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Utilization of Treated Mangro Leaves Meal in Pullet Diets and its Effect on Subsequent Hens Performance

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Abstract: This work aimed to improve the nutritive value of mangro leaves meal by cooking for 30 minutes or by supplementing either biogen or spices mixture e.g. Cardamom, Cumin, Hot and Black Pepper. The effects of feeding this meal on the productive performance during pullets development (8-20 wks of age) and laying hens periods (21- 28 wks of age) were determined. Four hundred and fifty 8- week old Hy- line egg strain female chicks were randomly divided into 15 dietary treatments in 5 replicates each of 6 birds. Each group during the studied periods was fed one of the 5 experimental diets without or with either biogen or spices mixture. Growth performance and nutrient digestibility during the pullet period (8-20 wks of age), while age at sexual maturity, egg production traits and the changes in body weight, ovary and oviduct, spleen and liver weight studies during the laying period (21-28 wks of age) were studied. Results obtained showed that the proximate analysis of mangro leaves meal showed that it contains reasonable amounts of protein and nitrogen free extract as well as relatively high amount of fiber. Boiling process tends to improve the mangro meal content of protein and decrease its content of ash and some of the anti-nutritional factors such as tannins. Improved feed conversion was associated with increased feed intake which contributed to the tendency of increase in body weight. Cooking treatment significantly increased pullets growth gain and improved feed conversion ratio, whereas feed intake and the number of dead pullets were not affected. Although, either Biogen or spices mixture had no enhancing effect on growth gain, feed intake and feed conversion rate tended to improve. Increasing inclusion level of mangro meal up to 10% significantly decreased laying rate, egg mass and impaired feed conversion. The opposite was true with 5% of the tested material since it imposed less effect. Neither boiling process nor either studied feed additives (biogen and spices mixture) had enhancing effect on most of the studied parameters of laying hens performance. It may be concluded that pullets can tolerate cooked mangro leaves meal at level 5% alone or 10% with Biogen supplementation to achieve comparable feed conversion to that of the control. Along the same line, laying hens can tolerate this tested material at level 5% alone without adversely affecting the layer performance.

Key words: Mangro leaves, egg production, Biogen supplementation

Introduction

In many countries, including Saudi Arabia, poultry feed is based primarily on corn and soybean meal which being the most expensive components of poultry diets. Fortunately, high fiber containing feedstuffs are utilized successfully in pullets and layers nutrition. Akiba and Matsumoto (1978) found that feeding of cellulose did not affect body weight gain and feed efficiency. Vargas and Naber (1984) found that dietary fiber (nutrients density) had no significant effect on egg production, egg weight, body weight change and energy balance. El-Deek *et al.* (1995) using experimental diets containing corn with cob, rice polishing and wheat bran at 20% or other combination of each two (40%) or three (60%) ingredients showed that Alexandria pullets growth during 8 to 23 wks of age, feed conversion ratio, egg number at 10% egg production and mortality rate were not affected by dietary composition. Moreover, El-Deek *et al.* (1988) with casuarinas branch lets; Osei *et al.* (1990) with gliricidia leaf meal; Yassein *et al.* (1998) with *leucaena leucocephala* and Talaat (2003) with *kochia*

indica indicated that, no adverse effects were recorded on performance of pullets and laying hens. On the other hand, Erstow *et al.* (1982) reported that pectin, lignin and alginate reduced chicks growth as feeding inclusion levels of dietary folacin-containing diet.

Mangro is a fast- growing leguminous plants. Its leaves are widely regarded as a source of reasonable quality protein (National Academy of Sciences, 1979) which makes it a promising feed for poultry. Like most halophytes, its ash content and anti-nutritional activity of cell wall, non starch polysaccharides (NSP), had an impairing effects on growth of birds (Choct and Anninson, 1992 and King *et al.*, 1997). Consequently, several feed processing techniques being introduced in an attempt to improve the nutritive quality of the non-conventional feedstuffs through correcting their nutritional defect.

Ghazalah (1996) explained the beneficial effect of boiling leucaena leaf meal in water to the ability of water as a solvent on the hydrogen bonds exist between the phenolic groups which represent the structure of the

Table 1: Proximate chemical analysis of raw and boiled Mangrof leaves meal

Type of meal	Dry matter,%	Crude protein,%	Crude fiber,%	Ether extract,%	Crude ash,%	NEF,%	Tannins, mg/g
Raw	94.43	9.26	16.68	8.23	19.35	40.65	10.41
Boiled	91.97	9.11	15.53	8.09	16.65	40.23	8.19

memosine and tannin nuclei, thereby, converting these deleterious materials to less toxic form. Also, the negative effects of anti-nutritive substances are normally eliminated by heating (Araba and Dale, 1990 a,b). The present advantage of natural feed additives could improve the utilization of nutrient substances for poultry diets (Makled, 1993). Biogen is a kind of non-antibiotic feed supplement. It's main ingredients include allicin, organic selenium, high unit hydrolytic enzymes. Hence, it has particular good flavor and appetizing function which can increase the palatability of feed, promote the secretion of digestive fluids and stimulate the appetite (Mona Osman, 2002). Moreover, there is a trend to use different spices to improve nutrient utilization with considerable success (Al-Harhi, 2002 and Abdo Zeinab *et al.*, 2003).

Due to the scarcity of information concerning the nutritive value of mangrof leaves meal as feedstuff in the pullet and laying hen diet, the present research was undertaken to investigate to what extent mangrof leaves meal could be included in pullets and layers diets without depressing their performance. The effect of treating the tested material with boiling water and incorporating Biogen and mixture of different spices supplemented to the experimental diets of pullet and laying hen on their productive performance was studied as well.

Materials and Methods

Four hundred and fifty -8 week old Hy - line chicks as a commercial egg strain were used for this study. Birds were reared in environmental controlled house at poultry experimental farm, faculty of Meteorology Environmental and Arid Land Agriculture, King Abdulaziz University. Part of the tested material (mangrof leaves meal) was processed by cooking in boiling water for 30 minutes and then dried to ~ 90% dry matter in air ventilated oven. Cooked and raw mangraf leaves were ground in a hammer mill to obtain a homogenous products for chemical analysis, according to the official methods (A.O.A.C, 1990) and feed formulation.

Dietary treatments included 3 levels of either raw or cooked mangrof leaves meal (0, 5 and 10%). Biogen* (0.5 g/kg) and spices mixture (2 g./kg) e.g. cardamom, cumin, hot and black pepper supplementation (1:1:1:1) were incorporated to the studied pullet and layer diets. Each of the 15 dietary treatments included 5 replicates of 6 chicks each. Birds were assigned to each dietary treatment and housed in 90 x 90x 40- wire cage. The composition and calculated analysis of the experimental

diets are shown in Table 2 which were formulated to be iso-coloric and iso-nitrogenous to meet strain requirements according to pullets and laying hens management and feeding guide. Individual body weight of birds to the nearest g, at 8, 11, 14, 17 and 20 wks of age were measured, then weight gain was calculated. Feed consumption for each replicate was also measured during the same studied experimental periods and feed conversion ratio was then calculated. At the end of pullet-development period (20 wks old), a total collection method for excreta was employed to determine nutrients digestibility. Excrement samples (feces + urine) were dried at 45 5C for five days and their dry matter, crude protein, fat, crude fiber and ash content as well as those of feed were determined according to the procedure of A. O. A. C (1990) and expressed on a dry matter basis.

During the experimental period of egg production (21-28) wks old, changes in body weight, egg production (h/d), egg weight, feed intake and feed conversion ratio were measured. Then, age at 30% laying rate, egg mass and feed conversion rate were calculated. At the end of the studied laying period (28 wks old), five hens were randomly chosen from each treatment and slaughtered to determine the effect of studied treatments on the relative and absolute weights of oviduct, ovary, spleen and liver.

Analysis of variance was performed using SAS software computer program (SAS, 1985) and student Newman Klaus Test to obtain the different probabilities. Analysis of variance was done using three ways analysis of variance testing the main effects of Mangrof levels, processing (boiling treatment and feed additives) and the interaction among them.

Results and Discussion

Nutritive value of mangrof leaves meal: The chemical analysis of raw and boiled mangrof leaves meal are presented in Table 1. The results indicated that it contains reasonable amounts of crude protein, fat, nitrogen free extract (NFE) and high amount of crude fiber. By cooking, the crude fiber and ash content were decreased by about 6.89 and 13.95%, respectively. Therefore, the tested material could be considered suitable feed for feeding poultry. Tannins content of mangrof leaves meal were also reduced by about 21.3% due to cooking.

This may be attributed to the effect of boiled water as a solvent on the hydrogen bonds exist between the phenolic groups which represent the structure of the

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Table 2: Composition and calculated analyses of the pullets and layers experimental diets

Ingredients	Mangrof levels in pullet diets,%			Mangrof levels in Laying diets,%		
	0.0	5.0	10.0	0.0	5.0	10.0
Yellow corn	61.10	61.00	60.90	50.20	49.9	49.65
Soybean meal (44%cp)	15.52	16.62	17.72	24.70	26.00	27.25
Wheat bran	20.0	14.0	8.00	12.0	6.00	0.00
Mangrof leaves meal	0.0	5.0	10.0	0.0	5.0	10.0
Commercial oil blend	0.0	0.0	0.0	3.50	3.50	3.50
Limestone	1.26	1.26	1.26	7.50	7.50	7.50
Dicalcium Phosphate	1.57	1.57	1.57	1.45	1.45	1.45
Vit + Min mix ¹	0.30	0.30	0.30	0.30	0.30	0.30
NaCl	0.25	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.00	0.00	0.00	0.10	0.10	0.10
Total	100.0	100.0	100.0	100.0	100.0	100.0
Calculated values:ME, Kcal/Kg diet	2653	2661	2669	2702	2710	2725
Crude protein,%	15.17	15.18	15.19	17.02	17.09	17.18
TSAA, %	0.53	0.53	0.53	0.66	0.66	0.66
Lyine,%	0.70	0.70	0.70	0.86	0.86	0.86
Ca, %	0.90	0.90	0.90	3.25	3.25	3.25
Available P, %	0.42	0.42	0.42	0.39	0.39	0.39

¹vitamins and minerals mixture provide per kilogram of diet: Vitamin A (as all-trans-retinyl acetate); 12000IU; vitamin E (all rac- α -tocopheryl acetate); 10IU; k₃ 3mg; Vit. D₃, 2200 ICU; riboflavin, 10mg; Ca pantothenate, 10mg; niacin, 20 mg; choline chloride, 500mg; vitamin B₁₂, 10Ug ; vitamin B₆, 105mg.; thiamine (as thiamine mononitrate), 2.2 mg; folic acid, 1mg; D-biotin, 50ug. Trace mineral (milligrams per kilogram of diet): Mn, 55; Zn, 50; Fe, 30; Cu, 10; Se, 1 and Ethoxyquin 3 mg.

Table 3: Body Weight and gains of Hy-line pullets during (8-20) wks of age as affected by levels of raw or boiled Mangrof meal in diets supplemented with Biogen® or spices mixture

Mangrof level, %	Boiling	Feed additive	Body weight, at					Total gain, (8-20) wks
			8- wks	11- wks	14- wks	17- wks	20- wks	
0.0	-	-	443.4	657.7	905.5	1059.2	1210.0	766.6
		Biogen	447.8	617.6	880.2	1065.8	1165.8	718.0
		Spices	446.7	624.4	885.0 ^a	1054.2	1195.0	748.3
Mean			446.0	633.2	890.2 ^a	1059.7 ^a	1190.3	744.3
5.0	-	-	439.3	628.3	882.5	1042.5	1175.0	735.3
		Biogen	453.3	630.7	890.8	1075.0	1219.2	765.9
		Spices	440.4	607.1	883.3	1054.2	1196.7	756.3
	+	-	447.6	658.9	888.7	1082.2	1251.7	804.1
		Biogen	447.6	595.6	873.3	1061.7	1215.0	767.4
		Spices	438.0	613.0	906.7	1053.3	1216.7	778.6
Mean			444.4	622.3	887.6 ^a	1061.5 ^a	1212.4	768.01
0.0	-	-	455.3	593.8	809.2	1005.0	1200.0	744.7
		Biogen	439.8	617.8	858.0	1020.8	1185.8	746.0
		Spices	444.8	586.8	836.7	1030.0	1180.0	735.2
	+	-	448.0	584.4	841.7	1029.2	1187.5	739.5
		Biogen	429.7	605.2	868.3	1067.5	1169.2	739.5
		Spices	441.0	615.0	874.2	1062.5	1230.0	789.0
Mean			443.1	600.5	848.0 ^b	1035.8 ^b	1192.1	749.0
Mean effect of boiling treatment								
	-		445.6	618.2	870.1	1045.2	1191.9	746.3 ^b
	+		442.0	612.0	875.5	1059.4	1211.7	769.7 ^a
Mean effect of feed additives								
		-	446.7	624.6	865.5	1043.6	1204.8	758.1
		Biogen	443.6	613.4	874.1	1058.2	1191.0	747.4
		Spices	442.2	609.3	877.2	1050.8	1203.7	761.5
		SEM	5.84	20.68	16.70	14.00	19.47	20.53
ANOVA								
Mangrof level			NS	0.06	0.0001	0.001	NS	NS
Boiling			NS	NS	NS	0.01	NS	0.05
Feed additives			NS	NS	NS	NS	NS	NS
Level x Boiling			NS	NS	NS	NS	NS	NS
Level x Additives			NS	NS	NS	NS	NS	NS
Boiling X Additives			NS	NS	NS	NS	NS	NS
Level X Boiling X Additives			NS	NS	NS	NS	NS	NS

^{a,b} Means within a column within the same treatment bearing different superscripts are significantly different.

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Table 4: Feed Consumption of Hy- line pullets during 8-20 wks of age as affected by level of raw or boiled Mangrof meal in diets supplemented with Biogen or spices mixture

Mangrof level, %	Boiling	Feed additive	Feed consumption, g./bird during				
			8-11 wks	12-14 wks	15-17 wks	18-20 wks	8-20 wks
0.0	-	-	1079.9	1060.9	1308.2	1476.9	3818.2
		Biogen	1037.1	1052.0	1243.4	1355.3	3671.3
		Spices	1054.2	1100.5	1266.8	1364.9	3762.7
Mean			1057.0	1071.1 ^b	1272.8 ^b	1399.1 ^b	3750.8 ^b
5.0	-	-	1028.3	1080.3	1369.2	1439.0	3837.6
		Biogen	1049.6	1107.3	1283.8	1523.3	3821.5
		Spices	1074.8	1106.3	1364.3	1533.0	2928.6
	+	-	1071.6	1096.6	1294.1	1457.7	2826.7
		Biogen	1030.7	1046.5	1372.7	1560.3	3840.0
		Spices	1066.1	1095.9	1217.8	1400.8	3730.0
Mean			1053.5	1088.8 ^{ab}	1317.0 ^{ab}	1485.7 ^a	3830.7 ^b
10.0	-	-	1060.4	1097.6	1412.4	1556.5	3959.5
		Biogen	1058.4	1101.0	1384.2	1531.2	3926.4
		Spices	1044.2	1104.7	1345.7	1415.0	3848.4
	+	-	1071.2	1128.2	1426.2	1532.4	4008.7
		Biogen	1056.6	1127.1	1307.8	1427.4	3848.5
		Spices	1089.1	1111.5	1379.6	1546.0	3966.7
Mean			1063.3	1111.7 ^a	1376.0 ^a	1501.4 ^a	3926.4 ^a
Mean effect of boiling treatment							
-			1054.1	1090.1	1330.9	1487.4	3841.6
+			1064.2	1101.0	1333.0	1466.1	3870.1
Mean effect of feed additives							
		-	1062.3 ^a	1092.7	1362.0	1492.5	3890.2
		Biogen	1046.5 ^b	1086.8	1318.4	1479.5	3821.5
		Spices	1065.7 ^a	1103.6	1314.9	1452.0	3890.2
SEM			12.92	85.32	45.42	56.51	114.05
ANOVA							
Mangrof level			NS	0.03	0.005	0.05	0.001
Boiling			NS	NS	NS	NS	NS
Feed additives			0.02	NS	NS	NS	NS
Level x Boiling			NS	NS	NS	NS	NS
Level x Additives			NS	NS	NS	NS	NS
Boiling X Additives			NS	NS	NS	NS	NS
Level X Boiling X Additives			NS	NS	NS	NS	NS

^{a-b} Means within a column within the same treatment bearing different superscripts are significantly different.

tannin nuclei. Thereby, converting these deleterious materials to less toxic form and improving the feeding value of the tested. Abd-Alla (1993); Ghazalah (1996) and Talaat (2003) who found that boiling process of the tested feedstuff decreased some of the anti-nutritional factors such as tannins.

Pullet-development performance: Results of pullets performance during different growth periods are presented in Table (3, 4, 5 and 6). Considering the whole period, it is clear that including mangrof leaves meal up to 10% in the experimental pullet diets linearly increased feed consumption, although all experimental diets were formulated to satisfy nutrient requirements of pullets according to the strain catalog recommendation. This increment was significant by about 4.68% over that of the control. It may be related to the fact that the birds have to increase their feed intake to meet energy requirements. Also, a tendency for pullets body weight change to increase was noticed among experimental

birds in this respect but such increase was insignificant. Such finding could be attributed to the ability of mangrof leaves meal to provide enough and adequate nutrients for normal development of the studied birds. Along the same line, the digestibility of OM, CP, EE, CF and Ca were not significantly affected by increasing inclusion levels of the tested material up to 10 %, indicating no adverse effects on nutrient utilization. So, improved feed conversion was associated with increased feed intake which contributed to the tendency of increase in body weight. Mortality rate was also not affected. The present finding is well correlated with the findings of El-Deek, (1995 and 2003) and Talaat (2003) who indicated that high fiber containing diets had no adverse effect on mortality rate. Although, the best values of growth gain and feed conversion ratio were obtained as using 5% of mangrof leaves meal in the experimental diet, no significant difference was found between this treatment and that of the control. Concerning boiling process of mangrof leaves meal, it

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Table 5: Feed conversion ratio and number of dead Hy- line pullets during (8 -20) of age as affected by level of raw or boiled Mangrof meal in diets supplemented with Biogen® or spices mixture

Mangrof level, %	Boiling	Feed Additive	Feed conversion ratio during period of					N. Of dedd at (8-20) wks
			(8-11) Wks	(11-17) wks	(14-17) wks	(17-20) wks	(8-20) wks	
0.0	-	-	5.08	4.28	7.92	13.8	5.73	1
		Biogen	7.41	5.18	9.12	8.1	6.25	1
		Spices	5.76	4.4	7.14	10.18	5.79	0
Mean			6.08	4.62	8.06	10.7	5.93ab	0.66
5.0	-	-	5.65	4.4	8.67	10.98	6.03	0
		Biogen	6.22	4.28	7.05	11.07	5.82	1
		Spices	7.37	4.04	8	10.92	6.07	1
	+	-	5.26	4.85	6.92	8.61	5.66	1
		Biogen	9.07	3.88	7.37	10.39	5.89	0
		Spices	7.09	3.74	8.81	8.72	5.69	1
Mean			6.78	4.2	7.8	10.11	586b	0.66
10.0	-	-	8.25	5.1	7.25	7.98	6.62	1
		Biogen	6.08	4.62	8.62	9.61	6.31	1
		Spices	8.41	4.54	6.99	9.45	6.18	0
	+	-	7.93	4.39	7.6	10.03	6.47	0
		Biogen	6.04	4.49	6.72	1098	5.81	0
		Spices	6.31	4.29	7.38	9.59	5.98	1
Mean			7.17	4.58	7.43	9.61	6.23a	0.5
Mean effect of boiling treatment								
-			6.69	4.54	7.86	10.01	6.10?	0.66
+			6.95	4.28	7.47	9.72	5.92?	0.5
Mean effect of feet additives								
-			6.43	4.61	7.67	10.28	6.1	0.33
Biogen			6.96	4.49	7.77	10.03	6.02	0.6
Spices			6.99	4.21	7.67	9.77	5.94	0.6
SEM			1.541	0.562	1.087	1.946	0.256	---
ANOVA								
Mangrof level			NS	NS	NS	NS	0.01	---
Boiling			NS	NS	NS	NS	0.02	---
Feed additives			NS	NS	NS	NS	NS	----
Level x Boiling			NS	NS	NS	NS	NS	----
Level x Additives			NS	NS	NS	NS	NS	----
Boiling x Additives			NS	NS	NS	NS	0.04	----
Level x Boiling x Additives			NS	NS	NS	NS	NS	----

a-b Means within a column within the same treatment bearing different superscripts are significantly different.

is obvious that cooking treatment significantly increased pullets growth gain by about 3.1% and improved FCR by about 2.95% whereas, no significant effect was recorded for the parameter of feed consumption. Boiling treatment had no effect on the number of dead pullets. This improvement may be attributed to increase the nutritive value of the tested material as a result of reducing the anti-nutritional substances such as tannins and ash content (Svihus *et al.*, 1997; Yasar and Forbes, 1999, 2000; Talaat, 2003). Inspection in Table 6, it is clear that boiling treatment had no significant effect on the digestibility of OM, EE, CF, CP and Ca, while, crude protein digestibility was increased by about 1.4% over the un-cooked one.

Regarding the feed additives effects, either Biogen or mixture of studied spices supplementation had no enhancing effect on growth gain and feed intake, whereas feed conversion rate tended to improve but without significant. The effectiveness of these additions was in agreement with those reported by Mona Osman

et al. (2002), Al-Harhi (2002) and El- Ghamry *et al.* (2004). However, It is worthy to note that function of spices mixture is more effective than Biogen one (2.6 vs.1.3%). Furthermore, supplemented diets with either Biogen or different spices addition had no significant effect on OM, CP, EE, CF and Ca digestibility as well as the number of dead birds. It may be concluded that the lack of enhancing effect of different feed additives used herein indicated that pullets performance was satisfied by composition of the experiment diets.

Regarding interaction effects, growth, feed consumption, feed conversion ratio and mortality were not significantly affected by the interaction between inclusion levels of mangrof leaves meal with either boiling process or feed additives, nor by boiling treatment and feed additives expect that of feed conversion parameter, nor by the three way interaction between inclusion levels of mangrof meal, feed additives and boiling treatment. On the other hand, there was significant interaction between inclusion levels of the tested material and either boiling

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Table 6: Nutrient digestibility of Hy-line pullets as affected by level of raw or boiled Mangrof meal in diets supplemented with Biogen® or spices mixture during (8-20) wks of age

Mangrof level, %	Boiling	Feed additive	Digestibility of nutrient, %				
			CP	EE	CF	OM	CA
0.0	-	-	72.3	69.1	17.3	80.3	15.5
		Biogen	81.5	79.6	28.7	84.2	25.5
		Spices	81.5	78.0	32.1	84.3	26.2
Mean			78.4	75.6	26.0 ^b	82.9	19.1
5.0	-	-	83.4	80.9	27.0	84.2	36.3
		Biogen	83.2	76.7	29.1	83.9	22.7
		Spices	78.4	66.9	30.5	82.0	11.30
	+	-	78.4	71.5	20.3	82.3	15.9
		Biogen	68.8	70.2	26.9	83.8	19.1
		Spices	77.4	69.7	13.3	81.5	30.8
Mean			80.6	72.7	24.5 ^b	83.0	18.2
10.0	-	-	81.8	73.7	35.5	82.7	30.1
		Biogen	78.1	59.7	32.3	80.3	26.5
		Spices	80.8	70.5	48.4	83.3	17.7
	+	-	86.3	76.6	41.3	83.9	36.9
		Biogen	81.6	72.8	31.8	81.5	23.0
		Spices	80.6	72.7	34.9	81.5	24.5
Mean			81.5	71.0	37.4 ^a	82.2	26.5
Mean effect of boiling treatment							
		-	80.1	72.9	31.2	82.8	22.4
		+	81.2	72.3	28.1	82.4	20.5
Mean effect of feed additives							
		-	80.4	74.3	28.3	82.7	24.9
		Biogen	81.4	71.8	29.8	82.7	23.4
		Spices	79.7	71.6	31.8	82.5	16.7
SEM			5.35	3.92	9.25	2.23	9.87
ANOVA							
Mangrof level			NS	NS	0.04	NS	NS
Boiling			NS	NS	NS	NS	NS
Feed additives			NS	NS	NS	NS	NS
Level x Boiling			NS	0.03	NS	NS	NS
Level x Additives			NS	0.01	NS	NS	NS
Boiling x Additives			NS	NS	NS	NS	NS
Level x Boiling x Additives			NS	NS	NS	NS	NS

^{a-b} Means within a column within the same treatment bearing different superscripts are significantly different.

process or feed additives for digestibility of EE. This indicates that the effect of either boiling treatment or feed additives on fat utilization depends on inclusion levels of mangrof leaves meal. Generally, great attention should be directed to tannins and ash content of the tested material which might be critical factors and could be overcome by cooking in boiling water for 30 minutes plus Biogen supplementation. So, it may be concluded that pullet can tolerate cooked mangrof leaves meal even at a level of 5% alone as a non-traditional feedstuff or 10% of this tested material with Biogen supplementation to achieve comparable feed conversion to that of the control.

Laying hens performance: The results in Table 7, indicated that although dietary mangrof leaves meal at 5% had no significant effect on the parameters of laying rate, egg weight, egg mass and feed conversion during the experimental period, 21–28 wks of age period, value of feed consumption was significantly increased by

about 4.98% over that of the control. These results are in agreement with those reported by El-Deek *et al.* (1988) who found that casuarinas branch lets up to 8% in laying hen diets had no adverse effect on egg production. Also, Udedibie and Lgwe (1989) showed that pigeon pea leaf meal in laying ration did not affect egg yield, while increased inclusion level up to 20% significantly decreased laying rate. On the other hand, increasing inclusion level of mangrof meal up to 10% significantly decreased laying rate, egg mass and impaired FCR however, feed intake and weight gain was significantly increased. Similar to this finding, Udedibie and Lgwe (1989) revealed that increasing inclusion level of Pigeon pea leaf up to 20% significantly decreased egg production. The inferior performance could be attributed to perhaps to the formulation of protein-tannin complexes in the gut which results in limiting dietary protein availability (Akbar and Gupta, 1985). Meanwhile, no adverse effect was recorded on mortality rate, age at 30% laying rate, ovary weight and its percentage, spleen

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Table 7: Layers performance as affected by level of raw or boiled Mangrof meal in diets supplemented with Biogen ® or a spices mixture during (21-28) wks of age

Mangrof levels, %	Boiling	Additive	Age at 30% Laying rate, d.	Body weight changes	Laying performance					
					Laying rate, %	Egg Weight, (g.)	Egg mass, (g.)	Feed intake, (g.)	FCR	N. Of Dead hens
0.0	-	-	152.3	56.9	61.7	49.9	30.7	84.7	2.81	0.33
		Biogen	150.3	78.1	52.7	46.2	24.3	79.2	3.37	1.00
		Spices	152.0	46.8	56.2	52.8	29.7	81.6	2.75	0.00
Mean			151.6	60.6 ^b	56.7 ^a	49.6	28.2 ^a	81.8 ^b	2.98 ^b	0.44
5.0	-	-	151.7	144.4	51.4	47.8	24.5	81.5	3.37	1.33
		Biogen	154.0	70.5	57.4	49.7	28.5	87.2	3.08	0.33
		Spices	156.3	32.2	57.3	51.1	29.1	86.3	2.97	0.67
	+	-	152.3	25.9	55.0	49.6	27.3	87.9	3.28	0.00
		Biogen	154.0	101.1	55.5	52.2	28.8	89.2	3.12	1.00
		Spices	155.3	53.7	52.9	49.5	26.2	82.8	3.46	0.33
Mean			153.9	60.8 ^b	54.9 ^a	50.0	27.4 ^a	85.8 ^a	3.21 ^b	0.61
10.0	-	-	154.0	155.4	42.6	47.2	20.1	85.9	4.36	0.67
		Biogen	155.0	84.6	50.7	51.3	26.0	91.3	3.52	0.33
		Spices	154.7	124.1	47.3	51.2	25.5	90.7	3.56	0.00
	+	-	152.7	116.7	48.1	49.0	23.1	88.1	4.07	0.00
		Biogen	152.0	175.0	47.3	49.0	23.5	86.8	3.70	0.00
		Spices	157.7	88.6	78.1	52.5	24.8	90.6	3.67	0.33
Mean			154.3	124.4	47.6	50.0	23.8	88.9	3.81	0.22
Mean effect of boiling treatment										
-			153.4	70.6	53.3	49.7	26.5	85.4	3.31	0.52
+			154.0	93.9	51.0	50.3	25.6	87.4	3.55	0.28
Mean effect of feed additives										
-			152.6	100.6 ^a	51.5	48.7 ^b	25.1	85.6	3.58	0.47
		Biogen	153.1	90.0 ^{ab}	52.9	49.7 ^b	26.2	86.7	3.36	0.53
		Spices	155.2	69.1 ^b	52.7	51.4 ^a	27.1	86.4	3.28	0.27
SEM			3.36	32.7	5.25	0.98	2.53	2.71	0.36	0.32
ANOVA										
Mangrof level			NS	0.0001	0.02	NS	0.03	0.007	0.005	NS
Boiling			NS	NS	NS	NS	NS	NS	NS	NS
Feed additives			NS	0.02	NS	0.001	NS	NS	NS	NS
Level x Boiling			NS	NS	NS	NS	NS	NS	NS	NS
Level X Additives			NS	NS	NS	0.002	NS	NS	NS	NS
Boiling x Additives			NS	NS	NS	NS	NS	NS	NS	NS
Level x Boiling x Additives			NS	NS	NS	0.03	NS	NS	NS	NS

a,bMeans within a column within the same treatment bearing different superscripts are significantly different.

and liver weight (Table 7 and 8). This may lead us to mention that laying hens have a more developed digestive system (gut capacity, microflora and enzymatic secretion), thereby could neutralize NSPs (El-Deek *et al.*, 2003).

Boiling treatment had no enhancing effect on laying performance, age at 30% laying and body weight changes (Table 7). Similar observation was recorded with the reproductive organs and its percentage as well as spleen and liver (Table 8). It seems to agree with an earlier observation of Hussain *et al.*, (1991) and Ghazalah, (1996), who indicated that tannins content might be more critical factor in determining the performance of layers which could be overcome by boiling process.

Regardless of mangrof meal levels and boiling technique, mixture spices supplementation had a beneficial effect on the parameter of egg weight which

significantly increased by about 5.54 and 3.42% over that of Biogen and control treatments, respectively. Also, Spleen weight and its percentage was significantly increased. The opposite was seen with the body weight changes and ovary weight and its percentage which significantly decreased compared with that of the control. However, either Biogen or spices mixture supplementation had no significant effect on the parameters of age at 30% egg production, laying rate, egg mass, feed intake and feed conversion.

As supplementing tested material with either Biogen , spices mixture, no significant interaction was observed in most of the studied traits of the productive performance. Exception was seen with egg weight as using mangrof levels and feed additives as well as three way interaction between mangrof level, boiling and feed additives. Generally, egg weight was considerably increased by about 5.2% as incorporating spices

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Table 8: Weight (g) and percentage oviduct, ovary, spleen and liver as affected by level of raw or boiled Mangrof meal in diets supplemented with Biogen® or spices mixture during (20 -28) wks of age

Mangrof level %	Boiling	Additive	Organs weithts							
			Oviduct (g)	Oviduct (%)	Ovary (g)	Ovary (%)	Spleen (g)	Spleen (%)	Liver (g)	Liver (g)
0.0	-	-	25.6	1.97	40.8	3.14	1.47	0.113	30.5	2.34
		Biogen	36.2	2.91	30.8	2.48	1.47	0.117	27.6	2.21
		Spices	44.7	3.49	29.2	2.27	1.57	0.122	28.5	2.22
Mean			35.5 ^b	2.79 ^b	33.6	2.79	1.5	0.118	28.9	2.26
50	-	-	38.3	2.88	33.7	2.53	1.7	0.128	26.9	2.02
		Biogen	42.2	3.16	41.5	3.12	1.57	0.118	32.2	2.42
		Spices	32.9	2.55	28.9	2.25	1.7	0.133	34.3	2.67
	+	-	35.9	2.8	32	2.47	1.4	0.109	29	2.26
		Biogen	45.6	3.3	36.5	2.63	1.47	0.105	29.2	2.1
		Spices	34.6	2.76	24.8	1.98	2.43	0.195	24.7	1.97
Mean			38.2 ^b	2.91 ^b	32.9	2.5	1.71	0.131	29.4	2.24
10	-	-	50.2	4.04	46.6	3.75	1.97	0.157	32.5	2.61
		Biogen	46.7	3.45	38.6	2.86	2.07	0.153	33.6	2.49
		Spices	43.2	3.37	20	1.55	1.83	0.143	30.2	2.35
	+	-	46.1	3.55	37.7	2.9	1.63	0.126	30.7	3.36
		Biogen	41.2	3.17	30	2.31	1.4	0.108	27.9	2.14
		Spices	24.4	1.74	33.6	2.4	1.93	0.138	28.5	2.04
Mean			42	3.22 ^a	34.4	2.63	1.81	0.137	30.6	2.33
Mean effect of boiling treatment										
-			40	3.09	34.4	2.66	1.7	0.131	30.7 ^a	2.37 ^a
+			38	2.89	32.4	2.45	1.71	0.13	28.3 ^b	2.15 ^b
Mean effect of feed additives										
-			39.2 ^{ab}	3.05	38.1 ^a	2.96 ^a	1.63 ^b	0.126 ^b	29.9	2.32
Biogen			42.2 ^a	3.2	35.5 ^a	2.68 ^a	1.59 ^b	0.120 ^b	30.1	2.27
Spices			35.9 ^b	2.79	27.3 ^b	2.09 ^b	1.89 ^a	0.146 ^a	29.2	2.55
SEM			3.47	0.29	4.28	0.34	0.186	0.014	1.93	0.149
ANOVA										
Mangrof level			0.009	0.03	NS	NS	NS	NS	NS	NS
Boiling			0.04	0.04	NS	NS	NS	NS	0.006	0.003
Feed additives			0.04	NS	0.004	0.003	0.01	0.001	NS	NS
Level x Boiling			0.01	0.01	NS	NS	NS	0.03	NS	NS
Level x Additives			0.009	0.001	NS	NS	NS	NS	NS	NS
Boiling x Additives			NS	NS	NS	NS	NS	NS	NS	NS
Level x Boiling x Additives			NS	NS	NS	NS	NS	NS	NS	NS

a,b Means within a column within the same treatment bearing different superscripts are significantly different.

mixture to the experimental diets containing 10% cooked mangrof leaves meal and by 4.61% as using 5% of the tested material plus Biogen supplementation. Also, there was a significant interaction between levels of mangrof meal and either boiling process or feed additives. Generally, it may be concluded that laying hens can tolerate mangrof leaves meal up to 5% without adversely affecting the layer performance. Meanwhile, neither boiling process nor studied feed additives had enhancing effect on most of the parameters of laying hens performance. However, Further research is still require to evaluating the effect of feeding mangrofe leaves meal with other additions on hens performance.

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