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**Performance Characteristics of Turkeys Fed Full-Fat Soybean or Soybean Meal Based Diets
Supplemented with Varying Levels of Protease Enzyme and Related Feed Costs**

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Abstract

Full-fat soybean and soybean meal are two major products of soybean processing used in livestock feed formulation. Enzyme-mediated improvement of feed digestibility has a direct effect on the amount of feedstuffs needed to satisfy nutritional requirements of animals, reduce manure output and cost of production. This study sought to evaluate the performance characteristics and cost benefits of turkeys fed either full-fat soybean (FFSB) or soybean meal (SBM) based diets supplemented with a commercial protease enzyme at varying levels. A total of 300 fifty-six day old unsexed British United turkeys were used in this study, they were allotted on weight equalization basis to 6 treatment groups, 5 replicates of 10 birds each. Two practical diets were formulated according to NRC, 1994 using FFSB or SBM and other conventional feedstuffs to meet the requirements for each phase; protease was supplemented at 3 levels (250 ppm, 500 ppm and 750 ppm). Feed and water were offered ad-libitum during the 56 days feeding trial divided into grower (56-84 days) and finisher (84-112 days) phases. Data analysis was done using ANOVA in a Completely Randomized Design. At the grower phase, feed cost per kg weight gain (N474.43) of birds fed SBM diets was lower than those fed FFSB diets (N497.26), while the reverse was the case at the finisher phase; SBM (N584.44) and FFSB (N517.26). Feed cost per kg diet increased ($p < 0.05$) with enzyme supplementation at both phases. At the grower phase, there was no significant difference between the cost per kg diet of FFSB or SBM while at the finisher phase, SBM diets were more expensive ($p < 0.05$). Birds fed SBM diets had higher daily weight gain (122.65g) and better FCR (3.14) than those fed FFSB (116.57g: 3.30) at the grower phase. At the finisher phase, turkeys fed FFSB based diets had higher daily weight gain and better FCR (125.07g: 3.53) compared with those fed SBM based diets (119.52g: 3.91). No significant difference ($p > 0.05$) was observed as a result of varying levels of enzyme supplementation on performance indices. It was concluded that SBM based diets were better for growing turkeys, while FFSB based diets were better for turkeys at the finisher phase as it reduced the feed cost per kg diet and increased the weight gain.

Keywords: Full-fat soybean, protease enzyme, soybean meal, supplementation, turkeys

Introduction

Soya bean (*Glycine max*) is an economic crop used for both human and animal feeding (Yin *et al.*, 2011). It is a leguminous oilseed and one of the world's largest and most efficient sources of plant protein used in compounding animal feed. According to Saha *et al.*, (2008) the chemical composition of soybean and most of its derived products are characterized by high protein content that ranges from 33 to 43%. The need to maximize the available soya bean for livestock feeding with minimal negative impact on the environment such as deforestation, destruction of biodiversity and pollution, therefore arises with increased public concerns regarding the environmental impact of animal agriculture has increased the need to reduce nutrients in the waste generated by food animal production (Angel *et al.*, 2011). Enzyme-mediated improvement of feed digestibility has a direct effect on the amount of feedstuffs needed to satisfy nutritional requirements of animals, reduce manure output and cost of production as feed costs account for between 65 – 75% of the total cost of monogastric animal production (Péron and Partridge, 2009). This study therefore aims to comparatively evaluate the performance characteristics and feed cost benefits of turkeys fed either full-fat soybean (FFSB) or soybean meal (SBM) based diets supplemented with a commercial protease enzyme at varying levels.

Materials and Methods

The experiment was conducted at the Turkey Unit, Teaching and Research Farm, Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria, West Africa

Experimental birds and management

A total of 300 one-day old unsexed British United turkeys were purchased from a reputable hatchery in Ibadan, South-West Nigeria. They were brooded together and allotted on weight equalization basis on day 55 prior to the commencement of the feeding trial on day 56 into six treatment groups. Two practical diets were formulated according to NRC, (1994) using FFSB or SBM and other conventional feedstuffs to meet the requirements for each phase (Table 1); a commercially available protease enzyme was supplemented at 3 levels of 250g, 500g or 750g/Ton. Feed and water were offered *ad-libitum* during the 56 day's feeding trial divided into grower (56-84 days) and finisher (84-112 days) phases.

Data collection and statistical analysis

Performance indices collected included initial weight, final weight, daily weight gain, feed intake, feed conversion ratio and percentage mortality, while feed cost was calculated. Data obtained was laid out in a 2 x 3 factorial arrangement and subjected to Analysis of Variance using SAS (2000) to determine the

main and interaction effects, significant means were separated using Duncan's Multiple Range Test (1955). The level of probability was expressed at 5 % confidence limit.

Results and Discussion

The performance and cost of benefits of growing turkeys fed either soya bean meal or full-fat soya bean supplemented with varying levels protease enzyme is as shown on Table 2. It indicated that birds fed SBM based diets had higher daily weight gain (122.65g) and better FCR (3.14) than those fed FFSB based diets (116.57g: 3.30) even though daily feed intake was not significantly influenced by the plant protein source. It also showed that, feed cost per Kg weight gain (₦ 474.43) of birds fed SBM based diets was lower compared with those fed FFSB diets (₦497.26). This is an indication that growing turkeys were better able to utilize SBM for growth than FFSB at a lower cost of production. This may be due to the higher protein requirement than energy for growth during this phase and the level of development of the gastro intestinal tract. At the finisher phase (Table 3), turkeys fed FFSB based diets had higher daily weight gain (125.07g) and better FCR (3.53) compared with those fed SBM based diets (119.52g: 3.91). This reverse order may be attributed to the fact that finisher turkeys require higher Metabolisable energy and lower percentage crude protein than growing turkeys: a requirement full-fat soya bean can better meet when compared to soya bean meal due to its higher metabolisable energy (3300kcal) and lower percentage crude protein (37%) than soya bean meal does (2420kcal:44 %). The feed cost per Kg weight gain was significantly higher for SBM diets (₦ 584.44) than for FFSB (₦517.26), which led to an increase in the feed cost benefit of rearing finisher turkeys with full-fat based diets. No significant difference ($p > 0.05$) was observed as a result of varying levels of enzyme supplementation on all performance indices measured during both phases of growth.

Conclusion

It was concluded that soya bean meal based diet was better for growing turkeys, while Full-fat soya bean based diet was better for turkeys at the finisher phase as it reduced the feed cost per kg diet and increased the weight gain. No significant difference in all performance indices measured could be appropriated to the varying inclusion levels of protease enzyme in the diets of turkeys fed either SBM or FFSB. This gives credence to the fact that the manufacturer's recommended level (500g/ton) is ideal.

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Table 1: Gross composition (g/kg) of experimental diets

	56 – 84 days		84 – 112 days	
	SBM	FFSB	SBM	FFSB
Ingredients				
Maize	555.00	485.00	610.00	571.00
Soya bean meal	260.00	-	209.00	-
Full-fat soya	-	274.00	-	250.00
Fish Meal	65.00	65.00	40.00	40.00
Palm oil	17.00	-	20.00	-
Wheat offal	50.00	123.00	70.00	88.00
Limestone	15.00	15.00	15.00	15.00
Bone Meal	27.00	27.00	27.00	27.00
Lysine	1.50	1.50	1.00	1.00
Methionine	2.00	2.00	0.50	0.50
*Vit/Min Premix	5.00	5.00	5.00	5.00
Common salt	2.50	2.50	2.50	2.50
Total	1000.00	1000.00	1000.00	1000.00
Calculated analyses				
Metabolisable energy (Kcal/Kg)	2952.92	2983.6	30007.76	3172.03
Crude protein (%)	21.90	21.5	18.71	18.69
Calcium (%)	2.38	1.82	1.86	1.86
Phosphorus (%)	0.90	0.89	0.85	0.85
Lysine (%)	1.27	1.25	1.04	1.04
Methionine (%)	0.62	0.62	0.41	0.41

*Turkey premix composition 5g per Kg diet: vit A: 12000IU, vit D₃: 2400IU, vit E: 25.0 mg, vit K₃: 3.5mg, vit B₁: 2.0mg, vit B₂: 8mg, vit B₆: 4mg, vit B₁₂: 0.015mg, Niacin: 60mg, Pantothenic acid: 15mg, Folic acid: 1500mg, Biotin: 150mg, , Iron: 4mg, Manganese: 90mg, Zinc: 70mg, Copper: 80mg, Cobalt: 80mg, Iodine: 0.15mg, Selenium: 0.2mg, Choline: 300mg.

Table 2: Effects of soya sources and protease enzyme inclusion levels on the performance and related feed cost of growing turkeys (56 - 84days)

Soya source	Protease inclusion (ppm)	Measurements								
		Initial weight (g)	Final weight (g)	Total weight gain (g)	Daily Weight gain (g)	Daily feed intake (g)	FCR	Mortality (%)	Feed cost/Kg diet	Feed cost/Kg weight gain
Main effects										
FFSB		3512.00	6776.00	3264.00	116.57	383.81	3.30	0.00	150.89	497.26
SBM		3505.93	6940.00	3434.07	122.65	378.69	3.14	0.00	150.85	474.43
	250	3525.90	6843.00	3319.00	118.47	382.94	3.26	0.00	149.62 ^c	487.06
	500	3510.00	6829.00	3319.00	118.52	371.43	3.14	0.00	150.87 ^b	472.58
	750	3491.00	6902.00	3411.00	121.82	388.61	3.27	0.00	152.12 ^a	496.89
Interaction										
FFSB	250	3598.00	6770.00	3172.00	113.29	389.21	3.45	0.00	149.60 ^c	515.63
FFSB	500	3556.00	6780.00	3224.00	115.14	367.07	3.19	0.00	150.90 ^b	480.82
FFSB	750	338.00	6778.00	3396.00	121.29	393.64	3.26	0.00	152.10 ^a	495.34
SBM	250	3453.80	6916.00	3462.20	123.65	376.71	3.06	0.00	149.60 ^c	458.50
SBM	500	3464.00	6878.00	3414.00	121.93	375.79	3.09	0.00	150.90 ^b	466.35
SBM	750	3600.00	7026.00	3426.00	122.36	383.57	3.28	0.00	152.10 ^a	498.45
SEM										
Soya source		46.41	101.08	93.70	3.35	6.94	0.09	0.00	0.27	13.04
Protease		56.71	116.25	87.78	4.31	8.12	0.11	0.00	0.00	16.19
Source x protease		32.34	75.73	73.42	2.62	4.89	0.06	0.00	0.19	9.69

SEM standard error of mean, FFSB full-fat soya bean, SBM soya bean mean

^{abc} Means along the same column with different superscripts are significantly different (P < 0.05)

Table 3: Effects of soya sources and protease enzyme inclusion levels on the performance and related feed cost of finisher turkeys (84 – 112 days)

Soya source	Protease inclusion (ppm)	Measurements								
		Initial weight (g)	Final weight (g)	Total weight gain (g)	Daily Weight gain (g)	Daily feed intake (g)	FCR	Mortality (%)	Feed cost/Kg diet	Feed cost/Kg weight gain
Main effects										
FFSB		6776.00	10278.00	3502.00	125.07	429.71	3.53	0.02	146.60 ^b	517.26
SBM		6940.00	10286.67	3346.67	119.52	451.69	3.91	0.13	149.46 ^a	517.26
	250	6843.00	10008.00	3165.00	113.04	414.50	3.79	0.10	146.78 ^c	556/31
	500	6829.00	10557.00	3718.00	113.14	461.21	3.53	0.20	148.03 ^b	532.34
	750	6902.00	10282.00	3380.00	120.71	446.39	3.84	0.20	149.28 ^a	572.89
Interaction										
FFSB	250	6770.00	10080.00	3310.00	118.21	404.50	3.49	0.20	145.35 ^f	507.78
FFSB	500	6780.39	10838.00	4058.00	144.93	476.93	3.44	0.40	146.60 ^e	490.07
FFSB	750	6778.00	9916.00	3138.00	112.26	407.71	3.75	0.00	147.85 ^d	553.92
SBM	250	6916.00	9936.00	3020.00	107.86	424.50	4.08	0.00	148.21 ^c	604.85
SBM	500	6878.00	10276.00	3398.00	121.36	445.50	3.72	0.00	149.46 ^b	556.60
SBM	750	7026.00	10648.00	3622.00	129.36	485.07	3.39	0.40	150.71 ^a	591.86
SEM										
Soya source		101.08	233.27	224.99	7.74	18.77	0.16	0.12	0.27	23.10
Protease		116.25	270.25	266.98	9.54	22.03	0.20	0.14	0.48	30.19
Source x protease		75.73	162.58	157.11	5.61	13.21	0.11	0.00	0.31	17.27

SEM standard error of mean, FFSB full-fat soya bean, SBM soya bean mean

^{abc} Means along the same column with different superscripts are significantly different (P < 0.05)