

## Effect of beniseed hulls treated with and without the maxigrain® enzyme on the production and quality of eggs of Black Nera laying hens

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### Abstract

The aim of this research was to study the effect of beniseed hulls treated with and without the Maxigrain® enzyme on the production and quality of eggs of Black Nera laying hens. The study involved nine diets with approximately 16% protein were formulated, including: CONT: soybean meal-based basal diet, WBSH15: 15% beniseed hull without enzyme, BSH15: 15% beniseed hull with enzyme, WBSH30: 30% beniseed hull without enzyme, BSH30: 30% beniseed hull with enzyme, WBSH45: 45% beniseed hull without enzyme, BSH45: 45% beniseed hull with enzyme, WBSH60: 60% beniseed hull without enzyme, BSH60: 60% beniseed hull with enzyme. The addition of Maxigrain was at a level 0.01%. A total of 189 Black Nera hens were used in this experiment, divided into 9 groups with 21 hens each replicated 7 times in a completely randomized design. They were fed for 12 weeks. The results showed that hens fed BSH60 ( $P < 0.05$ ) had higher change of body weight, while those fed WBSH45, WBSH60, and BSH60 diets ( $P < 0.05$ ) had higher feed intake. The control diet, BSH15, and BSH30 groups ( $P < 0.05$ ) had better egg production metrics, while WBSH 60 and BSH60 showed improvements in various egg quality parameters. Overall, it was recommended to use BSH15-30 diets for Black Nera hens for optimal egg quality production.

**Keywords:** Laying hens, Beniseed hulls, Maxigrain, egg production, egg quality.

### Description of Problem

Large amounts of maize and soybeans are required to produce poultry feed. In Nigeria, the challenge of high price and scarcity of maize and soybeans limits the production of suitable feed for large-scale poultry farming. As a result, the poultry industry is paralyzed and cannot meet the demand for eggs and chicken meat of the

large population. Despite efforts by several governments to increase maize and soybean production, demand continues to outstrip supply. To save the poultry industry, the opportunity to look for alternative feed must be created. Feed alone accounts for approximately 75% of production costs [1]. Agricultural by-products have been used as replacement for traditional feed ingredients

to reduce feed costs [2] and improve egg and meat production. Many of them are not fully exploited and are not used for human consumption in any way. If used correctly, it will free competition between humans and animals. Beniseed is an oilseed crop containing about 50% oil, 22-27% protein and 4-8% crude fiber [3, 4] and is mainly used to produce oils for the food industry. Farrah [5] found that although beniseed by-products are cheap food resources, but they mostly end up as waste in landfills. The production of beniseed oil produces a cake-like byproduct that is high in protein [6]. This cake-like residue is often used in poultry feed because it contains about 42% crude protein [7] but this proportion is lower due to anti-nutritional factors such as phytic acid and oxalates [3, 4], which limit calcium utilization [8]. Farrah [5] recommended using only 8% of beniseed in broiler feed; and 14% in the diet of laying hens. Kamel [2] recommended a 12% subsidy for roasted beniseed hulls in poultry production. Not only beniseed residues have problems with nutritional factors, but also many other by-products have nutritional inhibitory factors that could be exploited by exogenous enzymes [9]. Olajide [6] used maxi-grain-enriched beniseed hulls as a substitute for maize reported negative effects on percent daily egg production (% HDEP), egg weight and feed conversion ratio. The aim of this

study was to determine the effect of beniseed hulls treated with and without the Maxigrain® enzyme on the production and quality of eggs of Black Nera laying hens.

## Materials and Methods

### Study area

The study was conducted at the Teaching and Research Farms of Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria. Ikeji-Arakeji lies in the rainforest zone of Nigeria, which extends 70 151, North and 50 121East. The Climatic conditions followed those of the southwestern part of Nigeria, where the climate is generally influenced by the southwestern monsoon winds bringing rain from the Atlantic and the dry northwestern winds from the Sahara. The rainy season lasted about seven months (April to October). Rainfall is usually around 1524 mm per year. The air temperature is usually 28 to 31oC and the average annual relative humidity is usually around 80% [10].

### Source of experimental ingredients

Beniseed hulls were purchased from Ibadan, Oyo State, Nigeria and tested for general analysis. Crude analysis of beniseed hulls was done at Animal Care Konsult Research Laboratory, Ibadan, Ogun State, Nigeria. The proximate composition of the beniseed hulls is shown in Table 1.

**Table 1:** Proximate composition (g/100g) and energy values of beniseed hull

Parameter	%
Moisture	10.55
Total Ash	10.74
Crude protein	35.11
Ether extract	17.01
Crude fibre	12.68
Nitrogen free extract	13.91
Metabolizable energy (Kcal/kg)	3185.41

\*Energy = (Crude protein x 37 + Ether extract x 81.8 + Nitrogen free extract x 35.58) [11].

### **Feed formulation**

Nine diets with approximately 16% protein were formulated according to National Research Council [12] specifications for laying hens, which included the following: CONT: soybean meal-based basal diet, WBSH15: 15% beniseed hull without enzyme, BSH15: 15% beniseed hull with enzyme, WBSH30: 30% beniseed hull without enzyme, BSH30: 30% beniseed hull with enzyme, WBSH45: 45% beniseed hull without enzyme, BSH45: 45% beniseed hull with enzyme, WBSH60: 60% beniseed hull without enzyme, BSH60: 60% beniseed hull with enzyme. Maxigrain was added to Beniseed hulls at a level of 0.01% as adopted by Olajide [6] and Daramola [13]. The gross composition of the diets is shown in Table 2.

### **Source of experimental hens and experimental design**

A total of one hundred eighty nine (189) 18 weeks old Black Nera laying hens were purchased from Emmaflo Farm, Ibadan, Oyo State, Nigeria. They were divided into 9 groups of 21 hens each, and each group was divided into seven replicates of three hens reared in three-layers California-type colony cages (43 × 41 cm) and each cage unit represented one replicate. The design used was a completely randomized design (CRD).

### **Feeding and management**

The house has open metal mesh sides. Feeding troughs and nipples were placed in the cages.

Feed in mash form was provided daily in the morning (8:00 a.m.) and afternoon (1:00 p.m.), while water was provided ad libitum. The experiment lasted 12 weeks (84 days).

### **Data collection**

The weight of the hens was measured at the beginning and on the last day of the experiment. The difference in weight of the hens was determined by subtracting the initial weight from the final weight. Nutrient consumption shows the difference between the remaining nutrient and the supplied nutrient. Cumulative daily intake was recorded as total intake. The daily feed intake corresponds to the total food intake of 84 days. Eggs were collected three times daily (morning, afternoon and evening). The cumulative number of eggs in replicates per diet multiplied by 100 gave the hen's daily egg production (HDEP). Three carefully marked eggs were randomly collected from each treatment. Each egg was weighed using a sensitive scale calibrated to 0.001 g. Determination of egg white; the egg was cracked on a clean flat surface, the yolk and white were separated, and each egg was weighed using the same sensitive scale. To avoid mixing the whites and yolks, the eggs were cracked on the day of collection. The yolk colour was determined using the Roche Yolk Colour Fan. Shell weight was determined by first removing the membrane from the egg and drying it in an oven at 65°C for two days before weighing. Similarly, shell thickness was determined using a micrometer after removing the egg membrane. The collected eggs were assessed directly based on their freshness values.

### **Calculation**

The following parameters were calculated. Hen-day-egg-production (HDEP)

$$\text{HDEP} = \frac{\text{Total number of egg laid on a day}}{\text{Total number of hens}} \times 100$$

Feed efficiency (Feed conversion ratio (FCR))

$$\text{FCR} = \frac{\text{kg of food consumed}}{\text{kg of egg produced}} \times 100$$

**Data analysis**

Analysis of variance was performed on the data generated using the statistical package

SPSS [14]. Differences in means were separated using Duncan's multiple range test (DMRT).

**Table 2:** Gross composition (%) of graded level of without and with enzyme supplemented beniseed hulls in laying hens diet

Ingredients	CONT	WBSH15	BSH15	WBSH30	BSH30	WBSH45	BSH45	WBSH60	BSH60
Maize	54.70	55.10	55.10	54.00	54.00	54.10	54.10	53.90	53.90
Soybean meal	16.00	13.60	13.60	11.20	11.20	8.80	8.80	6.40	6.40
Beniseed hulls	0.00	2.40	2.40	4.80	4.80	7.30	7.30	9.60	9.60
Ground nut cake	8.50	8.40	8.40	8.70	8.70	8.50	8.50	9.05	9.05
Fish meal	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
Wheat offal	8.09	8.60	8.60	8.80	8.80	9.00	9.00	8.75	8.75
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.16	0.15	0.15	0.25	0.25	0.15	0.15	0.15	0.15
Premix*	0.25	0.25	0.25	2.50	2.50	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Bone meal	2.50	2.00	2.00	0.25	0.25	2.50	2.50	2.50	2.50
Limestone	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
S/Oil	0.50	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
<b>Nutrients</b>									
Crude protein (%)	16.20	16.15	16.14	16.12	16.12	16.03	16.02	16.05	16.06
ME (kcal/kg)	2883.73	2820.47	2820.47	2811.72	2811.72	2833.16	2833.16	2849.56	2849.56
Lysine	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.97
Methionine	0.35	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35
Calcium (%)	3.26	3.26	3.26	3.26	3.26	3.27	3.27	3.27	3.27
Phosphorus (%)	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
Fiber	4.08	3.99	3.99	3.94	3.87	3.74	3.74	3.62	3.62

CONT: soybean meal-based basal diet, WBSH15: 15% beniseed hull without enzyme, BSH15: 15% beniseed hull with enzyme, WBSH30: 30% beniseed hull without enzyme, BSH30: 30% beniseed hull with enzyme, WBSH45: 45% beniseed hull without enzyme, BSH45: 45% beniseed hull with enzyme, WBSH60: 60% beniseed hull without enzyme, BSH60: 60% beniseed hull with enzyme. Optimix Layers\* supplied the following per kg diet; Vit.A, 100000iu; Vit.D3; 20000iu; Vit.E, 100iu; Vit.K, 20mg; ThiamineB1, 15mg; RiboflavinB2, 40mg; PyridoxineB6, 15mg; Niacine, 150mg; Vit.B12, 0.01mg; Pantothenic acid, 50mg; Folic acid, 5mg; Biotin, 0.2mg; Choline chloride, 2mg; Anti-oxidant, 1.25g; Manganese, 0.8g; Zinc, 0.5g; Iron, 0.2g; Copper, 0.05g; Iodine, 0.12g; Selenium, 2mg; Cobalt, 2mg/kg.

**Results**

Table 3 shows the performance of the Black Nera laying hens fed graded beniseed hulls with or without the addition of exogenous enzyme (Maxigrain). Hens fed BSH60 ( $p < 0.05$ ) had higher change in body weight followed by those fed control, BSH30 and BSH45, while hens fed WBSH60 had lower. Hens fed WBSH45, 60% WBSH and BSH60 ( $p < 0.05$ ) had a higher TFI than those fed the control diet and other beniseed-based

diets. Those fed control, BSH15 and BSH30 ( $p < 0.05$ ) had a higher number of eggs per day, percentage of HDEP and better FCR, while those fed diets without enzyme had lower egg production per day, %HDEP and poor FCR. However, hens fed WBSH60 and BSH60 ( $p < 0.05$ ) had a higher egg weight than hens fed the control diet, while those fed WBSH15 and WBSH30 had lower egg weight.

**Table 3:** Performance of Black Nera laying hens fed graded level of beniseed hulls supplemented with and without Maxigrain enzyme

Parameters	CONT	WBSH15	BSH15	WBSH30	BSH30	WBSH45	BSH45	WBSH60	BSH60	SEM	LOS
NH	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	0.00	NS
IW (g)	1630.68	1630.36	1630.27	1630.69	1630.47	1630.35	1630.56	1630.19	1630.11	0.21	NS
CBW (%)	19.72	18.66	18.96	18.32	19.28	17.98	19.31	16.83	20.15 <sup>a</sup>	1.00	*
TFI (g)	2178.54 <sup>b</sup>	2230.62 <sup>b</sup>	2195.97 <sup>b</sup>	2324.07 <sup>ab</sup>	2156.07 <sup>b</sup>	2366.07 <sup>ab</sup>	2278.92 <sup>b</sup>	2471.07 <sup>a</sup>	2324.07 <sup>ab</sup>	101.83	*
DFI (g)	103.74	106.22	104.57	110.67	102.67	112.67	108.52	117.67	110.67	4.85	*
NE/d	16.00 <sup>a</sup>	12.00 <sup>b</sup>	17.00 <sup>a</sup>	11.00 <sup>a</sup>	17.00 <sup>a</sup>	9.00 <sup>d</sup>	12.00 <sup>b</sup>	9.00 <sup>d</sup>	11.00 <sup>c</sup>	3.20	*
EWt (g)	64.57 <sup>a</sup>	62.03 <sup>c</sup>	63.03 <sup>b</sup>	62.83 <sup>c</sup>	64.13 <sup>b</sup>	64.67 <sup>b</sup>	63.17 <sup>b</sup>	66.06 <sup>a</sup>	65.21 <sup>a</sup>	1.29	*
TEWt/day (g)	1033.12 <sup>a</sup>	744.36	1071.51 <sup>a</sup>	691.13	1090.21 <sup>a</sup>	582.03	758.04	594.54	717.31	201.50	*
%HDEP	76.19 <sup>a</sup>	57.14 <sup>a</sup>	80.95 <sup>a</sup>	52.38 <sup>a</sup>	80.95 <sup>a</sup>	42.86 <sup>c</sup>	57.14 <sup>c</sup>	42.86 <sup>c</sup>	52.38 <sup>d</sup>	15.25	*
FCR	2.11 <sup>c</sup>	3.00 <sup>b</sup>	2.05 <sup>c</sup>	3.36 <sup>b</sup>	1.98 <sup>c</sup>	4.07 <sup>a</sup>	3.01 <sup>b</sup>	4.16 <sup>a</sup>	3.24 <sup>b</sup>	0.82	*

CONT: soybean meal-based basal diet, WBSH15: 15% beniseed hull without enzyme, BSH15: 15% beniseed hull with enzyme, WBSH30: 30% beniseed hull without enzyme, BSH30: 30% beniseed hull with enzyme, WBSH45: 45% beniseed hull without enzyme, BSH45: 45% beniseed hull with enzyme, WBSH60: 60% beniseed hull without enzyme, BSH60: 60% beniseed hull with enzyme. NH = number of hens, IW = initial weight, CBW = change in body weight, TFI = total feed intake, DFI = daily feed intake, NE = number of egg, EWt = egg weight, TEWt = total egg weight, FCR = feed conversion ratio, %HDEP = % hen day egg production.

Table 4 shows the quality of eggs from Black Nera laying hens fed graded beniseed hulls with or without exogenous enzyme (Maxigrain). Hens fed WBSH60 and BSH60 ( $p < 0.05$ ) had greater egg weight, egg length, egg width, and albumen weight than hen fed the control diet and other beniseed-based diets, while hens fed the other diets had a lower egg weight, egg length, egg width and albumen weight. Yolk weight, shell weight, shell thickness and yolk were ( $p > 0.05$ ).

**Table 4:** Egg quality of Black Nera laying hens fed graded level of beniseed hulls supplemented with and without Maxigrain enzyme

Parameters	CONT	WBSH15	BSH15	WBSH30	BSH30	WBSH45	BSH45	WBSH60	BSH60	SEM	LOS
Ewt (g)	64.57 <sup>b</sup>	62.03 <sup>c</sup>	63.03 <sup>b</sup>	62.83 <sup>c</sup>	64.13 <sup>b</sup>	64.67 <sup>b</sup>	63.17 <sup>b</sup>	66.06 <sup>a</sup>	65.21 <sup>a</sup>	1.29	*
EL (cm)	57.12 <sup>b</sup>	56.20 <sup>b</sup>	56.20 <sup>b</sup>	56.61 <sup>b</sup>	56.052 <sup>b</sup>	56.41 <sup>b</sup>	55.09 <sup>b</sup>	58.270 <sup>a</sup>	58.160 <sup>a</sup>	0.94	*
EWd (cm)	42.70 <sup>b</sup>	41.20 <sup>b</sup>	41.30 <sup>b</sup>	41.70 <sup>b</sup>	4.17b	41.20 <sup>b</sup>	41.30 <sup>b</sup>	44.80 <sup>a</sup>	43.17 <sup>a</sup>	12.84	*
AIWt (g)	37.10 <sup>b</sup>	36.60 <sup>b</sup>	37.19 <sup>b</sup>	37.07 <sup>b</sup>	37.84 <sup>b</sup>	38.16 <sup>b</sup>	37.27 <sup>b</sup>	38.98 <sup>a</sup>	38.47 <sup>a</sup>	0.76	*
YWt (g)	20.02	19.23	19.54	19.48	19.88	20.05	19.58	20.48	20.22	0.40	NS
SWt (g)	6.46	6.20	6.30	6.28	6.41	6.47	6.32	6.61	6.52	0.13	NS
STk (mm)	0.34	0.45	0.44	0.34	0.34	0.44	0.34	0.34	0.33	0.05	NS
YC (RF)	10.00	9.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.33	NS

CONT: soybean meal-based basal diet, WBSH15: 15% beniseed hull without enzyme, BSH15: 15% beniseed hull with enzyme, WBSH30: 30% beniseed hull without enzyme, BSH30: 30% beniseed hull with enzyme, WBSH45: 45% beniseed hull without enzyme, BSH45: 45% beniseed hull with enzyme, WBSH60: 60% beniseed hull without enzyme, BSH60: 60% beniseed hull with enzyme. EWt = egg weight, EL = egg length, EWd = egg width, AIWt = albumen weight, YWt = yolk weight, SWt = shell weight, STk = shell thickness, YC = yolk color

## **Discussion**

It was observed that the change in body weight was ( $p>0.05$ ) higher in hens fed BSH60, perhaps, possibly due to their highest TFI, meaning they have to eat a lot to reach the similar weight as the control diet. However, those fed WBSH45 and WBSH60 had a higher TFI than those fed BSH60, but had a lower body weight, suggesting that they were not getting enough nutrients in their diet, which is likely due to higher BSH concentrations without dietary enzyme supplementation. This supports the report by Ag [15] and Beutler [16] that it is important for chickens to consume a diet that meets their nutritional needs for good growth. This further means that the enzyme supported BSH utilization at an inclusion level of 60%. In contrast, only those fed BSH15 and BSH30 laid the most eggs per day, suggesting that the Maxigrain enzyme improved besniseed hull at 15 and 30%. Maxigrain firmly opened the groceries phytate and/or oxalates such as calcium, phosphorus, methionine [6, 17], which are very important for laying hens [18]. The beneficial effect of supplementing BSH as an additive is 15-30%. The hens that fed BSH15-30 had the highest number of eggs per day, highest total egg weight, the highest %HDEP and best FCR as did counterparts that were fed the control diet. This is in agreement with White [19] who reported a significant increase in %HDEP with  $\beta$ -Mannanase enzyme and Daramola et al. (2021) reported that Maxigrain® enzyme has no negative effects on bird performance. Laying hens likely found it difficult to utilize BSH without replacing it with an enzyme, which was reflected in fewer eggs laid, lower total egg weight per day, lower %HDEP and an inability to utilize feed efficiently. The higher egg weight of hens fed BSH60 simply reflects their higher change of body weight. This supports the idea that heavier birds lay

progressively heavier eggs [20]. Egg length, egg width and albumen weight are indices that depend on egg weight. The greater egg length, width and albumen weight of eggs from birds fed WBSH60 and BSH60 also reflected their greater egg weight. This agrees consistent with Agbede [17] Penz and Jensen [20] and Rostagno [21] who found that heavier hens ate more to produce higher egg weight and albumen weight. The advantage of adding the BSH Maxigrain enzyme to the diet of laying hens is that it achieves an intense yellow or orange-yellow color, most desired by consumers [6, 22]. It should also be noted that the thickness of the eggshell was sufficient so that egg could reach the consumer in the best conditions. In general, Ryan and Mickay [23] demonstrated high %HDEP in hens fed BSH at 30 weeks of age. The SBSH in the diet of laying hens is capable of laying 240 to 270 or more eggs per year within the range given by Obioha [24] and Oluyemi and Roberts [25] emphasized that egg number is an important performance indicator of commercial laying hens. Despite feeding hens BSH15-30, egg weight in this study was lower but exceeded the 50 g [25].

## **Conclusion and Application**

Adding Maxigrain enzyme to BSH improves its utilization in laying hens, especially when supplemented at 15-30%. Hens fed with BSH15-30 showed higher egg production and better feed conversion compared to those fed a regular diet. Hens on a BSH diet without Maxigrain did not perform as well. Therefore, it is advised to supplement BSH with Maxigrain for optimal results in hens.

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