UTILIZATION OF MALTED SORGHUM SPROUT IN THE DIET OF REARING PULLETS AND LAYING HENS

UTILIZACIÓN DE BROTES DE SORGO MALTEADO EN LA DIETA DE POLLITOS Y GALLINAS PONEDORAS

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ADDITIONAL KEYWORDS

Feed utilization.

PALABRAS CLAVE ADICIONALES

Utilización de alimento.

SUMMARY

Two studies were conducted to evaluate the effect of long term feeding of malted sorghum sprouts (MSP) on the overall performance of egg-type chickens. Diets were formulated to include 0, 150 and 300 g/kg MSP levels for both growing and laying phases. A total of one hundred and forty-four (144) ten weeks old pullets were assigned to each of the four experimental groups. Overall final weight, feed consumption, daily weight gain, feed to gain ratio and age at first lay were measured in the first experiment. Average weight of the experimental birds increased with increasing levels of MSP. Higher levels of MSP did not affect feed to gain ratios ($p>0.05$) at the growing phase. Age at first lay was not significantly affected as the level of MSP inclusion increased. In the second experiment, egg produced per hen-day of the birds fed 0 g/kg MSP was significantly ($p<0.05$) higher than those that received 150 and 300 g/kg MSP diets. Serum albumin and serum globulin were significantly reduced ($p<0.05$) when birds were fed MSP diets while the serum uric acid levels were elevated. MSP inclusion in the diet significantly reduced egg cholesterol content. It was concluded that MSP can be included in the diets of growing pullets up to 300 g/kg. However, inclusion of MSP in laying hen's diet even at 150 g/kg did not yield satisfactory results. There is need to develop simple processing techniques to improve the utilization of MSP by laying hens.

RESUMEN

Se realizaron dos estudios para evaluar el efecto de la alimentación a largo plazo con brotes malteados de sorgo (MSP) en el rendimiento general de aves ponedoras. Las dietas fueron formuladas para incluir 0, 150 y 300 g/kg de MSP para las fases de crecimiento y puesta. Un total de 144 pollos de diez semanas de edad fueron asignados a cada uno de los cuatro grupos experimentales. En el primer experimento se midió el peso final total, consumo de alimento, aumento diario del peso, el cociente alimentación/ganancia y la edad a la primera puesta. El peso medio de las aves aumentó con el aumento de niveles de MSP. Los niveles más altos de MSP no afectaron la relación alimento/ganacia ($p>0,05$) en la fase de crecimiento. La edad a la primera puesta no fue afectada con el incremento de la

inclusión de MSP.

En el segundo experimento, la cantidad de huevos por día en las aves que comían 0 g/kg de MSP, fue perceptiblemente (p<0,05) mayor que en las que recibieron 150 y 300 g/kg de MSP. La albúmina y la globulina del suero fueron reducidas perceptiblemente (p<0,05) y los niveles de ácido úrico del suero aumentaron cuando las aves comían dietas con MSP. La inclusión de MSP en la dieta redujo perceptiblemente el contenido de colesterol en el huevo.

Se concluyó que el MSP se puede incluir en las dietas de pollos en crecimiento hasta 300 g/kg. Sin embargo, la inclusión de MSP en la dieta de gallinas ponedoras hasta 150 g/kg no rindió resultados satisfactorios. Es preciso desarrollar técnicas de procesado simples para mejorar la utilización de MSP por las gallinas ponedoras.

INTRODUCTION

Poultry keeping in tropical environment is one of the most popular enterprise adopted by small and medium scale farmers in rural and urban areas. One major factor militating against the industry is the competition between human and other livestock for available feed resources. This phenomenon has forced the price of feed ingredients like maize to an alarming rate. Given the special attention given to energy in monogastric nutrition, it has therefore become imperative to find alternative in other crops and their residues which are cheap and are without deleterious effect on animal performance.

Sorghum spp (Guinea corn) had replaced barley as a raw material in confectionery and brewering industry in many tropical countries (Banjoko, 1990). Malt is extracted from germinated sorghum seeds and the residue consists of sorghum shoots and roots. These residues are collectively referred to as malted sorghum sprout (MSP). Malting essentially involves soaking of cereal grain in this case sorghum for 24-48 hours under controlled condition of moisture, aeration and temperature. Thereafter the grains are transferred to an aseptically cleaned malting floor. The grains are allowed to germinate for 3-5 days. The resulting green malt is subsequently dried in a rotary dryer at a temperature of 70°C. The dried friable malt is then mechanically agitated to free the roots and the shoots which are separated through screening (Aletor *et al.*, 1998). Ologun *et al.* (1998) showed that sorghum rootlets, otherwise called malted sorghum sprout may be fed up to 40 percent to rats. Morrison (1984) suggested not more than 10-15 percent malt sprouts in the concentrate mixture for dairy cow. Information available on the utilization of MSP by egg-type chickens are scarce. To this end, it has become important to investigate the inclusion of MSP in the diets of growing pullets as well as laying birds.

MATERIALS AND METHODS

LOCATION

This study was carried out at the livestock Teaching and Research Farm of the University of Agriculture, Abeokuta, South West Nigeria. The area is 76 m above sea level, humid and located in the tropical rain forest vegetation zone with average temperature of 34.7°C. Natural lighting period of 12 hours per day prevailed throughout the period of the experiment.

DIETS

Three diets were formulated to contain 0, 150 and 300 g/kg malted sorghum sprouts (MSP). The test ingredient (MSP) was obtained from a reputable brewing industry. The gross composition of experimental diets for growing and laying stages of the experiment is presented in **table I**. The control diet contained 0 g/kg of MSP, 10.10 MJ/kg energy and 157.5 g/kg Crude protein (NRC, 1984). Diets 2 and 3 were formulated to contained 150 g/kg and 300 g/kg of MSP respectively. The diets were made isocaloric and isoproteinous. For the laying phase, the same levels of MSP were used for the respective diets as the growers diets. The control diet contained 10.43 MJ/kg and 170.9 g/kg Crude protein (NRC,1984). The diets were also formulated to be

Table I. *Gross composition of experimental diets (g/kg) and proximate composition of MSP.*
(Composición de las dietas experimentales (g/kg) y del MSP (gkg^{-1})).

Ingredients	Levels of MSP						
	Growing phase			Laying phase			
	0	150	300	0	150	300	MSP
Maize	400.0	250.0	100.0	420.0	270.0	120.0	
Malted sorghum sprout	0.0	150.0	300.0	0.0	150.0	300.0	
Soybean meal	60.0	40.0	20.0	60.0	60.0	60.0	
Groundnut cake	40.0	40.0	40.0	100.0	100.0	100.0	
Palm kernel meal	179.0	179.0	179.0	163.0	200.0	225.5	
Brewers dried grain	100.0	120.0	140.0	-	-	-	
Wheat offal	160.5	160.5	160.5	180.0	152.5	127.0	
Fish meal	-	-	-	10.0	10.0	10.0	
Bone meal	30.0	30.0	30.0	30.0	30.0	30.0	
Oyster shell	20.0	20.0	20.0	20.0	20.0	20.0	
Methionine	3.0	3.0	3.0	1.0	1.0	1.0	
Lysine	2.5	2.5	2.5	2.5	2.5	2.5	
Premix	2.5	2.5	2.5	2.5	2.5	2.5	
Salt	2.5	2.5	2.5	2.5	2.5	2.5	
Total	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	
Determined analysis							
Energy ($MJkg^{-1}$)	10.22	10.01	9.91	10.45	9.96	9.65	
Crude protein	170.0	176.4	178.8	170.0	172.6	175.8	224.3
Crude fibre	53.0	54.5	58.4	52.9	53.8	56.2	46.7
Ether extract	-	-	-	38.5	32.2	29.8	24.2
Dry matter	-	-	-	-	-	-	842.3
Ash content	-	-	-	-	-	-	63.0
Nitrogen free extract	-	-	-	-	-	-	641.8
Ca	-	-	-	-	-	-	1.9
P	-	-	-	-	-	-	3.5
HCN(mg/kg)	-	-	-	-	-	-	1.5

isocaloric and isoproteinous.

EXPERIMENT 1

Experiment design and management of growing pullets A total of one hundred and forty-four ten (10) weeks old pullet of Nera black ® strain were assigned to each of the three diets. Each diet had forty-eight birds. Each treatment was further divided into four replicate groups having twelve birds each in a completely randomized experimental arrangement. The pullets were kept on floor pens. Feed and water supplied *ad libitum*. Routine and occasional management, vaccination and medication were carried out as and when due. The experiment lasted for ten weeks. Feed consumption, weight gain, feed to gain ratio and age at first lay as well as quality assessment of the first eggs were determined.

EXPERIMENT II

At eighteen weeks the birds were transferred to battery cages from floor pens where they were housed until the end of the study. A five weeks allowance was given after the determination of age at first lay during which no record was taken. Forty-eight, twenty-five weeks old birds were assigned to each of the three diets formulated. The diets contained 0, 150 and 300 g/kg MSP levels. Each treatment was further sub-divided into four replicate groups of twelve birds each. All other management practices remain as descried in experiment 1. Records of laying performance of layers were taken, external and internal egg qualities assessment were also determined. Determination of some serum metabolites, plasma lipid profile as well as egg cholesterol were carried out.

Blood sampling

Blood samples were collected from two birds per replicate. The blood was collected via the brachial vein with the aid of syringe and needles where 2.5 ml of blood samples were collected from each bird into well labeled ethylene diamine tetraacetate (EDTA) bottles and another 2.5 ml was collected into a clean hypodermic syringe tube, they were allowed to clot and were refrigerated for six hours after which the serum was separated and poured into a clean test tube for further analysis.

Chemical analysis

Diets were analysed for proximate constituents according to A.O.A.C. (1990) procedure and cholesterol determination was done using the method of Folch *et al*. (1957).

Statistical analysis

All data collected were analysed using Minitab computer package® (Minitab, 1991). Significance differences in means were separated using Duncan Multiple range test (Gomez and Gomez, 1985).

RESULTS AND DISCUSSION

PROXIMATE COMPOSITION OF MALTED SORGHUM SPROUTS

The proximate composition of MSP is presented in **table I**. The dry matter value of 842.3 g/kg was recorded in this study. Crude protein value of 224.3

g/kg agrees with earlier reports of Aning *et al*. (1998) and Akinola (2002). A lower crude fibre of 46.7 g/kg was reported in this study which is different from 83.0 g/kg reported by Oduguwa *et al*. (2001). The general low crude fibre of MSP may be as a result of tender nature of the shoots and roots that is the formation of lignin has not taken place before the termination of the growth of the sorghum seedlings.

A higher ether extract value of 39.8 g/kg was obtained by Akinola (2002) for alkaline treated MSP while 22.4 g/kg was reported in this study. The difference noticed may be as a result of species differences. White sorghum was used to produce the MSP used in this study. A slightly elevated ash content value of 63.0 g/kg obtained here differs from 16.0 g/kg reported by Aning *et al*. (1998). This finding however agrees with the earlier report of Akinola (2002) who reported ash content of 70.0, 60.0 and 95.0 g/kg for untreated, fermented and alkaline treated MSP.

EXPERIMENT 1

Performance, age at first lay, external and internal egg quality traits of first eggs laid by growing pullets fed MSP based diets (10–20 weeks)

The highest average final body weight of 1702.40 g was recorded for birds fed 300 g/kg MSP diet followed by the group that received 150 g/kg MSP diet with 1654.56g while the birds fed 0 g/kg MSP diet recorded 1644.86 g **(table II)**. The result reveals that the average final body weight of the birds increased slightly with increasing level of MSP. There was however no significant difference (p>0.05) in the average weight at the end of the growing phase. The observed trend at this phase is in contrast to an earlier report by Adebule (2002) where weight gradually decreased with increasing levels of MSP when fed to pullet chicks (age 1-10 weeks). The birds at this phase are more matured and are likely to be able to handle elevated MSP levels in the diets.

There was no significant (p>0.05) effect of diet on average feed consumed per day across the dietary treatments. Also a slight higher value recorded for average weight gain in the birds fed 300 g/kg MSP was noted. Musharaf and Latshow (1991) earlier reported no significant (p>0.05) effect on weight gain when high sorghum were fed. There was a slight increase in the average weight gain in terms of live weight at high MSP levels up to 300 g/kg inclusion. There was no significant (p>0.05) difference in feed to gain ratio at this phase, this indicate that utilization of feed by birds on MSP diets were largely similar to those on control diet.

Age at first lay did not significantly (p>0.05) differ as the level of MSP increased, therefore, the inclusion of MSP in the diets of pullets up to 300 g/kg will not affect age at first lay. High MSP levels did not affect weight of the first eggs significantly. A slight reduction was however noticed as the level of MSP inclusion increased. Egg shape index of the first eggs of the group that received MSP diets was slightly higher than the group fed 0 g/kg MSP diet. This result was a reflection of the feed consumed. The analysis showed that there was no significant (p>0.05) effect on Hoffman-

TableII. *Performance, age at first lay, external and internal egg quality traits of first eggs laid by growing pullets fed MSP based diets (10-20 weeks).* (Eficiencia, edad a la primera puesta, caracteres externos e internos de calidad del huevo de pollos en crecimiento alimentados con dietas a base de MSP (10-20 semanas)).

	Levels of MSP			
Parameters	0	150	300	SEM
Performance				
Initial weight (g)	785.3	785.4	785.9	0.01
Final weight (g)	1644.9	1654.6	1702.4	14.50
Daily feed consumed (g)	63.9	65.3	63.7	0.02
Daily weight gain (g)	12.3	12.4	13.1	0.21
Feed to gain ratio	5.2	4.1	4.9	0.26
Age at first lay				
Age at first lay (days)	134.5	176.0	135.1	1.08
Egg External Qualities				
Weight (g)	42.4	41.2	39.4	1.17
Length (cm)	4.5	4.5	4.1	1.25
Breadth (cm)	3.4	3.1	2.9	0.12
Shape index	1.3[b]	1.4[a]	1.4[a]	0.69
Egg cleanliness	1.0	2.0	3.0	0.25
Internal Qualities				
Yolk weight (g)	14.8	14.5	15.0	0.12
Yolk (percent)	25.2	25.0	25.5	0.02
Shell weight (g)	5.7	5.6	5.7	0.05
Shell (percent)	9.8	9.5	9.7	0.06
Shell thickness (mm)	0.3	0.3	0.3	0.01
Albumen weight (mm)	37.3	38.6	38.2	0.34
Albumen (percent)	65.0	65.5	64.8	0.24
Albumen height (mm)	3.6	3.6	3.6	0.04
Yolk colour	1.4	1.9	2.3	0.08
Blood spot	0.5	0.6	0.6	0.07
Haugh unit	53.0	52.9	53.9	0.06

[abc]mean on the same row having different superscripts were significantly different ($p<0.05$).

La-Roche Colour fan (RYCF) scores. Birds on 150 g/kg MSP had slightly higher yolk colour values. This shows that MSP induced higher yolk colour values in eggs since white maize was used for all the birds. It should be noted that deeper yolk colour is preferred by consumers. Albumen weight did not differ significantly ($p>0.05$) across the dietary treatments. Kline *et al*. (1965) reported an increase in albumen weight and decrease in yolk weight as a result of increase in egg weight. Similar findings were reported by Cook and Briggs (1977). The result obtained in this study did not differ from these earlier reports. The haugh units was also not significantly ($p>0.05$) affected.

From the result, it is obvious that birds fed MSP based diets laying for the first time did not produced bad quality eggs.

EXPERIMENT II

Performance, external and internal egg quality of laying hens fed MSP based diets

The overall performance of laying birds fed MSP based diets are shown in **table III**. Result showed that egg produced varied significantly ($p<0.05$) across the dietary treatments. The mean values of 0.82, 0.61 and 0.41 were recorded for birds fed 0,150 g/kg and 300 g/kg MSP respectively. The sharp reduction recorded for MSP diets may be due to the presence of certain antinutritional factors in the feed. MSP is known to contain dhurrin a glucoside which on hydrolysis yield equal quantity of HCN (Ikediobi, 1989). Tannin an ANF is also known to be present in MSP (Aning *et al.*, 1998, Oduguwa *et al.*,2001, Oduguwa *et al.*, 2005). Tannins are complex polyphenolic compounds with great structural diversity. They have been reported to have detrimental effect on performance (Aganga and Adogla-Bessa, 1999). These factors may have had negative effect on nutrient utilization of the resulting MSP diet hence reduced laying performance. Kilogramme feed per kilogramme egg reduced as the level of MSP increased ($p<0.05$). A significantly lower value was recorded for birds on 300 g/kg MSP diet. This shows that more feed will have to be consumed for a kilogramme of eggs to be produced. A higher value obtained for birds on 0 g/kg MSP showed that the feed consumed were better utilized. Although, the feed intake values of birds fed 0 and 150 g/kg MSP diets were not significant ($p>0.05$) different from each other, dietary treatment with lower level of MSP inclusion induced

Table III. *Performance, external and internal egg quality of laying hens fed MSP based diets.* (Rendimientos, calidad externa e interna del huevo de gallinas ponedoras alimentadas con dietas a base de MSP).

Parameters	Levels of MSP			
	0	150	300	SEM
Performance				
Egg produced per Hen day	0.83[a]	0.62[b]	0.42[c]	1.18
Kg feed Kg^{-1} egg	2.07[a]	2.06[b]	1.90[c]	0.01
Feed consumed/day (g)	121.35[a]	121.27[a]	115.63[b]	0.52
Total number of eggs	8287.00[a]	6216.00[b]	4228.00[c]	1.18
External Qualities				
Egg weight	58.75	59.69	58.96	0.37
Egg length	5.34	5.37	5.28	0.08
Egg Breadth	3.80	3.86	3.86	0.04
Egg shell index	0.71	0.72	0.73	0.06
Internal Qualities (as in table II*)*				

[abc]mean on the same row having different superscripts were significantly different ($p<0.05$).

higher feed intake. This observation could be traced to the taste of the ingredient. MSP had been reported to have a bitter taste (Aning *et al.*, 1998, Oduguwa *et al.*, 2001). However, Aganga and Adogla-Bessa (1999) opined that the presence of Tannin in any feed ingredient would depress palatability.

All the parameters monitored in the external egg quality traits did not significantly ($p>0.05$) vary across the dietary treatments. It should be noted that slightly higher values were obtained for egg breadth and egg shape index in the group fed 300 g/kg MSP but did not significantly vary ($p>0.05$) across the dietary treatments. The analysis of yolk weight of laying birds showed no significant ($p>0.05$) variation among the dietary treatments though slightly higher values was obtained for birds fed 300 g/kg MSP like the analysis of the first egg, the study also revealed that dietary treatments did not in any way have significant ($p>0.05$) effect on Hoffman-La-Roche Colour fan (R.Y.C.F) score a slightly elevated value was recorded in birds fed 300 g/kg MSP levels. Malted sorghum sprouts may have certain pigment that confers such status on egg yolk. This is however not established in this study. Higher but not significant ($p>0.05$) values for blood and/ or *meat* spot incidence were obtained as the level of MSP inclusion increased. Haugh units were also not affected by dietary treatment ($p>0.05$). This observation reveals that dietary treatment of MSP based diets did not produce bad quality egg during the laying period.

Serum metabolites, plasma lipid profile and egg cholesterol of laying birds fed MSP based diets **(table IV)**

Serum creatinine did not vary significantly ($p>0.05$) across the dietary

Table IV. *Serum and plasma lipid profile of laying hens fed MSP based diets.* (Perfil sérico y plasmático de las gallinas ponedoras alimentadas con dietas a base de MSP).

	Levels of MSP			
	0	150	300	SEM
Parameters				
Serum Creatinine(mg/dl)	1.00	0.90	0.80	0.02
Serum Uric Acid(mg/dl)	2.3^{c}	2.52^{b}	3.83^{a}	0.06
Serum Albumin(mg/dl)	24.00^{a}	18.00^{b}	18.00^{b}	0.85
Serum Globulin(mg/dl)	15.87^{a}	13.50^{b}	12.00^{c}	0.45
SGOT(U/L)	5.50^{c}	6.50^{b}	7.50^{a}	0.24
SGPT(U/L)	5.03^{c}	6.05^{b}	6.50^{a}	0.18
Cholesterol esters	79.12^{a}	69.00^{b}	59.00^{c}	2.48
High density lipoproteins	23.12^{a}	21.87^{b}	18.17^{c}	0.63
Low density lipoproteins	40.35^{a}	31.25^{b}	30.11^{c}	1.44
Very low density lipoproteins	15.00^{a}	14.00^{b}	11.00^{c}	0.51
Egg Cholesterol(mg/egg)	205.30^{a}	121.98^{b}	98.85c	10.80

^{abc}mean on the same row having different superscripts were significantly different ($p<0.05$).

treatments. Serum uric acid serum albumin and serum globulin were significantly affected by dietary treatment. Uric acid metabolism is influenced by the amount of protein and amino acids in the diet (Oduguwa *et al.*, 2001). The slightly elevated uric acid of birds fed 300 g/kg MSP goes on to buttress the fact that utilization of protein was impaired and this was significantly affected by MSP levels ($p<0.05$). However, studies have shown that removal of uric acid from the blood is normally efficient such that the content rarely exceed a given content of the chicken blood (Scott *et al.* (1985). Albumin a major storage reservoir of protein due to its abundance and small size was significantly reduced ($p<0.05$). This is a further pointer to the earlier expressed opinion (Olorode and Longe, 1998). Serum globulin like others was significantly reduced ($p<0.05$) as the level of MSP increased.

Serum glutamate oxaloacertate (SGOT) and serum glutamate pyruvate transaminase (SGPT) values increased significantly ($p<0.05$) with increased level of MSP. The increased activities of the transaminases measured suggest that utilization of nutrient in the feed is very low. The reduced hen-day egg production recorded in the laying phase substantiates these findings. The increased activities recorded may not be unconnected with the activities of tannin. Tannin a glucoside have been implicated in binding protein (Aning *et al.*, 1998, Oduguwa *et al.* 2001), this may also be one of the reasons why increase transaminase activities was recorded.

Lipid profile. Cholesterol ester, a major constituent of plasma cholesterol was significantly reduced ($p<0.05$) across the dietary treatments. Higher levels of MSP inclusion in the diets show a corresponding reduction in triglyceride, high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoproteins (VLDL). These findings substantiate the report of Bitman and Wood (1980). Also in the observation of Story and Furumoto (1990), and increase in dietary fibre was reported to result in reducing the availability of plasma cholesterol for incorporation into lipoproteins. An elevation in the blood plasma lipoproteins could be associated with cholesterol deposition in egg especially with birds that received 0 g/kg MSP diet.

It was observed that the inclusion of MSP in the diet up to 300 g/kg reduced significantly ($p<0.05$) the egg cholesterol levels. This may be a pointer to the fact that the MSP had the potential to reduce egg cholesterol levels. The reduction observed as the level of MSP increased may probably be due to lower fat content in the dietary treatment with 150 and 300 g/kg. Nabert (1983) observed a significant increase in yolk cholesterol with the use of high levels (10-30 percent) dietary fat. Fibre having ability to reduce abdominal fat (Akinola, 2002) have been shown to affect cholesterol only to a lesser extent in broiler. Yolk fat was not affected significantly ($p>0.05$) with increased MSP, however, egg cholesterol reduced significantly ($p<0.05$) with increased MSP inclusion in the diets.

CONCLUSION

It can be concluded from the study that MSP can be fed to growing pullets up to 300 g/kg level. Its inclusion in layer diets even up to 150 g/kg did not yield satisfactory results. It may be necessary to assess the inclusion of enzyme capable of solving glucosides problems in layer when fed diets containing MSP. There were indications that egg cholesterol level were reduced with the inclusion of MSP in the diets.

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