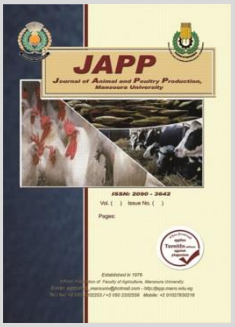
Journal of Animal and Poultry Production

Journal homepage: www.japp.mans.edu.eg
Available online at: www. jappmu.journals.ekb.eg

Effect of Feeding Diets Containing Treated Jatropha Seed Meal on Performance of Growing Rabbits

Walaa A. Salama*; Amal M. A. Fayed ; Hanan A. M. Hassanein; Fatma G. Ahmed and A. I. Abd-El- Lateif

Animal Production Research Institute, Agricultural Research Center, Giza, Egypt.



ABSTRACT

A study was assigned to assess the ameliorate the feeding value of jatropha seed meal by chemical or autoclave treatments and the feasibility of using in rabbit diets. Sixty weaned APRI rabbits, six weeks old with an average live body weight 707.26±4.54*g* were allotted randomly to five groups (twelve rabbits/treatment in 3 replicates). Five experimental diets were formulated where soybean meal protein of the basal diet (control) was replaced by chemically or autoclaved jatropha seed meal protein (CTJSM or ATJSM, respectively) of the rate of 15 or 30%. The growth trail continued lasted up to 14th week of age. There were final body weight and daily body weight gain with rabbits fed diets containing 15% CTJSM and 15% ATJSM diets close to rabbis fed control diets. The feed conversion ratio was significantly improved with 15% ATJSM and CTJSM diets compared with control. Digestion coefficients and nutritive values were insignificantly differed with tested diet contained 15% CTJSM compared to control. The control and tested groups resulted in the better dressing% compared to 30% CTJSM group. There were significantly increased in plasma ALT when replacing 15 or 30% ATJSM and 15% CTJSM, while plasma AST was significantly decreased when rabbit fed 15 % ATJSM compared to control. Economic efficiency and relative economic efficiency recorded the highest values with 15% CTJSM followed by 15% ATJSM, compared to control.Conclusively, It could be concluded soybean meal protein could be replaced by CTJSM and ATJSM protein at the level of 15%without an adverse in rabbits performance.

Keywords: Rabbits, Jatropha seed meal , soybean meal, growth .

INTRODUCTION

Jatropha curcas(L) or physic nut is a multipurpose and drought- resistant, large shrub or small tree. Although a native of tropical America, it now thrives throughout Africa and Asia. It grows in a number of climatic zones in tropical and sub-tropical regions of the world. Seed production ranges from about 0.1 t/ ha/year to over 8 t/ha/year (Heller, 1996). The seed yield reaches a peak after about five years of growth. *Jatropha curcas* offers multiple uses for the production of pharmaceutical ingredients, bio-pesticides, soap and cosmetics. *jatropha curcas* is recently planted in Egypt. The hectare is yield up to 5 tons seed given about 1.85 tons of oil in the year (El-Gamassy, 2008). The composition of jatropha oil by-products depends on the extraction process. jatropha seed meal obtained from the extraction of whole (non-dehulled) seeds. While, jatropha kernel meal, obtained from the complete oil extraction of dehulled seeds. jatropha kernel meal contains from 40% to more than 75% crude protein (DM basis). Well defatted jatropha kernel meal contains less than 2% oil. It is relatively low in fiber (crude fiber less than 10% DM) (Makkar and Becker 2009). This product is much lower in protein (about 16% DM) and much higher in fiber (crude fiber more than 33% DM) (Guedes *et al*., 2014).

However jatropha kernel meal contains anti-nutritive compounds, such as lectin, trypsin inhibitor (anti-trypsin), saponin, phytate, and phorbolester of all the compounds, phorbol ester is considered as the most toxic compound. The presence of high levels of antinutrional prevents their use in animal feeding. These anti-nutritive compounds need to be removed. The removal of phorbol esters would transform jatropha meal into a highly nutritious and high value feed ingredient for monogastrics, fish and ruminants (Hass and Mittelbach, 2000). There are various physical, chemical and biologically ways to destroy these phorbol esters in feeds. Physical treatment by heating in autoclave potentially reduces anti-trypsin and lectin contents in seed meal(Aderibigbe *et al*., 1997) Chicks fed diets containing jatropha meal had decreased in feed consumption and showed liver damage (Sumiati *et al*., 2011). However, Abd El- Hack *et al*. (2017) showed that productive performance of japanese quail was improved with heat treated jatropha meal.

The present research aimed to study the growth performance, nutrients digestibility coefficient, some blood constitutes of APRI rabbits feed treated jatropha seed meal. Also, economic of the studied treatments were evaluated

MATERIALS AND METHODS

The experiment was conducted at Kefir EL-Sheik experimental station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. Jatropha seed meal was ground by hammer mill and stored in an air-tight condition and kept for subsequent processing. The Autoclaved and chemical treatments were conducted at the Laboratories of By-Product Utilization

* **Corresponding author.**
E-mail address: dr. walaa.attia@gmail.com
DOI: 10.21608/jappmu.2020.87133

Research Department, Animal Production Research Institute, Giza, Egypt.

Processing of jatropha seed meal

Autoclaved treatment

Jatropha seed meal was treated in autoclave at 121 ^{O}C for 30 minutes as recommended by Aderibigde *et al*. (1997).After treatment of the meal, the drying was done in the open air for 10 min.

Chemical treatment

Jatropha seed meal was treated with sodium chloride10g/kg and calcium hydroxide 5g/kg according to Katole *et al*. (2013). After mixing the meal with the sodium chloride and calcium hydroxide 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.

Animals, management and growth trail

Sixty weaned APRI rabbits, six weeks old with an average live body weight 707.26±4.54*g* were allotted randomly in five dietary treatments (twelve rabbits /treatment in 3 replicates). Diets were formulated, to be nearly iso-nitrogenous and iso-caloric to cover the requirement of growing rabbits according to Agriculture Ministry Decree (1996). All animals were received the control diet for one week before the start of the experiment. Feed and water were offered *ad libitum*. Diets were formulated; including the control diet, while the other four diets were of autoclaved treated jatropha seed meal and chemically treated jatropha seed meal at 3.30 or 6.60 % in the diet instead of 15 or 30% soybean meal protein) are shown in Table (1).

Table 1. Ingredients (%) and chemical composition (%) of the experimental diets.

Ingredients	Control diet	ATJSM		CTJSM	
		15%	30%	15%	30%
Barley	30.26	29.77	30.45	29.77	30.45
Clover hay(12% CP)	26.74	26.74	25.45	26.74	25.45
Wheat bran	18.40	18.40	18.40	18.40	18.40
Soybean meal (44% CP)	18.00	15.29	12.60	15.29	12.60
Jatropha treated seed meal	-----	3.30	6.60	3.30	6. 60
Molasses	3.00	3.00	3.00	3.00	3.00
Di calcium phosphate	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
Lime stone	0.35	0.35	0.35	0.35	0.35
DL-Methionine	0.30	0.30	0.30	0.30	0.30
Anticoccidia (Diclazuril)	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100
Calculated analysis,%[1]					
CP%	17.70	17.62	17.58	17.62	17.57
CF%	12.87	13.08	12.97	13.08	12.97
EE%	2.17	2.34	2.51	2.34	2.51
NFE%	57.60	55.62	55.26	55.51	55.17
Ash%	9.66	11.34	11.68	11.45	11.78
DE kcal/ kg	2533.3	2511.3	2505.6	2511.4	2505.7

ATJSM : Autoclaved treated jatropha seed meal,
CTJSM: Chemically treated jatropha seed meal
[1]Each 3 kg of vitamins and minerals mixture contains: Vit. A 6000000 IU, Vit.B_1 2000mg, Vit.$B_2$4000mg, Vit.D_3 900.000 IU, Vit E 40.000mg, Vit. K_3 2000 mg, Pantothenic acid 10.000mg; Nicotinic acid, 50.000g; Vit. B_6 2000 mg; Vit. B_{12} 10 mg, Folic acid 3.0g, Biotin 50 mg, Cu 5g, choline 250.000mg,Mn 60g, Fe 50g, , Co 0.1 g, Se 0.1 g, Zn 50 g,Iodine 0.2 g and Antioxidant 10.000mg, calcium carbonate up to 3 kg .
[2]according to feed composition for animal and poultry feed stuffs used in Egypt (2001).

Chemical analyses of jatropha seed meal and soybean meal are presented in Table (2). The digestible energy (DE kcal/kg) of jatropha seed meal was calculated according to the equation of Cheeke (1987),

DE (kcal/g) = 4.36 -0.0491 x NDF

Where NDF% = 28.924+0.657 x CF%.

The experimental period lasted for 8 weeks. At the end of the experimental period (14 weeks of age), four rabbits were randomly taken from each group and fasted for 12 hours before slaughtering to determined carcass characteristics according to Steven *et al*. (1982).

Digestibility trials

Digestibility trials were carried out using four male rabbits from each experimental The rabbits were housed in metabolic cages where feces and urine were collected separately for 6 days as a collection period during which the feces were collected daily sprayed with 2% boric acid solution for trapping any ammonia released from feces. Feces were dried at 60^{o} C for 48 hours (till constant weight), finely ground and thoroughly mixed to ensure sample uniformity and then stored until being analyses. Proximate analysis of the diets and feces were carried out according to AOAC (2000).

Blood parameters

Blood plasma samples were taken after slaughtering collected in 5 ml. heparinized test tubes and centrifuged at 3000 r.p.m for 20 minutes then plasma were transferred and stored in deep freezer at approximately -20^{o}C till for some blood parameters aspartate amino transferase (AST) and alanine amino transferase (ALT) (Reitman and Frankel ,1957), creatinine (Schirmeister, 1964) and urea (Fawcett and Scott, 1960) determination.

Economic efficiency

The economic efficiency (EEF) was calculated according to the following equation: EEF = Net revenue / total costs Where the total cost calculated by Egyptian pound (L.E.) in the local market at the time of experiment.

Statistical analysis

All data were subjected to analysis of variance using the general linear models (GLM) procedure of SAS (2004) by the following model: $Y_{ij} = \mu + T_i + e_{ij}$, w here: μ= overall mean of Y_{ij}, T = effect of treatment, i = (1, 2,..,) and e_{ij}= experimental error. The significant differences between treatment means were separated using Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Chemical analysis of tested ingredients

Chemical composition of jatropha seed meal (JSM), autoclaved treated jatropha seed meal (ATJSM), chemically treated jatropha seed meal (CTJSM) compared to soybean meal is presented in Table (2). The results show that jatropha seed meal, in comparison to the soybean meal could be recommended as a good alternative protein source, where it contained close value of crude protein content (36.81, 36.75, 36.68 vs. 44.00%), While, the crude fiber was higher in JSM 13.53 , 13.28 ATJSM and 13.20% CTJSM compared with soybean meal (7.30%). Ether extract of soybean meal was lower (1.50 %) in comparison to JSM; 6.73%, ATJSM; 6.71% and CTJSM; 6.70% and NFE content (33.81, 34.11 and 34.30 vs. 40.70%). Also, soybean meal show higher digestible energy (3200kcal/kg) in comparison to JSM; 2503 kcal/kg, ATJSM; 2511.8 kcal/kg and CTJSM; 2514.3 kcal/kg. In this respect, Abo El-Fadel *et al*. (2011) found that jatropha seed meal contained 40.38%CP, 10.77% CF

and 9.45% EE and chemically jatropha seed meal contained 40.7%CP , 11.24 %CF and 10.33%EE. On the other hand, Elangovan *et al*. (2013) found that jatropha seed cake meal contained 17.56% CP, 19.32% CF, 22.37% EE, NFE 33.89% and 6.86% ash. Also, Oladunjoye *et al*. (2014) found that jatropha seed cake meal contained 23.00% CP, 29.2% EE, 8.11% CF, 31.29%NFE and 8.4% ash. The chemical composition of jatropha oil by-products depends on the extraction process.

Table 2. Chemical analysis of soybean meal, jatropha seed meal, autoclaved jatropha seed meal, (ATJSM) chemically treated jatropha seed meal (CTJSM) on DM% basis.

Item	Soybean meal *	JSM	ATJSM	CTJSM
DM%	88.50	92.98	92.80	92.82
Chemical analysis% (on DM basis)				
OM%	93.60	90.88	90.90	90.88
CP%	44.00	36.81	36.75	36.68
CF%	7.30	13.53	13.28	13.20
EE%	1.50	6.73	6.71	6.70
NFE%	40.70	33.81	34.16	34.30
Ash%	6.50	9.12	9.10	9.12
DE(Kcal/kg)**	3200	2503.3	2511.4	2514.3

JSM: jtropha seed meal, ATJSM: Autoclaved jatropha seed meal, CTJKML: Chemically treated jatropha seed meal.

*** Chemical analysis according to Feed composition for animal and poultry feedstuff used in Egypt (2001).* * DE (kcal/g) = 4.36 -0.0491 x NDF, Where NDF% = 28.924+0.657 * CF% according to Cheeke (1987).**

Growth performance

Results in Table (3) show that there were significant differences between treatments in final body weight and body weight gain. Final body weight and body weight gain were close to the control and rabbits fed 15% CTJSM and 15% ATJSM diets. While, feeding on 30% ATJSM and 30% CTJSM diets showed significantly (P<0.05) lower in final body weight and body weight gain when compared to control. Feed intake did not significantly differ between treatments. Feed conversion ratio was improved significantly when feeding 15% CTJSM diets compared with control and the worst values were recorded for 30% CTJSM diet. Oladunjoye *et al*. (2014) who found that final body weight, daily weight gain and feed conversion with rabbits fed diet containing 25% Jatropha seed meal treated with *Aspergillus niger* were close to that fed control diet and reported that no difference in feed intake between treatments. This contradict the report of Rakshit *et al*. (2008) who demonstrated that rats fed alkali and heat treated seed meal of *jatropha curcas* had reduced appetite and low feed intake. Belewu *et al*. (2010) found that 50% treated Jatropha meal with *Aspergillus niger* had no negative effect on both daily gain and feed intake of goats. Moreover, Elangovan *et al*. (2013) found that body weight of lambs improved with groups fed 25% Jatropha meal treated with 3% sodium bicarbonate compared with groups fed non treated Jatropha meal but still were lower compared to control group. Abo El-Fadel *et al*. (2011) found that daily feed intake was not significantly differ between experimental rations containing 25 and 50% treated or non-treated *Jatropha curcas* meals with lambs. The decrease in body weight and nutrients digestibilities for rabbits fed 30% ATJSM and CTJSM may be attributed to the residual anti-nutritional factors like lectins, saponins, tannins, phytic acids, trypsin inhibitors, hydrocyanides and phorboesters in jatropha seed meal (Makkar and Becker ,1999). Rakshit *et al*. (2008) stated that trypsin inhibitor content of jatropha seed meal as well as other anti-nutritional compounds negatively affecting digestibilities of nutrients in rats.

Table 3. Growth performance of rabbits fed diets containing treated jatropha seed meal.

Items	Control	ATJSM		CTJSM		SEM
		15%	30%	15%	30%	
Initial body weight(g)	712.00	701.00	713.30	700.00	710.00	4.54
Final body weight (g)	1792.3^{a}	1684.0^{ab}	1591.0^{bc}	1786.0^{a}	1534^{c}	29.48
Daily live body weight gain (g)	19.29^{a}	17.55^{ab}	15.67^{bc}	19.39^{a}	14.71^{c}	0.56
Daily feed intake (g)	79.00	65.00	64.00	63.33	68.63	1.63
Feed conversion ratio	4.09^{ab}	3.70^{bc}	4.08^{ab}	3.26^{c}	4.66^{a}	0.15

ATJSM: Autoclaved jatropha seed meal, CTJSM: Chemically treated jatropha seed meal.

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

Digestion coefficients and nutritive values of tested diets

Data in Table (4) indicate that digestion coefficients of DM and OM were not significantly affected by experimental treatments.

Table 4. Nutrients digestion coefficients and nutritive values of tested diets containing treated jatropha seed meal.

Items	Control	ATJSM		CTJSM		SEM
		15%	30%	15%	30%	
DM	67.00	60.40	63.00	62.75	60.00	0.73
OM	69.14	66.66	64.33	62.66	61.00	1.34
CP	77.32^{a}	69.25^{ab}	62.87^{b}	71.34^{ab}	61.21^{b}	1.95
CF	41.57^{a}	32.00^{b}	30.43^{b}	38.57^{a}	29.63^{b}	1.45
EE	79.69^{a}	69.27^{b}	68.08^{b}	71.11^{ab}	68.55^{b}	1.70
NFE	74.50^{a}	69.36^{ab}	66.02^{ab}	73.40^{a}	60.32^{b}	1.73
Nutritive value,%						
DCP	13.68^{a}	12.20^{b}	11.05^{c}	12.57^{ab}	10.75^{c}	0.37
TDN	58.67^{a}	51.41^{b}	50.80^{b}	55.28^{ab}	50.66^{b}	1.04
*DE kcal/kg	2599.0^{a}	2277.4^{bc}	2250.4^{c}	2448.90^{ab}	2244.2^{c}	43.75

ATJSM: Autoclaved jatropha seed meal, CTJSM: Chemically treated jatropha seed meal.

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

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

Digestion coefficients of CP, CF, EE, NFE and nutritive values of DCP, TDN and DE% were significantly affected by dietary treatments. 15% CTJSM group was better than other tested groups and no significant differences were obtained for this group compared to control group. Oladunjoye *et al*. (2014) found that digestibilities of DM, CP, EE and NFE were not significantly affected when rabbits fed on 25, 50 and 75 % jatropha seed meal treated with *Aspergillus niger* compared to the control. However, crude fiber digestibility was significantly lower with rabbits fed 75% seed meal treated with *Aspergillus niger* compared to the control. In this respect, El-Zelaky *et al*. (2011) reported that no significant differences in all nutrients digestibility OM, DM, CP, CF , EE, NFE and DCP (%) for lambs received 75% treated jatropha seed meal with lactic acid bacteria compared to control group. While, TDN of treated jatropha seed meal was significantly higher compared to control. On the other hand, Abo El-Fadel *et al*. (2011) found that digestibility of CP by lambs fed concentrate feed mixtures contained 50% untreated jatropha

seed meal was lower than digestibility of CP for concentrate feed mixtures contained 50% heated jatropha seed meal.

Carcass traits

Results of carcass traits are presented in Table (5) of studied carcass variables (dressing, live, heart, kidneys and edible giblets %) only dressing% was significantly affected by treatments under evaluation. All studied treatments including the control and tested groups resulted in better dressing% compared to 30% CTJSM group. These results disagree with those of Oladunjoye *et al.* (2014) who found that using 25, 50 and 75% fermented jatropha seed meal by *sprigillus niger* in rabbit diets reduced liver and spleen size, while carcass % not affected.

Table 5. Carcass traits of rabbits fed diets containing treated jatropha seed meal.

Items	Control	ATJSM		CTJSM		SEM
		15%	30%	15%	30%	
Dressing, %	53.83^{a}	51.33^{ab}	50.55^{ab}	52.63^{a}	47.35^{b}	0.75
Liver, %	2.94	2.56	2.46	2.89	2.26	0.10
Heart, %	0.433	0.349	0.445	0.451	0.432	0.01
Kidneys ,%	0.776	0.699	0.752	0.743	0.718	0.03
Edible giblets,%	4.14	3.60	3.65	4.08	3.41	0.14

ATJSM: Autoclaved jatropha seed meal, CTJSM: Chemically treated jatropha seed meal.

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

Blood parameters

Data of blood plasma constituents are illustrated in Table (6) it is worth noting that both ALT and AST were significantly differed between experimental groups. Treated jatropha seed meal groups showed higher ALT (u/l) values relative to the control group. While, 15% ATJSM group gave the lowest AST (u/l) value compared to other jatropha tested groups and the control.

Kidney metabolites of creatinine and urea-N were not significantly affected by studied by treatments. Elangovan *et al.* (2013) showed that serum of lambs, there were significant lower ALT and significantly higher AST with untreated or chemically treated jatropha-diets. Ojediran *et al.* (2018) found that creatinine and AST were no significant increase among the birds fed toasted defatted fermented jatropha meal, cooked defatted fermented jatropha meal, Sand-roasted defatted fermented jatropha meal.

Table 6. Blood parameters of rabbits fed diets containing treated jatropha seed meal.

Items	Control	ATJSM		CTJSM		SEM
		15%	30%	15%	30%	
ALT(U/L)	36.66^{b}	53.33^{a}	52.00^{a}	50.00^{a}	47.00^{ab}	2.16
AST(U/L)	36.33^{a}	29.00^{b}	32.50^{ab}	36.00^{a}	34.00^{ab}	1.05
Creatinine(mg/ dl)	1.03	1.05	0.91	1.00	1.10	0.02
Urea-N(mg/ dl)	32.00	29.00	23.50	29.50	24.50	1.30

ATJSM: Autoclaved jatropha seed meal, CTJSM: Chemically treated jatropha seed meal.

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

Economic Efficiency

Results illustrated in Table (7) showed that total feed cost was decreased by replacement of treated jatropha seed meal in rabbit diets. The lowest total feed cost was noticed with replacement of 15% CTJSM followed by replacement of 30% ATJSM. Economic efficiency was the highest for replacement of 15% CTJSM (2.51) followed by replacement of 15% ATJSM (2.28) and relative economic efficiency was improved with 15% CTJSM (138.67) followed by15% ATJSM (125.96) and the lowest value was observed with control group. Elangovan et al. (2013) found that feed cost/kilogram weight gain of rabbits which fed 25% and 75% jatropha meal in replacement for soybean meal were significantly higher than group fed diet contained control. Abo El-Fadel et al. (2011) found that replacement 50% soybean meal with biological jatropha meal in lambs diet decreased feed cost by 17.24% than the control group. At the same time, both economic return and economic efficiency were improved by 4.11 and 19.32%, respectively for as compared with control ration.

Table 7. Economic efficiency of rabbits fed diets containing treated jatropha seed meal.

Items	Control	ATJSM		CTJSM	
		15%	30%	15%	30%
Total average weight gain (g)	1.080	983	877.5	1086	824
Selling price/rabbit (LE) (A)	55.08	50.13	44.75	52.38	42.01
Total feed intake	4.424	3.640	3.584	3.546	3.843
Price/kg feed(LE)	4.42	4.20	4.08	4.21	4.10
Total feed cost/rabbit (LE) (B)	19.55	15.28	14.62	14.92	15.75
Net revenue(LE)[1]	35.53	34.85	30.13	37.47	26.26
Economic efficiency[2]	1.81	2.28	2.06	2.51	1.66
Relative Econ. Eff.[3]	100	125.96	113.81	138.67	91.70

ATJSM: Autoclaved Jatropha seed meal, CTJSM: Chemically treated Jatropha seed meal. Price of 1 kg live body weight =51 LE

(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.

CONCLUSION

It could be concluded that autoclaved and chemically jatropha seed meal can be incorporated in rabbit diets at 15% of protein of soybean meal without any adverse effect on rabbits performance.

REFERENCES

A.O.A.C. (2000).Official Methods of Analysis.17thed., published by the A.O.A.C., Washington, D.C., USA.

Abd El-Hack, M.E.; Alagawany, M. El-Sayed, S.A. and Fowler, J. (2017). Influence of dietary inclusion of untreated or heat- treated Jatropha meal on productive and reproductive performances and biochemical blood parameters of laying Japanese quail. PoultryScience, 96 (8):2761-2767.

Abo El-Fadel .M.H., Hussein, A.M. and Mohamed, A.H. (2011).Incorporation *Jatropha curcas* meal on lambs ration and It's effect on lambs performance. Nature and Science 9(2):15-18.

Aderibigbe, A. O.; Johnson,C. O. L. E.; Makkar, H. P. S.; Becker, K. and Foidl, N. (1997). Chemical composition and effect of heat on organic matter- and nitrogen degradability and some antinutritional components of Jatropha meal. Animal Feed Science and Technology 67: 223-243.

Agriculture Ministry Decree (1996). The standard properties for ingredients, feed additives and feed manufactured for animal and poultry. El-Wakaee El-Masria, Amirria Press Cairo, Egypt. No.192,95.

Belewu, M. A.; Belewu, K. Y. and Ogunsola, F. O. (2010). Nutritive value of dietary fungi treated *Jatropha curcas* kernel cake: Voluntary intake, growth and digestibility coefficient of goat . Agirc. Biol. J. North Am.1 (2):135-138.

Cheeke, P.R. (1987). Rabbit feeding and nutrition. Academic Press, Inc., Orlando, Florida, USA, p. 376.

Duncan, D.B. (1955). Multiple Range and Multiple F-Test. Biometrics, 11:1-42.

El- Gamassy, I. (2008). Improved wastewater reuse practices feasibility study on growing Jatropha utilizing treated wastewater in Luxor, Report No. 57, September, Cairo, Egypt.

El- Zelaky, O. A; Khalifa, E. I.; Mohamed, A. H.; Bahera, K. M. and Hussein, A. M. (2011). Reproductive performance of rahmani male lamps fed rations containing jaropha cake. Egyptian Journal of Sheep & Goat Sciences, Vol. 6 (2),15 –24.

Elangovan, A. V. ; Gowda, N. K. S. ; Satyanarayana, M. L. ; Suganthi, R. U. ; Rao, S. B. N. and Sridhar, M.(2013).Jatropha (*Jatropha curcas*) seed cake as a feed ingredient in the rations of sheep. Anim. Nut. Feed. Technol., 13 (1): 57-67.

Fawcett, J.K. and Scott, J.E. (1960). A rapid and precise method for the determination of urea. J. Clin. Path.,13:156-159.

Feed Composition for Animal and Poultry Feed Stuff used in Egypt (2001). Technical pulletil no. Central lab. For Feed and Food; Ministry of agriculture. Egypt.

Guedes, R. E. ;Cruz, F. de A. ; Lima, M. C. de ; Sant'Ana, L. D.; Castro, R. N. and Mendes, M. F. (2014). Detoxification of *Jatropha curcas* seed cake using chemical treatment: analysis with a central composite rotatable design. Ind. Crops and Products, 52: 537-543.

Hass,W. and Mittelbach, M. (2000). Detoxification experiments with the seed oil from *jatropha curcas* L. Ind. Crops Prod.,12:111-118.

Heller, J. (1996). Physic Nut, *Jatropha curcas* L. promoting 298 the conservation and use of underutilized and Neglected crops. Institute of Pant Genetic and Crop Plant Research, Gatersleben and International Plant Genetic Resource Institute, Rome, 88p.

Katole, S.; Saha, S. K.; Das. A.; Sastry, V. R. B.; Lade M.H. and Prakash, B. (2013).Nutrient intake, digestibility , and blood metabolites of goats fed diets containing processed Jatropha meal. Tropical Animal Health and Production.45(7):1563-1569.

Makkar, H. P. S. and Becker, K. (1999). Plant toxins and detoxification methods to improve feed quality of tropical seeds. Asian Aust. J. Anim. Sci.;12(3):467-480.

Makkar, H. P. S. and Becker, K. (2009). *Jatropha curcas*, a promising crop for the generation of biodiesel and value-added coproducts. Eur. J. Lip. Sci. Technol., 111 (8): 773-787

Ojediran, T. K.; Adegoke, O. E. and Emiola, I. A. (2018).Haematological Parameters, Serum Biochemistry and Gut Microbial Count of Broiler Chicks Fed Processed Dietary Fungi Treated *Jatropha curcas* Kernel Meals. Journal of Experimental Agriculture International.,27(6): 1-8.

Oladunjoye, I. O., Ojebiyi, O. O.; Ojediran, A. B. ; Adeniyi A. B. and Shonibare, S. A. (2014). Evaluation of Jatropha (*Jatropha curcas* L.) Seed Cake Meal as Feed for Rabbit International Journal of Agriculture Innovations and Research., 2, (6): 1150-1154.

Rakshit, K.D.; Darukeshwara, J.; Rathina, Raj, K.; Narasimhamurthy, K.; Saibaba, P. and Bhagya, S. (2008).Toxicity studies of detoxified Jatropha meal (*Jatropha curcas*) in rats. Food and Chemical Toxicology. 46 (12): 3621-3625

Reitman, S. and Frankel, S. (1957). A colorimetric method determination of serum glutamate oxaloacetate and glutamic pyruvate transaminase. Am. J. Clin. Pathol., 28:56-63.

SAS (2004).User's guide. Statistic. Version 9. SAS Inst. Cary, N.C. Releigh USA

Schirmeister, J. (1964). Determination of creatinine. Dtsch. Med Wschr., 89:1940.

Schneider, B.H. and Flatt, W.P. (1975). The Evaluation of feed through digestibility experiments. University of Georgia Press Athens, Georgia, USA.423p.

Steven Lukefapor, W.D.; Hohenboken; W.D. Cheeke; P.R. Patton N.M. and Kennick W.H. (1981).Carcass and meat characteristics of Flemish giant and New Zealand white purebred and terminal cross rabbits. Journal of Applied Rabbit Research, 4 (3): 66-72.

Sumiati, F.; Hermana, W. and Sudarman, A. (2011).Performan Ayam Broiler yang Diberi Ransum Mengandung Bungkil Biji Jarak Pagar (*jatropha curcas* L.) Hasil Fermentasi Menggunakan *Rhizopus oligosporus*. Media Peternakan 34(2): 117-125.

تأثير التغذية على علائق تحتوى على كسب بذرة الجاتروفا المعامل على الأداء الأنتاجى للأرانب النامية .

ولاء عطيه سلامة ، أمل محمد عبد المجيد فايد ، حنان أحمد محمود حسنيين ، فاطمة جلال أحمد و عطية إبراهيم عبد اللطيف

معهد بحوث الإنتاج الحيواني- مركز البحوث الزراعية – الدقي- جيزة- مصر.

أجريت هذه الدراسة بهدف تحسين القيمة الغذائية لكسب الجاتروفا بالمعاملات الحرارية والكيماوية وأمكانية استخدامها في علائق الأرانب.تم توزيع ٦٠ أرنب أبرى مفطوم عمر ٦ أسابيع عشوائيا بمتوسط وزن ٧٠٧,٢٦ ± ٤,٥٤ تم تركيب خمس علائق تجريبية حيث يتم إستبدال بروتين كسب فول الصويا فى عليقة الكنترول ببروتين كسب جاتروفا معامل حراريا أو كيماويا بنسبة ١٥ أو ٣٠%. استمرت التجربة حتى عمر ١٤ أسبوع. وجد تشابه نتائج وزن الجسم النهائى والزيادة الوزنية اليومية للأرانب المغذاة على العلائق التى تحتوى على ١٥% كسب جاتروفا معامل كيماوى وحرارى مع مجموعة الأرانب التى غذيت على عليقة الكنترول.وكذلك تحسنت كفاءة التحويل الغذائي تحسنا معنويا عند التغذية على ١٥%كسب جاتروفا معامل كيماويا و حراريا بالمقارنة بالكنترول. بينما كانت هناك فروق غير معنوية في معامل هضم كلا من البروتين، الألياف ، الدهن ، المستخلص الخالي من الأزوت، القيمة الغذائية معبرا عنها للبروتين المهضوم ،المركبات الكلية المهضومة ، الطاقة المهضومة للعلائق المختبرة المحتوية على ١٥% كسب جاتروفا معامل كيماويا بالمقارنة بالكنترول. بينما كان هناك نقص معنوي في وزن الجسم النهائي والزيادة الوزنيه اليومية مع التغذية على ٣٠% كسب جاتروفا معامل حراريا وكيماويا وكانت أفضل نتائج لنسبة التصافى للكنترول والمجاميع المختبرة مقارنة بمجموعة ٣٠% كسب جاتروفا معامل كيماوى .وجد زيادة معنوية في ALT فى الدم مع الاستبدال بنسبة ١٥%،٣٠% كسب جاتروفا معامل حراريا و ١٥% كسب جاتروفا معامل كيماوى بالمقارنة بالكنترول. بينما وجد نقص معنوي في AST مع الاستبدال بنسبة١٥%كسب جاتروفا معامل حراريا بالمقارنة بالكنترول. وكانت الكفاءة الاقتصادية والكفاءة الاقتصادية النسبية أعلي مع نسبة استبدال ١٥% كسب جاتروفا معامل كيماويا يليه نسبة استبدال ١٥% كسب جاتروفا معامل حراريا بالمقارنة بالكنترول التوصية: يمكن أن نستخلص من هذه الدراسة أمكانية إستبدال١٥% من بروتين كسب فول الصويا ببروتين كسب الجاتروفا المعامل حراري أوكيماوي في علائق الأرانب بدون أي تأثير سئ على الأرانب.