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Effect of Toxin Binder on Productive Performance of Lactating Friesian Cows

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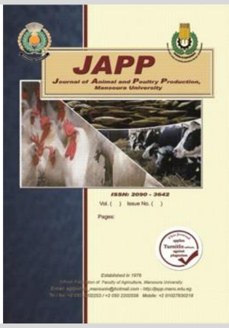

ABSTRACT

Twenty Friesian cows with an average weight of 540 ± 17.59 kg and running on 2nd to 5th lactating season were used at 60 days before calving and continued up to 120 days of lactation feeding trial to study the effect of toxin binder (bentonite and zeolite) on Productive Performance of Lactating Cows. Cows were randomly divided into four similar groups (n = 3). All cows were received basal rations (BR) that consists of concentrate feed mixture (CFM), corn silage (CS) and rice straw (RS). Group 1 received (BR) without supplement and served as control rations, whereas groups G2, G3 and G4 received control diet plus 2% Bentonite, 1% Bentonite plus 1% Zeolite or 2% Zeolite of DM intake as tested rations, respectively. Results showed that, supplemented groups were significant ($P<0.05$) higher intake of total DM, TDN and DCP than unsuplemented group. Also on the same trend, the concentrations of pH and TVFA's were increased significantly ($P<0.05$), while ammonia-N decreased significantly ($P<0.05$) in supplemented groups compared to G1. Group 2 recorded significantly ($P<0.05$) the highest concentrations of total protein, globulin, glucose and T3 and followed by G3 and G4, while G1 had the lowest values. While, albumin concentration decreased significantly ($P<0.05$) with bentonite and zeolite additives. While, the concentrations of creatinine, urea, total lipid and Ca as well as the activity of AST and ALT were nearly similar for the different groups. Yield of actual milk and 4% FCM were significantly ($P<0.05$) higher in G2 than those of G4 and G1, And no significant higher than G3 ration: G2 showed significantly ($P<0.05$) the highest contents of fat, protein, lactose, SNF and TS, while G1 had the lowest values. Ash content in milk was nearly similar for the different groups. Bentonite and zeolite supplementation improved feed conversion, and G2 recorded the best one. The difference were only significant between bentonite ration (G2) and the control one (G1). Group2 recorded the highest daily feed cost, output of 4% FCM yield, net revenue and economic efficiency followed by G3 and G4, while G1 had the lowest feed cost, net revenue and economic efficiency, while feed cost per one kg 4% FCM was lower significantly ($P<0.05$) with G2 followed by G3 and G4, while G1 had the highest value. In conclusion, bentonite supplement for lactating Friesian cows at the level of 2% of DM intake as toxin binder had the best positive effect on digestibility, rumen fermentation, some blood parameters, feed intake, milk yield and composition, feed conversion and economic efficiency, comparison with other supplemented rations and the control one (unsupplemented).

Keywords: Toxin Binder, cows, digestibility, rumen and blood parameters, Productive Performance and economic efficiency.

INTRODUCTION

Aflatoxins are produceing by different kinds of moulds that are found naturally in 20 to 30% of feeds globally (Streit *et al.*2013) and they have been caused many side effect as hepatotoxic, carcinogenic and immunosuppressive which produced by strains of *Aspergillus flavus*. Aflatoxins have 6 forms in which feed has type B1 that transforms to type M1 in milk by hydroxylated some metabolites (Creppy, 2002). Aflatoxins are rapidly absorbed from the gastrointestinal tract then effecting on reproductive system and remain unexplained (Bastaki *et al.* 2010). Contamination of animal feed with fungi and their toxins leads to negative impact on them as low rates of growth, disease then death, in addition to loss amounts of money to prevent and solving this problem (Wagacha, and Muthomi, (2008). Aflatoxins reduce milk production, decrease milk quality and feed efficiency and daily gain in beef cows, Moreover, compromised immune and ruminal functions and Liver malfunctions (Hashimoto *et al.* 2016). Bentonite clay is one of the main adsorbent materials in Egypt used to improve feed intake, digestibility of nutrients and daily gain of growing lambs (Salem *et al.* 2001). Bentonite includes layers in its structure and rich in mineral compositions that enhance to absorbance toxic molecules by gut cells (Eckhardt *et al.* 2014, Yarmots, 2014). Bentonite clay act as a reservoir and regulator of ammonia concentration in the rumen and consequently prevented ammonia toxicity and improved urea utilization from solution when concentrate is high and releases it back when concentrate low. So, the additive of bentonite to the daily Rahmani sheep and Zaraibi goats diets increase the nitrogen available to the rumen rumen microflora (Abd El-Baki *et al.* 1995, Bartos *et al.* 1982). All clays as bentonite have high cation exchange capacity without fundamental changes in structure (Kalivoda, 1987). Bentonite is a commonly used natural clay for livestock diets because it improves nutrients (Pulatov *et al.* 1983, Salem *et al.* 1999). Deng *et al.* (2010) pointed that clays contains chemical bonds linked to the active sites of

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type B of affaltoxin. Eckhardt *et al*. (2014) displayed that clays successfully adsorbed AFB1 in the gastrointestinal tract. The additives of Bentonite were safety for feeding livestock as 20 mg/Kg intake DM for all animal species (EFSA, 2013). On the other hand, Mesgaran (2005) showed that addition of 350 g bentonite/cow/day to the low forage diet slightly improved the **production** performance specially milk yield of Holstein cows. Katsoulos *et al*. (2006) found that when cows fed on concentrate ration supplemented with 1.25% clinoptilolite could be produced higher total milk yield than unsupplemented diets. The same trend was formed by Abd ElBaki *et al*. (2009) and Helal and Abd El- Rahman (2010) when supplemented bentonite to lactating buffalos and sheep, respectively. More recently, Sulzberger *et al*. (2016) pointed that when dairy cows fed on TMR with high grain challenge and supplemented with 0.5, 1 and 2% clay (on DM basis) milk yield tended to increase than the unsupplemented once. Mesgaran (2005) found that the addition of 305g sodium bentonite/cow/day to the low forage diet slightly enhanced milk yield of Holstein cows. Abd El-Baki *et al*. (2001) studied the effect of clays on animal nutrition and some physiological blood parameters. Lambs received pelleted complete feed formulated with 2% urea plus 3% tafla, 2.5% urea plus 3% tafla and the control diet without urea and tafla. Lambs fed urea plus tafla were higher ($p<0.01$) heamotogoical parameters, blood glucose and lower urea -N, and GPT than control one (unsupplemented with tafla).

Mainly zeolites consists of alumino and silicates (Jha, and Singh, 2016) and many positive effects are occurred as removing harmful toxic materials like heavy metals, ammonia and other small molecules in gastrointestinal tract (Kraljevic *et al*. 2017). Zeolite materials classified to two different materials, natural zeolite (clinoptilolite) and synthetic zeolite (NaP1). Zeolite kinds are used in many fields as animal feed and detergent industry (Durali and Tulay, 2011). Biological characteristics of zeolite such as ion exchange capacity, adsorption and related molecular sieve. Zeolites can be affecte on cow physiological reproductive state, ration structure and gastrointestinal pH becuse of including minerals as iron, calcium, phosphorus, magnesium, sodium, zinc, and manganese with suitble levels. (Bosi *et al*. 2002). Inglethorpe *et al*. (1993) shown that zeolites can be used as binding agents in animal feeds, acting as a buffer in the animals digestive system, storing nitrogen in the form of ammonium and releasing it gradually by ion exchange with sodium and potassium. Also, such as supplement could be taking up the rumen ammonia and releasing it be slow mannering which allowed rumen microorganisms to synthesize cellular protein continuously for easy assimilation into the digestive system of animals (Rizzi *et al*. 2003 and Mumpton & Fishman 1977). Positive effect of combined feed with zeolite on digestibility of nutrients, balance of nitrogen, calcium and phosphorous was explored by many investigitions. Moreover, zeolite is commonly used in dairy cow rations to reduce the impact of mycotoxins in the feed and negative impact of mold produced toxins in animal feeds (Kirolove *et al*. 1993). Many positive effects are occurred as removing harmful toxic materials like heavy metals, ammonia and other small molecules in gastrointestinal tract (Kraljevic *et al*. 2017), So that it considerably used in animal feeds as a pellet binder for improving ammonia utilization and reduce toxins, heavy metals and metabolic disorders (Bechtel and Hutchenson, 2003). Moreover, Zeolites are utilized for a large range to protect from symptoms of diiarrhea and milk fever (Papaioannou *et al*. 2005). Zeolite improves metabolism and prevents some metabolic diseases which reduces the risk of hypocalcaemia (Katsoulos *et al*. 2005). On applicable scale, Karmoun *et al*. (2011) fed cows on 100 or 200 g zeolite through forage mixture for five weeks, and found that Milk protein, lactose and solid not fat were significantly high in cows fed zeolite at the rate of 200 g.

The aim of this study is to determine the effect of betonies and zeolite additives on digestibility, rumen fermentation activity, blood serum biochemical, feed intake, milk yield and composition, feed conversion and economic efficiency of lactating Friesian cows.

MATERIALS AND METHODS

This study was completed during 2018 at El-Karada Experimental Station, Kafr El-sheikh province that belonging to the Animal Production Research Institute (APRI), Agriculture Research Center, Egypt.

Animals and experimental groups

Twenty Friesian cows with an average weight of 540 ± 17.59 kg and in 2nd to 5th lactation season were used in a feeding trial started at 60 days before calving and continued up to 120 milking days. Cows were randomly divided into four similar groups (5 cows in each group). All groups were received basal ration (BR) that consists of concentrate feed mixture (CFM), corn silage (CS) and rice straw (RS). Group 1 received (BR) without supplement and served as control, whereas groups 2, 3 and 4 received control diet plus 2% bentonite, 1%bentonite plus 1% ziolite or 2%ziolite of DM intake, respectively. Supplements of each dietary treatment group was well mixed with the CFM immediately before feeding. Animals were housed under semi-open shed. Chemical analysis of CFM, CS, RS and experimental ration (40% concentrate feed mixture (CFM), 35% corn silage (CS) and 25% rice straw (RS)) are shown in (Table, 1). The CFM consisted of 27% wheat bran, 41 % yellow corn, 26% uncorticated cotton seed meal, 4% molasses, 1.5% premix and 0.5% common salt.

Management procedure

Cows in all groups were individually fed the experimental rations based on body weight, milk yield and fat percentage according to (NRC, 1988). Amount of feeds were adjusted biweekly based on milk yield. Concentrate feed mixture was offered in two equal parts daily at 8 a.m. and 4 p.m. while corn silage and rice straw were offered in two equal parts daily at 10 a.m. and 3 p.m.. Water was individually offered three time daily.

Digestibility trials

Digestion trials were completed at the end of the feeding experimental period using all cows in each group to determine the digestion coefficients and feeding values of the experimental rations using acid insoluble ash (AIA) as a natural marker (Van Keulen and Young, 1977). Feces samples were taken from the rectum of each cow twice daily at 12 h intervals during the collection period. Samples of feedstuffs were taken at the beginning, middle and end of the collection period. Representative samples of feedstuffs and faces were chemically analyzed according to the methods of AOAC (2012). Digestions coefficients were calculated from the equations stated by Schneider and Flatt (1975).

Table 1. Chemical composition of feedstuffs and experimental rations.

Items	DM %	Composition of DM %					
		OM	CP	CF	EE	NFE	Ash
Feedstuffs							
CFM	90.76	92.33	16.58	12.68	3.07	60.00	7.67
CS	28.42	93.91	8.64	23.61	2.45	59.21	6.09
RS	91.15	83.59	2.56	31.79	1.09	48.15	16.41
Experimental rations							
G1	53.18	89.64	8.89	23.20	2.15	55.40	10.36
G2	55.56	89.92	9.70	22.11	2.24	55.87	10.08
G3	55.09	89.87	9.54	22.31	2.22	55.80	10.13
G4	54.69	89.82	9.40	22.49	2.21	55.72	10.18

Rumen liquor samples

At the end of each digestibility trial period, rumen fluid samples were taken from cows using stomach tube at 3 hours post morning feeding. Samples were filtered through 3 layers of gauze without squeezing and immediately subjected to the determination of pH value by pH meter. Ammonia nitrogen (NH3-N) concentration was measured according to Conway (1957) and total volatile fatty acids (TVFA's) according to the technique described by Warner (1964).

Blood samples

Blood samples were taken from the jugular vein of each cow by clean sterile needle in a clean dry plastic tube after 3 hours from the morning feeding. Samples left in room temperature for 2 hours to coagulate and then centrifuged at 3000 rpm for 15 min to separate serum and stored at -20 oC until analysis for total protein, albumin, globulin, urea, creatinine, total lipids, cholesterol, glucose, AST, ALT and T3 using kits and the methods reported by biochemistry (Bio merieux) laboratory reagents and products.

Milk yield and samples

Milk yield was measured after the calves were allowed to suckle their dams colostrum for the first four days. Cows were milked by milking machine twice daily at 6 a.m. and 5 p.m. After each milking, milk was weighed on certain day biweekly for all lactation periods. Milk samples of each animal were collected and mixed proportionally from morning and evening milking, where they take during mid-lactation period for the determination of milk composition.

Feed conversion ratio

Feed conversion ratio was determined as the amounts of DM, TDN and DCP required for producing 1 kg 4% FCM.

Economic efficiency

Economic efficiency was calculated as the ratio between the price of produced 4% FCM and the cost of feed consumed. The prices in Egyptian pound (LE) per ton were 4850 for CFM, 620 for CS and 650 for RS, 1920 for Bentonite, 5600 for Zeolite and 5.50 LE/Kg 4% FCM produced according to the prices of year 2018.

Statistical analysis

The data were analyzed using general linear models (GLM) procedure adapted by IBM SPSS Statistics (2014) for user's guide with one-way ANOVA. Significant differences in the mean values among dietary treatments were analyzed by Duncan's tests within SPSS program set at the level of significance P<0.05 (Duncan, 1955).

RESULTS AND DISCUSSION

Feed Intake, Nutrient digestibility and feeding values:

Data in Table (2) showing feed intake of cows during the experimental period for the different groups. Whereas the CFM was increased in supplemented groups comparison with unsupplemented control one. Cows in G2 showed significantly (P<0.05) the highest intake of total DM, followed by G3 and G4, while G1 was the lowest intake. It may be attributed to the significant impartment that happened for CFM after the addition of such additives in supplemented groups. Similar results were reported by (Abd El-Baki *et al*. 2001). Bentonite is one of the common natural clays used in livestock diets to improve feed intake (Saleh *et al*. 1999 and Salem *et al*. 2001). Colling *et al.* (1979) explained that addition of sodium bentonite to lambs fed high concentrate diets due to improve the feed intake. Also, May *et al.* (1988) found that feed intake increased with natural clays addition in diets of ruminants. But some searchers (Abd El-Baki *et al.* 2001, Salem *et al.* 2001) found that dry matter, organic matter and feed components were insignificant affected by supplemented bentonite. Gutierrez *et al*. (1999) found that no differences were observed between intake for the different zeolite levels when addition of zeolite levels 0, 1, 3 or 5% to sheep which fed star grass *ad libitum* and 300g of a commercial concentrate as the basal diet. Moate *et al*. (1985) and Johnson *et al*. (1988) reported that feed intake decreased by addition of natural clays. Aiad (1990) reported that supplement of bentonite, kaolin and tafla clays with 3% urea in sheep rations had no effect on feed intake.

Table 2. Feed intake (kg/head/day) for different experimental rations.

Items	Experimental rations				SEM
	G1	G2	G3	G4	
CFM	4.6	6.3	6.00	5.7	
CS	4.7	4.7	4.7	4.7	
RS	5.4	5.4	5.4	5.4	
Total DM	14.7^{c}	16.4^{a}	16.1^{ab}	15.8^{b}	0.17

a, b, c: Means in the same row with different superscripts differ significantly at (p< 0.05).

Data of digestibility of DM, OM, CP, CF, EE and NFE are presented in Table (3). All nutrient digestibilities were significantly (P<0.05) higher in groups 2, 3, 4 compared to those of control one. Bentonite group recorded the higher values of all nutrients than those of zeolite group, so bentonite minerals could be considerably affecting on protein and carbohydrate metabolism and digestion. In generally, minerals from Bentonite were supported CP and NFE than Zeolite. This effect may be refer to increase available feed to absorption and during digestion by overmuch the reactive surface areas of nutrients to effect of microorganism enzymes (Pulatov *et al.* 1983), and improving feed utilization by decelerates the feed rate time through the digestion tract and improving absorption consequently (Gabr *et al.* 2003). These data are in agreement with the findings of EL-Tahan *et al.* (2005) found that 2 and 4% clay supplemented to growing calves diets were significantly improved nutrients digestibility and feeding values. Effectively bentonite is considering as one of the common natural clays used in animal diets to improve digestibility of nutrients (Saleh *et al.* 1999). On other study, the supplementation 4 or 8% bentonite to growing lambs diets, improved significantly ($P<0.05$) the digestibility of OM, CP, CF and EE (Salem *et al.* 2001). Ha *et al.* (1985) reported that using bentonite at level 2 to 8|% in lams ratios increased CF an EE digestibility.

Moreover, Britton *et al.* (1978) reported that using bentonite in lambs diets increased OM digestibility. While, Martin *et al.* (1969) reported that using bentonite at 4 and 8% in sheep rations did not effect on OM digestibility. The improvement of digestibility may be due to an increase the retention time and rumen turnover rate (Ellis, 1983). On the other hand, Soliman *et al.* (2003) found that digestibility of all nutrients were significant increase by supplemented bentonite to cow contaminated aflatoxin diets. Similar results were achieved by Murzin, and Peshkova (1989) when add 6% zeolite (on DM basis) to the ration of Black Pied steers

Concerning the percentages of TDN and DCP in Table (3) its values were significantly ($P<0.05$) higher in G2 than those of G1 and G4. Whereas the values of TDN and DCP were higher in G4 compared to G1. Similar results were obtained by Britton *et al.*(1978), Saleh *et al.* (1999), Khattab *et al.* (2009) and EL-Tahan *et al.* (2005). The TDNI and DCPI were significantly ($P<0.05$) the highest with feeding on G2 then followed by G3 and G4 ration. The increasing TDN may be due to improvement of digestibility of CP, CF and EE. The improvement of DCP may be due to increased CP digestibility. Similar trends were obtained by the investigation of (Abd El-Baki *et al.* 2001, Salem *et al.* 2001).

Table 3. Nutrients digestibility and feeding values for different experimental groups.

Items	Experimental groups				MSE
	G1	G2	G3	G4	
Digestibility %					
DM	63.78^{c}	67.43^{a}	66.12^{ab}	65.37^{b}	0.45
OM	65.83^{c}	69.04^{a}	68.04^{ab}	67.28^{b}	0.38
CP	62.16c	66.61^{a}	65.65^{ab}	64.12^{b}	0.56
CF	54.43^{c}	59.04^{a}	57.78^{ab}	56.58^{b}	0.57
EE	66.66^{c}	70.16^{a}	69.04^{ab}	68.22^{b}	0.43
NFE	70.62^{c}	73.09^{a}	72.19^{ab}	71.72^{b}	0.3
Feeding values					
TDN%	60.50^{c}	63.89^{a}	62.88^{ab}	62.16^{b}	0.36
DCP%	5.53^{c}	6.46^{a}	6.26^{ab}	6.08^{b}	0.06
TDNI kg/d	8.89^{c}	10.47^{a}	10.12^{ab}	9.82^{b}	0.12
DCPI Kg/d	0.81^{c}	1.05^{a}	1.00^{ab}	0.96^{b}	0.04

a, b, c: Values in the same row with different superscripts differ at 5% level.

Rumen liquor parameters:

Data of Table (4) showed that the ruminal pH value and TVFA's concentration were mostly increased significantly ($P<0.05$) with bentonite, zeolite and its mixture supplemented groups G2, G3 andG4, While the ruminal ammonia concentrations were significantly ($P<0.05$) decreased in supplemented groups than that of control almostly.

The 2% bentonite supplemented group shown the highest value of TVFA's and lowest ammonia concentration were among the Experimental dietary treatments. These results may berefer to improving the digestibly of CP and NFE. Bentonite allow to increase the of availability feed to absorption and enhancing the digestion by overmuch the reactive surface areas of nutrients to exposing for microorganism enzymes (Pulatov *et al.* ,1983), and decreasing the feed rate time through the digestion tract and improving absorption (Gabr *et al.* 2003). Ehrlich and Davison (1997) reported that maize silage ration supplemented with bentonite for cows was increased rumen pH comparison with unsupplemented one. The same results with Marrero *et al.* (1987) and Ivan *et al.* (2001).were also outputted Nikkhah *et al.* (2000) reported that zeolite has positive effect on pH rumen. Recently, Khachlouf *et al.* (2018) found that the rumen pH was increased with zeolite. Supplemented for ruminant animals. Ahmad (2012) reported that ruminal, pH significantly increased as a result of tafla and bentofarm addition than that of the control. Ahmad (2012) reported that ruminal parameters as TVFA’s, significantly increased as a result of tafla and bentofarm addition than that of the control, Salem *et al.* (2001) found that addition of bentonite at 12 g dolomite and bentonite head/day to rations of growing sheep improved ($P<0.05$) the quantity of total volatile fatty acids in the rumen. Abd El-Baki *et al.* (1988) reported that the concentrations of TVFA’s increased by feeding sheep on rations included clay. . McCollum and Galyean (1983) reported that zeolite supplementation tended to produce high levels of TVFA’s. EL-Tahan *et al.*(2005) reported that the positive effect of supplemented bentonite may be due to catching NH3 and acted as reservoir and regular of ammonia with maize silage supplemented rations with possibility of gradual release at decreasing ammonia time.

Ahmad (2012) reported that the value of ammonia-N concentrations significantly took the vise versa, as a result of tafla and bentofarm addition Bartos *et al.* (1982) found that bentonite group was lower in content of ammonia concentration than without bentonite. This may be due to the ability of bentonite to adsorb ammonia from rumen fluid when its concentration being high and release it back when its concentration being falls. Also, Patterson *et al.* (1985) reported that ammonia concentration decrease in linear perspective with the increase in zeolite levels at 0, 100, 200 and 300g per day in the rumen of steers. On the other hand, some researchers disagree results (Moate *et al.* 1985, Johnson, 1988) when add bentonite and zeolite, had supplements Recently, Khachlouf *et al.* (2018) found that the rumen ammonia nitrogen was reduced with zeolite. Supplemented for rumenitant animals.

Table 4. Rumen liquor parameters of cows fed the experimental diets.

Items	Experimental groups				MSE
	G1	G2	G3	G4	
pH value	6.42^{c}	6.79^{a}	6.68^{ab}	6.61^{b}	0.13
NH3-N (mg/100 ml)	22.00^{a}	17.99^{c}	19.30^{bc}	20.14^{ab}	0.95
TVFA’s (meq/ 100 ml)	12.40^{c}	15.16^{a}	13.99^{ab}	12.92^{bc}	0.75

a, b, c: Values in the same row with different superscripts differ at 5% level.

Blood serum biochemical:

Data of some serum biochemical parameters of cows fed experimental rations after calving are presented in (Table, 5). The obtained data indicated that group 2 recorded significantly (P<0.05) the highest concentrations of total protein and globulin followed by G3 and G4, while G1 had the lowest values. While, albumin concentration decreased significantly (P<0.05) with bentonite and zeolite additives in comparison with control. Also, G2 revealed significantly the highest glucose and T3 concentrations followed by G3 and G4, while G1 had the lowest values. On the other side, the concentrations of creatinine, urea, total lipid and Ca as well as the activity of AST and ALT were closely similar with the different groups. These results revealed that bentonite and zeolite additives didn't have any adverse effects on liver and kidney functions. And increasing the level of glucose in the blood may be refer to release significant (P<0.05) physiological doses of thyroid hormones as T3 that oxidizes glycogen to glucose. Toprak *et al.* (2016) detected no significant effects were observed due to micronized.in zeolite addition to lambs concentrate feeds terms of blood urea nitrogen, plasma glucose, serum creatinine, and triglyceride, sodium, potassium and chlorine concentrations. However, serum total protein, calcium and phosphorus concentrations were affected by zeolite supplementation. Results of AST and albumin may be due to enhance the amino acids utilization for protein synthesis (Abdelmawla *et al.* 1998). Data of Ca level were agree with the findings of (Marian *et al.* 2018) when added 350g zeolite /cow/day, And Khachlouf *et al.* (2018). On the other hand, data of blood plasma total protein, albumin and globulin values were not significantly different between treatments bentonite supplementation to the diet of growing lambs.(Salem *et al.* 2001).

Milk yield and composition:

Data of milk yield and its composition are presented in Table (6). The yield of actual milk and 4% FCM were significantly higher (P<0.05) with all supplementation rations (|G2, G3 and G4) compared with control one, being the highest values were associated with bentonite ratio (G2).Concerning milk composition results of most milk concentrations were the highest contents of fat, protein and TS followed by G3, while G1 and G4 had the lowest values. Group 2 recorded significantly (P<0.05) the highest contents of lactose and SNF followed by G3 and G4, whereas G1 had the lowest values. Ash content in milk was nearly similar for the different groups. The yield of milk constituents reflect the variations in milk yield and milk composition among the different groups. The milk yield reflects the higher serum glucose and T3 of treated groups compared with control group. These data are according with those obtained by Salem *et al.* (2001) when supplemented bentonite to goat diets to improve milk yield and milk composition. Milk composition might changeable due to increase osmosis pressure in mammary follicle which increases water flow from blood into mammary follicle with fatty acids, amino acids and glucose. Khachlouf *et al.* (2018) found that milk yield was increased by zeolite additive, while milk fat and protein contents were not altered. Also, the findings of Abd El-Baki *et al.* (2001) demonstrated that due to the supplementation of cow diets with tafla clay with CFM plus supplemented urea treated rice straw ration, milk yield and fat percentage yield were (P<0.05) significantly higher. Ella (2007) summarized that supplementation of bentonite to lactating ewes diets increased milk yield. The` yield of actual milk and 4%FCM were significantly higher (P<0.05) with all supplemented rations (G2, G3 and G4) than those of control one (G1), being the highest values were associated with bentonite ration (G2).

Table 5. The effect of experimental rations on some biochemical in blood serum of cows during post- partum periods:

Items	Experimental groups				MSE
	G1	G2	G3	G4	
Total protein (g / dl)	6.71^{b}	6.97^{a}	6.92^{a}	6.75^{b}	0.21
Albumin (g / dl)	3.39^{a}	3.20^{b}	3.25^{b}	3.24^{b}	0.10
Globulin (g / dl)	3.32^{c}	3.77^{a}	3.67^{ab}	3.51^{b}	0.14
Creatinine (mg / dl)	0.79	0.78	0.78	0.79	0.01
Urea (mg / dl)	31.69	31.65	31.70	31.61	0.61
Total lipid (mg / dl)	0.36	0.37	0.37	0.37	0.02
Glucose (mg / dl)	48.63^{c}	56.21^{a}	55.30^{ab}	51.23^{b}	0.17
T3 (mg / dl)	1.10^{c}	1.24^{a}	1.20^{ab}	1.18^{b}	0.08
AST (u / l)	26.81	26.92	26.83	26.82	0.01
ALT (u/ l)	6.40	6.46	6.41	6.41	0.86
Ca (mg/dl)	8.39	8.46	8.41	8.41	0.28

a, b, c: Values in the same row with different superscripts differ at 5% level.

Feed conversion:

The values of feed conversion of cows fed the different experimental rations are presented in Table (6).

Cows supplemented with bentonite revealed the best results of feed conversion expressed as kg or g of DM, TDN or DCP/ kg 4% FCM. Group 2 recorded significantly (P<0.05) the lowest amounts of DM, TDN and DCP per kg 4% FCM followed by G3 and G4, while the highest amounts were detected with G1. These results are in agreement with those obtained by Mohsen *et al.* (2017) found that both sodium and calcium, bentonite adsorbed rumen ammonia, increased the live weight gain and tended to improve feed conversion. Ahmed (2012) reported that feed efficiency improved for lambs supplemented ration with tafla and bentofarm compared with non-supplemented ration. Also, Mohsen and Tawfik (2002) showed that the addition of the bentonite at 0, 2.5 and 5% of that to the rations caused a significant (p<0.05) improvement in feed conversion efficiency. On the other hand, Bulido and Fehring (2004) added ziolites at levels 3 or 5% (on DM basis) to calves diet, and founded that feed efficiency did not affected. But, Nowar *et al.* (1993) indicated that improvement of feed efficiency was observed, when Awassi sheep received diets contained 2.5 or 5% clay.

Economic efficiency:

Results of economic efficiency are presented in Table (7). Group 2 recorded significantly (P<0.05) the highest daily feed cost followed by G3 and G4, while G1 had the lowest feed cost. This might be due to the increase of CFM intake. While, feed cost per one kg 4% FCM was lower significantly (P<0.05) in G2 followed by G3 and G4, while G1 had the higher value. On the other side, G2 showed significantly (P<0.05) the highest output of 4% FCM yield, net revenue and economic efficiency followed by G3 and G4, while G1 had the lowest values. These results agreed with those obtained by Ahamed Hamed

(2012) notified that economic efficiency improved for lambs supplemented ration with tafla and bentofarm compared with non-supplemented ration.

Table 6. Effect of Feeding Lactating Cows on Experimental Ration on Milk yield and composition.

Items	Experimental Rations				MSE
	G1	G2	G3	G4	
Milk yield (kg/day)	9.31^{c}	12.87^{a}	12.06^{ab}	11.45^{b}	0.22
4% FCM	8.53^{c}	12.08^{a}	11.12^{ab}	10.50^{b}	0.36
Composition %					
Fat	3.44^{b}	3.58^{a}	3.48^{ab}	3.43^{b}	0.16
Protein	2.73^{b}	2.85^{a}	2.79^{ab}	2.72^{b}	0.03
Lactose	4.85^{b}	4.99^{a}	4.92^{ab}	4.90^{ab}	0.04
SNF	8.28^{b}	8.53^{a}	8.42^{ab}	8.34^{ab}	0.04
TS	11.72^{b}	12.11^{ab}	11.90^{ab}	11.77^{b}	0.16
Ash	0.70	0.70	0.71	0.72	0.01
Milk constituents (g \day)					
Fat	320.26^{b}	460.75^{a}	416.69^{ab}	392.74^{b}	0.35
Protein	254.16^{b}	366.8^{a}	336.47^{ab}	311.44^{b}	0.07
Lactose	451.54^{b}	642.21^{a}	593.35^{ab}	561.05^{ab}	0.09
SNF	769.01^{b}	1097.81^{a}	1015.45^{ab}	954.93^{ab}	0.09
TS	1091.13^{b}	1558.56^{a}	1435.14^{ab}	1347.67^{b}	0.35
Ash	65.17	90.09	85.63	82.44	0.01

a, b, c: Values in the same row with different superscripts differ at 5% level.

Table 7. Feed conversion and economic efficiency of the experimental rations for milk production.

Items	Experimental rations				SEM
	G1	G2	G3	G4	
Feed conversion:					
DM (kg/kg 4% FCM)	1.75^{a}	1.38^{b}	1.47^{ab}	1.53^{ab}	0,07
TDN (kg/kg 4% FCM)	1.06^{a}	0.88^{b}	0.92^{ab}	0.95^{ab}	0.05
DCP (g/kg 4% FCM)	97.30^{a}	89.40^{b}	91.73^{ab}	92.38^{ab}	2.54
Economic efficiency:					
Feed cost (LE/day)	39.32^{c}	49.22^{a}	47.87^{ab}	46.84^{b}	2.24
Feed cost (LE/ kg 4% FCM)	4.61^{a}	4.07^{c}	4.30^{b}	4.46^{ab}	0.64
Output of 4% FCM yield (LE)	46.92^{c}	66.44^{a}	61.16^{ab}	57.75^{b}	2.56
Net revenue (LE)	7.60^{c}	17.22^{a}	13.29^{ab}	10.91^{b}	1.05
Economic [1]	1.19^{c}	1.35^{a}	1.28^{ab}	1.23^{b}	0.12
Economic % [2]	19.33^{c}	34.99^{a}	27.76^{ab}	23.29^{b}	0,81

a, b, c: Values in the same row with different superscripts differ at 5% level.

[1] Economic efficiency = output of 4% FCM / feed cost.

[2] Economic efficiency % = net revenue * 100 / feed cost

CONCLUSION

It could be concluded that adding of bentonite into the diet of lactating Friesian cows at the level of 2% of DM intake gave positive effects on digestibility, rumen fermentation, some blood parameters, feed intake, milk yield and composition, feed conversion and economic efficiency.

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تأثير مضادات السموم الفطرية على الأداء الأنتاجى للأبقار الفريزيان

اشرف على مهنى و احمد شعبان شمس

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أجريت هذه الدراسة بهدف تحديد أفضل مركب اقتصادي من مضادات السموم الفطرية المضافه لعلائق الأبقار لتحسين أدائها الإنتاجي. حيث تم استخدام 12 بقرة فريزيان بمتوسط وزن 540 ± 17.59 كجم بالمواسم 2 – 5 و خلال الفترة من أخر 60 يوماً قبل الولادة و حتى نهاية اول 120 يوم للحليب. قسمت عشوائياً لأربع مجموعات تجريبية قدمت لها العلائق الأساسية المحتوية على علف مركز وسيلاج الذرة وقش الأرز. المجموعة الأولى مقارنة بدون إضافة ، الثانية أضيف لها 2% بنتونيت ، تم أحلال 50% و 100% من البنتونيت بالزيوليت بالمجاميع الثالثة و الرابعة على التوالى على أساس المادة الجافة المأكولة . أظهرت النتائج تحسن معنوي (P<0.05) لمعاملات الهضم لجميع العناصر الغذائية ومجموع المركبات الغذائية المهضومة للمجاميع المعاملة مقارنة بالكنترول ، وسجلت المجموعة الثانية أفضل القيم وبنفس الإتجاه و المعنوية (P<0.05) كانت نتائج الحموضة ، مجموع الأحماض الدهنية الطيارة للمجموعات المعاملة عن مجموعة المقارنة. بينما انخفضت قيم الأمونيا للمجاميع المعاملة عن المجموعة المقارنة . كانت قيم البروتين الكلى و الجلوبيولين و الجلوكوز و T3 للمجموعتين 2 و 3 أعلى معنوياً (P<0.05) عن غيرها في حين انخفض معنوياً الألبيومين مع كلا الإضافتين مقارنة بالكنترول و لاتوجد أختلافات معنوية بين المجموعات فى قيم الكرياتينين ، اليوريا ، الدهون الكلية ، AST، ALT، Ca برغم ارتفاع المجموعات المعاملة فى AST، ALT، Ca عن مجموعة المقارنة وارتفعت قيم المأكول معنوياً (P<0.05) من المادة الجافة و مجموع المركبات الغذائية المهضومة و البروتين المهضوم بالمجاميع المعاملة و كانت أعلاها المجموعة الثانية ثم الثالثة فالرابعة ، زاد محصول اللبن واللبن معدل الدهن 4% (P<0.05) معنويا بالمجموعة الثانية عن المجموعة الرابعة (الزيوليت) و المجموعة المقارنة . و قد أرتفعت قيم الدهون والبروتين واللاكتوز و TS و SNF للمجموعة الثانية معنوياً (P<0.05) عن مجموعة المقارنة بينما كان الأرتفاع غير مغنوى بالمجموعة الثالثة و الرابعة مقارنتاً بالكنترول. بينما تشابهت قيم الرماد لجميع المعاملات. أضافة البنتونيت و الزيوليت حسنت الكفاءة الغذائية. حيث سجلت المجموعة الثانية كفاءة أعلى معنوية عن الكنترول. بينما كانت الكفأءة الغذائيه غير معنوية مع المجموعة الثالثة و الرابعة مقارنتاً بالكنترول (P<0.05) للمادة الجافة و مجموع المركبات الغذائية المهضومة و البروتين المهضوم منسوبة لقيم اللبن المعدل 4% دهن. سجلت المجموعة الثانية أعلى قيمة معنوياً (P<0.05) لمتوسط الكفاءة الأقتصادية منسوباً للبن المعدل 4% دهن ثم الجاميع 3، 4، 1 على التوالى.لذا نستنتج أن إضافة البنتونيت لعلائق الأبقار الفريزيان الحلابة بمستوى 2% من المادة الجافة المأكولة كان له تأثير إيجابي على الهضم ، تخمرات الكرش، بعض عوامل الدم ، كمية المأكول، محصول اللبن الكلى واللبن معدل الدهن 4% و مكونات اللبن و الكفاءة التحويلية و الاقتصادية مقارنه بمجموعة الكنترول و مجموعة الزيوليت و مخلوط البنتونيت و الزيوليت.