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STUDIES ON MIXING TANNINIFEROUS PLANTS WITH AMMONIATED WHEAT STRAW IN BARKI SHEEP RATIONS ON DIGESTIBILITY, PERFORMANCE AND SOME BLOOD BIOCHEMICAL

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SUMMARY

Five dietary treatments in three trails were conducted with Barki sheep as follows: 60% Concentrate feed mixture (CFM) and 20% Ammoniated wheat straw (AWS) as basic diet with 20% Cassava (C) in T1, 20% *Prosopis juliflora* (P) in T2, 20% *Acacia Saligna* (A) in T3, 10% C + 10% A in T4 and 10% C + 10% P in T5. In Trial 1, Fifteen Barki rams (43± 1.85 kg) divided into equally five treatment groups to evaluate the effect of condensed tannin sources on apparent nutrients digestibility. The results indicated that the rams fed with T3 (20 % *A. Saligna)* at a maximum level of tannin (8.33 g /Kg DM) had a lower DMI (9.72 %) than the comparable group (T1) (P<0.05). Lower level of CT (3.87 g/Kg) in T2 diet have higher the digestibility coefficient (P>0.05) of DM, OM, CP, EE and CF than that on T1 diet by 3.90, 3.57, 1.87, 3.16 and 1.04%, respectively. Rumen ammonia concentrations were decreased with increasing of CT content in experimental diets (T3, T4, T1, T5 and T2, respectively). In Trial 2, Twenty five healthy Barki ewes at late pregnancy, weighing 41±2.29 kg at 3-5 years of age were randomly allocated into five dietary treatments to determine the milk yield and composition and some blood components changes due to tannin sources and productive performance of their offesprings. There was a significant increase (P<0.05) in milk yield with decreasing level of CT (6.42%) for ewes fed T2 ration when compared with the T1 group and there is no considerable variability in milk composition traits among all groups. And no significantly differences in average live body weight (ALBW) of offesprings among the all groups. The experimental diet T2 and T5 had significant increased (P<0.05) total protein and globulin (G) compared with the other experimental diets. No significant differences among different treatments regarding albumin was observed. Groups T3 and T4 have higher levels (P<0.05) of Urea-N and Creatinine when compared with the other groups. Values of AST and ALP were significantly higher (P<0.05) for the ewes in group T3 as compared to all groups, and the highest values of ALT were recorded (P<0.05) with T3. In Trial 3, Twenty-five healthy male Barki lambs after weaning, weighing 12±0.64 kg, aged 3- 4 month divided into five groups to evaluate the effect of tannin sources on growth performance and some blood components. The lambs fed diets T2 and T5 produced totally (P<0.05) higher final live body weight (29.03 Kg and 28.16 Kg, respectively) at the end of the experimental period (90 days) compared to the other groups. The results indicate that the experimental tanniniferous plants can be incorporated up to 20 % with ammoniated wheat straw without compromising the body health of the animals and the best impact of tanniniferous plants on the performance of Barki sheep was *Prosopis juliflora* (leaves & twigs), *Cassava* and *Acacia Saligna*, respectively.

Keywords: *Prosopis juliflora , Cassava, Acacia Saligna, digestibility, performance blood components, Barki sheep.*

INTRODUCTION

Feed occupies the first place among the multiple roles of the livestock industry and its value reached about 58.3% of the total value of agricultural production requirements. The total area of feed crops reached about 2458 acres throughout the year and represent about 16% of the total crop area in 2008 (Ministry of Agriculture and Land Reclamation Egypt, 2008). Leaves proteins from *Cassava*, *Acacia Saligna* and *Prosopis juliflora can* be part of the proposed solutions to overcome shortage of feedstuff, especially in the newly reclaimed land (Duda and El-Ashry, 2000). Tannins are polyphenolic compounds that are present in a variety of plants which are utilized as food and feed (Shahidi and Naczk, 2003). Condensed tannins (CT), polymers of flavanol units, are the most common type of tannins found in forage legumes, trees, and shrubs (Barry and McNabb, 1999). Tannin from different plants might show different response in digestibility and methane production. (Makkar, 2003 and Guglielmelli *et al*., 2011).

Acacia saligna is the most successful species of *Acacia* due to its tolerance to drought, ability to grow in salty soil, higher production of green biomass, higher crude protein content and good nutritive value (Degan *et al.,* 1997).

In Egypt, *Prosopis juliflora* has distributed through the natural habitats in the coastal areas of Red Sea and northern part of Sinai. *Prosopis juliflora* pods promises to be an alternate feed resource for livestock with high yield (169 kg/tree/year)

Cassava leaves have been used as a protein source and yield amounting 4.60 tones dry matter per hectare, it produced as by-product after root harvested (Ravindran and Rajaguru, 1988).

Mixing wheat straw with leaves of rich tannin-plant such *Cassava, Acacia* and *Prosopis* leaves may improve digestion due to diluting of tannin concentration and protein founded in these plants leaves might be help rumen microflora to more growing (Schlegel, 2015).

The objective of this study was undertaken to evaluate the effect of feeding *Cassava, Acacia saligna* and *Prosopis juliflora* (leaves & twigs) with anhydrous ammonia treated wheat straw on performance and feed utilization efficiency and rumen fermentation characteristics of Barki sheep.

MATERIALS AND METHODS

Three trials were conducted at Borg El Arab Livestock Research Station, Animal Production Research Institute, Ministry of Agriculture.

Experimental diets

The fodder trees of *Prosopis juliflora* , *Cassava* and *Acacia saligna* were harvested along the sub-roads of the North Western Coast of Egypt near the Mediterranean Sea, west of Alexandria city, latitudes 21° and 31° North and longitudes 25° and 35° East. The sun-dried edible (leaves & twigs as non-lignified stems) of *Cassava* (C), *Prosopis juliflora* (P) and *Acacia saligna* (A) fodder trees were subsequently chopped into shorter lengths (5 mm**)** in order to disallow feed selection, and mixed at different ratios with ground ammoniated wheat straw (AWS) to produce five mixed dietary rations. Concentrate feed mixture (CFM) has been used consists of 25% non-corticated cotton seed meal, 43% yellow corn, 25% wheat bran, 3.5% molasses, 2% limestone, 1% common salt and 0.5% minerals mixtures. Anhydrous ammonia was applied at the rate of 3% per ton of wheat straw (AWS) and the five dietary treatments were:

T1: 60% CFM plus 20% AWS & 20% C.
T2: 60% CFM plus 20% AWS & 20% P.
T3: 60% CFM plus 20% AWS & 20% A.
T4: 60% CFM plus 20% AWS & 10% C & 10% A.
T5: 60% CFM plus 20% AWS & 10% C & 10% P.

Experimental diets were fed according to NRC (1985) allowances which were adjusted according to productive stage and was offered twice daily at 09:00 h and 16:00 h after discarding the residues of the previous day. Animals were offered clean drinking water and block minerals free choice and the experiment period were consisted of three trials as follows:

Trial 1: Digestibility and nitrogen balance

Fifteen Barki rams were used in the digestibility trial, aged between 2 to 3 years with average body weight (ABW) of 43±1.85 kg, were housed individually in metabolism cages randomly (3 rams in each) and assigned to the five dietary treatments. Daily feed intake, faeces and urine were recorded every morning. Feed and faeces was determined by drying to a constant weight in a forced air oven at 55°C, then ground to pass a 1 mm screen and preserved for chemical analysis. Nitrogen balance values were mathematically calculated by subtracting (faecal N + urine N) values from total N intake values. Ground samples of feeds, diets and faeces were analyzed for dry matter (DM), total ash and N content (CP=6.25×N) in feeds, faeces, and acidified urine using Micro-Kjeldahl method according to the procedures described by A.O.A.C. (1995). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) analyzed according to method of Van Soest *et al.,* (1991). Organic matter (OM) contents were calculated by difference (by subtracting ash from DM). Extractable condensed tannins (CT) in all ingredients and diets offered were estimated by Butanol-HCl method according to Makkar (2003).

Ruminal attributes

Rumen liquor sample was collected from each rams at 4 hr. of post feeding using a stomach tube and placed in a 500 ml glass jar within 4-5 min of sampling recorded pH using a portable calibrated digital pH meter (HANNA pH-meter, model HI 8424). Rumen fluid was filtered through a four layers of muslin cloth, acidified with 18.6 N H_2SO_4 (0.02 mL per mL of ruminal fluid) to prevent ammonia volatilization and stored at -20°C for further analysis, ammonia-N was determined according to Conway (1957) and total volatile fatty acids VFA's concentration was determined according to Eadie (1967).

Trail 2: Ewes' performance and their offespring.

Twenty five healthy Barki ewes at late pregnancy, at 3-5 years of age with average body weight of each group (five per treatment) 41±2.29 kg were randomly allocated into five dietary treatments according to their weights and age. All animals were kept in a semi-open shaded yard and kept under the same managerial conditions during the experimental period. Experiment period were consisted of 2 intervals, late pregnant (4 weeks pre-partum), and suckling (8 weeks post-partum). Offered and refused feeds were daily weighed to determine total DMI. Ewes had free access to fresh tap water during all the experimental period. Samples of feed and refusals were oven-dried at 105°C to determine DM content, and total DMI. Live body weight of ewes and their offspring's were recorded biweekly till weaning

During suckling period, milk yield for individual ewes was recorded twice daily at 7 am and 5 pm weekly during the suckling period (8 weeks) which was estimated by weigh-suckle-weigh (WSW) (Ünal *et al.*, 2007). From birth day, lambs were all time with their dams and fed on dam's milk up to weaning age (8 weeks), lambs were separated from their dams at 5 pm on the evening proceeding the recording day. In the following morning day at 7 am, lambs were weighted and allowed to suckle their dams for 15 minutes period. Their body weights were then recorded and after finished suckling, ewes were hand milked to remove any residual milk. The difference in weight of the lamb before and after suckling plus the amount of milk by hand milking represented the amount of milk yield of the ewe and lambs separated again until 17 pm, at which time the procedure was repeated. Milk intake plus milk removed by hand milking represented daily milk yield. All lambs were weaned at 8 weeks of age.

Individual milk samples (100 ml) from all ewes in each group were taken weekly through lactation period, it collected by hand milking of both sides of the udder and pooling samples into one sample per ewe. Milk samples were directly analyzing concentrations of fat, protein, lactose and total solid using a milk Oscan device (Mark®, 133B, N. FOSS, Electric, Den mark).

Dairy efficiency was calculated from the following equation: DE = Milk Yield (Kg) /DMI (Kg).

Milk energy values were calculated by using equation proposed by Economides (1986) as follows: Calorific value (MJ/L) = 1.94 + 0.43 x whereas: x = fat%.

Fat corrected milk (4% FCM) =0.4x M +15× F, where M = quantity of milk in kg, F = amount of fat in kg.

At weaning, blood samples were taken from three ewes of each treatment before morning feeding via jugular venipuncture using sterile tube with anticoagulant, and centrifuged at 3000 rpm for 20 minutes to obtained plasma and frozen at -20◦C for late biochemical assay. The concentration values of total protein, albumin, creatinine and urea-N and the activities of the enzymes aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) were determined by spectrophotometer using commercial bio-Merioux kits (France). Globulin values were mathematically calculated by subtracting albumin values from total protein values.

Trial 3: Lamb growth performance

Twenty-five healthy male Barki lambs after weaning, weighing 12±0.64 kg and aged 2-3 months were divided into 5 treatment groups, the same of 5 previous mentioned dietary treatments of their mothers' treatment groups with 5 lambs in each according to the initial body weight and lasted for 90 days. The diets and fresh water were offered *ad libitum* for lambs. The residue of feed was collected daily then weighed before morning feeding and the diets offered at 8 a.m. daily. Lambs were weighed before the start of the study and their body weights were recorded at 15-day intervals at 8 a.m. after withhold food for 14 hours until the end of the trial. Dry matter intake of feed material, average daily gain and feed efficiency were estimated for each treatment whereas: Feed efficiency = kg (live mass gain)/ kg (feed DMI).

Blood samples

On the last day of the feeding trial, blood samples were taken from three animals of each treatment before morning feeding via jugular venipuncture using sterile tube with anticoagulant. Blood samples were centrifuged at 3000 rpm for 20 min to obtained plasma and stored -20◦C until subsequent biochemical assay. The concentration of total protein, albumin, creatinine and urea-N and the activities of enzymes aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) were determined by spectrophotometer using commercial bio-Merioux kits (France). Globulin values were mathematically calculated by subtracting albumin values from total protein values.

Statistical analysis

Statistical analysis was carried out using SAS (2003) and Duncan's multiple range Test (Duncan, 1955) was used to separate the means when the main effect was significant.

RESULTS AND DISCUSSION

Chemical compositions of diets:

The Chemical analyses of experimental feed stuffs are presented in Table (1) and calculated chemical compositions of the formulated diets are presented in Table (2). The dietary DM, OM, CF, EE, Ash, NDF and ADF were comparable in nutrient content, except the contents of CP decreased by 6.34, 9.67, 4.84 and 3.20% in the diets T2, T3, T4 and T5, respectively when compared to T1. This decrease is due to the higher protein content of *Cassava* compared to *Prosopis juliflora* and *Acacia saligna* (leaves & twigs).

Table (1): Chemical analysis (% on DM basis) of experimental feed stuffs.

Item	feedstuffs				
	CFM	AWS	C	P	A
Dry matter, DM	91.20	96.12	46.32	68.39	54.69
Organic matter, OM	93.90	90.95	88.46	93.30	91.46
Crude protein, CP	15.70	9.86	22.63	17.52	14.96
Crude fiber, CF	14.23	45.23	28.05	30.70	31.23
Ether extract, EE	3.13	1.90	4.92	3.32	1.97
Nitrogen free extract, NFE	60.84	33.96	32.86	41.76	43.30
Ash	6.10	9.05	11.54	6.70	8.54
Neutral Detergent Fiber, NDF	39.34	70.32	43.36	47.41	43.57
Acid Detergent Fiber, ADF	17.30	42.22	29.29	37.69	28.95
Condensed Tannin, CT (g/kg DM)	**	**	38.04	19.34	41.67

***= Not detected*

CFM: Concentrate Feed Mixture, AWS:- Ammoniated wheat straw, C:- Cassava, P:- Prosopis juliflora and A:- Acacia Saligna

Table (2): Calculated chemical composition (% on DM basis) of the experimental diets.

Item	Experimental diets				
	T1	T2	T3	T4	T5
Dry matter, DM	83.21	87.62	84.88	84.05	85.42
Organic matter, OM	92.22	93.19	92.82	92.52	92.71
Crude protein, CP	15.92	14.91	14.38	15.15	15.41
Crude fiber, CF	23.19	23.72	23.83	23.51	23.46
Ether extract, EE	3.24	2.92	2.65	2.95	3.08
Nitrogen free extract, NFE	49.87	51.64	51.96	50.91	50.76
Ash	7.78	6.81	7.18	7.48	7.29
Neutral Detergent Fiber, NDF	46.94	45.15	47.38	47.06	46.75
Acid Detergent Fiber, ADF	25.18	24.26	25.61	25.35	24.82
Condensed Tannin, CT (g/kg DM)	7.61	3.87	8.33	7.97	5.02

T1:- 60% CFM plus 40% AWS & C (50:50). T2:- 60% CFM plus 40% AWS & P (50:50). T3:- 60% CFM plus 40% AWS & A (50:50). T4:- 60% CFM plus 40% AWS & C & A (50:25:25), T5:- 60% CFM plus 40% AWS & C & P (50:25:25).

All experimental diets had a CP content above the minimum microbial requirement (7%) to support acceptable ruminal microbial activity and the maintenance requirement of CP for the host ruminant (McDonald *et al.*, 2002).

Contents of NDF and ADF were increased in T3, T4, T1 compared with T5 and T2. Higher contents of NDF and ADF in the diets correlated with the high levels of tannin interpreted by Makkar *et al.,* (1995) who indicated that the major difficulty encountered in fiber analysis of tannin-containing feeds using the detergent method is the presence of tannin-protein complexes. These complexes are insoluble and can appear in the fiber fraction during analysis which taken together. The condensed tannin, (CT) content (g kg-1 DM) varied widely from 8.33 to 3.87, with the highest for T3 and lowest for T2.

1^st trial: Intake and digestibility

Data of intake, digestibility and nitrogen balance are presented in Table (3). There was a negative linear relation between CT concentration and total DM intake (g/h/d). The rams fed T3 (20 % *A. saligna)* at a maximum level of tannin (8.33 g /Kg DM) had a lower DMI < (9.72 %) than the comparable group (T1) (P<0.05).

Table (3): Intake, digestibility, nutritive value and nitrogen balance of experimental diets.

Item	Experimental groups					±SE
	T_1	T_2	T_3	T_4	T_5	
DM intake (g/day)	957.68^{a}	975.48^{a}	864.62^{c}	898.41^{b}	962.09^{a}	6.513
			Digestion coefficients (%)			
Dry matter, DM	66.60	69.20	66.33	66.52	67.57	0.904
Organic matter, OM	68.85	71.31	68.31	68.43	69.24	1.835
Crude protein, CP	66.92	68.17	66.41	66.61	67.54	0.749
Ether extract, EE	73.43	75.75	72.58	73.03	74.56	0.998
Crude fiber, CF	53.70^{ab}	54.26^{a}	51.23^{b}	52.51^{ab}	53.90^{a}	0.759
Neutral detergent fiber, NDF	65.84^{ab}	67.03^{a}	63.76^{b}	65.23^{ab}	65.91^{ab}	0.769
Acid detergent fiber, ADF	61.12^{bc}	62.58^{a}	60.15^{c}	61.09^{bc}	61.81^{ab}	0.410
			N utilization (g/h/d)			
N intake, NI	24.39^{a}	23.27^{ab}	19.89^{c}	21.78^{b}	23.72^{a}	0.569
N output	21.50^{a}	20.02^{ab}	17.15^{c}	19.00^{b}	20.68^{ab}	0.548
N balance, NB	2.89^{b}	3.25^{a}	2.74^{b}	2.78^{b}	3.04^{ab}	0.089
			Nutritive value			
TDN (%)	66.47^{b}	69.22^{a}	65.81^{b}	66.00^{b}	67.06^{ab}	0.834
DCP (%)	10.65^{a}	10.17^{ab}	9.55^{b}	10.09^{ab}	10.41^{ab}	0.255

^{a,b} and ^{c} : Means denoted within the same row with different superscripts are significantly different at (P<0.05).

Reduced DMI is thought to be caused by three main mechanisms have been suggested to explain the negative effects of high tannin concentrations on voluntary feed intake: a reduction in feed palatability (McLeod, 1974) which could to due to the astringent taste resulting in feed avoidance (Kumar and Singh, 1984), the slowing of digestion, and the development of conditioned aversions (Mueller-Harvey, 2006).

Lower level of CT (3.87 g/Kg) in T2 increased the digestibility coefficients (P>0.05) of DM, OM, CP, EE and CF than those on T1 by 3.91, 3.57, 1.87, 3.16 and 1.04%, respectively. Because tannins are capable to binding with dietary proteins which makes it less degradable in the rumen (Min *et al.,* 2003). This Negative effect of CT on nutrients digestibility was consistent with Hassanat and Benchaar (2013) who observed that condensed tannins have the ability to reduce the digestibility of organic matter in the rumen. These results accord with several studies on the influence of tannin on nutrient utilization by ruminants (Komolong *et al.,* 2001).

In the present investigation, condensed tannins concentration in T3 suppressed NDF and ADF digestibility (P<0.05) by 3.16% for NDF and 1.59% for ADF than the comparable group (T1). This suggests that condensed tannins also have been shown to decrease digestion of cellulose by inhibiting endoglucanase activity of cellulolytic bacteria (McSweeney *et al.,* 2001) and ruminal fungi (McAllister *et al.,* 1994). The reduced fiber digestion was associated with shift in total VFA concentration in ruminal fluid.

Significant differences in N intake (P<0.05) were observed in our study, which was a reflection of differences in DM intake and differences in protein contents of treatment tanniniferous plants that due to the slightly higher N content of the *Cassava* compared with the *Prosopis juliflora* and the *Acacia* *saligna*. Therefore, the N intake was larger with the *Cassava* diet (T1) than with *Prosopis juliflora* (T2) and *Acacia saligna* (T3), respectively. Moreover, animals in all groups still maintained a positive N balance and their live weight. However, the higher NB (P<0.05) of rams on T2 group (3.25 g/h/d) *compared* (P<0.05) with T1 (2.89), T3 (2.74) and T4 (2.78). This could be described by the formation of tannins complexes with some digestive enzymes (trypsin and amylase) to form inactive complexes or with proteins and carbohydrates are inaccessible to microorganisms in lower gut which inhibit the digestive enzymes (Silanikove *et al.*, 1994). Highest values of N output were observed in T1 with significant differences (P < 0.05) compared to T3 which could be due to the slightly higher N content of the *Cassava* compared with the *Prosopis juliflora* and the *Acacia saligna*, respectively.

Total digestible nutrients (TDN) values of T2 was greater (69.22 %) than for all groups (P<0.05). However, the lowest digestible crude protein (P<0.05) values (9.55%) was noticed with T3 compared (P<0.05) with T1 group. This could be due to the slightly lower N content of the *Acacia saligna* compared with the N content of *Cassava* and *Prosopis juliflora* .

Ruminal fermentation

Data in Table (4) showed that, the average rumen ammonia concentration significantly (P<0.05) lower in T3 and T4, while was significantly (P<0.05) higher in T2. Rumen ammonia concentrations were decreased with increasing CT content in experimental diets (T3, T4, T1, T5 and T2, respectively). In all groups, the maximum ammonia concentrations exceeded the level considered the minimum required to maximize microbial growth (Satter and Slyter, 1974). In general, the reduction in rumen ammonia with increased CT content is associated with lower protein degradation, mainly through the formation of tannin–protein complexes that are minimally degraded by ruminal microbes (Molan *et al.*, 2001) and greater non-ammonia nitrogen flow to the duodenum (Waghorn, 1996). These complexes formed between tannins and proteins or other compounds are generally unstable (Kumar and Singh, 1984).

Table (4): Ammonia concentrations, total volatile fatty acids and pH of ruminal fluid of sheep fed different experimental diets.

Item	Experimental groups					±SE
	T1	T2	T3	T4	T5	
pH	6.18	5.95	6.22	6.19	6.05	0.079
NH3- N (mg/100 ml)	5.81^c	5.75^a	5.28^d	5.39^d	6.38^b	0.077
Total volatile fatty acids (mM/100ml)	6.98^b	7.67^a	6.15^c	6.64^b	7.53^a	0.143

$^{a, b,c}$ and ^{d}: Means denoted within the same row with different superscripts are significantly different at P<0.05.

Concentration of total volatile fatty acids (TVFA's) was significantly (P<0.05) higher with feed T2 and T5. In the contrary, TVFA's was lower (P<0.05) significantly with groups fed T3, T4 and T1. Parallel results were obtained by (McSweeney *et al.*, 2001) who observed that improved microbial protein synthesis and reduced protein degradation as decreased branched-chain VFA is commonly observed when protein degradation is reduced by tannins. Hassanat and Benchaar (2013) who observed CT have the ability to reduce the fermentation and digestibility of organic matter in the rumen, they also alter the proportions of VFA's the presence of CT may reduce the NH3 production in the rumen.

2nd trial: Ewes performance.

Results in Table (5) showed that variation in tannin level has effect on daily DM intake during milk production in Barki ewes. The lowest values of DMI as % of body weight were observed in T3 (3.18%) with significantly difference (P<0.05). The findings are in agreement with Mueller-Harvey, (2006) who reported that addition of tannins to dairy diets usually reduces feed intake, because of reduced palatability, decreased rate of digestion and development of conditioned aversion.

Throughout eight lactation weeks during the suckling period, average weekly milk yield showed the same trend of change, where gradual increase after lambing reaching its peak at the 3rd wk of lactation in all groups. While, it was gradually decrease till to 8 weeks of lactation. There was also a significant increase (P<0.05) in milk yield (g/h/d) with decreasing level of CT with an increase of 6.42% in ewes of T2 when compared with the T1. The increasing in milk production is near to that recorded by Anantasook *et al.*, (2014) who showed an increase of 10% in milk yield of cows fed 88 g of CT per kg DM. The same trend found in fat corrected milk, 4%FCM yield whereas; the lowest value was observed with T3 (714.86g/h/d) with significant differences (P<0.05) compared to the other groups. At this respect, similar results were previously observed by Maamouri *et al.,* (2011) in ewes, who found high level of *Acacia* feeding significantly decreased milk production.

Table (5): Feed intake, milk yield and composition of ewes fed different experimental diets.

Item	Experimental diets					±SE
	T_1	T_2	T_3	T_4	T_5	
Total DMI ,Kg/h/d	1.483	1.511	1.303	1.446	1.503	0.118
DMI as % BW	3.62	3.69	3.18b	3.53	3.67	0.094
Milk yield, g/h/d	551.86[bc]	587.29[a]	514.29[d]	541.71[c]	570.89[ab]	6.947
FCM yield, 4%	781.99[c]	841.88[a]	714.86[e]	759.48[d]	813.23[b]	6.397
Fat, %	6.78	6.89	6.60	6.68	6.83	0.266
Protein, %	4.86	4.89	4.72	4.76	4.88	0.171
Lactose, %	5.74	5.77	5.72	5.74	5.75	0.199
Total solids, %	16.52[ab]	16.94[a]	16.40[b]	16.47[b]	16.73[ab]	0.134
Solids not fats, SNF, %	9.74[b]	10.05[a]	9.80[b]	9.79[b]	9.90[ab]	0.066
Calorific value, MJ/L	4.86	4.90	4.78	4.81	4.88	0.063
Dairy efficiency, kg milk/kg DMI	0.372	0.389	0.395	0.375	0.381	0.011

[a, b,c,d] and [e] : Means denoted within the same row with different superscripts are significantly different at P<0.05.

As presented in our study there is no considerable variability in milk composition traits among the all groups, whereas, a specific role for CT concentration at 3.87 g/DM (T2) and 8.33 g/DM (T3) was unclear since the difference in milk composition (fat, protein and lactose) between the treatments was not significant, despite a trend toward lower percentages of different milk contents for ewes on the high CT content diets. In agreement with the present results, Abdalla *et al.,* (2013) found that fat percentage in goat milk was not affected by type of roughages. Also, El-Saadany *et al.,* (2016) cleared that there was a non-significant tendency of decrease in fat content in ewes milk fed *Cassava* as compared to other groups during all lactation weeks.

These results suggest that decreased total VFA productions in the rumen and digestion coefficients of all nutrients and the subsequently decreased availability of VFA and nutrients in the small intestine with feeding high CT may be responsible for decreasing milk yield traits in this study. In addition, T2 had the greatest values (P<0.05) of total solids (TS) and solids not fats (SNF) % compared the other treatments. This results in line with that observed by, El-Saadany *et al.,* (2016) who found TS content was significantly (P<0.05) lower in milk of ewes fed *Cassava* diet than in other groups (*Acacia - Atriplex*) during the 1[st] six weeks of lactation.

No significant differences were observed in dairy efficiency (kg milk/kg DMI) and calorific value (MJ/L) in this study. Apparently; these inconsistent findings are probably related to ruminant species, physiological stage and type of CT and dose.

Performance of offspring's:

As presented in our study Table (6), there is no considerable variability in average live body weight among all experimental groups from birth till weaning and the differences were not significant.

As shown in Fig. (1), it’s worth noting that total gain and average daily gain of lambs (males and females) was not affected at different ages affected by their mothers feeding shrubs plants. These results agreement with Shetaewi *et al.* (2001), Fasae *et al.*(2015) and El-Saadany *et al.* (2016). This means that feeding ewes during pre- and postpartum period on different forage types in this study was save without adversely effects on growth performance of lambs produced.

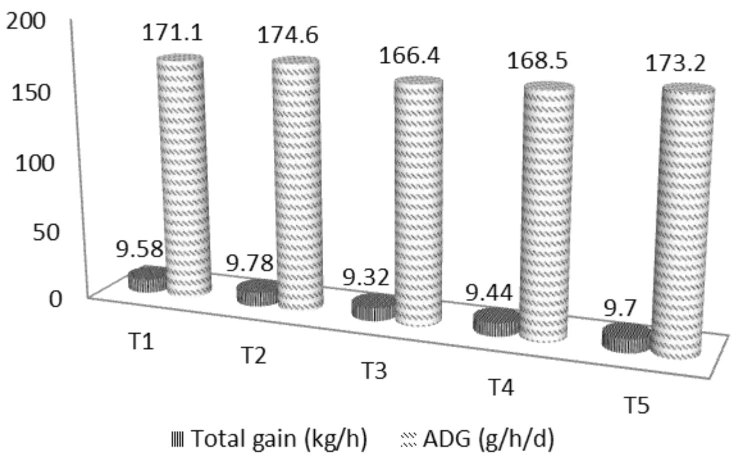

Fig. (1): Average LBW of lambs from ewes in the experimental groups.

Ewes blood parameters:

Table (6) shows that, T2 and T5 had significant (P<0.05) higher values of total protein and Globulin (G) compared with the other treatments. No significant difference among different treatments regarding Albumin (A) was observed. Increased total protein and its fractions could be attributed to the increase in digestibility of CP (Shahen *et al.*, 2004).

Groups T3 and T4 have higher levels (P<0.05) of urea-N and creatinine when compared with the other groups. Urea is a toxic end product of protein catabolism, yet rumen flora can utilize its nitrogen for microbial protein synthesis and increases its concentration may produce toxic effect (Aldoori *et al.,* 2011).

Table (6): Some blood biochemical parameters of Barki ewes fed different experimental diets.

Item	Experimental treatments					±S.E.
	T1	T2	T3	T4	T5	
Protein fraction						
Total protein, g/dl	7.82^{b}	8.59^{a}	7.41^{b}	7.72^{b}	8.47^{a}	0.181
Albumin(A), g/dl	2.65	2.81	2.40	2.48	2.77	0.127
Globulin(G), g/dl	5.17^{b}	5.78^{a}	5.01^{b}	5.25^{b}	5.70^{a}	0.121
Kidney function						
Urea-N, mg/dl	57.32^{b}	54.28^{c}	61.88^{a}	60.36^{a}	55.44^{bc}	0.705
Creatinine mg/dl	0.93^{c}	0.81^{d}	1.18^{a}	1.06^{b}	0.89^{cd}	0.032
Liver function						
AST, IU/l	99.62^{b}	91.84^{d}	118.49^{a}	101.85^{b}	95.83^{c}	0.927
ALT, IU/l	39.64^{ab}	37.87^{b}	41.19^{a}	40.82^{a}	38.72^{b}	0.634
ALP, IU/l	53.01^{b}	42.76^{d}	59.77^{a}	55.99^{b}	48.91^{c}	1.097

*$^{a, b,c}$ and ^{d}: Means denoted within the same row with different superscripts are significantly different at P<0.05***.**

Values of AST and ALP, IU/l were significantly higher (P<0.05) for the ewes in T3 as compared to all groups, also the highest values of ALT were recorded (P<0.05) with T3 and T4. Overall mean of kidney function and liver function values are in the normal range according to Fasae *et al.*, (2015).

3rd trial: Lamb growth performance:

Effect of experimental diets on subsequent growth performance traits of Barki lambs are presented in Table (7). As illustrated in fig (2) and Table (7), regardless of dietary treatment, all animals maintained live body weight in this trial whereas, the lambs of T2 and T5 produced totally (P<0.05) higher final live body weight (29.03 and 28.16 Kg, respectively) compared to the other groups.

The significantly (P <0.05) higher values of growth rate were observed for lambs in T2 (186.55 g/d) and T5 (179.33 g/d) and obtained higher (P<0.05) total gain (16.79 and 16.14 Kg, respectively) compared to the other experimental groups. Similar effects were observed in sheep and goats fed fresh or dried A. *salicini*, as shrub with a high CT content (Degen *et al.,* 1997). These findings are also in accordance with study of Abdullah *et al.,* (2011) who observed increased body weight when the basal diet (elephant grass) for Omani sheep was supplemented with *Prosopis juliflora* pods.

Table (7): Some growth characteristics, daily feed intake, feed conversion and feed efficiency in Barki lambs under different treatments.

Item	Experimental groups					±S.E.
	T_1	T_2	T_3	T_4	T_5	
Initial weight, (kg)	12.28	12.24	12.30	12.27	12.02	0.124
Final weight, (kg)	26.91^{b}	29.03^{a}	26.4^{b}	26.56^{b}	28.16^{a}	0.309
Total gain, (kg)	14.63^{c}	16.79^{a}	14.10^{d}	14.29^{cd}	16.14^{b}	0.128
Growth rate (g per day)	162.55^{c}	186.55^{a}	156.66^{d}	158.78^{cd}	179.33^{b}	1.236
Daily feed intake:						
Total DMI (g/h/d)	709.34^{a}	724.29^{a}	683.06^{b}	683.41^{b}	721.23^{a}	5.479
DMI as %BW	3.62	3.51	3.53	3.52	3.59	0.085
CP intake, (g/h/d)	112.93^{a}	107.99^{b}	98.22^{d}	103.54^{c}	111.14^{ab}	1.268
Tannins intake (g/h/day)	5.41^{a}	2.80^{c}	5.69^{a}	5.45^{a}	3.62^{b}	0.108
Feed conversion ratio:						
(kg DMI / kg Body gain)	4.36^{a}	3.88^{c}	4.36^{a}	4.30^{ab}	4.02^{cb}	0.100

a, b,c and d: Means denoted within the same row with different superscripts are significantly (P<0.05) different at P<0.05.

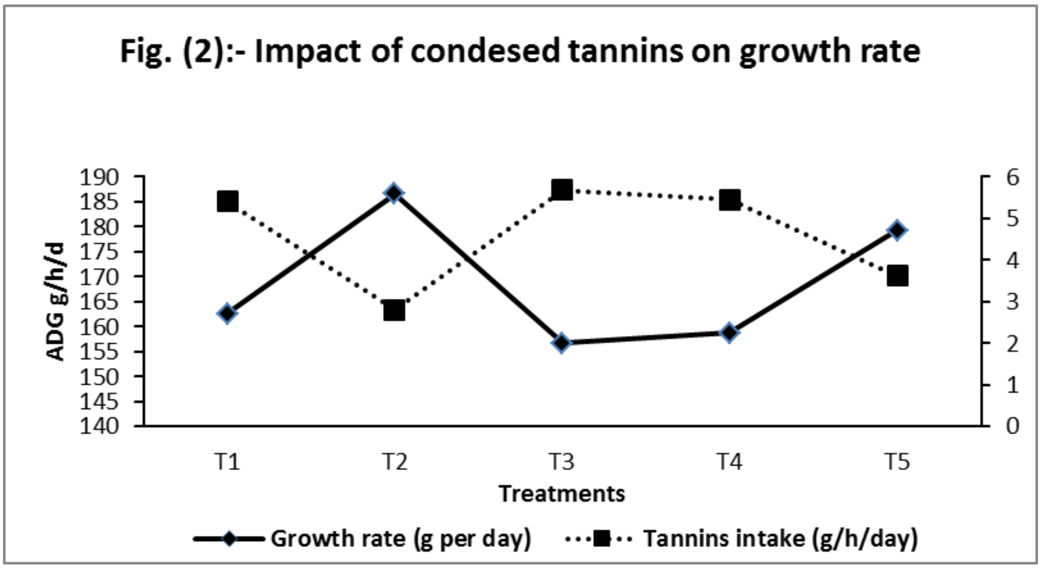

Fig. (2): Impact of condensed tannins on growth rate

This reduction in daily weight gain with increasing CT may be due to a combination of reduced voluntary feed intake and low digestibility of nutrients, attributed mainly to the high CT content (Chriyaa *et al.,* 1997).

The lower values (P<0.05) of DMI were marked in lambs fed T3 (683.06 g/h/d) and T4 (683.41 g/h/d) compared to the other groups although dry matter intake (%) was not different significantly between all experimental groups. The reduction in feed intake might be due to the CT suppressed the appetite of animals to the diet as it has slowly rates of digestion in the rumen (Mahgoub *et al.,* 2005).

Highest values of CP intake were observed with lambs in T1 (112.93 g/h/d) and T5 (111.14 g/h/d) with significant differences (P<0.05) compared to other experimental groups. This is attributed largely to the relatively high levels of CP in *Cassava*, that was consistent with (Wanapat, 2000) who found *Cassava* hay has been used successfully as a source of high protein roughage in lactating dairy cows. There was a significant difference in CT intake between the treatments whereas, the lowest value was observed with lambs in T2 (2.80) with significant differences (P<0.05) followed by T5 (3.62), T1 (5.41), T4 (5.45) and finally T3 (5.69). These could be due to the high content of CT in *A. saligna* (Krebs *et al.,* 2007). On the other hand, increased significantly (P<0.05) feed conversion ratio (FCR) for lambs in T2 (3.88) as compared T1, T3 and T4 groups that could be explain by high total feed intake in this groups, which had more palatability because tannins are usually associated to a decrease in palatability, and consequently discourage grazing (Ngwa, *et al.*, 2002). Also, high tannin levels reduce preference of plants by cattle, sheep and goats (Perevolotsky, *et al.*, 1993).

Blood biochemical parameters

Data of blood biochemical parameters of lambs are presented in Table (8). Total protein and globulin (G) decreased linearly (P<0.05) but serum enzymes ALT and ALP (IU/l)), Urea-N, and creatinine were taken opposite trend and increased linearly (P<0.05) as the level of CT in the diet increased.

Table (8): Some blood biochemical parameters of Barki lambs fed different experimental diets.

Item	Experimental treatments					±SE
	T1	T2	T3	T4	T5	
			Protein fraction			
Total protein, g/dl	6.51^{b}	7.36^{a}	6.46^{b}	6.50^{b}	6.79^{b}	0.104
Albumin(A), g/dl	2.64	2.87	2.54	2.58	2. 65	0.109
Globulin(G), g/dl	3.87^{b}	4.49^{a}	3.92^{b}	3.92^{b}	4.14^{b}	0.105
			Kidney function			
Urea-N, mg/dl	56.48^{ab}	51.72^{b}	60.79^{a}	57.04^{ab}	55.76^{ab}	1.605
Creatinine, mg/dl	1.58^{ab}	1.45^{b}	1.79^{a}	1.71^{a}	1.57^{ab}	0.067
			Liver function			
AST, IU/l	84.44	82.64	85.45	84.98	83.48	0.822
ALT, IU/l	34.38^{a}	30.26^{b}	35.18^{a}	35.06^{a}	33.90^{a}	0.824
ALP, IU/l	41.23^{c}	33.34^{d}	49.35^{a}	44.31^{b}	39.89^{c}	0.664

a, b,c and d: Means denoted within the same row with different superscripts are significantly (P<0.05) different at P<0.05.

No significant effect of dietary treatment (P<0.05) was found on albumin (A), and AST. Condensed tannins as a plant secondary compound may affect blood parameters by maintaining them (Raghuvansi *et al.,* 2007), decreasing (Joy *et al.,* 2001) or increasing others (Mohammed *et al.,* 2004).

CONCLUSION

The results from this trial suggest that low concentrations of CT increased nutrients digestibility, milk yield and growth performance as a consequence of an increase of rumen escape proteins and higher absorption of amino-acids. Dietary inclusion of leaves & twigs of *Acacia saligna Cassava and then Prosopis, respectively as a source of* tannin had negative impacts on productive performance when CT level in the diet is high. The findings suggest that leaves & twigs of *Prosopis*, *Cassava* and then *Acacia Saligna, respectively* can replace up to 20% dietary inclusion in the presence of relatively high concentrate meal contents in diets for Barki sheep. More research is required to determine the most appropriate ratios for the introduction of each of the experimental tanniniferous plants under different feeding strategies.

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دراسة تأثير خلط النباتات الغنية بالتانينات مع تبن القمح المعامل بالأمونيا في علائق الأغنام البرقي على الهضم،الأداء وبعض مكونات الدم الحيوية

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أجريت التجارب المزرعية في محطة بحوث برج العرب للأبحاث- معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية وذلك لدراسة مدى امكانية ادخال خلطات من الاشجار العلفية الغنية بالتانينات مع تبن القمح المعامل بالأمونيا على الهضم والأداء في أغنام البرقي وتم ذلك خلال عمل خمس خلطات لتكوين خمس علائق كالتالى:

1- 60% علف مركز +20% تبن قمح معامل بالأمونيا+ 20% أوراق وأفرع كاسافا
2- 60% علف مركز +20% تبن قمح معامل بالأمونيا+ 20% أوراق وأفرع بروسوبس
3- 60% علف مركز +20% تبن قمح معامل بالأمونيا+ 20% أوراق وافرع أكاسيا
4- 60% علف مركز +20% تبن قمح معامل بالأمونيا+ 10% أوراق وأفرع كاسافا+ 10% أوراق وأفرع أكاسيا
5- 60% علف مركز +20% تبن قمح معامل بالأمونيا+ 10% أوراق وأفرع كاسافا + 10% أوراق وأفرع بروسوبس.

اختبرت تلك الخلطات من خلال ثلاث تجارب:

التجربة الأولى: أجريت على 15 كبش برقى بمتوسط وزن 43±1.85 كجم قسمت لخمس مجاميع متجانسة فى الوزن لتقدير معاملات الهضم وكمية المأكول . اظهرت النتائج ان المجموعة المغذاة على (T3) والمحتوية على أعلى نسبة تانينات (8.33 جم /كجم مادة جافة) كان لها اقل كمية مأكول يومى بمعدل 9.72% مقارنة بمجموعة المقارنة (T1). واظهرت المجموعة ذات المستوى المنخفض من التانينات (3.87 جم/كجم) (T2) معاملات هضم أعلى بصفة غير معنوية لكل من المادة الجافة والمادة العضوية والبروتين الخام والدهن الخام والالياف الخام مقارنة باالمجموعة الاولى (T1) بحوالى 3.91% و 3.57% و 1.87% و 3.16% و1.04% على الترتيب. بينما تركيزات امونيا الكرش كانت تنخفض مع زيادة التانينات فى العلائق T3 و T4 و T1 و T5 و T2 على الترتيب.

التجربة الثانية : اجريت باستخدام 25 من اناث البرقى في مرحله الحمل المتأخر بمتوسط وزن 41± 2.29 كجم بعمر 3-5 سنوات وزعت عشوائيا لخمس مجموعات بحيث اشتملت كل معاملة على 5 حيوانات لتحديد مدى تأثر كمية وتركيب اللبن بنسبة التانينات ومصادرة وكذلك نمو الخلفة. اظهرت النتائج ان هناك زيادة معنوية فى كمية اللبن مع انخفاض تركيز التانينات بالعليقة بزيادة مقدارها 6.42% فى العليقة T2 عند المقارنة بالعليقة T1، بينما لم تتأثر مكونات اللبن بصورة معنوية وكذلك مدل النمو اليومى للخلفة.

التجربة الثالثة: استخدم فيها 25 حمل من ذكور البرقى بعد الفطام بمتوسط وزن 12±0.64 كجم بعمر 3-4 شهور قسمت الى خمس مجموعات لدراسة مدى تأثر اداء النمو بمستوى التانينات بالعليقة واظهرت النتائج ان الحملان المغذاة على العليقة T2 و T5 كان لها اعلى معدل للزيادة فى الوزن معنويا (29.03 كجم و 28.16 كجم على الترتيب) بنهاية فترة تجربة النمو والتى استمرت لمدة 90 يوم عند المقارنة مع باقى المعاملات. البروتين الكلى والجلوبيولين بالدم انخفض معنويا بصورة خطية مع زيادة نسبة التانينات بالعلائق فى حين ان انزيمات ALT و ALP (IU/I) واليوريا والكرياتينين اخذت اتجاة معاكس حيث ازدات قيمتهم خطيا بصورة معنوية مع زيادة مستوى التانينات بالعليقة.

ومن نتائج التجربة يمكن استنتاج أنة يمكن ادخال النباتات الغنية بالتانينات (البروسوبرس والكاسافا والأكاسيا) فى علائق أغنام البرقى مع التبن المعامل بالأمونيا حتى مستوى 20% من اجمالى العليقة بدون ظهور اثار سلبية على الاداء.