International Journal of Poultry Science 5 (6): 502-516, 2006
ISSN 1682-8356

Increasing Mangrof Leaves Meal Allowance in Layers Diets Through Enhancing its Nutritive Value

M.A. Al-Harthi
Faculty of Meteorology Environmental and Arid Land Agriculture, King Abdulaziz University, Saudi Arabia

Abstract: The objective of this study was to improve the nutritive value of mangrof leaves meal in order to increase its allowance in layer diets. The meal was subjected to boiling in an attempt to improve its nutritive value. The study also included testing the effect of supplementing the experimental diets containing the mangrove meal (boiled or raw) with Natugrain or a mixture of spices on laying performance and biological responses associated with egg production. Four hundred and fifty 30- week old Hy-line laying hens were randomly distributed to 15 groups each contained 5 replicates of 6 hens under the same environmental conditions throughout the period of 20 wks. Dietary treatments included 3 levels of either raw or boiled mangrof leaves meal (0, 5 and 10%) for 30 minutes. Each group was received one of these diets and with or without Natugrain and/or spices mixture. Diets were formulated to be isocaloric and iso-nitrogenous. Laying performance, quality of fresh and stored eggs (stored for one month in the refrigerators), intestinal characteristics, chemical composition of eggs and cholesterol contents of yolk as well as some blood plasma constituents were determined. Results obtained showed that mangrof leaves meal contains reasonable amount of the essential nutrients which play an important role in layers nutrition. Boiling process had an enhanced effect on the nutritive value by converting the deleterious materials to less toxic form. Mangrof leaves meal at level of 5% had no adverse effect on body weight gains of Hy-line hens during the laying period. However, increasing dietary Mangrof leaves to 10% adversely reduced weight gain by 19.7% compared to control group. Irrespective of Mangrof meal and feed additives, boiling treatment had no effect on weight gain of laying hens during 30-49 wk of age. Also, regardless of mangrove meal and boiling treatment, only Natugrain® increased weight gain by 24 and 9.6% compared to the negative control and spices supplemented group, respectively. Increasing inclusion level of mangrof leaves meal up to 10% significantly decreased laying rate percentage and egg mass during most of the experimental periods. Also, boiling or adding the feed additives did not stop this reduction. Irrespective of boiling treatment and feed additives, Mangrof leaves meal had no significant impact on egg weight during 30- 49 wk of age. Neither inclusion levels of the tested material nor boiling process nor Natugrain and spices supplementation had an enhancing effect on feed intake. Consequently, feed conversion was the worst as feeding diets containing un-boiled or boiled mangrof meal at level 10%. The impairment in FCR amount to 10.7% compared to control group. The opposite was true with feed additives supplementation which showed an enhanced effect. Increasing dietary mangrof leaves meal up to 10% significantly improved Haugh unit score, yolk color and shell thickness of fresh eggs and those stored for 30 days in the refrigerator, whilst there is different trend with yolk index. Boiling treatment and feed additives supplementation had no significant effect on egg quality traits. Also, mangrof meal levels, boiling process and feed additives had no adverse effect on chemical composition of egg components and plasma constituents. There were no significant interactions between Mangrof meal and boiling treatment and / or feed additives on rate of laying, egg weight, egg mass, feed intake and feed conversion. However, there is a trend for rate of laying, egg mass and feed conversion to improve when Natugrain® or mixture of different spices were added to diet containing 10% of boiled Mangrof leaves. Also, similar finding was observed with the parameters of fresh egg quality of 41 or 49 wk-old hens and those stored in the refrigerators as well as those of intestinal characteristics and reproductive organs. 7-There was a significant effect as feeding boiled Mangrof leave meal-containing diet on plasma albumin, total lipids and yolk protein. Yolk lipid showed an opposite trend to that shown in yolk protein. In general, it may be recommended to incorporate mangrof leaves meal at level 5% as a non-traditional ingredient in laying hen diets without adverse effect on their performance in order to get higher economic return as well as to control excessive body fat deposition and to improve productive and reproductive performance.

Key words: Mangrof leaves, layer diets, egg production

Introduction

As it is commonly known, feeding is the major factor that affects the poultry production. In many countries including Saudi Arabia, most of feedstuffs in poultry diets

Table 1: Composition and calculated analyses of experimental diets

Ingredients	Experimental diets, %				
	0.0	5.0		10.0	
		raw	boiled	raw	boiled
Yellow corn	50.2	49.9	49.9	49.65	49.65
Soybean meal (44%cp)	24.7	26	26	27.25	27.25
Wheat bran	12	6	6	0	0
Mangrof level[1]	0	5	5	10	10
Commercial oil blend	3.5	3.5	3.5	3.5	3.5
Limestone	7.5	7.5	7.5	7.5	7.5
Dicalcium Phosphate	1.45	1.45	1.45	1.45	1.45
Vit + Min mix**	0.3	0.3	0.3	0.3	0.3
NaCl	0.25	0.25	0.25	0.25	0.25
DL-methionine	0.1	0.1	0.1	0.1	0.1
Total	100	100	100	100	100
Calculated values					
ME Kcal/Kg diet*	2702	2796.8	2795.2	2879.9	2876.8
Crude protein	17.02	17.24	17.24	17.34	17.32
TSAA, %*	0.66	0.66	0.64	0.66	0.65
Lyine,%*	0.86	0.86	0.84	0.86	0.85
Ca, %*	3.25	3.25	3.2	3.25	3.25
Available P, %*	0.39	0.39	0.37	0.39	0.38

** Vitamins and minerals mixture provider per kilogram of diet: vitamin A 12000IU; vitamin E 10 IU; K 3mg; vit. D 2200 ICU; riboflavin 10mg; Ca pantothenate, 10 mg; niacin 20 mg; choline chloride 500 mg; vit.B_{12} 10ug; vit. B_6 1.5mg; thiamine, 2.2 mg; folic acid 1 mg; D-biotin 50ug . Trace mineral (mg/ kg diet): Mn 55; zn 50; fe 30; Cu 10; Se I and Ethoxquin 3 mg.

are imported. So, the development of dietary formulations, which allow locally available and cheaper new ingredients to be used, would reduce feed cost as well as saving the imports from some feed ingredients. Fortunately, there are considerable amounts of fiber containing feedstuffs are utilized successfully in the layers nutrition. Vargas and Naber (1984) found that dietary fiber or nutrient density had no significant effect on egg production, egg weight, body weight change and energy balance. Also, El-Deek *et al*. (1988) with casuarinas branch lets; Osei *et al*. (1990) with gliricidia leaf meal and Yassein *et al*. (1998) with *leucaena leucocephala* indicated that no adverse effect were recorded on performance of laying hens. Mangrof is one of the most useful perennial leguminous plants. It is highly palatable and cheap ingredient for livestock (National Academy of Sciences, 1979). The possibility of using mangrof leaves meal in poultry diets depending on the technically process that could be used to improve its nutritive value. Like most halophytes, polyphenol of the mangrof leaves meal traditionally have been considered anti-nutrients by animal and poultry nutritionists because of the adverse effect of tannins, one type of polyphenol, on protein digestibility (Jung, 1989). The anti-nutritional activity of cell wall non starch polysaccharides (NSP) had an impairing effects on growth and feed / gain of birds (Choct and Anninson, 1992; Jeroch *et al*., 1995 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. The negative effects of ash content and anti-nutritive substances are normally eliminated by boiling in water. Ghazalah (1996) with leucaena leaf meal and Talaat (2003) with kochia indica meal explained the beneficial effect of boiling process in water to the ability of water as a solvent on the ash content and hydrogen bonds exist between the phenolic groups which represent the structure of the tannin nuclei, thereby converting these deleterious materials to less impairment form.

For more than decade, the great interest in applying biotechnology for enzyme production and purification has led to the production of enzyme preparation for poultry feeds which can improve the utilization of high fiber containing feedstuffs in poultry diets (Makled, 1993; Zeweil, 1996b, El-Full Ensaf *et al*., 2000; Ghazalah *et al*., 2005 and Zeweil *et al*., 2005). Recently, there is a trend to use enzymes and spices to improve nutrient utilization with considerable success (Al-Harthi, 2002; Abdo Zeinab *et al.,* 2003; Choct, 2004 as well as Shivaram and Devegowda, 2004).

Due to the lack of information concerning the nutritive value of mangrof leaves meal as ingredient in layers diets, this work aimed to determinate the chemical composition and beneficial inclusion levels of mangrof leaves meal without any adverse effect on the performance of laying hens and biological responses associated with egg production. Enhancing influence of cooking process without or with either Natugrain enzyme (0.1 g/kg) or spices mixture (2g/kg) during laying period (30-50 wks of age) was also studied.

Table 2: Proximate analysis of raw and boiled Mangrof leaves meal (on DM basis)

Tested material	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

Materials and Methods

A total number of four hundred and fifty 30 week old Hy-line hens as a commercial egg strain were reared under the same management conditions in egg production batteries (90 x 90 x40 wire cage) in light-temperature controlled house at poultry experimental farm, Faculty of Meterology Environmental and Arid Land Agriculture, King Abdulaziz university. Hens were randomly divided into 15 groups included 30 birds each, in 5 replicates (6 hens per replicate). Mangrof leaves were harvested freshly throughout the entire experimental period from the red sea north of Jeddah in Saudi Arabia. Part of the tested material was processed by cooking in boiling water for 30 minutes and then dried to ~ 90% dry matter in air ventilated oven. Boiled and un-boiled mangrof 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 for feed formulation.

Dietary treatments included 3 levels each of boiled and un-boiled mangrof leaves meal (0, 5 and 10%). Natugrain® enzyme (0.1g/kg) and spices mixture (2 g./kg) e.g. cardamom, cumin, hot and black pepper (1:1:1:1) were also incorporated individually to the studied layer diets. All diets were formulated to satisfy nutrient requirements of laying hens according to the strain catalog recommendation (Table 1). Feed and water were offered *ad libitum.* Hens were individually weighed at the beginning and at the end of the experimental period (50 wks of age), while feed intake and feed conversion ratio was bi-weekly recorded and calculated. Egg production traits were recorded five times on 4-week intervals throughout the whole trial period which lasted for 20-week period starting at the 30 to 50 weeks of age. External and internal egg quality measures including Haugh unit, Yolk index and its color as well as shell thickness were taken on eggs of last three successive days at aged 40 and 50 wks. Part of egg samples used for measuring egg quality at aged 50 wks were stored for 30 days in the refrigerator to investigate the impact of the studied treatments on keeping quality of eggs. Also, five egg samples from each treatment at the same age (50 wks) were broken to determine yolk protein, fat and cholesterol as well as albumin protein and shell ash according to the procedures of Rutkowski and Krygier (1979) and A. O. A. C. (1990).

Blood samples were taken from five hens of each treatment during the slaughter test at the end of the experiment in hybridized tubes. Plasma was separated by centrifugation at 3000 rpm for 15 minutes and stored at - 20^{o}C until analysis. Plasma was analyzed for total protein, (g/100ml) applying the procedure described by Henry *et al.* (1974); albumin and globulin(g/100ml) according to Wooten (1982); total lipids (Chabrol and Charonnat, 1973) and total cholesterol (Watson, 1960); alanine asparatic transaminase (AST, U/L) and alanine transaminase (ALT, U/L) according to Retiman and Frankel (1957). These analyses were measured using commercial kits purchased from the Egyptian American Company of Laboratory Services and El-Nasr Pharmaceuticals Chemical Company, Cairo, Egypt. Relative and absolute intestinal and oviduct weights with their length as well as ovary weight were recorded.

Analysis of variance was performed using SAS software computer program (SAS, 1985). In order to determine significant differences between all possible mean comparisons, Duncan's Multiple Range Test (1955) was applied to the data. Statistical analysis was done according to three ways analyses of variance for the main effects of mangrof leaves meal, processing (boiling process and feed additives) and the interaction among them.

Results and Discussion

Nutritive value of mangrof leaves meal: The chemical composition of dried mangrof leaves meal either boiled or un-boiled are presented in Table 2. Values were calculated on an air dried basis as a percentage of the tested material. Results indicated that it contains reasonable amounts of the most nutritional substances which play an important role in layers nutrition. The high content of ash in this material, however, is a limiting factor in formulating layers diet, indicating its deleterious effect for livestock. Consequently, this forage was subjected to some treatments in an attempt to improve its nutritive value. By boiling, the crude fiber and ash content were decreased by about 6.89 and 13.95% than that of un-boiled, respectively. Therefore, the tested material could be considered a suitable feed for feeding layers. Udedibie and Igwe (1989) with pigeon pea leaf meal and Ghazalah, (1996) with leucaena leaf meal arrived to the same conclusion with their test materials. Also, tannins content of mangrof leaves meal were reduced by about 21.3 %compared to the un-boiled one. 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 tannin nuclei, thereby, converting these deleterious materials to less toxic form and improving the feeding value of the tested material as reported by Haslam *et al.* (1989). These results are in agreement with those

Table 3: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on body weight changes of laying hens during the period of 30-49 wks.

Mangrof level, %	Boiling	Additive	Initial weight, g	Final weight, g	Body weight gains, g
0.0	-	-	1461	1688	227
		Natugrain	1389	1661	272
		Spices	1417	1600	183
5.0	-	-	1444	1638	194
		Natugrain	1472	1711	239
		Spices	1527	1705	178
	+	-	1511	1766	255
		Natugrain	1450	1661	211
		Spices	1483	1772	289
10.0	-	-	1472	1644	172
		Natugrain	1494	1733	239
		Spices	1480	1672	192
	+	-	1450	1661	211
		Natugrain	1489	1616	127
		Spices	1503	1655	152
Main effect of Mangrof level, %					
0.0			1422	1650	228[a]
5.0			1481	1709	228[a]
10			1481	1664	183[b]
Main effect of boiling treatment					
-			1467	1673	206
+			1481	1688	207
Main effect of feed additives					
-			1504	1679	175[b]
Natugrain			1459	1676	217[a]
Spices			1482	1681	198[b]
SEM			111.4	132.8	21.9
ANOVA					
Mangrof level (M)			NS	NS	**
Boiling (B)			NS	NS	NS
Additives (F)			NS	NS	**
M x B			NS	NS	NS
M xF			NS	NS	NS
B x F			NS	NS	NS
M xB xF			NS	NS	NS

NS, not significant; **, significant p > 0.01. a-b, Mains within a column not sharing common superscripts are significantly different based on Duncan test.

reported by Abd-Alla (1993), Ghazalah, (1996) and Talaat, (2003) who found that boiling process of the tested feedstuff could decrease some of the anti-nutritional factors such as tannins.

It is well known that laying hens required low-density diet to control excessive body fat deposition and to improve productive and reproductive performance (El-Deek *et al.,* 1995, 2003 and Talaat, 2003). Therefore, Mangrof leaves meal with its considerable amount of nutrient may be suitable feedstuffs of worth to be tested in the laying hens diets where low density is desire.

Performance of laying hens

Body weight and gain changes: Results concerning body weight and gain are presented in Table 3, it is clear that initial live body weight of laying hens, 30- week old showed nearly similar values with no significant differences among treatment groups. This creates a suitable condition to appraise the effect of dietary treatments during the subsequent periods. With feeding tested diets to aged 50 wks, neither inclusion levels of mangrof leaves meal nor boiling process nor feed additives supplementation had significant effect on body weight. While, data of calculated weight gain revealed that increasing inclusion level of mangrof meal up to 10% resulted in a significant decrease in this parameter by about 19.7% than that of the control. The opposite was true with 5% mangrof meal which had no adverse effect in this respect. So, the inferior performance obtained for hens fed 10% mangrof meal could be attributed to its high ash and tannins content which being 19.4% and 10.4%, respectively. On the other hand, the main effect of boiling treatment on weight gain was not significant with no adverse effect. This results seems to agree with an earlier observation of Svihus *et al*., 1997; Yasar and Forbes, 1999& 2000 and Talaat, 2003) who reported that boiling process could increase the nutritive value of the tested material as a result of reducing the anti-nutritional substances such as tannins and ash content. Regarding the feed additives,

Table 4: Effect of feeding inclusion different levels of raw and boiled' Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of (30-33 wks)

Mangrof level, %	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR, g/g
0.0	-	-	94.8	56.8	53.8	107.1	2.00
		Natugrain	91.3	51.5	46.9	113.4	2.42
		Spices	93.3	54.3	50.7	107.4	2.12
5.0	-	-	88.9	53.3	47.4	107	2.26
		Natugrain	89.3	55.3	49.4	110.2	2.23
		Spices	91.5	54.9	50.2	112.7	2.25
	+	-	90.5	52.3	47.4	107.0	2.26
		Natugrain	85.1	56.2	47.8	109.0	2.28
		Spices	77.4	55.5	43	108.2	2. 52
10.0	-	-	88.5	52.7	46.6	109.4	2.35
		Natugrain	81.3	53.9	43.8	113.3	2.59
		Spices	87.3	55.7	48.6	104.7	2.16
	+	-	86.1	53.9	46.4	112.1	2.42
		Natugrain	91.3	54.3	49.6	115.4	2.33
		Spices	90.1	56.4	50.8	114.4	2.26
Main effect of Mangrof level, %							
0			92.9[a]	54.2	50.4	109.3	2.17[b]
5			87.1[b]	54.5	47.5	109	2.30[a]
10			87.4[b]	54.5	47.6	111.6	2.35[a]
Main effect of boiling treatment							
-			89.5[a]	54.3	48.6	109.5	2.26[b]
+			86.8[b]	54.7	47.5	110	2.34[a]
Main effect of feed additives							
-			89.8	53.8[b]	48.3	108.4	2.25[b]
Natugrain			87.7	54.2[ab]	47.5	112.3	2.37[a]
Spices			87.2	55.3[a]	48.3	109.5	2.27[b]
SEM			5.33	1.01	1.33	3.31	0.23
ANOVA							
Mangrof level (M)			**	NS	NS	NS	**
Boiling (B)			**	NS	NS	NS	**
Additives (F)			NS	**	NS	NS	**
MxB			NS	NS	NS	NS	NS
MxF			NS	NS	NS	NS	NS
BxF			NS	NS	NS	NS	NS
MxBxF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01

a-b Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

supplementation Natugrain enzyme had a superior effect on weight gain by about 24% improvement over the un-supplemented one. This result agrees with that found by Attia *et al*. (2001) who reported that body weight gain of laying hens was improved as using enzyme supplementation, as well as the findings of Zanella *et al*. (1999) and Ghazalah *et al*. (2005) which indicated that adding enzyme preparations to the commercial diets improved the body weight gain. Meanwhile, a slight improvement without significant was observed as adding spices mixture. Generally, no significant interaction was recorded on the change in the body weight during the studied laying period.

Egg production traits: Data of egg production traits including laying rate %, egg weight and its mass are presented in Table (4, 5, 6, 7, 8 and 9). These data indicated that increasing inclusion level of the mangrof meal up to 10% significantly decreased the rate of laying and egg mass for the average of the 5-period evaluated except that of (30-33) wks period with egg mass. For the whole experimental period, the decrease in laying rate amount to 1.94 and 11.0 % compared to control group for groups fed diet containing 5 and 10% Mangrof meal, respectively. It could be attributed to the presence of anti-nutritional substances in mangrof leaves meal. These result agree with that reported by Udedibie and Igwe (1989) who showed that increasing dietary pigeon pea leaf level over 20% significantly decreased laying rate. Also, results reported by Osei *et al*. (1990) indicated that adding gliricidia leaves meal in laying hen diets at levels of 0, 2.5, 5 and 7.5% significantly decreased hen-day egg production. The opposite was true with the parameter of egg weight which tended to increase as dietary inclusion of mangrof increased except that for the period (30-33) wks old. This increment was significant at the period of (46-49) wks old by about 3.61% over that of the control. Inspection in these tables, indicated that boiling treatment did not stop the reduction of laying rate percentage and egg mass for the average of the studied

Table 5: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of (34-37 wks)

Mangrof level, %	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR, g/g
0.0	-	-	95.6	58.8	56.2	109.1	1.95
		Natugrain	93.7	58.6	54.9	111.5	2.03
		Spices	87.3	57.8	50.5	110.1	2.18
5.0	-	-	92.5	55.3	51.2	111.7	2.19
		Natugrain	90.1	57.8	52.1	110.1	2.12
		Spices	92.1	57.1	52.6	113.3	2.16
	+	-	91.3	58.6	53.5	112.5	2.11
		Natugrain	77.8	58.9	45.8	109.0	2.38
		Spices	86.5	59.8	51.7	112.5	2.18
10.0	-	-	77.4	55.0	42.6	106.3	2.50
		Natugrain	85.7	57.3	49.2	111.7	2.27
		Spices	81.0	55.3	44.7	112.1	2.51
	+	-	79.4	55.9	44.4	113.9	2.57
		Natugrain	77.8	56.5	43.9	110.5	2.52
		Spices	85.7	58.1	49.5	112.1	2.27
Main effect of Mangrof level, %							
0.0			92.2^{a}	58.4^{a}	53.8^{a}	110.2	2.05^{c}
5.0			88.4^{ab}	57.9^{ab}	51.2^{b}	111.5	2.18^{b}
10.0			81.2^{b}	56.3^{b}	45.7^{c}	111.0	2.43^{a}
Main effect of boiling treatment							
-			88.4^{a}	57.0	50.4^{a}	110.6	2.20^{b}
+			83.0^{b}	57.9	48.1^{b}	111.7	2.33^{a}
Main effect of feed additives							
-			87.2	56.7	49.4	110.7	2.24
Natugrain			85.0	57.8	49.2	110.5	2.25
Spices			86.5	57.6	49.8	112.0	2.25
SEM			4.93	1.09	1.66	4.70	0.29
ANOVA							
Mangrof level (M)			**	**	**	NS	**
Boiling (B)			**	NS	**	NS	**
Additives (F)			NS	NS	NS	NS	NS
MxB			NS	NS	NS	NS	NS
MxF			NS	NS	NS	NS	NS
BxF			NS	NS	NS	NS	NS
MxBxF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. $^{a\text{-}b,..}$ Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

periods. The significant decrease in these trait was un-expected and in contrary to early studied of Ghazalah (1996) who reported that the increase in egg production and egg mass was associated with increased inclusion level of cooked leucanea meal. On the other hand, the average of egg weight was improved in this respect. The best value was recorded at the period of (46-49) wks old by about 2.1% over the un-boiled one. Also, Feed additives (Natugrain and spices mixture) supplementation also had no effect on this parameter of egg production and egg mass compared with that of the control over all the experimental periods expect that of laying rate % with spices mixture at period (42-45) wks old and that of egg mass with Natugrain enzyme at the period of (34-41) wks old and spices mixture at period of (46-49) wks old. Contrarily, there was a positive effect on egg weight over all the entire experimental periods. This increment may be due to enzyme and spices addition which improved the nutrient utilization (El-Deek *et al.,* 2003 and Choct, 2004). Meanwhile, the best value was recorded with the spices mixture during periods of (30-33) and (46-49)wks old and it was significantly more than the control. The improved egg mass due to spices mixture supplementation may be attributed to anti-microbial effect of the studied spices as well as its digestive enhancing effect (Cichewicz and Thorpe, 1996). Generally, the supplementation of either Natugrain or spices mixture showed no significant interaction in this respect.

Feed intake and feed conversion ratio: Results of Table 4, 5, 6, 7, 8 and 9 indicated that inclusion levels of the mangrof leaves meal did not significantly affect feed intake as compared to the control one for the average of the 5-period evaluated. Similar result was observed as using the boiling process and incorporating either Natugrain enzyme or spices mixture which had no enhancing effect in this respect. Concerning feed conversion ratio, it is clear that increasing dietary mangrof meal up to 10% in the laying hen diets gave the

Table 6: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of (38-41 wks)

Mangrof level, %	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR, g/g.
0.0	-	-	93.7	57.2	53.6	111.3	2.08
		Natugrain	96.1	61.8	59.4	116.0	1.96
		Spices	91.3	57.8	52.8	113.1	2.15
5.0	-	-	91.0	57.0	51.9	117.0	2.26
		Natugrain	89.7	64.6	57.9	113.7	1.97
		Spices	93.7	59.2	55.5	114.0	2.06
	+	-	91.7	62.2	57.1	115.1	2.02
		Natugrain	91.3	61.0	55.7	115.1	2.07
		Spices	85.3	57.3	48.9	115.1	2.36
10.0	-	-	77.4	60.9	47.1	117.1	2.49
		Natugrain	80.2	60.0	48.1	116.1	2.40
		Spices	86.1	58.5	50.4	118.0	2.34
	+	-	77.8	58.7	45.7	117.8	2.58
		Natugrain	84.1	62.2	52.3	117.1	2.24
		Spices	74.6	55.5	41.4	115.1	2.78
Main effect of Mangrof level							
0.0			93.7^{a}	58.9	55.2^{a}	113.6	2.06^{b}
5.0			90.4^{b}	60.2	54.5^{a}	115.0	2.12^{b}
10.0			80.0^{c}	59.3	47.4^{b}	116.8	2.47^{a}
Main effect of boiling treatment							
-			88.8^{a}	59.6	53.0^{a}	115.2	2.18b
+			84.1^{b}	59.4	50.0^{b}	115.9	2.32^{a}
Main effect of feed additives							
-			86.3	59.2	51.1^{b}	115.6	2.27^{a}
Natugrain			88.2	61.9	54.6^{a}	115.6	2.12^{b}
Spices			86.2	57.7	49.7^{b}	115.1	2.31^{a}
SEM			7.31	1.65	2.01	3.77	0.43
ANOVA							
Mangrof level (M)			**	NS	**	NS	**
Boiling (B)			**	NS	**	NS	**
Additives (F)			NS	**	**	NS	**
MxB			NS	NS	NS	NS	NS
MxF			NS	NS	NS	NS	NS
BxF			NS	NS	NS	NS	NS
MxBxF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. $^{a\text{-}b,\ldots}$ Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

worst feed conversion ratio than that of the control group through all studied periods. While, results indicated that Mangrof leaves meal at 5% had no significant effect on FCR of laying hens during most of the experimental periods as well as for the whole experimental period (30-49) wks of age (Table 3, 4, 5, 6, 7, 8 and 9). These results are similar to those reported by El-Deek *et al.,* (1988) who found that casuarinas branch up to 8% in the laying hen diets had no adverse effect on FCR and mortality. This may be explained by very sharp fall in the percentage of egg production and egg mass. So, changes in the parameter of feed conversion were parallel to the decrease in egg mass one. Regardless the levels of mangrof leaves meal, the main effect of boiling treatment on feed conversion was not enhanced. While, supplemented diets with either Natugrain or spices mixture had an enhancing effect throughout the entire experimental period. Results of Mathlouthi *et al.,* (2003) confirmed such findings. They concluded that supplementation of the diets with enzyme preparations improved the feed efficiency. However, the best feed conversion was recorded during period of (33-41) wks old with Natugrain enzyme supplementation by about 6.6% improvement over the control as well as adding spices mixture to the experimental layer diets improved feed conversion ratio by about 3.1% over that of the control at the period (46-49) wks old. Data of the interaction effects on feed conversion showed no significant differences among the inclusion levels of mangrof leaves meal , boiling treatment and / or feed additives for any tested laying periods as well as the whole experimental period.

Metabolic responses of laying hens

External and internal egg quality traits: External and internal egg quality traits are shown in Table (10, 11 and 12). It is clear that increasing inclusion level of mangrof leaves meal up to 10% significantly improved Haugh unit score of fresh eggs by about 11.1% and 12.6% throughout the two experimental period of (38-41) and

Table 7: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of (42-45 wks)

Mangrof level, %	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR g/g
0.0	-	-	83.3	59.5	49.5	119.1	2.41
		Natugrain	87.7	61.2	53.7	119.1	2.22
		Spices	81.4	61	49.7	117.4	2.37
5.0	-	-	88.1	58.7	51.7	120	2.33
		Natugrain	86.1	61.8	53.2	119.1	2.24
		Spices	85.7	60	51.4	120	2.34
	+	-	90.1	60.9	54.9	120	2.19
		Natugrain	83.3	58.6	48.8	120	2.46
		Spices	79.4	62.8	49.9	118.4	2.38
10.0	-	-	77.8	59.7	46.4	117.5	2.54
		Natugrain	70.6	59.8	42.2	110.1	2.61
		Spices	72.6	59.1	42.9	109.3	2.55
	+	-	68.7	62.5	42.9	117.5	2.74
		Natugrain	75.4	61.4	46.3	118.3	2.56
		Spices	75.0	59.9	44.9	120	2.68
Main effect of Mangrof level, %							
0.0			84.1[a]	60.6	50.9[a]	118.5	2.33[b]
5.0			85.4[a]	60.5	51.6[a]	119.5	2.32[b]
10.0			73.3[b]	60.1	44.0[b]	115.5	2.63[a]
Main effect of boiling treatment							
-			81.5[a]	60.1	48.9	116.8	2.39
+			78.6[b]	61.0	47.9	119.0	2.49
Main effect of feed additives							
-			81.6[a]	60.2	49.2	118.8	2.42
Natugrain			80.6[a]	60.5	48.8	117.3	2.41
Spices			78.8[b]	60.6	47.7	117.0	2.46
SEM			4.02	0.79	0.88	3.03	0.39
ANOVAMangrof level (M)			**	NS	**	NS	**
Boiling (B)			**	NS	NS	NS	NS
Additives (F)			**	NS	NS	NS	NS
MxB			NS	NS	NS	NS	NS
MxF			NS	NS	NS	NS	NS
BxF			NS	NS	NS	NS	NS
MxBxF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. [a-b,..] Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

(46-49) wks old, respectively. This improvement did not stop but it continued to be 8.2% over that of the control when eggs stored for one month in the refrigerator. Similar to the above result, yolk color was significantly improved by about 48.8% and 41.1% as well as shell thickness was increased over those of the control, respectively. No adverse effect was observed on eggs stored in the refrigerator. It may be related to the availability of pigmentation and its ash content which would improve dietary mineral balance for yolk and shell deposition, respectively. So, this indicates that feeding diet containing 10% mangrof leaves meal had a beneficial effect on Haugh unit score, yolk color and shell thickness. The main effect of boiling treatment on the previous parameters was highly significant except that of shell thickness at period (38-41) wks old and Haugh unit score of stored eggs. In that, egg shell thickness was increased by about 10.8% over those of dietary un-boiled mangrof leaves meal. This indicates that boiling treatment improved mineral availability for calcification of egg shell. Supporting the present results, soaking or wetting feeds may improve the bio-availability of iron and zinc which involved in bone and shell calcification as was reported by (Underwood and Stulle, 2001 and Perlas and Gibson, 2002). Whilst, supplemented diets with either studied feed additives had no detrimental effect on albumen and shell quality as well as no adverse effect was observed on yolk color. It is expected that antimicrobial effect of the tested spices (Cichewicz and Thrope, 1996 and Jones *et al.,* 1997) may delay the negative effect on albumen quality and consequence Haugh unit score. The improvement in yolk color may be due to the anti-oxidant activity function of spices mixture (Al-Harthi, 2004) On the other hand, yolk index decreased significantly as including dietary mangrof leaves meal at levels 5 and 10% compared with those of the control except that of 10% mangrof meal at the second period of egg quality measurements which increased significantly. Unfortunately, detractive yolk index of egg stored for one month was observed as using dietary mangrof meal in the experimental diets. This impairement may be

Table 8: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of (46-49) wks

Mangrof level	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR,g./g
0.0	-	-	80.2	58.2	46.6	119	2.57
		Natugrain	86.5	61.5	53.2	120	2.26
		Spices	85.3	62.9	53.7	120	2.24
5.0	-	-	85.7	61.5	52.7	118.5	2.28
		Natugrain	76.6	62	47.5	119	2.53
		Spices	84.5	63.7	53.8	118	2.23
	+	-	76.6	62.2	47.7	119	2.52
		Natugrain	66.3	66.3	43.9	120	2.74
		Spices	80.6	62.1	50.1	120	2.4
10.0	-	-	68.3	64	43.7	119	2.75
		Natugrain	69.1	61.4	42.4	118	2.74
		Spices	61.5	63.4	39	119.5	3.08
	+	-	62.3	62.5	38.9	119	3.09
		Natugrain	64.7	63.4	41	120	2.93
		Spices	63.5	64	40.6	120	2.96
Main effect of Mangrof level							
0.0			84.0^{a}	60.9^{b}	51.1^{a}	118	2.35^{b}
5.0			78.4^{b}	63.0^{a}	49.4^{a}	118.5	2.43^{b}
10.0			64.9^{c}	63.1^{a}	40.9^{b}	119	2.94^{a}
Main effect of boiling treatment							
-			77.5^{a}	62.1^{b}	48.1^{a}	118.5	2.50^{b}
+			69.0^{b}	63.4^{a}	43.7^{b}	120	2.75^{a}
Main effect of feed additives							
-			74.6^{ab}	61.6^{b}	45.9^{b}	118.5	2.62^{a}
Natugrain			72.6^{b}	62.9^{a}	45.7^{b}	120	2.63^{a}
Spices			75.0^{a}	63.2^{a}	47.4^{a}	120	2.54^{b}
SEM			6.62	0.89	1.83	3.77	0.43
ANOVA							
Mangrof level (M)			**	**	**	NS	**
Boiling (B)			**	**	**	NS	**
Additives (F)			**	**	**	NS	**
MXB			NS	NS	NS	NS	NS
MXF			NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. $^{a\text{-}b,\cdots}$ Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

explained by very sharp increase in the percentage of egg weight loss. However, feeding diets containing boiled mangrof meal to 49 wk old hens had no adverse effect on yolk index of fresh eggs and consequence to those eggs stored for 30 days in the refrigerator showed 8.6% improvement over the untreated ones. Concerning feed additives, it is interesting to report that, although spices mixture supplementation had an impairment effect on yolk index of fresh eggs, no adverse effect was recorded for this parameter of eggs stored for one month in the refrigerator. This improvement may be attributed to antimicrobial and digestive enhancing effect of spices as reported by Cichewicz and Thorpe, (1996), so, it would extend the shelf life of eggs.

Chemical composition of egg components and plasma constituents: Concerning the chemical composition of egg compounds (Table 13) and plasma constituents (Table 14), it is clear that feeding dietary mangrof up to 10% had no adverse effect on yolk protein, lipids and cholesterol as well as protein percentage of albumin and ash percentage of egg shell. Also, results of plasma total protein, albumin, globulin, total lipids, cholesterol and liver enzymes (AST and ALT) showed no significant changes. This indicated that liver functions were not adversely affected by inclusion level of dietary mangrof meal up to 10%. Meanwhile, the main effects of boiling treatment and feed additives on the previous parameters were not significant.

Intestinal and reproductive organs characteristics: Data of Table 15 indicated that although intestinal weight and its percentage did not significantly change, values of these parameters were decreased by about 4 and 5.5% as feeding diets containing inclusion level of mangrof meal up to 10%, respectively. However, intestinal length of bird received 5% mangrof meal in the diet increased significantly by about 4.1% over that of the control. The main effect of boiling treatment on the previous parameters was not significant. On the other

Table 9: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on laying performance parameters during the period of 30-49 wks old

Mangrof level, %	Boiling	Additive	Laying rate, %	Egg weight, g	Egg mass, g	Feed intake, g	FCR, g/g
0.0	-	-	89.5	58.1	52	113.3	2.18
		Natugrain	85.7	58.9	50.5	116	2.3
		Spices	87.7	58.7	51.5	117	2.28
5.0	-	-	89.2	57.2	51	116.3	2.29
		Natugrain	86.4	60.3	52.1	114.6	2.2
		Spices	89.5	58.9	52.7	116	2.21
	+	-	88	59	51.9	115	2.22
		Natugrain	80.8	60.2	48.6	114.6	2.36
		Spices	81.8	59.5	48.6	114.8	2.37
10.0	-	-	81.5	58.4	47.6	114	2.4
		Natugrain	77.4	58.7	45.4	114.2	2.52
		Spices	77.7	58.4	45.4	112.8	2.49
	+	-	74.8	58.7	43.9	116.3	2.65
		Natugrain	78.7	59.6	46.9	116.4	2.49
		Spices	77.8	58.8	45.7	116.2	2.55
Main effect of Mangrof level, %							
0.0			87.6^{a}	58.6	51.3^{a}	115.4	2.25^{b}
5.0			85.9^{b}	59.2	50.8^{a}	115.2	2.27^{b}
10.0			78.0^{c}	58.7	45.7^{b}	113.7	2.49^{a}
Main effect of boiling treatment							
-			84.9^{a}	58.6	49.7^{a}	114.9	2.32^{b}
+			80.3^{b}	59.3	47.6^{b}	115.5	2.43^{a}
Main effect of feed additives							
-			84.6^{a}	58.3	49.3	115.0	2.34
Natugrain			81.8^{b}	59.5	48.7	115.1	2.37
Spices			82.9^{ab}	58.8	48.7	115.1	2.37
SEM			2.31	0.51	0.63	2.21	0.21
ANOVAMangrof level (M)			**	NS	**	NS	**
Boiling (B)			**	NS	**	NS	**
Additives (F)			**	NS	NS	NS	NS
MXB			NS	NS	NS	NS	NS
MXF			NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01.$^{a-b,..}$ Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

Table 10: Effect of feeding inclusion levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on egg quality of 41- wk old hens

Mangrof level,%	Boiling	Additive	Hough unit score		Yolk index		Yolk color		Shell thickness, mm.	
			41 wk	49 wk	41wk	49wk	41wk	49wk	41wk	49wk
0.0	-	-	71	68	0.46	0.47	4	7	0.25	0.34
		Natugrain	76	85	0.5	0.4	4	7	0.26	0.37
		Spices	75	82	0.41	0.38	5	8	0.26	0.36
5.0	-	-	80	80	0.38	0.39	5	8.5	0.28	0.36
		Natugrain	86	84	0.42	0.37	4.5	8	0.28	0.36
		Spices	82	78	0.44	0.46	4.2	8	0.26	0.37
	+	-	80	84	0.38	0.4	4.8	8.2	0.26	0.38
		Natugrain	70	82	0.34	0.36	4.5	9	0.28	0.39
		Spices	77	84	0.43	0.37	4.6	9.1	0.27	0.39
10.0	-	-	80	95	0.5	0.47	4.6	10.5	0.28	0.41
		Natugrain	74	88	0.38	0.42	5	9.8	0.27	0.38
		Spices	85	82	0.45	0.37	6	10	0.28	0.41
	+	-	86	90	0.34	0.45	7.5	10.2	0.29	0.44
		Natugrain	80	89	0.4	0.48	8	11	0.29	0.43
		Spices	88	85	0.39	0.45	7	10.5	0.28	0.43
Main effect of Mangrof level, %										
0.0			74.0^{b}	78.3^{b}	0.46^{a}	0.42^{b}	4.3^{b}	7.3^{c}	0.26	0.36^{c}
5.0			77.5^{ab}	82.0^{ab}	0.40^{b}	0.38^{c}	4.6^{b}	8.5^{b}	0.27	0.38^{b}
10.0			82.2^{a}	88.2^{a}	0.40^{b}	0.44^{a}	6.4^{a}	10.3^{a}	0.28	0.42^{a}

Table 10 Contd.

Mangrof level,%	Boiling	Additive	Hough unit score		Yolk index		Yolk color		Shell thickness, mm.	
			41 wk	49 wk	41wk	49wk	41wk	49wk	41wk	49wk
Main effect of boiling treatment										
-			76.8^{b}	82.4^{b}	0.44^{a}	0.41	4.7^{b}	8.5^{b}	0.27	0.37^{b}
+			81.5^{a}	85.7^{a}	0.36^{b}	0.41	6.1^{a}	9.7	0.28	0.41^{a}
Main effect of feed additives-			79.4^{ab}	83.4^{ab}	0.41	0.44^{a}	5.2	8.9	0.27	0.39
Natugrain			75.5^{b}	85.6^{a}	0.41	0.40^{b}	5.2	9.0	0.28	0.39
Spices			81.4^{a}	82.2^{b}	0.41	0.40^{b}	5.3	9.1	0.27	0.39
SEM			7.4	7.3	0.17	0.19	1.7	1.9	.09	0.07
ANOVAMangrof level (M)			**	**	**	**	**	*	NS	**
Boiling (B)			**	**	**	NS	**	**	NS	**
Additives (F)			**	**	NS	**	NS	NS	NS	NS
MXB			NS	NS	NS	NS	NS	NS	NS	NS
MXF			NS	NS	NS	NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. a-b, Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

Table 11: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on egg quality traits stored for one month after collection at 49 wk- old hens

Mangrof %	Boiling	Additive	Hough unit score	Yolk index	Yolk color	Shell thickness, mm	Egg level, weight loss,%
0.0	-	-	74	0.492	7.5	0.33	2.73
		Natugrain	74	0.45	8	0.35	3.62
		Spices	72	0.438	8.5	0.35	2.33
5	-	-	75	0.396	8	0.36	4.68
		Natugrain	79	0.428	8	0.37	3.51
		Spices	77	0.408	8.5	0.37	3.08
	+	-	72	0.438	8	0.37	4.31
		Natugrain	74	0.42	8.5	0.42	3.33
		Spices	70	0.498	8.3	0.41	3.33
10.0	-	-	77	0.396	8.6	0.42	3.13
		Natugrain	82	0.342	8.5	0.41	3.28
		Spices	72	0.432	8.2	0.4	3.28
	+	-	80	0.468	8.3	0.37	3.45
		Natugrain	82	0.462	9.1	0.37	3.39
		Spices	82	0.45	9	0.4	2.67
Main effect of Mangrof level, %							
0.0			73.0^{b}	0.462^{a}	8.0^{b}	0.34^{c}	2.89^{c}
5.0			75.0^{b}	0.432^{b}	8.2^{b}	0.38^{b}	3.71^{a}
10.0			79.0^{a}	0.426^{b}	8.6^{a}	0.40^{a}	3.20^{b}
Main effect of boiling treatment							
-			76.0	0.420^{b}	8.2^{b}	0.37^{b}	3.29
+			77.0	0.456^{a}	8.5^{a}	0.39^{a}	3.41
Main effect of feed additives							
-			76.0	0.438^{a}	8.1^{b}	0.37	3.66
Natugrain			78.0	0.420^{b}	8.4^{a}	0.38	3.43^{b}
Spices			75.0	0.444^{a}	8.5^{a}	0.39	3.32^{b}
SEM			6.3	0.09	1.5	0.04	0.77
ANOVAMangrof level (M)			**	**	**	**	**
Boiling (B)			NS	**	**	**	NS
Additives (F)			NS	**	**	NS	**
MXB			NS	NS	NS	NS	NS
MXF			NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS

NS, not significant, **, significant p > 0.01. a-b,.. Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

Table 12: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on chemical composition of yolk, albumen and shell of 49 wk- old hens

Mangrof level, %	Boiling	Additive	Yolk protein	Yolk lipids,% Mg /g	Yolk cholesterol	Albumen protein,%	Shell
0.0	-	-	33.4	63.6	26.1	77.2	55.3
		Natugrain	32.3	64.5	25.3	76.6	56.5
		Spices	33.2	63.8	25.4	76.8	56.7
5.0	-	-	33.6	63.7	26.5	76.8	55.9
		Natugrain	33.6	63.4	25.5	77	56.1
		Spices	33.1	64.4	25.4	76.4	55.5
	+	-	32.7	64	24.9	76.7	55.8
		Natugrain	33	63.9	25.4	76.7	56
		Spices	32.3	63.8	25.3	77	56.2
10.0	-	-	33.3	62.9	25.8	76.7	55.8
		Natugrain	33.3	63.9	24.6	76.5	55.8
		Spices	32.9	64	25.5	76.7	57.1
	+	-	34.2	62.8	25.1	77.7	56
		Natugrain	33.6	63.3	25.7	77.1	55.8
		Spices	33.5	63.5	24.9	77.4	56.1
Main effect of Mangrof level, %							
0.0			33.0	63.9	25.6	76.8	56.5
5.0			33.1	63.9	25.5	76.8	55.9
10.0			33.5	63.6	25.3	77.0	56.1
Main effect of boiling treatment							
-			33.2	63.8	25.6	76.7	56.2
+			33.2	63.8	25.2	77.1	56.0
Main effect of feed additives-			33.4	63.6	25.7	77.0	55.9
Natugrain			33.2	63.8	25.3	76.8	56.0
Spices			33.0	63.9	25.3	76.9	56.3
SEM			0.55	0.51	0.75	0.78	0.59
ANOVA							
Mangrof level (M)			NS	NS	NS	NS	NS
Boiling (B)			NS	NS	NS	NS	NS
Additives (F)			NS	NS	NS	NS	NS
MXB			*	0.07	NS	NS	NS
MXF			NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS

NS, not significant, *, significant p > 0.04

Table 13: Effect of feeding inclusion different levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on plasma constituents of 49 wk-old hens

Mangrof leaves, %	Boiling	Additive	Total Protein g/100 ml	Plasma albumn, g/100 ml	Plasma globulin g/100 ml	Plasma Total lipids mg /100 ml	Plasma Cholesteol, mg/100 ml	Plasma ALT U/100 ml	Plasma AST, U/100 ml
0.0	-	-	4.97	2.5	2.47	670	173.5	10.7	23.8
		Natugrain	4.94	2.51	2.43	686	170.3	11.2	24.1
		Spices	4.83	2.44	2.39	697	171.2	10.8	23.4
5.0	-	-	4.93	2.37	2.56	669	166.2	11.3	24
		Natugrain	4.78	2.42	2.36	668	166.4	10.8	23.5
		Spices	5.07	2.57	2.5	701	168.8	10.4	23.2
	+	-	5.03	2.59	2.45	725	177.4	11.1	23.1
		Natugrain	4.94	2.51	2.44	707	176.2	11.5	23.1
		Spices	5	2.52	2.48	668	167.4	11.7	22.9
10	-	-	4.95	2.49	2.47	708	168	10.4	23.2
		Natugrain	5.1	2.59	2. 52	711	162.4	10.4	22.9
		Spices	5.1	2.57	2. 53	689	168.4	10.4	22.6
	+	-	4.84	2.45	2.39	676	163.4	11.5	24.6
		Natugrain	4.7	2.37	2.33	694	166.9	11.1	24.4
		Spices	4.83	2.32	2.51	687	161	11.6	23.6

Table 13 Contd.

Mangrof leaves, %	Boiling	Additive	Total Protein g/100 ml	Plasma albumn, g/100 ml	Plasma globulin g/100 ml	Plasma Total lipids mg /100 ml	Plasma Cholesteol, mg/100 ml	Plasma ALT U/100 ml	Plasma AST, U/100 ml
Main effect of Mangrof level, %									
0.0			4.91	2.48	2.43	684	171.7	10.9	23.8
5.0			4.96	2.49	2.46	690	170.4	11.1	23.3
10.0			4.92	2.46	2.46	694	165.0	10.9	23.6
Main effect of boiling treatment									
-			4.96	2.49	2.47	689	168.4	10.7[b]	23.4
+			4.89	2.46	2.43	693	168.7	11.4[a]	23.6
Main effect of feed additives									
-			4.94	2.47	2.47	690	169.7	11.0	23.7
Natugrain			4.89	2.48	2.41	693	168.4	11.0	23.6
Spices			4.96	2.48	2.48	688	167.4	10.9	23.1
SEM			0.17	0.08	0.11	18.6	5.72	0.51	0.65
ANOVAMongrof level (M)			NS	NS	NS	NS	NS	NS	
Boiling (B)			NS	NS	NS	NS	NS	0.001	NS
Additives (F)			NS	NS	NS	NS	NS	NS	NS
M X B			NS	0.01	NS	0.07	NS	NS	**
M X F			NS	NS	NS	NS	NS	NS	NS
B X F			NS	NS	NS	NS	NS	NS	NS
M XB X F			NS	NS	NS	*	NS	NS	NS

NS, not significant ; * significant p > 0.05 ;** significant p > 0.01.

[a, b, ..] Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

Table 14: Effect of feeding inclusion levels of raw and boiled Mangrof leaves supplemented with either Natugrain® or spices on hens intestinal characteristics and reproductive organs at 49 wks- old

Mangrof level, %	Boiling	Additive	Intestinal			Ovary		Oviduct W. g.		
%length,			W.g.	%	length cm	W.g.	%	W.g.	%	length cm
0.0	-	-	96	6.15	135	38	2.44	94	6.03	60
		Natugrain	95	5.89	150	31	1.92	91	5.64	50
		Spices	109	6.41	160	67	3.94	110	6.47	60
5.0	-	-	86	5.23	160	37	2.29	102	6.2	50
		Natugrain	106	6.22	160	42	2.92	90	5.29	65
		Spices	107	6.29	155	56	3.34	75	4.41	50
	+	-	93	5.47	160	47	2.96	94	5.52	55
		Natugrain	102	5.9	145	49	3.03	112	6.47	55
		Spices	113	6.44	145	33	1.9	91	5.19	55
10.0	-	-	103	6.36	150	32	1.94	62	3.83	65
		Natugrain	63	3.63	110	30	1.76	51	2.94	55
		Spices	116	6.93	145	24	1.41	48	2.87	45
	+	-	104	6.56	160	37	2.18	75	4.73	65
		Natugrain	88	5.45	150	24	1.39	106	6.56	50
		Spices	103	5.94	120	27	1.54	66	3.81	60
Main effect of Mangrof level [b]										
0.0			100	6.15	148[b]	45[a]	2.77[a]	98[a]	6.05[a]	57
5.0			101	5.93	154[a]	44[a]	2.74[a]	94[a]	5.51[a]	55
10.0			96	5.81	139[c]	29[ü]	1.70[b]	68[b]	4.12	57
Main effect of boiling treatment										
-			98	5.90	147	40[a]	2.44[a]	80[b]	4.85[b]	56
+			100	5.96	147	36[b]	2.15[b]	91[a]	5.38[a]	57
Main effect of feed additives										
-			96[b]	5.95[b]	153[a]	38[a b]	2.36	85[ba]	5.26[a]	59[a]
Natugrain			91[b]	5.42[c]	143[b]	35[b]	2.20	90[a]	5.38[a]	55[b]
Spices			110[a]	6.40[a]	145[b]	41[a]	2.42	78[b]	4.55[b]	54[b]
SEM			9.8	0.56	13.4	5.3	0.48	11.2	0.90	8.4
ANOVAMangrof level (M)			NS	NS	**	**	**	**	**	NS
Boiling (B)			NS	NS	NS	**	**	**	**	Ns
Additives (F)			**	**	**	**	NS	**	**	**
MXB			NS	NS	NS	NS	NS	NS	NS	NS
MXF			NS	NS	NS	NS	NS	NS	NS	NS
BXF			NS	NS	NS	NS	NS	NS	NS	NS
MXBXF			NS	NS	NS	NS	NS	NS	Ns	NS

NS, not significant, **, significant p > 0.01

[a, b, ..] Mains Within a column not sharing common superscripts are significantly different based on Duncan test.

hand, although spices mixture supplementation had a significant improvement on the intestinal weight and its percentage, intestinal length value was significantly decreased. Different trend was observed with Natugrain enzyme supplementation which had a detractive effect on the intestinal weight and its percentage as well as its length. Concerning the reproductive organs, no adverse effect was observed on ovary, oviduct weight and their percentage as using 5% mangrof meal in the experimental diets. However, increasing the tested material level up to 10% had highly significant detractive effect. This may provide further evidence for the decline in production efficiency as feeding diet containing 10% mangrof leaves meal. As for the effect of boiling process, ovary weight and its percentage had followed a different trend than that of oviduct weight ,its percentage and length. Ovary weight and its percentage was significantly decreased than those of the control, while, the other reproductive organs was significantly increased except that of oviduct length which did not significantly affected. On the other hand, although spices mixture supplementation had a significant improvement on ovary weight, a significant decrease in the oviduct weight percentage and its length compare to the un-supplemented one was evident.

In general, it may be recommended to use 5% mangrof leaves meal as a non-traditional ingredient in laying hen diets without adverse effect on their performance in order to get higher economic return as well as to control excessive body fat deposition and to improve productive and reproductive performance.

Acknowledgment

The author would like to express his appreciation to Prof. Dr. A. A. El-Deek, Faculty of Meteorology Environmental and Arid Land Agriculture, King Abdulaziz University, Saudi Arabia, for his support, and intellectual help in the experimental design, field trial, and preparation of this manuscript.

References

Abd-Alla, A.A., 1993. The utilization of guava by-products in broiler finisher diets. M. Sc. Thesis, Alexandria University.

Abdo, Zeinab, M.A., A.Z.M. Soliman and Olfat S. Barakat, 2003. Effect of hot pepper and Majoram as feed additives on the growth performance and the microbial population of the gastrointestinal tract of broilers. Egypt. Poult. Sci., 22: 91-113.

Al-Harthi, M.A., 2002. Efficacy of vegetable diets with antibiotics and different types of spices or their mixtures on performance, economic efficiency and carcass traits of broilers. J. Agri. Sci. Mansoura Univ., 27: 3531-3545.

Association of Official Analytical Chemists, 1990. Official Method of Analysis. 14th Ed. Published by the A. O. A. C., Washington, D. C., USA.

Al-Harthi, M.A., 2004. Responses of laying hens to different levels of amoxiline, hot pepper or green tea and their effects on productive performance, egg quality and chemical composition of yolk and blood plasma constituents. Egypt. Poult. Sci., 24: 845-868.

Attia, Y. A., S.A. Abd El-Rahman and Arie, K. Kies, 2001. Utilization of vegetable diets containing different levels of rice bran with or without commercial enzymes in Norfa laying hen diets. J. Agri. Sci. Mansoura Univ., 26: 3557- 3577.

Cichewicz, R.H. and P.A. Thorpe, 1996. The antimicrobial prosperities of Chile pepper (Capsicum species) and their uses in Mayan medicine. J. Ethnopharmacol, 52: 61-70.

Choct, M. and G. Anninson, 1992. Antinutritive effect of wheat pentosans in broiler chicken : roles of viscosity and gut microflora. Br. Poult.Sci., 33: 821-834.

Chabrol, E. and R. Charonnat 1973. Determination of total lipids. Press Medical, 45: 1713-1720.

Choct, M., 2004. Enzymes for the feed industry: past, present and future. XXII World's Poultry Congress, Istanbul, Turkey 8-13 June, 2004.

Duncan, D.B., 1955. The multiple range and F-tests. Biometrics, 11: 1-24.

El-Deek, A.A., E. El-Ansary, M. Asar, S. Hamdy and A. El-Nagar, 1988. The nutritive value of casuarinas branchlets for laying hens. Egypt. Poult. Sci., 8: 280-294.

El-Deek. A.A., S.M. Hamdy, M.A. Asar and M.S. El-Halag, 1995. Effect of feeding corn &cob, wheat bran and rice polishing in growing diets on growth and subsequent laying performance of Alexandria chickens. Pages 304-311 in: First Egyptian Hungarian Poultry Conference, Alexandria Egypt.

El-Deek, A.A., Y.A. Attia and Amal A. Soliman, 2003. Productively response of broiler breeder hens when fed practical or vegetable diets canting high levels of barley, sunflower meal or barley and sunflower meal without or with enzyme mixture sipplementation 3-Barley and un-dehulled sunflower meal. Mansoura Uni. J. Agri. Sci., 28: 2525-2537.

El-Full Ensaf, A., N.E.A. Asker, Halam Abdel-Wahed, and A.L.I. Omar, E.M., 2000. The use of rice bran in broiler and layer diets with reference to enzyme supplementation. Egyptian poultry Science, 20: 517-543.

Ghazalah, A.A., 1996. Utilization of leucaena leaf meal by layetrs and effect of tannins and memosine content. Egypt. Poult. Sci., 30: 637-655.

Ghazalah, A.A., A.H. Abd El-Gawad, M.S. Soliman and Amany and W. Youssef, 2005. Effect of enzyme preparation on performance of broilers fed corn-soybean meal based diets. Egypt. Poult. Sci., 25: 295-316.

Haslam, E., Lilley, T.H. Ya Cai, R. Martin and D. Magnolato, 1989. Traditional herbal medicines. The role of polyphenols. Plant Medica, 55: 1-8.

Henry, R.J., D.D. Cannon and J.W. Winkelman, 1974. Clinical Chemistry, Principles an Techniques, 2nd Edn. Harper and Row.

Jeroch, H., S. Danicke and J. Brufau, 1995. The influence of enzyme preprations on the nutritional value of cereals for poultry: a review, J. Anim. Feed Sci., 4: 263-285.

Jones, N.L., S. Shabib and P.M. Sherman, 1997. Capsaicin as an inhibitor of the growth of the gastic pathogen Helicobacter pylori, FEMS Microbial lett., 146: 223-227.

Jung, H.G., 1989. Forage lignins and their effect on fiber digestibility. Agron. J., 81: 33-38.

King, D., D. Ragland and O. Adeloa, 1997. Apparent and true metabolically energy values of feedstuff for ducks. Poult. Sci., 76: 1418-1423.

Makled, M.N., 1993. Enzyme as poultry feed supplement. 4th Symp. Animal, Poultry and Fish nutrition, El-Fayoum. Egypt, 5-9.

Mathlouthi, N., M.A. Mohamed and M. Larbier, 2003. Effect of enzyme preparations containing xylanase and B- glucanase on performance of laying hens fed wheat/ barley or maize/ soybean meal based diets. Br. Poult. Sci., 44: 60-66.

National Academy of Science, 1979. Tropical Legumes Resources for the future. national academy of science, Washington, DC.

Osei, S.A., R.S. Opoku and C.C. Atuahene, 1990. Gliricidia leaf meal as an ingradient in layer diets. Anim. Feed Sci. Tec., 29: 303-308.

Retiman, S. and S. Frankel, 1957. Calorimetric method for the determination of blood, aminotransferase enzymatic activities. Am. J. Clin. Pathol., 28: 56-63.

Rutkowski, A. and K. Krygier, 1979. Fat technology and analysis. Warsaw Agriculture University, press.

Perlas, L.A. and R.S. Gibson, 2002. Use of soaking to enhance the bioavailability of iron and zinc from rice based complementary foods used in the Philippines. J. Sci. Food Agri., 82: 1115-1121.

SAS Institute, 1985. SAS user's Guide; statistics, version 5th Edition SAS Institute, Inc., Cary, N.C., USA.

Svihus, B., R.K. Newman and C.W. Newman, 1997. Effect of soaking germination and enzyme treatment of whole barley on nutritional value and digestive tract parameters of broiler chickens. Br. Poult. Sci., 38: 390-396.

Shivaram, A.D. and G. Devegowda, 2004. Effect of enzyme (vegpro) supplementation to sunflower meal based diets on performance of laying hens. XXII World's Poultry Congress, Istanbul, Turkey 8-13 june, 2004.

Talaat, Enass, A.M., 2003. The effect of feeding different treated blue bush shrub (*kochia indica)* during pullet-development period on subsequent laying hen performance. M. Sc. Thesis, faculty of Agriculture, Alexandria University.

Udedibie, A.B. and F.O. lgwe, 1989. Dry matter yield and chemical composition of pigeon pea (C. cajan) leaf meal and nutritive value of pigeon pea leaf meal and grain meal for laying hens. Anim. Feed Sci. Tec., 24: 111-119.

Underwood, E.J. and N. Stulle, 2001. The mineral nutrition of livestock, 3rd Edn, CAB International, Wallingford, UK.

Vargas, R.E. and E.C. Naber, 1984. Relationship between dietary fiber and nutrient density and its effect on energy balance, egg yolk cholesterol and hen performance. J. Nutr., 114: 645-652.

Watson, D., 1960. Determination of cholesterol in blood. Clinical Chemistry Acta, 5: 637.

Wooten, I.D., 1982. Microanalysis in Medical Biochemistry. 6th ed. P. 58. churchill LTD. London.

Yassein. S.A., A.A. El-Ghamry and L.D. Abd El-Samee, 1998. Effect of replacing *Leucaena Leucocephala* and *Sesbania Aegyptica* for soybean meal on hen performance and egg quality. Egypt. Poult. Sci., 18: 225-239.

Yasar, S. and J.M. Forbes, 1999. Performance and gastro-intestinal response of broiler chickens fed on cereal grain- based foods soaked in water. Br. Poult. Sci., 40: 65-70.

Yasar S. and J.M. Forbes, 2000. Enzyme supplementation of dry and wet wheat- based feeds for broiler chickens: performance and gut responses. Br. J. Nutr., 84: 297-307.

Zeweil, H.S., 1996b. Enzyme supplements to diets of growing Japanese Quail. Egypt. Poult. Sci.16: 535-557.

Zanella, I., N.K. Sakomura, F.G. Silversides, A. Fiqueirdo and M. Pack, 1999. Effect of enzyme supplementation of broiler diets based on corn and soybean. Poult. Sci., 78: 561-568.

Zeweil, H.S., G.K. Salwa, Gendy and N.S. Isshak, 2005. Effect of rice bran and enzyme mixture supplementation on performance, digestibility and carcass traits of growing Japanese Quail. Egypt. Poult. Sci., 25: 225-240.

*A product of DSM Food Specialties, Delft, the Netherlands, marketed in alliance with BASF, Germany. It composed mainly of xylanase and $-gluconase. Its recommended dose of usage is 0.1g/kg.