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EFFECT OF MICROBIAL INOCULATION OF WHOLE PLANT CORN SILAGE ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF RAHMANI LAMBS

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ABSTRACT

This study was conducted to evaluate the effect of microbial inoculates of whole corn plants on silage quality, growth performance, blood constituents, carcass characteristics and economic efficiency of Rahmani lambs. Corn plants at doughy stage of maturity were inoculated with microbial inoculant (MID/1®) then chopped and ensiled. The results pointed that pH value of silage was 3.95 for un-inoculated and 3.80 for inoculated silage. Lactic acid concentration was 4.71 and 5.25% for un-inoculated and inoculated silage, respectively. Inoculated silage had higher concentration of total volatile fatty acids (3.00 %), acetic (1.15 %), propionic (0.85 %), butyric (0.35 %) and valeric acid (0.12 %) than un-inoculated (2.75, 0.99, 0.66, 0.25 and 0.09 %, respectively). Inoculated corn silage had a lower ammonia concentration (0.045 % on DM basis and 2.59 % ammonia of total nitrogen), than un-inoculated (0.053 and 3.87 %, respectively). It was noticed that corn silage with microbial inoculate increased crude protein, ether extract and ash, while decreased crude fiber, neutral detergent fiber and acid detergent fiber. Inoculate corn silage increased most minerals contents and gross energy value. Daily gain was significantly ($P<0.01$) increased (196.47 vs. 161.33 g/h/d). Feed intake of corn silage and feed conversion (6.56 vs. 7.80 kg feed/kg gain) were also increased ($P<0.01$).The results indicated that feed cost for producing one Kg gain was less for lambs fed inoculated corn silage compared with those fed un-inoculated, whereas economic efficiency improved by 19%. Inoculation significantly ($P<0.05$) increased hemoglobin, red blood cells count and phosphorus concentration. Dressing percentage[2], hind quarters, edible offals, the 9th, 10th and 11th ribs weight were significantly ($P<0.05$) higher. Yet, feeding inoculated corn silage could improve growth performance, feed conversion, carcass characteristics and decreased feed cost of producing one Kg gain (19% less than un-inoculated silage).

Keywords*: Corn silage, microbial inoculant, sheep performance, economic efficiency.*

INTRODUCTION

Corn silage is popular worldwide since maximum yield of nutrients per land unit can be harvested from it. In addition, the corn plant can also be handled mechanically at a convenient time and over a short period of time (**Church, 1991**). Recently corn silage had increased rapidly as green forage for cattle and small ruminants. This increase can be related to its relatively high energy content and ease of mechanization with which the whole plant can be ensiled to provide highly palatable source of energy and high quality forage (**Mohamed *et al*., 2003**). Also, **El-Ashry *et al.* (2003)** pointed that the nutritive value of corn silage as TDN, DE and DCP were 70.58%, 3112 Kcal/Kg DM and 5.85%, respectively, with wide nutritive ratio (1:12) which might be due to its great content of energy and low content of protein. There are many advantages in production of whole corn silage as TDN yield is 30-50% more than when crop is harvested as grain and stover. Ensiled corn crop can kept for a long period without significant losses in nutritive values. Corn crop can be harvested early to clear the land for fall plowing or second cropping (**Perry and Cecava, 1995**). Well-made corn silage is a very palatable product with moderate to high content of digestible energy, but usually has low to moderate digestible protein. On a dry matter basis, corn silage usually has 65-75% TDN, 8-9% CP, 0.33% calcium and 0.2% phosphorus (**Kellems and Church, 1998**).

Bolsen *et al*. (1996) stated that maintenance of anaerobic condition in the silo during fermentation and storage phases and maintenance of aerobic stability of silage during use in feeding are important factors for silage preservation. Failure to achieve such conditions may cause lower recovery of nutrients and produce poor quality silage, resulting in reduction of feed intake and animal performance (**Chen *et al*., 1994)**. Earlier criteria for effective preservation of an ensiled crop include high and rapid lactic acid production and reach pH below 4.2 (**Cleale *et al*., 1990**). The addition of homofermentative microorganisms has improved the fermentation process. Lactic acid producing microorganisms, that added at ensiling, inhibits growth of undesirable microorganisms due to rapid reduction in pH (**Lindgren *et al*., 1985** and **Rook *et al*., 1985**). **Enders *et al*. (1983)** stated that adding microbial inoculants increase aerobic stability of the ensiled material due to reducing number and activity of yeast and fungi.

Silage additives primarily containing lactic acid bacteria (LAB) had been investigated as a mean to improve aerobic stability of silage. Inoculating of crop with LAB at ensiling was speculated to improve aerobic stability by competition with yeast during the aerobic and fermentation phases (**Honig, 1990**). Some studies showed positive effect when forage inoculated with LAB prior to ensiling on the aerobic stability of silage (**Woolford, 1975**), while other studies showed negative effects (**Moon *et al*., 1980** and **Rust *et al*., 1989)**. However, some others showed no effect (**Schaefer *et al*., 1989** and **Sanderson, 1993**).

This work aimed to evaluate the effect of adding microbial inoculant for whole corn plants on silage quality besides studying the effect of feeding un-inoculated and inoculated corn silage on growth performance, carcass characteristics and economic efficiency of Rahmani lambs.

MATERIALS AND METHODS

This study was carried out at El-Serw Experimental Station located in Domietta Governorate, belonging to Animal Production Research Institute, Ministry of Agriculture, Egypt.

Ensiling process:

The whole corn plants at doughy stage of maturity were directly chopped 1 -1.5 cm length using chopping harvester machine. Two silage stacks were made, the first was used to produce un-inoculate silage that prepared without any addition, while the other was inoculated with biological inoculant (MID/1®) contains a total of compatible and specialized lactic acid bacteria, a range of anaerobic bacteria and an analyst for the fiber which produce glucose crisis to speed fermentation. The MID/1® inoculant was prepared by dilution of 1 liter to 100 liters of water and leaving for two hours then sprayed on 50 tons corn plant, then compacted well. Two stacks were covered separately by double-layer of linoleum plastic**,** then covered by a layer of soil approximately 20 cm^2 depth and straw bales to guarantee anaerobic condition. Samples from the two stacks were taken after 60 days to analyze silage quality and chemical composition.

Silage quality:

For evaluating silage quality, silage extract was prepared by homogenizing 20 gram fresh material with 100 ml distilled water then blending for 10 minutes **(Waldo and Schultz, 1956).** The homogenized sample was filtered through a double layer cheese cloth then solution was re-filtrated through a filter paper until it becomes perfectly clear. The pH value was directly determined using Orion 680 digital pH meter. Lactic acid concentration was evaluated by titration with 0.1 N sodium hydroxide solution using 0.5 ml of phenolphthalein indicator according to method of **ACF (1995)** using the following equation: Lactic acid = ml of Na OH x 0.09/ Sample weight x100. Total volatile fatty acids (VFA’S) concentration was determined according to **Warner (1964)**. Molar proportion of VFA’S (acetic, propionic, butyric and valeric acid) were measured according to **Bush *et al*. (1979)** using High Performance Liquid Chromatography (HPLC) under this condition, column: Rezex-organic acid, flow rate, 0.4, detector: UV- detector with wave length 200 nm. Ammonia nitrogen (NH_3-N) concentration was measured using method of **Conway (1962)**. Silage quality is shown in Table 1.

Experimental animals, rations, feeding and management:

Twelve weaned Rahmani lambs of 2- 3 months age and weighed 18.93 ±0.82 Kg were divided into two similar groups (6 animals each), each group was fed individually on the two experimental rations as follows, (R1): 50 % concentrate feed mixture (CFM) + 30% un-inoculated corn silage (UCS) + 20% wheat straw (WS) and R2: 50 % concentrate feed mixture +30 % inoculated corn silage (ICS) +20% wheat straw. The CFM consisted of 39% yellow corn, 25% undecorticated cottonseed meal, 20% wheat bran, 7% soybean meal, 5% molasses, 2.5% limestone, 1.0% common salt and 0.5% minerals mixture. Chemical composition of UCS, ICS, R1 and R2 were analyzed according to **AOAC (1995)**. Cell wall constituents were determined according to **Goering and Van Soest (1970)**. The wet ash and minerals extract was prepared according to **Krishna and Ranjhan (1980)**. And content of calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and potassium (K) were measured using Spectrophotometer while zinc (Zn), ferrous (Fe), manganese (Mn) and copper (Cu) were determined using Atomic Absorption Spectrometer. Chemical composition of UCS, ICS, R1 and R2 are presented in Table 2. Lambs were fed according to **NRC (2007) growth allowances**. The experiment feeding period lasted 150 days where ration offered twice daily at 8 am and 4 pm and the amounts of consumed feed were recorded. Drinking water was available all time. Feed conversion (kg feed/kg gain) and economical efficiencies (%) were calculated. Animals were weighed at the beginning of the trial then biweekly and the amounts of offered feed were adjusted according to animal's weight.

Blood sampling:

Blood samples were collected at the end of feeding trial through the jugular vein of lambs in each group. Whole blood was immediately used for hematological estimation. Plasma was separated from an others blood samples (heparinized test tube) by centrifugation at 4000 rpm for 20 minutes whereas a part was used for enzyme determination, while the other part was kept frozen at -20°C until other biochemical analysis. All biochemical constituents of plasma were determined calorimetrically using the specific kits.

Slaughter trait:

At the end of the growing trial, three animals from each group were randomly chosen and weighed for three successive days and fasted for 16 hours, then slaughtered. Slaughtered animals were skinned, dressed out and the hot carcass was weighed. Weights of heart, liver, spleen, kidneys and fat as well as the tests were estimated. Samples of eye muscle and feedstuffs were chemically analyzed according to **AOAC (1995)**. Economic efficiency was calculated as total output / total input according to the local prices in L.E. currency.

Data were statistically analyzed applying **SAS (2009**).

RESULTS AND DISCUSSION

Silage quality:

The apparent examination at the end of ensiled period show that both un-inoculated and inoculated corn silage were free from mold, fungi, caramelized or tobacco or vinegar odorous with greenish yellow color and good smell with suitable fermentation characteristics.

Table (1) shows the quality characteristics of the two types of silage. Value of silage pH was 3.95 for un-inoculated and 3.80 for inoculated silage. Lactic acid content was 4.71 and 5.25 %, respectively. Inoculated silage had higher content of total volatile fatty acids (3.00), acetic (1.15), propionic (0.85), butyric (0.35) and valeric acid (0.12%) than un-inoculated, 2.75, 0.99, 0.66, 0.25 and 0.09%, respectively. Inoculated corn silage had lower ammonia concentration (0.045 % on DM basis and 2.59% ammonia of total nitrogen) than un-inoculated (0.053 and 3.87%), respectively.

Activity of anaerobic bacteria decreased pH value to be below 4.0. **Gupta *et al*. (1981)** mentioned that silage with pH value 4.2 or less could be considered as good silage. Similar result was stated by **Church (1991), Etman *et al.* (1994), McDonald *et al.* (1995) and Sheperd and Kung (1996)** whom reported pH values for corn silage ranged from 3.42 to 4.2**0**. **Chatterjee and Maiti (1981)** reported that the quality of silage is most readily assessed by determining pH value, which should be less than 4.2 where this degree of acidity, also had invariable more lactic (3 to 13% on dry matter) and volatile acids, while butyric acid is present in traces only. In general, the butyric acid concentration of good silage is less than 0.2% and the ammonia nitrogen content is less than 11% of the total nitrogen.

Rook *et al*. (1985) evaluated silage inoculants containing lactobacillus plantarum on perennial Ryegrass with the addition of $2x10^4$, $1x10^5$, $1x10^6$ or $1x10^7$ lactobacillus plantarum/ kg ensiled grass. They found that increasing quantities of inoculate resulted in decreasing the quantities of ammonia–N and silage pH value, while increased quantities of residual water – soluble carbohydrate and lactic

Table (1) Quality parameters of un-inoculated (UCS) and inoculated (ICS) whole corn silage.

Item	UCS	ICS
pH	3.95	3.80
Lactic acid,%	4.71	5.25
Total volatile Fatty acids, %	2.75	3.00
Acetic acid,%	0.99	1.15
Propionic acid,%	0.66	0.85
Butyric acid,%	0.25	0.35
Valeric acid,%	0.09	0.12
Ammonia, % on DM basis	0.053	0.045
Ammonia, % of Total N	3.87	2.59

acid. **El-Ashry *et al.* (2003)** found pH value of corn silage being 3.8 which is in the normal range of good quality silage. Total VFA,s concentration was 2.41 mmol/100 ml indicating acceptable fermentation. The lactic acid was 5.22% on DM basis indicating a good quality silage. Ammonia concentration was 1.45% of total nitrogen. **Gaafer (2004)** measured the whole corn silage quality with different grain contents (low, medium and high), pH 3.95, 3.82 and 3.89, total organic acids % on DM basis 7.50, 7.30 and 7.34, total volatile fatty acids (TVFA,s) 3.30, 2.65 and 2.07, lactic acid 4.20, 4.65 and 5.27, acetic acid 1.13, 0.92 and 0.83, propionic acid 0.11, 0.22 and 0.29, isobutyric acid 0.52, 0.34 and 0.22, butyric acid 1.32, 0.92 and 0.37, isovaleric 0.16, 0.12 and 0.19, valeric acid 0.06, 0.13 and 0.17, ammonia-N as % on DM basis 0.09, 0.072 and 0.051 while were 6.88, 5.42 and 4.07 when expressed as % of total-N, respectively. **Abido (2005)** reported that silage pH values throughout the ensiling periods 4, 5, 6 and 7 weeks were 4.15, 4.05, 3.96 and 3.88 for un-inoculated, while 4.06, 3.95, 3.91 and 3.88 for microbial inoculated maize silage, respectively. pH value decreased at slower rate from the fourth week, which might be related to reduction of the anaerobic microorganism activity.

Abido (2005) found that the total VFA'S concentration throughout the ensiling periods were 2.14 , 2.23, 2.56 and 2.57 mmol/100 ml for un-inoculated maize silage and 2.26, 2.68 , 2.71 and 2.82 mmol / l00 ml for inoculated silage, respectively. The total VFA'S concentration in table (1) tended to be higher with inoculated silage. These results are in agreement with that reported by **Ranjhan (1980), Shaver *et al*. (1985) and Etman *et al.* (1994)** who found that the concentration of total VFA'S of corn silage ranged from 1.22 to 3.54 % of DM.

Langston *et al.* (1958) stated that high quality silage is characterized with low NH_3-N concentration. **McDonald *et al.* (1995)** reported that the concentration of NH_3–N as % DM of a good quality silage being usually less than 2.87% and should be less than 10% as % of total N. **Sheperd and Kung (1996)** showed that NH_3-N concentration of corn silage ranged between 0.04 and 0.15% of DM. **Abido (2005)** found that NH_3-N concentration throughout the ensiling periods were 6.81, 5.62, 3.12 and 2.91 % for un-inoculated maize silage and 6.54 4.79, 3.06 and 2.44 %, respectively with inoculated maize silage. Inoculated maize silage recorded the least concentration of NH_3– N as % DM at 7 weeks, while un-inoculated silage recorded the highest concentration. **Ohshima and McDoland (1978)** mentioned that proteolytic enzymes can lower the feeding value of an ensiled crop. These enzymes convert protein N to non protein nitrogen (NPN) forms such as peptides and free amino acids, whereas further reduction of ammonia and amines is largely caused by microbial activity.

Table 2: Chemical composition, cell wall constituents, minerals content of un-inoculated, inoculated corn silage and the experimental rations.

Item	Corn silage		Rations	
	Un-inoculated	Inoculated	R1	R2
Chemical composition,% on DM:				
Organic matter (OM)	91.53	90.72	90.75	90.51
Crude protein (CP)	8.57	10.86	10.87	11.56
Crude fiber (CF)	27.58	26.76	23.03	22.79
Ether extract (EE)	3.11	3.35	3.00	3.08
Nitrogen free extract (NFE)	52.27	49.75	53.85	53.08
Ash	8.47	9.28	9.25	9.49
Cell wall constituents,%				
Neutral detergent fiber (NDF)	41.25	38.61	50.01	49.21
Acid detergent fiber (ADF)	24.65	22.53	25.29	24.66
Minerals content				
Ca,%	0.25	0.42	0.554	0.605
P,%	0.23	0.38	0.573	0.618
Mg,%	0.16	0.23	0.294	0.315
Na,%	0.02	0.08	0.821	0.839
K,%	1.06	1.65	0.909	1.086
Zn, ppm	21.82	31.69	20.77	23.74
Fe, ppm	73.74	83.84	73.77	76.80
Mn, ppm	14.85	22.91	97.70	100.11
Cu, ppm	6.81	9.56	4.73	5.56
GE*, kcal/Kg DM	4090	4104	4087	4091

* Gross energy (GE) calculated according to **Blaxter (1966)**

Chemical composition, cell wall constituents, mineral content and growth energy:

Chemical composition, cell wall constituents, minerals content and energy value for un-inoculated, inoculated corn silage and the experimental rations are presented in Table (2). Results noticed that microbial inoculated corn silage increased crude protein (10.86 vs. 8.57%), ether extract (3.35 vs. 3.11%), ash (9.28 vs. 8.47%), while decreased crude fiber (26.76 vs. 27.58%), nitrogen free extract (49.75 vs. 52.27%), neutral detergent fiber (38.61 vs. 41.25%) and acid detergent fiber (22.53 vs. 24.65%).

Inoculated corn silage increased minerals contents of calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), Potassium (K), zinc (Zn), ferrous (Fe), manganese (Mn) and copper (Cu), being 0.42, 0.38, 0.23, 0.08, 1.65%, 31.69, 83.84, 22.91 and 9.56% compared with 0.25, 0.23, 0.16, 0.02, 1.06%, 21.82, 73.74, 14.85 and 6.81% for un-inoculated silage. Also, microbial inoculate corn silage increased gross energy value (4104 Kcal/Kg DM) than un-inoculated silage (4090 Kcal/Kg DM).

Ensiling had a promising effect on the chemical composition of corn silage, whereas contents of CP, EE and ash were increased, while contents of CF and NFE were decreased. The decreasing in contents of some nutrients during ensiling may be due to the decomposition of carbohydrates to carbon dioxide and water as a result of respiration by both plant cells and aerobic microorganisms and the fermentation of carbohydrates by lactic acid bacteria along with effluent loss (**Woolford, 1984**). He reported also that the carbohydrates and organic acids are respired resulting in loss of DM and energy plus the production of heat.

El-Ashry *et al.* (2003) reported that corn silage contents of DM, OM, CP, EE, CF, NFE and ash were 37.84, 94.31, 8.72, 2.34, 19.22, 64.03 and 5.69%, respectively, and these values agree with those reported by **Etman *et al*. (1994)**, **Mohamed *et al*. (1999)** and **Bendary *et al*. (2001)** for corn silage made from different local hybrids and varieties under Egyptian condition. **El-Shinnawy (2003)** indicated that DM, OM, CP, CF, EE, NEF and ash contents of un-inoculated corn silage (on DM basis) were 34.75, 93.21, 8.87, 27.90, 2.01, 54.43 and 6.79%, respectively. He also showed that DM, OM, CP, CF, EE, NFE and ash contents of whole corn silage inoculated with Pioneer 1132 inoculant were 35.21, 93.15, 8.91, 27.50, 2.06, 54.68 and 6.85%, respectively. **Gaafer (2004)** stated that whole corn silage contained low, medium and high grain contents had 29.12, 29.76 and 30.98% for DM contents, 93.28, 94.58 and 95.29% for OM, 8.65, 8.16 and 7.76% for CP, 26.30, 24.21 and 21.29% for CF, 3.34, 2.97 and 2.88% for EE, were 55.00, 59.24 and 63.37% for NFE and 6.72, 5.42 and found that inoculation of maize silage with microbes increased DM (33.52%), EE (1.82%) and ash (10.36%) compared with 32.88, 1.27 and 9.42% respectively, for un-inoculated. While, decreased OM (89.64%), CP (9.35%), CF (23.84%), NFE (54.63%), NDF (68.84%), ADF (33.62%), ADL (1.90%), hemicelluloses (35.22%) and cellulose (31.72%) compared with 90.58, 9.53, 24.62, 55.16, 77.44, 37.53, 4.48, 39.91 and 33.05% for un-inoculated, respectively. He reported also that EE and ash contents were increased, while ADF, ADL, cellulose and hemicelluloses were decreased for silage contained treated compared with untreated maize, while, no differences in contents of DM, CP, CF and NFE in both diets.

Table 3: Growth performance, feed conversion and economic efficiency for Rahmani lambs fed un-inoculated and inoculated corn silage.

Item	Experimental ration		SE	Sig.
	R1	R2		
No. of animal	6	6		
Feeding period, day	150	150		
Initial body weight, Kg	19.13	18.73	0.24	NS
Final body weight, Kg	43.33	48.20	0.87	**
Total weight gain, Kg	24.20	29.47	0.88	**
Average daily gain, g/h/d	161.33	196.47	5.88	**
Feed intake, DM/h/d				
Concentrate feed mixture	648.00	644.50	1.95	NS
Corn silage	361.00	396.67	6.55	**
Wheat straw	249.17	247.66	10.59	NS
Total DM intake	1258.17	1288.83	10.36	NS
Feed conversion, Kg feed/Kg gain	7.80	6.56	0.20	**
Feed cost for 1 Kg gain, EL	16.22	13.13		
Economic improvement, %		19		

NS= non- significant different. **= Means in the same row with different superscripts differ significantly at ($P< 0.01$).

Growth performance, feed conversion and economic efficiency:

Table (3) shows that total weight gain and average daily gain were significantly (P<0.01) higher for lambs fed inoculated corn silage (29.47 kg and 196.47 g/h/d) than those fed un-inoculated silage (24.20 Kg and 161.33 g/h/d). Feed intake for lambs fed inoculated corn silage (396.67 g/h/d) was higher (P<0.01) than un-inoculated (361.00 g/h/d) while total DM intake was insignificantly higher for inoculated than un-inoculated (1288.83 & 1258.17 g/h/d, respectively). Feeding inoculated corn silage improved feed conversion (6.56 kg feed/kg gain) (P<0.01) compared with un-inoculated (7.80). The present results indicated that feed cost to produce one Kg gain was less for lambs fed inoculated corn silage (13.13 EL) compared with un-inoculated (16.22 EL). Accordingly, feeding inoculated corn silage improved economic efficiency by 19%.

EL-Sayes *et al*. (1997) reported that feeding corn silage for fattening calves improved performance, reduced cost of feeding and minimized the amount of expensive concentrates in daily diet. **Mohsen *et al*. (2001)** concluded that calves fed 25% concentrate feed mixture (CFM) + 75% corn silage had the highest daily body weight gain and economic efficiency compared with those fed 100% corn silage (first period) or 75% CFM + 25% corn silage (Second period). They also added that ruminal ammonia-N and total volatile fatty acids were significantly decreased with increasing the level of corn silage up to 75% during both first and second periods. This result indicate that calves fed ration contained 25% CFM + 75 corn silage recorded the best results concerning digestibility, nutritive values, daily weight gain and economic efficiency. **Abido (2005)** found that lactating buffaloes fed microbial inoculated whole maize silage was higher (P<0.05) in DM and OM digestibility coefficients than feeding un-inoculated, but there was an insignificant increase in EE digestibility. Several studies recorded improvement in nutrients digestibility with using microbial inoculates (**Gordon, 1989, Kung *et al.*, 1993** and **El-Shinnawy, 2003**). **Abido (2005)** stated that using inoculated maize silage improved milk production, feed efficiency and economic efficiency for lactating buffaloes. **El-Ashry *et al.* (2008)** reported that buffalo heifers fed ration contained 50% corn silage and 50% concentrate feed mixture (CFM) showed improvement in productive and reproductive performance including live body weight, growth rate and feed conversion compared with those fed 75% corn silage and 25% CFM or fed 23% rice straw + 38.5% berseem hay+ 38.5% CFM. **Wohlt (1989)** reported that inoculated silage appeared to be more stable upon exposure to air when fed to cows as it increased fat corrected milk yield (FCM). **Gordon (1989)** found that cows fed inoculated grass silage produced more milk than those fed un-inoculated silage. **Kung *et al*. (1993)** evaluated the effect of two microbial inoculants on chemical composition and nutritive value of corn silage for lactating cows and found that inoculation with Pioneer 1174 inoculant (L.plonterum and streptococcus faecium) had little effect on silage composition and no effect on cow performance. Meanwhile, inoculation with Ecosyl (Lactobacillus plantarum) had no effect on silage composition but increased FCM yield and DMI. Microbial inoculation can improve also the nutritive value of corn silage. **Sheperd and Kung (1996)** found that supplemented the whole plant corn silage with enzyme containing cellulase and hemicellulase had no effect on dry matter intake of lactating cows.

Blood constituents:

Feeding inoculated corn silage rations significantly (P<0.05) increased hemoglobin (11.80 g/dl), red blood cells count (13.40 $X10^6$/ µl) and phosphorus concentration (5.94 mg/dl) compared with 10.90 g/dl, 12.30 $X10^6$/ µl and 5.45 mg/dl for un-inoculated corn silage rations, respectively. While white blood cells, total protein, total cholesterol, urea-N, creatinine, ALT, AST, calcium, sodium and potassium concentrations did not significantly differ among the two groups (Table 4). All blood plasma values were within the normal ranges as reported by **Kaneko (1989).** The high contents of hemoglobin, red blood cells and phosphorus for lambs fed inoculated corn silage may be due to the high contents of protein and minerals as shown in Table 2 and also due to the high digestibility and utilization compared with those fed un-inoculated silage rations as reported by **Gordon (1989)**, **Kung *et al.* (1993) and El-Shinnawy (2003)**.

Table 4: Effect of feeding un-inoculated and inoculated corn silage rations on blood plasma constituents of Rahmani lambs.

Item	Experimental ration		SE	Sig.
	R1	R2		
Hemoglobin, g/dl	10.90	11.80	0.15	*
Red blood cells $x10^6$ / µl	12.30	13.40	0.25	*
White blood cells $x10^3$/ µl	7.62	7.94	0.30	NS
Total protein, g/dl	6.15	6.27	0.40	NS
Total cholesterol, mg/ dl	151.60	152.40	6.00	NS
Urea-N, mg/dl	13.20	13.30	0.20	NS
Creatinine, mg/dl	1.20	1.21	0.01	NS
ALT, u/l	13.70	13.30	0.60	NS
AST, u/l	58.40	57.30	5.00	NS
Calcium, mg/dl	10.50	10.70	0.30	NS
Phosphorus, mg/dl	5.45	5.94	0.35	*
Sodium, m Eq/l	151.10	150.10	4.50	NS
Potassium, m Eq/l	5.06	5.11	0.20	NS

NS= non-significant.
*= Means in the same row with different superscripts differ significantly at ($P < 0.05$).

In another study, **Abido, (2005)** found that feeding lactating buffalo on microbial inoculated maize silage rations significantly increased blood serum glucose content and total protein compared with those fed un-inoculated silage rations, but no significant differences were noticed in albumin, globulin, A:G ratio, urea, total cholesterol, triglycerides, ALT, AST and creatinine.

Carcass characteristics:

Table (5) shows the effect of feeding un-inoculated and inoculated corn silage on carcass characteristics. The results pointed out that feeding inoculated corn silage significantly ($P<0.05$) increased the dressing percentage[2] (53.75%), hind quarters (31.62%), and the 9^{th}, 10^{th} and 11^{th} ribs weight (928.00 g) than those fed un-inoculated corn silage (51.45%, 29.98%, and 738.67 g) Other cuts, fore quarters, neck, brisket, flank and lion were insignificantly increased. Feeding inoculated corn silage insignificantly increased prime cuts (75.05 %) compared with feeding un-inoculated silage rations (72.86 %). The increase in dressing percentage of animals fed inoculated corn silage may be due to depression in the digestive tract content as a result of increasing digestion rate. **Mir and Mir (1993)** reported that dressing percentage and lion area of yeast fed steers were consistently better than the control group. Present data agree with those reported by **Salem *et al*. (2000)** who found that growth of lambs fed yeast culture (3 gm /h/d) attained improvement in carcass weight, slaughter weight and carcass characteristics. Similarly, **Hafez *et al.* (2011)** found that using yeast culture alone or yeast culture with selenium increased hot carcass weight and dressing percentage.

CONCLUSION

It could be concluded that feeding ration contained inoculated corn silage to Rahmani lambs improved growth performance, feed conversion, carcass characteristics and decreased feed cost of producing one Kg gain (by 19%) compared to lambs fed un-inoculated silage.

Table 5: Carcass characteristics, carcass cuts and meat analysis of lambs fed un-inoculated and inoculated corn silage rations.

Item	Experimental ration		SE	Sig.
	R1	R2		
No. of animal	3	3		
Fasting weight (FW), Kg	40.33	44.00	1.08	NS
Fasting empty weight (FEW), Kg	34.18	36.05	0.77	NS
Hot carcass weight, Kg	17.59	19.40	0.77	NS
Dressing percentage[1], %	43.59	44.08	1.12	NS
Dressing percentage[2], %	51.45	53.75	1.23	*
Carcass cuts, %:				
Fore quarters, %	16.40	17.39	0.29	NS
Hind quarters, %	29.99	31.62	0.41	*
Neck, %	6.12	7.42	0.36	NS
Rack, %	19.85	19.51	0.37	NS
Brisket, %	4.43	3.94	0.18	NS
Flank, %	5.80	5.71	0.25	NS
Lion, %	6.62	6.52	0.14	NS
Kidney fat, %	0.17	0.15	0.03	NS
Tail fat, %	10.62	7.74	1.15	NS
Prime cuts %	72.86	75.05	0.65	NS
The 9,10 and 11 ribs weight, g	738.67	928.00	52.08	*
The 9,10 and 11 ribs weight, %	4.19	5.79	0.56	NS
Meat, %	63.51	63.78	1.33	NS
Fat, %	11.37	13.96	1.42	NS
Bone, %	25.12	22.26	1.10	NS
Eye muscle area, cm^2	18.93	20.17	1.73	NS
Eye muscle analysis, %:				
Total moister, %	75.08	70.80	1.17	*
Crude protein (CP), %	66.23	66.93	0.79	NS
Ether extract (EE), %	25.19	23.73	0.63	NS
Ash, %	3.97	4.12	0.11	NS

NS= non-significant.
*= Means in the same row with different superscripts differ significantly at ($P < 0.05$).
[1]: Hot carcass weight/ Fasting weight X100. [2]: Hot carcass weight/ Fasting empty weight X100.
Prime cuts, %=(Fore quarters + Hind quarters + Rack + Lion %).

REFERENCES

ACF (1995). Analytical Chemistry of Foods (1995).Published by Blockie Academic and Professional, an imprint of chapman & Hall, Western Cleddens Road, Bishopbriggs, Glasgow, UK.

A.O.A.C (1995). Association of Official Analytical Chemists. The 16th ed. Official Methods of Analysis. Washungton, DC., USA.

Abido, A.M.M. (2005). Effect of using bacterial inoculantes on maize silage quality.M.Sc. Thesis. Faculty of Agriculture, Ain Shams University. Egypt .

Bendary, M.M., S.A. Mahmoud, E.M. Abd El-Raouf, M.K. Mohsen and H.M.A. Gaafar (2001). Econmical and nutritional evaluation of ensiling corn crop. Egyptian J. Nutrition and Feeds. (Special Issue): 89-103.

Blaxter. K.L, (1966). The Energy Metabolism of Ruminants. The 2 nd. Charles Thomes Publisher. Spring Field. Illinois, USA.

Bolsen, K. K., G. Ashbell and Z. Weinberg (1996). Silage fermentation and silage additive – review. Asian – Australian J. Anim. Sci., 9: 483 – 493.

Bush, K.J., R.W. Russel and J.W. Young (1979). Quantitative separation of volatile fatty acids by high performance liquid chromatography. J. Liquid Chromatography.

Chatterjee, B. N. and S. Maiti (1981). Silage and hay making. Indian Council of Agricultural Research, New Delhi.

Chen, J., M. R. Stokes, and C. R. Wallace (1994). Effects of enzyme – inoculant systems on preservation and nutritive value of hay crop and corn silage. J. Dairy Sci., 77: 501 – 512.

Church, D.D. (1991). Livestock Feeds and Feeding. The 3 Ed., Prentice Hall INC. Englewood Cliffs, New Jersey, USA.

Cleale, R.M., J.H. Firkins, F. Van Der Beek, J.H. Klusmeyer (1990). Effects of inoculation of whole plant corn forage with pediococcus acidilactici and lactobacillus xylosus on preservation of silage and heifer growth. J. Dairy Sci., 73: 711 – 718.

Conway, E.F. (1962). Micro diffusion analysis and volumetric error. Rev. Ed. Lockwrd, London, UK.

El-Ashry, M.A., I.A. Abou-Selim, H.M. El-Sayed and A.A. El-Aidy (2003). Effect of maize silage with berseem on the productive performance of dairy baffaloes. Egyptian J. Nutrition and Feeds. 6 (1): 25-36.

El-Ashry, M.A., G.F. Shahin, T.I. El-Monayer and S.B. Mehany (2008). Effect of feeding different concentrate: corn silage ratio on body weight and age at conception of buffalo heifers. Egyptian J. Nutrition and Feeds. 11 (2) : 277-292.

El-Sayes, M.F., M.R.M. Mostafa and M.K. Hathout (1997). Nutritional and economic efficiency for using the maize silage in fattening calves locally. 5th World Buffalo Congress. Animal Prod. Res. Inst. A. R. C. Giza Egypt., 386.

El-Shinnawy, A.M. M. (2003). Studies on silage in ruminants feeding. M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt.

Enders, G. L., Jr., S. L. Hoover and H. S. Kim (1983). Development of selected pairs of lactic acid producing bacteria as an inoculant for alfalfa silage. J. Dairy Sci., 66 (suppl.1): 184.

Etman, K.E.I., E.A. Khafagi, W.H. Abdil-Malik, M.K. Hathout and M.F.El-Sayes (1994). Conservation of green summer forage as silage and its utilization in feeding growing lambs. Proc. The 8th Conf. Egyptian Society of Animal Production. 175.

Gaafar, H.M.A. (2004). Effect of grain content in corn hybrids on nutritive value of whole plant corn silage. Egyptian J. Nutrition and Feeds. 7 (1): 1-10.

Goering, H.K. and P.J. Van Soest (1970). Forage fiber analysis (apparatus, reagent, procedures and some applications). USDA. Agricultural Handbook 379, Washington, DC, USA.

Gordon, F.J. (1989). A further study on the evaluation through lactating cattle of a bacterial inouclant as an additive for grass silage. Grass Forage Sci., 44: 353.

Gupta, P.C., L. Johnson and D.P. Sharda (1981). Note on the chemical composition and nutritive value of green maize and maize silage. Ind. J. Anim. Sci., 10:975.

Hafez, Y. H., A.M.M. Zeid, Hafsa F.H. Youssef and A. Sallam (2011). Effect of yeast culture on growth performance and carcass characteristics of Damascus kids. J. Animal and Poultry Prod., Mansoura Univ., Vol. 2 (7): 265 – 275.

Honig, H. (1990). The effect of prewilting conditions and weather. Small scale silage experiments. Pages 65 – 75 in Proc. Eurobac. Conf. Swed. Univ. Agric. Sci. Grass and Forage Rep. No. (3) 1990. P. Lingvall and S. Lindgren, ed. Swed. Univ. Agric. Sci., Uppsala, Sweden.

Kaneko, J.J. (1989). Clinical Biochemistry of Domestic Animals. 4th Edition. Academic press, Inc.

Kellems, R.O. and Church, D.C. (1998). Livestock Feeds and Feeding. 4th edition, Prentice Hall, Upper Saddle River, New Jersey, USA.

Krishna, G. and S.K. Ranjhan (1980). Laboratory Manual for Nutrition Research. First edition. Vikas Publishing House PVT LTD, New Delhi, India.

Kung, L., J.H. Chen, E.M. Kreck and K. Knutsen (1993). Effect of microbial inoculants on the nutritive value of corn silage for lactating dairy cows. J. Dairy Sci., 76: 3763 – 3770.

Langston, C.W., H. Irvin, C.H. Gordon, C. Bouma, H.G. Wismani, C.G. Melin and L.A. Moore (1958). Microbiology and Chemistry of Grass silage. Tech. Bull. 1187. Washington, USA.

Lindgren, S., K. Petterson, A. Jonsson, P. Linguall and A. Kaspersson (1985). Silage inoculantion. Swed. J. Agric. Res., 15: 9.

McDonald, P., R.A. Edwards, J.F.D. Greenhalgh and C.A. Morgan (1995). Animal Nutrition. 5th Ed., Copyright Licensing LTD., London.

Mir, Z. and P.S. Mir (1993). Effect of the addition of live yeast culture (*Saccharomyces cerevisiae*) on growth and carcass quality of stress fed high grain diets and on feed digestibility and in-situ degradability J. Ainm. Sci., 72:537.

Mohamed, M.M., S.M.M. Ahmed and M.M. Bendary (1999). Productive and reproductive performance of growing calves fed rations containing maize silage. Egyptian J, Nutrition and Feeds 2 (Special Issue): 445.

Mohamed, S.A., M.K. Mohsen, M.M. Bendary, E.M. Abdel-Raouf and H.M.A. Gaafar (2003). Performance of growing Friesian calves fed rations containing corn silage. 2- Blood constituents and carcass traits. Egyptian J, Nutrition and Feeds 6 (Special Issue): 727.

Mohsen, M.K., S.A. Mahmoud, E.M. Abdel – Raouf, M.M. Bendary and H.M.A. Gaafar (2001). Performance of growing Friesian calves fed rations containing corn silage. 1. Nutrient digestibility, rumen activity, live body weight gain and economic evaluation. Egyptian J. Nutrition and Feeds (2001) 4 (special Issue): 485 – 497. Proc. 8th Conf. Anim. Nutr., 23 – 26 October, Sharm El-Sheikh, Egypt.

Moon, N.J., L.O. Ely and E.M. Sudweeks (1980). Aerobic deterioration of wheat, Lucerne, and maize silages prepared with Lactobacillus acidophilus and a candid SPP. J. Appl. Bacteriol., 49: 75 – 87.

NRC (2007). National Research Council. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and new world Camelids. National Academy of Sciences. Washington, DC., USA.

Ohshima, M. and P. McDonald (1978). A review of the changes in nitrogenous compounds of herbage during ensilage. J. Sc. Food Agric., 29: 497.

Perry, T.W. and M.J. Cecava (1995). Beef Cattle Feeding and Nutrition. The 2nd Ed., Academic Press, INC, USA.

Ranjhan, S.K. (1980). Animal Nutrition in Tropics. The 1st edition Vikas Publishing House PVT LTD, New Delhi, India.

Rook, J.A., Sharon L. Bell and D.G. Armstrong (1985). The chemical composition of grass silages prepared with and without pre-treatment with inoculants containing lactobacillus plantarum. Anim. Feed Sci. and Tech., 13: 269 – 279.

Rust, S.R, H.S. Kim and G.L. Enders (1989). Effects of a microbial inoculant on fermentation characteristics and nutritive value of corn silage. J. Prod. Agric. 2: 235 – 241.

Salem. F.A., A.S. Soliman, M.R.M. El-Mahdy and S.M. Abd El-Mawla (2000). Effect of some feed additives to diets of growing sheep on growing performance, rumen fermentation, blood constituents and carcass characteristics. Annals of Agric. Sci. Moshtohor, 38:1733.

Sanderson, M.A. (1993). Aerobic stability and in vitro digestibility of microbially inoculated corn and sorghum silages. J. Anim. Sci., 71: 505 – 514.

SAS (2009). Statistical Analysis System. SAS User's Guide Statistics. SAS Institute Inc., Cary, NC., USA.

Schaefer, D.M., P.G. Brotz, S.C. Arpand D.K. Cook (1989). Inoculation of corn silage and high moisture corn with lactic acid bacteria and its effect on the subsequent fermentation and feedlot performance of beef steers. Anim. Feed Sci. Technol. 25: 23 – 38.

Shaver, R.D., R.A. Erdman and J.H. Vandersall (1985). Effect of silage pH on voluntary intake of corn silage. J. Dairy Sci., 67:2045.

Sheperd, A.C. and L. Kung (1996). An enzyme additive for corn silage: Effect on silage composition and animal performance. J. Dairy Sci., 79: 1760.

Waldo, D.R. and L.H. Schultz (1956). Lactic acid production in the rumen. J. Dairy Sci., 39: 1455.

Warner, A.C.I. (1964). Production of volatile fatty acids in the rumen methods of measurements. Nutr. Abstr. and Rev., 34:339.

Wohlt, J.E. (1989). Use of a silage inoculant to improve feeding stability and intake of a corn silage grain diet. J. Dairy Sci., 72: 545.

Woolford, M.K. (1984). The Silage Fermentation. Marcel Dekker, New York.

Woolford, M.K. (1975). Microbiological screening, of the straight chain fatty acids (C1–C12) as Potential silage additives. J. Sci., Food Agric. 26: 219 – 228.

تأثير إستخدام الملقح الميكروبي مع سيلاج الذرة بالكيزان على إداء النمو و صفات الذبيحة للحملان الرحماني

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اجريت هذه الدراسه بهدف معرفة تاثيرإضافة الملقح الميكروبى الى سيلاج الذره بالكيزان على جودة السيلاج الناتج واثر استخدام كل من السيلاج الغير ملقح أو الملقح على معدلات النمو، مكونات الدم، صفات الذبيحه والكفاءه الاقتصاديه للحملان الرحماني الناميه وذلك مع زيادة نسبة العليقة المالئة.

تم عمل السيلاج من نبات الذره الكامل بالكيزان سواء بدون أو بإضافة الملقح الميكروبى(MID/1®). تم تقسيم ١٢ حمل رحمانى نامى بعد الفطام بمتوسط عمر من ٢-٣ شهور و متوسط وزن يبلغ ١٨,٩٣±٠,٨٢ كجم الى مجموعتين تجريبيتين، غذيت الاولى على عليقه تتكون من ٥٠% مخلوط مركز + ٣٠% سيلاج ذره غير ملقح + ٢٠% تبن قمح (عليقه ١)، اما المجموعه الثانيه فغذيت على ٥٠ % مخلوط مركز + ٣٠% سيلاج ذره ملقح + ٢٠% تبن قمح (عليقه ٢).

أظهرت النتائج أن درجة pH السيلاج بلغت ٣,٩٥ لغير الملقح و ٣,٨٠ للملقح، تركيز حمض اللاكتيك بلغ ٤,٧١، ٥,٢٥ % للسيلاج غير الملقح وللملقح على التوالى. إضافة الملقح زاد من تركيز الاحماض الدهنيه الطياره الكليه، حمض الخليك، البروبيونك،البيوتريك، والفاليرك (٣,٠، ١,١٥، ٠,٨٥, ٠,٣٥، ٠,١٢ %) على التوالي بالمقارنه بمجموعة الغير الملقح (٢,٧٥،٠,٩٩،٠,٦٦،٠,٢٥،٠,٠٩%) على التوالي ، الا انه قلل من تركيز الامونيا و كذلك أدت إضافة الملقح الى زيادة محتوى السيلاج من البروتين الخام ، الدهن ، الرماد و زيادة الطاقة الكلية بينما أدت إلى إنخفاض محتوى السيلاج من الألياف الخام و مكونات جدر الخلايا. كما ادى الى زيادة محتوى السيلاج من معظم العناصر المعدنيه (كالسيوم، فوسفور، ماغنسيوم، صوديوم، بوتاسيوم، زنك، حديد، منجنيز، ونحاس).

وجد أن التغذيه على السيلاج الملقح أدت الى زياده معنويه (P<0.01) فى معدل النمو للمجموعة التي غذيت على السيلاج الملقح عن المجموعة التي غذيت على السيلاج الغير ملقح (١٩٦,٤٧, ١٦١,٣٣ جرام/راس /يوميا) على التوالي , زيادة المأكول من السيلاج الملقح عن الغير ملقح عند مستوى معنوي (P<0.01) , كذلك ادى الى تحسن معنوى (P<0.01) فى كفاءة تحويل الغذاء للسيلاج الملقح عن السيلاج الغير ملقح (٦,٥٦ , ٧,٨٠ كجم ماكول/كجم نمو) على التوالي , كما ادى الى تقليل تكلفة انتاج كيلوجرام نمو بنسبة ١٩% لمجموعة السيلاج الملقح عن مجموعة السيلاج الغير ملقح ومن ثم تحسين الكفاءه الاقتصاديه. أظهرت الاغنام المغذاه على السيلاج الملقح زياده معنويه (P<0.05) فى محتوى الدم من الهيموجلوبين، عدد كرات الدم الحمراء، والفوسفور. كما ادت التغذيه على السيلاج الملقح الى زياده معنويه (P<0.05) فى نسبة التصافى و نسبة أرباع الذبيحه الخلفيه و وزن العضلة العينة (اضلاع الذبيحة ٩ ،١٠ ،١١). وبالتالي يستنتج أن إستخدام سيلاج الذرة الملقح يمكنه تحسين معدل النمو و الكفائة التحويلية ونسبة التصافي وكذلك إنخفاض كلفة كيلو جرام النمو (بمقدار ١٩%).