IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 10, Issue 6 Ver. II (June. 2017), PP 13-16
www.iosrjournals.org

Utilization of Sorghum as Energy Source in the Diets of Broilerchickens: A Review

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Abstract: *Maize is the conventional source of energy in broilers ration in Nigeria. The ever growing demand for maize for human consumption, livestock feeds and some industrial uses has pushed its market price to an alarming height. The Metabolizable energy value of maize and sorghum are 3432 and 3256 kcal/kg respectively, the crude protein content of maize and sorghum are 9.0 and 11.0 respectively, the crude fat values of maize and sorghum are 3.25 and 4.25% while the crude fibre of maize and sorghum are 2.7 and 2.0 respectively. Sorghum is suitable alternatives to maize considering the cost, availability and their nutritive value. Several research findings revealed that there is no significant (P<0.05) difference in the performance parameters among the three energy sources. Alternative sources of energy will reduce the cost of feeds; improve protein availability and intake, increase efficiency and productivity of broiler chickens as well as the improving the profit margin of the poultry producers*.

I. Introduction

Poultry birds especially broilers play a significant role in the provision of animal protein required by man to meet his daily protein intake (Maidala and Istifanus, 2012). They have high growth rate, high feed conversion ratio, short generation interval (5-6 months), short intestinal feed transit of 2-3 hours and traits that respond to feeding and nutritional manipulations within days (Atteh,2003). The chicken meat is superior to that of other livestock species because it is associated with relatively lower calorie and sodium intake while containing high protein content than other sources of meat (Atteh, 2003). Poultry meat is nutritious, tender, juicy, tasty and generally appealing and accepted when processed (Omole *et al*., 2006). Feeding is the major constrain of poultry production which accounts for 70-85% of recurrent expenditure (Sanni and Ogundipe, 2005). The energy level of the feed is the major factor influencing feed intake as birds will under normal circumstances eat to satisfy their energy needs (Akinola and Sese, 2011). The other dietary nutrients usually vary in relation to dietary energy content of the diet if they are not to become deficient with low feed intake or consumed more with low energy diet. Maize is the major source of energy in poultry feeds and constitutes 50-70% of broilers ration (Ojowola and Olugbemi, 2011). It constitutes 40-60% of the feed of monogastric animals (Ayenor 1985; Ogbanna, 1991). Maize also serves as staple food for good proportion of Nigerians. The ever growing demand for maize for human consumption, livestock feeds and some industrial uses has pushed its market price to an alarming height (Odukwe, 1994). This is because maize is high in energy and forms the standard (100) against which other cereals grains is compared (Atteh, 2002). Maize has a fat content of about 4% and this fat is high linoleic acid (about 50%) making it excellent source of this essential fatty acid. The increasing competition between man and animals for available grains (Tegbe, *et al*., 1984: Egbunike and Achibang, 2002), the inadequate production of farm crop to meet the needs of man and his livestock (Babatunde, *et al*., 1990) and ever increasing cost of maize had made it necessary to critically re-evaluate some other grains like millet and sorghum for alternative energy sources in poultry production. In poultry nutrition energy is used for the provision of body heat, maintenance, growth and production (Inaku *et al.*2011). From the foregoing, it is imperative that effort should be made to explore comparative and cheaper alternative to this scarce, expensive and highly needed dietary resource so as to reduce cost of feed ingredients, improve availability, increase both efficiency and productivity of broiler chickens, improve poultry farmers profit margin and above all increase protein intake among the populace.

Sorghum (Sorghum bicolor (L) Moench) which belongs to the family Poacea is known as guinea corn in West Africa and locally called Okababa, Dawa, and Okili in three major languages of Nigeria (Adegbola, 2013). Sorghum originated from northeastern Africa where it was domesticated about 5,000 years ago (Mann *et al*, 1983) and it is the fifth most important cereal in the world after corn, rice, wheat, and barley with an annual production of about 57 million tonnes (FAOSTAT, 2012). Nigeria is the largest sorghum producer with an annual production of 6.9 million tonnes (FOASTAT, 2012) and thus the most important cereal grain in the country. Sorghum is another cereal crop that can be used to replace maize to reduce the cost of poultry production. (Etuk *et al.,* 2012). sorghum bicolor (L) Moench is a widely grown in semi arid environment and savanna regions of Nigeria. Mounder (2002) reported that sorghum is a traditional crop of much Africa and Asia and an introduced and hybridized crop in the western hemisphere. It benefit from an ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereals. Sorghum is next crop to maize in terms of cost, nutritive value and availability as poultry feeds (Subramanian and Metta, 2000).

Field observation in Nigeria revealed the inclusion of sorghum as poultry and rabbits (Abubakar *et al*., 2006). Other workers (Hancock, 2000; Dowling *et al* 2002; Travis *et al.*, 2006) have shown that sorghum could be a suitable feedstuff in the poultry industry. Parthasarathy, (2003) and Issa *et al*. (2007) reported that sorghum grains can play an important role in poultry feeds. Several verities of sorghum have been developed and introduced in Nigeria (IAR, 1999). However the diversity of chemical composition and antinutritional factors, mainly tannin resulting in variability and digestibility of sorghum from 35-60% or more has been reported (Becker, 1992). Varieties of sorghum, climatic conditions and soil conditions, fertilizers types are listed among the factors responsible for the variation in chemical composition of sorghum (Aduku, 1993; Tacon, 1995;Ngoka, 1997; Etuk and Ukejiofo, 2007;Etuk 2008). Several improve varieties have been developed and released in Nigeria since 1970s mainly by institute of agricultural research (IAR) Ahmadu Bello University Zaria.

The high cost of maize in Nigerian markets has affected profitability of poultry production negatively and thus, resulted in inadequate protein intake among Nigerians (Nkwocha et al., 2014). The cost of feed in poultry production constitute of about 70 to 85 percent of total production cost and out of these about 95 percent is meant for meeting the energy and protein requirement of the diet (Sanni and Ogundipe, 2005; Ravindran, 2014). Therefore, these necessitate the need for cheaper and always available cereal ingredient that can meet the energy requirement of the birds which constitute over 50-70% of broilers ration (Ojowola and Olugbemi, 2011). Sorghum was identified as the major crop that can easily replace maize because of its similarity in composition with maize (Subramanian and Metta, 2000; Ravindran, 2014). These made many scientist to evaluate the performance of birds fed with sorghum based diet and compared it with the performance of birds fed with maize based diet in order to produce a formulation that can be used to completely replace maize in poultry feed production.

II. Results And Discussion

Various observations revealed that sorghum has a nutritive value similar to maize (Subramanian and Metta, 2000). Ahmed *et al*., 2013 reported that Metabolizable Energy (ME) of sorghum was 14.40 MJ/kg while yellow maize has 14.17 MJ/kg. Therefore, the similarities in composition between maize and sorghum have made Sorghum a potential crop to replace maize. The amino acid composition of the two cereal revealed that the amino acids is fairly distributed. Sorghum contain low level of lysine but high tryptophan content relative to maize (Purseglove, 1972: Olomu, 1995) Macdonald *et al* ., 2000 reported that both maize, millet and sorghum have the main limiting indispensable amino acids argenine, lysine, methionine, Cystein and tryptophan. Xanthophylls and linoleic acids are much lower in sorghum than in maize and yellow endosperm with carotene and xanthophylls increases the nutritive value of sorghum. However, Sorghum grain contains some antinutritional factors that makes it less digestible than maize (Etuk *et al*., 2012). These anti-nutritional factors include the presence of tannin and phytic acids (Mohammad *et al*., 2011) which lowers the palatability, protein utilization and activity of digestive enzymes by non-ruminants (Medugu *et al*., 2010a). Tannins also affect carbohydrate utilization by forming complex compound which are difficult to digest (Akande et al., 2010; Maidala *et al*., 2013).

Field trials have shown the two cereals have no significant differences in daily feed intake (94.00-100.17g), daily weight gain (34.44- 43.17g) and feed conversion ratio (2.24-2.94)(Medugu et al., 2010a). Aladeen *et al*., 2013 fed maize millet and sorghum to finishing broiler birds as an energy sources and reported no significant differences in growth performance and mortality of the birds. Ibitoye *et al*. (2012) fed white and red millet varieties and white and red sorghum varieties with maize as a control diet in broilers and reported mean final weight gain (111.62-170.58), mean feed intake (466.88- 535.62) and feed conversion ratio (3.09-4.18) and the values are statistically similar (P>0.05). Bashar *et al*. (2012) fed maize, millet and sorghum to broilers and reported significant difference (P<0.05) in feed intake (45.26-47.49g), final body weight (484.08-587.76g), body weight gain (427.53-531.76g) and feed conversion ratio (2.49-2.98) in the starter phase but the values in the finisher phase were feed intake(132.80-135.72g), final body weight (1826.52-1967.52) and feed conversion ratio (2.94-2.97) and the values are statistically similar (P>0.05). In contrast Abubakar *et al.* (2011) reported a significant difference in feed intake (50.48- 63.88g), final weight gain (880.56- 1092.94) and cost of feed consumed (24.71- 30.94). (Table 8). Similarly Ojewola and Olugbemi, (2011) reported a significant differences in mean final feed intake (2600-3524.29), mean daily feed intake (53.08-71.92g) final weight gain (870-1130g)

The complementary nature of the cereals fed to broilers revealed no significant difference in live weight(2000.00-2250.00g, slaughter weight(1933.33-2188.33g), pluck weight(1874.82-2121.11g), dressed weight(1470.43-1708.17g) and dressing percentage(73.52-75.92) (P>0.05) (Medugu *et al* 2010b). The cuts of parts revealed no significant difference in head (2.36-2.38%), shanks (3.00-4.15%), neck (4.94-5.12%), wings (8.76-9.45%), thigh (13.00-13.16%), drumstick (9.31-10.25%) and thorax (9.90-10.14%) (Medugu *et* *al.(*2010b). Similarly the organs weight (%) has no dietary effect on the three energy sources in the heart (1.10-1.18%), full gizzard (10.02-10.85%), and liver (7.03-7.74%) (P>0.05) (Medugu *et al* 2010b). However Ibitoye *et al.*(2012) fed different energy sources and reported no significant differences in final body weight, and significant difference of organs weight of broilers fed the three cereal sources in the proventriculus(0.05-0.10%), lungs (0.04-0.07%), small intestine(0.23-0.27%), large intestine (0.32-0.61%) and liver (0.22-0.30%) (P<0.05). Adamu *et al*. (2012) reported broilers fed yellow sorghum to broilers as replacement for maize and reported live weight (1925.0-2200.0g), pluck weight (1750.0-2025.0g), eviscerated weight (1600.0-1712.5g) and carcass weight (1550.0-1612.5g) and the values are statistically similar (P>0.05).

Mohammed et al., 2013 fed graded levels of sorghum at 0%, 25%, 75%, and 100% and reported no significant differences in feed conversion ratio, weight of most internal organs and most of the blood parameters (P<0.05). The complementary nature of the cereals revealed the differences in the hematological parameters as it affected RBC (1.82-3.10, PCV (20.00-31.67%), Hemoglobin (4.07-6.83) and mean corpuscular value (97.13-119.20) (P<0.05) (Medugu *et al.*2010b). Similarly mean corpuscular hemoglobin (18.06-22.76), white blood cells (4.28-5.13), monocytes (6.67-13.67), lymphocytes (41.67-48.00), basophiles (0.00-2.00), Neutrophiles (33.00-43.00) and eosinophills (6.33-8.67) were statistically significant (P<0.05) (Medugu *et al.*2010b). Serum biochemical indices of broilers fed maize, millet and sorghum affected total protein (16.00-34.00), globulin (2.00-20.00), sodium (147.50-160.00), potassium (4.40-5.60), alkaline phosphatase (137.50-187.00) and bicarbonates (16.50-19.50) (P<0.05) Medugu *et al.* 2010b).

Economics of production revealed a significant reduction of cost of production when sorghum replace partially or all maize in broilers ration (Ibitoye *et al*., 2012; Etuk *et al* 2012: Adamu *et al*., 2013; Aladeen *et al*., 2013) The complementary nature of maize for sorghum as energy sources in feeding broilers in Nigeria can be encouraged as it does not affect most of the growth and carcass characteristics, this will reduce the cost and diversify the feed ingredients used as energy feedstuff.

References

[1]. Abubakar, A., Bashar, Y. A. and B. O. C. Eguke (2006). Pearl millet as substitute for maize in the diets of broiler chickens in Sokoto, Nigeria.Tropical Journal of Animal Science **9**: (2) 53-61.

[2]. Abubakar, A., Bello, A., Tukur, M. and Bashar, Y.A. (2011).Whole millet in the diet of broiler starter in a semi arid environment of Nigeria. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S. (Eds) **Value Re-orientation in Animal Production: A Key to National Food Security and sustainable Economy.** Pp 481-483. Proceedings of 36th Annual Conference of Nigerian Society of Animal Production. 13th-16th March, 2011.

[3]. Adamu, M.S., Kubkomawa, H.I., Doma, U.D. and Duduwa, A.T. (2012). Carcass and gut characteristics of broilers fed diets containing yellow sorghum (Sorghum bicolor) variety in place of maize. International Journal of Sustainable Agriculture. **4**(1): 08-11

[4]. Adegbola, A. J., Awagu, E. F., Kamaldeen, O. S., and Kashetu R. Q. (2013). Sorghum: Most under-utilized grain of the semi-arid Africa. Scholarly Journal of Agricultural Science, **3**(4):147-153.

[5]. Aduku A.O. (1993). Tropical feedstuff – analysis Table. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria, Nigeria.

[6]. Aduku AO (2004). Animal Nutrition in the Tropics. Feeds and Feeding, Pasture Management, Monogastric and Ruminant Nutrition, Davcon Computers and Business Bureau, Zaria, pp. 17 -18.

[7]. Ahmed M.A., Dousa B.M. and Abdel Atti Kh.A. 2013. Effect of substituting yellow maize for sorghum on broiler performance. J. World's Poult. Res. **3**(1): 13-17.

[8]. Akande, K.E. and Fabiyi, E.F. (2010). Effect of processing methods on some Antinutritional factors in Legumes seeds for poultry feeding. International Journal of Poultry Science **9** (10):996-1001

[9]. Akinola, L. A. F. and Sese, B.T. (2011). The feeding value of different dietary nutrients for Japanese quails. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S. (Eds) **Value Re-orientation in Animal Production: A Key to National Food Security and sustainable Economy.** Pp 481-483. Proceedings of 36th Annual Conference of Nigerian Society of Animal Production. 13th-16th March, 2011

[10]. Aladeen, A. M. A. and Omer Elbashier, M. (2013). The Effect of Replacement of Sorghum with Millet on Broilers Performance. International Journal of Science and Research (IJSR) **4** 6(14): 2319-706

[11]. Atteh, J.O. (2002). Principles and practice of livestock feed manufacturing. Adlek Printers. Ilorin Kwara State Nigeria, Pp: 13-17.

[12]. Atteh, J.O. (2003).Romancing The Chickens. The sixty eight inaugural lectures series. University of Ilorin, Nigeria.

[13]. Ayenor, G. S. (1985). Effects of cassava product yield and cyanide detoxification. Journal of Food Technology.**20**. 89-96.

[14]. Babatunde, G.M., Pond, W.G., Red, E.R. Jr. (1990). Nutritive value of rubber seed (Hevea brasilensis) meal utilization by growing pigs fed semi-purified diets in which rubber seed racal partially replaced soybean meal. Journal of Animal Science **68**:392-397

[15]. Bashar, Y.A., Abubakar, A. and Ukpele J. (2012). International Journal of Applied Agricultural and Apicultural Research Pearl Millet as an Alternative to Maize or Sorghum in the Diets of Broilers in Sokoto, Nigeria 8 (1) 1-8

[16]. Becker K (1992). Manipulation of the nutritional status of livestock by non-nutritive feed additives. In: Potential and limitations of biotechnology in livestock Production in developing countries. Part D: Biotechnology for the improvement of animal nutrition and health: Proc. Inter. Symp. held at Institute of Basic Animal Science, Faculty of Agric and Horticulture, Humboldt University of Berlin in co-operation with Council for Tropical and Subtropical Agricultural Research (ATSAR) Schwartz HJ and Franze H (eds), p. 101.

[17]. Dowling L.F, Arndt C, Hamaker B.R (2002). Economic viability of high digestibility sorghum as feed for market broilers. Agronomy Journal. **94**: 1050 – 1058.

[18]. Egbunike GN, and Achibong IO (2002). Performance and serum chemistry of growth: stimulated broiler finisher cassava peel based diet. Proc. of the 7th annual conference of the animal Sci. association of Nigeria (ASAN), Pp: 44-46.

[19]. Etuk, E.B. and Ukaejiofo, U.R. (2007). Tannin content and dietary effects of brown coat colored sorghum on the performance of young local turkey. Anim. Prod. Res. Adv., **3**(2): 86 – 90.

[20]. Etuk, E.B. (2008). Nutrient composition and feeding value of sorghum for turkeys. PhD Thesis, Federal University of Technology, Owerri, Nigeria.

[21]. Etuk, E. B., Ifeduba, A. V., Okata U. E., Chiaka I., Okoli, Ifeanyi C., Okeudo N. J., Esonu B. O., Udedibie A. B. I. and Moreki, J. C. (2012). Nutrient Composition and Feeding Value of Sorghum for Livestock and Poultry: a Review. Journal Animal Science Advances **2**(6): 510-524

[22]. FAOSTAT (2012). Food and Agricultural organization of the United Nation website http://faostat3.fao.org/browse/Q/ QC/E accessed on 10/11/2014.

[23]. Hancock, J.D. and Andrews D. J., (1995). Sorghum and millets for forage and feed. P. 325-364. In: Dendy, D.A. V. (ed.) Sorghum and the millets: Chemistry and Technology. Am. Assoc. Cereal Chem. St. Paul, M. N.Burton, G. W., A. T. Wallace and K. O.

[24]. Hancock, J.D. (2000). Value of sorghum and sorghum coproducts in diets for livestock In: Smith W. and R. A.Frederickson (ed.), Sorghum origin, history, Technology and Production. Willey Series Crop Sci. pp 731-751

[25]. IAR (1999). Code and description of crop varieties released by Institute of Agricultural Research, Ahmadu Bello University, Samaru, Federal Ministry of Science and Technology, Abuja, pp. 14 – 15.

[26]. Ibitoye, E. B., Olerede, B. R., Jimoh A. A. and Abubakar H. (2012). Comparative Performance and Organ Relative Weight of Broiler Chickens Fed Three Sources of Energy Diet. Journal Animal Production Advances, 2(5): 233-238

[27]. Inaku, E.N., Bawa, G.S., Olugbemi, T.S. and Buba,W. (2011). Nutritive value of yam feel meal in broiler diet. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S .(Eds) **Value Re-orientation in Animal Production: A Key to National Food Security and sustainable Economy.** Pp 481-483. Proceedings of 36th Annual Conference of Nigerian Society of Animal Production. 13th-16th March,2011

[28]. Issa, S., Hancock, J.D., Tuinstra, M.R., Kapran, I. and Kaka,S. (2007). Effects of sorghum variety on growth and carcass characteristics in broiler chicks reared in West Africa. Journal of Poultry Science **86**: 69-75

[29]. Maidala, A. and Istifanus, J.A. (2012). The role of micro livestock in alleviating protein deficiency and poverty reduction in Nigeria. Proceedings of 2nd National conference of school of vocational and technical education, College of Education Azare. Bauchi state (eds) Dantata, I.J., Maidala, A. and Garba, A.R.

[30]. Maidala, A., Doma, U.D. and Egbo, L.M. (2013). Effect of different processing methods on the chemical composition and antinutritional factors of soybean (Glycine max (L) Merrill). Pakistan Journal of Nutrition **12** (12) 2013

[31]. Mann, J.A., Kimber, C.T., and Miller, F.R. (1983). The origin and early cultivation of sorghums in Africa. Texas Agricultural Experiment Station Bulletin 1454.

[32]. McDonald, P., Edward, R.A., Greenhalgh, J.F.D., Morgan, E.A. (2000). Animal Nutrition, 5th Edition. Longman Scientific and Technical UK, pp. 476 – 530

[33]. Maunder ,B. (2002). Sorghum - The global grain of the future. Retrieved November 30, 2004 from http://www.sorghumgrowers.com/maunder.htm.

[34]. Medugu, C.I., Kwari, I.D., Igwebuike, J., Nkama,, I., Mohammed, I.D. and Hamaker, B. (2010a). Performance and economics of production of broiler chickens fed sorghum or millet as replacement for maize. Agriculture and Biology Journal of north America.**1**(3):321-325

[35]. Medugu, C.I., Kwari, I.D., Igwebuike, J., Nkama,, I., Mohammed, I.D. and Hamaker, B. (2010b).Carcass and blood components of broiler chickens fed sorghum or millet as replacement for maize. Agriculture and Biology Journal of north America.**1**(3):326-329

[36]. Mohammed A. Ahmed, Bakheit M. Dousa and Khadiga A. Abdel Atti (2013). Effect of Substituting Yellow Maize for Sorghum on Broiler Performance. J. World's Poult. Res. **3**(1): 13-17, 2013

[37]. Ngoka DA (1997). Crop Production in the Tropics: Theory and Practice. Alphabet Publishers, Owerri, pp. 120 -125.

[38]. Nkwocha, G.A., L. A. Agbabiaka , K.U. Anukam and T.O. Beketin, (2014). Growth response, Carcass and Blood characteristics of Finisher broilers fed Sorghum offal meal as dietary supplement. International Journal of Agri Science Vol. **4**(7): 392-398.

[39]. Ogbonna, J. U. (1991). Studies on the value of processed cassava peels in the nutrition of cockerel. Ph.D Thesis, University of Ibadan, Nigeria, 54-59.

[40]. Odukwe, C. A. (1994). The feeding value and composition of cassava root meal for broiler chicks. Ph.D Thesis, University of Nig. Nsukka, Nig. 20-27.

[41]. Olomu, J. M. (1995). Monogastric AnimalNutrition, Principles and Practice. 1st Edition. Jachem Publishers, Benin City, Nigeria. Pp 320.

[42]. Ojewola, G.S. and Olugbemi, F. (2011). Millet meal: a possible alternative dietary energy sources for broiler chickens. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S .(Eds) **Value Re-orientation in Animal Production: A Key to National Food Security and sustainable Economy.** Pp 481-483. Proceedings of 36th Annual Conference of Nigerian Society of Animal Production. 13th-16th March,2011

[43]. Omole, A.J., Adejimi, O.O., Adejurigbe, A.D., Tiamiyu, A.K. and Raji, A.M. (2006). **Small and medium scale broiler chicken farming**. Green choice Agric Publications 55pp

[44]. Parthasarathy, P.R., Guravo, K.R, Reddy, V.S. and Gowda,C.K. (2005). Linking producers and processors of sorghum for poultry feed. A case study from India.International Crops Research Institute for the Semi Arid Tropics (ICRISAT), New Delhi, India. pp 12

[45]. Purseglove, J.W. (1972). Tropical Crops – Monocotyledons, Longman Group Ltd., UK, pp 261 – 286.

[46]. Ravindran V. (2014). Poultry Development Review: Poultry feed availability and nutrition in developing countries. Food and Agriculture Organization of the United Nations accessed via http://www.fao.org/docrep/013/al705e/al7 05e00.pdf on 10/11/2014

[47]. Sanni, S.A. and Ogundipe, S.O. (2005). Economics of some modules of poultry production in Kaduna state. Nigerian Journal of Animal Production **32** (1):102- 107.

[48]. Subramanian, V. and Metta, V.C. (2000). Sorghum grain for poultry feed. In: Technical and Institution Options for Sorghum Grain Mold Management. Proc. International Consultation. Chandrasher A, Bandyopadhayi R and Hall AJ (eds.). International Crop Research for the Semi-Arid Tropics (ICRISAT). Patacheru 502 – 504, Andhra Pradesh, India, pp. 242 – 247

[49]. Tacon, A.G.J. (1995). Fishmeal replacers: A review of anti-nutrients within oil seeds and pulses. A limiting factor for the Aqua feed greed revolution. Paper presented at feed ingredients, Singapore, Asia, September 19 – 20, pp 153 – 181.

[50]. Tegbe, T.S, Atteh B, Jegede JO (1984). Utilization of agro-industrial by products (rice and wheat offal) in diet of pigs. Proc. of the Annual conference of the Nigeria society for animal production Nsukka, Nigeria

[51]. Travis, D.K., Tuinstro, M.R. and Hancock, J.D. (2006).Variation in nutritional value of sorghum hybrids with contrasting seed weight characteristics and comparisons with maize in broiler chicks. Crop Science. **46**:695-699.