Egyptian J. Nutrition and Feeds (2015), 18(2) Special Issue: 361-370

PRODUCTIVE PERFORMANCE OF NEW ZEALAND WHITE GROWING RABBITS FED ON DIETS CONTAINING DIFFERENT LEVELS OF TREATED CASTOR MEAL

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SUMMARY

The aim of this study was to evaluate the effect of replacing two levels (20 or 40%) of chemically or biologically treated castor meal (CTCM or BTCM) of the control diet soybean meal on growing rabbits performance. One hundred New Zealand White rabbits, six weeks old with an average live body weight ranging from 733 to 777g were randomly divided into five groups and each group was divided into 5 replicated (4 rabbits/replicate). The growing period lasted 8 weeks. Diets were offered *ad-libtium* and fresh water was available all times. Results indicated that chemical and biological treatments were somewhat affect chemical composition in which mainly CP content was markedly increased but CF was decreased by biological treatment. Nutrients digestibility data indicated that insignificant differences among dietary treatments in respect of DM and OM digestibilities. Digestibility of CF, EE, NFE and CP were significantly decreased by using diet containing 40% BTCM in comparison with control. The values of DCP and TDN were significant lower with 40% BTCM diet than those of control one, while the other tested diets mostly didn't differ significantly than control regarding these parameters. Nitrogen balance values were insignificant decreased for diets containing CTCM and BTCM at levels 20 and 40% compared with control diet. Final body weight and body weight gain values were insignificant decreased for rabbits fed all diets except for those fed on 40% BTCM diet that they values were decreased significantly compared with those of control one. Feed intake recorded the lowest value with rabbits fed 20% CTCM diet, while the highest value was occurred with those fed on 40% CTCM diet. Based on control diet most tested diets didn't affect significantly feed intake. The best FCR was occurred with 20% CTCM sit, while worst one was associated with 40% CTCM diet and difference among most treatments non-significant. There were no significant differences among treatments regarding the most blood constituents and all values were in the normal range. Diets contained CTCM or BTCM at 20% level were achieved the highest economic efficiency followed by control diet or 40% BTCM diet and the least one was associated with 40% CTCM diet. Generally, it could be recommended to use the CTCM or BTCM in growing rabbit's diets at 20% instead of soybean meal without any adverse effects on their growth performance and health condition.

Keywords: *Castor meal, chemically treatment, biologically treatment, rabbits performance, digestibility and blood constituents.*

INTRODUCTION

The castor oil plant (*Ricinuscommunis L.*) is a member of the spurge family of plants (*Euphorbiaceae*). Castor beans have been found in ancient Egyptians tombs dating back to 4000 B.C. According to the *Ebers papyrus* an Egyptian medical text from 1500 B.C., Egyptian doctors used castor oil for protect the eyes from irritation and body ointments (Long, 2005). Castor bean plant is highly toxic because of the presence of ricin, a water soluble glycoprotein concentrated in the seed endosperm but present in lower amounts in the rest of the plant and reputed to be one of the most poisonous of the naturally occurring compounds. Mainly it is grown commercially for the oil in seed, which is used primarily for industrial purposes and in the manufacture of cosmetics. Most of the world's product of castor oil with the annual production of 1,854,775 ton in the year 2013 (FAO, 2013). Castor bean meal is the main by-product of castor oil production. Pressing one ton of castor beans for oil extraction produces around 550 kg of cake, but this value can vary with seed oil content and oil extraction process according to Severino (2005). Castor meal can be used as fertilizer, fungicide, in plant-parasitic nematode control and animal feed. Castor meal is a product with high protein content (28–43%) but because of the presence of ricin and lectinin, castor bean meal is seldom used as a livestock feed (Aganga and Tshwenyane, 2003). Mechanism of ricin inhibit protein synthesis but other mechanisms are noted including apoptosis pathway, direct cell membrane damage, alteration of membrane structure and function and release of cytokine inflammatory mandatories (Day *et al.*, 2002). Lectin which unlike ricin have affinity for the blood cell. The ricin concentration in castor meal was 1.14-3.7mg/ kg DM (Diniz *et al.*, 2010). There are several methods like as physical, chemical and biological treatments are essential for detoxification of toxic material from castor meal and to improve their nutritive value. Autoclaving at pressure 15 psi for 60 min. and lime treatment (calcium oxide, 40g / kg) completely removed ricin from castor meal (Anandan *et al.*, 2005). Biological treatment used to reduce ricin by using certain fungi, such as *Penicillium simplicissimum* that reducing ricin by 16% (Godoy *et al.*, 2009).

Therefore, the objective of the present study was to investigate the effect of two replacement levels of soybean meal by treated chemically (Calcium oxide) and biologically (*Penicillium funiculusms)* castor meal on rabbits growth performance, digestibility, some blood parameter and economical profit.

MATERIALS AND METHODS

The experimental work of this study was carried out at Kafr EL-Sheikh station belonging to Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. The microbiological and chemical treatments were conducted at the Laboratories of By-Products Research Department, Animal Production Research Institute, Giza, Egypt.

Processing of castor meal:

Castor meal was obtained from El captain Company, Cairo, Egypt. It was ground by hammer mill and stored in an air-tight condition and kept for subsequent processing.

Biological treatment:

Fungal strain *Penicillium funiculusms* F-116 was obtained from Microbial Chemistry Department, National Research Center, Dokki, Egypt. The microorganisms were preserved on Potato Dextrose Agar (PDA) medium at 25 ^{o}C until used. About 50g of castor meal was weighted and packed in heat resistant bags (10 x 20 cm) and sterilized by autoclaving at 121 ^{o}C for 30 minutes. Spore suspension of *Penicillium funiculusms* was prepared and used to inoculate 500 ml capacity conical flasks containing 20g of cooled sterilized residue, moistened by basal medium containing (g/ L) 4% molasses, 0.4% urea, 0.2% KH_2 PO_4 and 0.03% $MgSO_4.7H_2O$ and incubated for 7 days. The treated castor meal was moistened at 65–70% and put specific fungal spawn and left for three weeks.

Chemical treatment:

Castor meal was treated using calcium oxide solution, with each kg diluted in 10 liters of water and applied at 60g of CaO per kg of castor meal as recommended by Oliveira *et al.* (2007). After mixing the meal with the CaO solution, the material rested for twelve hours (one night) and was then drained in a cemented area. The drying time, being varied according to the weather condition and was approximately 48h.

Animal's management and feeding:

One hundred weaned New Zealand White (NZW) rabbits, six weeks old with live body weight ranging from 733.00 to 776.67g were allotted to five dietary treatments of twenty rabbits per treatment. Each treatment was replicate five times and each replicate had four rabbits. All rabbits were kept under the same managerial and hygienic conditions and housed in metal battery cages supplied with separated feeders. Diets were offered *ad-libtium* and fresh water was available all times from automatic nipple drinkers. All rabbits were vaccinated against diseases and kept under veterinary control.

Five experimental diets were formulated, including the control diet without castor meal while, the other tested diets have chemically or biologically treated castor meal at 20 or 40% replacement of soybean meal (2.82 or 5.64% in basal diet). The ingredients of diets formulation and its chemical composition are presented in Table (1). All the experimental diets were formulated to be isonitrogenous and isocaloric, to meet all the essential nutrient requirements of growing rabbits (NRC, 1977).

Experimental parameters:

Growth performance:

Feed intake (FI, g/ rabbit/ day) and body weight gain (BWG, g/ rabbit/ day) were recorded weekly, while feed conversion was calculated accordingly as g feed / g gain over an experimental period of 8 weeks.

Digestion trial:

At the end of experimental feeding trial period (14 weeks of age), digestibility trials were carried out using 25 NZW males (5 from each treatment) to determine the nutrients digestion coefficients and nutritive value of experimental diets. A plastic net was placed under the cages to retain feces during the collection period (4 days), feces were collected daily before the morning meal and weighed fresh and dried at 60°C for 24 hrs in an air drying oven. Feces were sampled then ground and mixed, stored for subsequent chemical analysis. Data of quantities and chemical analysis of feed and feces were used to calculate the nutrient digestion coefficients and nutritive value for each dietary treatment, as described by Fekete (1985).

Table (1). Ingredients and chemical composition of experimental diets (on DM basis).

Ingredients	Control diet	CTCM		BTCM	
		20%	40%	20%	40%
Soybean meal (44% CP)	14.10	11.28	8.46	11.28	8.46
Castor bean meal	--	2.82	5.64	2.82	5.64
Barley	29.00	31.00	32.00	31.00	32.00
Wheat bran	15.00	15.00	16.50	15.00	16.50
Clover hay	35.15	33.15	30.65	33.15	30.65
Lime stone	0.70	0.70	0.70	0.70	0.70
Calcium carbonate ($CaCO_3$)	2.20	2.20	2.20	2.20	2.20
Sodium chloride (NaCl)	0.30	0.30	0.30	0.30	0.30
Vit.& min. mix[1]*	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.20	0.20	0.20	0.20	0.20
Anticoccidia(Diclazuril)	0.05	0.05	0.05	0.05	0.05
Molasses	3.00	3.00	3.00	3.00	3.00
Total	100	100	100	100	100
Chemical analysis (%)					
DM	89.40	90.06	90.17	89.76	90.26
OM	90.34	88.66	88.32	89.77	89.58
CP	16.73	16.48	16.38	16.68	16.65
CF	13.12	13.34	13.45	13.20	13.20
EE	2.50	2.63	2.53	2.67	2.06
NFE	57.99	56.21	55.96	57.22	57.67
Ash	9.66	11.34	11.68	10.23	10.42
DE kcal/ kg**	2520.35	2513.27	2509.73	2517.78	2517.78

CTCM: Chemically treated castor meal.
BTCM: Biologically treated castor meal.
**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 chloride 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 Antioxidant 10.0g.*
***DE (kcal/ kg) = 4.36-0.049 x [28.924 + 0.657 (CF %)] according to Cheeke, (1987).*

Chemical analyses:

Samples of castor meal, diets and feces were prepared to determine of moisture, ash, nitrogen, ether extract and crude fiber according to A.O.A.C. (2000).

Blood parameters:

Blood samples were taken from the five previous rabbits within each treatment at the time of slaughter test and were collected into dry clean centrifuge tubes containing drops of heparin and centrifuged at 3000 r.p.m for 20 minutes then plasma were transferred and stored in deep freezer at approximately -20ºC till the time of chemical analysis. Chemical analyses of the blood plasma were carried out for quantitative determination of blood total lipids (Zollner and Kirsch, 1962), cholesterol (Richmond, 1973), creatinine (Schirmeister, 1964), urea (Fawcett and Scott, 1960), total protein (Gornall *et al.*, 1949), albumin (Doumas and Waston 1971), transaminase (AST, aspartate aminotransferase and ALT alanine aminotransferase, Young, 1990). All biochemical analyses of blood samples were determined by using spectrophotometer.

Statistical analysis:

The experimental data were analyzed using general linear model using ANOVA procedures of SAS (2004) by the following model:

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

Where:

Y_{ij} = the observation of the parameter measured.

μ = Overall mean of Yij.

T_i = Effect of dietary treatment, i = (1….5).

e_{ij} = The random error term.

The Significant differences among treatment means were separated at alpha level ($P\leq0.05$) by Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Chemical composition:

Data presented in Table (2) showed the chemical analysis of castor meal (CM), chemically treated castor meal (CTCM) and biologically treated castor meal (BTCM). Comparable to CM, CTCM and BTCM contained of CP (33.01and 36.50 vs. 33.56%), CF (12.28 and 9.90 vs. 12.65%), EE (16.32 and 16.50 vs. 16.20%), NFE (24.98 and 25.09 vs. 28.48%) and DE (2547.39 and 2624.01 vs.2535.48kcal/ kg). Biological treated caster meal tended to somewhat higher in CP content. On the contrary, CF content appended to lower with biological treatments being 9.90%. In addition DE (kcal/ kg) increased with BTCM recording 2624.01 kcal/ kg. The obtained results showed that chemical treatment was markedly affected approximate analysis of castor meal. Nitrogen free extract was markedly decreased while, CP content was slightly decreased, but ash content increased pronouncedly. The obtained results are in agreement with those reported by Diniz *et al.*(2010) who found that castor meal comparable to castor meal treated with calcium oxide, where CP (35.78 vs 34.44%), EE (17.1 vs 17.3%).

Table (2). Chemical analysis of castor meal (CM), chemically treated castor meal (CTCM) and biologically treated castor meal (BTCM) on DM% basis.

Items	CM	CTCM	BTCM
DM%	90.40	91.20	90.12
OM%	90.89	86.59	87.99
CP%	33.56	33.01	36.50
CF%	12.65	12.28	9.90
EE%	16.20	16.32	16.50
NFE%	28.48	24.98	25.09
Ash%	9.11	13.41	12.01
DE(Kcal/ kg)*	2535.48	2547.39	2624.01

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

The efficiency of the alkaline treatment is attributed to ricin denaturation by lime **(**Lehninger *et al.*, 1995). Denaturation represents extreme alterations in the three-dimensional structure of a protein, which does not involve the breaking of peptide bonds and is almost always associated with loss of protein function **(**Lehninger *et al.*, 1995). With alkaline treatment turning the protein net charge negative, provoking electrostatic repulsion and breaking the hydrogen bridges that support the three-dimensional structure (Oliveira, 2008). In addition to loss of function, hydrophobic groups are exposed during denaturation, resulting in decreased protein solubility in aqueous solutions. Therefore, the disappearance of ricin subunits indicates the loss of solubility in the extraction buffer at pH 3.8, as shown by the changes for the denatured state of the toxin when submitted to alkaline treatment (60 g lime/ kg) (Oliveira, 2008). Increasing ash content of CTCM may be due to increase minerals as calcium when treated with lime. Biological treatment had positive effects on improving the nutritive value of castor meal, since the protein contents was increased. This result confirmed by those of Villas-Boas *et al.* (2002) who reported that biological treatment is used for increasing the nutritional value of many by-products because they have significant concentrations of simple carbohydrates such as mono and disaccharides. While, crude fiber content was reduced because microorganisms depend on this material as carbon source for growth and formation the microbial protein. However, increasing ash content may be attributed to the growth or degradation of organic matter of castor bean meal by microorganism. Reduction in NFE may be related to the consumption of carbohydrates by the microorganism as energy sources for their growth and multiplication. These results are in good agreement with those reported by Abdel-Aziz *et al.* (2014) who found that biological treatments are paralleled with decreased crude fiber and fiber fractions content with increased crude protein content.

Growth performance:

Results of final body weight (FBW, g), body weight gain (BWG, g/ rabbit/ day), feed intake (FI, g/ rabbit/ day) and feed conversion ratio (FCR) are illustrated in Table (3). The FBW and BWG were insignificant (P>0.05) decreased for rabbits fed all experimental diets except those fed on 40% BTCM diet, there values were significantly (P<0.05) decreased when compared to those of control diet. The FBW values of tested diets were ranged from 1821.00 to 1900.00g vs 2013.50g for control one and the corresponding range for BWG was from 19.17 to 22.15g *vs* 22.44g. Feed intake recorded the lowest value with rabbits fed 20% CTCM while, the highest value was occurred with rabbits fed on 40% CTCM diet. Generally, most tested diets didn't affect FI significantly in comparison with control one. The best FCR was occurred with 20% CTCM diet, while the worst one was associated with 40% CTCM diet and the differences among most treatments didn't significant. These results were agreement with Ani and Okorie (2002) who reported that when broilers fed 15% cooking castor meal were reduced feed intake and weight gain. Adedeji *et al.* (2006) assessed the utilization of boiled castor seed cake in diet for weaned rabbits and observed a tolerant level not more than 15%. Diniz *et al.* (2010) found that utilization of castor meal treated with lime solution in cattle diets at level 33 and 67% substation of soybean meal didn't affect their daily weight gain. Moreover, Oso *et al.* (2011) stated that utilization of fermented castor meal in starting cockerels chicks diet at level 50g/ kg diet didn't affect its growth response.

Table (3). Growth performance of growing rabbits fed on experimental diets.

Items	Control	CTCM		BTCM		SEM
		20%	40%	20%	40%	
Initial body weight (IBW, g)	756.67	776.67	736.67	733.00	747.67	6.99
Final body weight (FBW, g)	2013.50^{a}	1983.17^{a}	1900.0^{ab}	1974.00^{a}	1821.00^{b}	24.19
Body weight gain (BWG, g/ R/ d)	22.44^{a}	21.54^{a}	20.77^{ab}	22.16^{a}	19.17^{b}	0.39
Feed intake (FI, g/ R/ d)	94.40^{ab}	80.99^{b}	97.55^{a}	89.99^{ab}	86.55^{ab}	2.21
Feed conversion ratio (g feed/ g gain)	4.20^{ab}	3.75^{b}	4.69^{a}	4.06^{ab}	4.51^{ab}	0.14

a and b means in the same row with different superscripts are significantly different (P<0.05).

Nutrients digestibility:

The digestion coefficients of the experimental diets of the growing rabbits are shown in Table (4). These results indicated that insignificantly differences in DM and OM digestibilities among different diets. There were insignificantly decreased for digestion coefficients of CP, CF and NFE when rabbits fed diets containing CTCM and BTCM at levels 20% except for EE digestibility which had significantly (P<0.05) decreased with rabbits fed 20% CTCM when compared to control group. Digestion coefficients of CP, CF and EE were insignificant decreased with rabbits fed diets containing 40% CTCM compared to those fed on control diets. Nevertheless, NFE digestibility significantly (P<0.05) decreased with rabbits fed 40% CTCM when compared to control group. Digestion coefficient values of CP, CF, EE and NFE% were significantly (P<0.05) decreased with rabbits fed diets containing 40% BTCM when compared to control group. In this respect, Cobianchi *et al.* (2012) found that the digestibility coefficients of DM, OM and CP were not affected when replacing up to 67% of soybean meal by castor meal treated with calcium oxide in ration of dairy cows expect digestibility coefficient of EE which was reduced (P<0.05). On the other hand, Oso *et al.*, (2011) stated that utilization of fermented castor meal in starting cockerels chick diets at levels 5, 10 and 15% had no effect on EE digestibility while increased CF digestibility. Whereas DM and CP digestibility were reduced with increasing fermented castor meal in the diet compared to those the control group.

Table (4). Digestion coefficients of experimental diets.

Items	Control	CTCM		BTCM		SEM
		20%	40%	20%	40%	
DM %	68.07	61.84	68.07	64.61	67.61	1.38
OM %	70.64	63.96	64.30	71.75	71.59	1.39
CP %	76.56^{a}	75.72^{a}	74.05^{ab}	75.23^{a}	70.56^{b}	0.72
CF %	36.95^{a}	32.38^{ab}	29.63^{ab}	31.69^{ab}	26.96^{b}	2.71
EE %	74.92^{a}	67.06^{bc}	72.35^{ab}	69.93^{a}	62.73^{c}	1.58
NFE %	76.06^{a}	74.12^{ab}	72.34^{bc}	75.12^{ab}	69.87^{c}	0.90

a,b and c means in the same row with different superscripts are significantly different ($P \leq 0.05$).

Nutritive value and nitrogen balance:

Data concerning the nutritive value and nitrogen balance (NB) of the experimental diets of the growing rabbits are listed in Table (5). These results showed that digestible crude protein (DCP), total digestible nutrients (TDN) and digestible energy (DE) were significant lower with 40% BTCM diet than control one, while the other tested diets mostly didn't significant differ in these parameters than control group. Comparatively, Cobianchi *et al.* (2012) found that TDN was insignificantly decreased at level of 33% replacement of soybean meal by chemically treated castor meal, while it was reduced ($P<0.05$) at 67% replacement in cow diets. Moreover, Oliveira *et al.* (2010) indicated that the decrease in CP digestibility was probably due to the decrease in CP intake, which increase the participation of the fecal metabolic fraction.

As shown in Table (5), the results indicated that there was insignificant decrease in NB when rabbits fed on diets containing CTCM and BTCM at levels 20 and 40% compared to the rabbits fed on the control diet. These results are in agreement with those reported by Cobianchi *et al.* (2012) who found that the nitrogen balance was not affected by chemically treated castor ($P>0.05$) up to 67% replacement of soybean meal in dairy cow diets, indicating that nitrogen intake meet the nitrogen requirement of cows.

In general, the improvement of digestibility of all nutrients, nutritive value, FBW and daily BWG in rabbits fed diets containing CTCM comparable to those of rabbits fed diets containing BTCM may be due to the more efficiency of chemical treatment than biological treatment respecting to reduced toxicity level of the castor meal. Oliveira *et al.* (2007) stated that treatment with calcium oxide or calcium hydroxide (60g / kg castor meal) completely removed ricin from castor meal. Moreover, Diniz *et al.*, (2010) found that using lime treatment (calcium oxide) (60g / kg castor meal) reduced ricin by 96.6%. While, Godoy *et al.* (2009) found that using certain fungi such as *Penicillium simplicissimum* reduced ricin by only 16%. However, the reduction of all nutrients digestibility, nutritive value, FBW and daily BWG in rabbits fed 40% BTCM may be due to the increase of residual effects of castor allergen in castor meal which increased with increasing the level of BTCM in the diet. These results are in agreement with those reported with Oso *et al.* (2011) who stated that final live weight and average weight gain of the chicks reduced ($P<0.05$) with increasing dietary level of fermented castor meal in the diet.

Table (5). Nutritive value and nitrogen balance of experimental diets.

Items	Control	CTCM		BTCM		SEM
		20%	40%	20%	40%	
DCP %	12.81^{a}	12.48^{a}	12.13^{ab}	12.55^{a}	11.75^{b}	0.12
TDN%	65.75^{a}	62.92^{ab}	56.28^{b}	59.89^{ab}	55.33^{b}	1.34
DE kcal/ kg*	2913.3^{a}	2787.7^{ab}	2493.3^{b}	2653.6^{ab}	2451.1^{b}	58.92
NB %	67.98	66.55	64.05	63.08	63.07	0.87

DE = TDN X 44.3 according to (Schneider and flatt, 1975).

a and b means in the same row with different superscripts are significantly different ($P<0.05$).

Blood plasma constituents:

The plasma concentration values of total protein, albumin, globulin, cholesterol, total lipid, urea, creatinine, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are shown in Table (6). The obtained values of those parameters were within the normal range. It could be noticed insignificantly differences in concentration of plasma total protein, albumin, globulin, cholesterol, total lipid, creatinine, ALT and AST of plasma for rabbits fed different tested treatments. However, urea was significantly increased with rabbits fed diets containing of CTCM and BTCM at level 40% compared to those fed on control diet. Oso *et al.* (2011) stated that the utilization of fermented castor meal in starting cockerels chicks diet were not effected on total protein, albumin, globulin and uric acid. However, creatinine was significantly increased when dietary level of fermented castor meal increased in the diet. These results somewhat are in agreement with those obtained by Cobianchi *et al.* (2012) who found that the AST, ALT and urea concentration were insignificant differences among dairy cows fed on castor meal treated by calcium oxide up to 33% replacement of soybean meal.

Economic efficienc:y:

Profitability of using chemically and biologically castor meal in growing rabbit diets depended on feed cost and growth performance (Table 7). The lowest total feed cost / rabbit (12.78 LE) was observed with rabbits fed the diets containing 20% CTCM followed by those fed 40% BTCM (13.48 LE). While, groups fed the diets containing CTCM and BTCM at level 20% were achieved the highest economic efficiency (2.77 and 2.48) and relative economic efficiency (122.02 and 109.25) followed by a decreasing order by groups fed control diet or 40% BTCM (95.59) and the least one was the group fed 40%CTCM (91.62). Generally, it can be noticed that rabbits fed on the diets containing CTCM and BTCM at level 20% had the best economic return with compared to the other treatments.

It could be concluded that the chemically and biologically treated castor meal can be used in growing rabbit diets up to 20% as replacing of soybean meal without any adverse effect on growth performance of rabbits and healthy condition as well as its beneficial effect on feed cost and economical efficiency. Chemical treatment is more efficiency than biological treatment in respect of reducing the toxicity level of castor meal.

Table (6). Some blood constituents of growing rabbits fed on experimental diets.

Items	Normal range	Control	CTCM		BTCM		SEM
			20%	40%	20%	40%	
Total protein, g/ dl	5.5-6.5	6.37	6.25	6. 20	6.12	6.11	0.046
Albumin, g/ dl		3.93	3.91	3.81	3.64	3.43	0.12
Globulin g/ dl		2.68	2.53	2.46	2.19	2.18	0.12
Cholesterol, mg/ dl	10-80	36.48	36.45	35.13	35.17	37.41	2.73
Total lipid mg/ dl	150-400	354.68	365.74	354.67	377.74	381.85	3.72
Urea-N, mg/ dl	15-50	23.01^{b}	25.17^{ab}	29.06^{a}	26.74^{ab}	30.41^{a}	0.39
Creatinine, mg/ dl	0.5-2.6	1.42	1.42	1.60	1.46	1.64	0.048
AST(U/ L)	17-98	26.33	25.00	23.66	23.33	28.10	0.78
ALT(U/ L)	12-73	15.33	16.33	17.33	15.33	14.67	0.61

a, and b means in the same row with different superscripts are significantly different (P≤0.05).

Table (7). Economic efficiency of growing rabbits fed experimental diets.

Items	Control	CTCM		BTCM	
		20%	40%	20%	40%
Total average weight (kg)	1.256	1.206	1.163	1.240	1.074
Price of one kg body weight (LE)	40	40	40	40	40
Selling price/ rabbit (LE)(A)	50.24	48.24	46.52	49.6	42.96
Total feed intake	5.27	4.53	5.46	5.03	4.85
Price/ kg feed(LE)	2.91	2.82	2.76	2.83	2.78
Total feed cost/ rabbit (LE) B	15.34	12.78	15.07	14.24	13.48
Net revenue(LE)[1]	34.90	35.45	31.45	35.36	29.48
Economic efficiency[2]	2.27	2.77	2.08	2.48	2.17
Relative economic efficiency [3]	100	122.0	91.62	109.25	95.59

(1) Net revenue = A -B
(2) Economic efficiency = (A-B/ B)
(3)Relative economic efficiency = Economic efficiency of treatments other than the control / Economic efficiency of the control group.

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الأداء الانتاجي للارانب النيوزيلندي البيضاء الناميه المغذاه على علائق تحتوي على مستويات مختلفه من كسب الخروع المعامل.

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الهدف من الدراسه هو تقييم تاثير احلال مستويين 20 او 40% كسب الخروع المعامل كيميائيا وبيولوجيا من كسب الصويا على الاداء الانتاجي للارانب. قسمت عشوائيا مائة ارنب نيوزيلندي ابيض عمر 6 اسابيع متوسط وزنها 733-777 جم الى خمس مجاميع وقسمت كل مجموعه الى خمسه مكررات (4ارانب/ مكرر). استمرت تجربة النمو 8 اسابيع . قدمت العليقه حتى الشبع وكذلك الماء متاح طول الوقت. اظهرت النتائج ان المعاملات الكيميائيه والبيولوجيه اثرت على التركيب الكيميائي خاصة على المحتوى من البروتين الخام حيث ارتفع وحدث انخفاض للالياف الخام في المعاملة البيولوجيه. واظهرت معاملات الهضم اختلافات غير معنويه بين العلائق التجريبيه في معامل هضم الماده الجافه والماده العضويه. حدث انخفاض معنوي في معاملات هضم الالياف الخام ، مستخلص الاثير ، مستخلص خالي الازوت والبروتين الخام مع العليقه المحتويه على 40% كسب خروع معامل بيولوجيا مقارنة بالكنترول. كانت قيم البروتين المهضوم والمركبات الكليه المهضومه لعليقة 40% كسب خروع معامل بيولوجيا منخفضه معنويا عن الكنترول، بينما باقي العلائق التجريبيه الاخرى كانت في معظمها غير مختلفه معنويا. كانت قيم ميزان الازوت منخفضه انخفاض غير معنوي للعلائق 20 او 40% كسب خروع معامل بيولوجيا وكيميائيا مقارنة بالكونترول. وكانت قيم الوزن النهائي والزياده الوزنيه منخضة انخفاض غير معنوي مع الارانب المغذاه على جميع العلائق التجريبيه فيما عدا العليقه المحتويه على 40% كسب خروع معامل بيولوجيا مقارنه بالكنترول.سجل الماكول قيمه منخفضه مع الارانب المغذاه على 20% كسب خروع معامل كيميائيا بينما سجلت اعلى قيمه مع 40% كسب خروع معامل كيميائيا. مقارنة بالكنترول لم تسجل معظم العلائق التجريبيه اختلاف معنوي في الماكول. كانت افضل نسبه لمعامل التحويل الغذائي مع مجموعة 20% كسب خروع معامل كيميائيا، بينما اسوئها كانت مع عليقة 40% كسب خروع معامل كيميائيا وكانت الاختلافات غير معنويه في معظم العلائق. لم تظهر اختلافات معنويع في معظم مكونات الدم وكانت القيم جميعها داخل المدى الطبيعي لها. كانت العلائق المحتويه على 20% كسب خروع معامل كيميائيا وبيولوجيا افضل كفاءة اقتصاديه تليها الكنترول او 40% كسب خروع معامل بيولوجيا واخرها كانت مع عليقة 40% كسب خروع معامل كيميائيا. كانت النتيجه امكانيه احلال كسب الخروع المعامل كيميائيا او بيولوجيا حتى مستوى 20% في علائق الارانب الناميه دون اي اثار سيئه على الاداء الانتاجي والصحه.