

EFFICIENCY OF UTILIZING BASIL AND FENNEL HAY WITHOUT OR WITH SYMBIOTIC IN DIETS ON PERFORMANCE AND SOME METABOLIC RESPONSES OF GROWING RABBITS

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SUMMARY

The first aim of rabbits' diets formulation is to create a low-cost ration that meets the nutritional requirements of fattening rabbits. Seventy two weanling rabbits (42-day old) of NZW breed were utilized in 4x2 factorial arrangements. Treatments were carried out to evaluate the potential of including basil and fennel hay in rations of weanling NZW rabbits at four levels (0.0, 25%, 50% and 75%) as a substitute for alfalfa hay with (0.5 g/kg) or without a synbiotic. Seventy two broiler rabbits were divided to eight treatments, three replications each. Eight rations were formulated and fed to broiler rabbits from 42 to 91 days old. Experimental weaning rabbits were placed under the same managerial conditions and comparable veterinary. The response of broiler rabbits was investigated as growth rate, carcass traits and blood parameters. Replacing dietary alfalfa hay with BH and FH up to 75% produced best effects on growth rate of broiler NZW rabbits than the basal diet one, regardless of dietary synbiotic-fortification. Analogously, broiler rabbits had fed the synbiotic-enriched diets had positive effects growth performance to that of the basal diet one. Feeding the BH&FH-rations significantly improved total edible parts and carcass yield but decreased the abdominal fat of broiler rabbits. Synbiotic added-diets had useful effects on the percentages of CY, TEP and AF of broiler rabbits. Neither dietary BH&FH levels nor added synbiotic significantly decreased of blood plasma constituents measured herein such as TRG, CHO, vLDL and LDL-C and significantly increased of Alb. and HDL-C. Dietary BH&FH levels with the addition of synbiotic interactions had no significant effects for all criteria measured. Raldala concludes that there is a possibility of replacement of alfalfa hay by BH&FH in growing rabbits' diets up to 75% with significant productive performance and characteristics of carcass; Also, the addition of synbiotic (0.5gm/kg diet) led to improved rabbit growth, carcass yield and total edible parts% but decreased AF percentage.

Keywords: *dietary basil and fennel hay, synbiotic, Rabbits' growth, spleen and liver histology.*

INTRODUCTION

Domestic rabbits are primarily raised for meat production and secondarily as fur producers. As noted by FAO (1981), broiler rabbits as short-term animals have the competence, by mounting their production, to face the upcoming world higher meat emergency in the future. Since, the production of rabbits has been reported to play an important role in the supply of animal protein in Africa (Amaefule *et al.*, 2005). The major problem in commercial production of rabbits has been centered on the high cost of feeds. It is recognized that the cost of feeding represents about 65 to 75% of the cost of producing rabbits. The main objective of the composition of the diets is to reduce the cost of the diet with the supply of the weaning rabbit requirements. Reducing the high cost of rabbits feed could be achieved through the use of non-conventional cheaper feedstuffs or enhancing the metabolic rate of common rations by using some natural feed supplements. Attention has been focused on fennel and basil hay as an agricultural by-products which mainly contained stems and leaves of plant. These plants are cultivated in large areas in Upper Egypt. Fennel and basil are a potential source of natural antioxidant phenolic compounds, have effective reducing free radical scavenging, superoxide anion radical scavenging, anti-microbial and anti-fungi (Kri *et al.* 2007, Hanna *et al.* 2008). Using such plant by-product as non-conventional feedstuff for growing rabbits is the possible solution to the problem of feedstuffs' shortage and minimizes the environmental pollution. So, There are several studies that have been designed to investigate the possibility of using plant by-products

waste to feeding growing rabbits, especially as alternatives to Egyptian clover and alfalfa hay, which commonly by replacing 30-40% of the pelleted rations of broiler rabbits (Gaafar *et al.*, 2014; Galal *et al.*, 2014; Abo El-Maaty *et al.*, 2017). The restriction in the use of antibiotic in growing rabbits feeding has increased the interest of using alternative natural growth promoters that allow maintenance of high productivities and reduction of morbidity and mortality in commercial broiler rabbit's farms. Organic acids possess a dual action; antibiotic effect via reducing the intestinal bacteria action competing with the variable nutrients of the host (Hyden, 2000) and intermediary metabolites' substrates', enhance gastric proteolysis and availability of some elements that complex with (Kirchgeßner and Roth, 1988). Gibson *et al.*, 2004 reported that prebiotics are indigestible food ingredient(s) that promoting the growth and/or activity of one or a specific number of profitable bacteria in the cecal and so beneficially affect host animal. Indigestible and polysaccharides cannot be digested but are readily fermented by anaerobic colonic bacteria and this is making them suitably used (Mussatto and Mancilha, 2007). Prebiotics have shown considerable capacity in boosting health and rabbits' performance (Fonseca *et al.*, 2004; Pinheiro *et al.*, 2009). Probiotics as feed additives might potentially benefit the host animal by improving its intestinal microbial balance (Fuller, 1989). A few studies have been conducted on the use of synbiotics in feeding of growing rabbits. Therefore, the aim of the current research is investigate the growth performance, carcass trait and selected blood constituents of Weaning rabbits fed diets containing basil and fennel hay in absence of or presence of a synbiotic.

MATERIALS AND METHODS

This study was conducted in the Rabbits Production Unit, Agricultural Research and Experiment Station, Faculty of Agriculture, Mansoura University. The Chemical analyzes of the tested materials and the experimental diets were carried out at the Laboratory of Poultry Production Department, Faculty of Agriculture, Mansoura University, Egypt. The experimental work of the present research was conducted to investigate the effect(s) of different BH and FH inclusion levels (0.0, 25, 50 and 75%) with or without a synbiotic (Bio-Yeast[®]) on the growth rate of fattening rabbits. Impacts of these treatments on carcass traits, some haematobiochemical parameters and microscopic examination of both liver and spleen of fattening rabbits.

*Preparation of dried Basil (*Ocimum basilicum*) and Fennel (*Foeniculum vulgare*) hay:*

Basil (*Ocimum spp.*), belonging to the *Lamiaceae* family, is a pleasant by smelling perennial shrub which grows in large areas around the world (AKGÜL 1993; BARIAUX *et al.* 1992). Basil is one of the species used for the commercial seasoning, which is grown in Meddle Egypt to get leaves and seeds. The leaves and seeds contain 3-5 % volatile oil. Fennel (*Foeniculum vulgare*), the family *Lamiaceae* family, is cultivated mainly for seeds in Upper Egypt. The seeds contain 2-6 % volatile oil which is used as human feed additive for flavor. Basil (*Ocimum basilicum*) and Fennel (*Foeniculum vulgare*) were dehydrated before they mixed with other feed ingredients to formulate the testal pelleted rations.

Experimental weaned rabbits and rations:

Duplicate samples of dried basil hay (BH) and fennel hay (FH) were analyzed according to AOAC (2000).

Table (1): A proximate analysis of tested materials (As DM basis)

Item	Basil hay (BH)	Fennel hay (FH)
Dry matter (DM,%)	90	89.50
Crude protein (CP,%)	14.00	6.00
Crude fiber (CF,%)	23.50	16.50
Ether extract (EE,%)	10.00	8.00
ash, %	20.00	19.00
Nitrogen-free extract (NFE),%	32.50	50.50
Calcium (Ca,%)	0.60	0.75
Total phosphorus, %	0.10	0.08

Seventy-two unsexed NZW rabbits about 42 days of age, with the same initial live body weights, were assigned, in a (4x2) factorial within a completely randomized experimental design, to eight equal experimental groups (three rabbits/cage). Eight tested pelleted rations were prepared to meet all the broiler rabbit's essential nutrient requirements, according to NRC (1977) and crude fiber Fraction was determined in Regional center for Food and Feed (RCFF). BH plus FH content of the tested ration was substituted for 0.0, 9, 18 or 27% of Alfalfa hay (equivalent to replacement ratios of 0.0, 25, 50 or 75% of AH) with (0.5 g/kg) or without of Bio-Yeast[®] (a synbiotic) inclusion. Likewise expressed eventually perusing those manufacturer,

Table (2): Formulation and proximate analysis of the tested pelleted ration of weaning rabbits from 42 to 91 days old

Feedstuffs	Basal diet	25%	50%	75%
Soybean meal, 44%CP	10.5	12.5	14.5	16.5
Yellow corn	17.0	15.0	13.0	11.0
Wheat bran	17.0	17.0	17.0	17.0
Barley grain	15.0	15.0	15.0	15.0
Alfalfa hay	36.0	27.0	18.0	9.0
Basil hay (BH)	----	4.5	9.00	13.50
Fennel hay (FH)	----	4.5	9.00	13.5
Molasses	2.00	2.00	2.00	2.00
Dicalcium phosphate	0.70	0.70	0.70	0.70
Limestone	1.00	1.00	1.00	1.00
Vit. Min. Premix [§]	0.300	0.300	0.300	0.300
Sodium chloride	0.50	0.50	0.50	0.50
Total	100	100	100	100
Calculated analyses: As fed basis(NRC,1977) [¶]				
Digestible energy,kcal/kg	2631	2642	2650	2658
Crude protein, %	16.36	16.24	16.45	16.67
Crude fiber, %	13.33	12.74	12.18	11.33
Ether extract, %	2.63	3.20	3.75	4.29
Lysine, %	0.75	0.73	0.72	0.72
Meth., %	0.21	0.23	0.25	0.27
Meth. + Cyst., %	0.52	0.50	0.48	0.47
Calcium, %	1.12	1.06	1.00	0.95
Total phosphorus, %	0.57	0.55	0.54	0.53
Determined analyses: As DM basis (AOAC, 2000)				
Dry matter, %	91.01	90.86	90.45	91.13
Organic matter, %	83.03	81.99	81.52	82.12
Crude protein, %	17.98	17.87	18.18	18.29
Crude fiber, %	14.64	14.02	13.47	12.43
NDF, %	50.58	48.93	50.71	57.27
ADF, %	35.54	36.26	34.26	40.30
ADL, %	12.81	11.81	10.92	12.54
Hemicellulose,%	15.05	12.57	15.79	16.97
Cellulose,%	22.73	24.45	24.00	27.76
Lignin,%	8.70	7.75	7.93	8.44
Ether extract, %	2.89	3.52	4.15	4.71
Ash, %	9.01	7.98	8.87	8.93
Nitrogen free extract,%	55.49	56.61	55.33	55.64

[§]Each 3kg premix contained 12,000,000IU Vit. A, 2,500,000IU Vit. D₃, 10,000mg Vit. E, 2500mg Vit K₃, 1000mg Vit B₁, 4000mg Vit. B₂, 1500mg Vit. B₆, 10mg Vit. B₁₂, 10,000mg Pantothenic acid, 20,000mg Nicotinic acid, 1000mg Folic acid, 50mg Biotin, 500mg Choline chloride, 60mg Manganese, 55mg Zinc, 100mg Selenium, 1000mg Iodine, 35mg Iron, 10mg Copper, 250mg Cobalt, and Carrier CaCO₃ to 3kg. [¶]Calculated analyses are based on NRC (1977), except for test materials on actual nutrient determination. NDF=Nutrient detergent fiber, ADF=Acid detergent fiber and ADL=Acid detergent lignin.

the synbiotic included (Bio-Yeast[®]) is prebiotic besides probiotic. Prebiotic will be a buffered mix from claiming particular carboxylic acids once An interesting mineral transporter framework consolidated with a Mannan-oligosaccharide sourball and probiotic will be buffered mix of particular microscopic organisms for example, *saccharomyces cerevisiae*, *lactobacillus Acidophilus*, *streptococcus Facecium*, Furthermore lactic corrosive microscopic organisms. The feedstuffs contents and nutrient substances of the tested rations are founded in Table (2).

All rabbit groups were housed in a commercial wire net (50L×50W×45H cm) of three rabbits each. The cages were given for a manual feeders and nipple drinkers, and fed their respective experimental rations from 42 to 91 days of age. All weaning rabbits were keeping on the normal environmental, careful managerial and comparable veterinary all over the growth period from 6 to 13 week of age. Fresh water and feed were available *ad lib.* basis.

Initial live body weights (LBW) of weaned rabbits were recorded at the starting of growing period (42 days old). Weekly records on live body weight, feed consumed (FC) and body weight gain (BWG) of experimental broiler rabbits were also maintained on a replicate group basis. Also, feed conversion ratio (FCR) and body weight gain were calculated throughout the experimental period. The performance index (PI) was calculated according to North (1981). Mortality of broiler rabbits was recorded daily throughout the growth period.

At the end of the growth period (13 weeks of age), 3 animals from each experimental group were randomly chosen and fasted for 16 hours, weighed and slaughtered. Just after estimating live body weight at slaughter (LBW), rabbits were carefully sacrificed, skinned and emptied. The individual weights of fur plus legs (FPL), hot carcass weight with head (HCY) and total giblets weight [liver (LI), heart (HE), kidneys (KI), lungs (LU), spleen (SP)] were recorded. The total edible parts (TEP) were calculated as HCY plus total giblets. Relative weights of HCY, liver, heart, kidneys, lungs, spleen, fur plus legs and TEP were also calculated. Also, abdominal and kidney fat were weighted and expressed as a percentage of fasting weight.

At the time of slaughter, blood samples were taken from three growing rabbits in each experimental group, in clean heparinized tubes. Blood samples were immediately centrifuged at 3000 rpm for 20 minutes. Plasma samples were separated and stored at -20°C until biochemical analysis. The blood plasma was assigned for glucose (GLU; Trinder, 1969), total protein (TPR; Doumas *et al.*,1981), albumin (ALB; Doumas *et al.*,1971), triglycerides (TRI; Fossati and Prencipe,1982), total cholesterol (CHO; Allain *et al.*,1974) and high density lipoprotein-cholesterol (HDL-C; Sawle *et al.*,2002) and determines using commercial kits. Blood plasma level of low density lipoprotein-cholesterol (LDL-C) was also estimated by using the equation of Friedewald *et al.*(1972), as follows: $LDL-C = Total\ Cholesterol - (HDL-C + vLDL)$; where vLDL are very low-density lipoprotein which was calculated as concentration of plasma triglycerides divided by 5.

All data were subjected to statistical analysis as two factors-factorial analysis of variance using SAS Program (2004). Means were separated ($P \leq 0.05$) using Duncan's multiple range test (Duncan, 1955), for the comparison among means of the tested rations when the main effects were significant.

RESULTS AND DISCUSSION

Growth performance of broiler rabbits:

Data for growth performance of NZW rabbits during the whole experimental period as affected by of replacing dietary alfalfa hay with dried basil and fennel (BH and FH) with or without a synbiotic are summarized in Table (3). These data clarified that initial body weights of NZW broiler rabbits were those same values with no significant differences ($P > 0.05$) indicated the random distribution of rabbits among the different tested groups. It might have been watched that final LBW and BWG of fattening rabbits were positively influenced ($P \leq 0.05$) due to feeding rations holding 50 or 75% basil and fennel hay as compared to the animals receiving the control one (0% BH and FH) or group had fed 9% Basil and Fennel hay (25% reinstatement values of alfalfa hay). During the period 42-91 days old, feed consumed of broiler rabbits fed the rations inclusion 9, 18 or 27% BH and FH was significantly lower ($P \leq 0.05$) than that of the basal diet ones, regardless of dietary synbiotic inclusion. However, it was interesting to review that weaning rabbits fed the rations including 9, 18 or 27% BH and FH achieved superior performance index (PI) and feed conversion ratio (FCR) compared for those basal diet ones, irrespective of dietary synbiotic supplementation.

Total BWG, FCR and PI were significantly affected by Dietary basil and fennel levels where rabbits that fed the 27% basil and fennel hay-diets (to replace 75% of alfalfa hay) showed significant enhancements in total BWG, FCR and PI than those fed the other treatments. Besides that, Abo El-Maaty *et al.* (2017) found that feeding the sugar beet tops-rations for NZW growing rabbits caused positive effects on BWG, FCR.

Table (3): Biological evaluation of dietary level of basil and fennel hay and synbiotic addition on weaning NZW rabbit's performance from 42 to 91days-old

Item	Initial LBW (g)	Final LBW ¹ (g)	Total BWG ² (g)	PI ³ (%)	Total FC ⁴ (g)	FCR ⁵ (g: g)
BH and FH level (A)						
0.00% A1	760	2046 ^c	1286 ^c	55.45 ^e	4748 ^a	3.69 ^c
9.0% A2	758	2051 ^c	1293 ^b	61.41 ^c	4325 ^c	3.34 ^b
18.0% A3	759	2181 ^b	1422 ^a	66.49 ^b	4660 ^b	3.28 ^b
27.0% A4	758	2229 ^a	1471 ^a	72.37 ^a	4526 ^b	3.08 ^a
SEM	1.100	5.045	0.007	0.145	20.41	0.023
Significance	NS	*	**	*	*	*
Synbiotic (B)						
(0.0 g/kg) B1	759	2121 ^b	1362 ^b	63.50 ^b	4554 ^b	3.34
(5.0 g/kg) B2	759	2133 ^a	1374 ^a	64.25 ^a	4574 ^a	3.32
SEM	0.806	3.567	8.313	0.142	14.210	0.020
Significance	NS	*	*	*	*	NS
AB Interaction						
A1B1	759	2064	1305	55.48	4852	3.72
A1B2	760	2028	1268	55.41	4644	3.66
A2B1	758	2043	1285	62.48	4307	3.27
A2B2	758	2060	1302	63.58	4343	3.24
A3B1	760	2163	1403	65.15	4654	3.32
A3B2	758	2200	1442	67.90	4665	3.24
A4B1	758	2216	1458	67.94	4403	3.02
A4B2	758	2242	1484	68.31	4648	3.13
SEM	1.612	7.135	7.919	0.151	36.74	0.037
Sig.	NS	NS	NS	NS	NS	NS

¹⁻⁶: Refer to live body weight, body weight gain, the performance index, feed consumed and feed conversion ratio

^{a-c}: Means within same column with different superscripts are significantly different ($P \leq 0.05$).

NS: Not significant. *: Significant at $P \leq 0.05$. **: Significant at $P \leq 0.01$

Also, the enhanced growth performance, noted herein, accordance with the findings of Radwan and Khalil (2000) who indicated that gains and feed conversion ratio of rabbit fed fennel hay meal up to 50% of diets were higher than the animals receiving the control diet. Similarly, Abo El-Maaty *et al.* (2014), who observed that those impacts for incomplete or complete replacing dietary Egyptian clover by cucumber vines straw on performance of broiler rabbits. They noted that broiler rabbits fed rations including up to 22.5% cucumber vines straw achieved useful growth performance to those of the basal diet group. However, no significant differences in final LBW or BWG of broiler rabbits fed rations in which barseem hay completely substituted sugar beet tops hay but feed consumed was decreased while feed conversion was bested than in those fed the basal diet ones (Gaafar *et al.*, 2010).

Dietary synbiotic level significantly ($P \leq 0.05$) affected final LBW, BWG and PI of NZW broiler rabbits, but FC of fattening rabbits fed the synbiotic-included rations was significantly higher ($P \leq 0.05$) than the animals receiving the basal diet ones (Table 3). On the other hand, feed conversion was no significantly improved with adding synbiotic. The enhancement in growth performance, noted herein, resulted from synbiotic addition may be due to the beneficial microorganisms which increased nutrient utilization. In agrees with the our data, Abo El-Maaty *et al.* (2017) showed that dietary addition with a prebiotic (fracto-oligosaccharide) had a useful effect on production performance of broiler rabbits fed the ration in which alfalfa hay partial substituted sugar beet tops. Our reported data coincide with those recorded by Amber *et al.* (2014), who reviewed that a positive correlation between production performance of growing rabbits and prebiotic supplemented rations. Prebiotics create unfavorable condition for pathogenic role seems to be influenced by type & class of the included

prebiotic, diet piece & hygienic states of the animal. Prebiotics as queary feed components have alleviative or metabolic activity of a limited number of internal lactobacillus spp. (Gibson and Roberfroid, 1995); hence they may produce a similar action as probiotics (Huyghebaert *et al.*, 2011). In poultry, the suggested technique of prebiotics' action are; growth suppression of harmful intestinal microbes, expanded intestinal acidity, excitation of intestinal absorptive cells growth and excitation of the enteric immune system, So smoothing improved performance and health status of the birds (Chen *et al.*, 2015; Sethiya, 2016). We investigated in our research non-significant ($P>0.05$) effects of added synbiotic on dietary BH and FH. No morbidity or mortality of weaning rabbits recorded during the experemental growth-period. Generally, the upgrading in NZW weaning rabbits performance fed photogenic hay improve flavor and palatability of feed and Phytobiotic act also as antioxidant and so may thus indirectly stabilize the nutritional and sensorial feed quality.

Slaughter traits of growing rabbits:

The analysis of variance revealed highly significant ($P\leq 0.05$) differences among dietary treatments for CY, LI, TEP and AF (Table 4). Rabbits fed 18 and 27 % BH&FH (equivalent to replacement value of 50 or 57% of alfalfa hay) in rations had higher values of CY and TEP followed by those fed 9% BH&FH (equivalent to replacement value of 25% of alfalfa hay). However, the animals receiving the basal diet showed lower values for HCY, LI and TEP and higher values for AF than those fed the other experimental diets. Rabbits fed diets containing BH&FH had a significantly reduced the percentage of AF ($P\leq 0.05$). On the other hand, other dressing percentage values evaluated here had no effects. The enhancement in HCY and TEP of weaning rabbits, noted in our data, due to feeding the BH and FH-including rations agreement with the reporting by Radwan and Khalil (2002), who found that rabbits fed diets containing the fennel hay had significantly higher dressing %, but other carcass characteristics were not affected compeered with those fed the basal diet group. The present results are in agreement with that noted by Abo El-Maaty *et al.* (2017), who found that replacing the alfalfa hay in weaning rabbit rations with sugar beet tops had significantly higher values of total edible parts and carcass yield but decreased the abdominal fat of growing NZW rabbits. Also, Hanna *et al.* (2008), who elucidated the effects of dietary fennel and caraway seeds supplementation on carcass traits of weaning animals, and showed that carcass characteristics of weaning animals fed the rations including up to 0.6% fennel seeds was comparable to those of the basal diet group and caraway seeds-supplemented group.

Furthermore, the effects of incomplete or complete replacing of cucumber vines straw (CVS) for dietary Egyptian clover on carcass traits of growing animals, and indicated that carcass characteristics of broiler rabbits were evaluated by Abo Eglal *et al.* (2013), who reported that diets including up to 22.5% CVS (equivalent to a replacement value of 75% of Egyptian clover) were compared with those fed the basal diet on carcass traits of weaning rabbits; meanwhile, the relative weights of empty carcass & total edibale parts were negatively affected by 30% CVS dietary level. Also, Radwan and Khalil (2002), who reported that broiler rabbits fed fennel hay-diet, had significant differences in dressing %, but liver, heart percentage were not significantly differed. On the other hand, no significant differences in carcass characteristics of broiler rabbits fed completely replaced berseem hay with sugar beet tops hay rations Gaafar *et al.* (2010), while substituting ensiled sweet pototo vines for dietary barseem hay were not significantly affected on carcass characteristics of broiler rabbits when comparable to basal diet one Gaafar *et al.* (2014).

Weaning rabbits fed synbiotic-added ration had a significantly ($P\leq 0.05$) higher CY, TEP ($P\leq 0.01$) and LI ($P\leq 0.05$) as comparable to those fed the basal diet (Table 4). Also, rabbits fed synbiotic-supplemented diets showed the best values of AF compared with the basal diet group. However, supplemented dietary synbiotic had no effect on the relative weights of HE, KI, FPL, SP or LU of weaning animals. The useful effect of supplemented dietary synbiotic on CY, TEP and AF, reported in this research, is agreed with the data reported by Abo El-Maaty *et al.*, (2017) who recorded beneficial effects of dietary prebiotic on the percentages of CY, TEP and AF weight of NZW broiler rabbits. Our values are also go in accordance with the reviewing by Amber *et al.* (2014), who found a useful effect of dietary inclusion of prebiotic on carcass percentage of weaning rabbits with no effects on the relative weight of giblets. Furthermore, Attia *et al.* (2015), who noted that a significant inhance in carcass percentage of growing rabbits with intermittently administered mannan oligosaccharides (MOS) and a significant decrease in the fat content of broiler rabbit meat with continuous enrichment. Also they reported a significant enhancement in tenderness and water holding capacity of broiler rabbit meat when administered dietary MOS as compared to the control one. Meanwhile, Bovera *et al.*, 2012; Tazzoli *et al.*, 2012; El-Gohary and Abo El-Maaty, 2014 found no differences in carcass characteristics of fattening rabbits fed a diet supplemented with prebiotic. There are many factors such as nature and prebiotic dose, experimental planning, age and gut health status of growing rabbits influence the responsiveness of rabbits to added dietary prebiotic (Falcão-e-Cunha *et al.*, 2007). The synbiotic product displayed a greater growth-promoting effect than the probiotic lactobacillus sp. Product and increased the carcass yield percentage.

Moreover, a highly significant difference in the carcass characteristics (6 to 7%) was found between synbiotic group and both probiotic and basal diet groups (Abd El-Salam, 2011). Our data revealed no significant effects of the interactions between dietary level of BH&FH and synbiotic on all carcass characteristics tested in this research.

Table (4): Effects of dietary levels of herbal plant hay (basil and fennel hay) and synbiotic addition on carcass traits of 91 days old broiler rabbits

Item	LBW	CY ¹	LI ²	HE ³	KI ⁴	TEP ⁵	FPL ⁶	SP ⁷	LU ⁸	AF ⁹
BH and FH level (A)	(kg)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
0.00% A1	2046 ^c	52.50 ^c	3.167 ^c	0.283	0.933	56.88 ^c	18.83	0.057	0.783	0.310 ^a
25.0% A2	2051 ^c	54.00 ^b	3.167 ^c	0.267	0.783	58.22 ^b	17.33	0.053	0.733	0.290 ^b
50.0% A3	2181 ^b	55.97 ^a	3.667 ^a	0.250	0.833	60.72 ^a	15.83	0.070	0.767	0.198 ^c
75.0% A4	2229 ^a	56.00 ^a	3.333 ^b	0.233	0.833	60.40 ^a	17.33	0.050	0.683	0.192 ^c
SEM	5.045	1.590	0.354	0.020	0.054	1.667	1.064	0.009	0.074	0.034
Sig. ¹⁰	*	*	*	NS	NS	*	NS	NS	NS	*
synbiotic (B)										
(0.0 g/kg) B1	2121 ^b	53.75	3.500 ^a	0.267	0.858	58.38 ^b	17.08	0.057	0.750	0.341 ^a
(0.5 g/kg) B2	2133 ^a	55.78	3.167 ^b	0.250	0.833	60.03 ^a	17.58	0.060	0.733	0.199 ^b
SEM	3.567	1.124	0.250	0.014	0.038	1.179	0.752	0.006	0.052	0.043
Sig.	*	**	*	NS	NS	**	NS	NS	NS	**
AB Interaction										
A1B1	2064	48.67	3.667	0.267	1.033	53.64	20.00	0.063	0.833	0.326
A1B2	2028	55.33	2.667	0.300	0.833	59.18	17.67	0.050	0.733	0.255
A2B1	2043	56.67	3.000	0.267	0.667	60.60	16.67	0.043	0.733	0.308
A2B2	2060	53.67	3.333	0.267	0.900	58.17	18.00	0.063	0.733	0.245
A3B1	2163	54.33	3.667	0.267	0.833	59.10	15.00	0.063	0.733	0.269
A3B2	2200	56.33	3.667	0.233	0.833	61.06	16.67	0.077	0.800	0.199
A4B1	2216	55.33	3.667	0.267	0.900	60.16	16.67	0.057	0.700	0.267
A4B2	2242	56.00	3.000	0.200	0.767	59.97	18.00	0.050	0.667	0.196
SEM	7.135	2.248	0.500	0.029	0.076	2.357	1.505	0.013	0.104	0.057
Sig.	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

¹⁻¹⁰: Refer to percentages of carcass yield, liver, heart, kidneys, total edible parts, fur plus legs, spleen, lungs and AF=Abdominal fat respectively. NS: Not significant. *: Significant at P≤ 0.05 **: Significant at P≤ 0.01.

^{a-c}: Means bearing different superscripts in the same column are significantly different (P≤0.05). Sig.=Significance

Blood metabolites of weaned rabbits:

The effects of feeding rations including 9, 18 or 27 % BH&FH to substitute 25, 50 or 75% for dietary alfalfa hay on blood plasma components of broiler rabbits are presented in Table (5). Plasma total protein was not affected by different dietary treatments, although a tremendous, but insignificant increase in TPR levels with treatments. However, plasma albumin level was significantly higher for rabbits fed the 75% BH&FH diet compared by the other treatments. Of interest, the higher A/G ratio of the 75% BH&FH treated rabbits, which indicates lower immune response compared to the other treatments including the control one. It is well known that A/G ratio is considered as a good indicator for immunity in mammals and different avian species. The increased globulin level in plasma of rabbits fed the 25.0% and 50.0% BH&FH-diets support our previous A/G ratio results as blood globulins contain different immunoglobulin fractions. On the other hand, plasma protein level as affected by synbiotic supplementation, regardless of BH and FS levels was significantly higher for rabbits fed the synbiotic supplemented diet compared with the control ones. A similar trend was also observed for plasma globulin level, but not, for albumin. Moreover, the low A/G ratio in rabbits fed the synbiotic-supplemented diet may support the positive impact of synbiotic in enhancing immune responses of rabbits.

The results of the present research, in agreement with the reviewing of Galal *et al.* (2014), who explained that substituting dried strawberry vines for dietary Egyptian clover had no significant effect the plasma parameters of total protein and globulin. In addition, El-Gohary and Abo El-Maaty (2014), who showed that substituting the Egyptian clover in broiler rabbit ration with *Phaseolus vulgaris* straw were did not significantly affect on blood plasma metabolites of total protein and globulin.

The results summarized in Table (5) showed that dietary inclusion synbiotic caused significant increases ($P \leq 0.05$) in blood plasma metabolites of total protein and globulin, triglycerides and HDL-C of growing rabbits but were not significantly affect ($P > 0.05$) on plasma levels of albumin, Alb/Glo ratio, total cholesterol and LDL-C, irrespective of dietary BH&FH level. The increased in globulin concentration with synbiotic supplementation in the fattening rabbits ration as reported in the consistent research may be an indication of improved immunity in fattening rabbits. The enhanced level of plasma globulin of weaning animals fed the synbiotic-added rations in this work is in agrees with the reported by (Abo El-Maaty *et al.*, 2017, who found that dietary prebiotic included had a significant increased of plasma globulin of NZW growing rabbits. Also, Attia *et al.* (2015) showed that the enhanced total antioxidant capacity of growing rabbits influenced by dietary MOS-inclusion is an indication to a decreased oxidative stress in weaning rabbits and an enhancement in the general health status of the broiler rabbits. Furthermore, Abdelhady and El-Abasy (2015) indicated that dietary addition of probiotic, prebiotic and synbiotic the cell-mediated immune response of broiler rabbits. The reduce of a significant effect of synbiotic-inclusion diet on some of blood plasma parameters of weaning rabbits, reported in this research, is through with the results reviewed by El-Gohary and Abo El-Maaty (2014), who noted that plasma parameters of broiler rabbits had no significant effects with feeding prebiotic-fortified rations. Our results are also in partial agrees with those reported by Attia *et al.* (2015), who noted that dietary inclusion of MOS were not significantly affect on plasma metabolites to weaning rabbits. Apart from the effect of dietary herbal plant by-product, the noted means of blood parameters of broiler rabbits in our research agreement with the normal physiological values (Özkan *et al.*, 2012). Our data revealed no significant effects of the interactions between dietary level of BH&FH and synbiotic on all blood plasma constituents elucidated in this research.

Table (5): Effects of dietary levels of medical plant hay (Basil hay and fennel hay) and synbiotic addition on Blood plasma parameters of 91 days-old broiler rabbits.

Item	TPR ¹ (g/dL)	ALB ² (g/dL)	GLO ³ (g/dL)	Alb/Glo	TRI ⁴ (mg/dL)	CHO ⁵ (mg/dL)	HDL-C ⁶ (mg/dL)	vLDL (mg/dL)	LDL-C ⁷ (mg/dL)
BH and FH level (A)									
0.00% A1	5.54	2.89 ^c	2.65	1.09	54.63 ^a	78.70 ^a	21.28 ^c	10.93 ^a	46.50 ^a
25.0% A2	5.78	3.03 ^{bc}	2.75	1.11	49.09 ^b	68.06 ^b	22.48 ^b	9.82 ^b	35.75 ^b
50.0% A3	5.86	3.13 ^b	2.74	1.14	46.77 ^c	67.64 ^b	22.43 ^b	9.35 ^b	35.86 ^b
75.0% A4	5.94	3.28 ^a	2.66	1.25	46.83 ^c	66.95 ^b	23.98 ^a	9.37 ^b	33.61 ^b
SEM	0.143	0.072	0.100	0.049	1.722	2.858	1.219	0.344	1.758
Sig ⁸ .	NS	*	NS	NS	*	*	*	*	*
synbiotic (B)									
(0.0 g/kg) B1	5.14 ^b	3.08	2.63 ^b	1.18	50.31 ^a	70.43	22.03	10.06	38.33
(0.5 g/kg) B2	5.81 ^a	3.09	2.76 ^a	1.12	48.34 ^b	70.24	23.05	9.67	37.52
SEM	0.04	0.051	0.071	0.034	1.217	2.021	0.862	0.243	1.243
Sig ⁸ .	*	NS	*	NS	*	NS	*	NS	NS
AB Interaction									
A1B1	5.23	2.74	2.49	1.10	58.08	83.04	20.50	11.62	50.92
A1B2	5.84	3.04	2.80	1.09	51.18	74.36	22.05	10.24	42.07
A2B1	5.59	2.98	2.61	1.14	50.40	70.74	22.47	10.08	38.19
A2B2	5.96	3.08	2.88	1.07	47.77	65.37	22.49	9.55	33.32
A3B1	5.93	3.11	2.52	1.11	47.20	65.96	22.19	9.44	34.33
A3B2	5.79	3.14	2.65	1.18	46.33	69.32	22.66	9.27	37.39
A4B1	6.08	3.46	2.61	1.36	45.55	61.97	22.97	9.11	29.90
A4B2	5.81	3.10	2.71	1.15	48.10	71.92	24.98	9.62	37.31
SEM	0.202	0.102	0.141	0.069	2.435	4.042	1.723	0.487	2.486
Sig ⁸ .	NS	NS	NS	NS	NS	NS	NS	NS	NS

1-8: Refer to total protein, albumin, globulin, triglycerides, total cholesterol, high density lipoprotein-cholesterol and low density lipoprotein-cholesterol, respectively. NS: Not significant. *: Significant at $P \leq 0.05$. Sig. = Significance a-b: Means bearing different superscripts in the same column are significantly different ($P \leq 0.05$).

Spleen histology:

Microscopic section of spleen from rabbits fed the basal diet ones (Fig.9) shows the basic structure of the splenic tissues, in which a large white pulp(WP) area and a dark-stained red pulp area(RP) could be seen. There are also numerous blood capillaries, sinusoids and lymphocytic cells of different size in both areas.

It is clear that WP contains many reticular cells and many small, medium and large sized lymphocytes. Besides, it contains few lymphatic nodules (Figs 10, 11, 12). Of interest, the irregular distribution of the RP area within the WP one, expect for the spleen section from rabbits fed 18% BH and FH (Fig. 11) where RP area showed intensive aggregation of small lymphocytes, macrophage and lymph nodules. The impact of synbiotic inclusion to diets on enhancing the histological structure of the spleen, as observed in Figs. (13; 14; 15 and 16), in our study is evidenced by the presence of many lymph nodules, which have been reported to be directly related to better immunity. The increased proportion of RP areas in spleen sections from rabbits fed the basal diet with synbiotic, concomitant by an obvious increase in the number of large lymphocytes may support the early known fact that spleen is the main site of lymphocytes proliferation and differentiation (Junqueira, *et al.*, 1971).

In conclusion, herbal plant hay (BH &FH) can partially replace alfalfa hay in weaning rabbits' rations with useful performance and metabolic responses; synbiotic performs further enhancements on growth rate, feed conversion ratio, dressing-out percentage and macroscopic examination of liver and spleen tissues in fattening rabbits.

Liver histology

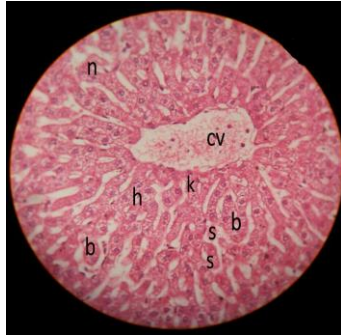


Fig. (1): T.S.In the liver from the control Treatment (H&E*40)



Fig. (2): T.S.In the liver from the 9.0%FH+BH Treatment (H&E *40)

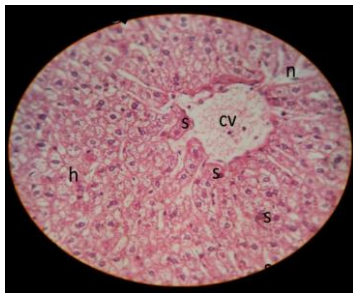


Fig. (3): T.S.In the liver from the 18.0%FH+BH Treatment (H&E *40)

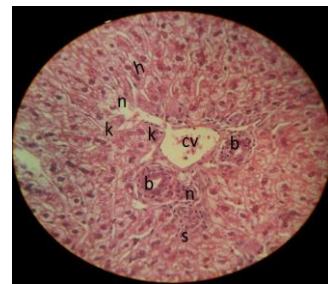


Fig. (4): T.S.In the liver from the 27.0%FH+BH Treatment (H&E *40)

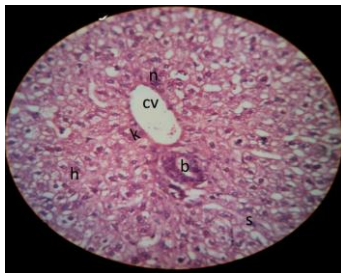


Fig. (5): T.S.In the liver from the Control+Symbiotic Treatment (H&E *40)



Fig. (6): T.S.In the liver from the (9.0%FH+BH)+Symbiotic Treatment (H&E *40)

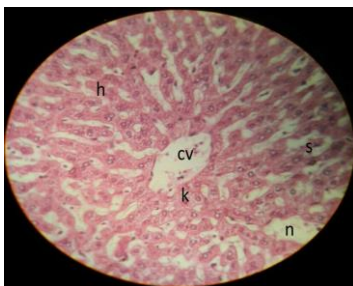


Fig. (7): T.S.In the liver from the (18.0%FH+BH)+Symbiotic Treatment (H&E *40)

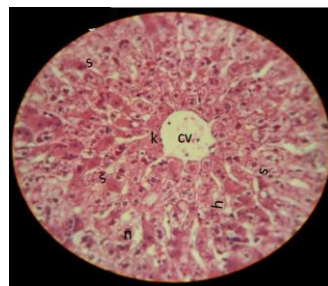


Fig. (8): T.S.In the liver from the (27.0%FH+BH)+Symbiotic Treatment (H&E *40)

Spleen histology

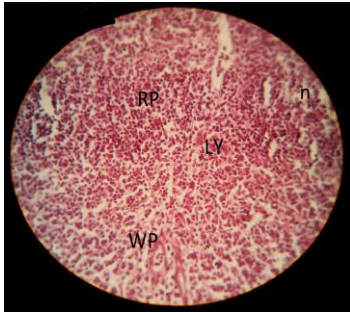


Fig. (9): T.S.In the spleen from the Control Treatment (H&E * 40)

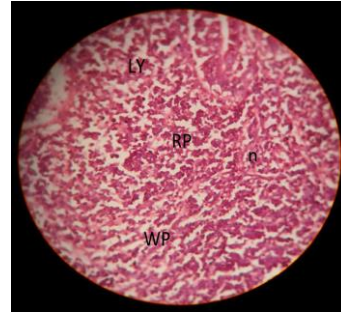


Fig. (10): T.S.In the spleen from the 9.0%FH+BH Treatment (H&E * 40)

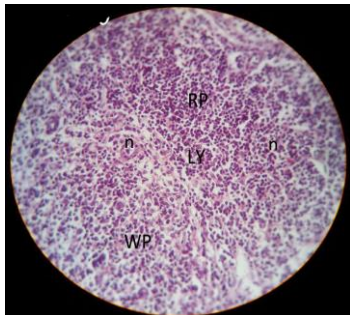


Fig. (11): T.S.In the spleen from the 18.0%FH+BH Treatment (H&E * 40)

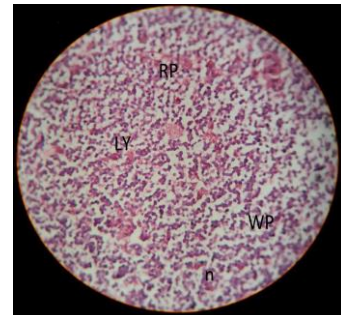


Fig. (12): T.S. In the spleen from the 27.0%FH+BH Treatment (H&E * 40)

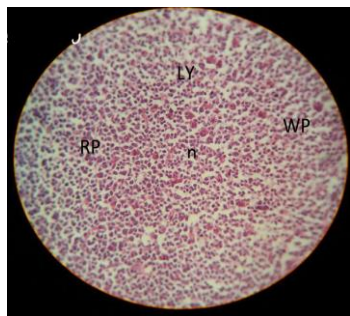


Fig. (14): T.S.In the spleen from the Control+Symbiotic Treatment (H&E * 40)

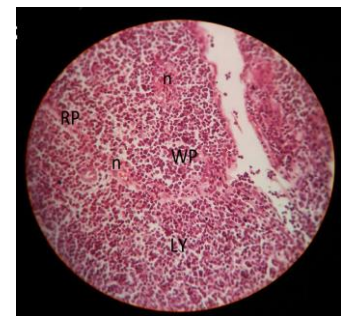


Fig. (15): T.S.In the spleen from the(9.0%FH+BH)+SymbioticTreatment (H&E * 40)

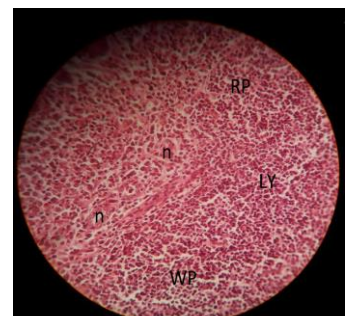


Fig (15): T.S.In the spleen from the (18.0%FH+BH)+SymbioticTretment(H&E * 40)

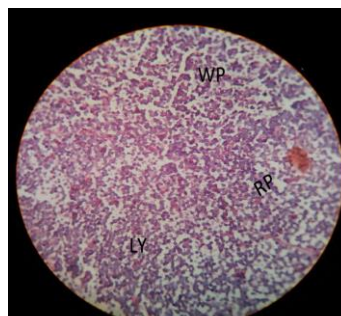


Fig. (16): T.S.In the spleen from the(27.0%FH+BH)+SymbioticTreatet (H&E * 40)

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كفاءة استخدام تبن الريحان والشمر بدون أو مع إضافة السنيبوتك في العلائق على الأداء الإنتاجي والاستجابة الغذائية للأرانب النامية

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صممت هذه الدراسة في تجربة عاملية (4x2) بهدف دراسة تأثير استخدام تبن الريحان والشمر في علائق أرانب النيوزيلاندى الأبيض النامية ليحل محل تبن البرسيم الحجازى، وقسمت المجاميع التجريبية لأربعة مجاميع بمستويات إحلال (0,0 ، 25 ، 50 و 75%) من البرسيم الحجازى فى وجود أو عدم وجود منشط نمو حيوي (السنيبوتك بمعدل 0,5 جم/كجم علف). تم توزيع عدد 72 خلفة أرانب عمر 6 أسابيع عشوائياً على ثمان مجموعات تجريبية بكل مجموعة ثلاث مكررات (ثلاث أرانب / مكررة). غذيت الأرانب من عمر 6 إلى 13 أسبوع على ثمان علائق تجريبية. وربيت جميع المجموعات التجريبية تحت ظروف رعائية وصحية موحدة.

تم تقييم الأداء الإنتاجي وخصائص الذبيحة وبعض مكونات الدم للمجاميع التجريبية وقد أوضحت النتائج المتحصل عليها:

أن إحلال تبن الريحان والشمر حتى مستوى 75% محل تبن البرسيم الحجازى كان له أثراً إيجابياً على معدلات النمو لأرانب النيوزيلاندى الأبيض النامية مقارنة بمجموعة الكنترول، كما أظهرت التغذية على العلائق المدعمة بالمشط الحيوى السنيبوتك أثراً إيجابياً على أداء النمو لأرانب النيوزيلاندى الأبيض.

وبغض النظر عن تأثير إضافة المنشط الحيوى (السنيبوتك) للعلائق فقد أوضحت النتائج أن التغذية على تبن الريحان والشمر أدت إلى زيادة معنوية فى محصول الذبيحة والأجزاء الكلية المأكولة مصحوبة بانخفاض معنوى فى دهن البطن.

كما أدت التغذية على العلائق المدعمة بمنشط النمو الحيوى (السنيبوتك) أثراً إيجابياً على محصول الذبيحة والأجزاء الكلية المأكولة مصحوبة بانخفاض فى دهن البطن.

كما أوضحت النتائج أن التغذية على العلائق التجريبية المحتوية على تبن الريحان والشمر أو العلائق المدعمة بالسنيبوتك أدت لانخفاض معنوى لبعض قياسات الدم للمجاميع التجريبية مثل الجليسيريدات الثلاثية والكوليستيرول و الكوليستيرول الليبوبروتيني منخفض الكثافة مصحوباً بزيادة معنوية فى بعض قياسات الدم الأخرى مثل الألبومين و الكوليستيرول الليبوبروتيني مرتفع الكثافة .

وخلصت هذه الدراسة إلى أنه يمكن إحلال تبن الريحان والشمر محل تبن البرسيم الحجازى حتى مستوى 75% مصحوباً بتأثيرات إيجابية على المظاهر الإنتاجية وخصائص الذبيحة لأرانب النيوزيلاندى الأبيض. وخلصت أيضاً إلى أن إضافة السنيبوتك إلى علائق أرانب النيوزيلاندى الأبيض النامية بمستوى 0,5 جم/كجم علف حسن معنوية من الأداء الإنتاجي وخصائص الذبيحة مصحوباً بانخفاض معنوى لدهن البطن.