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THE IMPACT OF TREATED LEMON PULP WITH YEAST ON GROWTH PERFORMANCE, NUTRITIVE VALUE, TOTAL ANTI-OXIDANT ENZYME AND IMMUNE RESPONSE OF GROWING RABBITS.

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The main target of current study was evaluated effect of incorporation of treated lemon pulp by Saccharomyces cerevisiae yeast (LPT) in growing rabbit diets on productive performance, anti-oxidant enzyme and immune response. Forty eight cross bred (New Zealand White (NZW) X California), 6 weeks age with live body weight ranging from 730.00 to 733.30g were divided into four experimental diet groups (twelve rabbits in each). Each treatment group was replicate six times and each replicates (2 rabbits in each replicate). These were divided into basal diet without LPT as a control group, while 3%, 6% and 9%LPT (replacement basal diet protein by three different levels of LPT protein) as the second, third, and fourth group, respectively.

***The results showed** no significant differences in final body weight (FBW, g), daily body weight gain [BWG (g/rabbit/day)], daily feed intake [FI (g/rabbit/day)] and feed conversion ratio [FCR, g feed/g gain] were observed among rabbit groups and control group. Moreover, no significant differences were observed in DM, OM, CP, CF, EE, NFE% digestibility and nutritive value among experimental groups. The total lipid (TL) value increased (P≤0.05) with rabbits fed 3and 6%LPT diets groups when compared to control and 9%LPT diets. While increasing LPT up to 9% decreased (P≤0.05) the concentrate of cholesterol and triglycerides in experimental groups as compared to control group. The lowest (P≤0.05) value of aspartate aminotransferase (AST) was observed with 6%LPT group when compared to control and 3% treated groups. The alanine aminotransferase (ALT) decreased (P≤0.05) with 6% LPT group when compared to 3 and 9% LPT dietary groups, while, no significant differences between treated groups and control group. The rabbit fed*

6%LPT diet increased (P≤0.05) in blood urea value when compared to rabbit fed control diet. No significant difference was detected in creatinine between LPT dietary groups and control group. The total anti-oxidant enzyme values were significantly (P ≤ 0.05) increased with rabbits fed on all LPT levels when compared to control group. Immunoglobulin titer IgG significantly (P ≤ 0.05) increased with rabbit fed 9%LPT as compared to control and other experimental groups. Immunoglobulin titer IgM was insignificantly difference between LPT dietary groups and control group.

***Conclusively**, suggesting that can be using LPT in growing rabbit diets up to 9% possible without any adverse effects on performance, digestibility and can be improvement of total anti-oxidant enzyme and immune response.*

Key words: Rabbits, performance, digestibility, immune, total anti-oxidant.

Agro-industrial wastes from fruit and vegetable are a matter of great concern and a big problem a commercial worldwide. The wastes left after processing rich in some essential nutrients that have the potency to be supplemented in animal diets as by-products. Incorporation of fruits and vegetable wastes in animal feeds improved palatability of diet and consequently consumed more in addition to decrease feed economic profit (Chaudry *et al*., 2004). Citrus by-products include dry pulps, molasses, washed pulp solids, and essential oils. Citrus pulp contains active anti-oxidants encompass of flavonoids, isoflavones, flavones, anthocyanins, coumarins, lignans, catechins, and isocatechins (Nobakht, 2013). Flavonoids may decrease the blood cholesterol and quench free radicals (Hougee *et al.* 2005). Citrus fruits extracts and citrus flavonoids exhibit a wide range of promising biological properties due to their phenolic profile and anti-oxidant properties (Montanari *et al.,* 1998).

Yeasts (*Saccharomyces cerevisiae)* are important natural growth promoters inclusion animal feeds. Yeasts are the best source of protein, amino acid and vitamins B complex (Özsoy and Yalçin , 2011). Also, yeast species are fungi (probiotics) that help intestinal microflora for improving health and productive performance (Schrezenmeir and de Vrese, 2001). Gao *et al.* (2008) concluded that yeast culture improves growth performance and immune system in broiler turkeys. The yeast as *Saccharomyces cerevisiae* secretes enzymes which improved digestibility and efficiency of feed utilization for rabbits (Numan, 2001). However, Kimsé *et al.* (2012) found that using yeast in rabbit diets caused no significant effects on various

production parameters. The effect of yeast on rabbit growth performance and health status depend on the dose, age, livestock conditions, and even between studies. Dadvar *et al.* (2014) found that processing of lemon pulp with *S. cerevisiae* improved the physical characteristics of pulp and increased the percentage of crude protein and the digestion coefficients of protein and NDF for goat.

Therefore, the objective of present study was investigated effect of replacing of lemon pulp treated with *Saccharomyces cerevisiae* yeast protein by basal diet protein in growing rabbit diets on productive performance, total anti-oxidant enzyme and immune response.

MATERIALS AND METHODS

The experiment was conducted in Borg El-Arab station following to Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Egypt. The laboratories works were carried out at Laboratories of By-Products Research Department, Animal APRI, Giza, Egypt. Dried lemon pulp and other ingredients obtained from locally market. The dried yeast purchased from Three Pyramids Alexandria Yeast Co., Alexandria, Egypt. Feed mixing and pelleting processes were carried out at Nobaria manufactory, Nobaria Station following to Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Egypt.

Yeast treatment and experimental diets

Dried lemon pulp (LP) was mixed with water at 1:2 ratio (pulp: water) to supply relative humidity of 85%. The measured pH value was 3.6. The optimum pH for yeast activity is between 5 and 6. Therefore, 6.4% bicarbonate was added to LP to increase the pH value. Then added 4% dried yeast (*Saccharomyces cerevisiae*) according to Dadvar *et al.* (2014).

Four experimental diets were formulated; control diet without dried lemon pulp treated (LPT), the other experimental diets were 3, 6 and 9% control diet protein replacing by LPT protein. The diets and fresh water were supplied *ad libitum.* The experimental period lasted for 8 weeks from 6 to 13 weeks of age. All experimental diets were formulated to be isonitrogenous and isocaloric, to meet all the essential nutrient requirements of growing rabbits (NRC, 1977) as shown in Table 1.

Table 1. Ingredients and chemical composition of experimental diets**.**

Ingredients	Control diet (0.0)	Level replacing of LPT protein (%)		
		3.0	6.0	9.0
Soybean meal (44% CP)	16.30	16.30	16.30	16.30
Yellow corn	13.80	13.85	10.86	9.00
Barley	13.00	13.00	13.00	13.00
Wheat bran	16.85	16.85	16.85	16.85
Clover hay	34.00	29.71	28.44	26.08
Lemon pulp treated (LPT)[1]	00.00	4.24	8.50	12.72
Dl- methionine	0.20	0.20	0.20	0.20
Di calcium phosphate	2.00	2.00	2.00	2.00
Sodium chloride (NaCl)	0.35	0.35	0.35	0.35
Vitamin and mineral primix[2]	0.30	0.30	0.30	0.30
Anti coccidia and fungi	0.20	0.20	0.20	0.20
Molasses	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**
Chemical analysis (DM basis)				
DM%	82.94	82.83	82.65	82.51
OM%	85.76	85.07	84.68	84.18
CP%	17.49	17.40	17.46	17.46
CF%	13.88	13.55	14.06	14.25
EE%	2.17	2.29	2.35	2.42
NFE%	55.43	55.27	53.99	53.14
Ash%	5.09	5.56	6.21	6.80
DE kcal/kg[3]	2615.42	2644.52	2612.66	2603.24
Price of feed (L.E./ton)	4927.18	4841.10	4729.96	4629.29

[1] **LPT contain**: 84.37%DM, 81.39%OM, 12.03%CP, 22.34%CF, 4.42% EE, 42.60% NFE, 18.61% Ash and 2223.53kcal/kg.

[2] **Each kg of vitamins and minerals mixture contains**: Vit. A 2.000.000 IU, Vit.B_1 0.33g, Vit.B_2 1.0g, Vit.D_3 150.000 IU, Vit E 8.33g, Vit. K 0.33 g, Pantothenic acid 3.33g; Nicotinic acid, 30.00g; Vit. B_6 2.00g; Vit. B_{12} 1.7 mg, Folic acid 0.83g, Biotin 33 mg, Cu 0.5g, Choline choloride 200mg,Mn 5.0g, Fe 12.5g, Mg 66.7mg, Co 1.33 mg, Se 16.6 mg, Zn 11.7g,Iodine 16.6 mg and Anti-oxidant 10.0g.

[3] DE (kcal/kg) = 4.36-0.049 x [28.924 + 0.657 (CF%)] according to Cheeke, (1987).

Animals and housing

Forty eight cross bread (New Zealand White, NZW X California), 6 weeks age with live body weight ranging from 730.00 to 733.30g were divided to four experimental groups (twelve rabbits in each). Each treatment group was

replicated six times (2 rabbits in each replicate). The experimental diets were divided into basal diet without LPT as a control group, while 3.0, 6.0 and 9% LPT (replacement basal diet protein by three different levels of LPT protein) as the second, third, and fourth groups, respectively during the experimental periods (6-14 weeks of age).

All rabbits were kept under the same managerial and hygienic conditions and housed in metal battery cages supplied with separated feeders. All rabbits were vaccinated against diseases and kept under veterinary control.

The traits studied:

Growth performance traits:

Daily feed intake (FI, g/rabbit/day) and daily body weight gain (BWG, g/rabbit/day) were recorded weekly, feed conversion ratio (FCR) was calculated accordingly as g feed / g gain over an experimental period. Mortality rate (%) was calculated, during the experimental periods (6-14 weeks of age).

Digestion coefficients and nutritive value

At the last week of the experimental period, twelve male rabbits were used to digestibility trial and divided to 4 groups of three per treatment. Rabbits were housed in individual metabolism cages. Faeces were collected daily before the morning meal and weighed fresh and dried at 60°C for 24 hrs in an air drying oven. Samples of lemon pulp treated, diets and faeces were prepared to determine of moisture, ash, nitrogen, ether extract and crude fiber according to A.O.A.C. (2000). Data of quantities and chemical analysis of feed and faeces were used to calculate the nutrient digestion coefficients and nutritive value for each dietary treatment, as described by Fekete (1985). Total digestible nutrients (TDN) were calculated as follows: % digestible crude protein + % digestible crude fiber + % digestible nitrogen free extract (NFE) + (2.25 % digestible ether extract (EE)). Digestible energy (DE, Kcal/Kg diet)) was calculated as follow: TDN × 44.3 according to Schneider and Flatt (1975).

Biochemical analysis:

Individual blood samples were taken 3 rabbits/ treatment at the end of trial. The samples were collected into dry clean centrifuge tubes and centrifuged at 3000 r.p.m for 20 minutes, then, samples were transferred and stored in deep freezer at -20°C till the time of chemical analysis. Blood chemical analyses were carried out for determination of plasma total lipids (Zollner and Kirsch, 1962), triglycerides, cholesterol, creatinine and urea nitrogen (Young, 2001) and transaminase (AST, aspartate aminotransferase and ALT alanine aminotransferase; Henry, 1964). All biochemical analyses in plasma were determined by using spectrophotometer.

Plasma total immunoglobulin titres was determined according to Tietz (1976). Total anti-oxidant enzyme in plasma was determined according to Koracevic *et al.* (2001) by colorimetric method.

Economic efficiency

The economic efficiency was calculated according to the following equation:

Economic efficiency (%) = (Net revenue/ Total feed cost) x 100.

Where, Net revenue =Selling price/rabbit- total feed cost/rabbit.

The price of ingredients and selling of one kg live weight of rabbits as the same price in the local market at the time of experiment (2017). Price of one kg live body weight was 50.00LE.

Statistical analysis

Data were analyzed according to Snedecor and Cochran (1982) using general linear model procedure of SAS software (SAS Institute**,** 2004) the following fixed model:

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

Where, Y_{ij} = An observation; μ = Overall mean; T_i = Effect of treatment groups; e_{ij} = Random error component assumed to be normally distributed.

Duncan's test was performed to detected significant differences among means (Duncan, 1955). Significant is acceptable at ($P \leq 0.05$).

RESULTS AND DISCUSSION

Growth performance

Growth performance of growing rabbits for experimental diets is illustrated in Table 2. No significant differences in FBW (g), BWG (g/rabbit/day), FI (g/rabbit/day) and FCR were observed among rabbit groups and control group. No mortality cases were observed with the all experimental groups during experimental periods.

These results are agreement with Suliman (2012) who found that no significant difference observed in productive performance for growing rabbits feeding LP up to 40% (replacing of yellow corn in basal diet with or without multi enzyme additive). Belhassen *et al.* (2016) concluded that no effects of yeast supplementation on BW, FI and FCR of growing rabbits. However, Basir and Toghyani (2017) observed that BW of broilers decreased when using graded level of lemon pulp as compared to control group and FCR impaired. Also, Ezema and Eze (2015) who found that

Table 2: Growth performance of growing rabbits fed on experimental diets.

Items	Level replacing of LPT protein (%)				P value	Sig. Test
	Control (0.0)	3.0	6.0	9.0		
IBW (g)	730.80 ±70.82	733.30 ±69.34	731.70 ±71.84	730.00 ±76.18	1.000	NS
FBW (g)	2027.50 ±50.52	2065.00 ±62.01	2088.33 ±54.74	1942.50 ±58.98	0.3062	NS
BWG (g/R/day)	22.75 ±0.87	23.36 ±0.64	23.80 ±0.69	21.27 ±0.87	0.1395	NS
FI (g/R/day)	96.98 ±1.91	101.47 ±1.45	104.54 ±1.20	100.60 ±1.12	0.1120	NS
FCR (Feed:gain)	4.29 ±0.12	4.37 ±0.14	4.42 ±0.12	4.78 ±0.18	0.0980	NS
Mortality rate (%)	0.0	0.0	0.0	0.0		NS

BWG and FI of rabbits increased with diets supplemented yeast. Onifade *et al.* (1999) observed that *Saccharomyces cerevisiae* improved growth performance and intake in domestic rabbits.

Nutrients digestion coefficients and nutritive value

Nutrients digestion and nutritive value of growing rabbits are presented in Table 3. No significant differences were observed in DM, OM, CP, CF, EE and NFE% digestibility and nutritive value between control group and experimental groups. The results herein were partial agreed with results obtained by Suliman (2012) who found that no significant difference observed in nutrients digestibility and nutritive value for rabbits feeding LP dietary up to 40%replacing of yellow corn in basal diet, aged 8th weeks, exception of DM, CP, CF and DCP were recorded significantly differences. Moreover, Diazi *et al.* (2014) found that *Saccharomyces cerevisiae* yeast supplementation (2 x 10^{8} UFC/exhibit/day) in the volcano rabbit negatively affects nutrients digestion.

Biochemical analysis

Effect of using the different levels of treated lemon pulp by *Saccharomyces cerevisiae* yeast in growing rabbit diets on blood parameters within normal range according to Steven (1974). are revealed in Table 4. All values of blood biochemistry were within the physiological ranges. The total lipid (TL) value increased (P≤0.05) with rabbits fed 3.0 and 6.0% LPT diets when compared with control and 9.0%LPT

Table 3: Digestion coefficients and nutritive value of growing rabbits fed on experimental diets.

Items		Level replacing of LPT protein (%)				P value	Sig. Test
		Control (0.0)	3.0	6.0	9.0		
Digestion coefficients	DM %	61.50 ±0.78	66.85 ±3.38	62.27 ±2.15	65.98 ±3.62	0.4624	NS
	OM %	67.53 ±0.56	71.64 ±2.96	67.78 ±1.86	71.13 ±3.05	0.5010	NS
	CP %	73.01 ±0.42	75.60 ±2.50	72.50 ±1.58	75.31 ±2.61	0.6125	NS
	CF %	24.70 ±3.08	31.12 ±1.87	25.37 ±2.67	30.51 ±6.72	0.5825	NS
	EE %	74.80 ±3.04	87.63 ±0.93	82.25 ±5.10	76.08 ±4.51	0.1342	NS
	NFE %	80.48 ±0.52	83.23 ±1.82	80.90 ±1.00	83.13 ±2.05	0.4614	NS
Nutritive value	DCP%	12.77 ±0.07	13.15 ±0.43	12.66 ±0.27	13.15 ±0.45	0.6591	NS
	TDN%	45.30 ±0.53	47.50 ±1.00	45.65 ±0.81	45.86 ±1.27	0.4106	NS
	DE Kcal/kg	2006.74 ±23.27	2104.39 ±44.21	2022.09 ±35.78	2031.39 ±56.41	0.4106	NS

diets. While increasing LPT up to 9% decreased (P≤0.05) the concentrate of cholesterol and triglycerides in experimental rabbit blood compared to control group. These results were agreed with Nazok and Rezaei (2010) found that using dried citrus pulp up to 16% significantly reduced triglyceride and cholesterol of laying hens. Moreover, no significant in blood cholesterol and triglyceride with broilers feeding LP up to 4.5% was observed by Nobakht (2013). Belhassen *et al.* (2016) concluded that no significant effects of *Saccharomyces cerevisiae* yeast supplementation (1g/kg diet) of blood cholesterol, creatinine, AST and ALT of growing rabbits. The decreasing in cholesterol by increasing LP inclusion may be attributed to content of soluble fiber in LP; fermentation of soluble fiber in caecocolic region produces short chain fatty acids (acetate, butyrate and propionate), which can decrease the hepatic synthesis of cholesterol (Glore *et al.,* 1994 and Suliman, 2012).

Table 4: Blood parameter of growing rabbits fed on experimental diets.

Items	Level replacing of LPT protein (%)				Normal range	P value	Sig. Test
	Control (0.0)	3.0	6.0	9.0			
TL (mg/dl)	1.360^{b} ±0.04	2.13^{a} ±0.20	2.01^{a} ±0.23	1.29^{b} ±0.27	1.0-3.2	0.0279	**
Cholesterol (mg/dl)	130.87^{a} ±11.90	106.47^{b} ±0.55	111.73^{b} ±2.01	106.00^{b} ±1.35	77.6 - 141.3	0.0429	**
Triglycerides (mg/dl)	280.63^{a} ±22.79	129.30^{b} ±5.84	131.70^{b} ±0.83	127.17^{b} ±5.62	110.1-310.0	<.0001	**
AST (U/l)	38.76^{a} ±1.17	27.80^{b} ±2.47	20.44^{c} ±1.69	23.83^{bc} ±0.63	10-120	<.0001	**
ALT (U/l)	32.91^{ab} ±1.23	39.72^{a} ±2.93	23.23^{b} ±1.27	35.61^{a} ±5.78	10-45	0.0273	**
Urea (mg/dl)	53.66^{b} ±2.42	57.85^{ab} ±0.87	65.76^{a} ±4.35	61.73^{ab} ±1.00	42.6-96.6	0.0334	**
Creatinine (mg/dl)	1.58 ±0.34	1.04 ±0.04	1.27 ±0.03	1.01 ±0.04	0.5-2.2	0.1340	NS

a, b, c Means within the same row with common letter(s) are not significantly different ($P<0.05$).

The lowest value of AST ($P=0.0001$) was observed with 6%LPT group when compared to control and 3% tested groups. No significant differences were observed between 6 and 9%LPT groups in AST. The ALT decreased ($P\leq0.05$) with 6% LPT group when compared to other groups. No significant difference in ALT value was recorded between 3, 6 and 9%LPT groups compared to control group. The rabbit fed 6%LPT diet increased ($P=0.0334$) in blood urea value when compared to rabbit fed control diet. Urea value was observed no significant differences between rabbit fed 3 and 9% LPT diets and control diet. No significant difference was detected in creatinine between LPT dietary groups and control group. Generally, the results herein were partial agreed with Suliman (2012) found that no significant difference was recorded in creatinine and urea between tested groups and control group for growing rabbits feeding LP up to 40% replacing for yellow corn in basal diet.

Influence of using LPT in growing rabbit diets on total anti-oxidant enzyme (TAO) and immunoglobulin titers (IgG and IgM) values are revealed in Table 5. The total anti-oxidant enzyme values were significantly ($P\leq0.05$) increased with rabbits fed on all LPT levels when compared to

Table 5: Total anti- oxidant enzyme and immune response of growing rabbits fed on experimental diets.

Items	Level replacing of LPT protein (%)				P value	Sig. test
	Control (0.0)	3.0	6.0	9.0		
TAO (mM/L)	0.51^{d} ±0.01	0.67^{b} ±0.01	0.60^{c} ±0.01	0.84^{a} ±0.01	<.0001	**
IgG (mg/dl)	601.00^{b} ±1.47	770.67^{b} ±104.76	778.00^{b} ±66.41	1003.33^{a} ±4.24	0.0054	**
IgM (mg/dl)	33.00 ±0.40	66.67 ±19.29	59.00 ±8.78	66.00 ±2.67	0.1416	NS

a, b,... and d, Means within the same row with common letter(s) are not significantly different (P<0.05).

control group. The highest (P≤0.05) value of TAO recorded with 9% LPT group when compared to all test groups. This result confirmed by Lu *et al.* (2017) who found that hepatic total anti-oxidant enzyme was significantly higher in experimental groups than control group for growing rabbits fed citrus pulp up to 21%in the diet.

Immunoglobulin G (IgG) significantly (P≤0.05) increased with rabbit fed 9%LPT compared to control and other experimental groups. No significant in IgG (p=0.1416) between 3 and 6% LPT groups and control group. Immunoglobulin M (IgM) was insignificantly between LPT dietary groups and control group. The results in current study are good agreement with those reported by Suliman (2012) who observed that significantly improvement of IgG of rabbit dietary LP up to 40% replacing for yellow corn of basal diet compared to control group. No significant differences of IgM were observed between control rabbits group and experimental groups. Pourhossein *et al.*, (2015) concluded that immunoglobulin IgG and IgM were higher p (≤0.05) with broiler feeding dietary sweet orange peel extract. Besides, Nobakht (2013) reported that not any significant differences among broiler groups feeding lemon pulp up to 4.5% in immunity parameters (RBC, WBC, heterophil%, lymphocyte% and heterophil/lymphocyte). Özsoy and Yalçin (2011) found that no significant effects were observed in antibody titer among broilers turkey feeding *Saccharomyces cerevisiae* yeast supplement (1,2 and 3g/kg yeast culture). Also, no significant differences between growing rabbits feeding diet supplementation with a live *Saccharomyces cerevisiae* yeast (1g/kg diet) Belhassen *et al.* (2016). Generally, the improvement in TAO enzyme and immunity system may be contributed to the ability of flavonoids contained in lemon peel inhibiting or killing many

bacterial strains to destroy some pathogenic protozoa and to scavenge free radicals. Also, Zanello *et al.* (2009) showed that *Saccharomyces cerevisiae* yeast (3 and 5g/kg diet) is probiotic having positive effects in treatment and prevent of diseases.

Economic efficiency

The profitability of using lemon pulp treated in growing rabbit diets depended on feed price and growth performance (Table 6). It is clear to that rabbit groups fed 9%LPT and control diet had lowest total feed cost/rabbit. But the highest net revenue was show with 6%LPT. On other hand, the highest economic efficiency (%) recorded with rabbits fed 6%LPT diet in comparison to others experimental diets.

Table 6: Economic efficiency of experimental diets.

Items	**Level replacing of LPT protein (%)**			
	Control (0.0)	**3.0**	**6.0**	**9.0**
Total body weight gain (kg)	1.30	1.33	1.36	1.21
Price of 1 kg body weight (L.E.)	50.0	50.0	50.0	50.0
Selling price/rabbit (L.E.) (A)	64.84	66.59	67.83	60.63
Total feed intake (kg)	5.43	5.68	5.85	5.63
Price of 1 kg feed (LE)	4.93	4.84	4.73	4.63
Total feed cost/rabbit (LE) (B)	26.76	27.51	27.69	26.08
Net revenue (LE)[1]	38.08	39.08	40.14	34.55
Economic efficiency[2](%)	142.29	142.05	144.96	132.46

Net revenue[1] =A - B

Economical efficiency (%)[2] = (Net revenue / B) X 100.

Conclusively, according the experiment results, using of treated lemon pulp with yeast in growing rabbit diets up to 9% (replacing of lemon pulp treated with yeast protein by basal diet protein) could be possible without any adverse effects on performance, digestibility and nutritive value. Also, utilization of LPT in growing rabbit diets could be improvement of total anti-oxidant enzyme and immune response.

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تأثير تفل الليمون المعامل بالخميره على الاداء الانتاجي والقيمه الغذائية وانزيمات الاكسدة والاستجابة المناعيه للارانب النامية

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الهدف الاساسي للدراسة الحاليه هو دراسة تأثير ادخال تفل الليمون المعامل بالخميره في علائق الارانب الناميه على الاداء الانتاجي وانزيمات الاكسده والاستجابة المناعيه. قسمت 48 ارنب خليط من الابيض النيوزيلاندي والكاليفورنيا عمر 6 اسابيع

متوسط وزن 730 الى 733.30 جم الى اربع مجاميع مختبره كل مجموعه تحتوي على 12 ارنب. قسمت العلائق التجريبيه الى عليقة كونترول لاتحتوي على تفل الليمون المعامل بالخميره و الى 3،6و 9% احلال بروتين تفل الليمون المعامل بالخميره من بروتين العليقة الكونترول.

لم تظهر اختلافات معنويه في الوزن النهائي ومعدل الزياده اليوميه ومعامل التحويل الغذائي بين مجاميع الارانب والمجموعه الكونترول. ولم يلاحظ اختلافات معنويه بين المجاميع المختبره في معاملات هضم كلا من الماده الجافة، المادة العضويه، البروتين الخام، الالياف الخام، مستخلص الاثير و مستخلص خالي الازوت وكذلك القيمة الغذائية. اظهرت الارانب المغذاه على 3و 6% تفل ليمون معامل ارتفاع معنوي في قيمة الليبيدات الكليه مقارنه بالمجموعتي الكونترول و 9% تفل ليمون معامل. بينما لوحظ ان بزيادة تفل الليمون المعامل الى 9% ادى الى انخفاض معنوي لكل من الكوليستيرول والجليسريدات الثلاثيه في دم الارانب التجريبيه مقارنة بمجموعة الكونترول. لوحظ ان مجموعة 6% تفل ليمون معامل كانت اقل قيمه معنويه AST مقارنه لمجموعتي الكونترول و 3% تفل ليمون معامل. حصل انخفاض معنوي لقيمة ALT لمجموعة 6% تفل ليمون معامل مقارنه مجموعتي 3و 9% ليمون معامل بينما لم يظهر اي اختلافات معنويه بينها وبين المجموعة الكونترول. ظهرت زياده معنويه لقيمة يوريا الدم للارانب المغذاه على 6% تفل ليمون معامل مقارنة بالكونترول. لم يظهر اي اختلافات معنويه للكرياتينيين بين المجاميع المغذاه على تفل الليمون المعامل ومجموعة الكونترول. سجلت مضادات الاكسده الكلية زياده معنويه مع الارانب المغذاه على تفل الليمون المعامل مقارنة بمجموعة الكونترول. لوحظ زياده معنويه في IgG للارانب المغذاه على 9% تفل ليمون معامل مقارنة بمجموعة الكونترل او مجاميع التجريبيه الاخرى. لم تسجل اي اختلافات معنويه في قيمة IgM بين المجاميع المغذاه على تفل الليمون المعامل ومجموعة الكونترول.

التوصية: من النتائج المتحصل عليها هو امكانية احلال تفل الليمون المعامل بالخميره في علائق الارانب الناميه حتى مستوى 9% من بروتين العليقه لم يظهر اي نتائج سلبيه على الاداء الانتاجي ومعاملات الهضم وانه ادى الى تحسن في مضادات الاكسده الكلية والاستجابة المناعيه.