both present and future, that they can adopt the use of Obatanpa, Abontem, Honampa or their mixture since it enhanced the performance of the broilers.

REFERENCES

Aboe P.A, Boa-Amponsem, K., Okantah, E.A, Butler P.T. (2006). Free range Village chickens on the Accra Plains, Ghana: Their husbandry and productivity; *Trop. Anim. Health Prod*. 38:235-248.

Aboe, P., Boa-Amponsem, K., Okantah, S.A., Butler, E.A., Dorward, P & Bryant, M. (2006). Free-range Village Chickens on the Accra Plains, Ghana: Their Husbandry and Productivity. *Tropical Animal Health and Production*. 38. 235-248. 10.1007/s11250-006-4356-x.

Aboe, P.A.T, Boa-Amponsem, K., Okantah, S.A., Dorward, P.T. & Bryant, M. J. (2006). Free-range village chickens on the Accra Plains, Ghana: their contribution to households. *Tropical Animal Health and Production*, 38: 223–234.

Abor Acres Broiler Management Handbook. Retrieved February 26, 2021, from https://www.aviagen.com.

Adei, D and Asante, B. (2012). Challenges and Prospects of the Poultry Industry in Dormaa District. *Journal of Science and Technology* (*Ghana*), 32 (1), 104-116.

Adei, D. & Asante, B. K. (2012). The challenges and prospects of the poultry industry in Dormaa District. *Journal of Science and Technology, 32*(1). Retrieved from http://www.ajol.info/index.php/just/article/view/75598 Ahmed, M. a, Dousa, B. M., & Atti, K. A. (2013). *Effect of Substituting Yellow Maize for Sorghum on Broiler Performance 1*. *3*(1), 13–17.

Ahenkora, K., Twumasi-Afriyie, S., Yao, P., Sallah, K., & Obeng-Antwi, K. (1999). Protein nutritional quality and consumer acceptability of tropical Ghanaian quality protein maize. *Food and Nutrition Bulletin*, *20*(3), 354–360. https://doi.org/10.1177/156482659902000313.

Akuamoa-Boateng A (2002). Quality Protein Maize:... - Google Scholar. (n.d.). Retrieved June 22, 2022, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Akuamoa-Boateng+A+%282002%29.+Quality+Protein+Maize%3A+Infant+feeding+trial+in+Ghana%2C+Ghana+Health+Service-+Ashanti%2C+Ghana.+1+–+45.&btnG=

Allen, O., Manfred, B. E., Priscilla, R., Obeng-A.K. and Stella, A. E. (2017). Maize improvement in Ghana - The contribution of CSIR. April 07, 2017, 5804.

Amofa, M. (2015). Introgression of Sugary *Su1* Gene from Sweet Corn into Obatanpa Using Backcross Breeding Approach. Master of Philosophy in Agronomy (Plant Breeding) Dissertation. Faculty of Agriculture, Department of Crop and Soil Sciences, Kwame Nkrumah University of Science and Technology. Kumasi, Ghana.

Amonelo, M.O and Roxas, D.B. (2008). Growth Performance of Broilers fed quality Protein Maize (QPM) – Based Diet. *Philippine journal of veterinary and animal sciences, 34(1). Retrieved from http://www.ejournals.phlform/cite.php?id = 8832.*

Andam, K.S., Johnson, M., Ragasa, C., Kufoalor, D.S., Das Gupta, S., (2017). A chicken and maize situation: the poultry feed sector in Ghana. IFPRI Discussion Paper 1601. Pp.52. Washington, D.C: International Food Policy Research Institute (IFPRI) <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/131055.

Azmal, S., Faruque, S., Bhuiyan, A., & Sarker, N. (2007). Effect of different maize-based diets on the production performance and carcass characteristics of broiler. *Journal of the Bangladesh Agricultural University*, *5*(2), 303–312. https://doi.org/10.22004/ag.econ.276634

Azim, A., Naseer, Z., & Ali, A. (1989). Nutritional evaluation of maize fodder at two different vegetative stages. *Asian-Australasian Journal of Animal Sciences*, *2*(1), 27–34. https://doi.org/10.5713/AJAS.1989.27

Badu-Apraku, B. (2006). Genetic variances and correlations in an early tropical white Maize Population after three cycles of recurrent selection for Striga resistance. Maydica 52:205–217.

Badu-Apraku, B., Twumasi-Afriyie S., Sallah, P.Y.K., Asiedu, E.A., Haag, W., Marfo, K.A., Ohemeng-Depaah, S., and Dzah, B.D. (2006). Registration of "Obatanpa GH" maize. *Crop Sci*. 46:1393–1395.

Badau, M. H., Abba, H. Z., Agbara, G. I., & Yusuf, A. a. (2013). *Proximate composition, mineral content and acceptability of granulated maize dumpling (Dambu Masara) with varying proportions of ingredients*. *2*(1), 7–16.

Bastianelli, D., Quentin, M., Bouvarel, I., Relandeau, C., Lescoat, P., Picard, M. and Tesseraud, S. (2007). Early lysine deficiency in young broiler chicks. Animal 1:587-594. *Animal*, *1*(4), 587–594. https://doi.org/10.1017/S1751731107685073

Bathla, S., Jaidka, M., & Kaur, R. (2019). Nutritive Value. *Maize - Production and Use*. https://doi.org/10.5772/INTECHOPEN.88963

Bello, O., Olawuyi, O., Ige, S., Mahamood, J., Afolabi, M., Azeez, M., & Abdulmaliq, S. (2014). Agro-nutritional variations of quality protein maize (Zea mays L.) in Nigeria. *Journal of Agricultural Sciences, Belgrade*, *59*(2), 101–116. https://doi.org/10.2298/jas1402101b

Beeson, W.M, Pickett, R.A, Mertz, E.T, Cromwell, G.L and Nelson, O.E. (1996) Nutritional value of high lysine corn. *Proc. Distillers Feed Res.*; 21: 70-72.

Bidi, T. N., Gasura, E., Ncube, S., Saidi, P. T., & Maphosa, M. (2019). Prospects of quality protein maize as feed for indigenous chickens in Zimbabwe: A review. *African Crop Science Journal*, *27*(4), 709. https://doi.org/10.4314/acsj.v27i4.11

Boateng, M, Okai, D.B, Baah, J and Donkoh, A. (2008) Palm kernel cake extraction and utilization in pig and poultry diets in Ghana. Livestock Research for Rural Development; 20 (7) 2008 (Article No. 99). http://www.cipav.org.10lrrd20/7/boat2009.htm Retrieved August 31, 2021

Boateng, M, Okai, D.B, Salifu, A. R. S and Ewool, M.B. (2012). A Comparative study of two Normal Maize Varieties: Effect on growth performance and carcass characteristics of Albino rats. *Journal of Animal Science Advances*; 2(9): 787-792. http://csirspace.csirgh.com/handle/123456789/1017

Boateng, M., Okai, D. B., Salifu, A. R. S. and Ewool, M. B. (2012). A Comparative Study of two Normal Maize and two Quality Protein Maize Varieties – Effects on Growth Performance and Carcass Characteristics of Albino Rats. *J Anim Sci Adv*, 2(9): 787-792.

Bressani, R. (1992). Nutritional value of high-lysine maize in humans. In Mertz E.T. (edition). Quality Protein Maize. American Association of Cereal Chemists, St. Paul. MN.oc.

Chukwu, U. M. (2010). *Performance and egg quality characteristics of layers-fed diets containing combinations of brewers dried grains, jack bean and cassava root meal*. Livestock Research for Rural Development, 2, 30-37.

CIMMYT (2001). "CIMMYT Annual Report available at Quality protein maize and farmers fight to stay ahead.

CIMMYT, (2001). International Center for Maize and Wheat Development, Final Progress Report: The Improvement and Promotion of Quality Protein Maize in Selected Developing Countries, Mexico City, Mexico.

Coe, E.H. Jr., Nueffer, M.G. and Hoisington, D. A. (1988). The genetics of maize. In G.F Sprague and J.W. Dudley, Eds. Corn and corn improvement. Agronomy Monographs No. 18; pp. 81-236. American Society of Agronomy: Madison, Wisconsin.

Coyne, F.P (1970). Improving Farm Storage of Maize.

CSIR (Centre for Scientific and Industrial Research)-Crops Research Institute. Vitamin A Maize for Ghana*; Benefits of using improved maize seed*. March 12, 2021.Sresearch.org.

CSIR, & MOFA. (2012). CSIR Crop Varieties Released and Registered in Ghana. *Varietal Release in Ghana*, *Cmv*, 58

Dei, H. K. (2017*). Assessment of Maize (Zea Mays) as Feed Resource for Poultry, Poultry Science*, Milad Manafi, Intech Open, DOI: 10.5772/65363. Available from: https://www.intechopen.com/books/poultry-science/assessment-of-maize-zea-mays-as-feed-resource-for-poultry.

De Oliveira, G. C., Moreira, I., De Souza, A. L. P., Murakami, A. E., Parra, A. R. P., De Oliveira Carvalho, P. L., & Borile, M. D. (2011). Corns with different nutritional profiles on growing and finishing pig feeding (30 to 90 kg). *Asian-Australasian Journal of Animal Sciences*, *24*(7), 982–992. https://doi.org/10.5713/ajas.2011.90587

Dei, K.H. (2017). *Assessment of Maize (Zea mays) as Feed Resource for poultry, poultry science*, Milad Manafi, Intech open, DOI: 10.5772/65363.Available from: http://www.intechopen.com/books/poultry-science/assessment-of -maize-Zea-mays-as-feed-resource for-poultry.

Demand Estimates. (2016). Washington: Economic Research Services.

Dolberg, F. (2007). Poultry production for livelihood improvement and poverty alleviation. *Poultry in the 21st Century: Avian Influenza and Beyond. Proceedings of the International Poultry Conference, Held. 2007.*, *2005*, 1–26.

Ekunwe, P., Soniregun, (2006). Economics of small scale deep litter system of egg production in Oredo Local Government Area of Edo State, Nigeria. *Citeseer*, *5*(1), 81–83. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.564.1418&rep=rep1&type=pdf

Eshetie, T. (2017). Review of Quality Protein Maize as Food and Feed: In Alleviating Protein Deficiency in Developing Countries. *American Journal of Food and Nutrition*, *5*(3), 99–105. https://doi.org/10.12691/ajfn-5-3-4

Ewool, M., Akromah, R., Ewool, M. B., Akromah, R., & Acheampong, P. P. (2016). *Performance of Pro-Vitamin A Maize Synthetics and Hybrids Selected for Release in Ghana Performance of Pro-Vitamin A Maize Synthetics and Hybrids Selected for Release in Ghana*. *June*.

Essay, S. (2020). *Poultry Industry in Nigeria*. Available from; https://www.essaysauce.com/economics-essays/poultry.industry-in-nigeria / > (Assessed 13-08-2020) *fdocuments.5RDU43ZH.net_arbor-acres-broiler-management-handbook.pdf.part*.

Food and Agriculture Organization (FAO). (2009). The state of food insecurity in the world.

Ghanaweb.com. (2013). "Tons of Maize rotting in Northern Region". Business News item on GhanaWeb.com, July 2013, Article 280240. *www.ghanaweb.com*

Girei, M. I. (2020). Poultry Production as a Tool for Economic Development and Sustainability: New Direction for Economic Transformation in Nigeria. *International Journal of Pure and Applied Science (IJPAS). Vol. 19 Pp 357: 2743-6264*

Heuzé V., Tran G., Lebas F.(2017). *Maize grain*. Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. *https://www.feedipedia.org/node/556. Last updated on September 7, 2017, 14:29*

Hossain, A., & Jayadeep, P. A. (2018). Comparison of total carotenoids, lutein, zeaxanthin, and β-carotene content in maize employing solvent extraction and in vitro physiological methods. *Journal of Food Biochemistry*, *42*(6), 1–9. https://doi.org/10.1111/jfbc.12653

Hotz, C., & Gibson, R. S. (2001). Assessment of home-based processing methods to reduce the phytate content and phytate/zinc molar ratio of white maize (Zea mays). *Journal of Agricultural and Food Chemistry*, *49*(2), 692-698

Hussaini, M. a, Ogunlela, V. B., & Ramalan, A. A. (2008). Mineral Composition of Dry Season Maize (Zea mays L.) in Response to Varying Levels of Nitrogen, Phosphorus and Irrigation at Kadawa, Nigeria. *World Journal of …*, *4*(6), 775–780. http://idosi.org/wjas/wjas4(6)/17.pdf%5Cnpapers2://publication/UUID/19E07035-F30B-4374-8CAB-D0A727AC5A65

http://www.nafis.go.ke/agriculture/maize/ https//doi.org/10.4314/just,v32i1.11.

https://www.livestocking.net/nutritional-difference-white-maize-yellow-maize-effect-poultry-birds.DOI: 10.3923/ijps.2018.543.551 URL: https://scialert.net/abstract/?doi=ijps.2018.543.551

https://www.livestocking.net/nutritional-difference-white-maize-yellow-maize-effect-poultry-birds

https://www.livestocking.net/nutritional-requirements-broiler-breeders-parent-stock.

Ibe, E. A., Ogundipe, S. O., Duru, S., Makinde, O. J. (2014). Growth Performance and Carcass Characteristics of Broiler Chickens fed two varieties each of Guinea Corn and Millet as Replacements for Dietary Maize. *World Journal of Life Sciences and Medical Research*: 3(2):46-52.

IFBC. (1990). International Food Biotechnology Council. Biotechnologies and food: Assuring the safety of foods produced by genetic modification. *Regulatory Toxicology and Pharmacology* 12: S1-S196.

Ikujenlola AV (2010). Effects of malting and fermentation. Retrieved June22,2022,fromhttps://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Ikujenlola+AV+%282010%29.+Effects+of+malting+and+fermentation+on+the+nutritional+qualities+of+complementary+foods+produced+from+maize+varieties+and+soybean+grains.+Ph.D+Thesis+Obafemi+Awolowo+University%2C+Ile-+Ife%2C+Nigeria&btnG

important possible benefits of setting up a poultry farm | jaspafarm. (n.d.). Retrieved March 14, 2022, from http://jaspafarm.blogspot.com/2016/08/benefits-of-poultry.html

IITA, International Institute of Tropical Agriculture. Maize crop (1982). Maize Production Manual. 1(8), 1–2.

Jasek, A. X. Li, Xu, H., Raab, R.M., Broomhead J.N. and Lee, J.T. (2018). Effects of Increasing Concentrations of Maize-Expressed Non-Starch Carbohydrase

Enzyme on Broiler Growth Performance and Ileal Nutrient Digestibility. *International Journal of Poultry Science, 17: 543-551.*

Jensen, H.A. & Dolberg, F. (2003). *A conceptual framework for using poultry as a tool in poverty alleviation.* Paper presented to the International Conference on Staying Poor: Chronic Poverty and Development Policy. IDPM, University of Manchester, 7–9 April 2003. (Available at *http://www.chronicpoverty.org/pdfs/conferencepapers/AskovJensen.pdf*).

Jennings, C. P., Aldinger, S. G., Kangu, F. N., Jennings, C. P., Purba, J. M., & Alotaibi, M. N. (2015). *No Title*□□□. *3*(7), 59–78.

Kataria R.(2014*) Proximate nutritional evaluation of maize... - Google Scholar*. Retrieved September7,2022,fromhttps://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Kataria+R.+Proximate+nutritional+evaluation+of+maize+and+Ricegluten+free+cereal.+Journal+of+Nursing+and+Health+Science.+2014%3B3%282%29%3A01-06&btnG=

Khan, N. A., Alam, M., & Khan, K. (2020). *Evaluating the Nutritional Value of the Newly*. *52*(2), 585–592.

Khatum, R.M, Howlider, A.R, Rahman, M.M and Hasanuzzama, M. (2003) Replacement of fish meal by silkworm pupae in broiler diets. *Pakistan Journal of Biological Science, 6(11): 955-958.*

Kidd, M. T., Kerr, B. J. and Anthony, N. B. (1998). Dietary interactions between lysine and threonine in broilers. *Poult. Sci*. 76:608-614. *Elsevier*. Retrieved November 26, 2021, from https://www.sciencedirect.com/science/article/pii/S0032579119405932.

Kling, I.G. (1991). Quality and Nutrition of Maize; IITA Research Guide 33. Ibadan: International. Institute of Tropical Agriculture; Pp. 9–21. Retrieved November 23, 2021, from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Kling%2C+I.G.+%281991%29.+Quality+and+Nutrition+of+Maize%3B+IITA+Research+Guide+33.+Ibadan%3A+International.+Institute+of+Tropical+Agriculture%3B+Pp.+9–21&btnG=

Lara, L. J., & Rostagno, M. H. (2013). Impact of heat stress on poultry production. *Animals*, *3*(2), 356–369. https://doi.org/10.3390/ani3020356

Maner, J. H., Pond, W. G., Gallo, J. T., Henao, A., Portela, R., & Linares, F. (1971). Performance of rats and swine fed Colombian floury-2, Colombian opaque-2 or normal corn. *Journal of animal science*, *33*(4), 791-796.

Mas-Ud, M., Dokurugu, F., & Kaba, J. S. (2021). Effectiveness of cowpea (Vigna unguiculata L.) living mulch on weed suppression and yield of maize (Zea mays L.). *Open Agriculture*, *6*(1),489–497.https://doi.org/10.1515/OPAG-2021

Maziya-Dixon, B., Kling, J. G., Menkir, A., & Dixon, A. (2000). Genetic variation in total carotene, iron, and zinc contents of maize and cassava genotypes. *Food and Nutrition Bulletin*, *21*(4), 419–422. https://doi.org/10.1177/156482650002100415

Mburu, M., Gikonyo, N., … G. K.-A. J.(2012), Nutritional and functional properties of a complementary food based on Kenyan amaranth grain (Amaranthus cruentus). *Ajol.Info*. Retrieved June 27, 2022, from https://www.ajol.info/index.php/ajfand/article/view/75608.

Meteorological Service Department (MSD). (2010). *Meteorological Service Department Division*. Sekyere West District, Mampong – Ashanti, Ghana.

Ministry of Agriculture and Animal Resources. (2012). Strategy & investment plan to strengthen the poultry industry in Rwanda. Final report. Available at:http://www.minagri.gov.rw/fileadmin/user_upload/documents. *Assessed on 20th September 2020.*

Minitab, I. (2017). "MINITAB statistical software". Minitab Release version 17.1.0.0. (PC/Windows 7) Minitab Inc.

MOA (2002). Field crops technical handbook.

MOA. (2004). Guidelines on Post-harvest and Maize Storage Management.

Mushipe J., Kunaka, K., Masaka J., Chivandi, E. (2017). Effects of Dietary substitution of ordinary maize meal with quality protein maize meal on the performance of broiler chicken. *Asian journal of animal and veterinary advances 12:4 pages 187 – 204*

Myjoyonline.com. (2015). "CRI-CSIR to release three new high-Protein Maize Varieties" National news item on myjoyonline.com. Posted by: John Addo-Fening on August 18, 2015. *www.myjoyonline.com* (Accessed on June 20, 2020)

Nartey, M. A., Odoi, F. N., Teye, M., Author, C., & Nartey (2018). Assessment Of Performance And Carcass Characteristics In Broiler Chickens Fed Diets Based On Quality Protein Maize Varieties (AbontemAnd Etubi) Developed In Ghana. *The International Journal of Engineering and Science (IJES)* ||, ||, 7.8 39-46. 23–42. https://doi.org/10.9790/1813-0708033946

National Research Council (NRC). (1988). Quality Protein Maize. National Academy Press, Washington D.C.; 1-70.

National Research Council (NRC). *(*1994*). Nutrient requirements of poultry* 9th Revised Edition. National Academy Press, Washington, DC, USA.

Nelson, T. S. (1994). Phytate phosphorus content of feed ingredients derived from plants. *Journal of Poultry Science.* 47, 1372-1374.

Nti, F.K. (2018). Economic Analysis of Ghana's Chicken Industry.

Nuss, E.T. and Tanumihardjo, S.A. (2011). The quality... - Google Scholar. (n.d.). Retrieved June27,2022,fromhttps://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Nuss%2C+E.T.+and+Tanumihardjo%2C+S.A.+%282011%29.+Quality+Protein+Maize++for+Africa%3A+Closing+the+protein+Inadequacy+Gap+in+Vulnerable++Populations.+American+Society+for+Nutrition.+Adv.Nutr.2%3A217-224&btnG=

Nweke, F. N. (2010). Rate of water absorption and proximate analysis of different varieties of maize cultivated in Ikwo local government area of Ebonyi State, Nigeria. *African Journal of Biotechnology*, *9*(52), 8913–8917. https://doi.org/10.4314/ajb.v9i52.

Okai D.B, Osei S.A and Tuah, A.K. (2001a). Growth performance and economic traits of pigs fed diets containing either normal maize or Obatanpa-A Quality Protein Maize. *J. Univ. Sci. and Tech.* 21: 1-5.

Okai D.B, Tua, A.K, and Owusu-A. A. (2001b). Phase feeding of pigs using Obatanpa-A Quality Protein Maize. *J. Univ. Sci. and Tech*. 21(1, 2, and 3): 5-11.

OKai D.B., Boateng M., Ewool M.B, Ankamaa D., and Osarunwense, S. O. (2015). Nutritional Evaluation of some new maize varieties: Effects on growth performance and carcass traits of Albino Rats. *African journal of food, Agriculture, Nutrition and Development. Vol.15: No. 4. Pp10306 – 10308.*

Okai, D.B and Boateng, M. (2007). Pig nutrition research in Ghana-some achievements, prospects and challenges. *Ghanaian J. Anim. Sci*. 23(1): 19-25.

Okai, D.B, Nyannor, E.K.D, Osafo E.L.K and Amankwah, A. (2007). Effects of Obatanpa (A Quality Protein Maize) with little or no fishmeal diets on growth performance and some carcass characteristics of finisher pigs. *Ghanaian Journal of Anim. Sci.*; 2, 3 (1): 63-70.

Okai, D.B, Nyannor, E.K.D, Osafo E.L.K and Amankwah, A. (2007). Effects of Obatanpa (A Quality Protein Maize) with little or no fishmeal diets on growth performance and some carcass characteristics of finisher pigs. *Ghanaian J. Anim. Sci*. 2, 3 (1): 63-70.

Okai, D.B., Osei, S.A., Tuah, A.K., Tumasi-Afriye S., Haag, S.W., Dzah, B., Ahenkorah, K and Osafo, E.L.K. (1994). The usefulness of Obatanpa, a quality protein maize variety, in the feeding of pigs in Ghana. Proc. Ghana Anim. Sci. Assoc.; 22:37-43.

OMAF (Ontario Ministry of Agriculture and Food). (1994). Field Crop Recommendations. Publication 296. Queen's Printer for Ontario, Toronto, Ontario.

Onimisi, P. A., Omage, J. J., Dafwang I. I. and Bawa, G. S. (2009). Replacement value of normal maize with quality protein maize (Obatanpa) in broiler diets. *Pakistan Journal of Nutrition* 8(2), 112–115. https://doi.org/10.3923/PJN.2009.112.115

Oppong, B.A, Onumah, E.E., Asuming-Brempong, S. (2016). Technical efficiency and production risk of maize production: evidence from Ghana. *Asian J. Agric. Extens. Econ. Soc*., 11 (3) Pp. 1-9.

O'Quinn, P. R., Nelssen, J. L., Goodband, R. D., Knabe, D. A., Woodworth, J. C., Tokach, M. D., & Lohrmann, T. T. (2000). Nutritional value of a genetically improved high-lysine, high-oil corn for young pigs. *Journal of Animal Science*, *78*(8), 2144–2149. https://doi.org/10.2527/2000.7882144x

Osborne and Mendel (1914). The amino acid in Nutrition and Growth. *Journal of Biological Chemistry*. 17: Pp 325 – 349.

Osei, S., et al. (1994). Quality protein maize as a broiler feed ingredient. Proc. Ghana Anim. Sci. Symp.

Osei, S. A., Dei, H. K., & Tuah, A. K. (1999). Evaluation of quality protein maize as a feed ingredient for layer pullet. *Journal of Animal and Feed Sciences*, *8*, 181–189. http://udsspace.uds.edu.gh/handle/123456789/1041. https://doi.org/10.22358/jafs/68837/1999

Osei, S.A., Okai, D.B and Tuah, A.K. (1999) Quality Protein Maize as the sole source of amino acids in the diets of starter pigs: A preliminary study. *J. Univ. Sci. Tech.*; 19:1-4.

Panda A. K., Raju M. V. L. N., Rama Rao, S. V., Lavanya, G., Pradeep Kumar Reddy E. and Shyam Sunder, G. (2010a). Replacement of Normal Maize with Quality Protein Maize on Performance, Immune Response and Carcass Characteristics of Broiler Chickens. *Asian-Australasian Journal of Animal Sciences*, *23*(12), 1626–1631. https://doi.org/10.5713/ajas.2010.10036

Panda A. K., Lavanya, G., Pradeep Kumar Reddy, E., Rama Rao, S. V, Raju, M. V. L., Shyam, Sunder, G. (2012). Utilization of quality protein maize in the diet of white leghorn layers. *Animal feed science and technology 172: 2 – 4 pages 216*

Panda A. K., Prakash B., Rama Rao, S. V., Raju, M. V. L. N, Shyam Sunder, G. (2013). Utilization of high-quality protein maize in poultry. *World's poultry science formal 69:4 pages 877 – 888*

Panda A. K., Raju, M. V. L. N., Rama Rao, S. V., Lavanya, G., Pradeep Kumar Reddy, E., Shyam Sunder, G. *(2011). Nutritional evaluation and Utilization of quality protein maize, Nityashree hybrid maize, and normal maize in broiler chickens, British poultry science, 52:5, 632 – 638, Dol: 10.1080/00071668, 2011 626758.*

Panda, A.K., Prakash, B., Rama Rao, S.V., Raju, M.V.L.N and Shyam Sunder, G. (2013). Utilization of high-Quality Protein Maize in poultry. *World's Poultry Science Journal*, Vol. 69.

Panda, A.K., Raju, M.V.L.N., Rama Rao, S.V., Lavanya, G., Pradeep Kumar Reddy, E. and Shyam Sunder, G. (2010b). Replacement of normal maize with Quality Protein Maize on performance, immune response and carcass characteristics of broiler chickens. *Asia Australian Journal of Animal Sciences* 23:1626-1631.

Panda, A.K., Zaidi, P.H., Rama Rao, S.V. & Raju, M.V.L.N. (2014). Efficacy of quality protein maize in meeting energy and essential amino acid requirements in broiler chicken production, *Journal of Applied Animal Research,* 42:2, 133-139, DOI:10.1080/09712119.2013.822812.

Prasanna, B., Vasal, S., Kassahun, B., science, N. S.-C., & 2001, undefined. (2001). Quality protein maize. *JSTOR*. https://www.jstor.org/stable/24105845.

Raninen, K., Lappi, J., Mykkänen, H., & Poutanen, K. (2011). Dietary fibre type reflects physiological functionality: Comparison of grain fibre, inulin, and polydextrose. *Nutrition Reviews*, *69*(1), 9–21. https://doi.org/10.1111/j.1753-4887.2010.00358.

Rajendran K and Samarendu M. (2003). Comparative Economic Analysis and Constraints in eggs production cage vs. deep litter systems of rearing in India. International journal of poultry science, 2:153-158. Retrieved March, 11, 2021, from *http://wwwgoogle.com/amp/s/scialert.net/abstract/amp.php%* 3fdoi=ijps.2003.153-158

Rajesekhar K. V., Prakash B., Vijaya L. K., Rama Roa, S. V., Raju, M. V. L. N. (2020). Effect of feeding a diet with alternate protein sources and quality protein maize on performance and nutrient utilization in broiler chickens. *Tropical animal health production 52:5 pages 2297 – 2302.*

Renden, J. A., Jr, E. T. and Kincaid, S. A. (1994). Lack of interactions between dietary Lysine or strain cross and photo schedule for male broiler performance and carcass yield. *Poultry Sci*. 73:1651-1662.

Rondon, M. & Ashitey, E. (2011). *Poultry and Product Briefs. Annual Report.* Accra: Global Agricultural Information Network.

Rondon, M., & Ashitey, E. (2011). *Grain and Feed Annual Report*: Assessments of Commodity and Trade Issues in Ghana.

Rostagno, H. S., Albino, L. F. T., Donzele, J. L., Gomes, P. C., Oliveira, R. D., Lopes, D. C., ... & Euclides, R. F. (2011). Tabelas brasileiras para aves e suínos. *Composição de alimentos e exigências nutricionais*, *2*, 186.

Rostagno, H. S., Albino, L. F. T., Donzele, J. L.,... - Google Scholar. (n.d.). Retrieved June 27, 2022,fromhttps://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&as_ylo=2000&as_yhi=2022&q=Rostagno%2C+H.+S.%2C+Albino%2C+L.+F.+T.%2C+Donzele%2C+J.+L.%2C+Gomes%2C+P.+C.%2C+Oliveira%2C+R.+D.%2C+Lopes%2C+D.+C.%2C+...+%26+Euclides%2C+R.+F.+%282011%29.+Tabelas+brasileiras+para+aves+e+suínos.+Composição+de+alimentos+e+exigências+nutricionais%2C+2%2C+186.&btnG=

Roxas, D. B., & Amonelo, M. O. (2008). Growth Performance Of Broilers Fed a Quality Protein Maize (QPM)-Based Diet. *Philippine Journal of Veterinary and Animal Sciences*, *34*(1), 1-1.

Salifu, A-R. S, Okai D.B, Boateng M and Ewool, M.B. (2012). A Comparative Study of Local Ghanaian Maize, Imported Yellow Maize and Two New Quality Protein Maize (QPM) Varieties – Etubi and Golden Jubilee – Effects on Growth Performance and Carcass Characteristics of Pigs. *Online Journal of Animal and Feed Research* 2012; 2(3): 218-223.

Salifu, A-R.S., Okai, D.B., Boateng, M. and Ewool, M.B. (2012). A comparative study of local Ghanaian maize, imported yellow maize and two new quality protein maize (QPM) varieties – Etubi and Golden Jubilee – Effects on growth performance and carcass characteristics of pigs. *Online J. Anim. Feed Res.*, 2 (3): 218-223. Science line/Journal homepages: http://www.science-line.com/index/; *http://www.ojafr.irs.*

Salifu, A-R.S., Okai, D.B., Boateng, M. and Ewool, M.B. (2012). A comparative study of local Ghanaian maize, imported yellow maize and two new quality protein maize (QPM) varieties – Etubi and Golden Jubilee – Effects on growth performance and carcass characteristics of pigs. *Online J. Anim. Feed Res.*, 2 (3): 218-223. Science line/Journal homepages: http://www.science-line.com/index/; *http://www.ojafr.ir*

Serna-Saldivar, S. O., Clegg, C., & Rooney, L. W. (1994). Effects of parboiling and decortication on the nutritional value of sorghum (Sorghum bicolour L. Moench) and pearl millet (Pennisetum glaucum L.). *Journal of Cereal Science*, *19*(1), 83-89. https://doi.org/10.1006/jcrs.1994.1011

Shiferaw, B., B.M. Prasanna, Hellin, J., and Banziger. (2011). "*Crops that feed the World* 6. Past.

Sinnadurai, S. (1992). Vegetable Cultivation. Asempa publishers, Accra. Ghana Pp. 27-35.

Sprague, G.F. and Eberhart S.A. (1977). Maize Breeding pp. 312-313. In Corn and Corn Improvement. Agronomy Monographs No. 18. American Society of Agronomy, Madison, Wisconsin.

Sumbo H, A., & Victor, I. A. (2014). Comparison of chemical composition, functional properties and amino acids composition of quality protein maize and common maize (Zea may L). *African Journal of Food Science and Technology*, *05*(03), 81–89. https://doi.org/10.14303/ajfst.2014.024

Tagoe, A. N. A., Atuahene, C. C., and Adjei, M. B. (2012). *The response of broiler chickens to dietary inclusion of alternanthera sessilis leaf meal (ASLM)*. Master of Philosophy dissertation, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. University of Ghana http://ugspace.ug.edu.gh 117.

Tekeba E. (2017) "Review of Quality Protein Maize as Food and Feed: In Alleviating Protein Deficiency in Developing Countries." *American Journal of Food and Nutrition*, vol. 5, no. 3: 99-105. Doi: 10.12691/ajfn-5-3-4. Available online at *http://pubs.sciepub.com/ajfn/5/3/4*. Science and Education Publishing.

Tiwari, M. R., Chapagain, P. B., Shah, M. K., & Shrestha, Y. K. (2013). Evaluation of Quality Protein Maize (QPM) and Normal Mazie for Growth Performance of Crossbred Piglets in Wester Hills of (Nepal) Evaluation of Quality Protein Maize QPM and Normal Mazie for Growth Performance of Crossbred Piglets in Wester Hills of Nepal. *Academia.Edu*, *13*(6). https://www.academia.edu/download/41381460/Evaluation_of_Quality_Protein_Maize_QPM20160122-10343-ouo18e.pdf

The Successes and Future challenges to the Role played by maize in Global Food Security; Food Security 3:307-27.

Timsina, K., & Agreement, F.T. (2016). *A Case Study on Poultry Farming an Enterprise Opportunity in Commercialization of Livestock Production for Food Security and Prosperity*.

Torres, P. I., Ramirez-Wong, B., Serna-Saldivar, S. O., & Rooney, L. W. (1994). Effect of decorticated sorghum addition on the rheological properties of wheat tortilla dough. *Cereal Chemistry*, *71*(5), 509-512.

United Nation. (2013). UN Commodity *Trade Statistics Database. Global Poultry Trends* 2013. Accessed on March 2021. http://www.thepoultrysite.com/articles/2972/global-poultry-trends-2013-chicken-import-rise-to-african-stable-in-oceania

USDA (2011). Foreign Agricultural Service, GAIN Report, April 15, 2011

USDA (United States Department of Agriculture). (2011). *Poultry and Products Brief Annual*. Accra-Ghana.

USDA United States Department of Agriculture. (2016). *World Agriculture Supply and*

USDA. (United States Department of Agriculture). (2013). *Ghana Poultry Report Annual*. Accra-Ghana

Vasal, S. K. (2000). Quality Protein Maize: Overcoming the hurdles. *Journal of crop production* 6:193-227.

Vaswani, S., Kumar, R., Kumar, V., & Roy, D. (2016). Nutritional and Mineral Composition of Different Varieties of Normal and High-Quality Protein Maize Fodder At Post-Cob Stage. *International Journal of Science, Environment and Technology*, *5*(5), 2719–2727. Https://Www.Researchgate.Net/Profile/Debashis-Roy 12/Publication/309669483_Nutritional_And_Mineral_Composition_Of_Different_Varieties_Of_Normal_And_High_Quality_Protein_Maize_Fodder_At_PostCob_Stage/Links/581c63b808aea429b291b68e/Nutritional-And-Mineral-

Vivek, B.S., Krivanek, A.F., Palacios-Rojas, N., Twumasi-Afriyie, S. and Diallo, A.O. (2008). Breeding quality protein maize (QPM): Protocols for developing QPM cultivars. CIMMYT

Watson, S.A, Ramstad, P.R. (1987). Corn Chemistry and Technology. St Paul: American Association of Cereal Chemists; Pp.605.

Warman, P. R., & Havard, K. A. (1998). Yield, vitamin and mineral contents of organically and conventionally grown potatoes and sweet corn. *Agriculture, ecosystems & environment*, *68*(3), 207-216.

William, C, Uzo J, Peregrine, W. (1991). Vegetable Production in the Tropics Longman. P.17. *www.grjournals.com.*

Wych, R.D. (1988). *Production of hybrid seed corn*. In G.F Sprague and J.W. Dudley, Eds. Maize and Maize Improvement. Agronomy Monographs No. 18; Pp 565-605. American Society of Agronomy: Madison, Wisconsin.

Yaw Kusi, L., Agbeblewu, S., Kwadwo Anim, I., & Minta Nyarku, K. (2015). The Challenges and Prospects of the Commercial Poultry Industry in Ghana: A Synthesis of Literature. *International Journal of Management Sciences*, *5*(6), 476–489. http://www.rassweb.com

Zhang, Y., Song, Q., Yan, J., Tang, J., Zhao, R., Euphytica, Y. Z.-, & 2010, undefined. (2010). Mineral element concentrations in grains of Chinese wheat cultivars. *Springer*, *174*(3), 303–313. https://doi.org/10.1007/s10681-009-0082-6.

APPENDICES

GROWTH PERFORMANCE ANOVA

ANALYSIS OF VARIANCE LIVEABILITY DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	222.2	55.56	0.96	0.455
Error	15	864.2	57.61		
Total	19	1086.4			

ANALYSIS OF VARIANCE FOR INITIAL BODY WEIGHT DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	360.1	90.03	1.31	0.312
Error	15	1032.7	68.85		
Total	19	1392.8			

ANALYSIS OF VARIANCE WEIGHT GAIN DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	363.5	90.87	1.52	0.247
Error	15	897.9	59.86		
Total	19	1261.4			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P Value
TRMT	4	258826	64706	1.00	0.437
Error	15	967672	64511		
Total	19	1226498			

ANALYSIS OF VARIANCE FCR DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	0.4468	0.1117	0.89	0.495
Error	15	1.8870	0.1258		
Total	19	2.3338			

ANALYSIS OF VARIANCE FOR INTAKE DAY 0-7

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	3887	971.7	1.00	0.436
Error	15	14522	968.2		
Total	19	18409			

ANALYSIS OF VARIANCE FOR LIVEABILITY DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	222.2	55.56	0.52	0.723
Error	15	1604.9	107.00		
Total	19	1827.2			

ANALYSIS OF VARIANCE FOR BODY WEIGHT DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	2568	642.1	1.28	0.322
Error	15	7539	502.6		
Total	19	10107			

ANALYSIS OF VARIANCE FOR WEIGHT GAIN DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	2503	625.8	1.37	0.292
Error	15	6869	457.9		
Total	19	9372			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	63719	15930	0.19	0.939
Error	15	1241122	82741		
Total	19	1304841			

ANALYSIS OF VARIANCE FOR FCR DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	0.07746	0.01936	0.96	0.456
Error	15	0.30148	0.02010		
Total	19	0.37894			

ANALYSIS OF VARIANCE FOR INTAKE DAY 7-14

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	6614	1653	0.77	0.559
Error	15	32023	2135		
Total	19	38637			

ANALYSIS OF VARIANCE FOR LIVEABILITY DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	308.6	77.16	0.83	0.525
Error	15	1388.9	92.59		
Total	19	1697.5			

ANALYSIS OF VARIANCE FOR BODY WEIGHT DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	9167	2292	1.68	0.207
Error	15	20479	1365		
Total	19	29646			

ANALYSIS OF VARIANCE FOR WEIGHT GAIN DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	8888	2222	1.67	0.210
Error	15	20001	1333		
Total	19	28889			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	625039	156260	0.73	0.583
Error	15	3191742	212783		
Total	19	3816781			

ANALYSIS OF VARIANCE FOR FCR DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	0.08064	0.02016	0.36	0.836
Error	15	0.84841	0.05656		
Total	19	0.92906			

ANALYSIS OF VARIANCE FOR INTAKE DAY 14-21

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	19062	4765	1.07	0.405
Error	15	66670	4445		
Total	19	85732			

ANALYSIS OF VARIANCE FOR LIVEABILITY DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	3173	793.2	3.93	0.022
Error	15	3025	201.6		
Total	19	6198			

ANALYSIS OF VARIANCE FOR BODY WEIGHT DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	78457	19614	2.75	0.068
Error	15	107145	7143		
Total	19	185602			

ANALYSIS OF VARIANCE FOR WEIGHT GAIN DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	77248	19312	2.73	0.069
Error	15	106012	7067		
Total	19	183260			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	3295999	824000	3.18	0.044
Error	15	3882075	258805		
Total	19	7178074			

ANALYSIS OF VARIANCE FOR FCR DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	0.1607	0.04017	1.18	0.358
Error	15	0.5095	0.03397		
Total	19	0.6702			

ANALYSIS OF VARIANCE FOR INTAKE DAY 21-28

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	49679	12420	1.33	0.305
Error	15	140402	9360		
Total	19	190081			

ANALYSIS OF VARIANCE FOR LIVEABILITY DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	3642	910.5	3.66	0.029
Error	15	3735	249.0		
Total	19	7377			

ANALYSIS OF VARIANCE FOR BODY WEIGHT DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	99574	24893	2.44	0.092
Error	15	152829	10189		
Total	19	252402			

ANALYSIS OF VARIANCE FOR WEIGHT GAIN DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	98546	24636	2.44	0.092
Error	15	151505	10100		
Total	19	250051			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	10235494	2558873	2.87	0.060
Error	15	13353175	890212		
Total	19	23588669			

ANALYSIS OF VARIANCE FOR FCR DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	0.7922	0.19805	2.36	0.100
Error	15	1.2600	0.08400		
Total	19	2.0523			

ANALYSIS OF VARIANCE FOR INTAKE DAY 28-35

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	38340	9585	0.79	0.547
Error	15	181036	12069		
Total	19	219377			

ANALYSIS OF VARIANCE FOR LIVEABILITY DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	2716	679.0	1.79	0.183
Error	15	5679	378.6		
Total	19	8395			

ANALYSIS OF VARIANCE FOR BODY WEIGHT DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	240585	60146	3.06	0.050
Error	15	295036	19669		
Total	19	535621			

ANALYSIS OF VARIANCE FOR WEIGHT GAIN DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	238199	59550	3.06	0.050
Error	15	291438	19429		
Total	19	529637			

ANALYSIS OF VARIANCE FOR CONSUMPTION DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	8289209	2072302	4.35	0.016
Error	15	7152623	476842		
Total	19	15441833			

ANALYSIS OF VARIANCE FOR FCR DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	3.154	0.7885	3.15	0.046
Error	15	3.756	0.2504		
Total	19	6.910			

ANALYSIS OF VARIANCE FOR INTAKE DAY 35-42

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMT	4	174454	43614	0.43	0.787
Error	15	1531576	102105		
Total	19	1706030			

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ANALYSIS OF VARIANCE FOR % BODY LIVE WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	2317834	579459	5.63	0.006
Error	15	1543486	102899		
Total	19	3861320			

ANALYSIS OF VARIANCE FOR % BREAST WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	9.954	2.488	2.04	0.140
Error	15	18.306	1.220		
Total	19	28.260			

ANALYSIS OF VARIANCE FOR % THIGH WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	1.654	0.4134	1.14	0.374
Error	15	5.427	0.3618		
Total	19	7.081			

ANALYSIS OF VARIANCE FOR % HEART WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.07728	0.019321	3.02	0.052
Error	15	0.09590	0.006394		
Total	19	0.17319			

ANALYSIS OF VARIANCE FOR % DUODENUM WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.6454	0.1613	1.47	0.262
Error	15	1.6511	0.1101		
Total	19	2.2965			

ANALYSIS OF VARIANCE FOR % LIVER WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	1.348	0.3370	2.64	0.075
Error	15	1.914	0.1276		
Total	19	3.262			

ANALYSIS OF VARIANCE FOR % PROVENTRICULUS WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.18142	0.045355	6.86	0.002
Error	15	0.09916	0.006611		
Total	19	0.28058			

Analysis of Variance FOR % GIZZARD WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.3131	0.07828	1.16	0.367
Error	15	1.0128	0.06752		
Total	19	1.3259			

ANALYSIS OF VARIANCE FOR % JEJENUM WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.6227	0.1557	1.49	0.256
Error	15	1.5713	0.1048		
Total	19	2.1940			

ANALYSIS OF VARIANCE FOR % ILEUM WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.3330	0.08326	1.75	0.191
Error	15	0.7125	0.04750		
Total	19	1.0455			

ANALYSIS OF VARIANCE FOR % CAECA WEIGHT

Source	DF	Adj SS	Adj MS	F-Value	P-Value
TRMTS	4	0.2499	0.06247	2.92	0.057
Error	15	0.3210	0.02140		
Total	19	0.5709			