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Evaluation of the Nutritive Value of Sorghum Variety ICSV400 in Broiler Diets

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Abstract: An experiment was conducted to evaluate the nutritive value of sorghum variety ICSV400 as a replacement for maize in broiler diets. Five diets were formulated for both the starter and finisher phases, in which the sorghum variety ICSV400 was included at 0, 25, 50, 75 and 100% replacement levels and the diets designated as treatments T1, T2, T3, T4 and T5, respectively. Sorghum variety ICSV400 was used to replace maize as a dietary energy source. Two hundred day old Anak 2000 broiler chicks were allotted to the five treatments in a completely randomized design. Each of the five treatments was replicated four times, with ten birds per replicate. At the starter phase, birds on T1 consumed significantly ($p<0.01$) less feed (61.63 g) than birds on T5 (74.35 g), T2 (73.98 g) and T4 (71.85 g), similar to those on T3 (67.07 g). Daily weight gain (24.02-33.04 g) and feed conversion ratio (2.26-2.83) were not significantly affected by dietary treatments. The finisher and pooled phases no significant differences between treatments were observed for all the parameters analyzed. Carcass parameters were not affected by dietary treatments but small intestine weight tended to decrease with increasing level of sorghum. Feed cost in N/kg gain tended to be lower (N166.90) in diet 4 (75% sorghum) and higher (N 213.58) in diet 3 (50% sorghum). It was concluded therefore that sorghum variety ICSV400 can completely replace maize in broiler diets without adverse effects on the general performance of the birds.

Key words: Sorghum variety ICSV400, maize, broiler chicks, performance

INTRODUCTION

There is increasing competition between man and livestock for available feedstuffs for food, feed and industrial raw materials. It is common knowledge that feeds constitute the greatest and most costly input in any livestock farm, especially poultry. Livestock industry in Nigeria is dependent on conventional and non-conventional feedstuffs and feed accounts for about 60-80% of the total cost of production, out of which energy constitutes 40-60% of the broiler ration (Pond *et al*., 2006). Aremu *et al*. (2010) stated that the provisions of energy and protein in the diet account for some 90% of the diet and over 60% of the overall cost of production. The high cost of poultry feed has been traced to increasing cost of maize, soya bean and groundnut, which are the main conventional sources of energy and protein (Faniyi, 2002). Nigeria, with a population of about 158 million (PRB, 2010) and poultry population of 150 million (Abubakar, 1998), will require a substantial improvement in poultry production to meet the basic minimum dietary protein needs of its people. High cost of livestock production resulted in the high cost of livestock products which in turn resulted in the inadequacy of animal protein intake in the developing countries including Nigeria. Ani *et al*. (2009) stated that an average Nigerian consume only 10 g of animal protein (or 29% of the requirement) per day of the minimum daily intake of 35 g recommended by Food and Agriculture Organization (FAO, 1997). FAO (1990) reported that protein intake in Nigeria was 44 g/person/day out of which animal protein constituted less than 2%. Yusuf *et al*. (2009) also reported the consumption of animal protein in this country to be 4.5 g/head/day as against the minimum requirement.

Ibe (2004) reported that two of the criteria for classifying countries as developed or less developed are per capita income and per caput animal protein consumption. Furthermore, those countries classified with per capita income of US $765 or less were the poorest countries of the world. Nigeria with per caput poultry meat consumption of 2.2 kg, egg consumption of 26 g and with per capita income of less than US $300, more than qualified as one of the poorest countries in the world. Ani and Adiegwu (2005) stated that a solution to the problem is to increase the level of animal production by intensifying the production of highly reproductive animals with short generation intervals such as poultry and rabbits (Fielding, 1991; Smith, 2001). Poultry is the quickest source of meat and its production involve the least hazardous and arduous process in relation to other livestock enterprises (Obioha, 1992). Poultry meat has a wide acceptance with little or no limitations in terms of traditional and religious taboos as compared to pork (Afolabi and Oladimeji, 2003).

Availability of balance feed is very important in poultry production and the quality of each feed ingredient in a diet determines the performance of the birds (Olabode and Onyekwere, 2010). Birds can only perform

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economically well and profitably if they consume on daily basis the appropriate amount of energy, protein, vitamins and minerals (Oluyemi and Roberts, 2000). The best and major source of dietary energy for poultry production is maize, which suffer serious competition despite its limited supply. However, numerous uses of maize which include production of biofuel in some countries will definitely worsen the situation with respect to its demand. This will cause astronomical rise on its prices all over the world. Maize represents about 45-60% (Okah, 2004) of most poultry diets. Thus, any effort to substitute maize with cheaper raw materials may significantly reduce the cost of production. This will make prices of poultry products more affordable to the common man. One of the ways of achieving this is the use of sorghum to replace maize. Sorghum (*Sorghum bicolor* (L.) Moench) is cheaper than maize especially at harvest and is more available year round. Sorghum variety ICSV400 is a pure line cultivar developed at the International Crops Research Institute for Semi Arid Tropics (ICRISAT) Asia center, Patancheru, AP, India in 1981-1985 through pedigree selection (Tabo *et al*., 1999). It has less demand compared to maize and other sorghum varieties and its production is gaining popularity among farmers in the study area.

MATERIALS AND METHODS

Experimental site: The study was conducted at the poultry section of teaching and research farm, Abubakar Tafawa Balewa University, Bauchi, Bauchi State. It was carried out in the months of April and May, 2009. The state occupies a land area of about 66,000 square kilometers. Bauchi Town is located within Southern Guinea Savannah on latitude 13°30' N and longitude 11°50' E at an altitude of 690.20 meters above sea level. The climate is characterized by two well defined seasons rainy (June-October) and dry (November-May). The total mean rainfall in the state is 700-900mm for the Northern zone, 690-1031mm for Central zone and 900-1300mm for the Western zone (BSADP, 2003). The mean temperature ranges between 19.15°C and 38.50°C. The highest temperature is observed in the months of April and May, while the lowest in the months of January and December every year. Highest relative humidity of 99% is observed in August and the lowest of 57% in February (Anonymous, 1999).

Experimental design and birds management: Two hundred day-old Anak 2000 broiler chicks were used for the research. They were brooded for seven days on deep litter using a commercial feed (chick marsh from vital feed company). Heat was provided using 200 watts electric bulb and charcoal stoves. At the end of the one week period, the birds were randomly allotted to five dietary treatments and replicated four times in a completely randomized design (CRD) with ten (10) birds per replicate. Initial weights of birds in each pen were taken. Feed and water were supplied *ad libitum*. Daily records of feed intake were taken, while body weight records were taken on weekly basis. Mortality was also recorded as it occurred. Vaccination against Gumboro and Newcastle diseases were carried out using Gumboro disease vaccine (IBDV) and Newcastle disease vaccine (NDV) lasota at week 2 and 3, respectively. Antistress was given on arrival and after each weighing.

Experimental diets: Five experimental diets for both starter and finisher phases were formulated with 23 and 20% crude protein respectively. Sorghum variety ICSV400 replaced maize in the diets at 0, 25, 50, 75 and 100% inclusion levels as diets 1, 2, 3, 4 and 5 respectively. The diets were formulated using maize, sorghum variety ICSV400, full fat soyabean, fish meal, bone meal, limestone, wheat offal, vitamin-mineral premix, methionine, lysine and salt. The parameters observed during the experiments were: Initial weight (IW), feed intake (FI), feed conversion ratio (FCR), body weight gain (BWG) and final body weight (FBW).

RESULTS AND DISCUSSION

The results of the performance of the broilers fed varying levels of sorghum variety ICSV400 based diets are presented in Table 3, 4, 5, 6 and 7. At the starter phase, daily feed intake was significantly ($p<0.01$) affected. Birds on treatment 5 (100% sorghum) consumed more feed (74.35 g) while birds on treatment 1 (control) consumed the least quantity of feed (61.63 g). Birds on treatment 5 (100% sorghum) tended to gain more weight (33.04 g) during the starter phase. They were followed closely by birds on treatment 4 (75% sorghum) with 31.32 g daily weight gain. Birds on treatment 3 (50% sorghum) tended to have the lowest value (24.02 g) of weight gain. However, the weight gain in the starter phase was not significantly ($p>0.05$) different for all the five treatments. This result did not agree with the report of Ogunmodede (1980) who found that replacing maize with sorghum resulted in a decrease in weight gain as the level of sorghum increases in the diet. Feed conversion ratio in the starter phase was not significantly affected by the dietary treatments. Birds on treatment 3 (50% sorghum) tended to have the highest feed conversion ratio (2.83) while birds on treatment 5 (100% sorghum) tended to have the lowest value of feed conversion (2.26). This result is in conformity with the findings of Okoye (1998) and Sizemore and Siegel (1993) who reported significant low feed conversion ratio with higher energy starter than low energy starter diets.

All the parameters observed during the finisher phase did not show any significant difference ($p>0.05$) among the 5 dietary treatments. However birds on treatment 5 (100% sorghum) tended to have the highest feed intake

Table 1: Broiler starter diets containing graded levels of sorghum variety ICSV 400 as replacement for maize

	Levels of replacement of maize by sorghum variety ICSV400				
Ingredients	0	25	50	75	100
Maize	44.33	33.25	22.17	11.08	0.00
ICSV 400	0.00	11.08	22.16	33.25	44.33
FFSB	35.97	35.97	35.97	35.97	35.97
Wheat offal	10.50	10.50	10.50	10.50	10.50
Fish meal	5.00	5.00	5.00	5.00	5.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (kcal/kg)	3048	3033	3019	3004	2989
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
Crude fiber (%)	3.81	3.81	3.81	3.81	3.81
Ether extract (%)	8.85	8.74	8.64	8.52	8.41
Calcium (%)	1.64	1.65	1.65	1.65	1.66
Total P (%)	0.74	0.76	0.79	0.81	0.89
Lysine (%)	1.55	1.56	1.58	1.59	1.60
Methionine (%)	0.51	0.50	0.49	0.48	0.47

Table 2: Broiler finisher diets containing graded levels of sorghum variety ICSV400 as replacement for maize

	Levels of replacement of maize by sorghum variety ICSV400				
Ingredients	0	25	50	75	100
Maize	51.25	38.44	25.62	12.81	0.00
ICSV 400	0.00	12.81	25.63	38.44	51.25
FFSB	28.05	28.05	28.05	28.05	28.05
Wheat offal	13.50	13.50	13.50	13.50	13.50
Fish meal	3.00	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
ME (kcal/kg)	3023	3006	2989	2972	2955
Crude protein (%)	19.76	19.88	20.01	20.14	20.27
Crude fiber (%)	3.75	3.75	3.75	3.75	3.75
Ether extract (%)	7.71	7.32	7.58	7.46	7.20
Calcium (%)	1.50	1.50	1.51	1.51	1.55
Total P (%)	0.65	0.68	0.70	0.73	0.76
Lysine (%)	1.28	1.30	1.30	1.32	1.35
Methionine (%)	0.44	0.43	0.43	0.41	0.40

(149.01 g) while birds on treatment 2 (25% sorghum) tended to have the least feed intake (125.87 g). This result agrees with the report of Bossan (2003) who reported that birds on higher energy diets consume less feed than those on low energy treatments. Daily weight gain was not significantly affected. Birds on treatment 4 (75% sorghum) tended to have the highest weight gain (39.34 g) and birds on treatment 2 (25% sorghum) tended to have the lowest weight gain (29.20 g). This non significant effect of diets on daily weight gain agrees with the findings of Adamu *et al*. (2001) and Nwoche *et al*. (2001) who found no significant difference ($p>0.05$) in weight gain as the replacement levels of sorghum for maize in broiler diets increases. Feed conversion ratio in the finisher phase ranged from 3.50 in treatment 4 (75% sorghum) to 5.07 in treatment 5 (100% sorghum), but the results did not indicate any statistical difference among all the 5 dietary treatments. The overall result of the experiment did not show any significant difference in all the parameters studied. However birds on treatment 5 (100% sorghum) maintain their lead in daily feed intake (111.68 g) and birds on treatment 3 (50% sorghum) consumed the least feed (99.24 g) compared to the rest of the treatments. Birds on treatment 4 (75% sorghum) had the highest (35.33 g) daily weight gain and those on treatment 2 (25% sorghum) and treatment 3 (50% sorghum) had the lowest 27.09 g each. Feed conversion ratio was higher (3.80 each) in birds on treatments 2 (25% sorghum) and 3 (50% sorghum) and the lowest (2.92) was in birds on

Table 3: Performance of broilers fed graded levels of sorghum variety ICSV400 based diets at starter phase

	Levels of replacement of maize by sorghum variety ICSV400						
Parameters	0	25	50	75	100	SEM	LS
Initial weight (g)	233	243	240	231	234	-	-
Daily feed intake (g)	61.63^{b}	73.98^{a}	67.07^{ab}	71.85^{a}	74.35^{a}	1.39	**
Daily weight gain (g)	26.31	29.14	24.02	31.32	33.04	1.15	NS
Final weight gain (g)	830	950	860	1070	1120	-	-
Feed conversion ratio	2.46	2.55	2.83	2.30	2.26	0.08	NS
Mortality	1	4	5	6	1	-	

NS: Not significant **: significant at p<0.01 LS: Level of significance SEM: Standard error mean

Table 4: Performance of broilers fed graded levels of sorghum variety ICSV400 based diets at finisher phase

	Levels of replacement of maize by sorghum variety ICSV400						
Parameters	0	25	50	75	100	SEM	LS
Initial weight (g)	830	950	860	1070	1120	-	-
Daily feed intake (g)	138.06	125.87	129.54	131.19	149.01	3.31	NS
Daily weight gain (g)	30.79	29.20	30.16	39.34	29.87	1.79	NS
Final weight gain (kg)	1.48	1.63	1.51	1.78	1.75	-	-
Feed conversion ratio	4.59	4.20	4.61	3.50	5.07	0.24	N S
Mortality	3	6	5	4	8	-	-

NS: Not significant LS: Level of significance SEM: Standard error mean

Table 5: Pooled performance of broilers fed graded level of sorghum variety ICSV 400 based diets

	Levels of replacement of maize by sorghum variety ICSV400						
Parameters	0	25	50	75	100	SEM	LS
Initial weight (g)	233	243	240	231	234	-	-
Daily feed intake (g)	99.09	99.93	99.24	101.52	111.68	1.86	NS
Daily weight gain (g)	28.55	27.09	27.09	35.33	31.46	1.14	NS
Final weight gain (kg)	1.48	1.63	1.51	1.78	1.75	-	-
Feed conversion	3.55	3.80	3.80	2.92	3.56	0.13	NS
Mortality	3	10	10	10	9	-	-

NS: Not significant LS: Level of significance SEM: Standard error mean

Table 6: Carcass Yield and gut characteristics of broilers fed graded levels of sorghum variety ICSV400 based diets (% body weight)

	Levels of replacement of maize by sorghum variety ICSV400						
Parameters (g)	0	25	50	75	100	SD	LS
Live weight (kg)	1.81	1.82	1.86	1.88	2.02	0.25	NS
Plucked weight (kg)	1.68	1.71	1.76	1.76	1.83	0.23	NS
Eviscerated weight (kg)	1.42	1.45	1.47	1.54	1.59	0.19	NS
Carcass weight (kg)	1.29	1.33	1.33	1.38	1.44	0.19	NS
Dressing %	72.95	72.87	72.74	73.30	71.84	4.92	NS
Head (g)	2.88	2.86	2.78	2.69	2.86	0.28	NS
Legs (g)	4.57	4.42	4.51	4.34	4.39	0.45	NS
Abdominal fat (g)	2.10	1.73	1.75	2.26	2.02	0.58	NS
Gizzard (g)	2.26	2.45	2.15	2.11	1.89	0.41	NS
Liver (g)	2.17	2.01	1.95	2.14	2.02	0.28	NS
Kidney (g)	0.32	0.30	0.25	0.25	0.26	0.15	NS
Pancreas (g)	0.34	0.39	0.35	0.29	0.32	0.08	NS
Spleen (g)	0.13	0.11	0.11	0.10	0.13	0.05	NS
Caecum wt (g)	0.86	1.06	0.83	0.76	0.69	0.30	NS
Small intestine wt (g)	5.08	5.28	4.46	4.40	4.28	0.85	p = 0.052
Large intestine wt (g)	0.17	0.21	0.21	0.19	0.21	0.08	NS
Lungs (g)	0.55	0.50	0.49	0.48	0.54	0.09	NS
Heart (g)	0.47	0.45	0.48	0.46	0.41	0.09	NS
Small intestine (cm)	190.00	203.88	190.87	183.75	200.50	23.23	NS
Large intestine (cm)	8.13	9.63	8.00	8.00	9.75	1.86	NS
Caecum length (cm)	17.69	17.75	16.38	15.88	14.50	2.78	NS

NS: Not significant LS: Level of significance SD: Standard deviation

treatment 4 (75% sorghum). Mortality during the experiment cut across all the treatments.

The result of all the carcass parameters studied at the end of this experiment did not show any significant difference among the 5 dietary treatments, except small intestine which tended to decrease with increasing level of sorghum. Birds on treatment 2 (25% sorghum) tended to have the highest value (5.28 g) and birds on treatment 5 (100% sorghum) tended to have the lowest value (4.28 g). Parameters like live, plucked, eviscerated and carcass weights tended to increase numerically as the level of sorghum increased. This result is in

Table 7: Economics of broiler production using ICSV400 sorghum variety based diets

	Levels of replacement of maize by sorghum variety ICSV400				
Parameters	0	25	50	75	100
Total feed intake (kg)	4.86	4.90	4.86	4.98	5.47
Feed cost (N/kg)	59.41	58.93	58.45	57.98	57.49
Total feed cost (N)	288.73	288.76	284.07	288.74	314.47
Total weight gain (kg)	1.40	1.43	1.33	1.73	1.54
Feed cost/kg gain (N)	206.24	201.93	213.58	166.90	204.20

conformity with the finding of El-Zubair and Jubarah (1993) who observed a linear increase in dressing percentage and abdominal fat percentage in response to increased dietary levels of sorghum germ meal (SGM). It also agrees with the report of Yusuf (2009) who reported that broilers placed on high energy-protein ratio diet tended to have improved carcass weight than those placed on low energy-protein ratio diets.

Conclusion: From the results obtained, it was concluded that sorghum variety ICSV400 has a high feeding value as an energy source and is a viable alternative to maize in broiler diets and can completely substitute maize in the diet of broilers without any adverse effect on the performance and carcass parameters. The mortality obtained were not due to diets but due to the high environmental temperatures during the period of the research (The months of April and May).

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