Using Bagasse as a natural adsorbent for aflatoxins in rabbit diets

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ABSTRACT

Thirty males growing White New Zealand (WNZ) rabbits of Aged 4 weeks with initial mean weight (750±50g) were divided into 5 equal groups were kept under the same managerial conditions were conducted to determine the effect of feeding dietary bagasse as a source of natural dietary fiber and to adsorbent for aflatoxins or natural contamination in rabbit diets and to evaluate of using dietary bagasse on growth performance of rabbits. The results obtained were : Group fed basal diet supplemented with bagasse at level 6% (T3,) recorded the best LBW (2279.2g) followed by group fed diet supplemented low dose of AFs+ bagasse at level 6% (T5) being (2177.5 g) ,meanwhile, group fed basal diet (control) (T1) was the worst one being (2087 g) ; group fed dietary bagasse at level 6% and low dose of AFs (75.0ppb) (T5) achieved significantly (P<0.05) the highest (TG) value(1402.0 g) ; rabbits group fed 6% bagasse and groups fed 6 % bagasse with Low aflatoxin dose (75.0ppb) significantly (P<0.05) consumed TFI less than control and other experimental groups ; No significant differences (p<0.05) were found among TFCR and Adsorption abilities ranged from 94.63-98.10 % the highest adsorption capacity was observed when using 6 % bagasse and 3 hr shaking time at low TAF concentration , while the lowest value of binding was obtained at level 3% bagasse and 1 hr shaking time and high TAF concentration. The study concluded that using dietary 6 % bagasse with Low aflatoxin dose (75.0ppb) in growing rabbit diets significantly improve growth performance and have Adsorption ability at low TAF concentration.

Key words: Growing rabbits- aflatoxin - Adsorption - bagasse - growth performance

الملخص

استخدم فى الدراسة عدد ٣٠ ارنب نيوزيلاندى نامى عمر شهر بمتوسط وزن ٧٥٠ جرام ± ٥٠ جرامتم تقسيمهم الى ٥ مجموعات متساوية وتم تربيتهم تحت ظروف متشابهة وذلك لدراسة تأثير إستخدام مصاصة القصب كمصدر طبيعى للألياف وكمادة إدمصاصية للأفلاتوكين او التلوث الطبيعى فى علائق الأرانب وتقدير اداء النمو للأرانب .
وكانت النتائج المحصل عليها هى سجلت المجموعة المغذاة على ٦% مصاصة قصب فقط احسن نمو تلتها المجموعة المغذاة على ٦% مصاصة قصب +الجرعة الضعيفة من الافلاتوكسين (٧٥ جزء فى البليون)- سجلت المجموعة الخامسة (التى تغزت على٦ % مصاصة قصب +الجرعة الضعيفة من الافلاتوكسين – معنويا أعلى قيمة زيادة كلية فى الوزن .
اوضحت النتائج هن المجموعة الخامسة المغذاة على ٦% مصاصة قصب +الجرعة الضعيفة من الافلاتوكسين (٧٥ جزء فى البليون) استهلكت بصورة معنوية كمية علف كلية اقل من الكنترول وباقى المجموعات التجريبية .
اوضحت النتائج انة لا يوجد اختلافات معنوية فى معامل التحويل الغذائى بين المجموعات التجريبية .

أظهرت النتائج المعملية ان قدرة مصاصة القصب بنسبة ٦% على الأدمصاص تراوحت من ٩٧,١٠ الى ٩٨,١ % عند ٣ ساعات للتركيز المنخفض من الأفلاتوكسين الكلية بينما سجل مستوى ٣% اقل مستوى .
توصى الدراسة بأن استخدام ٦% مصاصة قصب حسن اداء نمو الأرانب النامية وأيضاً حسن درجة الأدمصاص للأفلاتوكسينات الكلية التى تتواجد بتركيزات منخفضة فى العليقة .

INTRODUCTION

Aflatoxins are a group of secondary fungal metabolites – also known as mycotoxins – which are produced by fungi of the *Aspergillus* genus, particularly *A. flavus* (**Saladino *et al*. 2016**). Aflatoxin B1, is the most commonly occurring and potent of the aflatoxins is associated with a specific AGG to AGT amino acid Trans version mutation at codon 249 of the p53 gene in human HCC, providing mechanistic support to a causal link between exposure and disease **(Wu and Khlangwiset, 2010)**. Evidence of acute aflatoxicosis in humans has been reported worldwide especially in the third world countries like Taiwan, Uganda, India, Kenya and many others **(USAID, 2012).** Various strains isolated of fungi can produce AFs such as *A. flavus, A. parasiticus, A. oryzae, A. tamari, A. flavus Var. columnaris* and *A. parasiticus Var. globosus* **(Raper and Fennell, 1965).** Cereal grains, such as wheat and rice, in general, appear to be a good substrate for toxin production than the oilseeds such as cottonseed, soybean and peanuts **(Diener and Davis, 1968).** The fungi, which produce AFs, can be grouped into three classes according to their moisture requirements. The first class contains the field fungi, which need 22-25% moisture. The second includes storage fungi, which need 13-18% moisture and the third, which is the advanced decay fungi, require over 18% moisture **(Christensen, 1965).**Mycotoxins destroy the tissues by oxidizing proteins and most of them have immunosuppressive effects **(Kumar *et al.*, 2008).** Rabbits are highly susceptible to aflatoxins which are produced by *Aspergillus* molds. The median lethal dose (LD50) of aflatoxin B1 (AFB1) in rabbits was determined as a single oral dose of 300 mg/kg bodyweight (BW) **(Cardona *et al.*, 1991).** However AFB1 as low as 15 mg/kg feed caused high levels of morbidity and mortality **(Makkar and Singh, 1991).**Aflatoxins have been reported to cause liver cirrhosis as well as liver cancers **(USAID, 2012 & Thrasher, 2012)** Aflatoxins have also been reported to cause serious acute effects on the GIT **(Gursoy *et al.*, 2008).** World sugarcane production was estimated to be around1.91 Gt in 2013, about 0.77 Gt produced in Brazil alone, with an average productivity of 75 t ha_1 .During the harvest of sugarcane, the leaves and tops are left infield, whereas the stalks are transported to the mill where they are crushed to extract the sugar juice for the production of sugar and ethanol. Two major residues are produced by the sugarcane industry, the fibrous fraction following juice extraction (named bagasse), and the harvest residue (straw). These wastes are produced in large quantities, about 280 million metric tons of bagasse and straw per year, and they are expected to increase in the near future as this crop expands and new industrial plants are brought online **(José *et al.*, 2015).** Processed bagasse is added to human food as sugar cane fiber. It is a soluble fiber but can help promote intestinal regularity. One animal study suggests that sugar cane fiber combined with a high fat diet may help control type 2 diabetes. Bagasse is a good source of lignoceric and cerotic acids **(Kamal G. Nath., 2011).** On the dry weight basis, bagasse is primarily composed of cellulose (40-50%), hemicellulose (30-35%), and lignin (20-30%) (**Amin, 2011).** In Egypt, there is a wide gap between animal requirements and the available feedstuffs. Also, the rapid increase in the cost of animal protein source has get now an urgent need to increase livestock .This brings the rabbits into focus, as it forms a very important aspect of livelihood for socio economic reasons. Rabbit production has been noted to be one of the best means of alleviating the prevailing low animal protein consumption in developing countries due to certain characteristic of rabbits and rabbit meat **(Maidala and Istifanus, 2012).** The immune system consists of two main components: cellular and humoral. The immunoglobulin's or/and antibodies of humoral immunity are mainly concentrated on gamma globulins which are serum proteins with c mobility in electrophoresis **(Hegazy and El-Faramawy (2001).**

MATERIALS AND METHODS

The present experiment was carried out at farm of Sustainable Development Department, Environmental Studies and Research Institute, University of Sadat City, Menufiya governorate, Egypt during January to March, 2017. The laboratory work was done and Regional Center for food and feeds, Agriculture Research Center. The objective of this research is to determine the effect of feeding dietary bagasse as a source of natural dietary fiber ingredient and to adsorbent for aflatoxins or natural contamination in rabbit diets and to evaluate recent information of using dietary bagasse on growth performance of growing New Zealand White rabbits.

All chemicals were of analytical grade. Chemicals and Solvent were purchased from Merck (Darmstadt, Germany). *Aspergillus flavus* NRRL (3145) was obtained from the National Research Center (Dokki , Giza). St. Aflatoxins (B1, B_2, G_1 and G_2) were obtained from Sigma Chemical Company (St Louis, MO, USA).

Fungal growth Inoculum was prepared by incubating Potato Dextrose Agar (PDA) slant tubes (1.5x15 cm) inoculated with *A. flavus* spores for 7 to 21 days at 28 ºC. Spores of 10-day old (*A. flavus* culture) were scrapped loose with a loop after adding 3 ml sterile distilled water to each slant (***Shotwell et al., 1966).*** The Spores scraped by adding sterile distilled water to the surface growth on agar slant and an aliquot amount from the resulting spore suspension (1ml) added to conical flasks (2liters) containing yeast extract media. Mycelial mats after 10-day incubation at 30ºC were broken with a glass rod and collected by filtration through filter paper. Culture filtrates **(mother solution)** were extracted with chloroform (1:2, v/v).

Bagasse was obtained from local juice stores. Oven drying was done in a cabinet oven with air circulation at 60 C^{o} overnight whereas dried bagasse was milled by laboratory mill to pass a 2.0 mm-size mish pares to produce bagasse powder **(Kamal *et al*., 2014)**

Table (1) proximate composition of bagasse used for preparation of dietary fiber

Items	Proximate analysis (g/100 g dry matter)
Protein	**2.1**
Fiber	**34.4**

Ash	**1.38**
Cellulose	**37.08**
Hemicelluloses	**21.25**
Lignin	**6.42**
Silica	**1.0**
NDF	**65.97**
ADF	**44.72**
ADL	**7.64**

Animals, housing and experimental design

The study involved 30 males growing White New Zealand (WNZ) rabbits of Aged 4 weeks with initial mean weight (750±50g). Animals were divided into nine equal groups as shown in table (2). The study lasted two months period All animals were individually housed in galvanized wire cages (50 x 55 x 39 cm) provided with a feeder and automatic nipple drinker, and were kept under the same managerial conditions and all animals were weighed weekly.

Table (2). The experimental design used *in vitro* experiment

(T1)	Basal diet
(T2)	Received basal Diet supplemented with bagasse at level 3%
(T3)	Received basal Diet supplemented with bagasse at level 6%
(T4)	low dose of AFs+ bagasse at level 3%
(T5)	low dose of AFs+ bagasse at level 6%

Table (3). Composition of ingredient feed rations for control and treated groups.

Ingredients	**Control**	**T_2**	**T_3**
Alfa alfa	**25.0**	**23.0**	**20.0**
Wheat bran	**26.0**	**26.0**	**25.0**
Barley grains ,Ground	**20.0**	**20.0**	**20.0**
Soybean meal (44% CP)	**13.5**	**14.0**	**15.0**
Yellow corn, ground	**10.0**	**10.0**	**10.0**
Wheat straw	**1.5**	**-**	**-**
L- Methionine	**0.35**	**0.35**	**0.35**
Line stone	**0.9**	**0.9**	**0.9**
Di calcium phosphate	**1.9**	**1.9**	**0.35**
Premix*	**0.50**	**0.50**	**0.50**
Na Cl	**0.35**	**0.35**	**0.35**
Bagasse	**0.0**	**3.0**	**6.0**
Total (kg)	**100**	**100**	**100**
Calculated values**			

Crude protein %	**17.11**	**17.24**	**16.927**
ME, kcal/kg diet	**2520**	**2513**	**2490**
Crude fiber %	**11.965**	**11.59**	**12.139**
Ether extract %	**2.544**	**2.490**	**2.405**
Calcium %	**1.173**	**1.147**	**1.109**
Available phosphorus	**0.355**	**0.355**	**0.355**
Lysine %	**0.866**	**0.865**	**0.864**
Methionine	**0.599**	**0.599**	**0.596**
Cost/kg of diet in L.E. * **	**2.73**	**2.38**	**2.31**

*The premix (Vit. & Min.) was added at a rate of 3 kg per ton of diet and supplied the following per kg of diet (as mg or I.U. per kg of diet): Vit. A 12000 I.U., Vit. D3 2000 I.U., Vit. E 40 mg, Vit. K3 4 mg, Vit. B1 3 mg, Vit. B2 6 mg, Vit. B6 4 mg, Vit. B12 0.03 mg, Niacine 30 mg, Biotine 0.08 mg, Pantothenic Acid 12 mg, Folic acid 1.5 mg, Choline chloride 700 mg, Mn 80 mg, Cu 10 mg, Se 0.2 mg, I 40 mg, Fe 40 mg, Zn 70 mg and Co 0.25mg.

According to **Feed Composition Tables for animal & poultry feedstuffs used in Egypt (2001) and NRC (1994).

***According to market prices of the year 2017.

Live body weight (LBW): Individual body weight was taken weekly to the nearest ± 2.0 g by digital weighing scale (Mettler Toledo, Top Pan Sensitive Balance, J. Liang Int. Ltd. U.K.). The measurements were taken while the animals were held in a standing position.

Live body weight gain (LBWG) Individual LBWG for each rabbit was calculated at 2, 4,6,8,10 and 12 of experimental period by subtracting the initial LBW of a certain period from the final LBW of the same period, as follows:- $LBWG = W_2 - W_1$

Where: W_1 = LBW at the onset of a certain period.

W_2 = LBW at the end of the same period.

3.13.4. Feed intake (FI): Feed intake for each replicate under each treatment was weekly calculated, on a group basis, by subtracting the residual feed from the offered one. Average daily feed intake per rabbit was then calculated by using the following equations:

$$FI/rabbit/day = \frac{FI\ /\ replicate/week}{\text{No. of rabbits consumed feed daily during the week period}}$$

. Feed conversion ratio (FCR): Feed conversion ratio (FCR) (using the weight of mortality to correct FI data) weekly and whole experimental period was calculated for each replicate under each treatment and calculated as kg of feed used for producing one kg of body weight gain as follows:

FCR =Average feed intake (kg) per rabbit / body weight gain (kg) per rabbit.

4. RESULTS AND DISCUSSIONS.

4.1. Live body weight (LBW) (g) .

Live body weight (LBW) (g) of growing rabbits as affected by different levels of dietary bagasse are presented in Table (4) fig (1). No significant differences were detected in the experimental groups initial LBW which ranged between (745.83g) ($T_1$and T_3) to (775.0g) (T_5). The results during experimental period showed insignificant differences among the experimental groups. At the final of experimental period, LBW of tested rabbit groups cleared insignificant differences where, group fed basal diet supplemented with bagasse at level 6% (T_3,) recorded the best LBW(**2279.2**g) followed by Group fed diet supplemented low dose of AFs+ bagasse at level 6% **(T_5)** being (**2177.5 g)** ,meanwhile, group fed basal diet (control) (**T_1**)

Groups		bagasse		Low aflatoxin dose		Sig
		3%	6%	3% bagasse	6% bagasse	

was the worst one being (**2087** g) . These results were in agreement with those obtained by **Esmail *et al*., (2016)** who indicated that final body weight and feed intake of rabbits increased with increasing sugarcane bagasse levels. Also , **Maidala *et al*., (2016)** concluded that sugarcane bagasse can be used as a source of fibre in the diets of growing rabbits without deleterious effect with reduction in cost of production.

In this connection, **Harriet (2003**) reported that aflatoxins have been reported to cause digestive system effects such as diarrhea, vomiting, intestinal hemorrhage, and liver necrosis and fibrosis which may be causes LBW reduction**.**

Table 4. **Live body weight (LBW) (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb) .**

Parameters	T_1	T_2	T_3	T_4	T_5	
I.W.(g)	745.83±35.62	767.5±35.62	745.83±35.62	760±35.62	775±35.62	NS
LBW2	1130± 44	1123.33±44	1112.5±44	1081.67±44	1176.67±44	NS
LBW 4	1710± 77.57	1651.7±77.57	1558.3±77.57	1546.7±77.57	1600±77.57	NS
LBW 6	1982.5±97.15	1973.3±97.15	1994.2±97.15	1847.5±97.15	1971.7±97.15	NS
LBW 8	2087±118.38	2156.7±108.07	2279.2±108.07	2146±118.38	2177.5±108.07	NS
TLBW	2087±118.38	2156.7±108.07	2279.2±108.07	2146±118.38	2177.5±108.07	NS

T1= Basal diet ; T2 = basal Diet supplemented with bagasse at level 3%, T3 = basal Diet supplemented with bagasse at level 6% ; T4: low dose of AFs+ bagasse at level 3% ; T5: low dose of AFs+ bagasse at level 6% ;
I W.(g) : Initial weight (g) ; LBW2: Live body weight after 2 weeks of experimental period ; LBW4: Live body weight after 4 weeks of experimental period ; LBW6 : Live body weight after 6 weeks of experimental period ; LBW8: Live body weight after 8 weeks of experimental period ; TLBW: Total Live body weight the experimental period . NS = not significant SE= standard error

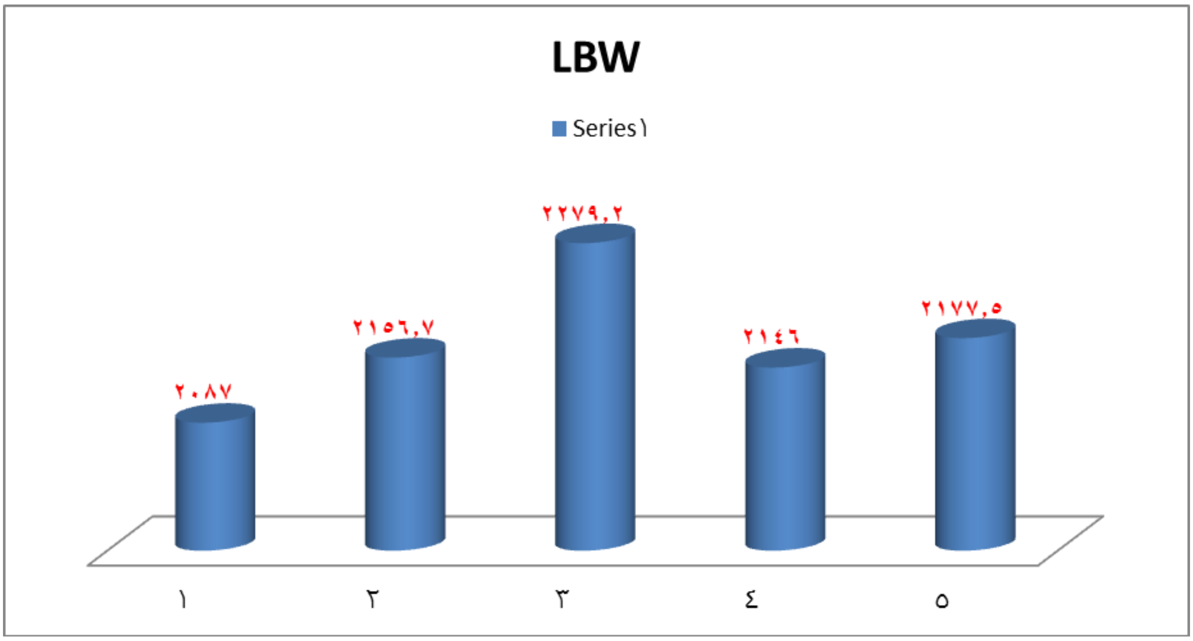

Fig. (1) Total live body weight (TLBW) (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb)

4.2. Live body weight gain (LBWG) (g):

Live body weight gain (LBWG) (g) of growing rabbits as affected by different levels of dietary bagasse are illustrated in Table (5) and fig.(2). Data of LBWG (g) after the second week cleared that group fed dietary bagasse at level 6% and low dose of AFs (75.0ppb) (T_5) achieved significantly ($P<0.05$) the highest (LBWG) value (219.17g) meanwhile , group fed dietary bagasse at level 3% and low dose of AFs (75.0ppb) (T_4) recorded the lowest one (130).

In this concern , **Maidala *et al.*, (2016)** reported that the rabbit is also a very

Groups / Parameters	Control	Treatment				Sig.
		bagasse		Low aflatoxin dose(75.0ppb)		
		3%	6%	3% bagasse	6% bagasse	
	T_1	T_2	T_3	T_4	T_5	
LBWG 2	$205^{ab}\pm21.12$	$170^{abc}\pm21.12$	$164.17^{abc}\pm21.12$	$130^{c}\pm21.12$	$219.17^{a}\pm21.12$	*
LBWG 4	$249.17^{a}\pm28.8$	$240.83^{a}\pm28.79$	$193.33^{a}\pm28.79$	$177.5^{a}\pm28.79$	$172.5^{a}\pm28.79$	*
LBWG 6	$110.83^{b}\pm35.5$	$158.33^{b}\pm35.51$	$155.83^{b}\pm35.51$	$200.83^{ab}\pm35.5$	$280.83^{a}\pm35.51$	*
LBWG	$44^{c}\pm22.65$	$45^{bc}\pm20.68$	$85^{abc}\pm20.68$	$137^{a}\pm22.65$	$26.67^{c}\pm20.6$	*

efficient converter of feed to animal protein and the meat is very nutritious, easily digested, extremely low in cholesterol and sodium and contains more protein and less fat, when compared to various other meats. The advantages projected include the high reproductive rate, rapid maturity, high genetic potential, efficient feed utilization, limited competition with humans for food and high quality nutritious meat

Table 6. Live body weight gain (LBWG) (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb) .

8					**8**	
TG	**1334±115.24**	**1389.1^{a}±105.2**	**1533.33±105.2**	**1398±115.24**	**1402.^{a}±105.2**	*

a, b …….c values within a row with different superscripts significantly different (p<0.05).

* = p < 0.05 NS = not significant SE= standard error **T_1**= Basal diet ;; **T_2** = basal Diet supplemented with bagasse at level 3%, **T_3** = basal Diet supplemented with bagasse at level 6% ; **T_4**: low dose of AFs+ bagasse at level 3% ; **T_5**: low dose of AFs+ bagasse at level 6% ; **LBWG 2**: Live body weight gain after 2 weeks of experimental period ; **LBW4**: Live body weight gain after 4 weeks of experimental period ; **LBW6 :** Live body weight gain after 6 weeks of experimental period ; **LBWG8:** Live body weight gain after 8 weeks of experimental period ; **TG**: Total Live body weight gain the experimental period .

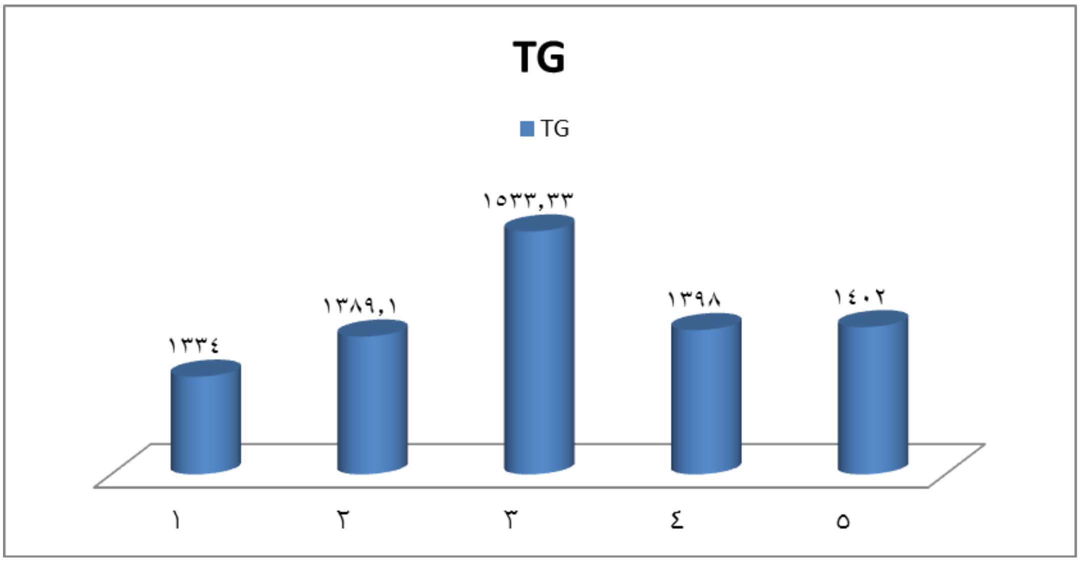

Fig. (2) Total live body weight gain (TLBWG) (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb)

Feed intake (FI) (g)

Results feed intake (g) (FI) of growing rabbits as affected by different levels of dietary bagasse are presented in Table (7) fig (3) . Data indicated that Rabbit groups fed Basal diet ; 3% bagasse and 3% bagasse with Low aflatoxin dose (75.0ppb) significantly P<0.05 consumed more feed than Rabbit groups fed 6% bagasse or 6% bagasse with Low aflatoxin dose (75.0ppb) after two ;4 and 6weeks of experimental period (Table 7) . After 8 weeks of experimental period, rabbit groups fed 3 or 6% bagasse and groups fed 3or 6 % bagasse with Low aflatoxin dose (75.0ppb) significantly (P<0.05) consumed more feed than control group. Meanwhile, total feed intake showed that rabbit groups fed 6% bagasse and groups fed 6 % bagasse with Low aflatoxin dose (75.0ppb) significantly (P<0.05) consumed feed less than control and other experimental groups. These results are agree with those obtained by **Ismail *et al*., (2016)** who indicated that final body weight and feed intake of rabbits increased with increasing sugarcane bagasse levels. The highest performance index could be observed with rabbits fed (sugarcane bagasse replace to 50% berseem hay) diet and control diets (0% sugarcane bagasse). Also, **Guilherme *et al*., (2015)** stated that sugarcane bagasse is a very promising raw material for the production of glucose, xylose, ethanol and methane.

Table 7. Feed intake (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb).

a, b ……. values within a row with different superscripts significantly different (p<0.05).

* = p < 0.05 NS = not significant SE= standard error **T_1**= Basal diet ; **T_2** = basal Diet supplemented with bagasse at level 3%, **T_3** = basal Diet supplemented with bagasse at level 6% ; **T_4**: low dose of AFs+ bagasse at level 3% ; **T_5**: low dose of AFs+ bagasse at level 6% ; **FI2**: Feed Intake after 2 weeks of experimental period ; **FI4**: Feed Intake after 4 weeks of experimental period ; **FI6 :** Feed Intake after 6 weeks of experimental period ; **FI8:** Feed Intake after 8 weeks of experimental period ; **TFI**: Total Feed Intake of experimental period .

Groups / Parameters	Basal diet	Treatments				Sig.
		bagasse		Low aflatoxin dose		
		3%	6%	3% bagasse	6% bagasse	
	T1	T2	T3	T4	T5	
FI2	$536.67^{a}\pm23.2$	$535^{a}\pm23.2$	$499.17^{ab}\pm23.2$	$551.67^{a}\pm23.2$	$504.17^{ab}\pm23.2$	*
FI4	$979.17^{a}\pm87.24$	$852.5^{ab}\pm87.24$	$852.5^{ab}\pm87.24$	$684.17^{b}\pm87.2$	$760.83^{ab}\pm87.24$	*
FI6	$702.5^{b}\pm65.31$	$837.5^{ab}\pm65.31$	$909.17^{ab}\pm65.31$	$790^{ab}\pm65.31$	$889.17^{ab}\pm65.31$	*
FI8	$139.38^{b}\pm31.04$	$240^{a}\pm25.34$	$285^{a}\pm27.76$	$300^{a}\pm27.76$	$240^{a}\pm25.34$	*
TFI	5147.88±355.99	5277.5±290.67	5285±318.41	4951.5±318.4	5135.83±290.7	NS

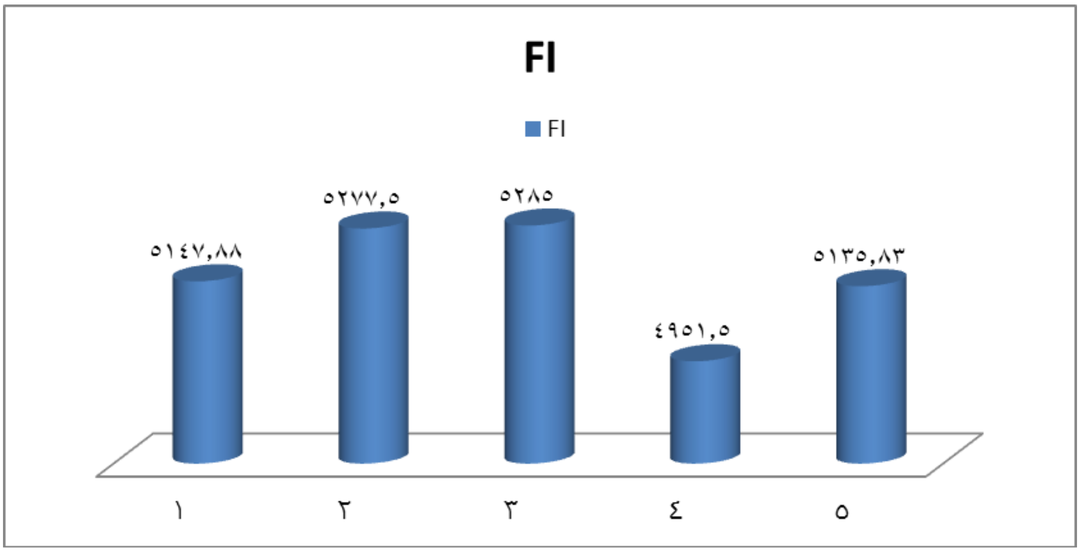

Fig. (3) Feed intake (g) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb).

Feed conversion ratio (FCR) (g)

Results of feed conversion ratio (FCR) of growing rabbits as affected by different levels of dietary bagasse and aflatoxin doses are presented in Table (8) and fig (4). After two weeks of experiment, the better FCR value was significantly ($p<0.05$) detected with rabbit group fed 6% bagasse with low aflatoxin dose (75.0ppb) being (2.38) compared to control and other experimental groups. No significant differences ($p<0.05$) were found among FCR_6 and TFCR .these results means that different levels of dietary bagasse up to 3 % adsorb the low aflatoxin dose (75.0ppb) and improved feed efficiency . These results are in agreement with those obtained by **Ismail *et al.*, (2016)** who indicated that final body weight and feed intake of rabbits increased with increasing sugarcane bagasse levels. The highest performance index could be observed with rabbits fed (sugarcane bagasse replace to 50% berseem hay) diet and control diets (0% sugarcane bagasse).

Sugarcane bagasse is principally composed of cellulose, hemi-cellulose and lignin (about 40% , 34% and 20% respectively on dry wright basis) **(Garg *et al* ,. 2004) .** Cellulose is a crystalline homo – polymer of glucose with p-4 glycosidic linkage and intermolecular hydrogen bonds. Hemicelluloses is a heteropolymer of mainly xylose with p-4 linkage with other substances of acetyl feruoyl and glycouronyl groups.

Lignin is a polyhydroxy compound. It offer a numbers of hydroxyl sites for binding **(Abo Haggar, 2006**).

Groups / Parameters	Basal diet	Treatments				Sig.
		bagasse		Low aflatoxin dose		
		3%	6%	3% bagasse	6% bagasse	
	T1	T2	T3	T4	T5	
FCR2	**$2.74^{b}\pm0.52$**	**$3.5^{ab}\pm0.52$**	**$3.56^{ab}\pm0.52$**	**$4.61^{a}\pm0.52$**	**$2.38^{b}\pm0.52$**	*
FCR4	**$4.01^{ab}\pm0.57$**	**$3.58^{ab}\pm0.57$**	**$4.91^{ab}\pm0.57$**	**$3.75^{ab}\pm0.57$**	**$5.14^{a}\pm0.57$**	*
FCR6	**7.27±2.09**	**8.95±2.09**	**8.17±2.09**	**6.88±2.09**	**3.29±2.09**	**NS**
FCR8	**$4.37^{b}\pm2.12$**	**$11.54^{a}\pm1.73$**	**$3.05^{b}\pm2.12$**	**$2.51^{b}\pm2.12$**	**$8.75^{ab}\pm1.91$**	*
TFCR	**3.22±1.12**	**3.84±0.92**	**3.42±1.12**	**3.6±1.0**	**6.19±0.92**	**NS**

Table 8. Feed conversion ratio (FCR) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb).

a …….b values within a row with different superscripts significantly different (p<0.05).

* = p < 0.05 NS = not significant SE= standard error **T_1**= Basal diet ; **T_2** = basal Diet supplemented with bagasse at level 3%, **T_3** = basal Diet supplemented with bagasse at level 6% ; **T_4**: low dose of AFs+ bagasse at level 3% ; **T_5**: low dose of AFs+ bagasse at level 6% ; **FCR2**: Feed Conversion ratio after 2 weeks of experimental period ; **FCR4**: Feed Conversion ratio after 4 weeks of experimental period ; **FCR6**: Feed Conversion ratio after 6 weeks of experimental period ; **FCR2**: Feed Conversion ratio after 8 weeks of experimental period ; **TFCR**: Total Feed Conversion ratio of experimental period .

Con. Of AF(ppb)	**105.58**

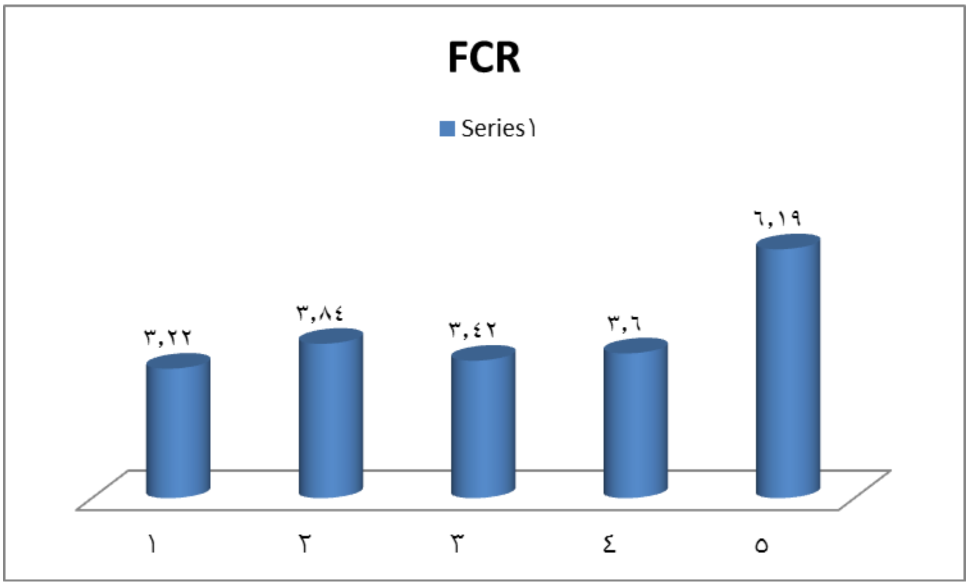

Fig. (3) Feed conversion ratio (FCR) as affected by different levels of dietary bagasse supplemented with Low aflatoxin dose (75.0ppb)

***In vitro* experiment: Adsorption of Aflatoxins by bagasse**

This study was conducted to determine the efficacy of bagasse and its ability to adsorb TAF , under the influence of several factors in cluding : adsorbent level (3and 6% w/v), contact time (shaking)1,2, and 3 hrs , TAF concentration (105.8 ppb) .

Table 9 . Concentration of remaining TAF Treated by bagasse as affected by different Treatment.

Treatment	Shaking		
Bagasse Addition W/V %	1hr	2hr	3hr
3	95.26	95.92	96.21
6	97.10	97.63	98.10

Table 10. Percent of bounding TAF using bagasse as affected by different Treatment.

Con. of. TAF(ppb)	105.58		
Treatment	Shaking		
Bagasse Addition W/V %	1hr	2hr	3hr
3	5.0[a]	4.3[ab]	4.0[ab]
6	3.1[ab]	2.5[b]	2.0[b]

The physical methods used for the removal of mycotoxins focused in using nutritionally inert sorbent in the diet that can sequester mycotoxins and reduce their adsorption from the gastrointestinal tract. The utilization of mycotoxins – binding adsorbent is the most applied way to protect animals against the harmful effects of contaminated feed. Sugarcane bagasse is principally composed of cellulose, hemi-cellulose and lignin (about 40% , 34% and 20% respectively on dry wright basis) **(Garg *et al* ,. 2004) .**

Cellulose is a crystalline homo – polymer of glucose with p-4 glycosidic linkage and intermolecular hydrogen bonds. Hemicelluloses is a heteropolymer of mainly xylose with p-4 linkage with other substances of acetyl feruoyl and glycouronyl groups. Lignin is a polyhydroxy compound. It offer a numbers of hydroxyl sites for binding **(Abo Haggar, 2006**).

Adsorption abilities ranged from 94.63-98.10 % the highest adsorption capacity was observed when using 6 % bagasse and 3 hr shaking time at low TAF concentration , while the lowest value of binding was obtained at level 3% bagasse and 1 hr shaking time and high TAF concentration.

These results almost in agreement with **Munagapati *et al.* (2018)** who concluded high ability of banana peel powder as an adsorbent to remove of anionic dyes from aqueous solution. They also concluded that the adsorption increase by increasing contact time. This is because banana peel has an irregular and porous surface which is adequate for adsorption. **Oyewo *et al.* (2016)** indicated that nanostructured banana peels is a potential adsorbent for the removal of radioactive substances from aqueous solution and also from real mine water. **Vekiru *et al.* (2015**) studied the *in vitro* binding assessment and *in vivo* efficacy of several adsorbents against aflatoxin B_1 and concluded the ability of adsorbents to ameliorate aflatoxin induced effects in poultry basically correlated with the *in vitro* findings.

Conclusions:

The study concluded that using dietary 6 % bagasse with Low aflatoxin dose (75.0ppb) in growing rabbit diets significantly improve growth performance and have Adsorption ability at low TAF concentration. ranged from 94.63-98.10 % the highest adsorption capacity was observed when using 6 % bagasse and 3 hr shaking time at low TAF concentration , while the lowest value of binding was obtained at level 3% bagasse and 1 hr shaking time and high TAF concentration.

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