EFFICIENCY OF USING RICE HUSKS IN FEEDING GROWING RABBITS AS ANTI-AFLATOXINS

M.H.S. El-Sanhoury

Poultry Production Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt

(Received 1/8/2017, accepted 3/9/2017)

SUMMARY

This experiment was carried out to investigate the effect of using rice husks (RH) like anti-aflatoxins and source of fibers at 0, 3, 6, 9 and 12 % as replaced clover hay in the rations of growing rabbits. Seventy-five unsexed, weaned New Zealand White rabbits of 5 weeks old were randomly divided into five experimental groups (15 rabbits / group). The trial continued for 8 weeks. The results obtained showed that using rice husks in growing rabbits diets: low content significant of total aflatoxins in growing rabbit diets and faeces. No significant effect on productive performance (live body weight, daily body weight gains and feed conversion ratio), expect 3% RH was highly significant in feed consumption compared with control group. The control group numerically highest but not significant (P>.05) for TDN value and digestibility coefficients of dry matter, organic matter, crude protein, crude fiber and nitrogen free extract compared to RH groups. Rabbits fed 12% RH had the lowest values (P>.05) for digestibility coefficients of organic matter, crude protein, crude fiber and nitrogen free extract compared to the other groups, however, it showed significantly (P<.05) higher digestibility of ether extract than other groups. Higher dressing and weight of hot carcass percentages were recorded for rabbits fed 3% RH. Plasma total protein, albumin, globulin, A/G ratio, total lipids, cholesterol or alanine aminotransferase (ALT) concentration were not significantly affected due to including RH into rabbit diets. However aspartate aminotransferase (AST) was significantly decreased by different levels of RH. Rabbits had 6% RH in their diet showed higher economic efficiency percentage compared with other group. The results revealed that 6% RH can be used in growing rabbit diets as anti–total aflatoxins and source of fiber without any adverse effect on productive performance and carcass characteristics with high obtained economic efficiency value.

Keywords: *rice husks, clover hay, growing, rabbit, productive, anti-aflatoxins, economic efficiency.*

INTRODUCTION

Rice husks have rich high fiber and high ash, especially silica. Silica works on the adsorption of toxins and also helps high fibers in preventing diarrhea in rabbits. Rabbits can survive on all forage diets, optimum performance can only be insured in a mixed feeding regime involving forage and formulated feed (Adeniji, *et al.* 2014 and Cheek *et al.,* 2006). Some studies have been carried out on the possibility of replacement or supplementation of rice husk in to rabbits diets as alternative protein energy source (Omole and Ajayi, 2006); however, little is known about the potential of rice husk when supplemented with probiotics in rabbits feeding. Adeniji, *et al.,* (2014) noted that rice husk has high digestive energy contents for rabbits. Also, rice husk which is a by-product of rice milling is more cheaper and available in Egypt. Although, husk is a cheap agro-based industrial by-product which has been fed to rabbit (Adeluku *et al.,* 2004), it is a fibrous ingredient with about 39-42% crude fiber content that has limited the extent to which it can be used in the diet of rabbits (Adeniji, *et al.,* 2014). The role of fiber is considered mainly for preventing digestive trouble of the growing rabbits, and also for improving performance of does (Gidenne, 2000). Gidenne and Perez (2000) studied the digestive health (morbidity as well mortality) of the post-weaned was dependent on the level and quality of ligno-cellulosic content of the diet.

However, Ehrlien *et al.,* (2003) observed that rabbits are non-ruminant herbivora and can consumed high fiber diets hence regarded as hind gut digesters. Never the less, fermentation of cellulose and other fibrous components is post gastric, this occurs in the caecum and colon which are well developed in rabbits, and harbor of a considerable amount of microbial population (Abdel Rahman *et al.,* 2008). These microorganisms are involved in starch and cellulose digestion.

Moreover, Arafa (2014) found that, RH can be used as natural anti-mycotoxin to detoxify aflatoxin contaminated broiler diets. Also, Arafa *et al*., (2012) studied that using RH at 2.5% in low-level aflatoxin (naturally contaminated) diets, had no adverse effects on performance of broiler or traits of carcass.

The present study aimed to evaluate the effect of rice husks as feedstuffs in the diet of growing rabbits on the evaluation of total aflatoxins, productive performance, digestibility of nutrients, carcass characteristics, some blood constituents and economic evaluation.

MATERIALS AND METHODS

The experimental work of study was carried out at the Centre of Agricultural Studies and Consultations (CASC), Rabbits Production Unit (RPU), Faculty of Agriculture, Ain Shams University, Cairo, Egypt. Rice husk is the outer layer of rice grain and it is a waste obtained after partially polished rice grain for human use. The rice husk obtained for this study was in dry form, then cleaned and ground.

Experimental rabbits:

seventy-five, unsexed, New Zealand White (NZW) weaned rabbits of 5 weeks of age with an average intial body weight of 685g were randomly divided into 5 treatment groups (15 rabbits/group). Each group was subdivided into five replicates, each of 3 rabbits and the initial live body weights of all treatment groups were almost equal.

Experimental diets:

The treatment diets were iso-caloric, iso-nitrogenous and iso-fibrous and were formulated in pellets form to ensure an adequate supply of all nutrients recommended by Lebas *et al.,* (1997) for growing rabbits. The first group was served as control diet without RH. Rabbits in second, third, fourth and fifth group were fed basal diet containing 3, 6, 9 and 12% RH, respectively.

Management:

The experimental rabbits were housed in galvanized metal wire cages. Each cage was 60 x 50 x 40 cm for length, width and height, respectively, and provided with feeders and automatic watering system, with three rabbits per each cage. The cages were located in a naturally ventilated and lighting building. The treatment diets were offered to the rabbit's *ad libitum* and fresh water was available all the time during the treatment period. All treatment rabbits were also vaccinated against Rabbit *Pasteurellosis* at the beginning of the experimental period.

Rabbits were individually weighed at the beginning of the treatment, then at weekly intervals until the end of the experiment. Daily weight gain, daily feed consumption, feed conversion ratio and mortality rate were calculated. The feeding trial was continued for 8 weeks.

Digestibility trials：

At the last week of the treatment, digestibility trial was conducted using 20 rabbits (4 rabbits from each treatment group), which were housed individually in metabolic cages that allow faeces and urine separation according to the method of Perez *et al.,* (1995). The digestibility trials extended for 7 days, the preliminary period was 3 days and the collection period extended for 4 days. Feed intake was exactly recorded. Faeces were collected daily, weighed and dried at 60-70°C for 24 hours, bulked, finely ground and stored for chemical analysis. The apparent digestibility coefficients of DM, OM, CP, CF, EE and NFE for the tested diets were estimated. The total digestible nutrients (TDN) were calculated according to the classic formula (Cheeke *et al.*, 1982). The digestible energy (DE) of RH was calculated according to Fekete and Gippert (1986) by applying the equation: DE (kcal/kg) = 4253-32.6 (CF %) -144.4 (total ash%).

Carcass characteristics and blood samples：

At the end of the treatment period, four rabbits from each treatment were randomly taken, individually weighed and slaughtered. After complete bleeding, pelt and viscera were removed and then carcass and giblets (liver, heart, and kidney) were weighed. Dressing percentage included relative weights of carcass, giblets and head were estimated according to Steven *et al.,* (1981). Blood samples were collected at slaughtering time in heparinized glass tubes. Blood plasma was separated by centrifugation at 3000 rpm for 15 minutes. The collected plasma was stored at -20°C until biochemical assay. Plasma total protein was determined according to Gornall *et al.* (1949) and albumin was estimated according to Doumas *et al.,* (1971). Plasma globulins values were obtained by subtracting albumin values from total protein values. Plasma total lipids, cholesterol and plasma transaminases (AST, ART) were determined according to Zollner and Kirsch (1962), Richmond (1973), and Reitman and Frankel (1957), respectively by commercial kits.

Chemical analysis:

The chemical composition of the RH, experimental diets and faeces were analyzed according to A.O.A.C. (2005) and the results are presented in Tables (1 and 2). Experimental diets were analyzed for fiber fractions, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) using Tecator Fibretic System according to Goering and Van Soest (1970) procedures. Hemicellulose was calculated as the different between NDF and ADF, while cellulose was calculated as the difference between ADF and ADL.

Aflatoxin assessment:

Aflatoxins in diet and faeces were determined according to Roos *et al*., (1997) and A.O.A.C. (2005) using HPLC technique (Agillent 1100 series U.S.A. with column C_{18}, Lichosphez 100 RP-18, 5 µm x 25 cm).

Economic efficiency (EEf) :

The EEf was calculated according to the following equation:

EEf= A-B/B X 100

Where A is the selling cost of obtained gain (LE per kg) and B is the feeding cost of this gain. The performance index (PI) was calculated according to the equation described by North (1981) as follows:

PI = Live body weight (Kg)/ Feed conversion x 100.

Production efficiency factor (PEF) was calculated according to Emmert (2000) as follows:

PEF = [Livability × Mass (Kg) /FCR × Age in days] × 100

<u>*Where*</u>: Livability = 100 – Mortality rate (%)

Mass (Kg) = Final live body weight.

Statistical analysis:

Data were statistically analyzed by using SAS program (SAS, 2004) according to the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = the observation on the I^{th} treatment

µ = Overall mean

T_i = Effect of the i^{th} treatment

eij = Random error treatment.

Duncan's Multiple Range test (Duncan, 1955) was also used for the comparison among means of the experimental groups.

Table (1). Chemical analysis of rice husks and clover hay.

Ingredient	DM %	CP %	CF %	EE %	Ash %	NFE %	DE Kcal/kg
Rice husks	90.2	3.5	36.5	4.5	18	25.2	463.9
Clover hay	89.67	12.5	30.0	2.30	10.25	33.62	1795

Table (2). Composition and chemical analysis of the experimental diets.

Ingredients (%)	Control	3%RH	6%RH	9%RH	12%RH
Yellow corn	7	8	8.5	9	9
Barley grains	15	15.5	15.5	15.5	15
vegetable oil	0.1	0.2	0.45	0.7	1.3
Soybean meal (44%CP)	12	13	13.5	14	14
Sunflower (36%CP)	6	6	6.5	7.5	9
Rice husks	0	3	6	9	12
Clover hay	28	25	21.4	17.25	13
Wheat bran	28.4	26.1	25	23.8	23.5
Bone meal	1.25	1.25	1.25	1.25	1.25
Limestone	0.8	0.8	0.85	0.9	1
Vit & Min Premix*	0.3	0.3	0.3	0.3	0.3
NaCl	0.5	0.5	0.5	0.5	0.5
Lysine	0.03	0.03	0.03	0.03	0.03
DL-Methionine	0.15	0.15	0.15	0.15	0.15
Anti-toxin#	0.2	-	-	-	-
Total	100	100	100	100	100
Chemical Analysis (as fed basis):A. Evaluated:					
DM %	89.5	89.7	89.9	89.6	89.8
OM %	82.09	82.01	81.90	81.28	81.12
CP %	16.21	16.20	16.13	16.19	16.15
CF %	14.24	14.26	14.26	14.18	14.14
EE %	2.74	2.94	3.28	3.62	4.27
NFE %	48.90	48.62	48.22	47.29	46.55
NDF%	32.82	32.59	32.45	32.16	32.00
ADF%	18.54	18.96	19.33	19.60	19.93
ADL%	5.37	5.32	5.26	5.15	5.06
Ash %	7.41	7.69	8.00	8.32	8.68
B. Calculated:					
DE Kcal/Kg	2449.47	2433.18	2417.02	2405.01	2403.59
Calcium %	1.25	1.21	1.18	1.14	1.12
Total phosphorus %	1.19	1.16	1.13	1.11	1.08
Lysine %	0.840	0.843	0.840	0.841	0.834
Methionine+Cystine %	0.714	0.709	0.707	0.711	0.714

** Each 3kg of premix contains: Vit. A 12000000 IU; Vit. D_3 2000000 IU; Vit. E 10000 mg; Vit. K_3 2000 mg; Vit. B_1 1000 mg; Vit. B_2 5000 mg; Vit. B_6 1500 mg; Vit. B_{12} 10 mg; Biotin 50 mg; Coline chloride 250000 mg; Pantothenic acid 10000 mg; Nicotinic acid 30000 mg; Folic acid 1000 mg; Manganese 60000 mg; Zinc 50000 mg; Iron 30000 mg; Copper 10000 mg; Iodine 1000 mg; Selenium 100 mg; Cobalt 100 mg and $CaCO_3$ 3000 mg.*

#HSCAC: hydrated sodium calcium aluminosilicate

RESULTS AND DISCUSSION

Chemical analysis and nutritive values of clover hay and rice husks.

Results of proximate analysis (on dry weight basis) of clover hay used in this research in comparison with rice husks are illustrated in Table (1). The analysis indicated that clover hay was the highest in crude protein (12.5%), while RH was the lowest (3.5%). Ether extract was relatively higher in RH (4.5%) than those found in clover (2.3%). While nitrogen–free extract was higher in clover (33.62%) than those found in RH (25.2%). Ether extract and NFE contents of RH indicated a possibility of using it to replace clover hay partially as an energy source in rabbits. On the other hand, RH contained the highest values of crude fiber (36.5%) and ash (18%) followed by clover (30.0% and 10.25%), respectively.

However, the calculated energy (DE Kcal /Kg) value of RH were much lower (463.9) than clover hay (1795), it was necessary to increase the level of fat as the level of RH increased to keep all diets Iso-Caloric (Table 2).

2. Total aflatoxins.

Table (3) indicated the effect of RH supplemented on the total aflatoxin in feed faeces of growing rabbits. Firstly, RH supplementation decreased total aflatoxin in feed and faeces and these differences between control and treatments were highly significant ($P \leq 0.01$). Also, when RH supplementation had increased, the total aflatoxin had decreased in feed and faeces. That's mean, RH supplementation were overcome aflatoxin level, and consequently improved the feed digestibility. Secondly, total aflatoxin in faeces were higher than in feed and decreased by increasing the RH supplementation, and that’s may be the role of RH in reducing the aflatoxin in rabbit's body and consequently improved the health of rabbits.

Huwing *et al.* (2001) reviewed the efficiency of different materials, such as activated charcoal, zeolites, hydrated sodium calcium aluminosilinate, other clays, polymers, yeast and yeast products, as adsorbents for different mycotoxins. They found that HSCAS showed almost total protection against the adverse effects of aflatoxins but were very limited in counteracting the mycotoxin zearalenone. HSCAS clay acts as an alflatoxin enterosobent that tightly and reactively binds these poisons in the gastrointestinal tract of animals, decreasing their bioavailability and associated toxicities.

Table (3): Average of total aflatoxins in rations and residue of aflatoxin in excreta of rabbit fed different dietary treatments at 91 days of age

Item	Control	3 % RH	6 % RH	9 % RH	12 % RH	Sig.
Total aflatoxin in feed (μg/kg)	8.89[a] ±1.15	1.10[b] ±0.15	0.99[b] ±0.11	0.98[b] ±0.09	0.89[b] ±0.08	**
Total aflatoxin in faeces (μg/kg)	12.95[a] ±2.30	3.31[b] ±1.09	3.41[b] ±1.10	3.45[b] ±1.11	3.50[b] ±1.14	**

[a, b] *Means within the same row with different superscripts are significant1y different at P<.05, * *= (P≤.01).*

Productive performance:

The data presented in Table (4) showed that the final live body weight (LBW) and daily weight gain (DWG) of growing NZW rabbits were higher for the treatments received diets containing 3 or 12% RH compared to the control group.

Concerning daily feed consumption (DFC) values, higher values ($p<.05$) were obtained for the groups fed RH diets at 9–13 and 5–13 weeks of age compared to the treatment group without RH. While, insignificant effect on DFC was noticed for the experimental groups during the period from 5–9 weeks of age. On the other hand, no significant differences were found between FCR values among tested groups through the experimental periods.

These results are in agreement with those reported by Adeniji, *et al.* (2014) who reported no significant effect ($P>.05$) of treatment on final live body weight, daily weight gain and daily feed intake.

Mortality number (Table 4) indicated that growing rabbits can tolerate different dietary levels of RH in their diets.

Nutrient digestibility and nutritive values:

Digestibility coefficients of nutrients of the experimental diets are presented in Table (5). Control group recorded the highest but non-significant ($P>.05$) digestibility coefficients of dry matter, organic matter, crude protein, crude fiber and nitrogen free extract compared to RH groups. Rabbits fed 12% RH had the lowest values ($P>.05$) for digestibility coefficients of organic matter, crude protein, crude fiber and nitrogen free extract compared to other groups. Rabbits fed 12% RH diet showed significantly ($P<.05$) higher ether extract than other groups. Concerning TDN values, the control group had insignificantly higher TDN as compared to RH groups.

Blood parameters:

Data of blood plasma constituents are presented in Table (6). Plasma total protein, albumin, globulin, A/G ratio, total lipids, cholesterol or ALT concentration were not significantly affected due to adding RH to rabbit diets. However, there was a significant ($P<.05$) decrease in AST value associated with using RH in rabbits diets. This may reflect that rabbits fed diets containing RH having better live-ability than those of the control group. The concentrations of total plasma protein and its fractions are within the normal ranges reported by Melby and Altman (1974). Generally, the obtained results of blood components in the present study were within the normal concentrations reported by Hillyer and Quesenberry (1994).

Although, the results of blood parameters were in normal level, but numerically, globulin and A/G ratio were improved by RH supplementation. That's mean, the rabbit's immunity had improved by RH supplementation and reducing the aflatoxin contamination. Also, liver function was improved by RH replacing and that's clear by AST concentration was significantly decreased ($p \leq .05$).

Table (4). Effect of feeding RH different levels on productive performance

Item	Control	3 % RH	6 % RH	9 % RH	12 % RH	Sig.
Live body weight (g) at:						
5 weeks	635.9 ±31.17	644.65 ±31.55	660.9 ±29.19	617.15 ±67.1	639.65 ±35.18	NS
9 weeks	1293.03 ±47.11	1340.53 ±72.32	1211.78 ±48.91	1243.03 ±54.92	1272.09 ±45.19	NS
13 weeks	1947.68 ±72.57	2055.18 ±58.68	1981.25 ±66.28	1943.93 ±43.60	1982.01 ±41.17	NS
Daily body weight gain (g) from :						
5– 9 weeks	21.89 ±1.72	23.19 ±1.99	18.37 ±2.54	20.87 ±1.31	21.05 ±1.19	NS
9 –13weeks	21.91 ±1.71	23.81 ±1.60	25.63 ±1.85	23.38 ±1.29	23.68 ±1.45	NS
5 –13 weeks	21.89 ±1.35	23.49 ±0.82	22.01 ±1.4	22.13 ±1.67	22.39 ±1.18	NS
Daily feed consumption (g) from :						
5– 9 weeks	73.97 ±2.65	81.8 ±5.91	68.72 ±3.99	76.31 ±4.58	75.20 ±4.11	NS
9 –13weeks	108.05[b] ±6.05	122.47[a] ±3.69	118.32[ab] ±2.32	112.96[ab] ±4.17	115.45[ab] ±5.11	*
5 –13 weeks	91.05[b] ±3.41	102.14[a] ±3.79	93.51[ab] ±2.61	94.64[ab] ±3.71	95.34[ab] ±3.99	*
Feed conversion ratio (Feed/Gain) from :						
5– 9 weeks	3.38 ±0.31	3.54 ±0.39	3.75 ±0.43	3.67 ±0.35	3.57 ±0.39	NS
9 –13 weeks	4.93 ±0.39	5.16 ±0.59	4.62 ±0.27	4.84 ±0.29	4.88 ±0.51	NS
5 –13 weeks	4.17 ±0.25	4.33 ±0.19	4.27 ±0.30	4.26 ± 0.27	4.24 ±0.25	NS
Mortality number	1	1	1	2	1	-

[a, b] Means within the same row with different superscripts are significant1y different at P<.05,
*Sig.= Significance, NS= Not Significant and *= ($P \leq .05$) .*

Table (5). Effect of feeding different levels of RH on nutrients digestibility coefficients (%) and nutritive values of growing rabbits

Item	Control	3 % RH	6 % RH	9 % RH	12 % RH	Sig.
Dry matter	67.48±2.96	63.41±1. 98	62.93±2.45	63.48±2.42	63.85±1.88	NS
OM	70.26 ±2.92	66.92±1.42	66.76±2.08	67.36±1.55	65.06±2.58	NS
Crude protein	75.50±2.70	72.86±2.05	72.24±1.93	71.94±1.64	70.95±1.87	NS
Ether extract	74.89[c]±1.68	75.21[c]±1.73	71.57[d]±1.65	81.34[b]±0.99	83.04[a]±1.06	
Crude fiber	47.72±4.17	45.01±3.04	42.08 ±2.91	41.63±4.33	39.71±4.38	NS
NFE	72.92±1.96	71.95±2.25	71.68±1.87	71.35±1.68	69.67 ±2.13	NS
TDN (%)	61.44±1.89	58.54±1.35	57.18±2.60	57.30±1.97	58.05±2.98	NS

[a, b,] Means within the same row with different superscripts are significant1y different at P<.05,
*Sig. = Significance, NS= Not significant and * = ($P \leq .05$).*
OM= Organic matter, NFE= Nitrogen free extract, TDN= Total digestable nutreints

Table (6). Effect of feeding different levels of RH on plasma blood parameters of growing rabbits

Parameter	Control	3 % RH	6 % RH	9 % RH	12 % RH	Sig.
Total proteins (g/dl)	7.24±0.15	7.22±0.17	6.83±0.20	7.03±0.15	6.96±0.26	NS
Albumin (g/dl)	4.59±0.28	4.17±0.40	4.37±0.32	4.03±0.38	4.00±0.36	NS
Globulin (g/dl)	2.65±0.28	3.06±0.56	2.46±0.30	3.01±0.43	2.98±0.38	NS
A / G ratio	1.72±0.31	1.34±0.36	1.75±0.34	1.35±0.29	1.34±0.40	NS
Total lipids (g/dl)	360.1±44.7	368.3±31.1	390.5±42.2	434.8±51.2	450.7±69.2	NS
Cholesterol (mg/dl)	97.47±16.31	104.98±14.9	116.43±17.9	94.13±7.5	121.34±12.8	NS
AST (IU/L)	33.20^{a} ±1.15	18.89^{b}±4.13	12.61^{b} ±2.98	14.59^{b} ±2.19	16.25^{b}±1.84	*
ALT (IU/L)	12.49±2.39	10.21±2.24	12.43±2.74	12.89±2.15	11.13±2.09	NS

[a, b] Means within the same row with different superscripts are significantly different at P<.05,
*Sig.= Significance, NS= Not significant and * = (P≤.05).*

Carcass characteristics:

Carcass traits and dressing percentage of growing rabbits like affected by different RH treatments are presented in Table (7). No significant differences were detected in all trails of carcass traits. However, higher dressing and hot carcass weight percentages were recorded for rabbits fed 3% RH. These results are in harmony with Arafa (2014) who found that edible, carcass and heart weights percentage were insignificantly differed in broiler groups received rice hulls (2.5 or 5%), 0.2% hydrated sodium calcium aluminosilicate (HSCAC) and 0.05% yeast cell wall (YCW)

Table (7). Effect of feeding RH different levels on carcass characteristics of growing rabbits

Trait	Control	3 % RH	6 % RH	9 % RH	12 % RH	Sig.
Dressing percentage	59.94 ± 1.92	61.91 ±0.88	60.08 ±0.84	60.33 ±1.03	60.57 ±1.09	NS
Hot carcass weight (%)	53.12 ± 1.53	55.47 ±0.95	53.39 ±0.99	54.06 ±0.81	54.01 ±1.04	NS
Giblets weight (%)	4.49 ±0.37	4.46 ±0.34	4.96 ±0.34	4.72 ±0.41	4.71 ±0.39	NS
Liver weight (%)	3.14 ±0.19	3.12 ±0.15	3.59 ±0.16	3.21 ±0.18	3.27 ±0.19	NS
Kidney weight (%)	0.71 ±0.07	0.65 ±0.06	0.66 ±0.08	0.80 ±0.09	0.75 ±0.08	NS
Heart weight (%)	0.32 ±0.05	0.35 ±0.06	0.38 ±0.08	0.37 ±0.07	0.36 ±0.04	NS
Body skin weight (%)	18.12 ±0.48	17.61 ±0.54	18.02 ±0.79	17.45 ±1.05	17.89 ±0.59	NS

[a, b] Means within the same row with different superscripts are significant1y different at P<.05),
Sig.= Significance NS=Not Significant.

Economic evaluation:

Data for economical evaluation are summarized in Table (8). The economical evaluation was calculated on the recent prices of local market for feed ingredients and selling price of live rabbits during experimental period. The average cost/ Kg of final experimental diet ranged between 4.25 and 4.32 LE and it was clear that using RH at levels 3 or 6% relatively reduced cost / Kg final diets, while the highest levels of RH 9 or 12% relatively increased cost / Kg compared with the control group. This difference could be explained on the basis that DE Kcal /Kg content of RH were much lower than clover hay (463.9 vs. 1795 DE Kcal / Kg). By using RH, it was necessary to increase the level of the expensive vegetable oil in diet, in order to keep experimental diets iso-caloric.

However, the obtained results showed that RH incorporated at 6% on the expense of clover hay supported the calculated economic efficiency and relative economic efficiency of rabbits as efficiently as the control diet being (65.71 vs. 63.07 and 104.2 vs. 100.0) respectively. These results are in general agreement with those reported by Arafa *et al.*, (2012) who stated that feeding broiler chicks 2.5% RH presented similar economic efficiency compared to those of control group. Concerning PI and PEF values, rabbits fed 6% RH presented higher values when compared with the control group and other group.

Table (8). Effect of feeding RH different levels on economic evaluation of growing rabbits

Item	Control	3 % RH	6 % RH	9 % RH	12 % RH
Average of feed consumed (Kg/rabbit)	5.64	6.13	5.61	5.68	5.72
Price/kg feed(L.E)	4.28	4.25	4.26	4.29	4.32
Total feed cost (LE)	24.14	26.05	23.90	24.37	24.71
Average weight gain(Kg/rabbit)	1.31	1.41	1.32	1.33	1.34
Price/kg live body weight (LE)	30	30	30	30	30
Total return (LE)	39.36	42.31	39.60	39.78	40.27
Net return (LE)	15.22	16.26	15.70	15.40	15.56
Economic efficiency (%) ¤	63.07	62.40	65.71	63.23	62.97
Relative economic efficiency (%) #	100	98.95	104.20	100.26	99.85
Performance index	46.71	47.46	46.39	45.61	46.75
Production efficiency factor (PEF)	77.85	79.10	77.32	70.59	77.91

¤ *Economic efficiency= net return/total feed cost*100. Whereas net revenue= total return - total feed cost.*
 # Assuming that the relative economic efficiency of the control diet equals 100.

CONCLUSION

From the present results, it could be stated that adding rice husks at inclusion rate 6% to practical rabbit diet as a replacement of clover hay would have a positive effect on economic efficiency of growing rabbit without any adverse effect on productive performance or carcass traits of rabbits comparable to the control.

REFERENCES

Abdel Rahman, M. S., W. U. Biobaku, E. A. Abdul and E. B. Babalola (2008). Growth responses of rabbits fed graded level of groundnut shell; Effect on weight and enzyme acitivites. Journal of Pure and Applied Science. 1:44 - 50.

Adeniji, A.A., H. Duwa and M. Umar (2014). The Value of Rice Husk Fed with or Without Probiotics and Enzymes Supplementation to Replace Groundnut Cake in the Diets of Grower Rabbits. Globale Journal Bio. Agr. Healthe Sci.,Vol. 3 (4): 48-54.

Adeluku, A. A., M. E. Aduke, E. E. Harris and S. Eva, (2004). The value of rice husk diet, Aimual report, Institute of animal research, Mankon, Cameroun, Pp. 34 -36.

AOAC (2005). Association of Official Analytical Chemists. Official methods of analysis 18th Ed. Washington D.C., USA.

Arafa, A.S.M. (2014). Using some feed ingredients as antitoxins in broiler diets. M. Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Arafa, A.S.M.; F. Abdel-Azeem; M. El-Sanhoury and M.A. Shebl (2012). Using rice hulls as antitoxin in broiler diets. 11th Conf. Agric. Dev. Res., Fac. Agric., Ain Shams Univ., Egypt. 70-82.

Cheeke, P. R., N.M. Patton and G.S. Tempelton (1982). *Rabbit production*. 5th Edition, Interstate Printers and Publishers Danville II., USA.

Doumas, B.T., W. Wabson and H.G. Biggs (1971). Albumin standards and measurement of plasma albumin with bromocresol green. Clinical Chemical Acta, 31:87.

Duncan, D.B. (1955). Multiple range and multiple F test. Biometrics, 11:1-42.

Emmert, J. (2000). Efficiency of phase-feeding in broilers. Proceeding. California Animal Nutrition Conference. May 10-11. Fresno California, USA.

Fekete, S. and T. Gippert (1986). Digestibility and nutritive value of nineteen important feedstuffs for rabbits. Journal of Applied Rabbit Research, 9 (3): 103-108.

Gidenne, T. (2000). Recent advances in rabbit nutrition: Emphasis on fiber requirements. Review. World Rabbit Sci.,8 (1), 23-32.

Gidenne, T. and J. M. Perez (2000). Replacement of digestible fiber by starch in the diet of the growing rabbit. 1- Effects on digestion, rate of passage and retention of nutrients. Ann. Zootech. 49: 357-368.

Goering, H. K. and P.T. Van Soest (1970). Forage fiber analysis (apparatus, reagent, procedures and some applications). ARS, US. Dept. Agr. Handbook, Washington, DC. 20402.

Gornall, A.C., C.J. Bardawill and M.M. David (1949). Determination of plasma protein by means of the biurent reaction. Journal of Biological Chemistry, 177: 751.

Hillyer, E.V. and K.E. Quesenberry (1994). Ferrets, Rabbits and Rodents clinical medicine and surgery. *Basic Approach to Veterinary Care Rabbits* 165-166.

Huwing, A., S. Freimund, O. Kappeli and H. Dutler (2001). Mycotoxin detoxification of animal feed by different adsorbents. Toxicology Letters 122: 179-188.

Lebas, F., P. Coudert, H. Rochambeau and R. G. Thẻbauff (1997). Nutrition and feeding. The rabbit. husbandry, heath and production, pp: 19-44.

Melby, E.C. and N. H. Altman (1974). *Biochemical constituents of serum* in: Hand Book of Laboratory Animal Science E.C. Merck (1974).

North, M.O. (1981). Commercial chicken. Production Annual. 2nd Edition, Av., Publishing Company I.N.C., West Post. Connecticut, USA.

Omole, T. A. and 0. E. Ajayi, (2006). Improving the nutritive value of rice by chemical treatments; World Animal Reviews 20: 11-31.

Perez J.M., F. Lebas, T. Gidenne, L. Maertens, G. Xiccato, R. Parigi-bini, A.R. Dalle-zotte, M.E. Cossu, A. Carazzolo, M.J. Villamide, R. Carabaño, M.J. Fraga, M.A. Ramos, C. Cervera, E. Blas, J. Fernández, E. Falcao, L. Cunha and J. Bengala Freire (1995). European reference method for in vivo determination of diet digestibility in rabbits. *World Rabbit Science*, 3: 41-43.

Reitman, S. and S. Frankel (1957). A colorimetric method for the determination of plasma aspartate aminotransferase and alanine aminotransferase. American Journal of Clinical Pathology, 28: 56-63.

Richmond, W. (1973). Determination of cholesterol in blood plasma by enzymatic colorimetric method. Clinical Chemistry, 19: 1350.

Roos, A.H.; H.J. Van der Kamp and E.C. Marley (1997). Comparison of immununeaffinity columns for the determination of aflatoxin in animal feed an maize. Mycotoxin Research, 13: 1-10.

SAS., (2004). SAS procedure Guide, Version 6.12 th. SAS Institute, Cary, NC.,

Steven, W.D., W.D. Hohenboken, P.R. Cheeke, N.M. Patton and W.H. Kennick (1981). Carcass and meat characteristics of Flemish Giant and New Zealand White purebred and terminal cross rabbits. Journal of Applied Rabbit Research., 4: 66.

Zollner, N. and K. Kirsch (1962). Determination of total lipids in blood plasma by a colorimetric method. Z. Ges. Exp. Med., 135:545.

تأثير استخدام سرسة الأرز في تغذية الأرانب النامية كمضاد للأفلاتوكسين

مراد حامد شاكر السنهوري
قسم إنتاج الدواجن – كلية الزراعة – جامعة عين شمس.

أجريت هذه التجربة للتعرف علي تأثير استخدام قشور الأرز كمضاد للسموم ومصدر للألياف في أعلاف الأرانب. حيث أستخدم قشور الأرز بمعدل 0 و 3 و 6 و 9 و 12٪ على حساب دريس البرسيم في اعلاف الأرانب النامية. تم استخدم عدد 75 أرنب مفطوم غير مجنسين من النيوزيلاندي الأبيض عمر 5 أسابيع وقسمت الأرانب إلى خمس مجموعات تجريبية (15 أرانب / مجموعة) واستمرت التجربة لمدة 8 أسابيع. وكانت أهم النتائج المتحصل عليها من استخدام قشور الأرز في أعلاف الأرانب النامية هي:

* انخفاضا معنويا لمحتوى أعلاف الأرانب النامية والروث من الأفلاتوكسين
* لم يكن هناك تأثيرا معنوي على الأداء الإنتاجي (لوزن الجسم و الزيادة اليومية في وزن الجسم و معامل التحويل الغذائي) الا أن 3% من قشور الأرز زادت معنويا من استهلاك العلف بالمقارنة بالكنترول.
* لم تتأثر معاملات الهضم للمركبات الغذائية المختلفة فيما عدا مستخلص الدهون.
* لم تتأثر مكونات بلازما الدم بالمعاملات الغذائية فيما عدا (AST) حيث انخفضت معنويا.
* لم تتأثر صفات الذبيحة بالمعاملات الغذائية.
* أفضل كفاءة اقتصادية سجلت عند استخدام 6٪ قشور الأرز في أعلاف الأرانب النامية مقارنة بالكنترول.

نستخلص من هذه الدراسة انه يفضل استخدام 6٪ قشور الأرز كمضاد للأفلاتوكسين وكمصدر للألياف في أعلاف الأرانب النامية بدون أي تأثير سيئ على الأداء الإنتاجي وصفات الذبيحة مع تحقيق أفضل كفاءة اقتصادية.