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Research Article

Introduce Sweet Potato Vines as Good Roughage for Small Ruminants

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Received: March 15, 2016; **Published:** April 27, 2016

Abstract

In order to introduce the sweet potato vines (SPV) as good roughage for small ruminants, three treatments (sun dried, silage with or without inoculants, 11C33) were carried out to come over their anti-nutritional compounds and pesticides residues contents. Four rations were studied, fresh SPV (FSPV), (control) (R_1); sun dried sweet potato vines (SDSPV) (R_2); uninoculated SPV silage (USPVS) (R_3) and inoculated with (11C33) bacteria (ISPVS) (R_4). All form of SPV was fed *ad libtum,* while concentrate feed mixture (CFM) was fed according to NRC (1994). The effect of treatments on concentration of anti-nutritional compounds, detoxification of pesticides residues, energetic values, rumen fermentation characteristics and degradability of roughages, blood picture and the consequently sheep performance was also studied. Digestibility trials were conducted with twelve Barki rams (three rams for each ration), while rumen fermentation trials were conducted with three fistulated female Barki ewes. Feeding trials were applied with twenty late pregnant Barki ewes. Milk production, milk composition, feed intake and following up of the new born lambs were studied. Data showed that: 1- All silages were excellent and had a normal pH with the superiority of those inoculants, 2- Crude protein content was increased by ensilage either with or without inoculants, while CF, NDF, ADF, hemicellulose and cellulose were decreased; 3- All anti-nutritional compounds were reduced by the sun-drying and silage making compared to the fresh one with more influence with inoculants in that respect; in the same trend, concentration of pesticide residues was decreased; 4- More TDN value and N-balance were resulted with ISPVS ration; 5- Rumen fermentation for inoculants SPVS lead to less ruminal $NH\text{-}N_3$, more VFA's concentrations, more effective degradability (ED) of DM, CP and CF, more microbial protein (MP) synthesis, highest cellulolytic bacteria and lowest protozoa counts values; 6- Feeding ISPVS ration resulted in more lamb's weaning weight, gain and ADG compared with other tested rations. In the meantime, ewes had produced more milk, 4% FCM, better feed conversion, feed efficiency and good economic return and 7- Serum glucose, total protein and albumin concentrations was significantly higher ($P < 0.05$) for ewes fed either USPVS or ISPVS rations. On the other hand, ewes fed ration contained FSPVS was higher ($P < 0.05$) in urea; cholesterol; AST and ALT than other rations. So, feeding ISPVS ration could be successfully and economically a good roughage for lactating ewes. However, it is necessary to carry on more research in this respect for a long term feeding on such materials with analysis of metabolites; blood; milk and meat products for animals fed such materials.

Keywords: *Sweet potato vines; Anti-nutritional compound; Pesticides residue; Physical and biological treatments, digestibility, degradability, lactating ewes- lambs- weaning weight.*

Introduction

Increasing feed costs and the need for rations based on locally available feedstuffs has shifted nutritionists studies to unconventional feedstuffs for ruminants [2]. Considerable quantities of crop residues by uncommon agro-industrial are generated every year in most developing countries in the tropics and subtropics. Most of the mentioned crop residues are suitable for feeding livestock; however, because of lack of technical-know-how they are considered as waste and are disposed [3]. Using crops by-products led to some advantages such as participating in solving the problem of feed shortage, decrease the cost of feeding and alleviating the pollution problems [4]. One of such alternative feedstuffs is the sweet potato vines (SPV) which produced and left over after harvesting and can remain green during a long

period and it is also a valuable forage for ruminants and other livestock species [5]. Sweet potato (*Ipomoea batatas*) is a tropical crop of a relatively short vegetative cycle the tubers of which are usually employed for human and animal consumption [6]. In Egypt the annual productions of sweet potato were estimated to be about 3.76 million tons [7], consequently there is a huge amount of SPV can be used. Nutritionally, SPV are a rich source of protein, fiber, vitamins, also had moderate to good quantities of all the essential amino acids, the DM content of fresh SPV was 11.9% and crude protein was 19.8% of DM [8]. [9] reported that SPV could be used as an alternative supplementary feed for calves and small ruminants dry season and can be fed to dairy cattle as well [10]. Due to the presence of anti-nutritional compounds such as trypsin inhibitor, hallucinogens, saponins, tannins, phytate and oxalate [11,12], it can potentially be a negative effects on livestock production; which in turn it case reduction in palatability, digestibility, utilization of nutrients and rumen fermentation, resulting in not only decreased production but also low quality of meat and milk products due to the presence of such hazardous residues [13]. On the other hand, pesticides are widely used with sweet potato growers in most developing countries; it's classified as extremely hazardous by the world health organization (WHO). [14] reported that application of a pre plant soil-incorporated (PPI) insecticide is standard procedure to reduce the possibility of insect damage to marketable sweet potatoes. Seventy-two insect species have been reported from sweet potato foliage or associated with roots [14]. Therefore, pesticide residues and contamination commonly occur in agricultural products and environments. However, drying, ensiling process and biological additives may be participating to solve these problems. Biotechnological processes, especially ensiling process and biological additives may help in solving the anti-nutritional factors problems [15]. Ensiling with 11C33 inoculants (Dual purpose contains homofermentative and heterofermentative lactic acid bacteria) could improve chemical composition, fermentation characteristics, aerobic stability and feeding values of silage, also it could reduces the tannins, phytic acid and trypsin inhibitors [16]. Meantime, fungi, bacteria, and other microorganisms can degrade pesticides to be used by them as their food source [17]. The objective of this study was to evaluate the effect of sun-drying, ensiling process and biological additives (11C33 inoculants) of SPV on their anti-nutritional compounds concentrations, detoxification of pesticides residues, rumen fermentation and sheep performance.

Materials and Methods

The present study was conducted at Noubaria Experimental Station, Animal Production Research Institute, Agriculture Research Center, Egypt.

Fresh SPV were daily harvested from the nearby field and were chopped (6–8 cm long pieces) by chopper machine prior to feeding. Dried SPV were made by spread it out on concrete out-doors in the sun for 3-4 days.

Silage preparation and its quality

Chopped sweet potato vines (SPV) were spread out on the floor overnight for wilting to reduce the moisture content. Two underground trenches (2 ton each) were filled with tested SPV. No inoculants were introduced in the first trench, while one g of 11C33 (dual purpose containing total viable lactic acid producing (1.1×10^{11} CFU/g) from multiple strains of *(Lactobacillus buchneri, Lactobacillus plantarum and Entrococcus faecium)*/liter water / ton fresh material was added in the second trench. Molasses were added at the rate of 3% (on DM basis) to enhance the carbohydrate fermentation processing. The two trenches were tightly covered with plastic sheet after pressing the SPV layers by tractor. Then it was covered with 25 cm of soil layer to guarantee anaerobic condition and left for 60 days. In order to determinate the silage quality, polyethylene bags (three for each kind of silage) were packed by 500 g materials pressed well and kept closed and left at room temperature for 60 days as well. After that period bags were opened, color and odor were directly examined .Values of pH, ammonia-N, lactic, acetic, and butyric acids were determined in the extraction of silage. Values of pH were determined directly using Beckman pH meter. The concentration of ammonia-N was determined using magnesium oxide (MgO) as described by [18]. Determination of lactic, acetic and butyric acids was achieved using gas chromatography according to [19]. Proximate analyses were performed according to [20] methods. Aerobic stability was measured according to [21].

Determination of anti-nutritional compounds

Approximately 200 mg (DM) of SPV and its silages were extracted in 10 ml of aqueous acetone (7:3 v/v) in a water bath and maintained at 39–40°C for 90 min [22]. Total tannins were determined according to [23]; oxalates by the titration method of [24]. The trypsin inhibitor activity was determined by the method of [25]. Cyanide content was determined by the method of [26]; phytic acid concentration by a colorimetric procedure described by [27]. Glycosides concentration was determined by the method of [28], while saponins were extracted and isolated according to [29].

Determination of pesticide residues

Concentrations of pesticide residues in fresh; dried and silages of SPV and in milk were detected according to [20] by gas chromatographic multiresidue quantitative determination of organo-halogen, organonitrogen and organophosphrous compounds. These analytical procedures were kindly carried out by the Department of Environmental Studies, Institute of Graduate Studies and Research, University of Alexandria, Egypt.

Digestibility and nitrogen balance trials

Digestibility and nitrogen balance trials were carried out using three Barki rams (41 ± 1.30 kg, live body weight) for each ration. Each trial lasted for four weeks; the first three weeks as a preliminary period, followed by one week for feces and urine collection. Animals were offered tested roughages *ad libitum* twice a day at 8.0 a.m and 4.0 p.m. plus 600 g/head/d concentrate feed mixture (CFM) in order to meat their maintenance requirements according to [1]. The four rations were: fresh sweet potato vines (FSPV) plus CFM (R_1) (control); sun-dried sweet potato vines (SDSPV) plus CFM (R_2); uninoculated sweet potato vines silage (USPVS) plus CFM (R_3) and inoculated sweet potato vines silage by (11C33) inoculants (ISPVS) plus CFM (R_4). CFM consists of 33% yellow corn, 10% soybean meal, 18% wheat bran, 18% rice bran, 13% undecorticated cotton seed meal, 4.50% molasses, 2% limestone, 1% salt, 0.50% mineral mixtures. Water was freely offered. Chemical composition of feeds, feces and urine was determined according to [20]. Fiber fractions (NDF, ADF and ADL) were determined according to [30].

Rumen fermentation and in situ trials

Three ruminally-canulated Barki ewes were used for testing the rumen fermentation and *in situ* trials. Rumen samples were withdrawn before feeding and 1, 3 and 6 hrs after feeding for *in vitro* incubation using the zero rate techniques as described by [31]. Ruminal pH and NH_3-N values were determined as described before. Total VFA's were determined by steam distillation as described by [32]. Rumen volume was determined by colorimetric method of Cr-EDTA before, 3 and 6 hrs after feeding [33]. Total bacteria count was carried out according to [34]. Cellulolytic bacteria were carried out by using roll-tube technique [35]. Count of protozoa was carried out according to [36] based on the use of a hemacytometer (Hausser Scientific, Horsham, PA). The microbial protein synthesized (gMP/day) in the rumen of sheep fed the experimental rations was calculated using the model equation by [37] as follow: g MP / day = mole VFA produced / day × 2 × 13.48 × 10.5 × 6.25 / 100, where one mole VFA yield about 2 mole ATP [38], one mole ATP produce 13.48 Y_{ATP} (g DM microbial cell); [39], whereas N % of dry microbial cell = 10.5 [40].

Nylon bags technique [41] was used to determine degradability of DM, CP and CF for tested roughages. Two polyester bags (7×15 cm) with pore size of 45 µm were used for each incubation time. Approximately of 5g air-dried roughage (ground to 2 mm) were placed in each bag. Bags were incubated in the rumen of each sheep and withdrawn after 3, 6, 12, 24, 48, 72 and 96 h. After the bags were withdrawn from the rumen, they were rinsed in tap water until the water became clear, then they were squeezed gently. Microorganisms attached to the residual sample were eliminated by freezing at -20°C [42] Zero-time washing losses (a) were determined by washing 2 bags in running water for 15 min. The degradation kinetics of DM, CP and CF were estimated (in each bag) by fitting the disappearance values to the equation $P = a + b (1- e^{-ct})$ as proposed by [43], where P represents the disappearance after time t. Least-squares estimated soluble fractions are defined as the rapidly degraded fraction (a) slowly degraded fraction (b) and the rate of degradation (c) respectively. The effective degradability (ED) for the tested silages were estimated from the equation cited by [44], ED = a + bc / (c + k), where k is the out flow rate.

Feeding trials

Twenty late pregnant Barki ewes (last 4-6weeks of gestation period) at 2nd and 3rd seasons were used in this experiment. Ewes were divided into four similar groups (5 ewes each) and fed in feeding group according to [1]. After lambing ewes and lambs were weighed directly after 15hr and weighed at 15; 30; 45 and 60 days of age and the lambs were weaned at 60 days of age. The lambs were isolated out of their dams after the second meal at 3.0 pm till the next day. The lambs were stayed 8 hr daily apart from their dams, then weighed before suckling and after suckling, then ewes were completely hand milk till stripping on the next day morning and milk yield was recorded. Milk components were analyzed for fat, total solid (TS), solid not fat (SNF), total protein (TP) and ash percentages according to the methods of [45], while lactose was calculated by difference.

Economic evaluation

Economical efficiency was estimated as the price of daily gain (L.E) / daily feed cost (as fed, L.E/ewe). Economic indicators derived were based on farm gate prices in egyptian pound (LE) as follows; concentrate feed mixture (CFM) = 2300 L.E\ton, fresh sweet potato vines = 200 L.E\ton, dried sweet potato vines = 900 L.E\ton and uninoculated sweet potato vines silage = 270 L.E\ton, inoculated sweet potato vines silage = 280 L.E\ton. Marketed weaned lambs (L.E 44/kg) were considered.

Sampling and analysis of blood serum

At the same day of milking, blood samples were directly collected from jugular vein of ewes into vacuum tube before morning feeding. The vacuum tube was centrifuged at 3000 rpm for 15min, and then blood serum was separated into polypropylene tube and stored at -18°c until analysis. Various chemical parameters were calorimetrically determined using commercial kits; following the same steps as described by manufactures. Concentration of serum glucose was determined according to [46]; total proteins (TP) as described by the Biuret method according to [47]; albumin (A) according to [48]; globulin (G) was calculated by subtracting the albumin value from total protein value; urea was detected according to [49]; cholesterol according to [50]; while liver function was assessed by measuring the activities of aspartate aminotrasferase (AST) and alanine aminotransferase (ALT) according to [51].

Statistical analysis

Data of milk yield, milk composition and blood parameters obtained from this study were statistically analyzed according to [52] for PC. The following model was subjected:

$$Y_{ijkl} = \mu + T_i + a\,(T)_{IJ} + W_K + E_{ijkl}$$

Where: Y_{ijkl} = Parameter under analysis; μ = Overall mean; T_i = The fixed effect of treatment; T_{IJ} = The random effect of animal (j) within treatment (i); W_K = The fixed effect of week when K = 1,2,….,8; E_{ijkl} = random error. Also, data of digestibility trail, rumen study and performance of lambs were subjected to one way analysis of variance as described by [53]. Statistical processes were carried out using the General Linear Models adapted by [52] for PC. Significant differences among means were separated using LSD test according to [54].

Results and Discussion

Chemical composition and fiber fractions

The chemical profiles and fiber fractions of CFM, FSPV, SDSPV, USPVS and ISPVS are shown in Table (1). The CP content of sweet potato vine was similar to value reported by [55,56] while, it was lower than that reported by [57,3] (CP contents of 23.3 and 21.55 g/100g DM, respectively). Similarly, the cell wall constituents (NDF and ADF) observed in this study was higher than those reported by [58,56]. [59] noted that the proportion of cell wall components of a plant increases with increasing stage of maturity as the proportion of cell contents decreases. Secondly, some leaves fall off during the handling of the sweet potato tuber sacks before and after they reach the markets. It could be observed that making silage resulted in decreasing CF, NDF, ADF, hemicellulose and cellulose but ash and EE contents were increased. The more reduction in cell wall component was observed with ISPVS. However, NDF was reduced by about 15.08 and 9.44 % in ISPVS and USPVS, respectively. These could be due to the effect of enzymes produced by anaerobic microorganisms in silage. These data was agreed with that reported by [16] speculated that inoculated silage with dual-purpose inoculants were decreased fiber fractions

compared with uninoculated one. Solar drying treatment did not showed positive improve in fiber components in the cell wall of sweet potato vines. The CP content of fresh and dried sweet potato vines was similar while a higher value was found with both ensiling materials (Table 1).

Items	CFM	FSPV	SDSPV	USPVS	ISPVS
Chemical analysis					
OM	91.11	90.07	89.57	89.38	89.66
CP	15.78	10.83	10.79	11.12	11.79
CF	12.14	25.94	26.04	23.28	21.12
EE	2.76	2.58	2.67	3.06	3.38
NFE	60.43	50.72	50.07	51.92	53.37
Ash	8.89	9.93	10.43	10.62	10.34
Fiber fractions					
NDF	40.27	37.81	38.06	34.24	32.11
ADF	25.53	26.03	26.11	23.84	21.94
ADL	4.16	6.65	6.68	6.51	6.03
Hemicelluloses	14.74	11.78	11.95	10.40	10.17
Cellulose	21.37	19.38	19.43	17.33	15.91

Table 1: *Chemical composition and fiber fractions of materials fed to sheep (% on DM basis).*

CFM: concentrate feed mixture, FSPV: fresh sweet potato vines, SDSPV: sun dried sweet potato vines, USPVS: uninoculated sweet potato vines silage, ISPVS: inoculated (11C33) sweet potato vines silage.

Silage quality

It was observed that inoculated or uninoculated silages were free from molds, with suitable fermentation characteristics, yellowish green color, and good smell and free from any signs of dust smells or tobacco odor. Inoculated or uninoculated silages were excellent and have a firm texture. However, values of pH could indicated for good preserved silage, it were within normal range (3.84 and 4.06) with the superiority of ISPVS and then uninoculated one (Table 2). [60,61] indicated that good silage should have a pH value of 4.20 or less. [62] reported that pH value of inoculated silage with lactic acid bacteria (LAB) was decreased compared with the uninoculated, whereas LAB produced organic acids through its growth which reduced pH value. The NH_3-N concentrations were within the normal range given by [63] being 1.02 to 3.62 % of DM, where inoculated silage recorded the least concentration; and good quality silage is usually less than 2.87. Higher lactic and acetic acids were recorded with ISPVS. Inoculation increased acetate concentration which was partly attributable at least to the presence of *L.buchneri,* as sugars and lactate fermented to acetate [64]. The growth of lactic acid bacteria reduced pH value and DM energy losses but it increase silage bunker life. The protein breakdown is almost inhibited with decreasing pH value; this might be due to that lactic acid organisms could help to reduce the breakdown of protein to ammonia. However, fermentation characteristics are in agreement with previous studies reported by [65,66]. Aerobic stability is great importance because it is not only a potential cause of nutrient and DM losses; it also leads to health risks to animals and humans due to mycotoxins produced by undesirable microorganisms [67]. The results in the current study indicated that inoculation improved the aerobic stability of ensiled. Meantime, inoculation with lactic acid bacteria could reduce the yeast and mold population, and increased aerobic stability. However, several subsequent studies had confirmed the efficacy of using inoculants to increase silage aerobic stability [68,69].

Items	Uninoculated silage	Inoculated silage
DM,%	34.87	33.68
pH value	4.06	3.84
NH_3-N,% of DM	1.29	1.06
Lactic acid, % of DM	4.71	5.13
Acetic acid, % of DM	3.17	3.32
Butyric acid, % of DM	1.03	0.91
Aerobic stability, h*	39.3	54.80

Table 2: *Silage quality at the opening day.*

**Aerobic stability was defined as the number of hours that takes to a 2°C increase in silage temperature above ambient temperature occurs in air exposed silage.*

Concentrations of anti nutritional compounds

The screening of anti-nutritional compounds in the FSPV, SDSPV, USPVS and ISPVS revealed the presence of oxalate, trypsin inhibitor activities, tannins, cyanide, phytate, glycoside and saponins (Table 3). The oxalate content of the FSPV (4.86%) was very high compared to the value obtained for the tannins, cyanide, phytate, glycoside and saponins contents. The value was found to be higher than that reported for FSPV (308 mg/100g) by [70]. [11] concluded that with increasing use of sweet potato as animal feed, it is becoming more critical to increase the edible plant portion without deleterious nutritional composition (e.g trypsin inhibitors). Genotype, growing environment and growth stage are known to affect trypsin inhibitor activity (TIA) in sweet potato roots and vines. However, sweet greens potato had three to five folds more crude protein than roots. The tannin content of the FSPV was lower than that reported by [71] (9.01mg/100g). The cyanide content of the FSPV was lower than that reported for FSPV by [70] (30.24 mg/100g). The phytate content of the FSPV was seen to be higher than that reported for FSPV (1.44) by [70] and far much lower than that reported by [72]. The glycoside content of the FSPV was observed to be 2.31mg/100g. The saponin content was observed to be higher than that reported for FSPV (0.423mg/100g) by [71]. It was clear that making silage either with or without inoculant could be a good process to reduce concentration of anti-nutritional compounds in sweet potato vines in comparison with sun-dried treatment. Sun dried treatment decreased the concentration of oxalate, trypsin inhibitor activities, tannins, cyanide, phytate, glycoside and saponins by about 40, 38, 39, 28, 22, 40 and 42%, respectively. While, uninoculated silage decreased such the concentrations by about 50, 39, 47, 40, 28, 55 and 57%, respectively. Meantime, inoculation with (11C33) bacteria was found to be more an effective method in improving sweet potato vines by decreasing anti-nutritional concentrations by about 60, 58, 60, 54, 55, 65 and 74%, respectively. Inoculation had more influence in that respect, whereas, it resulted in less concentration of anti-nutritional compounds than the critical percentages. These could be explained by the role of lactic acid bacteria in the solubilization of such chemicals in the silage's bunker [73].

Compound	FSPV	SDSPV	USPVS	ISPVS
Oxalate (%)	4.86	2.92	2.45	1.94
TIU/g*	3.61	2.24	2.20	1.51
Tannins (mg/100g)	6.19	3.75	3.31	2.47
Cyanide (mg/100g)	1.07	0.77	0.64	0.49
Phytate (mg/100g)	5.63	4.39	4.08	2.54
Glycoside (mg/100g)	2.31	1.38	1.03	0.80
Saponins (mg/100g)	0.42	0.24	0.18	0.11

Table 3: *Concentrations of anti nutritional compounds in fresh, sun dried and ensiling sweet potato vines fed to sheep (% on DM basis).*

TIU/g = trypsin inhibitor units per gram, CFM: concentrate feed mixture, FSPV: fresh sweet potato vines, SDSPV: Sun dried sweet potato vines, USPVS: uninoculated sweet potato vines silage, ISPVS: inoculated (11C33) sweet potato vines silage.*

Concentration of pesticides residues

The pesticides used in the treatments of sweet potatoes crop used in the present work are presented in Table (4). Making silage of SPV inoculated or uninoculated showed lower values of pesticides residues compared with the fresh or dry form. So, it is a good process to reduce concentration of such residual pesticides in SPV. Inoculation with 11C33 had more influence in that respect, as it resulted in less concentration of such pesticides residual than the limits of quantification (LOQ vs. 0.05 mg/kg). These effects could be explained by the role of lactic acid bacteria in solubilization of such chemicals in the silage bunker. [74] reported that the biochemistry of organophosphorus compound degradation by most of the bacteria seems to be identical, in which a structurally similar enzyme (organophosphate hydrolase or phosphotriesterase) catalyzes the first step of the degradation. [75] found that the remarkably degradation of the malathion during the fermentation could be attributed to its instability at low pH ranges, regardless of bacterial decomposition.

Compound	Trade name	*LOQ mg kg^{-1}	Residues (mg kg^{-1})			
			FSPV	SDSPV	USPVS	ISPVS
Triazophos	Hostathion	0.05	0.21	0.09	0.06	<LOQ
Dimethoate	Dimethoate	0.05	0.08	<LOQ	<LOQ	<LOQ

Table 4: *Concentrations of pesticides residues (mg kg-1) in fresh, dried and ensiling sweet potato vines.*

** LOQ: Limits of quantification, CFM: concentrate feed mixture, FSPV: fresh sweet potato vines, SDSPV: sun dried sweet potato vines, USPVS: uninoculated sweet potato vines silage, ISPVS: inoculated (11C33) sweet potato vines silage.*

Digestibility and nitrogen balance trials

The highest ($P < 0.01$) digestibility value of nutrients and cell wall constituent was recorded for ration contained ISPVS than those fed other rations (Table 5). These could be related to the microbial inoculants which cause solubilization of carbohydrates esters of phenolic monomers in the cell wall [76,77]. They also reported the improvements in nutrients digestibility coefficients followed the inoculants treatment. [16] cited that the effect of inoculants on digestibility may be a consequence of improved nutrient preservation during the fermentation process and conservation of greater proportion of nutrients digestibility. While the lowest ($P < 0.01$) digestibility value was obtained for ration contained FSPV. However, anti-nutritional compounds may alter the bacterial population in the rumen, thus they can affect the digestibility of dietary components and alter as well the end products of fermentation [15]. Silage making resulted in hydrolysis of such anti-nutritional compounds which were reflected on its less effect on digestibility by animals. Additionally, these results could mainly related to the effect of pesticides residues altering the bacterial population in the rumen and resulted in lower digestibility [78]. Prolonged exposure to low levels of pesticides can interfere with metabolic processes, hence altering normal utilization of nutrients by motility alterations or pathological lesions in the gastrointestinal tract [79].

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
Nutrient digestibility (%)						
DM	63.48^{d}	66.03^{c}	68.20^{b}	71.16^{a}	0.36	**
OM	65.86^{d}	68.55^{c}	69.80^{b}	71.87^{a}	0.29	**
CP	60.51^{c}	63.89^{b}	64.67^{b}	66.99^{a}	0.60	*
CF	56.93^{d}	59.52^{c}	62.20^{b}	64.15^{a}	0.25	**
EE	66.71^{c}	69.75^{b}	71.91^{ab}	72.72^{a}	0.58	*
NFE	70.11^{c}	72.77^{b}	73.38^{b}	75.27^{a}	0.32	*

Cell wall constituent digestibility (%)						
NDF	58.25[d]	61.84[c]	65.16[b]	68.82[a]	0.71	**
ADF	51.97[d]	54.76[c]	57.82[b]	61.63[a]	0.21	**
Hemicellulose	67.55[d]	71.81[c]	73.77[b]	76.35[a]	0.46	**
Cellulose	62.14[d]	65.06[c]	67.19[b]	70.90[a]	0.49	**

Table 5: *Nutrients and cell wall constituent digestibility of the experimental rations fed to rams (means ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ** P< 0.01.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

Feed intake of roughage was significantly (P < 0.01) decreased in R_1 compared to other rations (Table 6). Highest feed intake of roughage was recorded with ration contained inoculated silage. The DM intake of R_2, R_3 and R_4 were increased by about 6, 11 and 17% than R_1, respectively. The hazardous effect of dimethoate and cypermethrin on feed intake could be due to its effect on the center nervous system (CNS), particularly the hypothalamus which contains centers governing feed consumption. Also, hyperglycemia which was observed in treated animals exposed to such insecticides [80]. Not only that, but in addition of anti-nutritional compounds which can have potentially negative effects on livestock production; included reduction in palatability, digestibility and utilization of nutrients [13]. Ration contained ISPVS was recorded the highest (P< 0.01) TDN value; while the lowest (P< 0.01) TDN value was obtained with ration contained FSPV as a result of the less digestion coefficients of both crude protien and soluble carbohydrate. Digestible crude protien followed the same pattern as TDN. The lower values of nutritive value were related to the less digestion of cellulose accompanied with the alteration of bacterial population [81]. Retained nitrogen (g/h/d) was positive in all tested groups which indicating normal metabolism status of animals. Data of nitrogen retained in FSPV was the lowest (P< 0.01) value (4.80g) while it was the highest (8.43g) in ISPVS, this mean that treatments improved nitrogen retention. This was reflected in better (P< 0.01) N-utilization of the ration fed to sheep. In the present study, increases in N retention with R4 appeared to be related to improved N digestion due to more N-intake and as opposed to a reduction in urinary N excretion. In this respect, [82,83,16 and 84] had the same conclusion with sheep fed inoculated silage.

Items	**Experimental rations**					
	R_1	**R_2**	**R_3**	**R_4**	**SEM**	**Sig.**
DM intake (g/h/d)						
CFM, g	538.26	538.26	538.26	538.26	-	-
roughages, g	511.07[d]	571.63[c]	621.85[b]	689.32[a]	7.62	**
Total DMI, g	1049.33[d]	1109.89[c]	1160.11[b]	1227.58[a]	7.62	**
Roughage: concentrate ratio	49 : 51	52 : 48	54 : 46	56 : 44	-	-
Nutritive values (%)						
TDN	61.91[d]	64.28[c]	65.58[b]	67.72[a]	0.26	**
DCP	8.09[c]	8.44[b]	8.59[b]	9.07[a]	0.08	*
Nitrogen utilization(g/h/d)						
N-intake	22.45[d]	23.46[c]	24.65[b]	26.59[a]	0.13	**
N-absorbed	13.58[d]	14.99[c]	15.94[b]	17.81[a]	0.17	**
N-retained	4.80[d]	5.69[c]	6.58[b]	8.43[a]	0.13	**
N- retained as % of N-intake	21.38[d]	24.25[c]	26.69[b]	31.70[a]	0.55	**
N- retained as % of N-absorbed	35.35[c]	37.96[c]	41.28[b]	47.33[a]	0.78	**

Table 6: *Dry matter intake (g/h/d), nutritive values and nitrogen utilization of the experimental rations fed to rams (means ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ** P< 0.01.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

Ruminal fermentation

Resulted in Table (7) indicated that rumen liquor pH values did not significantly differ among treatments. The obtained values were within the normal ranges (6.39-6.51) as reported by [85] who indicated that cellulolytic bacteria need a rumen pH of about 6.2 and 7.0 in order to multiply rapidly and colonize the epidermal surfaces of plant fragments within 5 min. and provided that sufficient ammonia. While concentration of ruminal metabolites (NH_3-N, mg/100mlR.L and VFA, meq/100 mlR.L) was significantly (P < 0.01) varied among the experimental rations. The overall mean of NH_3-N concentration in the rumen of ewes fed R_1 was showed highest (P < 0.01) NH_3-N value, while R_4 showed the lower (P < 0.01) concentration than the other rations. Lower NH_3-N concentration may give best utilization of ammonia – N by rumen microbes [86]. The obtained results were in agreement with those obtained by [73,16 and 87] who indicated that both uninoculated and inoculated silage had lower concentration of NH_3-N as compared with fresh materials. However, this concentration was in range and considered as optimal for the growth of ruminal micro-organisms [88]. Higher rate of ammonia-nitrogen production was observed with R_4 and R_3 (4.79 and 4.62, respectively). Both uninoculated and inoculated silage had quite similar rate of production. Highest value of VFA's concentrations and rate of production were observed with ISPVS ration as it was expected from the higher digestibility of CF. [89] found high concentration of TVFA's in the rumen fluid when biological-treated roughages were fed; they attributed such increase to the high fiber breakdown; meantime, lower (P< 0.01) concentrations and rate of production obtained were for R_1. These results are in agreement with those obtained by [90,91 and 92] who found that TVFA's concentration in rumen liquor increased when silage was fed, while [93] reported that, TVFA's concentration was higher (P< 0.05) for control group than other groups fed rations containing corn silage. In the same line, [94] found that VFA's concentration in rumen is governed by several factors such as DM digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to other parts of the digestive tract and the microbial population in the rumen and their activities. The overall mean revealed that high (P< 0.05) rate of out flow from the rumen was obtained with ewes fed R_1 and R_2 compared to the other two rations which showed almost similar rate of out flow. The rate of out flow observed in this study with R_4 could be considered as suitable rate of out flow for efficient microbial protein (MP) synthesis. So, average values of MP synthesis ranged from 50.48 to 114.30 (g/d) for R_1 and R_4 respectively, so, it was lower (P< 0.01) for R_1 than other rations. In a previous study by [95,66] the improved microbial biomass yield (MBY) in the inoculated silage versus the control one suggested that the effect was due to improved protein preservation during ensiling. However, it was also concern that the increase in MBY may not have been true for growth of ruminal bacteria but it may rather due to bacterial glycogen accumulation, particularly when growing on corn silage. Thus, in this study it had more conclusive evidence that LAB inoculation of silage resulted in more efficient formation of ruminal microbial biomass than that occurred in uninoculated silage.

Items	Experimental rations					
	R1	R2	R3	R4	SEM	Sig.
pH value	6.51	6.47	6.43	6.39	0.09	ns
NH_3-N concentration(mg/100mlR.L)	15.07^a	14.19^b	13.87^c	12.16^d	0.04	**
Rate of NH_3-N production(mg/100 mlR.L/hr)	3.04^b	3.11^b	4.62^a	4.79^a	0.09	**
VFA's concentration (meq/100 mlR.L)	8.34^d	10.26^c	12.19^b	13.94^a	0.11	**
Rate of VFA's production (meq/100 mlR.L/hr)	3.11^d	3.59^c	4.16^b	4.92^a	0.14	**
Rumen volume (L)	3.19^c	3.31^c	4.06^b	4.48^a	0.08	*
Out flow rate (%hr)	6.58^a	6.23^a	5.37^b	5.12^b	0.15	*
Microbial Protein Synthesis (g/h/day)	50.48^d	65.73^c	83.80^b	114.30^a	4.12	**

Table 7: *Overall mean of rumen parameters for ewes fed the experimental rations (means ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05, ** P< 0.01 and ns = Not significant.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

There were significant (P < 0.01) decline in total bacterial counts and cellulolytic bacteria in the rumen of sheep fed rations contained FSPV and SDSPV, while those fed ration contained ISPVS showed more counts (Table 8). Inoculated with 11C33 is also observed to stimulate cellulolytic bacteria in the rumen, increase fiber digestion and flow of microbial protein from the rumen. The degradation of roughage components was improved due to the treatment effect by inoculation [96; 97 and 98]. [99] found out that the cellulolytic bacteria populations were significantly higher in cows fed epiphytic lactic acid bacteria inoculated in silage than cows fed uninoculated silage. [100] cited that the concentration of protozoa in ruminal contents was generally increased with increasing the percent of concentrates (starch) to roughage silage rations and the results of present study were in convenient with the their report.

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
Total bacteria counts, $\times 10^8$ cfu/ml	1.06^d	1.21^c	1.39^b	1.47^a	0.02	**
Cellulolytic bacteria counts,$\times 10^6$ cfu /ml	4.13^d	4.52^c	4.96^b	5.32^a	0.03	**
Total protozoa counts, $\times 10^6$ cfu /ml	4.93^a	4.27^b	3.92^c	3.71^c	0.07	*

Table 8: *Rumen microbial counts for ewes fed the experimental rations (means ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ** P< 0.01.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

Degradation kinetics

Estimate ruminal degradation constants (washing loss fraction "a", degradable fraction "b", rate of degradation "c") and effective degradability "ED" fitted with rates of DM, CP and CF disappearance of such roughages are presented in Table (9). It illustrated that predicted constants were lower (P < 0.05) in FSPV and SDSPV compared with the USPVS and ISPVS for DM, CP and CF degradability of such roughages. However, ISPVS had more soluble and degradable fractions (a and b), rate of degradation (c) and effective degradability (ED) than other roughages. This could be due to the more nutrients digestibility. This finding agreed with those reported by [101; 102 and 103] they found an increase in protein flow from the rumen of sheep fed diet inoculated with lactic acid bacteria; also, soluble ; insoluble fractions and the effective degradability was increased. These could be due to the effect of inoculation on the function of the cell wall of such materials and decreased concentrations of all anti-nutritional compounds. In contrary, [104,105] reported that microbial inoculation did not affect *in situ* dry matter, organic matters, and neutral detergent fiber degradability of the silages. The decrease of degradability of both FSPV and SDSPV may be due to the negative effect of anti-nutritional compounds on ruminal microorganisms. [106] concluded that protease inhibitors content as well as other anti-nutritional compounds could affect on rumen degradability. The great degradation effect of the rumen microorganisms helps the animal to tolerate considerable concentrations of the pesticides [107]. [108] suggested that cellulolytic and hemicellulolytic bacteria are more sensitive to low pesticides concentrations than other types. Rumen microorganisms could play a great role in detoxification mechanism for some of the pesticides and herbicides to which ruminants may be exposed [109]

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
DM						
A	19.12^{c}	18.95^{c}	23.17^{b}	24.68^{a}	0.24	*
B	38.26^{d}	40.20^{c}	43.92^{b}	47.11^{a}	0.34	*
C	0.043^{c}	0.044^{c}	0.051^{b}	0.059^{a}	0.001	*
ED	41.66^{c}	42.85^{c}	50.82^{b}	55.91^{a}	0.49	*
CP						
A	21.65^{c}	21.46^{c}	24.28^{b}	25.73^{a}	0.25	*
B	41.54^{c}	43.93^{c}	48.12^{b}	51.21^{a}	0.68	*
C	0.048^{c}	0.047^{c}	0.056^{b}	0.059^{a}	0.001	*
ED	47.21^{c}	48.27^{c}	55.61^{b}	59.68^{a}	0.56	*
CF						
A	12.03^{c}	12.58^{bc}	13.11^{b}	14.97^{a}	0.14	*
B	22.64^{c}	23.03^{c}	27.84^{b}	31.49^{a}	0.25	*
C	0.038^{c}	0.040^{c}	0.046^{b}	0.053^{a}	0.001	*
ED	24.68^{d}	25.74^{c}	29.96^{b}	35.08^{a}	0.21	*

Table 9: *Degradation kinetics of DM, CP and CF for single roughage in ewes fed the experimental rations (mean ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

a: soluble fraction (%); b: potentially degradable fraction (%); c: rate of nutrient degradation (% h^{-1}).

ED: effective degradability=a+ [bc/c + k], where k is the out flow rate.

*SEM: standard error of mean; Sig.: significant; * P< 0.05.*

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

Performance of lambs

Mean values for birth and weaning weights (kg); gain (kg) and ADG (g) of lambs are presented in Table (10). The birth and weaning weights for lambs from R_3 and R_4 groups were significantly higher (P < 0.01) as compared with R_1 and R_2 groups. But there were no significant differences between R_1 and R_2 groups. Highest value of weaning weight was recorded with R_4. On the mean time, gain and average daily gain during suckling period for R_4 were recorded the highest values as compared with other groups. These results are consistent with the observed higher milk production for this ration (Table 11). These results are in agreement with [110; 87 and 111] who reported that increasing of milk yield will lead to an increase in weaning weight.

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
No. of lambs	5	5	5	5	-	-
Birth weight (kg)	3.77^{b}	3.69^{b}	3.93^{a}	3.98^{a}	0.09	*
Weaning weight (kg)	11.71^{c}	12.10^{c}	12.72^{b}	13.34^{a}	0.11	**
Gain (kg)	7.94^{d}	8.41^{c}	8.79^{b}	9.36^{a}	0.05	**
ADG (g)	132.40^{d}	140.20^{c}	146.50^{b}	156.00^{a}	0.87	**

Table 10: *Performance of lambs suckling their dams fed the experimental rations (mean ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

ADG: average daily gain.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ** P< 0.01.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

Milk yield and milk composition

Milk yield; 4% FCM; DMI; feed conversion and feed efficiency of ewes fed the experimental rations are presented in Table (11). Milk yield was significantly increased (P < 0.01) for ISPVS containing ration compared with other rations. Improving of the digestion coefficients of most of the nutrients and the feeding values of ISPVS containing ration (R_4) was reflected on more milk yield produced by ewes fed such ration, also, these results could probably attributed to the higher of glucose and protein concentration in blood serum of R_4 (Table 15). It led to an increase in milk lactose synthesis and consequently milk production being increased. In this respect, values of 4% FCM production were taken the same trend as that of milk yield. The obtained results indicated the positive effect of treatment groups over that of the control group (R_1). Values of 4% FCM production of R_2; R_3 and R_4 was significantly increased (P < 0.01) by about 6.94; 17.19 and about 29.91 %, respectively when compared with R_1. The obtained values are in agreement with those reported by [112; 87; 113 and 114] who illustrated that inclusion silage in dairy animals ration resulted in increasing milk yield, these may be due to one or more of the following reasons, 1) higher DMI and higher nutrients digestibility and 2) increased rumen micro flora activity which lead to an improve of feed efficiency hence an increase milk production. However, silage inoculated with LAB's has a probiotic effect on ruminant performance, as it may change the rumen environment and interact with rumen microorganisms in such a way to enhance feed utilization. Therefore, helpful information might be obtained through measurements of fiber degradability and nitrogen metabolism [90]. Data of feed conversion as gDMI/g 4% FCM was improved by 8.16 and 14.80% with rations contained USPVS and ISPVS, respectively compared with that contained FSPV. While, no significant differ between ration contained SDSPV and the control group.

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
No. of ewes	5	5	5	5	-	-
Weight of ewes (kg)	40.90	41.20	40.85	41.10	0.29	ns
DMI (g/h/day)	1184.25^d	1237.97^c	1273.46^b	1307.90^a	8.27	**
Milk yield (g/h/day)	339.70^d	360.20^c	390.30^b	428.50^a	4.55	**
4%FCM (g/h/day)	357.53^d	382.35^c	418.99^b	464.49^a	4.40	**
Feed $conv^{-1}$	3.49^a	3.44^a	3.26^b	3.05^c	0.02	*
Feed $conv^{-2}$	3.31^a	3.24^a	3.04^b	2.82^c	0.02	*
Feed $efficiency^{-3}$	0.302^c	0.309^c	0.329^b	0.355^a	0.01	*

Table 11: *Performance of ewes fed the experimental rations (mean ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS

**4 % FCM was calculated as: 0.4 × milk yield (kg) + 15 × fat yield (kg); [115].*

FCM=Fat corrected milk (4%); Feed conv-1= Feed conversion as g DMI/ g milk yield; Feed conv-2=Feed conversion as g DMI/ g 4% FCM; Feed efficiency-3= Feed efficiency as on 4% FCM.

*SEM: standard error of mean; Sig.: significant; * P< 0.05, ** P< 0.01 and ns = not significant.*

a, b, c and d: means in the same row with different superscripts are significantly (P< 0.01 or P< 0.05) different.

The current results emphasized that inoculation silage could improve the efficiency of protein and energy utilization in milk production as reported by [116]. Moreover, inclusion of ISPVS in dairy ewes rations could significantly increased milk fat percentage. [117] stated that fat content in milk of cows fed silage inoculated with *Lactobacillus buchneri* may be positively affected. Milk protein percentage was significantly increased ($P < 0.05$) with USPVS and ISPVS containing rations (Table 12). The increase in milk protein percentage in the current study may be due to the more energy being available or milk protein synthesis, these finding agreed with [118, 100]. More ($P < 0.05$) lactose; total solid and solid not fat percentages was obtained with feeding ISPVS containing ration. No significant differences between the tested rations for milk ash percentage. Results obtained here are in harmony with those found by [87; 100 and 111] who speculated positive effect of inclusion inoculated silage in dairy rations in comparison of the traditional ration. In contrary, earlier results obtained by [119,120] inoculated that percentage of milk components or yield did not differed when inclusion silage inoculated with *Lactobacillus acidophilus and Propionibacteria freudenreichii* in dairy rations.

Items (%)	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
Fat	4.35^c	4.41^c	4.49^b	4.56^a	0.02	*
Protein	4.54^b	4.59^b	4.68^a	4.73^a	0.03	*
Lactose	6.57^c	6.64^c	6.87^b	7.12^a	0.06	*
Ash	0.76	0.73	0.73	0.73	0.03	ns
Total solid	16.22^c	16.37^c	16.77^b	17.14^a	0.07	*
Solid not fat	11.87^c	11.96^c	12.28^b	12.58^a	0.07	*

Table (12): *Chemical composition (%) of milk produced by ewes fed the experimental rations (mean ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ns = not significant.*

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

Concentration of pesticides residues in milk

All pesticide residues in milk produced by ewes fed experimental rations were less than limits of quantification (< LOQ, mgL^{-1}) Table (13). [17] reported that microbes (fungi, bacteria, and other microorganisms) could degrade or breakdown the pesticides due to their used them as feed source.

Compound	Trade name	*LOQ mg L^{-1}	Residues (mg kg^{-1})			
			R_1	R_2	R_3	R_4
Triazophos	Hostathion	0.01	<LOQ	<LOQ	<LOQ	<LOQ
Dimethoate	Dimethoate	0.01	<LOQ	<LOQ	<LOQ	<LOQ

Table (13): *Concentrations of pesticides residues (mgL^{-1}) in milk produced by ewes fed experimental rations.*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

**LOQ: Limits of quantification.*

Economic evaluation

It is of interest to observe that economic cash return (L.E/h/d) was more pronounced with ration contained ISPVS, followed by ration contained USPVS; while R_1 was the lowest efficiency and R_2 recorded intermediate economic return and efficiency (Table 14). The improvement of economical efficiency for R_3 and R_4 groups could be related to the high feed efficiency, as well as to the positive effect of inoculated silage on the nutritive value of tested ration not only that but to the less concentration of anti-nutritional compounds and

pesticides residues concentrations than the critical percentages . The current study confirmed that, there is a positive relation between biological and economical efficiency. The results of the economical efficiency tended to be in harmony with the results of biological efficiency. For both economical and biological efficiency, the higher revenues of R_4 were offset by a higher biological performance.

Items	Experimental rations			
	R_1	R_2	R_3	R_4
Daily feed cost (L.E/ewe)	2.07	2.16	2.03	2.09
Price of daily gain (L.E)	5.83	6.17	6.45	6.86
Economical return (L.E/h/d)	3.76	4.01	4.42	4.77
Economic efficiency (%)	2.82	2.86	3.18	3.28

Table 14: *Economic efficiency of ewes fed the experimental rations.*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

Blood biochemical and serum constituents

Values of some blood constituents of ewes fed the different experimental rations are presented in Table (15). Serum glucose, total protein and albumin concentrations was significantly higher ($P < 0.05$) for ewes received rations contained USPVS and ISPVS than other rations. These may be attributed to their higher nutrients digestibility. Insignificant differences among rations were observed for globulin concentration. On the other hand, ewes fed ration contained FSPV was higher ($P < 0.05$) for urea; cholesterol; AST and ALT than other rations. [121] reported that dietary protein and energy levels are the most effective factors in blood picture. Constituents with this conclusion, [122] revealed that plasma total protein concentration was not significantly affected when feeding isonitrogenus and isoenergetic rations irrespective of ingredients that formulated such rations. [123] showed that the use of homolactic acid bacteria as an inoculant for grass silage can resulted in lower concentrations of blood urea-N when it fed to growing steers. It is likely that this is brought by improved silage protein quality [124] which led to better rumen microbial capture of forage nitrogen [125] in turn it could resulting in lower ruminal ammonia-N production and recycling through the blood as blood urea-N. [126] found that the increase level of serum cholesterol may be responsible for inducing atherosclerotic changes. They also reported that the accumulation of pesticides in liver was associated with the disturbance of lipid metabolism and an elevation in serum cholesterol. Serum levels of AST and ALT were within the physiological range, and it decreased according to which no dysfunction in hepatic activity would be occurred.

Items	Experimental rations					
	R_1	R_2	R_3	R_4	SEM	Sig.
Glucose, mg/dl	44.63^b	45.87^b	49.91^a	51.16^a	0.75	*
Total protein (TP), g/dl	6.96^c	7.19^b	7.28^{ab}	7.36^a	0.04	*
Albumin (A), g/dl	4.13^b	4.20^b	4.31^a	4.34^a	0.08	*
Globulin (G), g/dl	2.83	2.99	2.97	3.02	0.06	ns
Urea, mg/dl	32.81^a	28.36^b	23.75^c	22.86^c	0.44	*
Cholesterol, mg/dl	70.13^a	65.19^b	63.85^b	63.21^b	0.74	*
AST, u/l	69.55^a	62.34^b	59.60^c	58.11^c	0.51	*
ALT, u/l	32.46^a	28.94^b	23.84^c	22.96^c	0.38	*

Table 15: *Blood serum parameters of ewes fed the experimental rations (mean ± SE).*

R_1: CFM + FSPV; R_2: CFM + SDSPV; R_3: CFM + USPVS and R_4: CFM + ISPVS.

*SEM: standard error of mean; Sig.: significant; * P< 0.05 and ns = not significant.*

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

Conclusion

Conclusively, it could be advisable to inoculate SPV silage with lactic acid bacteria (11C33) in order to overcome the harmful effect of anti-nutritional compounds and concentration of pesticide residues. In that case, it is successfully and economically to fed SPV inoculated with 11C33 bacteria as good roughage for lactating ewes which could be beneficial in improving production of milk and performance of suckling lambs. However, it is necessary to carry on more research in this respect for a long term feeding on such materials with analysis of metabolites; blood; milk and meat products from animals fed such materials.

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