

## **USE OF LOW TANNIN SORGHUM TO REPLACE YELLOW CORN PARTIALLY OR TOTALLY IN BROILER RATIIONS**

**El-Afifi, T. M.<sup>1</sup> ; Akila S. Hamza<sup>1</sup> ; H. S. Soliman<sup>2</sup> ; H. F. A. Motawe<sup>1</sup> ; M. A. El-Sherbiny<sup>1</sup> ; P. W. Waldroup<sup>3</sup> and M. M. El-Shinnawy<sup>4</sup>.**

<sup>1</sup> Regional Center for Food and Feed, Agric. Res.Center, Giza, Egypt.

<sup>2</sup> Animal Production Dept., Fac. Agric., Ain Shams University.

<sup>3</sup> Poultry Science Dept., University of Arkansas, Fayetteville AR.U.S.A.

<sup>4</sup> Anim. and Poult. Dep., Faculty of Agric. Mansoura Univ.

### **ABSTRACT**

An experiment was conducted to evaluate the best level of low tannin- sorghum grains to be included in broiler diets as a source of energy partially or completely replace yellow corn. Chemical composition and nutritional value of low tannin-sorghum grains were determined. Six hundred and thirty one day old Cobb broilers were used in this study. The chicks were randomly distributed among five dietary treatments (Control and four treatments). The experimental diets contained 4 levels of low-tannin sorghum grains during each stage of the three stages of growth (starter; grower and finisher). Each dietary treatment was offered to 3 replicates each replicate contained 42 chicks housed in broiler cages. The diets were formulated to be iso-caloric and iso-nitrogenous and covering the chick requirements as recommended by the management guide data of cobb chicks. The effects of different inclusion rates of low-tannin sorghum on growth performance and carcass characteristics were evaluated. The economic efficiency of replacing yellow corn by low-tannin sorghum was calculated. During the entire growth period (starter, grower and finisher), there were no significant differences in live body weight, weight gain, feed intake and feed conversion between chicks fed the control diet and those fed diets containing low-tannin sorghum up to 100%. There was also no significant difference in carcass yield at 35 days of age between birds fed the control diets and those fed diets containing different levels of sorghum. The economical efficiency study showed that replacing 50% and 25% of yellow corn with sorghum grains had the best economical efficiency and relative economical efficiency. Accordingly, this study demonstrated that low-tannin sorghum can safely be used in the broiler starter, grower and finisher rations as a substitute for yellow corn up to 100%, in spite of the exceptionally lower protein content of the sorghum, the present results confirm previous results in the livestock that low or non-tannin sorghum could partially or completely replace yellow corn in broilers rations. The fact that sorghum normally contains 10-11% CP compared to corn emphasizes the importance of using sorghum on the productive and economic efficiency of broilers especially in areas where the white skin color of broilers has consumer preference.

**Keywords:** Low tannin sorghum, broiler, performance, carcass

### **INTRODUCTION**

Dietary energy ingredients represent the major items in feed cost in livestock and poultry operations. The poultry industry in Egypt has suffered heavy losses due to the continual increase in input prices. Apart from the increased prices of other inputs there is an estimated increase in corn and soy prices by 50% and 75% between 2008 and 2012 associated with world economic crisis; increased energy prices; increased demand for energy by

emerging markets as well as the advent of the ethanol revolution. Feed cost represent about 70 to 80% of the total running cost of poultry operations. Energy sources as corn represents about 65 to 70% of the feed formulation. Thus corn as an energy source represents about 50% of the total feed cost. Livestock and poultry feed cost is likely to continue on upwards swing (Conolly, 2012) driven by the increased medium class; urbanization; change in consumer behavior and consequently increased demand for animal protein sources. Therefore, exploring the possibility of using alternative energy feed ingredients in livestock and poultry feeds either to reduce cost of production or to broaden the opportunities to nutritionists to formulate the least or the best cost rations became an urgent necessity (Nyannor *et al.*, 2007). Sorghum is considered to be the fifth most important crop after wheat, rice, corn and barley (Bryden *et al.*, 2009). Sorghum is tolerant to drought and salinity thus it occupies areas unsuitable for growing corn in stress-prone semi-arid region (FAO 2009). Sorghum is the only cereal that contains tannins. Tannins reduced pre-harvest molding; enhance resistance to pathogens and pests; lower bird depredation and lower pre-harvest germination Taylor (2001).

Many research workers suggest that maximum level of dietary tannins is between 3 and 2.5% on dry matter basis. Giner-Chavez (1996) however reported that levels of tannins ranging from 0.5% to 2.0% in poultry diets can cause depression in growth and egg production while levels of 3% to 7% can cause death. Tannins are phenolics that form complexes with protein thus making it resistant to enzyme digestion (Giner-Chavez 1996). Due to plant breeding efforts the sorghum currently produced are tannin free in the U.S.; Europe (Vignau – Loustau and Huyghe 2008), Australia; India and Thailand (Awika and Rooney 2004; Subramanian *et al.*, 2000 and Walker 1999). Those new varieties are excellent sources of energy and protein for broilers; layers; turkeys and water fowl (Nyachoti *et al.*, 1996). In countries where birds' predation is a serious issue, the production of low tannin sorghum may not be of economic importance. The use of high tannin sorghum cultivates is likely to be more economical (Taylor, 2003; Kyarisiima *et al.*, 2004).

The nutrient profile of sorghum in terms of protein is very similar or slightly higher than corn (Kriegshauser, *et al.*, 2006). Amino acid digestibility compares favorably with corn, especially the newer sorghum varieties (Smith and Waldroup 1988) and (Lemme, *et al.*, 2004). The fat content of grain sorghum and thus the energy value for poultry is slightly lower than corn but these differences can easily balance other sources of energy as animal by products meals or oils (Beyer, 2010). Compared to corn, grain sorghum contains reduced quantities of yellow xanthophylls. In some cases where lighter color meat products are preferred by the consumer, sorghum may be the suitable grain to use. Where color is required for some poultry products, other sources of pigments such as marigold oil, yeast products, synthetic compounds and even corn dried distillers grains with solubles (DDGS) could be used as sources for the yellow pigmentations (Beyer, 2010).

The main objectives of this study are therefore to determine the effects on broiler performance; carcass characteristics and economic efficiency of partially or completely replacing yellow corn by low tannin sorghum.

## **MATERIALS AND METHODS**

### **Experimental chicks**

The present work was carried out in the poultry house in Nubaria (North West of the Nile), affiliated to the Regional Center for Food and Feed, Agric. Res. Center, Ministry of Agric., Egypt. Six hundred and thirty commercial (630) day-old Cobb broilers were purchased from (El-Wadee Poultry Company). The average initial live body weight of all birds was nearly similar (Av. 45 gm/chick). Chicks were distributed randomly among five dietary treatments (control and four tested groups). Birds were placed in brooders battery with 14 birds per compartment; nine compartments were assigned to each dietary treatment. The trial was conducted under controlled lighting period (24hrs.).

### **Experimental diets**

#### **Sorghum:**

A low or non-tannin sorghum sample of U.S. origin was donated to the Regional Center for Food and Feed by Dakahlia Poultry Company.

Sorghum was analyzed for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fibers (CF), minerals and amino acids using standard official methods (AOAC, 2005). A comparison between the determined chemical compositions of sorghum with that of corn based on the NRC 1994 are shown in Table 1.

The tested diets were formulated to contain 25, 50, 75, and 100% low tannin sorghum in place of corn. These diets were formulated to cover the chick requirements according to the management catalogue for Cobb chicks as shown in Tables 2, 3 and 4. The commercial sample used in this study is of U.S. sorghum and contains 0.08% to 0.19 % tannin or less. All diets were iso-coloric and iso-nitrogenous being 3000; 3100 and 3200 Kcal ME/kg and 23%; 22% and 20% CP for starter; grower and finisher rations, respectively.

Feed and water were provided *adlibitum* throughout the whole growth period.

Body weight, weight gain; feed intake, feed conversion and mortality rate were recorded at 14; 28 and 35 days of age for all treatments.

At 35 days of age; three chicks from each replicate were randomly selected, slaughtered for determination of carcass traits. The weights of breast meat, thigh, drum stick, liver and gizzard were recorded.

### **Economical efficiency**

The economic efficiency and relative economical efficiency of the various experimental diets were calculated based to both the market price kg feed and the market price kg live body weight gain.

### **Statistical analysis**

The data obtained were subjected to a one way analysis of variance using the linear model (GLM) of SAS (SAS institute, 1991). Treatment means

were subjected to Duncan's new multiple range test ( $P < 0.05$ ) (Duncan, 1955) to detect the significant differences between means.

**Table (1): Nutrient compositions of corn (estimated) and low tannin sorghum (determined).**

| Item          | Sorghum (Determined) | Corn (NRC, 1994) |
|---------------|----------------------|------------------|
| Dry matter    | 87                   | 88               |
| CP%           | 7.5                  | 8.5              |
| Fat%          | 3.2                  | 3.8              |
| Fiber%        | 2.3                  | 2.2              |
| ME (Kcal /Kg) | 3288                 | 3350             |
| TME (kcal/Kg) | 3376                 | 3470             |
| Ca%           | 0.04                 | 0.02             |
| Total P%      | 0.30                 | 0.08             |
| Potassium%    | 0.35                 | 0.30             |
| Sodium%       | 0.04                 | 0.04             |
| Amino acids:  |                      |                  |
| Arg%          | 0.35                 | 0.38             |
| Gly%          | 0.31                 | 0.33             |
| Ser%          | 0.40                 | 0.37             |
| His%          | 0.22                 | 0.23             |
| Iso%          | 0.35                 | 0.29             |
| Leu%          | 1.14                 | 1.00             |
| Lys%          | 0.21                 | 0.26             |
| Meth%         | 0.16                 | 0.18             |
| Cys%          | 0.17                 | 0.18             |
| Phe%          | 0.47                 | 0.38             |
| Tyr%          | 0.34                 | 0.30             |
| Thr%          | 0.29                 | 0.29             |
| Try%          | 0.80                 | 0.06             |
| Val%          | 0.44                 | 0.40             |

**Table (2): Composition of broiler starter diets (0-14 d) with different levels of low tannin sorghum (as- fed basis).**

| Ingredients                      | Starter |                        |        |        |        |
|----------------------------------|---------|------------------------|--------|--------|--------|
|                                  | Control | Sorghum inclusion rate |        |        |        |
|                                  |         | 25%                    | 50%    | 75%    | 100%   |
| Yellow corn (7.5%)               | 48.421  | 36.345                 | 24.182 | 12.133 | 0.000  |
| Grain sorghum (7.5%)             | 0.000   | 11.750                 | 23.582 | 35.313 | 47.105 |
| Soybean meal                     | 44.268  | 44.570                 | 44.881 | 45.179 | 45.480 |
| Vegetable oil                    | 3.107   | 3.150                  | 3.190  | 3.230  | 3.280  |
| Dicalcium phosphate              | 1.965   | 1.950                  | 1.940  | 1.930  | 1.920  |
| Limestone                        | 1.247   | 1.240                  | 1.230  | 1.220  | 1.220  |
| Vit. & min. mixture <sup>1</sup> | 0.300   | 0.300                  | 0.300  | 0.300  | 0.300  |
| Choline chloride                 | 0.075   | 0.075                  | 0.075  | 0.075  | 0.075  |
| Salt                             | 0.300   | 0.300                  | 0.300  | 0.300  | 0.300  |
| DL. Methionine <sup>2</sup>      | 0.267   | 0.270                  | 0.270  | 0.270  | 0.270  |
| L. lysine – HCL <sup>2</sup>     | 0.050   | 0.050                  | 0.050  | 0.050  | 0.050  |
| Calculated values%               |         |                        |        |        |        |
| CP                               | 23.000  | 23.000                 | 23.000 | 23.000 | 23.000 |
| ME (Kcal /Kg )                   | 3000    | 3000                   | 3000   | 3000   | 3000   |
| Lysine                           | 1.400   | 1.400                  | 1.400  | 1.400  | 1.400  |
| Methionine + Cystine             | 1.040   | 1.040                  | 1.040  | 1.040  | 1.040  |
| Calcium                          | 1.000   | 1.000                  | 1.000  | 1.000  | 1.000  |
| Available P                      | 0.500   | 0.500                  | 0.500  | 0.500  | 0.500  |

<sup>1</sup>Vitamin-mineral mixture supplied per Kg diet :Vit. (D3),2000 I.U;VIT.(E),10 mg; Vit.(B1),1mg;Vit.(B2), 5 mg;Vit (B6), 1.5mg; Vit.(B12),10 µg; Biotin, 50 µg; Choline chloride,500mg; pantothenic acid, 10 mg;Niacin,30 mg; folic acid,1mg; manganese, 60mg; ZINC,50mg;Iron,30 mg; Copper, 10mg; Iodine,1mg; Selenium,0.1mgandCopalt,0.1mg Vit.(A),12000 IU.

<sup>2</sup> Lysine and Methionine were added according to management recommendation guide data for Cobb broilers.

**Table (3): Composition of broiler grower diets (15-28d) with different levels of low tannin sorghum (as-fed basis).**

| Ingredients                     | Control | Grower<br>Sorghum inclusion rate |        |        |        |
|---------------------------------|---------|----------------------------------|--------|--------|--------|
|                                 |         | 25%                              | 50%    | 75%    | 100%   |
| Yellow corn (7.5%)              | 59.740  | 44.630                           | 29.439 | 14.619 | 0.000  |
| Grain sorghum (7.5%)            | 0.000   | 14.662                           | 29.438 | 43.849 | 58.065 |
| Soybean meal                    | 33.310  | 33.702                           | 34.082 | 34.455 | 34.823 |
| Vegetable oil                   | 2.840   | 2.894                            | 2.948  | 3.002  | 3.054  |
| Dicalcium phosphate             | 1.760   | 1.754                            | 1.742  | 1.730  | 1.719  |
| Limestone                       | 1.150   | 1.146                            | 1.140  | 1.134  | 1.128  |
| Vit & mini mixture <sup>1</sup> | 0.300   | 0.300                            | 0.300  | 0.300  | 0.300  |
| Choline chloride                | 0.070   | 0.070                            | 0.070  | 0.070  | 0.070  |
| Salt                            | 0.560   | 0.562                            | 0.558  | 0.554  | 0.550  |
| DL. methionine <sup>2</sup>     | 0.190   | 0.200                            | 0.203  | 0.207  | 0.211  |
| L. lysine- HCL <sup>2</sup>     | 0.080   | 0.080                            | 0.080  | 0.080  | 0.080  |
| Calculated values%              |         |                                  |        |        |        |
| CP                              | 22.000  | 22.000                           | 22.000 | 22.000 | 22.000 |
| ME (Kcal /Kg )                  | 3100    | 3100                             | 3100   | 3100   | 3100   |
| Lysine                          | 1.300   | 1.300                            | 1.300  | 1.300  | 1.300  |
| Methionine + Cystine            | 1.000   | 1.000                            | 1.000  | 1.000  | 1.000  |
| Calcium                         | 0.900   | 0.900                            | 0.900  | 0.900  | 0.900  |
| Available P                     | 0.450   | 0.450                            | 0.450  | 0.450  | 0.450  |

<sup>1</sup>Vitamin-mineral mixture supplied per Kg diet :Vit. (D3),2000 I.U;VIT.(E),10 mg; Vit.(B1),1mg;Vit.(B2), 5 mg;Vit (B6), 1.5mg; Vit.(B12),10 µg; Biotin, 50 µg; Choline chloride,500mg; pantothenic acid, 10 mg;Niacin,30 mg; folic acid,1mg; manganese, 60mg; ZINC,50mg;Iron,30 mg; Copper, 10mg; Iodine,1mg; Selenium,0.1mgandCopalt,0.1mg Vit.(A),12000 IU.

<sup>2</sup> Lysine and Methionine were added according to management recommendation guide data for Cobb broilers.

**Table (4): Composition of broiler finisher diets (29-35 d) with different levels of low tannin sorghum (as-fed basis).**

| Ingredients                     | Control | Finisher<br>Sorghum inclusion rate |        |        |        |
|---------------------------------|---------|------------------------------------|--------|--------|--------|
|                                 |         | 25%                                | 50%    | 75%    | 100%   |
| Yellow corn (7.5%)              | 63.418  | 47.229                             | 31.266 | 15.525 | 0.000  |
| Grain sorghum (7.5%)            | 0.000   | 15.743                             | 31.266 | 46.574 | 61.671 |
| Soybean meal                    | 29.685  | 30.093                             | 30.496 | 30.893 | 31.285 |
| Vegetable oil                   | 3.092   | 3.150                              | 3.207  | 3.264  | 3.320  |
| Dicalcium phosphate             | 1.628   | 1.615                              | 1.602  | 1.590  | 1.578  |
| Limestone                       | 1.120   | 1.113                              | 1.107  | 1.099  | 1.092  |
| Vit & min. mixture <sup>1</sup> | 0.300   | 0.300                              | 0.300  | 0.300  | 0.300  |
| Choline chloride                | 0.075   | 0.075                              | 0.075  | 0.075  | 0.075  |
| Salt                            | 0.441   | 0.437                              | 0.433  | 0.428  | 0.424  |
| dl. Methionine <sup>2</sup>     | 0.168   | 0.172                              | 0.176  | 0.181  | 0.185  |
| L. lysine – HCL <sup>2</sup>    | 0.073   | 0.073                              | 0.072  | 0.071  | 0.070  |
| Calculated values%              |         |                                    |        |        |        |
| CP                              | 20.000  | 20.000                             | 20.000 | 20.000 | 20.000 |
| ME (Kcal /Kg )                  | 3200    | 3200                               | 3200   | 3200   | 3200   |
| Lysine                          | 1.160   | 1.160                              | 1.160  | 1.160  | 1.160  |
| Methionine + Cystine            | 0.920   | 0.920                              | 0.920  | 0.920  | 0.920  |
| Calcium                         | 0.900   | 0.900                              | 0.900  | 0.900  | 0.900  |
| Available P                     | 0.450   | 0.450                              | 0.450  | 0.450  | 0.450  |

<sup>1</sup>Vitamin-mineral mixture supplied per Kg diet :Vit. (D3),2000 I.U;VIT.(E),10 mg; Vit.(B1),1mg;Vit.(B2), 5 mg;Vit (B6), 1.5mg; Vit.(B12),10 µg; Biotin, 50 µg; Choline chloride,500mg; pantothenic acid, 10 mg;Niacin,30 mg; folic acid,1mg; manganese, 60mg; ZINC,50mg;Iron,30 mg; Copper, 10mg; Iodine,1mg; Selenium,0.1mgandCopalt,0.1mg Vit.(A),12000 IU.

<sup>2</sup> Lysine and Methionine were added according to management recommendation guide data for Cobb broilers.

## RESULTS

The proximate analysis of sorghum compared to corn (Table 1) indicates that unexpectedly the low tannin sorghum sample used in this study was lower in its protein; ether extract (EE), Metabolizable Energy Adjusted for Nitrogen Balance (MEN), True Metabolizable Energy (TME) and Lysine content compared to corn. These differences are expected since the nutritive value of sorghum is greatly affected by the variety of sorghum; climatic and soil conditions and type of fertilizers (Aduku 1993; Tacon, 1995 and Etuk, 2008).

The results of broiler performance in terms of live body weight (BW), body weight gain (BWG), feed intake (FI) and feed conversion (FC) for the starter period (1 to 14 days of age); the grower period (15 to 28 days of age) and the finisher period (29 to 35 days of age) are summarized in Table 5.

**Starter period:** There were no significant differences in body weight, weight gains, feed intake and feed conversion of chicks fed the control diet and those given diets containing 25%, 50%, 75% and 100% sorghum at 14 days of age. However, the lowest feed conversion in the starter period was observed by chicks fed the control diet.

**Grower period:** Results showed no significant differences in the body weight, weight gain, and feed intake and feed conversion for chicks fed either the control diet or diets containing 25%, 50%, 75% and 100% sorghum.

**Finisher period:** There were no significant differences in body weight, weight again, feed intake and feed conversion for chicks fed either the control diet or diets containing 25%, 50%, 75% and 100 % sorghum, respectively

The performance of broiler given the low tannin sorghum was encouraging. The growth rates of birds subjected to the different levels of sorghum and those chicks fed control diet were almost similar without any significant differences among treatments. The final bird weight and feed efficiency ratio didn't vary among birds given yellow corn diet or those given diets containing low tannin sorghum (Table 5). These data suggest that low tannin sorghum can replace yellow corn up to 100% without any adverse effects on chick performance.

The mortality rate ranged between 0- 4.7% during the whole experimental period among chicks given the 5 experimental diets.

**Carcass characteristics:** Table (6) summarizes the percentages of different parts and organs of broiler chicks fed the experimental diets at 35 days of age.

Dressing percentage, breast meat, drum sticks, thigh, liver and gizzard weights were not significantly different among birds given different levels of sorghum or those given the control diet. Dressing percentage of the control group was 75.13% while it was 76.46, 76.15, 76.50 and 76.53% for those fed 25%, 50%, 75% and 100% sorghum, respectively.

**Economical evaluation:** Data concerning the economical evaluation of feeding broilers different experimental diets to 35 days of age as affected by substituting yellow corn partially or totally by low tannin sorghum are presented in Table (7).



It is obviously that the inclusion of low tannin sorghum in the dietary treatments decreased production costs as compared to that of control. Average economical efficiency values of different treatments (feed/kg gain) being the best for broiler fed diets contained 50% sorghum followed by those contained 25%. The lowest economic efficiency value was recorded for chicks given diets containing 75% or 100% sorghum grains.

For the relative economical efficiency, averages of improvement due the dietary treatments ranged between 2.67% and 10%, being the best for chicks given diets containing 25% sorghum grains.

## **DISCUSSION**

The present results indicated that low tannin sorghum can safely be used in the starter, grower and finisher broiler rations as a replacement for corn up to 100%, in spite of its slightly low protein content of the sorghum sample used in the present study. Sorghum with high protein content could be included in poultry feeds as a tool to reduce cost of production associated with decreased level of dietary soy meal supplement. These results agreed with those obtained by Titus and Fritz (1971), Gualtieri and Rapaccini (1990), and Subramanian and Metta (2000) who stated that birds fed diets containing high level of sorghum (low tannin) performed similar to those given corn in terms of weight gain, feed consumption and conversion. Also, the present results agreed with those reported by Thakur *et al.*, (1984) and Rama Rao *et al.*, (1995) who stated that low tannin sorghum can replace maize from 50 to 70% without adverse effect on broiler performance. Shelton *et al.*, (2004) stated that pigs fed corn and non-waxy sorghum had similar growth and carcass traits. Douglas *et al.*, (1990) concluded that grain sorghum has nearly similar nutritive value to yellow corn when fed to boilers.

**Table (7): Economic efficiency of experimental dietary treatments.**

| <b>Items</b>                     | <b>control</b> | <b>T1</b> | <b>T2</b> | <b>T3</b> | <b>T4</b> |
|----------------------------------|----------------|-----------|-----------|-----------|-----------|
| Average final L.B.W (g)          | 1674           | 1669      | 1712      | 1661      | 1678      |
| Feed intake (kg)                 | 2.747          | 2.716     | 2.773     | 2.793     | 2.787     |
| Total cost of feed (L.E)         | 8.53           | 8.39      | 8.51      | 8.51      | 8.44      |
| Total revenue / chick (L.E)      | 26.79          | 26.71     | 27.39     | 26.58     | 26.85     |
| Net revenue / chick (L.E)        | 18.26          | 18.32     | 18.88     | 18.02     | 17.91     |
| Economic efficiency              | 2.14           | 2.18      | 2.22      | 2.12      | 2.12      |
| Relative economic efficiency (%) | 100.00         | 101.87    | 103.74    | 99.07     | 99.07     |

**The selling price of each kg live body weight (16L.E).**

For the carcass yield the present results agreed with those of Subramanian and Metta (2000), who stated that carcass yield, carcass fat, gizzard and liver were not significantly different among chick given corn diets compared to these given low tannin sorghum diets. The dressing percentage values obtained in this study were almost similar to those reported for broiler chicks by Marion and Woodroof (1966).

The present study demonstrated the economic advantage of replacing yellow corn by sorghum in diets for broilers. In this respect, Hala



(1998) found that, low tannin sorghum can be used in the diet of broilers at level up to 100% with no obvious deterioration of economical efficiency.

### **Conclusions**

In spite of, the low protein content of the low tannin sorghum used in the present work, the present results demonstrated that low tannin sorghum could completely substitute corn in broiler diets without any obvious deterioration on broiler productive performance and carcass characteristics. Replacing 50% and 25% yellow corn with low tannin sorghum gave the best results for economic efficiency and relative economical efficiency. More researches are needed however to explore the possibility of using other varieties of sorghum grains in different poultry species.

### **REFERENCES**

- Aduku, A.O. (1993). Tropical feedstuff – analysis able. Department of Animal Science. Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria, Nigeria.
- Awika, J.M. and Rooney, L.W. (2004). Sorghum phytochemicals and their potential impact on human health. *Phytochemistry*, 65: 1199-1221.
- Association of Official Analytical Chemists, A.O.A.C (2005). "Official methods of analysis, 18<sup>th</sup>. Ed. Vol. 1, published by the A.O.A.C. Benjamin Francklin Station, Washington, DC.
- Beyer, S. (2010) "Sorghum in poultry production feeding guide": p16 published by United Sorghum Check off Program 4201 N.Interstate-27 Lubbock, Texas. [www.Sorghumcheckoff.com](http://www.Sorghumcheckoff.com)
- Bryden, W. L., P. H. Selle; D. J. Cadogan; X. Li, N. D. Muller; D. R. Jordan; M. J. Gidley; and W. D. Hamilton, (2009). A review of the nutritive value of sorghum in broilers. *Rural Industry Res. Dev. Corp. Kingston, Aust.* pp25
- Conolly, A. (2012). Seminar presentation on "Pushing the boundaries- performance and profitability". *Poultry International Magazine*, Mark Clement (ed). January 2012. p.18 [www.wattagnet.com](http://www.wattagnet.com)
- Douglas, J. M., T. W. Sullivan, P. L. Bond, and F. J. Struwe. (1990). Nutrient composition and metabolizable energy values of selected grain sorghum varieties and yellow corn. *Poult. Sci.* 69:1147-1155.
- Duncan, D.B. (1955). Multiple range and Multiple F test. *Biometrics*, 11: 1-42.
- Etuk E.B. (2008). Nutrient composition and feeding value of sorghum for turkeys. PhD Thesis, Federal University of Technology, Owerri, Nigeria.
- FAO, (2009). Grassland Index. A searchable catalogue of grass and forage legumes. FAO
- Giner-Chavez, B.I. (1996). Condensed tannins in tropical forages- PhD. Thesis. Cornell University, Ithaca, NY, USA.
- Gualtieri, M., and S. Rapaccini, (1990). Sorghum grain in poultry feeding. *Journal of World's Poultry Science*. 46: 246-254.
- Hala M. Abdel-Wahed (1998). The use of sorghum or rice bran in broiler and layer diets with reference to enzyme supplementation. Ph.D. Thesis. Faculty of Agriculture, Fayoum, Cairo University, Egypt. pp180

- Kriegshauser, T.D., M.R.Tuinstra, and J.D.Hancock, (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.
- Kyarisiima, C.C; M.W. Okot; and B. Svihus (2004). Use of wood ash in the treatment of high tannin sorghum for poultry feeding. *South African Journal of Animal Science* 34 (2):110 – 115.
- Lemme, A., V. Ravindran, and W.L. Bryden (2004). Ileal digestibility of amino acids in feed ingredients for broilers. *World Poult. Sci. J.* 60(4): 423-437.
- Marion, J.K., and J.G. Woodroof (1966). Composition and stability of broiler carcass as influenced by dietary protein and fat. *Poultry Sci.* 45: 241-247.
- National Research Council, NRC, (1994). Nutrient requirements of poultry. 9<sup>th</sup> revised edition, National Academy Press, Washington, DC.
- Nyachoti, C.M.; J.L. Atkinson; and S. Leeson, (1996) Response of broiler chicks fed a high-tannin sorghum diet. *Appl. Poult. Res.* 5: 239-245.
- Nyannor, E.K.D., S.A. Adedokun, B.R. Hammaker, G. Ejeta, and O.Adeola (2007). Nutritional evaluation of high-digestible sorghum for pigs and broiler chicks. *J.Animal Sci.*, 85: 196-203.
- Rama Rao, S.V., N.K. Praharaj, M.V.L.N. Raju, S.C. Mohapatra, M.M. Chawak, , and S.K. Mishra, (1995). Replacement of yellow maize with tannin free sorghum in white leghorn layer diet. *Indian Journal of Poultry Science* 30:76–78.
- SAS (1991). SAS/STAT User's guide. SAS Institute, Cary, NC, USA, 1028.
- Shelton, J. L., J. O. Mathews, L. L. Southern, A. D. Higbie, T. D. Bidner, J. M. Fernandez, and J. E. Pontif. (2004). Effect of nonwaxy and waxy sorghum on growth, carcass, and glucose and insulin kinetics of growing-finishing barrows and gilts. *J. Anim. Sci.* 82:1699-1706.
- Smith, N.K., Jr, Waldroup, P.W. (1988) Estimation of the tryptophan requirement of male broiler chickens. *Poultry Science*.67(8):1174-1177.
- Subramanian, V., and Metta V.C. (2000). Sorghum grain for poultry feed: pages 242-247 in Technical and Institutional options for sorghum grain mold management: proceedings of an International consultation, 18-19 May 2000, ICRISAT, Patancheru, India
- 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.
- Taylor, J.R.N. (2001). Methods to be used to Identify and Specify Characteristics Desired by Industrial Processors that use Sorghum as an Input, Technical Report #2. Task Order No. 4.1. USAID, Gaborone, Botswana.
- Taylor, J.R.N. (2003). Overview: Importance of sorghum in Africa. In: Belton, P.S. ; Taylor, J.R.N. (Eds). *Afripro Workshop on the proteins of sorghum and millets: Enhancing nutritional and functional properties for Africa*. Pretoria South Africa, 2 – 4 April 2003.

- Thakur, R.S., P.C.Gupta, and G.P.Lodhi, (1984). Feeding value of different varieties of sorghum in broiler ration. Indian Journal of Poultry Sci. 19: 103-107.
- Titus, H.W., and J.C. Fritz (1971). The scientific feeding of chicken. 5<sup>th</sup> Ed. The Interstate Printer and Publishes, Inc. Danville, Illinois.
- Vignau-Loustau L. and C.Huyghe, (2008). Stratégies Fourragères. France Agricole Editions, 2008.
- Walker, T. (1999). Sorghum grain for poultry and swine. ASA Technical Bulletin vol. AN20.

## إستخدام السورجم منخفض المحتوى من التينينات محل الأذره الصفراء جزئياً أوكلياً في علائق دجاج التسمين

طارق محمد العفيفي<sup>١</sup>، عقيله صالح حمزة<sup>١</sup>، حسين سعد سليمان<sup>٢</sup>، هادي فتحي عباس<sup>١</sup>،  
محمد أحمد الشربيني<sup>١</sup>، ولدروب<sup>٣</sup> و محمد محمد الشناوي<sup>٤</sup>

<sup>١</sup> المركز الاقليمي للاغذية والاعلاف-مركز البحوث الزراعية-جيزه-مصر

<sup>٢</sup> قسم الإنتاج الحيواني- جامعة عين شمس- القاهرة - مصر

<sup>٣</sup> قسم الدواجن، جامعة أركانسس، فاينيفالي آر، الولايات المتحدة الأمريكية

<sup>٤</sup> قسم الإنتاج الحيواني والدواجن كلية الزراعة- جامعة المنصورة

أجريت تجربه تقييم افضل نسبه اضافته من السورجم منخفض التينينات كمصدر للطاقة في علائق دجاج التسمين محل الأذره الصفراء جزئياً أوكلياً. أجريت التحاليل لمعرفة التركيب الكيماوي والتغذوي للسورجم منخفض التينينات. إستخدم عدد ستمائه وثلاثون ككتوتاً عمر يوم من نوع سلالة Cobb. حيث تم توزيع الكتاكيت على خمس معاملات (عليقه قياسية و أربع معاملات) إشتملت العلائق التجريبيه على أربع مستويات من السورجم منخفض التينينات وذلك خلال كل مرحله من مراحل النمو الثلاثه(بادي ، نامي وناهي). قسمت كل معاملة إلى ثلاث مكررات كل مكرر إحتوى على عدد ٤٢ ككتوتاً والتي وضعت داخل أقفاص. تم تركيب العلائق بحيث كانت كلها متزنه في محتواها من الطاقة والبروتين وتغطي إحتياجات الكتاكيت طبقاً لتحليل السلالة الخاص بسلالة Cobb. تم تقييم تأثير نسب الإضافة المختلفه لسورجم منخفض التينينات عن طريق أداء النمو صفات الذبيحه. تم حساب الكفاءة الإقتصادية لإحلال السورجم منخفض التينينات محل الأذره الصفراء. خلال فترة النمو الكليه (بادي، نامي و ناهي) لم يلاحظ أي فارق معنوي من حيث وزن الجسم ، الوزن المكتسب، كمية الغذاء المأكول ومعامل التحويل الغذائي بين الطيور التي تغذت على العليقه القياسية وتلك المغذاه على علائق إحتوت على سورجم منخفض التينينات حتى مستوى إحلال ١٠٠%. لم يكن هناك فروق معنويه في تصافي الذبيحه عند عمر ٣٥ يوماً بين الطيور التي تغذت على العليقه القياسية وتلك المغذاه على علائق إحتوت على السورجم منخفض التينينات. أوضحت الدراسه الإقتصادية أن إحلال ٥٠% و ٢٥% من الأذره الصفراء بالسورجم أعطى أفضل كفاءه إقتصادية وأفضل كفاءه إقتصادية نسبيه. وعليه فإن هذه الدراسه أوضحت أنه يمكن إستخدام السورجم منخفض التينينات في علائق دجاج التسمين في كل من مرحله البادي، النامي و الناهي بشكل آمن بمعدل إحلال يصل الي ١٠٠% محل الأذره الصفراء وذلك برغم إنخفاض محتواه من البروتين والنتائج الحاليه تؤكد نتائج سابقه يظهر فيها إمكانية إحلال السورجم منخفض التينينات جزئياً أوكلياً محل الأذره الصفراء في علائق دجاج التسمين.

حقيقه أن السورجم عادة ما يحتوي على ١٠-١١% بروتين مقارنة بالأذره مما يؤكد على أهمية إستخدام السورجم في العمليه الإنتاجيه والإقتصادية لدجاج التسمين خاصة في المناطق التي يكون لون الجلد الأبيض مفضلاً لدى المستهلك.

### قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة

مركز البحوث الزراعية

أ.د / خليل الشحات شريف

أ.د / على ابراهيم لبيب



**Table (5): Effect on broiler performance of partial or complete substitution of yellow corn by low tannin sorghum.**

| Item   | Dietary treatment        | Sorghum %                |                          |                          |                           |
|--|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|
|  | Control                  | 25%                      | 50%                      | 75%                      | 100%                      |
| <b>Starter stage (1-14 days old)</b>               |                          |                          |                          |                          |                           |
| Live body weight (g)                               | 348 <sup>a</sup> ±14.22  | 369 <sup>a</sup> ±12.77  | 377 <sup>a</sup> ±7.07   | 355 <sup>a</sup> ±23.18  | 366 <sup>a</sup> ±18.02   |
| Body weight gain (g)                               | 303 <sup>a</sup> ±14.22  | 324 <sup>a</sup> ±12.77  | 322 <sup>a</sup> ±7.07   | 310 <sup>a</sup> ±23.18  | 321 <sup>a</sup> ±18.02   |
| Feed intake (g)                                    | 390 <sup>a</sup> ±14.57  | 399 <sup>a</sup> ±11.36  | 404 <sup>a</sup> ±23.00  | 392 <sup>a</sup> ±4.59   | 395 <sup>a</sup> ±2.83    |
| Feed conversion (feed / gain)                      | 1.29 <sup>a</sup> ±0.06  | 1.23 <sup>a</sup> ±0.03  | 1.22 <sup>a</sup> ±0.04  | 1.26 <sup>a</sup> ±0.03  | 1.23 <sup>a</sup> ±0.06   |
| <b>Grower stage (15-28 days old)</b>               |                          |                          |                          |                          |                           |
| Live body weight (g)                               | 1223 <sup>a</sup> ±43.84 | 1256 <sup>a</sup> ±10.69 | 1288 <sup>a</sup> ±33.37 | 1243 <sup>a</sup> ±23.26 | 1244 <sup>a</sup> ±36.10  |
| Body weight gain (g)                               | 866 <sup>a</sup> ±43.84  | 887 <sup>a</sup> ±10.69  | 911 <sup>a</sup> ±33.37  | 888 <sup>a</sup> ±23.26  | 879 <sup>a</sup> ±36.10   |
| Feed intake (g)                                    | 1462 <sup>a</sup> ±45.76 | 1463 <sup>a</sup> ±47.88 | 1488 <sup>a</sup> ±35.60 | 1466 <sup>a</sup> ±15.89 | 1451 <sup>a</sup> ±29.70  |
| Feed conversion (feed / gain)                      | 1.69 <sup>a</sup> ±0.08  | 1.65 <sup>a</sup> ±0.06  | 1.63 <sup>a</sup> ±0.01  | 1.65 <sup>a</sup> ±0.07  | 1.65 <sup>a</sup> ±0.02   |
| <b>Finisher stage (29-35 days old)</b>             |                          |                          |                          |                          |                           |
| Live body weight (g)                               | 1674 <sup>a</sup> ±36.47 | 1669 <sup>a</sup> ±5.77  | 1712 <sup>a</sup> ±19.14 | 1661 <sup>a</sup> ±4.58  | 1678 <sup>a</sup> ±11.68  |
| Body weight gain (g)                               | 460 <sup>a</sup> ±36.47  | 413 <sup>a</sup> ±5.77   | 423 <sup>a</sup> ±19.14  | 418 <sup>a</sup> ±4.58   | 434 <sup>a</sup> ±11.68   |
| Feed intake (g)                                    | 895 <sup>a</sup> ±29.60  | 855 <sup>a</sup> ±14.57  | 902 <sup>a</sup> ±21.66  | 935 <sup>a</sup> ±10.12  | 941 <sup>a</sup> ±25.72   |
| Feed conversion (feed / gain)                      | 2.16 <sup>ab</sup> ±0.08 | 2.07 <sup>a</sup> ±0.04  | 2.13 <sup>ab</sup> ±0.11 | 2.24 <sup>b</sup> ±0.10  | 2.18 <sup>ab</sup> ±0.14  |
| <b>Overall experimental period (1-35 days old)</b> |                          |                          |                          |                          |                           |
| Live body weight                                   | 1674 <sup>a</sup> ±36.47 | 1669 <sup>a</sup> ±5.77  | 1712 <sup>a</sup> ±19.14 | 1661 <sup>a</sup> ±4.58  | 1678 <sup>a</sup> ±11.68  |
| Body weight gain (g)                               | 1629 <sup>a</sup> ±36.47 | 1624 <sup>a</sup> ±5.77  | 1667 <sup>a</sup> ±19.14 | 1616 <sup>a</sup> ±4.58  | 1633 <sup>a</sup> ±11.68  |
| Feed intake (g)                                    | 2747 <sup>a</sup> ±51.01 | 2716 <sup>a</sup> ±47.78 | 2773 <sup>a</sup> ±41.30 | 2793 <sup>a</sup> ±71.53 | 2787 <sup>a</sup> ±107.11 |
| Feed conversion (feed / gain)                      | 1.68 <sup>a</sup> ±0.08  | 1.68 <sup>a</sup> ±0.06  | 1.66 <sup>a</sup> ±0.04  | 1.73 <sup>a</sup> ±0.11  | 1.71 <sup>a</sup> ±0.13   |

a,b Means within a row with different superscripts are significantly different ( P <0.05 ).

**Table (6): Carcass characteristics of Cobb broilers given diets containing 0.0, 50.0, 75.0 and 100% low tannin sorghum in place of yellow corn.**

| Item                          | Treatment | Dressing (%) | Breast (%)                | Thigh (%)  | Drum stick (%) | Liver (%)  | Gizzard (%) |
|-------------------------------|-----------|--------------|---------------------------|------------|----------------|------------|-------------|
| Control                       |           | 75.13±1.60   | 18.52 <sup>ab</sup> ±0.16 | 7.66 ±0.14 | 4.89±0.10      | 2.12±0.18  | 3.42 ±0.16  |
| Treatment1<br>(25% Sorghum)   |           | 76.46±0.88   | 19.12 <sup>a</sup> ±1.32  | 7.48 ±0.11 | 5.07±0.25      | 2.69 ±0.22 | 3.29 ±0.17  |
| Treatment 2<br>(50% Sorghum)  |           | 76.15±3.20   | 19.85 <sup>a</sup> ±0.67  | 7.14 ±0.28 | 4.87±0.13      | 2.33 ±0.11 | 3.49 ±0.28  |
| Treatment 3<br>(75% Sorghum)  |           | 76.50±2.20   | 18.10 <sup>b</sup> ±0.83  | 7.60 ±0.25 | 5.15±0.13      | 2.24 ±0.18 | 3.60±0.26   |
| Treatment 4<br>(100% Sorghum) |           | 76.53±1.13   | 19.85 <sup>a</sup> ±0.76  | 7.07 ±0.39 | 4.77±0.04      | 2.41 ±0.31 | 3.61±0.09   |

a, b means within the same column with different superscripts are significantly different at (P<0.5).

