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Effects of supplementing *Masakwa* creamy white sorghum with selected synthetic enzymes on the performance and cost benefit of broiler chickens

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Abstract

An experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Abubakar Tafawa Balewa University Bauchi to investigate the growth performance and cost benefit of broiler chickens fed Masakwa creamy white sorghum supplemented with three selected synthetic enzymes: Natuzyme, Maxigrain and Phytase. Five experimental diets were formula ted for the broiler chickens at both the starter (23% CP) and finisher (20% CP) phases labeled as Diets 1: maize control, Diet 2: sorghum without enzyme, Diet 3: sorghum supplemented with Natuzyme, Diet 4: sorghum supplemented with Maxigrain and Diet 5: sorghum supplemented with Phytase. Three hundred (300) broiler unsexed "Marshal" chicks were randomly allotted to the dietary treatments with four replications each and 15 birds per replicate in a completely randomized design. Feed and water were supplied ad libitum throughout the experimental period of eight weeks. Results showed that at the starter phase, daily feed intake (49.23-60.26g), daily weight gain (23.11-32.28g) and feed conversion ratio(1.87-2.13g); at the finisher (101.11-146.29g; 30.01-69.07g and 2.12-3.37), and the overall phases (75.17-103.22g; 26.57-50.68g and 2.00-2.75) were significantly (P<0.05) different across the treatments. The best performance was obtained on maize diet closely followed by enzyme supplemented sorghum based diets, while the least was observed in unsupplemented sorghum diet. Based on the cost benefit analysis, Diet 1 (maize based diet) had the cheapest feed cost while the highest value was on Diet 2 (unsupplemented sorghum diet) for all the phases. It can therefore be concluded that Masakwa sorghum supplemented with different enzymes can be used in broiler chicken diets for better performance in comparism with the unsupplemented sorghum diet. It is economical to supplement Masakwa sorghum variety with any of the synthetic enzyme because the feed cost ₦/kg gain is lower than the values on unsupplemented sorghum diet.

Keywords: Broiler chickens, Masakwa sorghum, Synthetic enzymes, Tannin,

INTRODUCTION

Livestock especially poultry production seem to be recognized as the fastest industry which can overcome the animal protein deficiency especially in third world countries due to the short generation interval, high turnover rate and economic efficiency (Inuwa *et al*., 2020). Generally, broiler production is known to be capital demanding due to high cost of conventional feed ingredient especially the energy and protein sources **(**Tuleun *et al*., 2005). Poultry industry has been unable to tackle its numerous challenges in which high cost of feed is the most paramount challenge the industry is currently facing (Gbenga, 2021). The high cost of feed has been attributed to high cost of poultry products which affected the quality and

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quantity of animal protein intake of Nigerians. Gbenga (2021) further reported that the high cost and shortage of maize has forced many farmers out from the poultry business. However, the country has struggled over the years to encourage local production of maize as a means of solving these challenges but to no avail. One important measure that can be taken to alleviate this situation is the use of alternative energy sources such as sorghum (Medugu *et al*., 2010). Sorghum varieties in Nigeria have been reported to contain tannin in a range of 0.012 to 0.215%. In poultry, tannins are known to reduce feed intake, feed efficiency, growth rate, egg production, protein utilization and damaged the mucosal lining of digestive tract; reduce palatability and digestibility which had adverse effects on metabolism and toxicity of livestock (Hancock, 2000).

A number of feed additives such as antibiotics, vitamins, minerals, probiotics and other growth promoters are being used to improve animal performance especially broiler chicken **(**Ndelekwute *et al*., 2015). Enzymes have been approved for use in poultry feed because they are natural products and pose no threat to the animal or consumers (Marte *et al*., 2021). The use of non sulphur polysaccharide degrading enzymes in animal feed industries is basically to improve the efficiency of feed utilization, increase the rate of growth, and enhance the health conditions and functions of the gastrointestinal tracts of animals as well as to reduce environmental pollution by decreasing output of dropping (Oyeagu *et al*., 2015). Non sulphur polysaccharide enzymes are also used to break the anti-nutritional factors like phytate molecules that bind phosphorus and some other mineral elements in sorghum grains and other feedstuff. The study therefore was aimed at investigating the effects of supplementing *Masakwa* creamy white sorghum with different synthetic enzymes on the performance and cost benefit of broiler chickens.

MATERIALS AND METHODS

Study area

The experiments were conducted between October and December, 2022 at the Poultry Unit of the Teaching and Research Farm, Abubakar Tafawa Balewa University, Bauchi, Nigeria. The climate is characterized by two well defined rainy season (June – October) and dry season (November – May). The mean rainfall is 700 – 900mm for the Northern zone, 690 - 1031mm for Central zone and 900 – 1300mm for the Western zone**.** The mean temperature ranges between 19.15^0C and 40^0C. The highest temperature is usually from March to May, while the lowest from January to December (BSADP, 2003).

Feeding Trial

Three hundred (300) day old 'Marshal' broiler chicks of mixed sexes purchased from Plateau State were randomly allotted to five experimental diets that were replicated four times in a completely randomized design of fifteen birds per replicate. Feed and water were provided *ad libitum* throughout the experimental period. Five experimental diets for both starter (23% CP) and finisher (20% CP) phases were formulated in which Diet 1 (maize) which serve as control and Diet 2 was without enzyme while Diets 3, 4 and 5 were supplemented with Natuzyme (0.035%), Maxigrain (0.010%) and Phytase (0.035%) enzymes respectively, using soya bean meal as plant protein source.

Data Collection

Daily records of feed intake were taken while body weights were measured on weekly basis. Routine managements such as vaccinations and medications were carried out as at when due. Data obtained on daily feed intake (DFI) and daily weight gain (DWG) were used to determine

the feed conversion ratio (FCR). Body weight, feed consumption and feed conversion ratio were measured as the performance indices and cost per kilogram of feed and feed cost per kilogram weight gain were calculated to show the financial benefit of supplementing *Masakwa* creamy white sorghum variety in broiler chicken diets.

Data Analysis

Data collected were subjected to analysis of variance techniques as outlined by Steel and Torrie (1980) using the statistical Software of Minitab, 17.3.1., (Minitab, 2014). Differences between treatment means were separated using Duncan's Multiple Range Test, DMRT, (Duncan, 1955).

RESULTS AND DISCUSSION

The percentage compositions of the experimental diets for broiler starter and finisher are shown in Table 1.

Table 1: Percentage composition of Masakwa white creamy sorghum based diets supplemented with selected synthetic enzymes based on weeks

	Diets									
Ingredients	Maize (control)	Maize (control)	Sorghum (No enzyme)	Sorghum (No enzyme)	Sorghum (Natuzyme)	Sorghum (Natuzyme)	Sorghum (Maxigrain)	Sorghum (Maxigrain)	Sorghum (Phytase)	Sorghum (Phytase)
	1-4 weeks	5-8 weeks	1-4 weeks	5-8 weeks	1-4 weeks	5-8 weeks	1-4 weeks	5-8 weeks	1-4 weeks	5-8 weeks
Maize	48.94	52.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sorghum	0.00	0.00	51.82	53.69	51.82	53.69	51.82	53.69	51.82	53.69
SBM	30.86	24.60	27.98	23.11	27.98	23.11	27.98	23.11	27.98	23.11
Wheat offal	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00	10.00	15.00
Fish meal	5.00	3.00	5.00	3.00	5.00	3.00	5.00	3.00	5.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
+ Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100	100	100	100	100
Calculated Analysis										
ME (Kcal/kg)	2950	2950	2900	2900	2900	2900	2900	2900	2900	2900
Crude protein (%)	23.14	20.00	23.11	20.40	23.11	20.40	23.11	20.40	23.11	20.40
Crude fiber (%)	4.33	4.50	5.27	5.50	5.27	5.50	5.27	5.50	5.27	5.50
Ether extract (%)	4.05	3.93	3.51	3.40	3.51	3.40	3.51	3.40	3.51	3.40
Calcium (%)	1.52	1.36	1.54	1.37	1.54	1.37	1.54	1.37	1.54	1.37
Phosphorus (%)	0.60	0.48	0.61	0.51	0.61	0.51	0.61	0.51	0.61	0.51
Methionine (%)	0.33	0.30	0.32	0.29	0.32	0.29	0.32	0.29	0.32	0.29
Lysine (%)	0.96	1.02	0.89	0.98	0.89	0.98	0.89	0.98	0.89	0.98

+*A bio-organics nutrient supplement containing Vit. A; 4000000 i.u, Vit. D3; 800000 i.u, Vit. E; 9200mg; Niacin 11000mg; Vit. B2 2000mg; Vit B6; 1200mg; Vit B12 6mg; Vit. K3 800mg; Pantothenic acid 3000mg; Bipotin 24mg; Folic acid 300mg; Choline*
hloride 120000mg; Cobalt 80mg; Copper 1200mg; Iodine 400mg; Iron 8000mg; Manganese 16000mg; Selenium 80mg; Zinc 12000mg; Anti-oxidant 500mg. ME= Metabolizable energy, SBM= Soya Bean Meal

The crude protein and metabolizable energy are adequate for raising broiler chickens in the tropics (Oluyemi and Roberts, 2013).The productive performance of broiler chickens fed *Masakwa* creamy white sorghum variety supplemented with selected synthetic enzymes are

presented in Table 3. The results revealed that broiler chickens fed maize based diet had the highest (P<0.001) performance followed by enzyme supplemented sorghum diets whereas unsupplemented sorghum diet had the lowest body weight.

Table 2: Performance of broiler chickens fed *Masakwa* creamy white sorghum supplemented with selected synthetic enzymes

	Diets					
Parameters	**Maize**	**Sorghum no enzyme**	**Sorghum + natuzyme**	**Sorghum +maxigrain**	**Sorghum + phytase**	**SEM**
Productive performance						
Initial weight (g)	129.44	129.29	129.38	129.40	129.41	0.49^{NS}
Body weight at 4 wks (g)	1033.21^{a}	776.71^{c}	850.20^{b}	867.40^{b}	888.4^{b}	21.88^{***}
Final weight (g)	2967.20^{a}	1617.1^{d}	2021.01^{c}	2110.21^{bc}	2159.3^{b}	32.52^{***}
Starter phase (1-4 weeks)						
Daily feed intake (g)	60.26^{a}	49.23^{c}	52.39^{bc}	54.82^{b}	54.99^{b}	1.71^{***}
Daily weight gain (g)	32.28^{a}	23.11^{c}	25.74^{b}	26.36^{b}	27.11^{b}	0.69^{***}
Feed conversion ratio	1.87^{a}	2.13^{b}	2.05^{a}	2.08^{ab}	2.03^{a}	0.02^{***}
Mortality (Number)	0	1	0	1	0	___
Finisher phase (1-4 weeks)						
Daily feed intake (g)	146.29^{a}	101.11^{d}	124.36^{c}	127.49^{c}	132.33^{b}	1.48^{***}
Daily weight gain (g)	69.07^{a}	30.01^{c}	41.81^{b}	44.02^{b}	45.06^{b}	1.34^{***}
Feed conversion ratio	2.12^{a}	3.37^{c}	2.97^{b}	2.90^{b}	2.94^{b}	0.04^{***}
Mortality (Number)	0	0	0	0	0	___
Overall phase (1-8 weeks)						
Daily feed intake (g)	103.22^{a}	75.17^{d}	88.53^{c}	91.16^{bc}	93.66^{b}	1.41^{***}
Daily weight gain (g)	50.68^{a}	26.57^{c}	33.41^{b}	35.19^{b}	36.11^{b}	1.04^{***}
Feed conversion ratio	2.00^{a}	2.75^{c}	2.51^{ab}	2.49^{b}	2.49^{b}	0.09^{***}
Mortality (Number)	0	1	0	1	0	___

^{abc} Means bearing different superscripts within the same row differ ** = (P<0.01),*** = (P< 0.001), NS= Not significant; SEM= Standard error of the means

At the starter phase, daily feed intake (49.23- 60.26g), daily weight gain (23.11- 32.28g) and feed conversion ratio (1.87- 2.13) were all significantly affected by the dietary treatments (P<0.05). The control (diet 1) recorded superior performance in all the parameters measured closely followed by all the enzyme supplemented diets. While the unsupplemented diet recorded poor performance for the parameters measured. At the finisher phase, daily feed intake (101.11 – 146.29g), daily weight gain (30.01- 69.07g) and feed conversion ratio (2.12 – 3.37) showed significant difference (P<0.05) across the treatment groups. The overall phase followed the same pattern, daily feed intake (75.17 – 103.22g), daily weight gain (26.57 – 50.68g) and feed conversion ratio (2.00- 2.75). This result is in conformity with the findings of Ranade *et al*. (1992) that exogenous enzymes added to broiler chicken diets allow the supplementation of endogenous enzyme production, thus improves the assimilation of nutrients by the birds. This result was collaborated by Kwari *et al*. (2012) and Ibe (2014) that birds fed sorghum based diet perform poorly due to anti-nutritional factors such as tannin, phytic acid and oxalate which affected digestibility of nutrients and hampered nutrient assimilation, thereby resulting in poor performance of the birds. Similarly, Daramola *et al*. (2021) reported that poorly digestible protein present in sorghum decreases feed intake and body weight gain when four varieties of sorghum supplemented with maxigrain enzyme was fed to broiler chickens. The result also agrees with that of Amao (2018) and Oliaei *et al.* (2016) that supplementing sorghum based diets with Natuzyme improved broiler chickens weight. The low feed intake in birds fed unsupplemented sorghum based diet collaborate the result of Ibe (2014) that creamy sorghum based diet recorded low intake by birds as a result of high

oxalate present in the grains which affect feed intake and utilization of nutrients. The oxalate form complexes with minerals particularly calcium, thereby making them unavailable to the body and causes irritation of the gut. This then resulted in lower feed intake due to inhibition of protein and energy lowering utilization in broiler chickens. Metwally *et al*. (2020) reported significant ($P < 0.05$) body weight and weight gain when broilers were fed diets containing 0, 250 and 500 µg / kg feed supplemented with optizyme which is a multi enzymes. The higher final weight and consequently average daily weight gain (g/day) observed in birds fed diets supplemented with different enzymes in comparism with the unsupplemented diet agrees with findings of Onimisi *et al*. (2016) who observed similar trend when pullets were fed sorghum based diets supplemented with different enzymes.

The significant difference observed in the final weight gain disagrees with the findings of Fasiullah *et al*. (2010) who observed that final weight was not affected by exogenous enzyme supplementation to broiler diets. This he attributed to the difference in dietary ingredients among various studies with a large diversity and concentration of chemical characteristics existing among plant based feed ingredients, as well as interactions among constituents within feed ingredients and diets. Similarly, the results was not in line with the findings of Taheri and Shirzadega (2017) who reported no significant changes in feed intake and final weight gain of broiler chickens fed Natuzyme supplemented diets. The reduction in feed to gain ratio due to enzyme supplementation agreed with the findings of Onimisi *et al*. (2016) who reported that exogenous enzyme greatly improved the feed conversion abilities of broiler chicks and growing pullets fed sorghum based diet supplemented with different enzymes. The reduced feed conversion ratio observed in enzyme supplemented diets also agreed with the earlier findings of Onu *et al*. (2011) who observed that exogenous enzymes greatly improve the feed conversion abilities of broiler chicks fed enzyme supplemented diets. Alabi *et al*. (2017) reported that higher weight gains of broiler chickens fed wheat bran based diets supplemented with Natuzyme and Maxigrain enzymes. Similarly, Ahmadi (2016) and Chotinsky (2015) reported that adding enzymes to broiler diets improved feed conversion ratio values.

The financial benefit of broiler chicken fed *Masakwa* creamy white sorghum supplemented with selected synthetic enzymes is presented in Table 3. Results revealed that higher feed costs were recorded in the supplemented diet, while the lowest feed cost was observed on the unsupplemented diet.

Table 3: Cost benefit of broiler chickens fed *Masakwa* creamy white sorghum supplemented with selected synthetic enzymes

Parameters	Diets				
	Maize control	Sorghum no enzyme	Sorghum + natuzyme	Sorghum +maxigrain	Sorghum + phytase
Starter phase:					
Total feed intake (kg)	1.69	1.38	1.47	1.53	1.54
Feed cost (₦/kg)	256.05	255.66	256.97	256.32	256.32
Total feed cost (₦)	432.72	352.81	377.75	392.17	394.73
Total weight gain	0.90	0.65	0.72	0.74	0.76
Feed cost ₦/kg gain	480.08	542.78	542.65	529.96	519.38
Finisher phase:					
Total feed intake (kg)	4.10	2.83	3.48	3.57	3.71
Feed cost (₦/kg)	243.71	243.84	244.83	244.33	244.33
Total feed cost (₦)	999.21	690.07	852.01	872.26	906.46
Total weight gain	1.93	0.84	1.17	1.23	1.26
Feed cost ₦/kg gain	517.73	821.51	728.21	709.15	719.41
Overall phase:					
Total feed intake (kg)	5.79	4.21	4.95	5.10	5.25
Feed cost (₦/kg)	249.88	249.75	250.90	250.33	250.33
Total feed cost (₦)	1431.93	1042.88	1229.76	1264.43	1301.19
Total weight gain	2.84	1.49	1.87	1.97	2.02
Feed cost ₦/kg gain	504.20	699.90	657.63	641.84	644.79

This was due to the additional cost of enzymes used. The cost ₦/ kilogram gain was higher on the unsupplemented diet, while the least was recorded on the maize control diet. The enzyme supplemented diet all recorded lower values as compared to the unsupplemented diet. This result is in agreement with the findings of Widyaratne *et al*. (2011) that birds fed sorghum base diets had poor feed conversion ratio, weight gain and depressed feed intake as a result of poor digestibility of protein which resulted in poor weight gain and also affected the feed cost.

The feed cost ₦/kg gain was lower on the control diet than other treatment diets. Similarly, the enzyme supplemented diets all recorded lower feed cost ₦/kg gain than the unsupplemented diet. The higher values recorded in the supplemented diets is in line with the report of Lawan *et al*. (2022) that enzyme supplementation results in higher cost ₦/kg gain when soya bean residue was supplemented with Kingzyme on broiler performance. The findings is also in agreement with the report of Ibe (2014) that the cost/kg gains were higher for birds fed sorghum based diet compared to birds fed maize diet. But the report disagreed with the findings of Medugu *et al*. (2010) that higher cost per kg gain was recorded on maize based diet compared to millet and low tannin sorghum based diets.

CONCLUSION

It was observed from the study that Masakwa (creamy white) sorghum variety when supplemented with different synthetic enzymes improved growth performance with concomitant reduction in cost of raising broiler chickens in comparism with the unsupplemented sorghum diet. Also, further studies should be conducted on other poultry species such as cockerels, layers, guinea fowl, turkeys and quails to ascertain its suitability in poultry birds.

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